

EFFECT OF ELECTRONIC USAGE AND SCREEN TIME ON NIGHTTIME SLEEP DURATION AMONG CHILDREN AGED BETWEEN 4-8 YEARS

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ABSTRACT

Introduction: Electronic device use has become highly prevalent among children and is increasingly recognized as a significant behavioural factor affecting sleep health. Early primary school years represent a critical period for sleep regulation, and excessive screen exposure—particularly before bedtime—may adversely influence sleep duration and quality. However, limited data are available from rural Indian paediatric populations.

Materials and Methods: This school-based cross-sectional observational study included 132 children aged 4–8 years selected using simple random sampling from rural primary schools in Mandya district. Data were collected using structured, validated parent-reported questionnaires assessing screen exposure, sleep duration, and sleep disturbances using the Children's Sleep Habits Questionnaire (CSHQ). Statistical analysis included descriptive statistics, Chi-square test, and Pearson correlation analysis. A p-value <0.05 was considered statistically significant.

Results: Screen exposure was observed in 78.8% of children, with 48.5% exposed to more than 60 minutes per day, exceeding recommended limits. The mean screen duration was 64.82 ± 38.15 minutes. The mean nighttime sleep duration was 9.28 ± 1.14 hours, while mean total sleep duration was 9.57 ± 1.05 hours, indicating marginal sleep insufficiency in a substantial proportion of children. Severe sleep disturbance was identified in 37.9% of children, while 33.3% had moderate disturbance.

A statistically significant positive correlation was observed between screen exposure and CSHQ score ($r = 0.52$, $p < 0.001$), indicating increased sleep disturbance with greater screen use. Conversely, total sleep duration demonstrated a significant negative correlation with sleep disturbance severity ($r = -0.48$, $p < 0.001$), suggesting a protective effect of longer sleep duration. Mean screen exposure increased progressively across sleep disturbance categories, from 18.24 ± 12.52 minutes in the normal/mild group to 76.82 ± 34.18 minutes in the severe group ($p < 0.001$). Similarly, mean total sleep duration decreased significantly from 10.41 ± 0.74 hours in the normal/mild group to 8.91 ± 1.02 hours in the severe disturbance group ($p < 0.001$). A strong association was observed, with increasing screen exposure significantly associated with higher prevalence and severity of sleep disturbance ($p < 0.001$).

Conclusion: This study highlights a high prevalence of screen exposure (78.8%) among children aged 4–8 years, with 48.5% exceeding the recommended daily screen-time limits. Sleep disturbances were also common, with 71.2% of children demonstrating moderate to severe sleep disturbance based on the Children's Sleep Habits Questionnaire, indicating a significant burden of sleep-related problems in this age group.

Screen exposure was found to be significantly associated with reduced nighttime and total sleep duration and with greater severity of sleep disturbance. Children with screen exposure had poorer sleep outcomes compared to those without exposure, and higher screen use was linked to higher CSHQ scores, reflecting increased sleep disturbance. Conversely, longer sleep duration was associated with lower severity of sleep disturbance, suggesting a protective effect of adequate sleep.

These findings identify screen exposure as a prevalent and modifiable behavioral factor influencing sleep health in early primary school children. The results underscore the importance of parental education, appropriate regulation of screen use, and reinforcement of healthy sleep hygiene practices, particularly during early childhood, to promote optimal sleep, growth, and neurodevelopment.

Keywords: Screen time, Sleep duration, Sleep disturbance, electronic devices, Paediatric sleep, CSHQ, Children, Sleep hygiene

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INTRODUCTION

Screen time, also referred to as digital screen exposure, is defined as the amount of time an individual spends using electronic media such as television, smartphones, tablets, computers, and other digital devices. With the advent of the digital era, these devices have become an integral part of everyday life, and children born in the new millennium are often described as “digital natives,” growing up surrounded by screens for both information and entertainment. Consequently, screen exposure now constitutes a substantial proportion of children’s sedentary behaviour and has the potential to shape lifestyle patterns extending into adolescence and adulthood. Globally, screen time among children has risen sharply, accompanied by shifts in the types of sedentary behaviours observed. This study was conducted using the CSHQ score as the primary tool to assess sleep habits and identify sleep disturbances in children.

The prevalence of excessive screen time shows wide variation, ranging from 10% to 93.7% in high-income countries and 21% to 98% in middle-income countries 6-9. Data from Western India further underscore this trend, reporting an average total screen time of 2.7 hours per day among children aged six years and below, with television viewing alone accounting for approximately 1.6 hours daily.

Excessive screen exposure has been associated with a range of adverse behavioural and health outcomes in children, including inattention, irritability, temper tantrums, and suboptimal academic performance. One of the most concerning effects relates to sleep, as screen use—particularly during evening hours—can suppress melatonin secretion, delay sleep onset, and reduce overall sleep duration 10. In addition, prolonged exposure to short-wavelength, high-energy blue light from digital devices has been linked to visual strain, headaches, ocular dryness, and, over the long term, an increased risk of vision-related problems 11. Beyond sleep and visual health, sustained high screen time from early childhood has been associated with increased sedentary behaviour, unfavourable body composition, higher cardiometabolic risk, obesity, poor sleep habits, behavioural difficulties, lower self-esteem, developmental concerns, and an elevated risk of non-communicable diseases later in life. Lifestyle patterns characterised by reduced physical activity and prolonged sedentary time are widely recognised contributors to the ongoing childhood obesity epidemic.

The relationship between screen time and impaired sleep in the paediatric population is complex and multifactorial, involving behavioural, psychological, physiological, and environmental mechanisms. Screen-based activities may increase cognitive and emotional arousal, delay bedtimes, displace sleep, and expose children to artificial light that interferes with circadian regulation. These mechanisms often interact, amplifying their combined effect on sleep. Given the sensitive developmental periods of early and middle childhood, repeated sleep disruption may have cumulative consequences for physical growth, emotional regulation, academic performance, and overall well-being.

Although digital technology offers educational and social benefits, concerns persist regarding its potential impact on children’s health, particularly sleep and learning outcomes. Large population studies in school-aged children have shown associations between higher screen time and poorer sleep, alongside behavioural and academic challenges, while also highlighting the modifying influence of socioeconomic factors.

Sleep is a fundamental biological need for children, supporting brain development, memory consolidation, emotional processing,

and physical growth. Age-specific sleep duration recommendations have been established to promote optimal health and development. However, increasing use of electronic devices, especially during the pre-bedtime period, has been consistently linked to difficulties initiating and maintaining sleep. In early childhood, screens are frequently introduced into daily routines, including evening hours, making young children particularly vulnerable to sleep disruption. Evidence increasingly demonstrates an inverse association between screen exposure and nighttime sleep duration in children aged 2–6 years, with higher screen use associated with shorter total sleep time and poorer sleep quality. Population-based analyses indicate that portable electronic devices may exert a stronger influence on sleep duration than non-portable screens, even after accounting for sociodemographic and lifestyle factors.

Research in preschool-aged children indicates that sleep plays a key mediating role between screen exposure and child well-being, with excessive screen time associated with adverse psychosocial outcomes and adequate sleep partially offsetting these effects. Observational studies show that preschool children often exceed recommended screen time limits, particularly on weekends, which is accompanied by disrupted sleep routines and inconsistent sleep–wake patterns. Evidence from infants and toddlers further demonstrates poor adherence to screen time guidelines, with higher screen exposure linked to shorter and more fragmented sleep. Interventional studies support these findings, showing that limiting screen use before bedtime improves sleep efficiency and reduces night awakenings, identifying pre-bedtime screen exposure as a modifiable determinant of sleep in early childhood.

The widespread and increasing exposure of young children to electronic media has raised significant concerns regarding its potential impact on nighttime sleep duration during early childhood, a critical period for brain development, emotional regulation, and physical growth. Although existing studies have demonstrated an inverse association between screen time and sleep duration, much of the available evidence is either observational, focused on broader age ranges, or derived from high-income settings, limiting its direct applicability to diverse paediatric populations. Given the high prevalence of screen exposure in this age group and the modifiable nature of media-use behaviours, there is a clear need for focused investigation to clarify the relationship between electronic media use and nighttime sleep duration in preschool children. In view of this, the present study was undertaken.

MATERIALS AND METHODS

Source of Data: Data were collected from children studying at a selected rural primary school located in Nagamangala Taluk, Mandya district.

Study Period: The study was conducted over a period of 18 months from March 2024 to October 2025.

Study Design: A school-based, cross-sectional observational study.

Study Population: The study population comprised of school-going children aged 4–8 years enrolled in the selected school of Nagamangala taluk, Mandya District during the study period and who gave consent.

Sampling Method: Participants were selected using simple random sampling to ensure adequate representation of the target population. Schools were selected using computer generated

random numbers from Nagamangala Taluk, and students within the selected schools were invited to participate in the study.

Sample Size

The sample size was calculated based on an assumed prevalence of excessive screen time of 60%, derived from previous literature. The sample size was estimated using the formula:

$SS = 4pq / d^2$ Where:

p = assumed prevalence = 60

d = allowable error = 20% of p = 12

$SS = 4pq / d^2 = 4 \times 60 \times 40 / (12)^2 = 66$

Thus, the minimum required sample size was 66. To improve the precision of the study and to account for the study design and possible non-response, the sample size was doubled, resulting in a final sample size of 132 participants.

INCLUSION CRITERIA

Children aged 4-8 years enrolled in the selected school with parental written informed consent.

EXCLUSION CRITERIA

Children with:

- Developmental delay
- Autism spectrum disorder
- Special educational needs
- Visual or hearing impairment
- Children on any medication

- Children whose parents/guardians did not provide consent

Method of Collection of Data

After obtaining Institutional Ethics committee clearance and permission was also obtained from the school authorities before data collection. A list of eligible rural schools in the study area was prepared, and two school were selected using computer-generated random numbers. Written informed consent was obtained from the parents or legal guardians of all participating children. Children aged between 4 and 8 years studying at the selected school were enrolled during the study period. Data were collected using structured, pre-validated, parent-reported questionnaires. Information regarding electronic screen device usage, average daily screen time, sleep duration, and sleep-related habits was obtained. No invasive procedures or interventions were performed during the study. Confidentiality of the participants was maintained, and data were used solely for research purposes.

Statistical Analysis

Collected data were entered into Microsoft Excel for analysis. Descriptive statistics, including mean and standard deviation, were used to summarise continuous variables. The Chi-square test was used to assess the association between screen time and nighttime sleep duration. A p value of less than 0.05 was considered statistically significant.

RESULTS

TABLE 1. Age Distribution (n = 132)

Age (years)	Frequency (n)	Percentage (%)
4	24	18.2
5	25	18.9
6	24	18.2
7	32	24.2
8	27	20.5
Total	132	100
Mean $\pm$ SD	6.10 $\pm$ 1.41	6.10 $\pm$ 1.41

The study included 132 early primary school children aged 4–8 years, with a fairly even distribution across age groups, ensuring adequate representation of each developmental stage. The largest

proportion of children were 7 years old (24.2%), followed by 8-year-olds (20.5%). Children aged 4 and 6 years each constituted 18.2% of the sample, while 5-year-olds accounted for 18.9%.

TABLE 2. Gender Distribution (n = 132)

Gender	Frequency (n)	Percentage (%)
Female	69	52.3
Male	63	47.7
Total	132	100

Gender distribution in the study population was nearly balanced, with females comprising 52.3% and males 47.7%.

TABLE 3. Mother's Education Level (n = 132)

Education Level	Frequency (n)	Percentage (%)
Primary	32	24.2
Secondary	26	19.7
Graduate	27	20.5
Postgraduate	47	35.6
Total	132	100

Maternal education levels showed a predominance of higher educational attainment, with more than one-third of mothers being postgraduates (35.6%). Graduates and those with primary

education constituted 20.5% and 24.2% respectively, while 19.7% had secondary education

TABLE 4. Father’s Education Level (n = 132)

Education Level	Frequency (n)	Percentage (%)
Primary	30	22.7
Secondary	37	28
Graduate	30	22.7
Postgraduate	35	26.5
Total	132	100

Fathers demonstrated a more evenly distributed educational profile, with secondary education being the most common (28.0%), followed by postgraduate education (26.5%). Primary and graduate education each accounted for 22.7%.

TABLE 5. Number of Children in Family (n = 132)

Number of Children	Frequency (n)	Percentage (%)
1	52	39.4
2	36	27.3
	44	33.3
Total	132	100

Most families had either one child (39.4%) or two children (27.3%), while one-third (33.3%) had three or more children. Family size can influence screen exposure and sleep routines due to shared devices and reduced parental monitoring in larger households.

TABLE 6. Screen Use (n = 132)

Screen Use	Frequency (n)	Percentage (%)
Yes	104	78.8
No	28	21.2
Total	132	100

Screen exposure was highly prevalent among the study population. Out of 132 children, 104 children (78.8%) were exposed to electronic screens, while only 28 children (21.2%) had no screen exposure. This finding indicates that the majority of early primary school children in the study population were exposed to electronic devices. The high prevalence of screen exposure reflects the widespread use of digital media in young children and highlights screen time as an important behavioral factor influencing sleep health in this age group.

TABLE 7. Screen Duration (n = 132)

Duration	Frequency (n)	Percentage (%)
0 minutes	28	21.2
30 - 60 minutes	40	30.3
60-120 minutes	44	33.3
>120 minutes	20	15.2
Total	132	100
Mean ± SD	64.82 ± 38.15	64.82 ± 38.15

Most children were exposed to screen time for 60–120 minutes per day (33.3%), followed by 30–60 minutes (30.3%), while 21.2% of children had no screen exposure. Notably, 15.2% of children had screen exposure exceeding 120 minutes per day. Overall, nearly half of the children (48.5%) had screen exposure exceeding 60 minutes per day, which is above recommended limits. The mean screen duration was 64.82 ± 38.15 minutes, indicating a substantial burden of screen exposure among early primary school children.

TABLE 8. Night-Time Sleep Duration (n = 132)

Night Sleep Duration	Frequency (n)	Percentage (%)
< 8 hours	18	13.6
8–10 hours	82	62.1
> 10 hours	32	24.3
Total	132	100
Mean ± SD	9.28 ± 1.14	

Most children (62.1%) had nighttime sleep duration between 8–10 hours, followed by 24.3% who slept more than 10 hours. However, 13.6% of children had sleep duration less than 8 hours, which is below the recommended duration for this age group. The mean nighttime sleep duration was 9.28 ± 1.14 hours.

TABLE 9. Nap Duration (n = 132)

Nap Duration Category	Frequency (n)	Percentage (%)
31–60 minutes	35	26.5
>60 minutes	39	29.5
Total	58	43.9
	132	100

Daytime nap duration varied considerably, with 43.9% of children napping for more than 60 minutes, while 29.5% slept for 31–60 minutes and 26.5% for 30 minutes or less. Longer daytime

naps may reflect compensatory sleep behavior due to insufficient nighttime sleep.

TABLE 10. Total 24-Hour Sleep Duration (n = 132)

Total Sleep (hours)	Frequency (n)	Percentage (%)
7	3	2.3
8	20	15.2
9	33	25
10	53	40.2
11	21	15.9
12	2	1.5
Total	132	100
Mean ± SD	9.57 ± 1.05	9.57 ± 1.05

Total daily sleep duration clustered around 10 hours, with 40.2% of children achieving this duration. However, a significant proportion slept only 8–9 hours (40.2%), and a small subset slept 7 hours or less (2.3%). The mean total sleep duration falls at the

lower end of recommended ranges for children aged 4–8 years, suggesting widespread marginal sleep insufficiency rather than extreme deprivation.

TABLE 11. Severity Distribution Based on CSHQ Category (n = 132)

CSHQ Severity Category	Frequency (n)	Percentage (%)
Normal / Mild Disturbance	38	28.8
Moderate Disturbance	44	33.3
Severe Disturbance	50	37.9
Total	132	100

Severity classification based on total CSHQ score showed that 28.8% of children had normal or mild sleep disturbance, 33.3% had moderate disturbance, and 37.9% had severe sleep disturbance. Mean screen use increased progressively with increasing severity category, from 18.24 ± 12.52 minutes in the normal/mild group to 42.31 ±

21.44 minutes in the moderate group and 76.82 ± 34.18 minutes in the severe group.

This association was statistically highly significant ($p < 0.001$), indicating that higher screen exposure is strongly associated with greater severity of sleep disturbance.

TABLE 12. CSHQ Score

Variable	Mean ± SD
Total CSHQ Score	68.73 ± 17.18

The mean total CSHQ score was 68.73 ± 17.18, indicating that, on average, the children had relatively high sleep disturbance scores. The large standard deviation suggests considerable variability in sleep habits and sleep-related problems among the participants. Since higher CSHQ scores are associated with poorer sleep quality and a greater likelihood of sleep

disturbances, the observed mean score indicates that sleep-related issues were common in the study population. These findings highlight the importance of routine assessment of sleep patterns and early identification of sleep problems in children to facilitate timely interventions and improve overall health and well-being.

Table 13: Correlation of Screen Exposure and Sleep Duration with Total CSHQ Score (n = 132)

Variable	Pearson r	p-value	Direction of Association
Screen Use (minutes)	0.52	< 0.001	Strong positive correlation
Total Sleep Duration(24 h, hours)	–0.48	< 0.001	Moderate-to-strong negative correlation

A statistically significant positive correlation was observed between screen use duration and total CSHQ score ($r = 0.52$, $p < 0.001$), indicating that increased screen exposure was associated with greater severity of sleep disturbance. Conversely, total sleep duration demonstrated a statistically significant negative correlation with total CSHQ score ($r = -0.48$, $p < 0.001$), suggesting that children with longer sleep duration experienced

fewer sleep disturbances. These findings demonstrate that screen exposure is an important modifiable risk factor contributing to sleep disturbance, while adequate sleep duration has a protective effect on sleep quality. The strength and direction of these correlations support the role of behavioral factors in influencing sleep health among children.

TABLE 14. Association of CSHQ Severity Category with Screen Use

CSHQ Severity Category	Screen Use (min)
Normal / Mild (n =38)	18.24 ± 12.52
Moderate (n = 44)	42.31± 21.44
Severe (n = 50)	76.82 ± 34.18
p-value	< 0.001

Mean screen use duration increased progressively with increasing severity of sleep disturbance. Children in the normal/mild CSHQ category (n = 38) had the lowest mean screen use (18.24 ± 12.52 minutes), followed by children in the moderate category (n = 44) with a mean screen use of 42.31 ± 21.44 minutes. Children in the severe category (n = 50) had the highest mean screen use

of 76.82 ± 34.18 minutes. This difference was statistically highly significant (p < 0.001).

These findings demonstrate a clear dose–response relationship between screen exposure and sleep disturbance severity, indicating that increased screen use is strongly associated with worsening sleep quality in children.

TABLE 15. Association of CSHQ Severity Category with Total Sleep Duration

CSHQ Severity Category	Total Sleep Duration (hours)
Normal / Mild (n = 38)	10.41± 0.74
Moderate (n = 44)	9.62 ± 0.88
Severe (n = 50)	8.91 ± 1.02
p-value	< 0.001

Mean total sleep duration showed a progressive decline with increasing severity of sleep disturbance. Children in the normal/mild CSHQ category (n = 38) had the highest mean total sleep duration (10.41 ± 0.74 hours), followed by those in the moderate category (n = 44) with a mean sleep duration of 9.62 ± 0.88 hours. Children in the severe category (n = 50) had the

lowest mean total sleep duration (8.91 ± 1.02 hours). This difference was statistically highly significant (p < 0.001). These findings demonstrate a significant inverse relationship between total sleep duration and severity of sleep disturbance, indicating that shorter sleep duration is strongly associated with worsening sleep disturbance severity.

TABLE 16. Association Between Screen Use Duration and CSHQ Severity Category

Screen Use (minutes)	Normal / Mild	Moderate	Severe	PValue
0 min	20(71.4%)	6 (21.4%)	2 (7.1%)	< 0.001
30-60 minutes	10(25%)	18(45%)	12 (30%)	< 0.001
60-120 minutes	6(13.6%)	14 (31.8%)	24 (54.5%)	< 0.001
>120 minutes	2(10%)	6 (30%)	12 (60%)	< 0.001
Total	38(28.8%)	44(33.3%)	50(37.9%)	< 0.001

A statistically significant association was observed between screen time duration and severity of sleep disturbance (Chi-square test, p < 0.001). Among children with no screen exposure, the majority (71.4%) had normal or mild sleep disturbance, while only 7.1% had severe disturbance. As screen time increased, the proportion of children with severe sleep disturbance increased progressively, reaching 54.5% among those with 60–120 minutes

of screen exposure and 60.0% among those with more than 120 minutes. Conversely, the proportion of children with normal or mild sleep disturbance decreased with increasing screen time. These findings demonstrate a clear dose-dependent relationship between increasing screen exposure and worsening sleep disturbance severity.

TABLE 17. Association Between Nighttime Sleep Duration and CSHQ Severity Category (n = 132)

Nighttime Sleep Duration (hours)	Normal / Mild	Moderate	Severe	P Value
< 8 hours	2 (1.5%)	5 (3.8%)	11(8.3%)	< 0.001
8–10 hours	20 (15.2%)	30 (22.7%)	32 (24.2%)	< 0.001
> 10 hours	16 (12.1%)	9(6.8%)	7 (5.3%)	< 0.001
Total	38 (28.8%)	44 (33.3%)	50 (37.9%)	< 0.001

A statistically significant association was observed between nighttime sleep duration and sleep disturbance severity (χ^2 test, p < 0.001). Among children sleeping less than 8 hours, the majority belonged to the severe sleep disturbance category (8.3%), whereas children sleeping more than 10 hours were more likely to have normal or mild sleep disturbance (12.1%). The proportion of severe sleep disturbance decreased progressively with increasing sleep duration, indicating that shorter sleep duration is associated with greater severity of sleep disturbance.

DISCUSSION

The present study evaluated the association between screen exposure and sleep disturbances among 132 children aged 4–8 years using the Children’s Sleep Habits Questionnaire (CSHQ).

The findings demonstrate a high prevalence of screen use, substantial sleep disturbances, and a significant relationship between increasing screen exposure and worsening sleep quality.

The study population was evenly distributed across the age range of 4–8 years, with a slight predominance of 7-year-old children (24.2%) and a near-equal gender distribution (52.3% females and 47.7% males). Such demographic balance minimizes age- and gender-related bias and enhances the generalizability of the findings to early primary school children. Maternal and paternal educational status showed relatively high educational attainment, with over one-third of mothers and one-fourth of fathers being postgraduates. Despite this favorable educational background, screen exposure remained highly prevalent, suggesting that increasing digital media use among children transcends parental

educational status, a phenomenon reported globally in recent years.¹⁶

A major finding of the study was the remarkably high prevalence of screen exposure, with 78.8% of children using electronic devices. Nearly half of the children (48.5%) were exposed to screens for more than 60 minutes daily, while 15.2% exceeded 120 minutes per day. These findings are consistent with global trends demonstrating increasing digital media use among preschool and school-age children. International guidelines from the World Health Organization and the American Academy of Pediatrics recommend limiting recreational screen exposure in young children because excessive screen time has been associated with adverse physical, behavioral, and sleep outcomes.^{1,2,25} The high prevalence observed in the present study reflects the growing integration of smartphones, tablets, televisions, and digital learning platforms into children's daily routines.¹⁶

Sleep duration analysis revealed that although most children (62.1%) slept between 8 and 10 hours per night, 13.6% slept less than 8 hours, which is below age-specific recommendations. The mean nighttime sleep duration was 9.28 ± 1.14 hours, while the mean total 24-hour sleep duration was 9.57 ± 1.05 hours. According to recommendations from the American Academy of Sleep Medicine, children aged 6–12 years should ideally obtain 9–12 hours of sleep per 24 hours.³ Therefore, a considerable proportion of children in the present study appear to be receiving insufficient sleep. Inadequate sleep during childhood has been associated with impaired cognitive performance, behavioural problems, reduced academic achievement, obesity, and emotional dysregulation.^{3,12}

The mean total CSHQ score in the present study was 68.73 ± 17.18 , indicating a substantial burden of sleep disturbances among participants. Furthermore, only 28.8% of children fell into the normal or mild disturbance category, whereas 71.2% demonstrated moderate-to-severe sleep disturbances. This prevalence is higher than that reported in several community-based pediatric studies, suggesting that sleep-related problems may be increasingly common in contemporary children exposed to digital media.^{11,12} The large standard deviation of CSHQ scores also indicates considerable heterogeneity in sleep behaviours among children.

One of the most important findings of this study was the significant positive correlation between screen use duration and total CSHQ score ($r = 0.52$, $p < 0.001$). This moderate-to-strong positive correlation indicates that increasing screen exposure is associated with worsening sleep quality and greater sleep disturbance severity. Similar findings have been reported by numerous international studies. A systematic review by Hale and Guan demonstrated that increased screen time is consistently associated with delayed sleep onset, shorter sleep duration, and poorer sleep quality among children and adolescents.⁴ Similar conclusions have been reported by Carter et al., Lund et al., and Janssen et al.^{5,23,24} The observed association may be explained through multiple biological and behavioral mechanisms.

Exposure to screen-emitted blue light suppresses melatonin secretion, resulting in delayed circadian rhythm initiation and prolonged sleep latency.⁶ Additionally, interactive digital content may increase cognitive and emotional arousal, making it more difficult for children to transition to sleep.²² Screen use often displaces bedtime routines and directly reduces time available for sleep.^{4,5,17} These mechanisms collectively contribute to poorer sleep quality and increased sleep disturbances among children with greater screen exposure.

The study further demonstrated a significant negative correlation between total sleep duration and CSHQ score ($r = -0.48$, $p < 0.001$). Children who slept longer experienced fewer sleep disturbances, whereas shorter sleep duration was associated with worsening sleep quality. This inverse relationship highlights the protective role of adequate sleep in maintaining healthy sleep behaviors. Similar findings have been reported in pediatric sleep

literature, where shorter sleep duration has consistently been linked to increased behavioral insomnia, night awakenings, daytime sleepiness, and impaired daytime functioning.^{12,18,19}

Analysis of CSHQ severity categories further strengthened the evidence for a dose–response relationship between screen exposure and sleep disturbance. Mean screen use increased progressively from 18.24 ± 12.52 minutes in the normal/mild group to 42.31 ± 21.44 minutes in the moderate group and 76.82 ± 34.18 minutes in the severe disturbance group ($p < 0.001$). Such a graded increase strongly supports the hypothesis that greater screen exposure contributes to worsening sleep outcomes. The presence of a dose-dependent relationship is particularly important because it strengthens the likelihood of a causal association rather than a coincidental correlation. Similar dose-dependent associations have been reported previously.^{7,8,21}

Similarly, total sleep duration demonstrated a progressive decline across increasing severity categories. Children with normal or mild sleep disturbances slept an average of 10.41 hours, whereas those with severe disturbances slept only 8.91 hours ($p < 0.001$). These findings suggest that sleep quantity and sleep quality are closely interconnected. Reduced sleep duration may worsen sleep-related behaviors, while sleep disturbances themselves may contribute to fragmented and insufficient sleep.^{12,19}

The categorical analysis of screen exposure further revealed that children with no screen use were substantially more likely to have normal or mild sleep disturbance (71.4%), whereas severe sleep disturbance was observed in only 7.1% of these children. In contrast, among children exposed to screens for more than 120 minutes daily, 60% experienced severe sleep disturbances. This clear gradient demonstrates a strong dose-dependent association between screen time and sleep problems. Similar dose-response relationships have been reported in studies from North America, Europe, and Asia, where each additional hour of screen exposure significantly increased the risk of sleep-related difficulties.^{5,7,9,20,24}

Nighttime sleep duration also showed a significant association with sleep disturbance severity. Children sleeping less than 8 hours were predominantly represented in the severe disturbance category, whereas those sleeping more than 10 hours were more likely to have normal or mild disturbance scores. These findings support current recommendations emphasizing adequate sleep duration as an essential component of child health.^{3,12}

The strengths of the present study include the use of a validated sleep assessment tool (CSHQ), inclusion of multiple dimensions of sleep behavior, and evaluation of both continuous and categorical measures of screen exposure. The identification of significant correlations, dose-response relationships, and highly significant statistical associations strengthens the validity of the findings.

However, certain limitations should be acknowledged. The cross-sectional design limits the ability to establish causality. Screen exposure was based on parental reporting and may be subject to recall bias. The study did not differentiate between device types, content characteristics, timing of screen use before bedtime, or weekday-weekend variations, all of which may influence sleep outcomes. Future longitudinal studies incorporating objective measurements of screen exposure and sleep parameters are warranted.^{19,23,24}

In conclusion, the present study demonstrates that screen exposure is highly prevalent among early primary school children and is strongly associated with poorer sleep quality and increased sleep disturbance severity. Increased screen time showed a significant positive correlation with CSHQ scores, while longer sleep duration was associated with fewer sleep disturbances. The observed dose-dependent relationship between screen exposure and sleep disturbance highlights screen use as a modifiable behavioral risk factor. These findings underscore the importance of educating parents, teachers, and healthcare providers regarding healthy media habits and the promotion of age-appropriate screen

time limits to improve sleep health and overall well-being among children. ^{1,2,25}

CONCLUSION

This study shows that electronic screen exposure is highly prevalent among children aged 4–8 years, with 78.8% of children exposed and 48.5% exceeding recommended screen time limits. The mean total sleep duration was at the lower end of recommended levels, and sleep disturbances were common, with 37.9% having severe disturbance. A statistically significant positive correlation was found between screen exposure and sleep disturbance severity ($r = 0.52$, $p < 0.001$), while total sleep duration showed a significant negative correlation with sleep disturbance ($r = -0.48$, $p < 0.001$). Increasing screen time was associated with progressively worsening sleep disturbance and reduced sleep duration, demonstrating a clear duration-dependent relationship. These findings indicate that excessive screen exposure is an important modifiable risk factor affecting sleep health in children. Limiting screen time and promoting healthy sleep practices are essential to improve sleep quality and overall well-being in this age group.

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