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Expert Opinion Article

A Study to Assess the Association of Duration of Smartphone Use with Sleep Quality and Cognitive Functioning in Undergraduate Medical Students

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Abstract

Purpose: This cross-sectional study investigated the prevalence and effects of smartphone usage patterns on sleep quality and cognitive functioning among undergraduate medical students.

Methods: We conducted our study on 200 students selected through stratified random sampling at Atal Bihari Vajpayee Government Medical College, Vidisha. Data were collected using standardized instruments including the Pittsburgh Sleep Quality Index (PSQI), Montreal Cognitive Assessment (MoCA), and Mobile-Related Sleep Risk Factors (MRSRF) questionnaire. Statistical analysis was performed using SPSS v16.0, with $p<0.05$ considered significant.

Results: The average screen usage time was 5-6 hours daily, with 26.5% of participants reporting >7-8 hours of daily use. The mean PSQI score was 5.74±2.13, with 79% of students experiencing mild sleep difficulty. The mean MoCA score was 26.81±1.72, with 20.5% showing mild cognitive impairment. Despite high prevalence of both smartphone use and sleep/cognitive issues, no statistically significant association was found between screen time and sleep quality ($p=0.99$) or cognitive function ($p=0.872$).

Conclusions: While a substantial proportion of medical students experience mild sleep difficulties and cognitive impairment, our findings suggest that smartphone usage patterns may not be directly responsible for these issues. Nevertheless, education on mindful smartphone use remains important for maintaining overall wellbeing and academic performance.

Keywords: Sleep quality, Smartphone, Undergraduate Medical Students, Cognitive Function

Introduction

Sleep is a physiological state of unawareness regulated homeostatically.[1] It plays a crucial role in maintaining healthy bodily and mental processes, removing cellular toxins, preventing disease, and healing the body and mind.[2–4] Similarly, cognitive function-encompassing the mental operations necessary for learning, managing information, and reasoning-is essential for academic success.

In the last decade, technological advancement has transformed how we interact with the world, particularly through smartphones. For college students, these devices serve dual purposes: providing educational assistance and facilitating instant communication through social media platforms like WhatsApp, Facebook, Instagram, and Snapchat . Medical students, in particular, have increasingly preferred online platforms for self-study and competitive exam preparation.[5]

However, this digital immersion may come with costs.[6]Research suggests smartphone use at night can lead to sleep disturbances , while the World Health Organization has indicated that exposure to Radio-frequency Electromagnetic Field Radiation (RF-EMFR) from mobile phones may increase body core temperature and potentially impair cognitive function.[7,8] Nighttime phone use has been linked to decreased mental attention and cognitive performance due to resulting fatigue , and a meta-analysis by Carter et al. revealed a positive correlation between poor sleep quality and pre-bedtime media device use.[7]

Given these concerns, we hypothesized that prolonged smartphone use would be associated with poor sleep quality and cognitive impairment in

undergraduate medical students. Our study aimed to investigate this relationship and its potential implications for academic performance.

Materials and Methods

Study Design and Participants

We employed a cross-sectional descriptive design to assess smartphone usage duration and its effects on sleep and cognition in undergraduate medical students (aged 18-24 years) at Atal Bihari Vajpayee Government Medical College, Vidisha, Madhya Pradesh. The study commenced after obtaining approval from the Institutional Ethics Committee and was conducted over a two-month period.

Using stratified random sampling, we selected 200 undergraduate medical students who met our inclusion criteria: age between 18-24 years, daily smartphone use, and willingness to participate. We excluded students with diagnosed sleep disorders, chronic respiratory problems, chronic physical or mental illnesses affecting sleep, those using prescription medication for at least three months, and those unwilling to provide consent.

Assessment Tools

1. **Pittsburgh Sleep Quality Index (PSQI)**: This validated instrument identifies sleep quality through 19 self-report questions across 7 components. Each component receives a score of 0-3, with the total score ranging from 0-21. A score >5 indicates poor sleep quality.
2. **Montreal Cognitive Assessment (MoCA)**: This brief paper-format test helps detect cognitive impairments across multiple domains including executive functions. A score <26 is considered indicative of cognitive impairment.
3. **Mobile-Related Sleep Risk Factors (MRSRF) Questionnaire**: This tool assesses smartphone usage patterns through seven questions covering daily usage time, bedtime use with lights out, blue light filter use, device placement during sleep, and airplane mode settings.
4. **Semi-structured Socio-demographic Interview Proforma**: Used to collect socio-demographic information and patterns of mobile use.

Procedure

After providing participants with a brief overview of the study, we obtained written informed consent from those who voluntarily agreed to participate. Participants were informed they could withdraw at any time without consequences. Each participant completed the socio-demographic proforma followed by the PSQI, MoCA, and MRSRF questionnaires.

Statistical Analysis

Data were analyzed using SPSS for Windows (Version 16.0). Descriptive statistics were expressed as percentages for categorical variables and as mean ± standard deviation for continuous variables. Proportions were compared between groups using the Chi-square test, with $p<0.05$ considered statistically significant.

Results

Demographic Characteristics

The mean age of participants was 21.54±1.5 years, with a mean weight of 60.84±12.38 kg. Our sample included 109 males (54.5%) and 91 females (45.5%). All participants owned at least one smartphone.

Smartphone Usage Patterns

Table 1: Pattern and Practices (MRSRF) of Smartphone Users

Parameter	Categories	Frequency (%)
Average screen time per 24 hours	1-2 hours	6 (3%)
	3-4 hours	39 (19.5%)
	5-6 hours	102 (51%)
	7-8 hours	53 (26.5%)
Use of smartphone after lights out	Yes	111 (55.5%)
	No	89 (44.5%)
Use of blue light filter	Yes	140 (70%)
	No	60 (30%)
Smartphone on airplane mode during sleep	Yes	7 (3.5%)
	No	193 (96.5%)
Smartphone near pillow during sleep	Yes	164 (82%)
	No	36 (18%)

The average screen usage time was 5-6 hours daily, with 26.5% of participants reporting >7-8 hours of daily use. Approximately 55.5% of participants used their phones after lights out (immediately before sleep), and 70% used blue light filters. Only 3.5% activated airplane mode during sleep, while 82% kept their phones near their pillows while sleeping (Table 1).

Sleep Quality Assessment

Table 2: Comparison of Sleep Quality in Males and Females

Sleep Quality	Males (n=109)	Females (n=91)	Total (n=200)
Mild difficulty (PSQI 1-7)	92 (84.47%)	66 (72.53%)	158 (79%)
Moderate difficulty (PSQI 8-14)	17 (15.53%)	25 (27.47%)	42 (21%)

The mean PSQI score was 5.74±2.13 (range: 1-12), with 79% of students experiencing mild sleep difficulty (PSQI 1-7) and 21% experiencing moderate sleep difficulty (PSQI 8-14). Mild sleep difficulty was observed in 84.47% of males and 72.53% of females (Table 2).

Cognitive Function Assessment

The mean MoCA score was 26.81±1.72 (range: 22-30), with 20.5% of students showing mild cognitive impairment (MoCA <26).

Association Between Smartphone Use, Sleep Quality, and Cognitive Function

Table 3: Comparison of Sleep Quality (Global PSQI Score) with various MRSRF

Parameter	Categories	Mild Sleep Difficulty (PSQI 1-7)	Moderate Sleep Difficulty (PSQI 8-14)	p-value
Average screen time per 24 hours	1-2 hours	5 (2.5%)	1 (0.5%)	0.99
	3-4 hours	29 (14.5%)	10 (5%)	
	5-6 hours	82 (41%)	20 (10%)	
	7-8 hours	42 (21%)	11 (5.5%)	
Smartphone near pillow during sleep	Yes	127 (63.5%)	37 (18.5%)	0.72
	No	31 (15.5%)	5 (2.5%)	
Total		**158 (79%)**	**42 (21%)**	

Table 3 presents the comparison of sleep quality with various smartphone usage patterns. Among participants with 5-6 hours of daily screen time, 41% had mild sleep difficulty and 11% had moderate sleep difficulty. Similarly, among those using smartphones for 7-8 hours daily, 21% had mild and 5.5% had moderate sleep difficulty. However, no statistically significant association was found between total screen time and sleep quality (p=0.99) or between keeping the phone near the pillow and sleep quality (p=0.72).

Table 4: Comparison of Cognitive Function (MoCA Score) with various MRSRF

Parameter	Categories	Normal Cognitive Function (MoCA ≥26)	Mild Cognitive Impairment (MoCA <26)	p-value
Average screen time per 24 hours	1-2 hours	5 (2.5%)	1 (0.5%)	0.872
	3-4 hours	30 (15%)	9 (4.5%)	
	5-6 hours	78 (39%)	24 (12%)	
	7-8 hours	46 (23%)	7 (3.5%)	
Smartphone near pillow during sleep	Yes	132 (66%)	32 (16%)	0.761
	No	27 (13.5%)	9 (4.5%)	
Total		**159 (79.5%)**	**41 (20.5%)**	

Table 4 shows the comparison of cognitive function with smartphone usage patterns. Among participants with 5-6 hours of daily screen time, 39% had normal cognitive function and 13% had mild cognitive impairment. Among those using smartphones for 7-8 hours daily, 22% had normal

cognitive function and 4.5% had mild cognitive impairment. No statistically significant association was found between total screen time and cognitive function (p=0.872) or between keeping the phone near the pillow and cognitive function (p=0.761).

Discussion

Our study revealed high prevalence and persistence of smartphone use among undergraduate medical students, with an average screen time of 5-6 hours daily and 26.5% reporting >7-8 hours of daily use. These findings align with those of Nazish Rafique and colleagues, who found that students at Imam Abdul Rahman Bin Faisal University spent approximately 8.57±4.59 hours daily on mobile devices, with 38% reporting >8 hours of daily use.[8]

We found that 92.5% of participants used their smartphones after lights out (for an average duration of <30 minutes), yet this did not significantly affect sleep quality. Similarly, a study at King Saud University Medical City in Riyadh, Saudi Arabia,[9] reported that 92.4% of participants used mobile devices after lights out . However, a larger study including 90,000 young people found only 17% used mobile devices after lights out, possibly due to greater parental supervision in this younger population (grades 7-12).[10]

Contrary to our findings, a study on 844 Flemish participants aged 18-94 found that using mobile devices after lights out negatively impacted PSQI scores and sleep quality.[9] A Japanese study on younger individuals (aged 13-19) reported similar results . However, these studies did not specify the duration of mobile use or whether participants used blue light filters, which 70% of our participants reported using.[11]

Our study found no correlation between increasing screen time and poor sleep quality, daytime sleepiness, sleep disturbances, or increased sleep latency (p=0.99). This contradicts literature suggesting that prolonged cell phone use exposes individuals to radio-frequency electromagnetic fields (RF-EMF), potentially leading to depression, sadness, temper, headache, anxiety, forgetfulness, tinnitus, and decreased sleep quality.[12]

Additionally, we found no statistical association between smartphone location during sleep and sleep quality, despite 82% of participants keeping their phones near their pillows and 63.5% experiencing mild sleep difficulty. This contrasts with a cross-sectional study by Nazish Rafique at Imam Abdulrahman Bin Faisal University, which found that keeping mobile phones near pillows during sleep increased sleep latency, sleep disturbances, and daytime sleepiness.[8]

Several mechanisms might explain such effects: the urge to check notifications on nearby phones , disturbances from vibrations, heat from charging phones, and RF-EMF exposure. RF-EMF exposure can alter EEG patterns during REM and non-REM sleep.[13–15] Even when not in use, mobile phones emit RF-EMF that can penetrate the skull and reach the brain potentially causing neuronal hyperexcita bility and resulting in sleep problems.[16,17]

The discrepancy between our findings and previous research might be attributed to several factors. First, the high prevalence of blue light filter use (70%) among our participants may have mitigated potential negative effects on sleep quality. Second, our study population consisted exclusively of medical students who might have better awareness of healthy sleep practices. Third, cultural and environmental factors specific to our study setting might have influenced the results.

Limitations

Our study has several limitations. First, its cross-sectional design prevents establishing causal relationships. Second, self-reported data may be subject to recall bias and social desirability bias. Third, our sample was limited to medical students from a single institution, potentially limiting generalizability. Fourth, we did not account for all potential confounding factors such as academic stress, caffeine consumption, and exercise habits, which might influence both sleep quality and cognitive function.

Conclusion

While our study revealed high prevalence of smartphone use, mild sleep difficulties, and mild cognitive impairment among undergraduate medical students, we did not find statistically significant associations between smartphone usage patterns and sleep quality or cognitive function. This suggests that other factors may play more important roles in determining sleep quality and cognitive function in this population.

Nevertheless, the high prevalence of sleep difficulties (79%) and cognitive impairment (20.5%) among medical students is concerning and warrants attention. Educational institutions should consider implementing programs to promote healthy sleep hygiene and mindful smartphone use, regardless of whether direct causal relationships exist.

Future research should employ longitudinal designs to better establish causality, include objective measures of sleep quality and smartphone use, and account for potential confounding factors. Additionally, intervention studies testing the effects of reduced smartphone use or improved usage habits on sleep quality and cognitive function would provide valuable insights for developing effective recommendations.

References-

1. Brown LK. Can sleep deprivation studies explain why human adults sleep? Curr Opin Pulm Med 2012;18(6):541–5.
2. Curcio G, Ferrara M, Degennaro L. Sleep loss, learning capacity and academic performance. Sleep Medicine Reviews 2006;10(5):323–37.
3. Davies SK, Ang JE, Revell VL, Holmes B, Mann A, Robertson FP, et al. Effect of sleep deprivation on the human metabolome. Proc Natl Acad Sci U S A 2014;111(29):10761–6.
4. Cappuccio FP, D'Elia L, Strazzullo P, Miller MA. Sleep duration and all-cause mortality: a systematic review and meta-analysis of prospective studies. Sleep 2010;33(5):585–92.
5. Al-Barashdi H, Bouazza A, Jabur N. Smartphone Addiction among University Undergraduates: A Literature Review. JSRR 2015;4(3):210–25.
6. Hale L, Guan S. Screen Time and Sleep among School-Aged Children and Adolescents: A Systematic Literature Review. Sleep Med Rev 2015;21:50–8.
7. Carter B, Rees P, Hale L, Bhattacharjee D, Paradkar MS. Association Between Portable Screen-Based Media Device Access or Use and Sleep Outcomes: A Systematic Review and Meta-analysis. JAMA Pediatr 2016;170(12):1202–8.
8. Alshobaili FA, AlYousefi NA. The effect of smartphone usage at bedtime on sleep quality among Saudi non- medical staff at King Saud University Medical City. J Family Med Prim Care 2019;8(6):1953–7.
9. Munezawa T, Kaneita Y, Osaki Y, Kanda H, Minowa M, Suzuki K, et al. The association between use of mobile phones after lights out and sleep disturbances among Japanese adolescents: a nationwide cross-sectional survey. Sleep 2011;34(8):1013–20.
10. Exelmans L, Van Den Bulck J. Bedtime mobile phone use and sleep in adults. Social Science & Medicine 2016;148:93–101.
11. Thomée S, Härenstam A, Hagberg M. Mobile phone use and stress, sleep disturbances, and symptoms of depression among young adults--a prospective cohort study. BMC Public Health 2011;11:66.
12. Sahin S, Ozdemir K, Unsal A, Temiz N. Evaluation of mobile phone addiction level and sleep quality in university students. Pak J Med Sci 2013;29(4):913–8.
13. Loughran SP, Wood AW, Barton JM, Croft RJ, Thompson B, Stough C. The e¡ect of electromagnetic ¢elds emitted by mobile phones on human sleep.
14. Wagner P, Röschke J, Mann K, Hiller W, Frank C. Human sleep under the influence of pulsed radiofrequency electromagnetic fields: A polysomnographic study using standardized conditions. Bioelectromagnetics 1998;19(3):199–202.
15. Tattersall JEH, Scott IR, Wood SJ, Nettell JJ, Bevir MK, Wang Z, et al. Effects of low intensity radiofrequency electromagnetic fields on electrical activity in rat hippocampal slices. Brain Research 2001;904(1):43–53.
16. Ferreri F, Curcio G, Pasqualetti P, De Gennaro L, Fini R, Rossini PM. Mobile phone emissions and human brain excitability. Ann Neurol 2006;60(2):188–96.
17. Ragupathi D, Ibrahim N, Tan KA, Andrew BN. Relations of Bedtime Mobile Phone Use to Cognitive Functioning, Academic Performance, and Sleep Quality in Undergraduate Students. Int J Environ Res Public Health 2020;17(19):7131.