

Evaluation of Impact of Screen Time on Anxiety, Sleep Quality, and Behavioral Problems in Children: A Prospective Evaluation at a Tertiary Care Hospital

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ABSTRACT

Background: Screen time exposure among children has increased markedly with the widespread use of smartphones, television, tablets, computers, and gaming devices. Excessive screen use may affect emotional regulation, sleep pattern, attention, and behavior. Anxiety, poor sleep quality, and behavioral problems are increasingly observed among children with prolonged and unsupervised digital media exposure.

Aim: To evaluate impact of screen time on anxiety, sleep quality, and behavioral problems in children.

Materials and Methods: This prospective observational study was conducted among 135 children attending a tertiary care hospital. Children were enrolled after obtaining informed consent from parents or guardians. Screen time exposure was assessed using a structured questionnaire, including average daily screen duration, type of device used, purpose of screen use, bedtime screen exposure, and unsupervised screen use. Anxiety symptoms were assessed using an age-appropriate standardized anxiety screening tool. Sleep quality was evaluated using a structured sleep assessment questionnaire, and behavioral problems were assessed using a parent-reported behavioral checklist. Data were analyzed using appropriate statistical methods, and a p-value of less than 0.05 was considered statistically significant.

Results: Among 135 children, the majority belonged to the 9–12 years age group, 55 children (40.74%), and males were slightly more common, 72 children (53.33%). The most common daily screen exposure was 2–4 hours/day, observed in 57 children (42.22%), while 40 children (29.63%) had screen time of more than 4 hours/day. Smartphone was the most

commonly used device, reported in 78 children (57.78%). Anxiety, poor sleep quality, and behavioral problems increased significantly with longer screen duration. Anxiety was present in 57.50%, poor sleep quality in 75.00%, and behavioral problems in 60.00% of children with screen time >4 hours/day. Bedtime screen exposure was significantly associated with anxiety ($p=0.004$), poor sleep quality ($p<0.001$), and behavioral problems ($p=0.002$).

Conclusion: Increased screen time exposure was significantly associated with anxiety, poor sleep quality, and behavioral problems in children. Bedtime and unsupervised screen use should be monitored, and parental guidance is essential to promote healthy digital habits.

Keywords: Screen Time, Anxiety, Sleep Quality, Behavioral Problems, Children.

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Article History:

Received: 11-04-2018, Revised: 02-05-2018, Accepted: 27-05-2018

Access this article online	
Website: www.ijmrp.com	Quick Response code 
DOI: 10.21276/ijmrp.2018.4.3.069	

INTRODUCTION

Screen time exposure has become an important public health concern in childhood because digital devices are now deeply integrated into education, recreation, communication, and family life. Children are increasingly exposed to smartphones, televisions, tablets, computers, video games, and internet-based media from an early age. While digital media can support learning, communication, and access to information, excessive or poorly regulated use may interfere with essential developmental activities

such as sleep, physical play, reading, social interaction, and parent-child communication. Therefore, the assessment of screen time has become an important part of pediatric health evaluation, especially in school-going children and adolescents.¹ Childhood is a critical period for emotional, cognitive, behavioral, and social development. During this phase, the brain is highly responsive to environmental stimulation, routine formation, and behavioral reinforcement. Screen-based activities may influence children not

only through the duration of exposure but also through the type of content, timing of use, level of parental supervision, and presence of screens in the bedroom. Entertainment-based media, gaming, social media, and rapidly changing audiovisual content may produce overstimulation, reduce attention span, and disturb emotional regulation. For this reason, pediatric guidance emphasizes the need to ask about daily recreational screen time and the presence of internet-connected devices in the child's bedroom.² Sleep is one of the most important biological processes affected by screen exposure. Adequate sleep is essential for memory consolidation, growth, immune function, emotional control, attention, and learning. Screen use, particularly during evening or bedtime hours, may delay sleep onset by increasing psychological arousal and reducing the time available for sleep. Bright light exposure from screens may also interfere with circadian rhythm and melatonin secretion. In addition, children may continue using devices secretly or respond to notifications after bedtime, which can fragment sleep and contribute to daytime sleepiness. These mechanisms explain why bedtime screen exposure is considered an important parameter in studies evaluating sleep quality among children.³ Screen time is also increasingly discussed in relation to anxiety and other internalizing symptoms in children and adolescents. Excessive engagement with screens may reduce face-to-face interaction, outdoor play, and opportunities for emotional coping through real-life social experiences. Online content may expose children to age-inappropriate material, social comparison, cyberbullying, fear-provoking information, or performance pressure through games and social media. Although screen use alone cannot be considered the only cause of anxiety, it may act as a contributing factor when combined with poor sleep, sedentary lifestyle, family stress, academic pressure, and lack of supervision. Hence, evaluating anxiety symptoms in relation to screen time provides useful information for preventive pediatric counseling.⁴ Behavioral problems represent another important outcome related to excessive or unregulated screen exposure. Children with prolonged screen use may show irritability, impulsivity, inattention, hyperactivity, aggression, emotional outbursts, poor frustration tolerance, and reduced compliance with routines. These problems may arise because screen-based activities provide immediate reward, rapid stimulation, and easy escape from boredom, while reducing time spent in structured play, family interaction, reading, physical activity, and peer communication. Behavioral changes may be more prominent when screen use is unsupervised, used as a calming tool, or allowed during meals and bedtime. Therefore, assessment of behavioral problems along with screen habits is clinically relevant.⁵ The relationship between screen time and child health is not limited to one domain. Screen exposure may influence anxiety, sleep quality, and behavior through interconnected pathways. For example, prolonged screen time may reduce physical activity and delay bedtime; poor sleep may then increase irritability, emotional instability, and anxiety; and behavioral difficulties may further increase dependence on screens as a coping or distraction mechanism. This cycle may be particularly important in children attending tertiary care hospitals, where developmental, behavioral, sleep-related, and psychosocial concerns are frequently encountered. A prospective approach can help in observing these associations more systematically and may provide stronger clinical insight than a single-time assessment.⁶

MATERIALS AND METHODS

This was a prospective observational study conducted among children attending a tertiary care hospital. The study was designed to evaluate impact of screen time on anxiety, sleep quality, and behavioral problems in children. A total of 135 children were included in the study.

Inclusion Criteria: Children within the selected pediatric age group whose parents or guardians agreed to participate were included. Children with regular exposure to digital screens such as television, smartphones, tablets, computers, or video games were eligible for assessment.

Exclusion Criteria: Children with known neurological disorders, severe developmental delay, diagnosed psychiatric illness, chronic systemic illness affecting sleep or behavior, or those receiving medications that could influence sleep or anxiety were excluded from the study.

Methodology

Screen Time Assessment: Screen time exposure was assessed using a structured questionnaire completed by parents or guardians. Parameters included average daily screen time, type of device used, purpose of screen use, screen exposure before bedtime, unsupervised screen use, and duration of continuous screen viewing.

Assessment of Anxiety: Anxiety symptoms were assessed using an age-appropriate standardized anxiety screening tool. Parameters included excessive worry, fearfulness, irritability, restlessness, separation-related anxiety, school-related anxiety, and physical symptoms associated with anxiety.

Assessment of Sleep Quality: Sleep quality was evaluated using a structured sleep assessment questionnaire. Parameters included bedtime, sleep duration, sleep latency, night awakenings, difficulty waking in the morning, daytime sleepiness, bedtime screen exposure, and overall sleep disturbance.

Assessment of Behavioral Problems: Behavioral problems were assessed using a parent-reported behavioral checklist. Parameters included hyperactivity, inattention, aggression, emotional dysregulation, peer relationship difficulties, temper tantrums, reduced social interaction, and poor academic or daily functioning.

Demographic details such as age, sex, residence, socioeconomic status, parental education, family type, and school-going status were recorded. Clinical and behavioral information was collected through direct interview with parents or guardians using a predesigned proforma.

Statistical Analysis

Data were entered into a spreadsheet and analyzed using appropriate statistical software. Descriptive statistics were used for demographic and clinical variables. Categorical variables were expressed as frequency and percentage, while continuous variables were expressed as mean and standard deviation. Associations between screen time exposure and study outcomes were assessed using suitable statistical tests, with a p-value of less than 0.05 considered statistically significant.

RESULTS

Table 1: Distribution of Children According to Socio-demographic Characteristics

Table 1 shows the socio-demographic profile of the 135 children included in the study. The majority of children belonged to the age

group of 9–12 years, comprising 55 children (40.74%), while children aged 5–8 years and 13–16 years each constituted 40 children (29.63%). With regard to gender distribution, males were slightly more predominant, accounting for 72 children (53.33%), whereas females constituted 63 children (46.67%). The residence distribution revealed that most participants were from urban areas, with 82 children (60.74%), while 53 children (39.26%) belonged to rural areas. Analysis of family type showed that the majority of children belonged to nuclear families, accounting for 91 children (67.41%), whereas 44 children (32.59%) belonged to joint families. Regarding school-going status, most children were attending school, comprising 126 children (93.33%), while only 9 children (6.67%) were not school-going.

Table 2: Pattern of Screen Time Exposure Among Children

Table 2 demonstrates the pattern of screen time exposure among the study participants. The most common duration of average daily screen time was 2–4 hours per day, observed among 57 children (42.22%). Children using screens for more than 4 hours daily constituted 40 children (29.63%), while 38 children (28.15%) had screen exposure of less than 2 hours per day. Smartphones were identified as the most commonly used device among children, reported in 78 participants (57.78%). Television use was noted in 26 children (19.26%), followed by tablets in 14 children (10.37%), computers/laptops in 9 children (6.67%), and video game consoles in 8 children (5.93%). Regarding the purpose of screen use, entertainment was the most common reason, observed in 65 children (48.15%), whereas educational use was reported in 32 children (23.70%). Mixed use for both educational and entertainment purposes was noted among 38 children (28.15%). Screen use before bedtime was present in 89 children (65.93%), while 46 children (34.07%) did not use screens before sleep. Furthermore, unsupervised screen use was reported in 76 children (56.30%), indicating that more than half of the children accessed digital devices without parental supervision.

Table 3: Association of Average Daily Screen Time with Anxiety, Sleep Quality, and Behavioral Problems

Table 3 evaluates the association between average daily screen time and anxiety, sleep quality, and behavioral problems among

children. A statistically significant association was observed between increasing screen time duration and anxiety levels ($p=0.0005$). Anxiety symptoms were present in only 6 children (15.79%) among those with screen time less than 2 hours/day. However, the prevalence increased to 18 children (31.58%) in the 2–4 hours/day group and further increased to 23 children (57.50%) among children with screen time exceeding 4 hours/day. A significant association was also found between screen time duration and poor sleep quality ($p<0.001$). Poor sleep quality was observed in 8 children (21.05%) in the group with less than 2 hours/day of screen time. The prevalence increased to 25 children (43.86%) among children with 2–4 hours/day exposure and reached 30 children (75.00%) among those exposed to screens for more than 4 hours/day. Similarly, behavioral problems showed a statistically significant association with increasing screen time duration ($p<0.001$). Behavioral problems were present in only 5 children (13.16%) among those with screen time less than 2 hours/day, whereas 20 children (35.09%) in the 2–4 hours/day group and 24 children (60.00%) in the >4 hours/day group demonstrated behavioral disturbances.

Table 4: Association of Bedtime Screen Exposure with Anxiety, Sleep Quality, and Behavioral Problems

Table 4 depicts the relationship between bedtime screen exposure and psychological as well as behavioral outcomes among children. Anxiety symptoms were significantly more common among children with bedtime screen exposure compared to those without bedtime screen exposure (43.82% vs 17.39%; $p=0.004$). Poor sleep quality was also significantly associated with bedtime screen exposure ($p<0.001$). Among children exposed to screens before bedtime, 55 children (61.80%) had poor sleep quality, whereas only 8 children (17.39%) without bedtime screen exposure experienced poor sleep quality. Behavioral problems were similarly more prevalent among children with bedtime screen exposure. Behavioral disturbances were observed in 41 children (46.07%) with bedtime screen exposure compared to only 8 children (17.39%) among those without bedtime screen use, and the association was statistically significant ($p=0.002$).

Table 1: Distribution of Children According to Socio-demographic Characteristics

Variable	Category	Number of children (n=135)	Percentage (%)
Age group	5–8 years	40	29.63
	9–12 years	55	40.74
	13–16 years	40	29.63
Sex	Male	72	53.33
	Female	63	46.67
Residence	Urban	82	60.74
	Rural	53	39.26
Type of family	Nuclear	91	67.41
	Joint	44	32.59
School-going status	School-going	126	93.33
	Not school-going	9	6.67

Table 2: Pattern of Screen Time Exposure Among Children

Screen time parameter	Category	Number of children (n=135)	Percentage (%)
Average daily screen time	<2 hours/day	38	28.15
	2–4 hours/day	57	42.22
	>4 hours/day	40	29.63
Most commonly used device	Smartphone	78	57.78
	Television	26	19.26
	Tablet	14	10.37
	Computer/Laptop	9	6.67
	Video game console	8	5.93
Main purpose of screen use	Educational	32	23.70
	Entertainment	65	48.15
	Mixed use	38	28.15
Screen use before bedtime	Present	89	65.93
	Absent	46	34.07
Unsupervised screen use	Present	76	56.30
	Absent	59	43.70

Table 3: Association of Average Daily Screen Time with Anxiety, Sleep Quality, and Behavioral Problems

Outcome variable	<2 hours/day n=38	2–4 hours/day n=57	>4 hours/day n=40	p-value
Anxiety present	6 (15.79%)	18 (31.58%)	23 (57.50%)	0.0005
Anxiety absent	32 (84.21%)	39 (68.42%)	17 (42.50%)	
Poor sleep quality present	8 (21.05%)	25 (43.86%)	30 (75.00%)	<0.001
Poor sleep quality absent	30 (78.95%)	32 (56.14%)	10 (25.00%)	
Behavioral problems present	5 (13.16%)	20 (35.09%)	24 (60.00%)	<0.001
Behavioral problems absent	33 (86.84%)	37 (64.91%)	16 (40.00%)	

Table 4: Association of Bedtime Screen Exposure with Anxiety, Sleep Quality, and Behavioral Problems

Outcome variable	Bedtime screen exposure	Bedtime screen exposure	p-value
	present n=89	absent n=46	
Anxiety present	39 (43.82%)	8 (17.39%)	0.004
Anxiety absent	50 (56.18%)	38 (82.61%)	
Poor sleep quality present	55 (61.80%)	8 (17.39%)	<0.001
Poor sleep quality absent	34 (38.20%)	38 (82.61%)	
Behavioral problems present	41 (46.07%)	8 (17.39%)	0.002
Behavioral problems absent	48 (53.93%)	38 (82.61%)	

Table 5: Mean Anxiety, Sleep Disturbance, and Behavioral Scores According to Screen Time Duration

Parameter	<2 hours/day	2–4 hours/day	>4 hours/day	p-value
	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	
Anxiety score	6.21 $\pm$ 2.18	8.74 $\pm$ 3.05	11.62 $\pm$ 3.41	<0.001
Sleep disturbance score	5.84 $\pm$ 2.11	8.39 $\pm$ 2.86	12.18 $\pm$ 3.24	<0.001
Behavioral problem score	7.13 $\pm$ 2.46	10.28 $\pm$ 3.17	13.45 $\pm$ 3.62	<0.001

Table 5: Mean Anxiety, Sleep Disturbance, and Behavioral Scores According to Screen Time Duration

Table 5 compares the mean anxiety, sleep disturbance, and behavioral problem scores according to different durations of screen time exposure. A statistically significant increase in anxiety scores was observed with increasing screen time duration ($p < 0.001$). Children with screen time less than 2 hours/day had the lowest mean anxiety score (6.21 ± 2.18), while those with screen exposure of 2–4 hours/day had a moderately higher score (8.74 ± 3.05). The highest anxiety score was noted among children with screen time exceeding 4 hours/day (11.62 ± 3.41).

A similar trend was observed for sleep disturbance scores. Children with screen exposure less than 2 hours/day demonstrated the lowest sleep disturbance score (5.84 ± 2.11), whereas scores increased to 8.39 ± 2.86 among children with 2–4 hours/day screen exposure and further increased to 12.18 ± 3.24 among children exposed for more than 4 hours/day. The association was statistically significant ($p < 0.001$), indicating worsening sleep quality with increasing screen exposure.

Behavioral problem scores also increased progressively with longer screen time duration. The mean behavioral score was 7.13 ± 2.46 among children with screen time less than 2 hours/day, which increased to 10.28 ± 3.17 in the 2–4 hours/day group and reached 13.45 ± 3.62 among children with screen exposure exceeding 4 hours/day. This association was statistically significant ($p < 0.001$), suggesting that excessive screen exposure may significantly contribute to behavioral disturbances in children.

DISCUSSION

In the present study, most children belonged to the 9–12 years age group, comprising 55 children (40.74%), followed equally by the 5–8 years and 13–16 years age groups, with 40 children (29.63%) in each category. Males were slightly more represented than females, 72 (53.33%) versus 63 (46.67%), and most children were school-going, 126 (93.33%). This age and school-going distribution is comparable with Page et al. (2010), who studied 1013 children with a mean age of 10.95 ± 0.41 years and assessed the relationship between screen viewing and psychological difficulties. In that study, children spending more than 2 hours per day watching television or using computers had higher odds of psychological difficulties, with odds ratios of 1.61 for television viewing and 1.59 for computer use. In comparison, the present study also found that children with more than 4 hours/day of screen time had higher anxiety symptoms, poor sleep quality, and behavioral problems, indicating that the school-age period is particularly vulnerable to excessive screen exposure.⁷

In the present study, 82 children (60.74%) were from urban areas and 53 children (39.26%) were from rural areas, while 91 children (67.41%) belonged to nuclear families. This urban predominance may reflect greater availability and accessibility of digital devices in urban households. Mistry et al. (2007) evaluated television exposure and behavioral outcomes among children at 5.5 years of age and reported that television exposure of more than 2 hours/day and having a television in the child's bedroom were important media-related variables. The present study similarly observed that 57 children (42.22%) had screen exposure of 2–4 hours/day and 40 children (29.63%) had exposure of more than 4 hours/day, suggesting that a large proportion of children exceeded

commonly recommended limits. While Mistry et al. focused mainly on television exposure, the present study included multiple digital devices, reflecting the broader pattern of modern screen exposure.⁸

Smartphones were the most commonly used device in the present study, reported among 78 children (57.78%), followed by television in 26 children (19.26%), tablets in 14 children (10.37%), computers/laptops in 9 children (6.67%), and video game consoles in 8 children (5.93%). Entertainment was the commonest purpose of screen use, reported in 65 children (48.15%), while educational use was reported in 32 children (23.70%). Owens et al. (1999) studied television-viewing habits and sleep disturbance in school children and found that specific television habits, including bedtime viewing and bedroom television, were associated with sleep difficulties. Compared with that earlier television-based study, the present study shows a shift from television to smartphones as the dominant device, but the adverse association with sleep remains consistent, as 63 children (46.67%) in the present study had poor sleep quality overall, increasing to 75.00% among children using screens for more than 4 hours/day.⁹

The present study demonstrated a significant association between increasing screen time and anxiety symptoms. Anxiety was present in 6 children (15.79%) with screen time less than 2 hours/day, 18 children (31.58%) with 2–4 hours/day, and 23 children (57.50%) with more than 4 hours/day, with a statistically significant p -value of 0.0005. Gentile et al. (2011), in a 2-year longitudinal study of 3034 children in Singapore, reported that pathological gaming prevalence was approximately 9% and that depression, anxiety, social phobia, and lower school performance appeared as outcomes of pathological gaming. In comparison, the present study found a higher proportion of anxiety symptoms among heavy screen users, probably because it included overall screen exposure rather than only pathological gaming, and also assessed children in a hospital-based setting.¹⁰

Poor sleep quality showed a strong dose-response relationship with screen time in the present study. Poor sleep quality was observed in 8 children (21.05%) with screen time less than 2 hours/day, 25 children (43.86%) with 2–4 hours/day, and 30 children (75.00%) with more than 4 hours/day, with $p < 0.001$. Paavonen et al. (2006) studied 321 children aged 5–6 years and reported that active television viewing and passive television exposure were related to sleeping difficulties, particularly sleep-wake transition disorders and overall sleep disturbances. The present study supports these findings, as children with higher screen exposure had progressively poorer sleep outcomes, although the present study included smartphones, tablets, computers, and gaming consoles in addition to television.¹¹

Behavioral problems were also significantly associated with increasing daily screen time in the present study. Behavioral problems were present in 5 children (13.16%) with screen exposure less than 2 hours/day, 20 children (35.09%) with 2–4 hours/day, and 24 children (60.00%) with more than 4 hours/day, with $p < 0.001$. Cheng et al. (2010), in the Japan Children's Study, reported that television exposure of 4 hours or more per day was present in 29.40% of children at 18 months, 24.50% at 30 months, and 21.00% at both ages, and that television exposure at 18 months was positively associated with hyperactivity-inattention at 30 months. The present study showed a similar direction of

association, with 29.63% of children exposed to screens for more than 4 hours/day and 60.00% of them having behavioral problems, suggesting that prolonged screen exposure may contribute to hyperactivity, inattention, and emotional dysregulation.¹² Bedtime screen exposure was present in 89 children (65.93%) in the present study and showed significant association with all three major outcomes. Anxiety was present in 39 children (43.82%) with bedtime screen exposure compared with 8 children (17.39%) without bedtime exposure ($p=0.004$). Poor sleep quality was present in 55 children (61.80%) with bedtime screen exposure compared with 8 children (17.39%) without bedtime exposure ($p<0.001$). Behavioral problems were also higher among those with bedtime screen exposure, 41 children (46.07%) versus 8 children (17.39%), with $p=0.002$. Garrison et al. (2011) reported that evening media use and violent media content were associated with increased sleep problems among preschool-aged children, while nonviolent daytime media use did not show the same effect. The present study supports this timing-related effect, showing that screen use before sleep was more strongly associated with poor sleep and psychological problems than screen exposure alone.¹³

The present study also found a progressive rise in mean anxiety, sleep disturbance, and behavioral problem scores with increasing screen time. Anxiety scores increased from 6.21 ± 2.18 in children with less than 2 hours/day to 11.62 ± 3.41 in those with more than 4 hours/day. Sleep disturbance scores increased from 5.84 ± 2.11 to 12.18 ± 3.24 , while behavioral problem scores increased from 7.13 ± 2.46 to 13.45 ± 3.62 across the same screen time categories, all with $p<0.001$. Pagani et al. (2010), in a prospective longitudinal study of 1314 children, reported that each additional hour of television exposure at 29 months was associated with 7.00% lower classroom engagement, 6.00% lower mathematics achievement, and 10.00% higher victimization by classmates. Although their outcomes were academic and psychosocial rather than anxiety and sleep scores, both studies demonstrate a graded adverse association between increasing screen exposure and child functioning.¹⁴

Unsupervised screen use was present in 76 children (56.30%) in the present study, indicating that more than half of the children used screens without adequate parental monitoring. This may partly explain the high proportion of entertainment-based screen use, seen in 65 children (48.15%), and the increased behavioral problems among heavy screen users. Zimmerman et al. (2007) reported that the relationship between early television exposure and later attentional problems was particularly related to noneducational viewing and exposure before 3 years of age. In comparison, the present study found that entertainment-based screen use was more common than educational use, and behavioral problems increased from 13.16% in children using screens for less than 2 hours/day to 60.00% in those using screens for more than 4 hours/day. This suggests that not only duration, but also content and supervision, are important determinants of adverse behavioral outcomes.¹⁵

CONCLUSION

The present study concluded that increased screen time exposure was significantly associated with higher anxiety, poor sleep quality, and behavioral problems in children. Children with more than 4 hours of daily screen time showed greater adverse

psychological and behavioral outcomes. Bedtime screen exposure was also strongly linked with poor sleep and emotional difficulties. Regular monitoring of screen use and parental supervision are essential to promote healthy digital habits among children.

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Source of Support: Nil.

Conflict of Interest: None Declared

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Cite this article as: Bal Kishan, Manoj Kumar Mahato. Evaluation of Impact of Screen Time on Anxiety, Sleep Quality, and Behavioral Problems in Children: A Prospective Evaluation at a Tertiary Care Hospital. *Int J Med Res Prof.* 2018 May; 4(3): 305-11. DOI:10.21276/ijmrp.2018.4.3.069