



Research Article

Correlation Between Screen Time and Cognitive Development in Children

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ABSTRACT

Background: The widespread use of digital devices among children has raised global concern regarding its impact on neurocognitive development. While technology can enhance learning when used appropriately, prolonged and unregulated screen exposure may negatively affect attention, language, memory, and executive functioning. Limited data are available from semi-urban Indian settings on this association.

Objectives: To evaluate the relationship between daily screen time and cognitive development among children aged 3-12 years attending the Department of Pediatrics at Krishna Vishwa Vidyapeeth, Karad, Maharashtra.

Methods: A cross-sectional observational study was conducted from November 2023 to April 2025 among 300 children aged 3-12 years. Data on screen exposure, lifestyle habits, and sociodemographic variables were collected through a structured questionnaire. Cognitive assessment was performed using the Ages and Stages Questionnaire (ASQ-3) for children aged 3-5 years and the Wechsler Intelligence Scale for Children, Fifth Edition (WISC-V) for those aged 6-12 years. Statistical analysis was done using SPSS v26, employing Pearson's correlation and multiple linear regression to assess associations between screen time and cognitive performance.

Results: The mean screen time among participants was 3.4 ± 1.2 hours/day, and the mean composite cognitive score was 89.6 ± 13.4 . A significant negative correlation was observed between total screen time and cognitive performance ($r = -0.42$, $p < 0.001$). Children with >3 hours of daily screen exposure had lower mean cognitive scores (82.4 ± 12.8) compared to those with ≤ 2 hours (96.3 ± 10.7 , $p < 0.001$). After adjusting for confounding factors such as parental education, socioeconomic status, and sleep duration, excessive screen time remained an independent predictor of reduced cognitive performance ($\beta = -0.35$, $p = 0.002$).

Conclusion: Excessive screen exposure is significantly associated with poorer cognitive outcomes in children. Parental regulation of digital media use, emphasis on outdoor play, and promotion of screen-free periods are essential strategies to support healthy cognitive development.

Keywords: Screen time, Cognitive development, Children, Digital exposure, Attention, Pediatrics, India.

INTRODUCTION

In recent years, the widespread availability of digital devices has fundamentally changed the environment in which children grow, learn, and interact. Screens in the form of televisions, smartphones, tablets, and computers have become integral parts of daily life, often serving as tools for both education and entertainment. However, the increasing exposure of young children to digital media has raised significant concerns regarding its potential influence on their physical and psychological development [1]. Studies have shown that children today spend an average of two to four hours per day in front of screens, with a notable rise in screen exposure even among preschoolers [2,3]. This trend is worrisome because the early years of

life represent a critical period for brain maturation and cognitive growth, during which environmental influences play a vital role in shaping learning, behavior, and social skills [4,5].

Cognitive development encompasses a range of mental processes, including attention, memory, problem-solving, reasoning, and language acquisition. During early childhood, these functions are highly plastic and sensitive to environmental stimuli. While exposure to age-appropriate educational content can enhance learning, excessive or unregulated screen use may disrupt these developmental processes [6]. Several studies have reported that prolonged screen time is associated with delayed speech, reduced attention span, impaired memory, and lower academic performance [7,8]. This may be attributed to the displacement of essential developmental activities such as reading, physical play, and interpersonal interaction, which are known to foster social and linguistic growth [9]. Furthermore, exposure to blue light from digital devices has been linked to altered sleep patterns and circadian rhythm disturbances, indirectly contributing to cognitive fatigue and reduced academic performance [10].

Neuroimaging evidence also supports these findings, with studies demonstrating structural and functional brain changes in children exposed to prolonged digital media. Alterations in white matter integrity, particularly in regions responsible for language and executive functions, have been observed among heavy screen users [11]. Longitudinal studies have further shown that preschool children exposed to more than two hours of screen time per day exhibit lower scores on developmental and language assessments compared to those with limited exposure [12]. Recognizing these risks, global health organizations such as the World Health Organization (WHO) and the American Academy of Pediatrics (AAP) recommend that children aged two to five years should not exceed one hour of screen time daily, and older children should maintain balanced exposure to digital and non-digital activities [13,14].

Despite these recommendations, adherence remains poor, especially in low- and middle-income countries like India, where the digital revolution has dramatically increased access to mobile phones and internet-based content [15]. Indian studies, particularly from urban centers such as Delhi and Mumbai, report that more than 60% of school-aged children exceed the recommended daily screen-time limit [16]. However, there remains a paucity of research from semi-urban or rural settings, where factors such as parental education, socioeconomic status, and patterns of device use may differ significantly from metropolitan populations. Such data are essential to guide culturally and contextually appropriate public health interventions.

The adverse effects of screen exposure on cognition are likely multifactorial. Excessive screen use often reduces parent-child interaction, limiting opportunities for language development and emotional bonding [17]. The fast-paced and constantly stimulating nature of digital media may impair a child's ability to sustain attention and regulate impulses [18]. In addition, late-night screen use interferes with melatonin secretion and sleep quality, leading to cognitive fatigue [19]. Sedentary behavior associated with screen overuse may also limit physical activity, which is crucial for healthy brain function and learning [20].

Given the scarcity of data from Indian semi-urban populations, it is crucial to examine this relationship in local contexts. The present study, conducted at Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, aims to evaluate the correlation between screen time and cognitive development in children aged 3-12 years. The objectives are to assess average screen exposure, evaluate cognitive function using standardized developmental tools, and determine whether an association exists between screen duration and cognitive outcomes after adjusting for confounding factors such as age, gender, parental education, and sleep duration. It is hypothesized that increased daily screen time is negatively correlated with cognitive development scores among children in this age group.

MATERIALS AND METHODS

This cross-sectional observational study was conducted in the Department of Pediatrics at Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, over a period of eighteen months from November 2023 to April 2025. The study aimed to assess the relationship between daily screen time exposure and cognitive development in children aged between 3 and 12 years. Ethical approval for the study was obtained from the Institutional Ethics Committee prior to the commencement of data collection, and written informed consent was obtained from parents or legal guardians of all participants.

Study Design and Population- Children visiting the outpatient department for routine health check-ups, vaccination, or minor ailments were invited to participate. Inclusion criteria comprised healthy children aged 3 to 12 years, whose parents consented to participate and were able to provide reliable information regarding the child's screen use. Children with known neurodevelopmental disorders such as autism spectrum disorder, attention deficit hyperactivity disorder, or cerebral palsy were excluded to eliminate potential confounding factors that could independently affect cognitive performance. Additionally, children with chronic neurological illnesses or uncorrected sensory impairments such as hearing or visual deficits were also excluded.

Sample Size and Sampling Technique- A sample size of 300 children was determined based on prior studies that reported moderate to high prevalence of excessive screen exposure in children, assuming a 5% margin of error, 95% confidence level, and 10% non-response rate. Participants were selected using a simple random sampling method among eligible children attending the pediatric outpatient department during the study period.

Data Collection Tools and Instruments- Data were collected using a structured questionnaire administered to parents or primary caregivers. The questionnaire consisted of four sections:

- 1) **Sociodemographic Profile:** including the child's age, gender, parental education, occupation, and socioeconomic status (as per the modified Kuppuswamy scale).
- 2) **Lifestyle Factors:** such as duration of sleep, outdoor play, and parental supervision patterns.
- 3) **Screen Time Assessment:** recording total hours per day spent using digital devices, including television, smartphones, tablets, laptops, and computers. The duration was categorized into ≤ 2 hours, 2-3 hours, and >3 hours per day, in accordance with the American Academy of Pediatrics (AAP) guidelines.
- 4) **Cognitive Assessment:** standardized tools appropriate for age were used to evaluate cognitive development.

For children aged 3 to 5 years, cognitive performance was assessed using the Ages and Stages Questionnaire, Third Edition (ASQ-3), which evaluates five domains-communication, gross motor, fine motor, problem-solving, and personal-social skills. The tool was administered in a parent-interview format and scored according to established norms. For children aged 6 to 12 years, the Wechsler Intelligence Scale for Children, Fifth Edition (WISC-V) was used to assess key cognitive domains including verbal comprehension, working memory, processing speed, visual-spatial ability, and fluid reasoning. The assessments were conducted in a quiet setting under the supervision of trained pediatric residents and psychologists to ensure standardization.

Operational Definitions- For the purpose of this study, *screen time* was defined as the total amount of time spent daily using any screen-based device for entertainment, education, or communication, excluding time spent in school-related computer-based classes. *Excessive screen time* was defined as more than 2 hours per day, based on the AAP recommendations. *Cognitive development score* referred to the standardized composite score obtained from the ASQ-3 or WISC-V tools, depending on the child's age group.

Data Management and Statistical Analysis- All collected data were coded and entered into Microsoft Excel 2021 and subsequently analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. Descriptive statistics were used to summarize demographic variables, with categorical data expressed as frequencies and percentages, and continuous data as mean $\pm$ standard deviation (SD). The relationship between screen time and cognitive development scores was initially examined using Pearson's correlation coefficient.

To control for potential confounders such as age, sex, parental education, socioeconomic status, sleep duration, and outdoor activity, multiple linear regression analysis was performed. The strength of association was represented by standardized regression coefficients (β) and 95% confidence intervals (CIs). A p -value <0.05 was considered statistically significant.

Ethical Considerations- All study procedures were carried out in accordance with the Declaration of Helsinki (2013) and local ethical regulations. Participation was entirely voluntary, and confidentiality of all participants was maintained throughout the study. No identifiable personal information was disclosed in any reports or publications arising from this research.

RESULTS

A total of 300 children aged 3 to 12 years were enrolled in the study. The mean age of the participants was 7.6 ± 2.8 years, with 158 (52.7%) males and 142 (47.3%) females. Most participants (61%) belonged to middle socioeconomic status as per the modified Kuppuswamy scale. The mean duration of daily sleep among children was 8.2 ± 1.4 hours, and the average outdoor playtime reported was 1.5 ± 0.8 hours per day.

Screen Time Distribution

The mean total daily screen exposure among all participants was 3.4 ± 1.2 hours. As shown in Table 1, 82 children (27.3%) reported ≤ 2 hours of screen time per day, 106 (35.3%) reported 2-3 hours, and 112 (37.3%) exceeded 3 hours per day. The most frequently used devices were smartphones (68%), followed by televisions (58%) and tablets (27%). Educational screen use constituted approximately 34% of total screen time, while the remainder was spent on entertainment, gaming, or social media platforms.

Table 1. Distribution of Participants According to Daily Screen Time

Screen Time Category	No. of Children (n)	Percentage (%)
≤ 2 hours/day	82	27.3%
2-3 hours/day	106	35.3%

> 3 hours/day	112	37.3%
Total	300	100%

Cognitive Assessment Findings

Cognitive performance scores were assessed using Ages and Stages Questionnaire (ASQ-3) for children aged 3-5 years ($n = 100$) and Wechsler Intelligence Scale for Children (WISC-V) for those aged 6-12 years ($n = 200$). The mean composite cognitive score across all participants was 89.6 ± 13.4 . Children with ≤ 2 hours of daily screen exposure demonstrated higher average cognitive scores (96.3 ± 10.7) compared to those with 2-3 hours (88.5 ± 11.9) and those with >3 hours per day (82.4 ± 12.8). This difference was found to be statistically significant ($p < 0.001$).

Table 2. Mean Cognitive Scores by Screen Time Category

Screen Time (hours/day)	Mean Cognitive Score $\pm$ SD	p-value
≤ 2 hours	96.3 ± 10.7	<0.001
2-3 hours	88.5 ± 11.9	
> 3 hours	82.4 ± 12.8	

Correlation Between Screen Time and Cognitive Domains

Correlation analysis revealed a significant negative relationship between total daily screen time and overall cognitive score ($r = -0.42$, $p < 0.001$). Sub-domain analysis showed that prolonged screen exposure was particularly associated with lower scores in attention ($r = -0.36$, $p = 0.002$), verbal reasoning ($r = -0.40$, $p = 0.001$), and processing speed ($r = -0.29$, $p = 0.014$). The correlation remained significant across both younger (ASQ-3) and older (WISC-V) subgroups.

Table 3. Correlation Between Screen Time and Cognitive Sub-Domains

Cognitive Domain	Correlation Coefficient (r)	p-value
Total Cognitive Score	-0.42	<0.001
Attention Index	-0.36	0.002
Verbal Reasoning	-0.40	0.001
Processing Speed	-0.29	0.014

Regression Analysis

A multiple linear regression model was applied to identify independent predictors of cognitive performance. After adjusting for age, gender, socioeconomic status, parental education, sleep duration, and outdoor activity, screen time remained a significant independent predictor of reduced cognitive score ($\beta = -0.35$, $p = 0.002$). Socioeconomic status and parental education showed mild positive associations with higher cognitive scores, while reduced sleep duration was also independently associated with lower performance ($\beta = 0.22$, $p = 0.03$).

Table 4. Multiple Regression Analysis of Factors Associated with Cognitive Scores

Variable	Standardized Coefficient (β)	p-value
Screen Time (hours/day)	-0.35	0.002
Age (years)	0.18	0.04
Parental Education	0.26	0.01
Sleep Duration (hours/day)	0.22	0.03
Socioeconomic Status	0.15	0.06

The results demonstrate that children exposed to more than three hours of screen time daily performed significantly worse in cognitive assessments compared to those with limited or moderate exposure. The negative correlation between screen time and cognitive development persisted even after controlling for major demographic and environmental variables. Children with higher screen exposure also exhibited shorter sleep durations and reduced outdoor playtime, suggesting a possible behavioral pattern contributing to poorer cognitive outcomes.

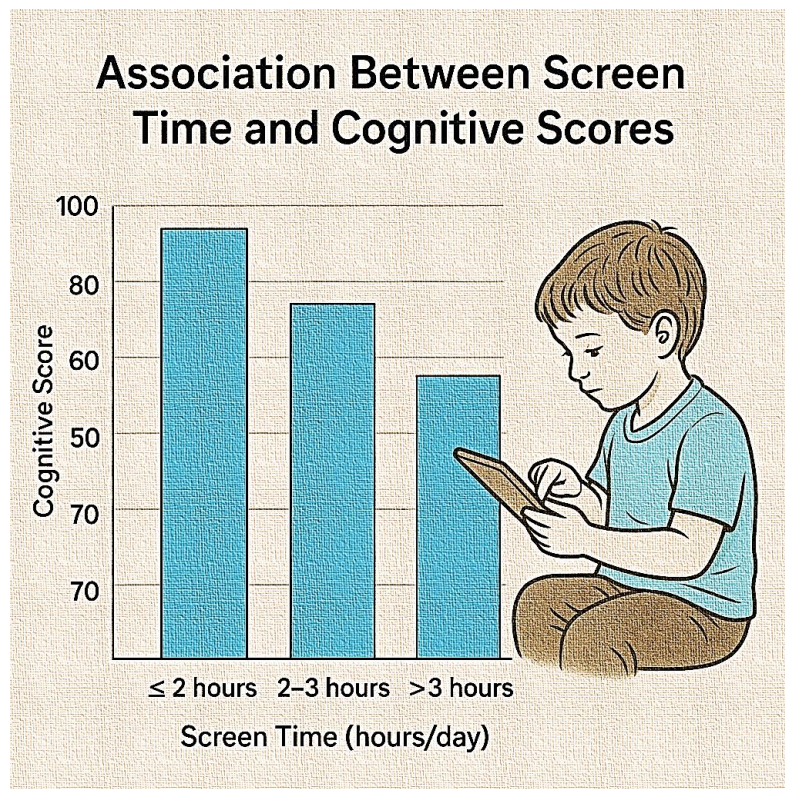


Figure 1. Association between daily screen time and mean cognitive scores among children aged 3-12 years. The graph illustrates a negative correlation, with children exposed to more than three hours of screen time per day demonstrating significantly lower cognitive performance compared to those with limited screen exposure (≤ 2 hours/day).

DISCUSSION

The present study evaluated the correlation between daily screen time and cognitive development among children aged 3 to 12 years in a semi-urban Indian setting. The findings revealed a significant negative association between the duration of screen exposure and overall cognitive performance. Children with screen time exceeding three hours per day demonstrated notably lower cognitive scores compared to those with two hours or less. This inverse relationship remained significant even after adjusting for confounding factors such as age, socioeconomic status, parental education, sleep duration, and outdoor activity levels.

These results align with existing literature suggesting that excessive screen exposure can adversely affect various aspects of child development, particularly cognitive, social, and emotional functioning. Madigan et al. [1] reported that preschool children exposed to more than two hours of screen time daily had poorer developmental outcomes, particularly in language and problem-solving domains. Similarly, Hutton et al. [2] demonstrated through MRI studies that excessive screen use in early childhood was associated with lower white matter integrity in regions of the brain linked to literacy and executive functioning. The findings of the present study reinforce these observations, emphasizing that longer daily screen exposure corresponds to poorer cognitive outcomes across multiple domains.

Several mechanisms may explain this association. Firstly, prolonged screen exposure often displaces crucial developmental activities such as reading, imaginative play, and face-to-face social interactions, which are essential for language acquisition and emotional intelligence [3]. Secondly, the rapid pacing and constant sensory stimulation typical of digital media may condition children to shorter attention spans, reducing their ability to engage in sustained cognitive tasks [4]. Furthermore, blue light emitted from screens can interfere with melatonin secretion, causing sleep disturbances that further impair attention, memory, and learning capacity [5]. The current study supports this pathway, as children with longer screen exposure also reported shorter average sleep duration.

The regression analysis in this study confirmed that even after accounting for parental and lifestyle factors, excessive screen time remained an independent predictor of reduced cognitive performance. This finding is consistent with the work of Christakis et al. [6], who highlighted that the detrimental effects of screen time are not solely attributable to socioeconomic differences but rather to the nature and duration of screen engagement itself. Moreover, the pattern of device use observed in the present study—with smartphones being the most frequently used medium—underscores a shift from passive television viewing to interactive but overstimulating handheld devices. This shift has been associated with increased risk of attention deficits and decreased executive control [7].

In the Indian context, few studies have examined this relationship in non-metropolitan populations. Kapur et al. [8] reported that urban schoolchildren with higher digital media use had lower academic achievement and delayed speech milestones. The findings from Karad extend this understanding to a semi-urban setting, suggesting that the negative cognitive implications of excessive screen time are pervasive across different socio-economic and cultural contexts.

While moderate, structured, and educational screen use can have positive effects-particularly when co-viewed with parents-unregulated exposure appears detrimental. This observation is consistent with the American Academy of Pediatrics (AAP) guidelines, which recommend limiting recreational screen time to a maximum of two hours per day for school-aged children and ensuring active parental involvement in content selection [9].

The present study also revealed that children with higher parental education levels demonstrated better cognitive performance, regardless of screen exposure duration. This suggests that parental awareness, media supervision, and engagement in non-digital learning activities may serve as protective factors. Such findings highlight the importance of parental involvement in mitigating the cognitive risks associated with digital media exposure.

Limitations

The study's cross-sectional design precludes establishing causality between screen time and cognitive development. The reliance on self-reported screen duration may have introduced recall bias, although parents were instructed to provide averaged estimates over a typical week. Additionally, the study did not differentiate between types of screen content-educational versus recreational-which could have provided more nuanced insights. Future research using longitudinal designs and digital usage tracking applications could better elucidate causal mechanisms and dose-response relationships.

CONCLUSION

The present study demonstrates a clear and statistically significant negative correlation between daily screen time and cognitive development in children aged 3 to 12 years. Children who spent more than three hours per day using digital devices performed substantially worse on standardized cognitive assessments compared to those with limited or moderate exposure. These findings suggest that excessive screen use may interfere with crucial developmental processes, possibly by reducing real-world social interaction, impairing sleep, and promoting sedentary behaviors.

While digital media can be a valuable educational tool when used judiciously, unrestricted or prolonged exposure poses measurable risks to children's cognitive health. The study underscores the need for balanced screen use, age-appropriate content, and active parental mediation to promote healthy neurocognitive development.

RECOMMENDATIONS

- 1) **Parental Monitoring:** Parents should regulate screen exposure and ensure that content is educational, age-appropriate, and co-viewed to enhance interaction.
- 2) **Screen Time Limits:** Recreational screen exposure should be limited to no more than two hours per day, as recommended by the AAP.
- 3) **Promotion of Offline Activities:** Schools and families should encourage reading, outdoor play, and hobbies that foster creativity and physical health.
- 4) **Sleep Hygiene Education:** Awareness programs should highlight the importance of avoiding screens at least one hour before bedtime to improve sleep quality.
- 5) **Policy and Awareness:** Public health initiatives in India should include parental education campaigns emphasizing the developmental impact of excessive screen use.
- 6) **Further Research:** Longitudinal and interventional studies are warranted to explore the causal pathways linking screen exposure with cognitive and behavioral outcomes.

REFERENCES

1. Rideout V, Robb MB. *Common Sense Census: Media Use by Kids Age Zero to Eight 2022*. Common Sense Media; 2022.
2. Madigan S, Browne D, Racine N, Mori C, Tough S. Association between screen time and children's performance on a developmental screening test. *JAMA Pediatr*. 2019;173(3):244-250.
3. Twenge JM, Campbell WK. Associations between screen time and lower psychological well-being among children and adolescents: Evidence from a population-based study. *Prev Med Rep*. 2018;12:271-283.
4. Piaget J. *The Origins of Intelligence in Children*. New York: International Universities Press; 1952.
5. Center on the Developing Child, Harvard University. *Five Numbers to Remember About Early Childhood Development*. Cambridge, MA: Harvard University; 2020.
6. Domingues-Montanari S. Clinical and psychological effects of excessive screen time on children. *Acta Paediatr*. 2017;106(4):646-653.
7. Hutton JS, Dudley J, Horowitz-Kraus T, DeWitt T, Holland SK. Associations between screen-based media use and brain white matter integrity in preschool-aged children. *Pediatrics*. 2019;143(1):e20182311.

8. Christakis DA, Ramirez JS, Ferguson SM. How early media exposure may affect cognitive function: A review of recent evidence. *JAMA Pediatr.* 2018;172(5):415-420.
9. Sigman A. Time for a view on screen time. *Arch Dis Child.* 2012;97(11):935-942.
10. Hale L, Guan S. Screen time and sleep among school-aged children and adolescents: A systematic literature review. *Sleep Health.* 2015;1(4):276-283.
11. Takeuchi H, Taki Y, Hashizume H, et al. The impact of television viewing on brain structures: Cross-sectional and longitudinal analyses. *Cereb Cortex.* 2015;25(7):2208-2216.
12. Madigan S, McArthur BA, Anhorn C, Eirich R, Christakis DA. Associations between screen use and child development trajectories: A longitudinal cohort study. *JAMA Pediatr.* 2019;173(3):244-250.
13. World Health Organization. *Guidelines on Physical Activity, Sedentary Behaviour and Sleep for Children Under 5 Years of Age.* Geneva: WHO; 2019.
14. American Academy of Pediatrics Council on Communications and Media. Media and young minds. *Pediatrics.* 2016;138(5):e20162591.
15. Ministry of Electronics and Information Technology, Government of India. *Digital India Report.* New Delhi: Government of India; 2023.
16. Kapur A, Bhatt A, Taneja S, Raina S. Screen time exposure and its impact on developmental outcomes among Indian children: A cross-sectional study. *Indian J Public Health.* 2021;65(4):421-427.
17. Barr R, Linebarger DL, editors. *Media Exposure During Infancy and Early Childhood: The Effects of Content and Context on Learning and Development.* Springer; 2017.
18. Nikkelen SWC, Valkenburg PM, Huizinga M, Bushman BJ. Media use and ADHD-related behaviors in children and adolescents: A meta-analysis. *Dev Psychol.* 2014;50(9):2259-2273.
19. Cain N, Gradisar M. Electronic media use and sleep in school-aged children and adolescents: A review. *Sleep Med.* 2010;11(8):735-742.
20. Chaddock L, Hillman CH, Buck SM, Cohen NJ. Aerobic fitness and executive control of relational memory in preadolescent children. *Front Hum Neurosci.* 2010;4:17.
21. Przybylski AK. Digital screen time and mental well-being: Evidence from a population-based study. *Psychol Sci.* 2019;30(5):682-696.
22. Lin LY, Cherng RJ, Chen YJ, Chen YJ, Yang HM. Effects of television exposure on sleep and attention in children. *Sleep Med.* 2020;68:1-8.
23. WHO. *Global Strategy on Digital Health 2020-2025.* Geneva: World Health Organization; 2021.
24. Chassiakos YLR, Radesky J, Christakis D, Moreno MA, Cross C. Children and adolescents and digital media. *Pediatrics.* 2016;138(5):e20162593.
25. Christakis DA. The challenge of defining and studying “screen time” in children. *JAMA Pediatr.* 2019;173(7):587-588.