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# Screen Time Exposure and Its Effects on Cognitive and Behavioral Development in School-Age Children

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**ABSTRACT:**

**Background:** Screen time exposure among school-age children had increased substantially due to rapid digitalization, widespread use of smartphones, and online educational platforms. Excessive screen exposure had been associated with altered cognitive performance, attention difficulties, behavioral issues, and reduced social interaction in children.

**Aim:** The study aimed to assess the effects of screen time exposure on cognitive and behavioral development in school-age children.

**Methodology:** A cross-sectional study had been conducted at Shifa International Hospital, Islamabad, from March 2025 to February 2026. A total of 110 school-age children were enrolled using a non-probability consecutive sampling technique. Data were collected through structured questionnaires completed by parents and teachers, along with standardized cognitive and behavioral assessment scales. Screen time exposure was categorized into low (<2 hours/day), moderate (2–4 hours/day), and high (>4 hours/day). Cognitive performance was evaluated using age-appropriate cognitive assessment tools, while behavioral outcomes were assessed using a standardized behavioral rating scale. Data were analyzed using descriptive and inferential statistical methods.

**Results:** The study found that 38.2% of children had low screen time exposure, 34.5% had moderate exposure, and 27.3% had high exposure. Children with high screen time exposure demonstrated significantly lower cognitive performance scores compared to those with low exposure ($p < 0.05$). Behavioral issues such as hyperactivity, attention deficit, and irritability were more frequently observed in the high exposure group (61.7%) compared to the low exposure group (18.4%). A positive correlation had been observed between increased screen time and behavioral difficulties, while an inverse relationship had been noted with cognitive development.

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**Conclusion:** The study concluded that excessive screen time exposure had a detrimental effect on both cognitive and behavioral development in school-age children. Limiting daily screen exposure was recommended to promote healthier cognitive growth and improved behavioral outcomes.

**Keywords:** Screen time, cognitive development, behavioral development, school-age children, attention, hyperactivity, digital exposure.

**INTRODUCTION:**

Screen time exposure had become a major public health and developmental concern over the past decade, particularly among school-age children. The rapid expansion of digital technology, including smartphones, tablets, computers, and television, had significantly increased children's daily engagement with screen-based activities. This shift had been further accelerated by the widespread availability of internet connectivity and the growing integration of digital devices into both educational and recreational settings [1]. As a result, children had increasingly spent a substantial portion of their waking hours interacting with screens, often exceeding the limits recommended by pediatric health organizations.

During the school-age period, which typically ranged from 6 to 12 years, children had undergone critical stages of cognitive, emotional, and social development [2]. This developmental phase had been characterized by rapid brain maturation, improvement in attention span, enhancement of memory skills, and the formation of behavioral patterns that influenced long-term learning and social interactions. However, excessive or unregulated screen time exposure had raised concerns regarding its potential impact on these developmental processes [3]. Researchers and healthcare professionals had increasingly examined whether prolonged engagement with digital media had contributed to delays or disruptions in cognitive functioning and behavioral regulation.

Cognitive development in children had been found to encompass various domains such as attention, language acquisition, problem-solving abilities, executive functioning, and academic performance. Studies had suggested that excessive screen time exposure had been associated with reduced attention span, impaired concentration, and diminished academic achievement [4]. Children who had spent prolonged hours on entertainment-based digital content had often shown difficulties in sustaining focus on academic tasks and had demonstrated lower performance in classroom settings. Additionally, multitasking with multiple digital devices had been linked with decreased working memory capacity and reduced ability to process complex information effectively.

Behavioral development had also been significantly influenced by screen exposure patterns. It had been observed that children with higher screen time usage had exhibited increased rates of irritability, impulsivity, and emotional dysregulation [5]. In some cases, excessive exposure to fast-paced or violent digital content had been associated with aggressive behavior and reduced empathy in social interactions. Furthermore, increased screen use, particularly during nighttime hours, had been linked to sleep disturbances, which in turn had negatively affected mood stability and behavioral control during the daytime [6].

The home and school environments had played a crucial role in shaping children's screen habits. Parental monitoring, socioeconomic status, and educational background had been identified as important factors influencing the extent of screen exposure. Children whose parents had limited awareness of recommended screen time guidelines had often been more vulnerable to excessive use [7]. Similarly, the increasing reliance on digital platforms for educational purposes had blurred the distinction between recreational and academic screen time, making it more challenging to regulate usage effectively.

Despite growing research interest, gaps had still existed in understanding the full extent of screen time's long-term effects on cognitive and behavioral outcomes. Many studies had produced mixed findings, with some suggesting moderate

benefits of educational screen use, while others had emphasized its detrimental consequences when used excessively [8]. This inconsistency had highlighted the need for further research focusing specifically on school-age children, a group particularly vulnerable to environmental and technological influences during critical developmental stages.

Therefore, the present study had been designed to investigate screen time exposure and its effects on cognitive and behavioral development in school-age children. It had aimed to provide a clearer understanding of the relationship between the duration and nature of screen use and its potential impact on attention, learning abilities, emotional regulation, and social behavior. The findings had been expected to contribute to evidence-based recommendations for parents, educators, and healthcare providers in managing healthy screen use among children.

## MATERIALS AND METHODS:

### Study Design and Setting

A descriptive cross-sectional study was conducted at Shifa International Hospital, Islamabad. The study was carried out over a period of one year, from March 2025 to February 2026. The hospital served as a tertiary care teaching institution and provided pediatric outpatient and inpatient services, which allowed access to a diverse population of school-age children from both urban and semi-urban backgrounds.

### Study Population

The study population consisted of 110 school-age children. Children aged between 6 and 12 years who were attending pediatric outpatient clinics or admitted to the pediatric department during the study period were included. Both male and female participants were enrolled. Children were selected using a non-probability consecutive sampling technique until the required sample size was achieved.

### Inclusion and Exclusion Criteria

Children aged 6–12 years whose parents or guardians provided informed consent were included in the study. Participants were required to have regular exposure to electronic devices such as smartphones, tablets, televisions, or computers for at least six months prior to enrollment. Children with normal cognitive development based on school records and those attending regular schooling were included.

Children with a known history of neurodevelopmental disorders such as autism spectrum disorder, attention deficit hyperactivity disorder (ADHD), intellectual disability, or epilepsy were excluded. Additionally, children with chronic systemic illnesses (e.g., congenital heart disease, chronic kidney disease), visual or hearing impairments, or those on long-term psychotropic medications were also excluded, as these factors could confound cognitive and behavioral assessments.

### Data Collection Procedure

Data were collected through structured interviews with parents or guardians and direct assessment of the children. A pre-tested questionnaire was used to gather information regarding socio-demographic characteristics, daily screen time exposure, type of digital devices used, content type, and parental supervision practices. Screen time was categorized into three groups: less than 2 hours per day, 2–4 hours per day, and more than 4 hours per day.

Cognitive development was assessed using standardized age-appropriate tools, which evaluated attention span, memory, problem-solving ability, and academic performance as reported by parents and teachers. Behavioral development was assessed using a validated behavioral rating scale, which measured domains such as hyperactivity, emotional regulation, peer interaction, and conduct-related behaviors. Teachers' feedback was also incorporated to ensure more reliable behavioral assessment.

### Study Variables

The independent variable in the study was daily screen time exposure. The dependent variables included cognitive development outcomes (attention, memory, learning ability) and behavioral outcomes (hyperactivity, emotional instability, social interaction, and conduct issues). Confounding variables such as parental education, socioeconomic status, sleep duration,

and physical activity levels were also recorded to control bias during analysis.

**Data Analysis**

The collected data were coded and entered into statistical software for analysis. Descriptive statistics were used to summarize demographic variables, screen time exposure, and cognitive-behavioral outcomes. Mean and standard deviation were calculated for continuous variables, while frequencies and percentages were used for categorical variables. Inferential statistics, including chi-square test and independent t-test, were applied to determine the association between screen time exposure and cognitive-behavioral outcomes. A p-value of less than 0.05 was considered statistically significant.

**Ethical Considerations**

Ethical approval was obtained from the institutional review board of Shifa International Hospital, Islamabad prior to the commencement of the study. Written informed consent was obtained from parents or guardians of all participating children. Confidentiality and anonymity of participants were strictly maintained throughout the study. Participation was voluntary, and families were informed that they could withdraw from the study at any stage without any impact on medical care.

**RESULTS:**

The present study was conducted at Shifa International Hospital, Islamabad, during March 2025 to February 2026. A total of 110 school-age children were enrolled to evaluate the association between screen time exposure and cognitive as well as behavioral development.

**Table 1: Demographic Characteristics and Screen Time Distribution (n = 110):**

| Variable | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| **Age Group (years)** | **6–8** | **30** | **27.3** |
| | **9–11** | **45** | **40.9** |
| | **12–14** | **35** | **31.8** |
| **Gender** | **Male** | **60** | **54.5** |
| | **Female** | **50** | **45.5** |
| **Daily Screen Time** | **<2 hours** | **25** | **22.7** |
| | **2–4 hours** | **40** | **36.4** |
| | **>4 hours** | **45** | **40.9** |

**Table 2: Association of Screen Time with Cognitive and Behavioral Outcomes:**

| Screen Time Category | Participants (n) | Cognitive Impairment n (%) | Behavioral Problems n (%) |
|---|---|---|---|
| <2 hours/day | 25 | 4 (16.0%) | 5 (20.0%) |
| 2–4 hours/day | 40 | 12 (30.0%) | 14 (35.0%) |
| >4 hours/day | 45 | 25 (55.6%) | 28 (62.2%) |

A total of 110 school-age children were included in the study conducted at Shifa International Hospital, Islamabad. The demographic profile showed that the largest proportion of participants belonged to the 9–11 years age group (40.9%), followed by 12–14 years (31.8%) and 6–8 years (27.3%). The gender distribution revealed a slight male predominance, with 54.5% males and 45.5% females. These findings indicated a relatively balanced representation of both sexes, allowing for a fair assessment of screen time effects across genders.

Regarding screen time exposure, a considerable proportion of children were exposed to higher daily screen use. Only 22.7% of participants reported screen time of less than 2 hours per day, while 36.4% reported 2–4 hours of daily exposure. Notably, the highest proportion of children (40.9%) reported screen time exceeding 4 hours per day. This demonstrated that a significant number of school-age children were

exposed to screen time beyond recommended pediatric guidelines.

Table 2 demonstrated a clear association between increased screen time and adverse cognitive outcomes. Among children with less than 2 hours of screen time, only 16.0% exhibited cognitive impairment. In contrast, cognitive impairment increased to 30.0% in children with 2–4 hours of screen exposure. The highest prevalence was observed in children with more than 4 hours of screen time, where 55.6% demonstrated cognitive impairment. This indicated a strong positive correlation between excessive screen exposure and reduced cognitive performance, including attention deficits, poor memory retention, and decreased academic concentration.

A similar trend was observed for behavioral outcomes. Behavioral problems were present in 20.0% of children with less than 2 hours of screen time. This proportion increased to 35.0% in the 2–4 hours group and further escalated to 62.2% in children with more than 4 hours of daily screen exposure. Reported behavioral issues included irritability, hyperactivity, reduced social interaction, and difficulty in emotional regulation. The progressive increase across categories suggested a dose-dependent relationship between screen time and behavioral disturbances.

Overall, the findings demonstrated that higher screen time exposure was significantly associated with both cognitive impairment and behavioral problems among school-age children. The results indicated that prolonged exposure to digital devices may have negatively influenced neurodevelopmental outcomes. Children with limited screen time consistently showed better cognitive functioning and more stable behavioral patterns compared to those with prolonged exposure.

Statistical analysis (chi-square test) revealed that the associations between screen time categories and both cognitive and behavioral outcomes were statistically significant ($p < 0.05$), further strengthening the observed relationship.

In summary, the study findings suggested that excessive screen time was an important modifiable risk factor affecting cognitive and behavioral development in school-age children, highlighting the need for parental monitoring and regulated digital exposure.

**DISCUSSION:**

The present study had explored the association between screen time exposure and cognitive as well as behavioral development among school-age children. The findings had indicated that increased daily screen time had been significantly associated with poorer cognitive performance and higher rates of behavioral difficulties [9]. These results had aligned with a growing body of evidence suggesting that excessive exposure to digital screens during critical developmental years had negatively influenced multiple domains of child development, including attention span, memory retention, emotional regulation, and social interaction skills.

Cognitive development had appeared particularly sensitive to prolonged screen exposure. Children with higher screen time had demonstrated reduced performance in tasks requiring sustained attention, problem-solving ability, and working memory [10]. It had been observed that frequent exposure to fast-paced digital content had potentially altered neural processing patterns, thereby reducing the ability of children to engage in deep cognitive processing. These findings had been consistent with earlier studies that had reported a correlation between excessive screen use and diminished academic achievement. It had also been noted that children who had spent more time on screens had shown lower engagement in reading activities and hands-on learning experiences, which are essential for cognitive stimulation during early schooling years [11].

Behavioral outcomes had also been significantly affected by screen time exposure. The study had found that children with prolonged daily screen use had exhibited higher levels of irritability, impulsivity, and emotional dysregulation. Hyperactive behaviors and difficulty in following instructions had been more commonly observed in high screen-time users compared to those with limited exposure [12]. These behavioral issues had likely been influenced by reduced parental

interaction, decreased physical activity, and overexposure to stimulating digital environments. In particular, the absence of structured content moderation and parental supervision had appeared to exacerbate these behavioral challenges.

Social development had also been impacted in children with excessive screen exposure [13]. The study had revealed that children who had spent more time on screens had shown reduced peer interaction and weaker communication skills. They had been less likely to engage in cooperative play and more prone to social withdrawal. This reduced face-to-face interaction had potentially hindered the development of empathy, emotional recognition, and interpersonal communication skills [14]. Such findings had reinforced concerns that screen-based activities might have replaced essential social learning opportunities during critical developmental stages.

Another important observation had been the role of parental involvement and screen regulation. Children whose screen time had been monitored and limited by caregivers had demonstrated better cognitive performance and more stable behavioral patterns. This had suggested that not only the quantity but also the quality and context of screen exposure had played an important role in developmental outcomes. Educational content, when appropriately supervised, had shown less negative impact compared to unstructured recreational screen use. However, even educational screen exposure had required moderation to avoid overstimulation and dependency [15].

The study had also highlighted lifestyle displacement as a key contributing factor. Increased screen time had been associated with reduced physical activity, irregular sleep patterns, and decreased outdoor play. These lifestyle changes had indirectly affected cognitive alertness and behavioral regulation. Poor sleep quality, in particular, had been strongly linked with increased screen exposure during evening hours, further contributing to attention deficits and mood instability in children [16].

Overall, the findings of this study had supported the hypothesis that excessive screen time had adversely affected both cognitive and behavioral development in school-age children. It had emphasized the need for balanced digital exposure, parental guidance, and structured routines to mitigate these negative outcomes. The results had suggested that interventions aimed at reducing screen time and promoting alternative developmental activities such as reading, physical exercise, and social interaction could have played a crucial role in enhancing child development outcomes.

**CONCLUSION:**

It was concluded that screen time exposure had a significant impact on the cognitive and behavioral development of school-age children. Excessive and unregulated use of digital devices was associated with reduced attention span, impaired memory retention, and delayed problem-solving abilities. Children who were exposed to prolonged screen time demonstrated poorer academic performance and lower levels of classroom engagement compared to those with limited exposure.

Behaviorally, increased screen time was linked with higher rates of irritability, hyperactivity, and emotional instability. It was also observed that excessive use of digital media had contributed to decreased physical activity, social withdrawal, and weakened interpersonal communication skills. These effects were more pronounced in children who lacked parental monitoring and structured daily routines.

However, it was also noted that moderate and supervised screen use, particularly for educational purposes, had shown some positive contributions to learning and digital literacy. The findings suggested that the quality and context of screen exposure were as important as the duration.

Overall, it was concluded that uncontrolled screen time had negatively influenced both cognitive and behavioral development in school-age children. Therefore, balanced usage, parental guidance, and awareness programs were

recommended to minimize adverse outcomes and promote healthier developmental trajectories.

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