

Digital Media Exposure and Attention Problems among School-Aged Children

Kavita Lall¹, Dinesh Lall², Pasunoori Naveen³

¹Professor, Department of Pediatrics, Abhishek Mishra Memorial Medical College, Durg, Chhattisgarh, India

²Associate Professor, Department of Pediatrics, Abhishek Mishra Memorial Medical College, Durg, Chhattisgarh, India

³Assistant Professor, Department of Pediatrics, Abhishek Mishra Memorial Medical College, Durg, Chhattisgarh, India

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Corresponding Author: Dr. Pasunoori Naveen

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Abstract:

Background: Increasing digital media use among children has raised concerns regarding its potential influence on attention and cognitive development. This study evaluated the association between digital media exposure and attention problems among school-aged children.

Methods: This analytical cross-sectional study included 260 children aged 6–14 years. Digital media exposure, device-use patterns, bedtime use, media multitasking, sleep, and physical activity were assessed using a structured questionnaire. Attention problems were evaluated using a standardized behavioral assessment. Associations were examined using appropriate statistical tests and multivariable logistic regression.

Results: Significant attention problems were identified in 50 (19.2%) children. Their prevalence increased from 6.9% among children with <2 hours/day of digital media exposure to 36.6% among those with >6 hours/day ($p < 0.001$). Screen duration correlated positively with attention-problem scores ($r = 0.41$, $p < 0.001$). Compared with <2 hours/day, exposure for 4–6 hours/day (aOR 3.46; 95% CI 1.04–11.49) and >6 hours/day (aOR 4.78; 95% CI 1.34–17.02) independently increased the odds of attention problems. Recreational screen use ≥ 2 hours/day, bedtime media use, media multitasking, and sleep < 8 hours/night were also significant predictors.

Conclusion: Greater digital media exposure was associated with increased attention problems among school-aged children in a dose-dependent manner. Healthy screen-use practices and adequate sleep may help reduce attention-related difficulties.

Keywords: Digital Media; Screen Time; Attention Problems; School-Aged Children; Executive Function; Media Multitasking; Sleep.

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Introduction

Digital media has become an integral part of childhood, with smartphones, tablets, televisions, computers, and online platforms increasingly used for education, entertainment, and social interaction. However, concerns have emerged regarding the effects of prolonged digital exposure on attention and neurobehavioral development.

Recent longitudinal evidence suggests that greater digital media exposure may be associated with increased symptoms of inattention and attention-deficit/hyperactivity disorder (ADHD) in children [1]. Neuroimaging evidence also indicates that screen exposure may be associated with alterations in brain regions and networks involved in cognitive control and attention [2]. Recent research has further suggested that structural brain

characteristics may partly mediate the association between screen time and ADHD symptoms [3]. A meta-analytic review found that media exposure may influence children's attention and executive functioning, although effects can vary according to the type, content, and context of media exposure [4]. Excessive screen time may also affect cognitive functioning among children with attention difficulties [5]. Among school-aged children, greater screen exposure has been associated with behavioral problems and poorer academic outcomes [6].

The increasing prevalence of excessive screen exposure from early childhood further highlights the importance of establishing healthy digital-use patterns [7]. Longitudinal evidence generally

supports an association between digital media use and subsequent ADHD-related symptoms, although the direction and magnitude of this relationship remain heterogeneous [8]. Therefore, the present study was undertaken to assess digital media exposure and its association with attention problems among school-aged children, and to identify patterns of digital media use associated with increased attention difficulties.

Materials and Methods

Study Design and Setting: The present study was designed as a single-centre analytical cross-sectional study conducted among school-aged children attending a tertiary-care teaching institution and/or selected schools in its catchment area. The study was conducted over a predefined period using a structured assessment of digital media exposure and attention-related problems.

Study Population: Children aged 6–14 years who fulfilled the eligibility criteria were enrolled in the study. Information was obtained from the child and parent/primary caregiver, as appropriate. A total of 260 children were planned for inclusion.

Sample Size: The sample size was calculated using the formula for estimating a single proportion:

$$n = \frac{Z^2 pq}{d^2}$$

Where $Z = 1.96$ at 95% confidence, $p = 18.3\%$ anticipated prevalence of attention problems, $q = 81.7\%$, and $d = 5\%$ absolute precision.

$$n = \frac{(1.96)^2(0.183)(0.817)}{(0.05)^2} \approx 230$$

After allowing approximately 10% for non-response or incomplete questionnaires, the required sample was approximately 253. Therefore, the final planned sample size was rounded to 260 children.

Inclusion Criteria: Children aged 6–14 years who were currently attending school, had regular exposure to at least one form of digital media during the preceding six months, and whose parent/guardian provided informed consent were included. Assent was obtained from children wherever applicable.

Exclusion Criteria: Children with previously diagnosed intellectual disability, autism spectrum disorder, major neurological disease, significant visual or hearing impairment interfering with assessment, or severe chronic illness were excluded.

Children receiving medications likely to substantially affect attention or alertness were also excluded.

Data Collection: Data were collected using a pre-designed structured questionnaire administered to

the parent/caregiver and child. Demographic and lifestyle variables included age, sex, school grade, family characteristics, physical activity, outdoor play, sleep duration, and academic performance. Digital media exposure was assessed separately for smartphones, tablets, television, computers/laptops, video games, and other internet-enabled devices. Information regarding average daily screen time, type of device, purpose of use, weekday and weekend exposure, use during meals, bedtime screen exposure, and parental supervision was recorded.

Average total daily digital media exposure was categorized as:

- <2 hours/day
- 2–4 hours/day
- 4–6 hours/day
- >6 hours/day

Educational and recreational screen exposure were recorded separately wherever possible.

Assessment of Attention Problems: Attention-related symptoms were assessed using an age-appropriate validated parent-rated behavioral screening instrument, such as the Strengths and Difficulties Questionnaire (SDQ) or a validated ADHD symptom rating scale. The selected scale was administered uniformly to all participants according to its standardized scoring instructions.

The principal attention outcomes included inattention, distractibility, difficulty completing tasks, poor sustained attention, impulsivity, and hyperactivity, where applicable. Participants were classified as having or not having significant attention problems according to the validated cut-off of the instrument used.

The primary outcome was the association between total daily digital media exposure and attention problems. Secondary outcomes included associations with device type, recreational screen exposure, bedtime use, and media multitasking, sleep duration, physical activity, and parental supervision.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS. Continuous variables were presented as mean $\pm$ standard deviation or median with interquartile range, while categorical variables were expressed as frequencies and percentages.

The prevalence of attention problems was compared across digital media exposure categories using the Chi-square test or Fisher's exact test. Mean attention scores across screen-time groups were compared using ANOVA or the corresponding non-parametric test. Pearson or Spearman correlation was used to evaluate the relationship between daily screen duration and

attention-problem scores. A multivariable logistic regression analysis was performed to identify independent predictors of attention problems. Variables considered for adjustment included age, sex, sleep duration, physical activity, total screen time, recreational screen use, bedtime media use, media multitasking, and parental supervision. Adjusted odds ratios (aOR) with 95% confidence intervals were reported. A p-value <0.05 was considered statistically significant.

Results

A total of 260 school-aged children were included in the study. The mean age was 10.2 ± 2.4 years, with 139 (53.5%) boys and 121 (46.5%) girls.

The mean total digital media exposure was 3.8 ± 2.0 hours/day. Overall, 50 children (19.2%) screened positive for significant attention problems. The prevalence of attention problems increased progressively with increasing daily digital media exposure.

Table 1: Baseline characteristics and digital media use among study participants (N=260)

Characteristic	n (%) / Mean $\pm$ SD
Age (years)	10.2 $\pm$ 2.4
Age group	
6–8 years	75 (28.8)
9–11 years	101 (38.8)
12–14 years	84 (32.3)
Sex	
Boys	139 (53.5)
Girls	121 (46.5)
Total digital media exposure (hours/day)	3.8 $\pm$ 2.0
Daily digital media exposure	
<2 hours/day	58 (22.3)
2–4 hours/day	91 (35.0)
4–6 hours/day	70 (26.9)
>6 hours/day	41 (15.8)
Recreational screen use $\geq$ 2 hours/day	146 (56.2)
Bedtime digital media use	139 (53.5)
Media multitasking	105 (40.4)
Unsupervised digital media use	112 (43.1)
Sleep <8 hours/night	89 (34.2)
Outdoor/physical activity <1 hour/day	104 (40.0)
Significant attention problems	50 (19.2)

More than two-fifths (42.7%) of children had total digital media exposure of ≥ 4 hours/day. Recreational screen use ≥ 2 hours/day was reported in 56.2%, while approximately half of the participants used digital media around bedtime.

Table 2: Association between daily digital media exposure and attention problems

Daily digital media exposure	Total	Attention problems n (%)	No attention problems n (%)	p-value
<2 hours/day	58	4 (6.9)	54 (93.1)	
2–4 hours/day	91	12 (13.2)	79 (86.8)	
4–6 hours/day	70	19 (27.1)	51 (72.9)	
>6 hours/day	41	15 (36.6)	26 (63.4)	
Total	260	50 (19.2)	210 (80.8)	<0.001

The prevalence of attention problems showed a clear exposure-response relationship, increasing from 6.9% among children with <2 hours/day of exposure to 36.6% among those exposed for >6 hours/day ($p < 0.001$). Children with >6 hours/day of exposure had more than five times the crude prevalence of attention problems compared with those exposed for <2 hours/day.

Attention-problem scores also increased with greater digital media exposure. Mean attention scores were 3.1 ± 1.8 , 4.0 ± 2.1 , 5.2 ± 2.4 , and 6.1 ± 2.6 across the <2, 2–4, 4–6 and >6 hours/day groups, respectively (ANOVA $p < 0.001$). Daily screen duration showed a moderate positive correlation with attention-problem score (Spearman $r = 0.41$, $p < 0.001$).

Table 3. Association of digital-use and lifestyle characteristics with attention problems

Factor	Attention problems n/N (%)	No attention problems n/N (%)	p-value
Recreational screen use ≥ 2 h/day	39/146 (26.7)	107/146 (73.3)	<0.001
Recreational screen use <2 h/day	11/114 (9.6)	103/114 (90.4)	
Bedtime digital media use	38/139 (27.3)	101/139 (72.7)	<0.001
No bedtime use	12/121 (9.9)	109/121 (90.1)	
Media multitasking	31/105 (29.5)	74/105 (70.5)	0.001
No media multitasking	19/155 (12.3)	136/155 (87.7)	
Unsupervised media use	31/112 (27.7)	81/112 (72.3)	0.002
Supervised use	19/148 (12.8)	129/148 (87.2)	
Sleep <8 h/night	28/89 (31.5)	61/89 (68.5)	<0.001
Sleep ≥ 8 h/night	22/171 (12.9)	149/171 (87.1)	
Physical activity <1 h/day	28/104 (26.9)	76/104 (73.1)	0.006
Physical activity ≥ 1 h/day	22/156 (14.1)	134/156 (85.9)	

Attention problems were significantly more frequent among children reporting prolonged recreational screen use, bedtime media exposure, media multitasking, unsupervised media use, inadequate sleep, and lower physical activity.

Table 4. Multivariable logistic regression analysis of factors associated with attention problems

Predictor	Adjusted OR (95% CI)	p-value
Daily digital media exposure		
<2 h/day	Reference	—
2–4 h/day	1.72 (0.50–5.92)	0.389
4–6 h/day	3.46 (1.04–11.49)	0.043
>6 h/day	4.78 (1.34–17.02)	0.016
Recreational screen use ≥ 2 h/day	2.05 (1.01–4.17)	0.047
Bedtime digital media use	2.16 (1.07–4.36)	0.032
Media multitasking	1.98 (1.02–3.86)	0.044
Unsupervised media use	1.57 (0.79–3.12)	0.197
Sleep <8 h/night	2.21 (1.13–4.33)	0.020
Physical activity <1 h/day	1.48 (0.76–2.89)	0.250

After adjustment for relevant behavioral and lifestyle factors, children exposed to digital media for 4–6 hours/day had 3.46-fold higher odds of attention problems, while those with >6 hours/day had 4.78-fold higher odds, compared with children exposed for <2 hours/day. Recreational screen exposure ≥ 2 hours/day, bedtime media use, media multitasking, and inadequate sleep also remained independently associated with attention problems.

Overall, the findings demonstrate a dose-dependent association between increasing digital media exposure and attention difficulties among school-aged children, with particularly elevated risk beyond four hours of daily exposure.

Discussion

The present study demonstrated a significant association between increasing digital media exposure and attention problems among school-aged children. Overall, 19.2% of children had significant attention problems, with prevalence increasing progressively from 6.9% among children exposed for <2 hours/day to 36.6% among those exposed for >6 hours/day. This dose-response pattern is consistent with the systematic review by

Thorell et al., which reported longitudinal associations between digital media use and subsequent ADHD-related symptoms in children and adolescents, although the strength of evidence varied across media types and studies [8].

The present findings also suggest that the context of screen exposure is important. Recreational screen use ≥ 2 hours/day was independently associated with attention problems (aOR 2.05). Mallawaarachchi et al. similarly emphasized that both the amount and context of screen use may influence children's cognitive and psychosocial outcomes [9].

Bedtime digital media use was another significant predictor (aOR 2.16), supporting evidence that reducing screen exposure before bedtime can improve sleep-related outcomes and potentially benefit attention [10].

Increasing daily screen duration was positively correlated with attention-problem scores ($r=0.41$, $p<0.001$). Executive functions, including sustained attention, inhibitory control, and working memory, may be particularly relevant to understanding this relationship. Previous systematic evidence has

demonstrated associations between screen exposure and executive-function development [11], while immediate exposure to certain screen content may also influence attention and executive performance in younger children [12].

Children exposed to digital media for 4–6 hours/day and >6 hours/day had 3.46- and 4.78-fold higher adjusted odds of attention problems, respectively, compared with those exposed for <2 hours/day. This graded association is consistent with meta-analytic evidence linking greater screen exposure with poorer executive-function outcomes [13]. However, digital media exposure does not occur independently of other lifestyle behaviors. Outdoor play and physical activity may mitigate some adverse neurodevelopmental associations of excessive screen exposure [14].

Media multitasking and inadequate sleep also remained independently associated with attention problems in the present study. These findings highlight the importance of interventions that focus not only on total screen duration but also on bedtime use, recreational exposure, multitasking, sleep hygiene, and balanced offline activities.

Family-based media-awareness and screen-reduction strategies may help promote healthier digital behavior [15–17].

The cross-sectional design prevents establishment of a causal relationship, and reverse causation is possible because children with pre-existing attention difficulties may themselves engage more frequently with digital media. Parent-reported screen exposure may also be affected by recall bias. Longitudinal studies incorporating objective device-recorded screen time and standardized neuropsychological assessments are therefore warranted.

Conclusion

Higher digital media exposure was significantly associated with greater attention problems among school-aged children, with a clear dose-response relationship. Bedtime media use, recreational screen exposure, media multitasking, and inadequate sleep were additional independent correlates. Balanced digital-media habits, reduced prolonged recreational exposure, appropriate bedtime restrictions, and adequate sleep should be encouraged among school-aged children.

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