Original Article

Impact of Electronic Device Use on Sleep Quality among Medical College Students

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Abstract

Background: Sleep is essential for homeostasis, learning, and cognitive performance. In modern times, medical students are exposed to electronic devices for academic and recreational purposes. Sustained screen time, particularly near bedtime, is believed to have a negative impact on sleep quality by affecting the circadian rhythms and slowing the release of melatonin. The current study aimed to evaluate the impact of using electronic devices on the quality of sleep among medical college students. **Material and Methods:** This observational study was done on 50 medical students. A pretested, validated, and structured questionnaire was used to collect the demographic data at the baseline, and the pattern of the use of electronic devices, and the Pittsburgh Sleep Quality Index (PSQI) was used to collect data. The device usage characteristics that included duration, use time before going to sleep, and the purpose of using the device were compared with the sleep quality. Chi-square and independent t-tests were used to determine the statistical significance, where $p < 0.05$ was thought to be significant. **Results:** The mean age of the cohort was 21.2 ± 1.8 years, with a higher percentage of females (56%). The primary device used by 90% of participants was smartphones, and the mean usage was 6.5 ± 2.3 hours per day. More importantly, 88% of these devices were used within one hour of bedtime, and the common reason was the use of social media or entertainment (70%). The assessment of sleep quality by PSQI showed scores 8.6 ± 3.5, with 76% classified as poor sleepers (PSQI >5). The following were found to be significantly associated with poor sleep quality: daily device usage of more than 4 hours ($p=0.02$), usage within one hour of bedtime ($p=0.01$), and higher mean daily usage duration ($p<0.01$). **Conclusion:** Excessive screen time per day and use of devices before sleep were strongly linked to poor quality of sleep among medical students. Interventions such as promoting screen-free time, pre-sleep routines, and structured digital hygiene are required. These measures could help decrease adverse effects and, more importantly, improve sleep quality in this group.

Keywords: Circadian rhythm, Electronic devices, Pittsburgh Sleep Quality Index (PSQI), screen time.

Received: 02 June 2026 **Revised: 18 June 2026** **Accepted: 10 July 2026** **Published: 13 July 2026**

Introduction

Sleep is important for cognitive performance, emotional and physical well-being. However, inadequate and low-quality sleep is widespread among students.[1] Medical students are particularly vulnerable because their demanding coursework, longer study hours, and academic stress combine to decrease sleep duration, leading to fragmented sleep, which affects learning, mood, and clinical performance.[2] Over the past decade, the ubiquitous use of electronic devices, such as smartphones, tablets, laptops, and e-readers, has added an omnipresent, changeable, variable that can further worsen sleep among this population. Rapid and cheap availability of the internet across India has led to heavy use of smartphones among young adults, which makes them more vulnerable. It has been shown that electronic devices cause sleep disturbances by various mechanisms. The first one is by exposure to short-wavelength (blue) light from LED screens, which is known to suppress the nocturnal release of melatonin secretion and causes a shift of circadian phase. This leads to a delayed onset of sleep and reduces the sleep quality and efficiency.[3] Experimental evidence has indicated that night use of e-readers that emit light delays circadian timing, decreases evening sleepiness, and decreases alertness the next morning as compared to reading printed text.[3] Second, the psychological and emotional stimulation linked to social media, communicating, gaming, or job-related screen time increases physiological and cognitive engagement at sleep onset and lengthens sleep latency and disrupts further sleep.[4] Third, the time spent on the device replaces time spent sleeping, so-called time-displacement effect, such that the regular use of screens at the end of the day directly lowers the total amount of time spent asleep.[5] In young adult and student age groups, a steady input of epidemiological research suggests that the use of devices at night is linked to poorer subjective sleep quality,

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DOI:
10.21276/amit.2026.v13.i2.823

How to cite this article: Khan TT, Khan MI, Ansari S. Impact of Electronic Device Use on Sleep Quality among Medical College Students. Acta Med Int. 2026;13(2):1060-1064.

reduced sleep time, more daytime sleepiness, and growing insomnia symptoms.[5,6] The more students reported using their phones before going to bed, the more frequent the awakening is, and the worse the functioning of academic performance, as well as the increased exposure to nocturnal screens, the more frequent the symptoms of depression and anxiety, which, in turn, can deteriorate the quality of sleep.[6,7] It is interesting to note that this probability is rather high that this is a two-way street: impulsive or comfort-seeking use of night devices is more likely to be enhanced by poor sleep, and vice versa, it is self-reinforcing. The epidemiological research among young adults and students who had the habit of using electronic devices at night showed worse subjective sleep quality, reduced duration of sleep, increased daytime drowsiness, and increased incidence of symptoms of insomnia.[5,6] An increased nocturnal screen time is linked to signs of depression and anxiety, both of which are also likely to disrupt sleep, and college students who use their phones at bedtime report more frequent waking and poor academic functioning.[6,7] The relationship of device use appears to be a vicious cycle of poor sleep leading to impulsive or comfort-seeking nighttime device use, which further leads to poor quality sleep and creates a self-reinforcing cycle. In the context of medical education, impaired sleep quality leads to consequences such as loss of memory because sleep is crucial for memory consolidation and attention. It can also lead to errors of judgment clinically and decrease the precision during clinical decision making, leading to increased risk of medical errors.[2,8] Chronic insufficient sleep can also cause burnout, mood fluctuations, and poor physical health, impacting long-term professional and personal costs for medical students.[8] Although growing international evidence regarding the adverse effects of increased screen time exposure is available, there is limited data regarding the same in South Indian Medical colleges. Since the accommodation in the medical colleges, such as shared rooms, the influence of other peers may lead to an increased tendency to use devices. Additionally, the timing and content of devices used, whether for academic purposes or social media engagement, can modulate sleep; therefore, local evidence is essential to institute appropriate interventions. With this background, the current study was designed to investigate the impact of electronic device use on the quality of sleep-in medical students of our college in South India.

Materials and Methods

This observational study was done in the Department of Physiology, Maheshwara Medical College & Hospital, Patancheru, Hyderabad, Telangana. Institutional Ethical approval was obtained for the study. Written consent was obtained from all the participants of the study after explaining the objectives of the study. All the available information from the subjects was kept confidential as per the Helsinki declaration on Human research.

Since the prevalence of poor sleep among medical students has been reported to range from 50% to 70%, assuming 50% prevalence gives the maximum sample size.

The formula is $n = \frac{Z^2 P(1-P)}{d^2}$

Z = 1.96 (95% confidence)

P = 0.50

d = 0.14 (14% absolute precision)

$$n = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.14)^2}$$

$$n = 48.98 \approx 49$$

Inclusion Criteria

- Medical students
- Aged 18–25 years.
- Male and female students
- Ownership and regular use of at least one electronic device (smartphone, laptop, tablet, or television).
- Willingness to provide informed consent and complete study questionnaires.

Exclusion Criteria

- Students with a known history of sleep disorders (sleep apnea, narcolepsy).
- On prescription drugs such as sedatives, stimulants, or medications affecting sleep patterns.
- History of chronic systemic illness or psychiatric disorders.

A total of 50 medical students were recruited based on the inclusion and exclusion criteria from different academic years (first to final year). Both male and female students aged 18–25 years were eligible for inclusion.

Data Collection Methods

Structured Questionnaire: A pretested and validated questionnaire, which was designed to capture demographic details (age, gender, year of study), lifestyle factors, and patterns of electronic device use (type of device, duration of daily use, timing of use, purpose such as academic or entertainment, and use within 1 hour of bedtime), was used.

Sleep Quality Assessment: The Pittsburgh Sleep Quality Index (PSQI) was employed to assess sleep quality. The PSQI is a validated instrument consisting of 19 self-rated questions grouped into seven components: sleep latency, duration, efficiency, disturbances, medication use, daytime dysfunction, and subjective sleep quality. A global PSQI score >5 was considered indicative of poor sleep quality.

After recruitment, subjects were briefed about the study's purpose and procedures. After obtaining written informed consent, they were asked to complete the questionnaire and PSQI form. Data collection was conducted in a classroom setting under supervision to ensure completeness and reliability.

Statistical analysis: All the available data were uploaded to an MS Excel spreadsheet and analyzed by SPSS version 26 in Windows format. The continuous variables were represented as mean, standard deviation, frequency, and percentage. Independent t-tests were applied for comparison of continuous variables. Chi-square test was used to examine associations between the categorical variables, such as device use before bedtime and poor sleep quality. The values of p (<0.05) were considered significant.

Results

A total of n=50 participants were studied during the duration of the study. The mean age of the cohort was 21.2 ±1.8 years, with

the age range of 18-24 years. 56% of the participants were females and 44% were males. The distribution of participants showed that final-year students were the largest subgroup (34%), followed by third-year (24%), second-year (22%), and first-year (20%) students. These features represent a relatively representative sample of undergraduate medical students, who represent all stages of study, which will allow the findings to be more applicable to this population.

Table 1: Baseline Characteristics of the Study Participants

Characteristic	Category	Number (n)	Percentage
Gender	Male	22	44
	Female	28	56
Academic Year	First Year	10	20
	Second Year	11	22
	Third Year	12	24
	Final Year	17	34
Age (years)	Mean ± SD	21.2 ± 1.8	
	Range	18 – 24	

The trends of using electronic devices are given in [Table 2]. The prevalence of smartphones as the main gadget (90%), and 10% of participants were using laptops, indicated the dominant use of smartphones in everyday life. The average daily screen time was (6.5±2.3), and 76% of participants spent more than 4 hours per day on the devices, showing the risk of prolonged screen exposure. Regarding bedtime routines, 88% of them admitted to using devices within an hour of their bedtime, which has been shown to have an adverse effect on the circadian rhythm. Answering the main intention behind the use of the device before bedtime was reported to be for entertainment or social media engagement in 70% of subjects, 18% of them were used primarily for academic purposes, and 12% of them used it for both. The results indicate that increased use of devices for recreational purposes near bedtime is a potential factor contributing to poor sleep quality.

Table 2: Patterns of Electronic Device Use among Medical Students

Device Use Characteristic	Category	Number (n)	Percentage
Primary Device Used	Smartphone	45	90
	Laptop	5	10
Daily Device Use (hours)	Mean ± SD	6.5 ± 2.3	
	4 hours	12	24
	>4 hours	38	76
Use within 1 hour of bedtime	Yes	44	88
	No	6	12
Primary Purpose before bed	Social media/ Entertainment	35	70
	Academic Purposes	9	18
	Both	6	12

[Table 3] describes the quality of sleep of the participants according to the PSQI scores. The average PSQI score was 8.6 ± 3.5, exceeding the benchmark of 5, indicating that most of the cohort have poor sleep quality. As a matter of fact, 38 participants out of the total 50 were considered to be poor sleepers. The component analysis revealed significant issues with daytime dysfunction (mean 1.7 ± 0.8) and sleep latency (mean 1.6 ± 0.9), which means that they had problems with falling asleep and being tired throughout the day. Poor outcomes were also caused by subjective sleep quality (1.4 ± 0.8) and sleep disturbances (1.5 ± 0.6). The sleep medication usage was minimal (0.2 ± 0.6), which implies that lifestyle and use of devices are the sources of the problems rather than physiological issues. These results prove that poor sleep quality is a prevalent issue among the student population and that this is directly correlated with behavioral and environmental factors and not medical factors.

Table 3: Sleep Quality Assessment based on Pittsburgh Sleep Quality Index (PSQI) (N=50)

PSQI Component	Score, Mean ± SD
Subjective Sleep Quality	1.4 ± 0.8
Sleep Latency	1.6 ± 0.9
Sleep Duration	1.2 ± 0.9
Habitual Sleep Efficiency	1.0 ± 0.9
Sleep Disturbances	1.5 ± 0.6
Use of Sleep Medication	0.2 ± 0.6
Daytime Dysfunction	1.7 ± 0.8
Global PSQI Score	8.6 ± 3.5
Global PSQI Score > 5 (Poor Sleepers), n (%)	38 (76.0%)

[Table 4] shows the relationship between the attributes of device use and the quality of sleep. The proportion of students who slept poorly was 84.2%; they were commonly found to be using the devices over 4 hours a day, as opposed

to 50% of the good sleepers, and this relationship was statistically significant (p=0.02). Similarly, the use of the devices within 1 hour of bedtime was much more frequent among poor sleepers (97.4%) than good sleepers (58.3%), and the statistical significance of the difference was very high (p=0.01). Interestingly, the use of entertainment-related usage was found to be more frequent in the poor sleepers as compared to the good sleepers (86.8% vs. 66.7%); however, the association was not found to be significant. Notably, there was a significant difference in the mean hours of device use per day among poor sleepers (7.1 ± 2.1 hours) and good sleepers (4.8 ± 1.9 hours) (p<0.01). These findings indicate that an extended period of device use and timing of exposure before sleep are associated with poor quality of sleep.

Table 4: Association between Electronic Device Use Characteristics and Poor Sleep Quality (PSQI >5)

Device Use Characteristic	Good Sleep (PSQI ≤5) n=12	Poor Sleep (PSQI >5) n=38	P value
Daily device use >4 hours	6 (50.0%)	32 (84.2%)	0.02*
Use within 1 hour of bedtime	7 (58.3%)	37 (97.4%)	0.01*
Entertainment/social media use before bedtime	8 (66.7%)	33 (86.8%)	0.19
Mean daily device use (hours)	4.8 ± 1.9	7.1 ± 2.1	<0.01*
*Significant			

Discussion

The current study aimed to investigate the impact of electronic device use on sleep quality among young medical students of South India. The overall findings show that prolonged screen exposure, especially near bedtime, was a significant factor that was significantly associated with decreased quality of sleep as indicated by high global PSQI scores, which was shown by the poor sleeper in this cohort. The baseline demographic profile of this study showed a balanced distribution of participants based on gender as well as academic years. The mean age of the cohort was 21.2 years. This is the age when typical medical students are exposed to both academic stress and increased use of electronic devices. Such profile characteristics are consistent with earlier studies that report a high prevalence of technology usage among the young university population.[9] The assessment of predominant device usage showed that smartphones were widely used, 90% of the participants reporting them as their primary device. Similar findings have been reported by other studies, which have found that smartphones are widely used among young students because of their accessibility, portability, and multifunctionality.[10] The mean daily usage as assessed by screen time was 6.5 hours in this study, which shows that there was excessive screen time in this cohort. 76% of the participants have used the devices for more than 4 hours per day. These levels are considered as high as a maximum recommended use should not be more than 2 hours per day.[11] The assessment of use habits showed that the critical determinants of sleep quality were bedtime use of devices. In this study, 88% of students were found to be using devices within one hour of bedtime, with the majority of engagement being for social media. It has been shown that the blue light from the device screen suppresses melatonin release, which delays the onset of sleep and disrupts circadian rhythms.[3] This fact was confirmed by observations of the current study, which showed that longer average daily screen exposure was high among the poor sleep quality students as compared to lower hours for the good quality sleepers, with use of the device at bedtime being the important determinant [Table 4]. The assessment of sleep quality as revealed by PSQI, with a mean global score of 8.6, and with this 76% of the students were classified as poor sleepers. All the components of sleep were affected, which included sleep latency, disturbances, and daytime dysfunction, including both delayed sleep initiation and non-restorative sleep. These results are in line with prior studies that reported low quality of sleep among medical students because of academic stress that is augmented by overuse of screens.[12,13] The fact that our cohort used minimal sleep medications implies that the sleep disturbances were more likely to be the behavioral type and modifiable. The results of the associations between device use and sleep have shown statistical significance based on the length of daily use and the use close to bedtime. Those who spent over 4 hours or more a day using such devices were found to be 1.7 times prone to poor sleep quality, with late-night use found in almost all poor sleepers. Interestingly, the purpose of use (entertainment vs. academic) was not statistically significantly correlated, which indicates that the timing and duration of exposure to the content are more important than the type of content that a person is exposed to. Evidence of this has been observed by East Asia and European studies that evening device use was a powerful predictor of sleep latency and shorter sleep duration with or without the activity type.[4,14] Overall, these results from our study support the idea that poor sleep quality in medical students is closely associated with the overuse and inappropriate timing of using devices. Considering the implications of sleep deprivation on cognitive performance, processing emotions, and academic achievements, specific interventions, which include limiting screen time, establishing digital curfews before going to bed, and teaching sleep hygiene, are highly needed in this susceptible group. The present study has certain limitations because it was conducted in a single institution with a relatively small sample size, which may limit the generalizability of the findings. Furthermore, the cross-sectional design precludes establishing causal relationships. Larger multicenter longitudinal studies are recommended to validate these findings. The limitations of this study were because of modest sample size, and single center study was because of time constraints. A longitudinal study with larger sample would be required to generalize the findings of this study.

Conclusion

Within the limitations of the current study, a strong association was found between electronic device use and poor sleep quality among the medical students in South India. The important factors associated with poor sleep were excessive daily screen

time and daily use of devices in the hour before bedtime, and more than three-fourths of the participants were identified as poor sleepers. The results highlight that the time and length of time spent on the device are more influential in determining the quality of sleep rather than the nature of the activity. Well-defined interventions, including digital curfews, encouraging screen-free bedtime activities, and systematic sleep hygiene education, have the potential to increase the results of sleep and overall student well-being and academic achievement.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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