

Let The Eyes Be Away From The Screen- Problematic Smartphoneuse In Adolescence And Sleep Quality

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Abstract

Background: There has been a significant increase in the smartphone use among adolescents after COVID pandemic. Concurrently, there is an increased incidence of mental health problems and sleep disturbances in this age group

Objective : To estimate the prevalence of problematic smartphone use among midadolescents using Smartphone Addiction Scale (SAS) and its effect on sleep quality

Study design : Cross sectional analytical study done in school children of age group 14-17 years in Thanjavur urban block from August 2023- July 2024

Intervention and outcomes: Predesigned validated questionnaires for determining problematic smartphone use (SAS Scale) and sleep quality (Adolescent Sleep WakeScale) were administered to children. Questionnaires were evaluated and the outcomes were analysed.

Statistical analysis : Continuous data with a normal distribution were expressed as mean with standard deviation. Categorical data were expressed as frequencies with percentages. Fisher's exact test was used to compare frequencies between groups. The Mann-Whitney U test was used to compare the median scores between groups. Statistical significance was set at $p < 0.05$.

Results : The prevalence of smartphone addiction was found to be 17% among 400 participants. Addicted adolescents had lower sleep quality scores ($p < 0.0001$) and took longer time to fall asleep ($p = 0.012$). The use of smartphone for non academic purposes and the use at weekends were strongly associated with addiction. Bedtime use was also significantly associated, with 33.1% of users addicted compared to 9.3% of non-users ($p < 0.001$).

Conclusion: This study reveals a significant association between problematic smartphone use and factors like gender, non-academic use, and bedtime access. Those children with problematic smartphone use had lower sleep quality scores highlighting the need for interventions to promote healthier smartphone habits among adolescents.

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Keywords:

- Smartphone use
- Smartphone Addiction Scale
- COVID pandemic

Introduction:

The first smartphone was designed by IBM in 1993 which included a touchscreen interface for doing calculations, address books and notepads. It had facilities to make calls as well as receive faxes and emails. The introduction of 4G and 5G technology in 2009 and 2019 respectively were major milestones in the history of smartphones. Beyond 2023, the rise of artificial intelligence have revolutionised smartphone technology.

The incidence of mental health issues like depression, poor sleep quality and suicidal thoughts is on increase in children and young people in the recent times. The smartphone usage in these population is also on a steep rise^[1]. Smartphone ownership is now practically universal among youngsters aged 11 and above, and the highest prevalence of mental health problems occurs during adolescence. Recent years have seen an increase in research on the prevalence of problematic smartphone use (PSU), a behaviour that shares characteristics with behavioural addictions, such as tolerance, withdrawal (e.g., distress when the battery runs out), preoccupation, neglect of other activities, loss of control, and persistent use despite evidence of harm^[2,3]. The term problematic smartphone use and smartphone addiction are used interchangeably in previous studies. However, public health officials are still unsure of the potential relationship between smartphone usage and mental health among young people. This study was done to estimate the prevalence of problematic smartphone use and the effect on sleep quality.

Materials & Methods:

This was a Cross sectional study and the assessment was done with two prevalidated questionnaires. A structured questionnaire was also used to compare the age at first use of smartphone, usage at weekends and bedtime usage. The study population involved children of age group 14-17 years studying in urban schools of Thanjavur district. The sample size was 400. The schools were chosen by simple random sampling method. 5 schools were selected

by simple random sampling. Of these, 10 children of each class who use smartphones were selected. Questionnaires were distributed and explained to the students and consent was obtained.

Problematic smartphone use was assessed using Smartphone addiction scale short version^[4]. Responses will be given on a sixpoint likert scale ranging from 1 to 6. Scores on single items were summed up, those with higher score indicating problematic smartphone use. Sleep quality was assessed using Adolescent sleep wake scale. The scores of ASWS were compared among those having problematic smartphone use and the control group.

Statistical analysis: The data were entered in an MS Office Excel sheet and analysed using SPSS version 16. Continuous data with normal distribution was expressed as mean with standard deviation. Categorical data were expressed as frequencies with percentages. Fisher's exact test was used to compare frequencies between groups. The Mann-Whitney U test was used to compare the median scores between groups. Statistical significance was set at $p < 0.05$.

Results:

- Most participants were 14 years old (52.8%), followed by 15-year-olds (19.8%), 16-year-olds (19.4%), and 17-year-olds (8%). Females made up 73.8% of the sample, while males accounted for 26.2% [Table 1]. The majority started using smartphones between ages 10-14. 77.8% accessed smartphones through their parents, 18.5% owned a device, 3.3% accessed through siblings, and 0.5% via friends.
- 53.2% used smartphones for non-academic purposes, while 46.8% used them only for academic reasons. On weekends, 58.3% used smartphones for 1-2 hours, 21.3% for 2-4 hours, and 11.8% for over 4 hours.
- 17% (n=68) were classified as having problematic smartphone use (PSU) according to the Smartphone Addiction Scale (SAS), while 83% (n=332) did not.

- Among those using smartphones for non-academic purposes (n=213), 75.6% (n=161) were not having PSU, while 24.4% (n=52) had. The Fisher exact value was 17.74, with a p-value of <0.001 which was significant.
- Smartphone use at bedtime is strongly linked to PSU. Among those using smartphones at bedtime (n=130), 66.9% (n=87) were non-addicted and 33.1% (n=43) were addicted. The Fisher's exact value was 35.2, with a p-value <0.001 which was significant [Figure 2].
- Weekend smartphone use was strongly associated with PSU. Among those who used smartphones for more than four hours (n=47), 55.3% (n=26) were non-addicted, and 44.7% (n=21) were addicted [Figure 1]. The Fisher's exact value was 33.97, with a p-value <0.001 which was significant.

The overall ASWS score was lower in adolescents with PSU ($p < 0.0001$). The time to fall asleep was significantly longer in those adolescents ($p = 0.012$), but night awakenings showed no significant difference ($p = 0.617$).

Table 1. Description of the age categories of the adolescents

observed in the study (n=400).

S. No	Age category	n	%
1	14 years	211	52.8
2	15 years	79	19.8
3	16 years	78	19.4
4	17 years	32	8

Table 2. Description of various scales and their components observed in the adolescents in the study (n=400)

S.No	Parameter (ASWS scale)	Mean	SD	Median	IQR	Min	Max
1	Going to bed	4.25	1.05	4.3	3.6-5	1.2	6
2	Falling asleep and reinitiating	4.88	0.9	5	4.2-5.8	1.2	7
3	Return to wakefulness	3.69	1.53	3.8	2.5-4.5	1	6
4	ASWS score	4.24	0.78	4.2	3.7-4.8	2.4	6
5	Time to fall asleep (min)	20.6	22.8	15	6-30	1	120
6	Night awakenings (times)	1.83	1.92	2	0-3	1	10

Several sleep parameters were assessed using ASWS[Table 2]. The mean score for the “Going to bed” component was 4.25 (SD = 1.05), with a median of 4.3 and an interquartile range (IQR) of 3.6-5. The “Falling asleep and reinitiating sleep” component had a mean score of 4.88 (SD = 0.9), with a median of 5 and an IQR of 4.2-5.8. The “Return to wakefulness” component had a mean of

3.69 (SD = 1.53), a median of 3.8, and an IQR of 2.5-4.5. The overall ASWS score had a mean of 4.24 (SD = 0.78), with a median of 4.2 and an IQR of 3.7-4.8. Regarding sleep latency, the average time to fall asleep was 20.6 minutes (SD = 22.8), with a median of 15 min and a wide range of 1-120 min. Night awakenings averaged 1.83 times per night (SD = 1.92), with a median of 2 and a range of 1-10 times.

FIGURE 1. Comparison of smartphone use on weekends with respect to Problematic Smartphone use (PSU) status (as per SAS score) in mid-adolescent children.

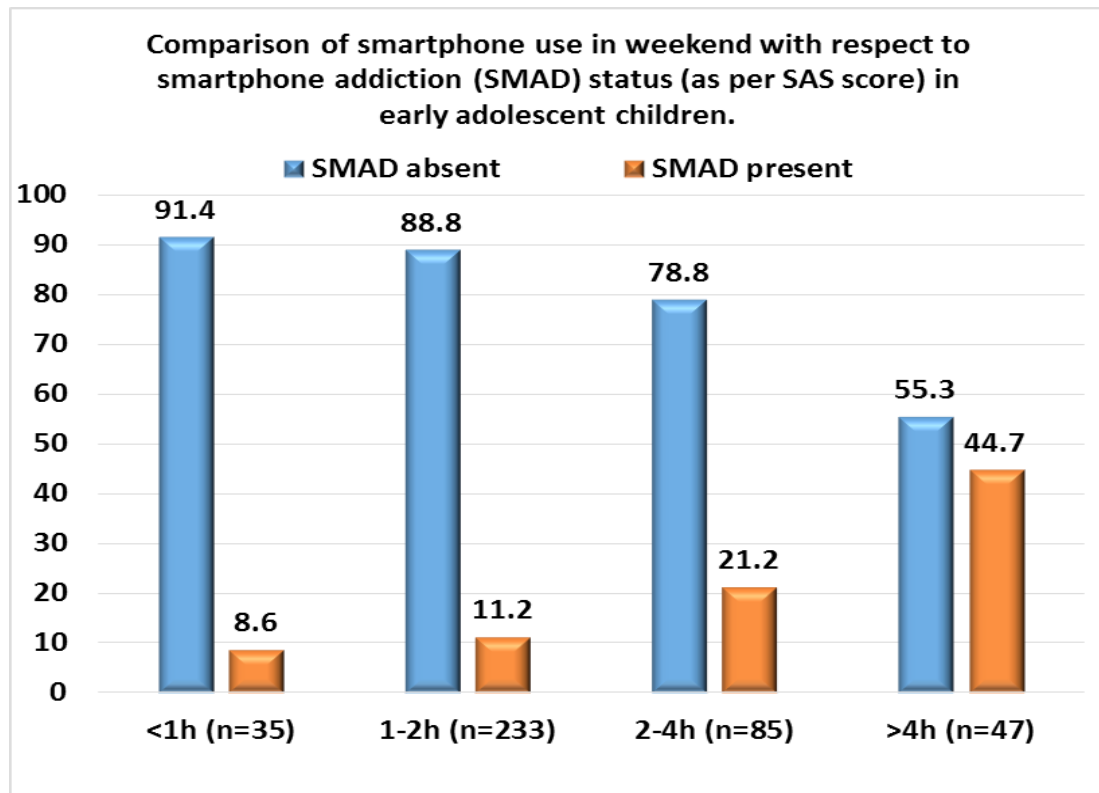


Table 3. Comparison of the median scores of clinical parameters and various components of the ASWS scale with respect to smartphone addiction in adolescents.

S. No	Parameter	SMAD absent (n=332)		SMAD present (n=68)		Mann Whitney U	Rank sum	P Value
		Median	IQR	Median	IQR			
1	Age(y)	14	14 - 16	14	14 - 16	11250	66528, 13672	0.962 (NS)
2	Age of first use (y)	11	10 - 14	10	8 - 14	10202.5	67661, 12548	0.208 (NS)
3	Going to bed	4.3	3.7 - 5	4	3.3 - 4.8	9244	68610, 11590	0.018*

4	Falling asleep and reinitiating	5.2	4.4 – 5.8	4.4	3.5 – 5	6804.5	71049, 9150	<0.0001*
5	Return to wakefulness	4	2.5 – 5	3.5	2 – 4.5	9173.5	68680, 11519	0.014*
6	ASWS score	4.3	3.7 – 4.8	3.8	3.2 – 4.3	7142.5	70711, 9488	<0.0001*
7	Time to fall asleep	10	5 – 30	25	10 – 30	9129.5	64407, 15972	0.012*
8	Night awakenings	2	0 – 3	1.5	0 – 3.75	10865	199.2, 206.7	0.617 (NS)

Comparison of the median scores of clinical parameters and ASWS scale components with respect to PSU status indicated that the median age was similar in both groups (14 years), with no significant difference ($p=0.962$). However, the age at first smartphone use was slightly earlier in adolescents with PSU (median 10 years vs. 11 years in adolescents, without PSU ($p=0.208$)). Significant differences were found in sleep behaviour, with

addicted adolescents scoring lower in the “Going to bed” ($p=0.018$), “Falling asleep and reinitiating” ($p<0.0001$), and “Return to wakefulness” ($p=0.014$) categories. The overall ASWS score was also lower in adolescents with PSU ($p<0.0001$). The time to fall asleep was significantly longer in those adolescents ($p=0.012$), but night awakenings showed no significant difference ($p=0.617$) [Table 3].

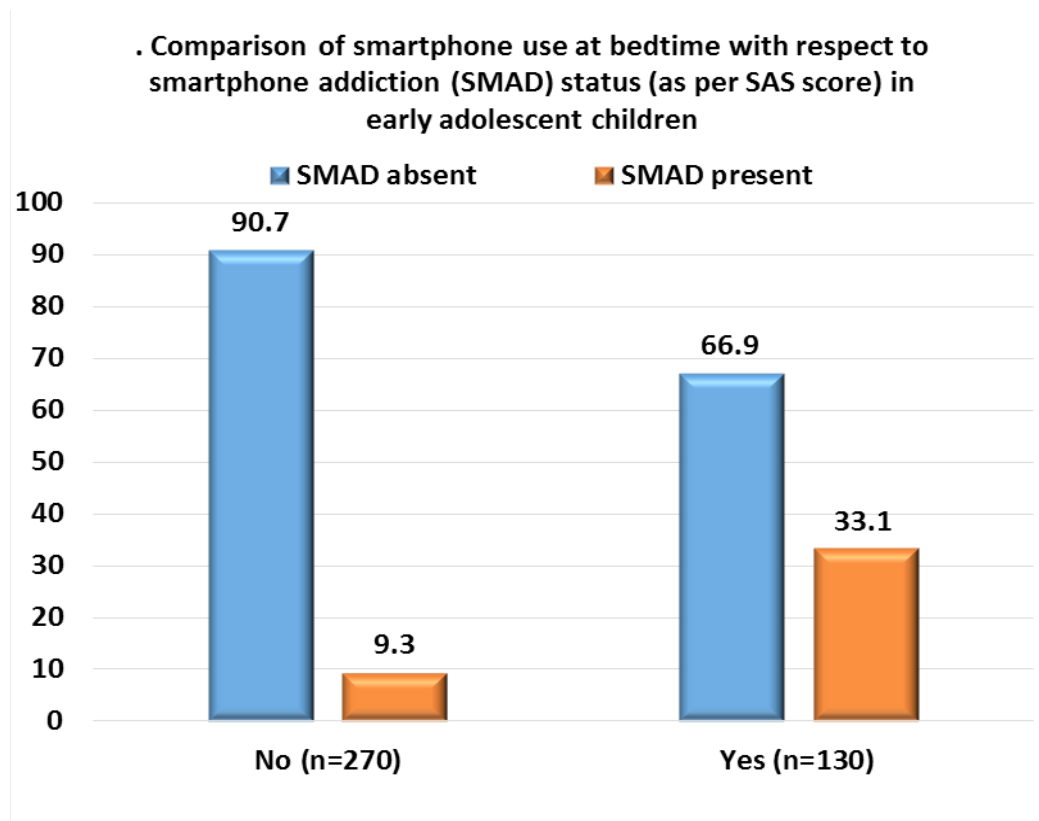


FIGURE 2. Comparison of smartphone use at bedtime with respect to problematic smartphone use (PSU) status (SAS score) in mid-adolescent children

Discussion:

Smartphone use among adolescents has become increasingly prevalent, raising concerns about its potential association with addiction and impact on various aspects of health and well-being. Adolescents aged 14 years, 15 years, 16 years, and 17 years all exhibited similar rates of smartphone addiction, suggesting that age alone may not be a strong predictor of PSU within this specific age range. Several aspects of smartphone use have been explored in relation to smartphone addiction. The use of smartphones for non-academic purposes was a significant predictor of PSU ($p < 0.001$). Adolescents who used smartphones for activities unrelated to academics were more likely to exhibit PSU (24.4%) than were those who primarily used smartphones for academic reasons (8.6%). This finding aligns with existing literature that has linked excessive engagement in social media, gaming, and entertainment apps to higher addiction risks^[5]. Non-academic smartphone use likely reflects more recreational and compulsive engagement, contributing to the development of addictive behaviours.

Bhanderi et al. showed that the longer the duration and number of daily hours spent on smartphone use, the higher is the likelihood of developing smartphone addiction^[6]. This suggests a vicious cycle in which smartphone addiction leads to more time spent on the device, which perpetuates addiction.

Smartphone access played a crucial role in the prevalence of PSU ($p = 0.007$). Adolescents who owned their smartphones were significantly more likely to exhibit addiction (28.4%) than those who accessed smartphones from their parents (13.8%) or siblings (23.1%). This suggests that personal ownership of smartphones may facilitate greater autonomy and less parental regulation, leading to higher levels of smartphone use and addiction^[7].

One of the most significant findings of this study was the strong association between smartphone use at bedtime and smartphone addiction. This finding

is particularly concerning and has been reported in previous studies^[8]. The use of smartphones at bedtime has been linked to poor sleep quality, delayed sleep onset, and reduced sleep duration, all of which can have negative consequences for adolescents' overall health and development.

Additionally, the study found significant differences in several sleep-related parameters, as measured using the Adolescent Sleep Wake Scale (ASWS), between adolescents with and without PSU. Adolescents with PSU had significantly lower scores on the "going to bed" ($p = 0.018^*$), "falling asleep and reinitiating" ($p < 0.0001^*$), "return to wakefulness" ($p = 0.014^*$), and overall ASWS score ($p < 0.0001^*$) components, indicating poorer sleep quality and greater sleep disturbances. These adolescents also took longer to fall asleep ($p = 0.012^*$), with a median time of 25 min compared with 10 min in non-PSU adolescents.

Excessive screen exposure has been linked to poor psychosocial well-being in some studies, with sleep serving as a mediating factor^[9]. Several mechanisms have been identified as responsible for the negative impacts of screen time on sleep, including displacement of sleep time, increased arousal that harms sleep quality, circadian rhythm disruptions due to light exposure, and heightened depressive symptoms^[10].

These findings underscore the detrimental effect of problematic smartphone use on sleep, a critical aspect of adolescent health. Poor sleep has been associated with a range of adverse outcomes, including cognitive impairment, emotional dysregulation, and an increased risk of mental health disorders such as anxiety and depression^[11]. The prolonged use of smartphones, especially at night, disrupts sleep patterns, perpetuating a cycle of sleep loss and increased screen engagement^[12,13].

Despite the valuable insights gained from this study, several limitations must be acknowledged. First, the cross-sectional design of the study prevented the establishment of causal relationships between smartphone addiction and the observed parameters. Second, reliance on self-reported

data for both smartphone use and PSU status introduces the possibility of a response bias. Future studies should incorporate objective measures of smartphone use, such as screen-time monitoring through smartphone applications, to obtain more accurate data. Third, this study was conducted in a single geographical location, which may limit the generalizability of the findings to other populations. Finally, this study did not account for other factors that may influence smartphone addiction, such as parental involvement, academic pressure or mental health status.

Conclusion:

In conclusion, this study highlights the significant association between problematic smartphone use

and various demographic, behavioural, and sleep-related factors in adolescents. These findings emphasize the need for increased awareness of and interventions to promote healthy smartphone use among adolescents. Future research should explore the underlying causes of smartphone addiction and develop effective strategies to mitigate its negative effects on adolescent well-being.

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