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Correlation between the duration of smartphone usage prior to sleep and sleep quality

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Abstract:

Background: Mobile phones have become indispensable in contemporary life, particularly for young adults. Although mobile technologies, devices, and software have undoubtedly improved our lives in certain areas such as medical applications, we often overlook their potential negative effects.

Aim & objectives: This study aimed to investigate the effect of mobile phone usage minutes before falling asleep on sleep quality. To achieve the aim of the study, the objectives were to examine the correlation between mobile phone usage prior to falling asleep and three key factors: (i) sleep duration, (ii) subjective sleep quality, and (iii) excessive daytime sleepiness among health trainees at Raipur Institute of Medical Science, Raipur.

Materials & methods: The study was approved by the Institutional Ethics Committee. This study was conducted in July and August 2018. The study included a representative sample of 100 health trainees from diverse training programs. The age range of 17–23 years included both male and female college students. All health trainees from the various programs who agreed to participate in the study met the specified inclusion criteria.

Results: In total, 100 students were included in this study. The average age of the students was 20 years old. Among the participants, 29 (29%) were males and 71 (71%) were females. 22% of the students reported using their smartphones for less than 15 minutes before going to sleep, 28% used them for 15-30 minutes, 29% used them for 31-60 minutes, and 21% used them for more than 60 minutes. According to the PSQI score, 49% of the students exhibited satisfactory sleep quality, while 51% displayed unsatisfactory sleep quality.

Conclusion: The findings of this study suggest that reducing smartphone use prior to sleep can significantly improve sleep quality. Future research should explore the long-term effects of smartphone usage on sleep quality and investigate potential interventions to promote healthier sleep habits.

Key words: Smartphones; Mobile phones; Health trainees; Sleep quality; Sleep deprivation; Potential health hazards.

Introduction:

Mobile phones have become indispensable in contemporary life, particularly for young adults. Although mobile technologies, devices, and software have undoubtedly improved our lives in certain areas such as medical applications, we often overlook their potential negative effects. Increasing research indicates that smart phones can have detrimental effects on biophysiological processes, particularly sleep [1, 2]. Using mobile phones can have a detrimental impact on academic performance, as per a study conducted by Li et al. [3]. This study examined the relationship between cell phone use, locus of control, sleep quality, academic achievement, and subjective well-being. Another study [2] suggested that using mobile phones extensively within an hour before attempting to sleep or using them in bed after lights out is associated with sleep disruption. This disruption can lead to impaired daytime functioning and increased anxiety, depression, fatigue, and psychological stress, as per the study. Research [4,5] has also shown similar results, with a longer time taken to fall asleep, reduced sleep efficiency, more sleep disturbances, and greater daytime dysfunction in adults' subjects. The excessive fatigue during the day was attributed to using a mobile phone immediately before going to bed. Overall, using a cellular phone immediately before bed has been linked to several negative outcomes. [6]. Some studies have indicated that the use of cell phones after bedtime is associated with increased fatigue, later bedtime, and decreased total sleep duration [7,8]. Only a small number of studies have found meaningful links between mobile phone usage and sleep disruption in adults. Brunborg et al. demonstrated a notable association between the use of mobile phones before bedtime and a delay in the time it takes to fall asleep, resulting in reduced sleep quality [9]. Research has closely linked achieving sufficient sleep to improve physical, cognitive, and psychological health, not only in adults, but also in children and adolescents. In a large group of college students, Lepp et al. [10] examined the correlation between overall cell phone usage (N = 496), specifically texting (N = 490), and the level of satisfaction with life (SWL). Researchers have found a negative correlation between cell phone usage, texting, and academic performance and a positive correlation with anxiety [10]. Exposure to sunlight or using mobile phones for lighting in the morning can potentially stimulate the production of serotonin in the pineal gland [11]. Medium or intense light can inhibit melatonin secretion, which follows the circadian rhythm [12]. Experts have proposed several theories to explain how excessive smartphone use disrupts sleep. These theories include interference with sleep, heightened psychophysiological arousal, delayed circadian rhythm due to exposure to bright light, exposure to electromagnetic radiation, and physical discomfort resulting from prolonged media use [13]. Research has indicated that sleep disorders and sleep deprivation are associated with poor academic performance and increased daytime sleepiness in college students [14, 15]. This study aimed to investigate the effect of mobile phone usage minutes before falling asleep on sleep quality. To achieve the aim of the study, the objectives were to examine the correlation between mobile phone usage prior to falling asleep and three key factors: (i) sleep duration, (ii) subjective sleep quality, and (iii) excessive daytime sleepiness among health trainees at Raipur Institute of Medical Science, Raipur.

Materials & methods:

The study was approved by the Institutional Ethics Committee. This study was conducted in July and August 2018. The study included a representative sample of 100 health trainees from diverse training programs. The age range of 17–23 years included both male and female college students. All health trainees from the various programs who agreed to participate in the study met the specified inclusion criteria. The exclusion criteria included health trainees from various programs who declined to participate in the study, as well as individuals with a past medical history of alcohol or substance abuse or sleep difficulties. This is a cross-sectional study. The trial lasted for 2 months. We employed the Pittsburgh Sleep Quality Index (PSQI) questionnaire, comprising 19 self-assessed items and five questions assessed by the bed partner or roommate. In this investigation, we considered only the last five items of clinical information. However, we did not include them in the PSQI ranking, and hence did not include them in the report. The 19 self-rated questions evaluated many aspects of sleep quality such as sleep length and latency, habitual sleep efficiency, sleep disruptions, usage of sleep medicine, and daytime dysfunction. The authors categorized these 19 items into seven component scores, with each score having equal weight on a scale ranging from 0 to 3. Subsequently, we combined the seven individual component values to calculate a comprehensive PSQI score, which ranged from 0 to 21. A higher score on this scale indicates lower sleep quality. A global sum beyond 5 suggests substandard sleep quality, whereas a sum below 5 indicates satisfactory sleep quality. This study also utilized a self-developed questionnaire based on a Likert scale, which is a widely accepted standard for measuring attitudes and opinions, to gather data on smart device usage.

Ethical considerations:

Informed consent Before conducting the necessary investigations, we obtained written consent from the subjects. The Institutional Ethical Committee (IEC) provided the necessary ethical clearance.

Statistical analysis:

All data were stored in Microsoft Office Excel, and their accuracy was verified using IBM SPSS Statistics version 20. The study employed a chi-squared test to assess and evaluate the sleep quality of individuals, considering their demographic features. The authors of the current study calculated the connections between the usage of mobile phones before going to sleep and characteristics related to sleep using bivariate Pearson correlation analysis.

Results:

In total, 100 students were included in this study. The average age of the students was 20 years old. Among the participants, 29 (29%) were males and 71 (71%) were females (Table 1). 22% of the students reported using their smartphones for less than 15 minutes before going to sleep, 28% used them for 15-30 minutes, 29% used them for 31-60 minutes, and 21% used them for more than 60 minutes. According to the PSQI score, 49% of the students exhibited satisfactory sleep quality, while 51% displayed unsatisfactory sleep quality (Table 2).

Table 1: Socio demographic characteristics of the study sample

Variables	Groups	N (%)
Age	18-19	27(27)
	20-21	55(55)
	22-23	18(18)
	Total	100(100)
Gender	Female	71(71)
	Male	29(29)
	Total	100(100)

Table 2: Characteristics of smartphone use and sleep quality in the study sample.

Variables	Groups	N (%)
Minutes spent on device before fall asleep (MSDA)	<15	22(22)
	15-30	28(28)
	31-60	29(29)
	>60	21((21)
	Total	100(100)
Sleep quality (Based on PSQI score) **Sleep index**	Poor	51(51)
	Good	49(49)
	Total	100(100)

The mean global PSQI score was 4.97, with a standard deviation of 2.04. The scores range from 0 to 13 (Table 3). Among bad sleepers, males accounted for 31%, whereas females accounted for 79%. In contrast, among good sleepers, 27% were male, while 69% were female. The analysis in Table 4 did not find any statistically significant correlations between age, sex, and sleep quality.

Table 3: Descriptive statistics for PSQI scores.

Domains	Mean	SD	Percentiles		
			25	50	75
Sleep quality	0.70	0.56	0	1	1
Sleep latency	0.56	0.62	0	.5	1
Sleep duration	1.08	.88	0	1	2
Sleep efficiency	0.05	0.21	0	0	0
Sleep disturbance	0.88	0.92	0	1	2
Sleep medication	0.10	0.39	0	0	0
Day time dysfunction	0.91	0.76	0	1	1.75
Global PSQI score	4.97	2.04	4	5	6

able 4: Distribution of study subjects according to sociodemographic variables and sleep quality.

Variables	Groups	Sleep quality		Total	Chi-square test
		Poor	Good		
Sleep index	Male	16 (31)	13 (27)	29 (29)	0.594
	Female	35 (69)	36 (73)	71 (71)	
	Total	51 (100)	49 (100)	100 (100)	
Age in Years	18 – 19	11 (21)	16 (33)	27 (27)	0.411
	20 – 21	31 (61)	24 (49)	55 (55)	
	22 – 23	9 (18)	9 (18)	18 (18)	
	Total	51 (100)	49 (100)	100 (100)	

The authors of the present study assessed the Pearson correlation between the duration of smart mobile device use and excessive daytime sleepiness, sleep duration, and sleep quality (Table 5). There was a strong positive correlation ($p<0.05$) between the amount of time spent on a smart mobile device before falling asleep and the subjective sleep quality. The frequency with which respondents had trouble sleeping as a result of using a smart mobile device 30 min before going to bed was found to have a significant association with their subjective sleep quality ($p<0.05$). The frequency at which participants woke up during sleep to utilize their smartphones was strongly associated with daytime dysfunction ($p<0.01$) and sleep disturbance ($p<0.05$).

Table 5: Pearson's correlation between PSQI and smartphone usage by respondents.

Parameters	MSDA	HOTSDSD	HOWMSSD	HMTWSSD	SD	SDB	SL	DD	HSE	SSQ	UOM	PSQI
MSDA		.24	.29	.16	.83	.54	.12	.49	.00**	.01*	.15	.01*
HOTSDSD			.03*	.58	.59	.13	.05	.34	.35	.00**	.00**	.00**
HOWMSSD					.80	.01*	.34	.00**	.69	.05	.61	.04*
HMTWSSD						.03*	.27	.01*	.35	.26	.51	.10
SD						.62	.78	.80	.47	.08	.45	.00**
SDB							.13	.06	.19	.00**	.09	.00**
SL								.39	.00**	.00**	.10	.00**
DD									.14	.007**	.72	.00**
HSE										.00**	.03*	.01*
SSQ											.03*	.00**
UOM												.00**

Note: MSDA-Minutes spent on device before falling asleep, HOTSDSD-How often had trouble sleeping due to use of smart device 30 min before bed, HOWMSSD: How often waken up in the middle of sleep to use smart device HMTWSSD-How, How many times waken up when sleeping due to smart device, SD-Sleep duration, SDB-Sleep disturbance, SL-Sleep latency, DD-Daytime dysfunction due to sleepiness, HSE-Habitual sleep efficiency, SSQ-Subjective sleep quality, UOM-Use of Medication, PSQI-Pittsburgh Sleep Quality Index. P was significant at *0.05; **0.01.

Discussion:

This study aimed to evaluate the correlation between pre-sleep mobile phone usage and its effects on sleep quality among health trainees at RIMS in Raipur. The percentage of female participants exceeded that of male participants, with females accounting for 71% and males accounting for 29%. Our study found that 51% of students had poor sleep quality, as determined by the PQSI scale. This percentage is comparable to the findings of a study conducted on medical students in Iran, in which 40.6% were identified as bad sleepers. Similarly, studies in Brazil and Pakistan reported rates of 38.9% and 77%, respectively, among their study individuals [16-19]. Of the students with poor sleep quality, there were 35 females (69%) and 16 males (31%). However, no significant correlation was observed between sex and sleep quality. In a study conducted by Ghoreishi et al., [16] 44.8% of the poor sleepers were male and 38% were female. However, the difference in the sex distribution was not statistically significant. In the present investigation, the average (standard deviation) global PSQI score was found to be 4.97 (2.04). In a previous study conducted by Soni et al [20] involving adolescents, the mean (SD) score was 10.75 (3.49). Similarly, in another study conducted by Waqas et al among medical students, the mean (SD) score was 8.1 (3.12) [18].

This study demonstrated a correlation between the duration of smart mobile device usage and excessive daytime sleepiness, as well as the duration and quality of sleep. There was a strong positive relationship between the amount of time spent on a smart mobile device before falling asleep and the subjective sleep quality ($p<0.05$). There was a correlation between the amount of time respondents spent on their smart mobile devices and a decrease in their sleep duration. The frequency with which respondents had trouble sleeping as a result of using their smart mobile devices within 30 min before going to bed had a significant impact on their subjective sleep quality ($p<0.1$). This study examined the correlation between daytime dysfunction caused by excessive sleepiness and various factors related to smart mobile device use. These factors included the amount of time respondents spent on their devices before falling asleep, the frequency of sleep disturbances caused by device use 30 min before bed, the frequency of waking up during sleep to use the devices, and the number of times the respondents woke up because of device use while sleeping. The results showed that all of these factors, except for the frequency of sleep disturbances 30 min before bed and the amount of time spent on devices before falling asleep, had a significant relationship ($p<0.5$) with daytime sleepiness. The research conducted by Slater and Steier [21] and Mak et al. [22] showed a notable impairment in daytime functioning as a result of inadequate sleep quality.

The participants were instructed to assess their sleep quality, referred to as subjective sleep quality. The subjective sleep quality of the respondents showed a significant correlation with the amount of time they spent on smart mobile devices before going to sleep ($p<0.5$), as well as the frequency of sleep difficulties caused by using smart mobile devices 30 min before bedtime ($p<.01$). The frequency with which participants woke up during sleep to use their smartphones was found to be significantly correlated with daytime dysfunction, with a p-value of less than 0.5. The findings presented in Table 5 unequivocally demonstrated a correlation between the duration of smart mobile device usage and excessive daytime dysfunction caused by tiredness as well as subjective sleep quality. If left unattended, these issues can potentially culminate in severe sleep problems. Insufficient sleep can significantly impact students' academic performance, potentially leading to headaches, physical aches, and decreased self-esteem. Research has indicated that there may be negative impacts on the quality of naps, increased daytime sleepiness, and longer napping duration when individuals engage in prolonged use of various types of digital devices [22]. Insufficient sleep quality has also been linked to prehypertension in adolescents. Poor sleep quality is associated with elevated blood pressure [23].

Conclusion:

This study provides empirical evidence on the influence of intelligent mobile gadgets on sleep quality. Sleep disturbance is strongly associated with daytime impairment. Health trainees must maintain a high degree of alertness and attentiveness during their learning phase to gain the knowledge and abilities necessary for patient care. However, daytime dysfunction and poor sleep quality can result in substantial stress and mental health issues. Future research should explore the long-term effects of smartphone usage on sleep quality and investigate potential interventions to promote healthier sleep habits.

Conflict of interest:

The authors declare that they have no conflict of interest.

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