

Sleep, Anxiety and Academic Performance in Adolescents in Relation to Screen Time

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ABSTRACT

Background: Adolescents today experience heightened levels of sleep disturbances and anxiety, closely linked to their academic performance. Research indicates that excessive screen time can worsen these issues by disrupting sleep patterns and increasing anxiety. Examining the connections between screen time, sleep quality, and academic outcomes is essential for creating strategies to support adolescent well-being and academic success. The aim of the study was to assess the impact of screen time on sleep, anxiety, and academic performance among adolescents aged 14 to 18 years.

Methodology: Four hundred school going adolescents aged between 14-18 years were taken as study subjects. Screen time, anxiety, and sleep hygiene were evaluated using Questionnaire for screen time of adolescents (QueST), Beck Anxiety Inventory (BAI), and Adolescents Sleep Hygiene Scale (ASHS), respectively. Data was analyzed with SPSS version 26.0. The mean and standard deviation of the quantitative variables were measured. Association between categorical variables was measured by Chi-square test.

Results: Among the participants, 52.3% averaged 6.5-8 hours of sleep per day, and 68.8% exhibited mild anxiety. Excessive screen time, particularly for entertainment, had a significant negative impact, with students using screens for >6 hours daily showing poorer sleep hygiene ($p=0.000$) and a decline in academic performance ($p=0.000$). There was a significant association between screen time and anxiety levels, with those spending 2-6 hours on screens daily showing increased anxiety ($p=0.019$).

Conclusion: This study underscores the detrimental effects of excessive screen time on adolescents' sleep, anxiety, and academic performance. Reducing screen usage can enhance sleep quality and lower anxiety, thereby improving academic outcomes.

Keywords: Screen time, adolescents, sleep, anxiety, academic performance.

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INTRODUCTION

Adolescents today are deeply embedded in a digital world where the internet and social media are integral to socializing, communicating, and showcasing talents. This generation (Generation Z) has grown up surrounded by digital information and screen-based entertainment. According to the World Health Organization, screen time refers to 'time spent passively watching screen-based entertainment' on devices such as TVs, computers, and mobile phones, excluding active screen-based activities requiring physical

movement [1]. The American Academy of Paediatrics reports that 75% of adolescents own a cell phone, and 25% use it primarily for social media [2].

Excessive use of electronic devices, both during the day and at bedtime, is linked to sleep disturbances and an increased risk of short sleep duration [3]. Screen time can delay bedtime, disrupt sleep due to notifications, and lower overall sleep quality, resulting in daytime sleepiness and diminished academic performance [4-7]. Research indicates that adolescents with higher academic achievement tend to sleep more and spend less time on sedentary screen activities compared to their lower-performing peers [8]. The use of gadgets at bedtime significantly impacts the time taken to fall asleep and academic outcomes [9]. Furthermore, anxiety levels in adolescents mediate the relationship between sedentary screen time and sleep quality, emphasizing the need to examine how different screen types affect emotional and behavioural health [10-11].

The correlation between screen time and anxiety is evident but decreases when screen time is reduced [12]. A Canadian study highlighted that the percentage of adolescents spending five or more hours daily on social media increased from 11% in 2013 to 20% in 2017, with those reporting moderate to severe mental distress rising from 24% to 39% during the same period [13]. Adolescents aged 14-17 who used screens for more than seven hours a day were twice as likely to be diagnosed with depression compared to those with less than one hour of screen time daily [14]. The COVID-19 pandemic exacerbated these trends, with many students engaging in online learning and reporting daily screen use ranging from 2 to 6 hours, with some exceeding 8 hours [15].

A study on adolescent screen time by Khan A et al. revealed that adolescents spending over two hours per day on screens primarily use them for watching television (54.3%), playing electronic games (38.4%), and using computers (44.6%) [16]. Another study that included 1803 secondary school students from 21 districts of Bangladesh reported that 87% of adolescents use electronic gadgets, with 39% watching cartoons or movies, 27% engaging in social media, and 17% playing video games [17]. On weekdays, 95.6% of adolescents spend nine or more hours on screens, with 82% using them until they fall asleep [18].

The impact of screen time on sleep quality and academic performance is complex and multifaceted. Some research suggests significant associations between excessive internet use, poor sleep quality, anxiety, and depression among high school students [19]. Conversely, other studies report non-significant relationships between screen time and sleep quality [9].

High screen use for social activities and entertainment may interfere with study time, hinder academic achievement, and elevate stress levels [20-21]. Additionally, high screen users are more likely to seek mental health support or medication for psychological issues [14].

Despite the substantial research on screen time's effects, several critical gaps remain in understanding its influence on adolescents, particularly regarding the interplay between sleep, anxiety, and academic performance. First, there is a lack of research examining how different types of screen use, such as social media or gaming, specifically contribute to these outcomes. Additionally, the developmental stage of adolescents, whose cognitive, emotional, and social maturation may make them more susceptible to the negative consequences of excessive screen time, was not adequately addressed in previous studies. Furthermore, few studies have considered how the content consumed on screens (e.g., social media, violent video games) might differently affect adolescents' mental health and academic performance. Exposure to excessive screen time has been linked to sleep disturbances, heightened anxiety, and reduced academic performance, with each of these factors potentially influencing one another.

Adolescents in this age group are particularly vulnerable to the effects of screen time due to heightened peer influence, social media use, and the increasing academic pressure they face, all of which can exacerbate the negative consequences on their well-being and educational outcomes. Hence, this study aims to explore the impact of screen time on sleep, anxiety, and academic performance in adolescents. By examining these relationships, we seek to understand how screen time influences adolescents' well-being and educational outcomes.

METHODOLOGY

A cross-sectional study was conducted after obtaining approval from the Institutional Ethics Committee. Description of study subjects – 'school going adolescents aged between 14 and 18 years.' Four schools in the

catchment area of a tertiary care hospital were selected through lottery method. All the students studying in ninth, tenth, eleventh and twelfth grades, attending school on the day of sample collection meeting the fixed criteria were sampled after obtaining permission from the school authorities. Written informed consent was obtained from all participants after introducing them to the purpose of the research, confidentiality and personal data protection were guaranteed, assuring them of the voluntary nature of research participation. Adolescents in the age group of 14-18 years, willing to give informed consent were included through random sampling. All those with history of diagnosed psychiatric illnesses including Specific Learning Disorders and substance use, and those with history of chronic medical conditions and prolonged use of medications were excluded. The use of random sampling in the study, which targeted 14-18-year-olds meeting the inclusion criteria, ensured relevance to the study's objectives. Exclusion of those with confounding medical and psychiatric conditions minimized bias. Random school selection and informed consent ensured a representative, ethical sample.

Sample

Sample size was determined by using the formula, $n=Z^2 P(1-P)/d^2$, where n is the sample size, Z is the level of confidence (taken as 95%), P is expected prevalence (prevalence of poor sleep quality in adolescents with excessive screen time is taken as 50%), and d is precision (taken as 0.05).

Using the formula with $Z=1.96$, $p=0.50$, and $d=0.05$: $n=384.16$. Hence, the sample size calculated was approximately 385 participants. However, to ensure sufficient statistical power, a total of 410 participants were included in the study.

Procedure

Sociodemographic data was obtained including age, gender, socioeconomic status (modified Kuppuswamy scale), parent's education and occupation. Questions about the type of gadgets used and their purpose, change in academic performance (compared to grades from the previous academic year), and the mean daily sleep duration were also included. Screen time, anxiety, and sleep hygiene were evaluated using Questionnaire for screen time of adolescents (QueST), Beck Anxiety Inventory (BAI), and Adolescents Sleep Hygiene Scale (ASHS), respectively [22-24].

Rating Scales

Questionnaire for Screen Time of Adolescents (QueST) was designed for assessing habitual volumes of screen time in adolescent population. It measures screen time across five constructs: studying, working/internship-related activities, watching videos, playing video games, and using social media/chat applications. The QueST has demonstrated satisfactory content validity, indicating 94% and 98% of overall clarity and representativeness, respectively [22].

The Beck Anxiety Inventory (BAI) consists of 21 self-reported items (four-point scale) used to assess the intensity of physical and cognitive anxiety symptoms during the past week. Scores range from 0 to 63: minimal anxiety levels (0-7), mild anxiety (8-15), moderate anxiety (16-25), and severe anxiety (26-63) [23].

The Adolescent Sleep Hygiene Scale (ASHS) is a 32-item self-report measure used to assess adolescent sleep hygiene. It includes four qualitative items to ascertain usual bedtime and wake time on weekdays and at weekends, and 28 quantitative items that are used to calculate nine subscale scores: physiological, cognitive, emotional, sleep environment, daytime sleep, substances, sleep stability, bedtime routine, and bed sharing. Using a six-point ordinal rating scale ranging from 1 = never to 6 = always, adolescents indicate how often each item occurred during the past month. Higher scores on the scale indicate better sleep hygiene [24].

Statistical Analysis

Data was entered in Microsoft Excel and analysed with Statistical Package for Social Sciences (SPSS) software version 26.0. The mean and standard deviation of the quantitative variables were measured. Association between two categorical variables was measured by using Chi-square test. P value ≤ 0.05 was taken as statistically significant.

RESULTS

A total of 410 students participated in the current study. Of those, 10 responses were excluded due to incomplete forms and improper marking of answers, leaving 400 valid responses for analysis.

The mean age of the students was 14.95 ± 0.89 years. The majority were within the age group of 14 to 15 years (73%). Males comprised 64% of the sample. Most students came from educated backgrounds, with 72% reporting their fathers had an education and 67.8% reporting their mothers were educated. Most participants (69.3%) were from a middle socioeconomic status background. Among the 400 students, the mobile phone was the most used gadget (93.3%). This was followed by laptops (69.8%), tablets (54.8%), and televisions (49.3%).

The primary reason for gadget usage was watching web series and movies (74.5%). Social media usage was also significant (71.8%), as well as online education (67.5%). Internet gaming and browsing were nearly equal in prevalence, at 56.3% and 57%, respectively.

Sleep patterns among the students varied, with 52.3% averaging 6.5 to 8 hours of sleep per day. Additionally, 45.5% of students reported getting 4.5 to 6 hours of sleep. Extreme sleep durations were less common, with 0.5% sleeping 2 to 4 hours and 1.8% sleeping more than 8 hours per day.

Regarding academic performance, 38.8% of students reported an improvement, 37.3% experienced a decline, 23.3% maintained their previous performance levels, and 0.3% reported excellent academic performance.

The Questionnaire for Screen Time of Adolescents (QueST) revealed significant differences in the purposes of screen use among students. The data indicated that adolescents spent more time on screens for entertainment purposes, with an average value of 4.19 ± 1.66 hours per day. In contrast, the average screen time dedicated to academic activities was notably lower, at 2.31 ± 1.44 hours per day, as shown in Table 1

Table 1: QueST Questionnaire

QueST variables	Mean	S.D.
Studies	1.93	1.32
Study-related work	0.38	0.63
Academics (studies+ study-related work)	2.31	1.44
Watching videos	1.92	1.01
Playing video games	1.07	0.98
Social media	1.20	0.92
Entertainment (watching videos+ playing video games +social media)	4.19	1.66

The ASHS (Adolescent Sleep Hygiene Scale) provides eight subscale scores and an overall sleep hygiene score, with higher scores denoting better outcomes in each dimension of sleep hygiene. Analysis of the subscale scores revealed that the sleep stability factor (mean = 2.77, SD = 1.48) indicated the poorest sleep hygiene among participants. This was followed by the behavioural arousal factor (mean = 3.36, SD = 1.45) and the bed routine factor (mean = 3.50, SD = 2.01). Conversely, the highest subscale score was observed for the substance use factor (mean = 5.89, SD = 0.55), indicating relatively better sleep hygiene in this area, followed by the day sleep factor (mean = 4.85, SD = 1.62), as depicted in Table 2.

Table 2: Adolescent Sleep Hygiene Scale

Adolescent Sleep Hygiene Scale	Mean	S.D.
Physiological factor	3.93	0.95
Behaviour arousal factor	3.36	1.45
Cognitive factor	3.54	1.13

Sleep environment factor	4.50	1.19
Sleep stability factor	2.77	1.48
Daytime sleep factor	4.85	1.62
Substance factor	5.89	0.55
Bedtime routine factor	3.50	2.01
Total ASHS Score	4.02	0.64

Most students (68.8%) exhibited mild anxiety, with a notable portion (30.8%) experiencing moderate anxiety, and 0.5% reported severe anxiety, as assessed by the Beck Anxiety Inventory. The study found that a majority of students who engaged in 2.1 to 6.0 hours of screen time for entertainment purposes exhibited poor sleep hygiene scores. A highly significant inverse relationship was observed between screen time for entertainment and sleep hygiene, with a p-value of 0.000, as shown in Table 3. These findings suggest that increased screen time dedicated to entertainment activities is associated with worse sleep hygiene.

Table 3: Association between entertainment screen time and total ASHS score

Entertainment	Total ASHS Score		
	<3.8	3.8-4.9	>4.9
≤ 2 hours	4	31	2
2.1 – 6.0 hours	107	203	17
> 6 hours	23	12	1

Chi-square=23.71; P-value=0.000 (highly significant)

In the present study, a significant association was identified between screen time for entertainment and changes in academic performance among students. Specifically, those with less than 2 hours of daily screen use demonstrated an improvement in academic performance. Conversely, students who engaged in more than 6 hours of screen time per day exhibited a decline in academic performance. The association between screen time and academic performance was statistically significant, with a p-value of 0.000, indicating a strong relationship between extended screen use and adverse effects on academic outcomes, as depicted in Table 4.

Table 4: Association between entertainment screen time and change in academic performance

Entertainment screen time	Change in academic performance			
	Maintained	Improved	Excellent	Declined
≤ 2 hours	9	25	1	2
2.1 – 6.0 hours	85	126	0	116
> 6 hours	1	4	0	31

Chi-square=65.63; P-value=0.000 (highly significant)

Utilizing Beck Anxiety Inventory, it was observed that students who spend 2 to 6 hours per day on entertainment activities show significant levels of mild to moderate anxiety, with a p value of 0.019, as shown in Table 5.

Table 5: Association between levels of anxiety and entertainment screen time

Beck Anxiety Inventory	Entertainment screen time		
	≤ 2 hours	2.1 – 6.0 hours	> 6 hours
Mild anxiety	17	235	23
Moderate anxiety	20	90	13
Severe anxiety	0	2	0

Chi-square=11.81; P-value=0.019 (statistically significant)

In our study, we observed that students with mild to moderate anxiety exhibited significantly poorer sleep hygiene scores. Statistical analysis revealed this relationship to be significant, with a P value of 0.012, as depicted in Table 6.

Table 6: Association between levels of anxiety and total ASHS scores

Beck Anxiety Inventory	Total ASHS score		
	<3.8	3.8-4.9	>4.9
Mild anxiety	89	169	17
Moderate anxiety	45	76	2
Severe anxiety	0	1	1

Chi-square=12.84; P-value=0.012 (statistically significant)

DISCUSSION

The aim of this study was to assess the impact of screen time on sleep, anxiety, and academic performance among school-going adolescents aged 14 to 18 years. The mean age of the participants was 14.95 ± 0.89 years, with the majority (73%) being 14- to 15-year-olds. The sample predominantly comprised males (64%) from educated backgrounds, consistent with findings by Rashid and others [17].

The present study found that mobile phones were the most used devices (93.3%), followed by laptops (69.8%), tablets (54.8%), and televisions (49.3%). This contrasts with the findings of Khan and others, where 54.3% of adolescents used televisions and 44.6% used computers [16]. The primary uses of these gadgets were watching web series and movies (74.5%), engaging in social media (71.8%), online education (67.5%), browsing (57%), and internet gaming (56.3%). This differs from studies who reported lower engagement in these activities, with only 39% watching cartoons or movies, 27% using social media, and 17% playing video games [17]. The increased use of mobile phones and reduced use of traditional devices in the current study are likely a result of technological advancements and evolving preferences. Higher engagement in activities like streaming and social media suggests changing media consumption habits and greater connectivity. Additionally, changes in adolescent interests and pressures might have influenced their screen time patterns. These trends highlight the need to consider contemporary behaviours when evaluating the effects of screen time on adolescents.

Previous studies have indicated that excessive internet use for socializing and digital screen exposure before sleep can impair sleep quality [25-26]. In our study, 52.3% of students reported sleeping 6.5 to 8 hours per night, while 45.5% slept 4.5 to 6 hours, which aligns with a Chinese study. However, only 1.8% of students reported sleeping more than 8 hours, significantly lower than the 20.3% reported by Zhang and others [27]. The discrepancy in sleep duration may be due to increased digital screen exposure and socializing online, which can disrupt sleep quality and reduce total sleep time. Furthermore, differences in study populations and lifestyle factors might contribute to the lower percentage of students sleeping more than 8 hours in our study compared to the Chinese study.

The study revealed that most students spent 2.1 to 6.0 hours on screen time for entertainment and social interaction and had poor sleep hygiene, demonstrating a significant inverse relationship between screen time and sleep quality ($p = 0.000$). This contrasts with the findings of authors who reported no significant relationship between screen time and sleep quality in a study conducted among undergraduate medical students, where data on electronic gadget usage were collected using a pre-tested proforma [9]. The strong inverse relationship in our study may result from the extensive screen time specifically for entertainment and social interaction, which can particularly disrupt sleep. Variations in study designs, populations, and measurement criteria for screen time and sleep quality might account for the differences from other studies. Academic performance was inversely related to screen time, with students using screens for less than 2 hours showing improvement, and those using screens for more than 6 hours showing a decline. This significant association ($p = 0.000$) could be attributed to the distraction and time taken away from studies, as suggested by Ritchie and others [20]. Additionally, reduced sleep time, irregular sleep patterns, and poor sleep quality,

which negatively impact school performance, may contribute to this decline [28-29]. The distraction caused by smartphones for social media and amusement further hinders concentration, leading to poorer academic results and increased academic stress [21]. Regarding anxiety, 68.8% of students reported mild anxiety, and 30.8% reported moderate anxiety. Those spending 2 to 6 hours daily on entertainment and social interactions experienced significant levels of mild to moderate anxiety, consistent with findings, suggesting that extensive digital media use is linked to higher anxiety levels in adolescents [14]. The significant levels of mild to moderate anxiety among students could be attributed to prolonged screen time, which can contribute to mental strain and reduced quality of offline interactions.

Overall, these findings underscore the importance of monitoring and managing screen time among adolescents to promote better sleep hygiene, reduce anxiety, and enhance academic performance. Studies indicate that interventions involving electronic TV monitoring devices, contingent feedback systems, and clinic-based counselling are particularly effective in reducing screen time [30]. Additionally, schools can integrate digital wellness education into their curricula, highlighting the negative effects of excessive screen use on sleep and mental health. Parents and caregivers should establish consistent "no screen" zones, such as during bedtime and meals, and encourage offline activities like physical exercise, outdoor sports, and creative hobbies. Furthermore, utilizing technology—such as apps that track and limit screen time—can help adolescents become more mindful of their usage and foster better self-regulation.

The study's cross-sectional nature limits the ability to draw causal inferences between screen time and its effects on sleep and anxiety. Another limitation is the reliance on self-reported data, which may have introduced response bias and affected the accuracy of the findings.

CONCLUSION

In conclusion, this study highlights the adverse effects of excessive screen time on adolescents' sleep, anxiety, and academic performance. Prolonged screen use, especially beyond two hours a day, is linked to poorer sleep quality, heightened anxiety, and lower academic achievement. Targeted interventions are essential to address these negative effects, foster healthier screen habits, and encourage a more balanced approach to technology use. Overall, reducing screen time is essential for improving adolescents' sleep hygiene, lowering anxiety levels, and enhancing academic performance.

Future recommendations

Future research should focus on developing and evaluating interventions designed to reduce excessive screen time and their impact on improving sleep quality, anxiety levels, and academic performance in adolescents. Longitudinal studies should be conducted to track the long-term effects of screen time on mental health and educational outcomes. Moreover, implementing comprehensive guidelines in schools and homes to regulate screen use and encourage healthy sleep practices could significantly benefit adolescents' overall well-being and academic success.

Declarations

Ethics approval and consent to participate: The study was reviewed and approved by Institutional Ethics Committee, Dr. Pinnamaneni Siddhartha Institute of Medical Sciences & Research Foundation, approval number - UG/745/22 (ICMR). Written informed consent to participate in this study was provided by the participants.

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