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Association Between Screen Time Duration and Attention- Deficit/ Hyperactivity Disorder Symptoms Among Children Aged 4–6 Years

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ABSTRACT

Background: The rapid increase in screen time among children has raised urgent public health concerns due to its potential link with Attention- Deficit/ Hyperactivity Disorder (ADHD)-related symptoms. Emerging evidence suggests that excessive and early exposure to digital media may contribute to inattention, impulsivity, and behavioral dysregulation. This study aimed to examine the association between the duration of gadget use and ADHD symptoms in children aged 4–6 years.
Subjects and Method: A cross-sectional study was conducted at four early childhood education institutions in Kartasura, Central Java, Indonesia. A total of 87 children aged 4–6 years were included. Screen time duration was assessed using a 7-day parent-reported observation sheet. ADHD symptoms were measured using the ADHD Rating Scale-5 (ADHDRS-5). The association between screen time duration and ADHD symptoms was analyzed using Pearson's correlation test.
Results: There was a statistically significant positive correlation between screen time duration and ADHD symptoms ($r = 0.35$; $p = 0.001$).
Conclusion: Longer screen time duration is associated with higher levels of ADHD symptoms among children aged 4–6 years.

Keywords: attention deficit hyperactivity disorder, screen time, preschool-aged children

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BACKGROUND

New technologies, particularly mobile and interactive screen media, have become deeply embedded in children's daily lives. Children today are often described as "digital natives," growing up within a rapidly evolving digital environment shaped by widespread access to mobile devices (Muppalla et al., 2023). In response to potential developmental risks, the World Health Organization (WHO) recommends that preschool children aged 2–5 years engage in no more than one hour of screen time per day, emphasizing that less is better for optimal health and development.

Despite these guidelines, adherence remains low. International evidence suggests that only 25–35% of preschool-aged children meet the recommended limits (Hinkley et al., 2018). In Indonesia, screen

exposure among young children has risen sharply, with the proportion of five-year-old children using screen-based devices increasing from 38% in 2011 to 80% in 2015 (Gunawan et al., 2021), reflecting a rapid and widespread shift toward digital media use from an early age (Nurhidayah et al., 2026).

While electronic media have transformed learning, communication, and access to information, accumulating evidence suggests that excessive screen use may pose long-term risks to children's health, making it an emerging public health concern (Liu et al., 2022). For example, early exposure to television between the ages of six and 18 months has been linked to increased emotional reactivity, aggression, and externalizing behaviors (Oswald et al., 2020). Within this context, the relationship between screen time and the risk of Attention-Deficit/Hyperactivity Disorder (ADHD) symptoms in children has gained increasing attention in public health research. Screen media can offer cognitive benefits, particularly in supporting learning and educational engagement. However, excessive use and frequent multitasking across multiple media platforms have been associated with poorer executive functioning and lower academic performance (Muppalla et al., 2023).

Emerging evidence further indicates that high levels of screen exposure, especially from smartphones, tablets, and other digital media, are associated with increased inattention, impulsivity, and hyperactivity (Khanani et al., 2025). Several mechanisms may explain this relationship. Prolonged screen use can overstimulate the developing brain through rapid scene changes, reward-driven content, and instant feedback (Christakis et al., 2018), potentially conditioning children to prefer high-intensity stimulation and reducing their ability to sustain attention in less stimulating environments such as classrooms. In addition, excessive screen time may displace essential developmental activities, including physical play, social interaction, and adequate sleep (Khanani et al., 2025; Jia et al., 2025), all of which are critical for cognitive and behavioural regulation. Sleep disruption, in particular, has been consistently linked to ADHD-like symptoms. From a public health perspective, concerns extend beyond the duration of screen exposure to include its quality and timing, with early and unregulated use, especially in preschool-aged children, posing greater developmental risks. The purpose of this study was to examine the association between the duration of gadget use and ADHD symptoms in children aged 4–6 years.

SUBJECTS AND METHOD

1. Study design

A cross-sectional study was conducted in November 2025 at four early childhood education institutions in Kartasura, Central Java, Indonesia.

2. Population and sample

The study population comprised 237 children aged 4–6 years. Based on the Slovin formula, the minimum required sample size was 70. A total of 87 children were purposively selected and included in the analysis. Participants were excluded if parents failed to complete the ADHD Rating Scale-5 questionnaire and daily records of their children's gadget use.

3. Study variables

ADHD symptoms were measured using the ADHD Rating Scale-5 (ADHDRS-5), which consists of 18 items according to DSM-5 criteria and is divided into two domains: inattention and hyperactivity-impulsivity. Each item is rated on a Likert scale ranging from 0 to 3, with higher scores

indicating greater symptom severity. Validity testing showed that all item correlation coefficients exceeded the r-table value of 0.31, indicating acceptable item validity. The instrument also demonstrated high internal consistency, with a Cronbach's alpha of 0.91. For analytical purposes, cutoff scores for the ADHD Rating Scale-5 Home Version were based on age- and sex-specific norms. Female children with total scores ≥25 and male children with total scores ≥31 was categorized as high-risk or suspected ADHD. The scale's construct validity has been established through confirmatory factor analysis (CFA), and it demonstrates good concurrent and predictive validity in identifying ADHD symptoms (Alhossein et al., 2022)

Screen time exposure duration was assessed using a seven-day diary questionnaire, recording children's daily screen use. The instrument captured all forms of electronic screen exposure, including smartphones, tablets, laptops, computers, and televisions. Each episode of a child's screen use was recorded in the questionnaire, including the start and end times, type of device, presence of parental supervision (co-viewing), and type of content (fast/ interactive or slow/educational). The score represents the level of screen time duration, with higher scores indicating longer durations of screen use

4. Data Analysis

Univariate analysis was performed to describe study variables, including age, sex, ADHD symptom scores, and duration of gadget use. Categorical data were presented as frequencies and percentages, and continous data as means and standard deviations. The association between screen time duration and ADHD symptoms was analyzed using Pearson's correlation coefficient. A p-value <0.05 was considered statistically significant, while a p-value ≥0.05 indicated no statistically significant association.

5. Ethical consideration

This study received ethical approval from the Health Research Ethics Committee of the Faculty of Health Sciences, Universitas Muhammadiyah Surakarta, Central Java, Indonesia (No. 1632/KEPK-FIK/XI/2025), following review in accordance with the seven principles of research ethics established by the World Health Organization (WHO, 2011). Written informed consent was obtained from the parents of participating children prior to data collection.

RESULTS

The study included 87 children aged 4–6 years, with a mean age of 5.01 years. Female participants slightly predominated (54%) compared to males (46%). The average duration of screen time exposure was 0.91 hours/day, ranging from 0.21 to 2.71 hours/day. Most children (65%) had screen time duration of ≤1 hour/day, while 29% were exposed to screen time for more than 1 to 2 hours/day, and only 6% exceeded 2 hours/day (see **Table 1**).

Table 1. Sample characteristics

Children's characteristics	n	%
Age (years old)	Mean= 5.01 (min. = 4 & max. = 6)	
Sex		
Male	40	46
Female	47	54
Duration of screen time (hours)	Mean= 0.91 (min. = 0.21 & max. = 2.71)	
≤ 1 hour/day	57	65
> 1 – ≤ 2 hours/day	25	29

Children's characteristics	n	%
> 2 hours/day	5	6
ADHD Symptoms (score)	Mean = 12.84 (min. = 0 & max. = 33)	
No risk	5	5.8
Low risk	53	60.9
Moderate risk	20	23
Serious risk	9	10.3

The mean ADHD symptom score was 12.84, with scores ranging from 0 to 33. Most children were categorized as having low risk of ADHD symptoms (60.9%), followed by moderate risk (23%) and serious risk (10.3%). Only 5.8% of children were classified as having no risk of ADHD symptoms. These findings indicate that although the majority of children had relatively limited screen time exposure, a considerable proportion still exhibited moderate to serious levels of ADHD related symptoms.

Most children used a combination of smartphones and televisions for screen exposure (48.28%), followed by smartphones alone (32.18%). Television only use accounted for 12.64%, while the use of tablets, laptops, or mixed devices was relatively uncommon. Regarding screen time duration, the majority of children (65.52%) were exposed to screens for ≤1 hour/day, whereas 34.48% had screen exposure exceeding 1 hour/day (see **Table 2**).

In terms of content viewed, nearly half of the children (49.43%) mainly watched educational or slow tempo content, such as learning videos, children's songs, and educational cartoons. Fast paced or action entertainment content was reported in 29.89% of children, while smaller proportions were exposed to mixed educational and entertainment content (14.94%) or social/communication related use (2.30%).

Parental guidance during screen time was relatively common, with 52.87% of parents always accompanying their children during screen use and 43.68% sometimes providing supervision. Only 3.45% of children used gadgets without parental accompaniment. These findings suggest that smartphones and televisions were the dominant sources of screen exposure, educational content was the most frequently accessed type of media, and parental involvement during children's screen use was generally high.

Table 2. Analysis of screen time duration

Screen time component measurement	Characteristics	n	%
Types of Gadgets	Smartphone	28	32.18
	Tablet/iPad	4	4.60
	Television	11	12.64
	Smartphone and Television	42	48.28
	Smartphones and Laptops	1	1.15
	PC tablet and Television	1	1.15
Screen time duration	≤ 1 hour/day	57	65.52
	> 1 hour/day	30	34.48

Screen time component measurement	Characteristics	n	%
Content watched	Educational / slow tempo: learning videos, children's songs, letter/number learning content, slow motion cartoons.	43	49.43
	Fast-paced/action entertainment: fast-paced cartoons, action videos, TikTok, YouTube Shorts, games.	26	29.89
	Social / communication: video calls, family chats, voice calls.	2	2.30
	Educational and Entertainment	13	14.94
	Education, Entertainment, Social/ Communication	3	3.45
Parental guidance during screen time	Always	46	52.87
	Sometimes	38	43.68
	Not accompanying	3	3.45

The distribution of ADHD symptom categories varied across screen time duration groups (see **Table 3**). Among children with screen time ≤1 hour/day, the majority were classified as having low risk ADHD symptoms (73.7%), while only 3.5% were categorized as serious risk. In contrast, among children with screen time >1 to ≤2 hours/day, the proportion of low risk decreased to 36.0%, whereas moderate risk and serious risk increased to 32.0% and 20.0%, respectively.

Children with screen time >2 hours/ day showed the highest proportion of serious risk ADHD symptoms (40.0%), while none were categorized as having no risk. These findings suggest a trend in which longer screen time duration is associated with greater severity of ADHD related symptoms among children aged 4–6 years.

Table 3. Distribution of ADHD symptom characteristics based on duration of screen time

Screen time duration	ADHD Symptoms							
	Serious risk		Moderate risk		Low Risk		No risk	
	n	%	n	%	n	%	n	%
≤ 1 hour/day	2	3.50	11	19.3	42	73.7	2	3.5
> 1 – ≤ 2 hours/day	5	20.0	8	32.0	9	36.0	3	12
> 2 hours/day	2	40.0	1	20.0	2	40.0	0	0

Pearson's correlation analysis in Table 9 demonstrated a moderate positive association between screen time duration and ADHD symptom scores (r = 0.35, p = 0.001). This finding indicates that increased screen time duration is significantly associated with higher ADHD symptom severity.

Table 4. Pearson Correlation Analysis Between Screen Time Duration and ADHD Symptoms

Independent variable	r	p
Screen time duration (hour)	0.35	0.001

RESULTS

This study found a statistically significant positive correlation between screen time duration and ADHD symptoms among children aged 4–6 years (r= 0.35; p= 0.001), indicating that longer screen exposure was associated with higher levels of ADHD related symptoms. These findings are important from a public health perspective, considering the rapid increase in digital media use among young children worldwide. The widespread accessibility of smartphones, tablets, televisions, and internet-based entertainment has substantially increased children's daily screen exposure, particularly during the early developmental period. Excessive screen time in preschool children has therefore emerged as a growing public health concern due to its potential impact on cognitive, behavioral, emotional, and psychosocial development.

The findings of this study are consistent with previous evidence suggesting that prolonged digital media exposure may negatively affect attention regulation and impulse control during early childhood. Elena and Martin (2025) reported that higher screen time among preschool children was associated with emotional dysregulation and impaired attention capacity, while Baumgartner et al. (2022) found that intensive media exposure may promote multitasking behaviours that reduce sustained attention and increase distractibility. Given that ADHD related symptoms in early childhood may persist into adolescence and adulthood, prolonged screen exposure may contribute to long term developmental and educational challenges if not addressed appropriately.

One potential mechanism underlying this association is visual and auditory hyperstimulation caused by rapidly changing images, bright colors, intense sounds, and immediate reward systems commonly found in digital media. Such stimulation may condition children to prefer rapid and highly stimulating input, potentially affecting the maturation of executive functions and self-regulatory abilities. Repeated exposure to fast paced digital content may reduce children's tolerance for slower activities requiring concentration and patience, thereby increasing inattentive and impulsive behaviors. Chen et al. (2023) further suggested that excessive screen exposure may interfere with inhibitory control development through alterations in fronto striatal connectivity, which plays a central role in behavioral regulation.

Fast paced digital content, including short videos, advertisements, and interactive games, may also overload attentional systems and reinforce sensation seeking tendencies. Wallace et al. (2023) stated that even brief exposure to high-speed media content can impair executive functioning, particularly sustained attention and impulse control. In the context of public health, these findings are concerning because impaired self-regulation and attentional difficulties during preschool years may negatively influence school readiness, academic performance, social interaction, and mental health outcomes later in life.

Despite the statistically significant association observed in this study, the correlation strength was relatively weak (r = 0.35), indicating that screen time duration represents only one component of a broader and multifactorial pathway contributing to ADHD symptoms. ADHD is influenced by complex interactions among genetic, biological, psychological, and environmental factors. Genetic predisposition, parenting practices, sleep quality, nutritional status, physical activity, psychosocial environment, parental mental health, and prenatal factors may also substantially influence children's behavioral development. Therefore, screen

exposure should be viewed as a modifiable environmental risk factor rather than the sole determinant of ADHD related symptoms.

From a public health standpoint, the findings highlight the importance of early preventive strategies to promote healthy digital habits among children and families. Parents, healthcare providers, educators, and policymakers should work collaboratively to encourage age-appropriate screen use, increase parental supervision, and promote balanced daily activities that include active play, social interaction, reading, and adequate sleep.

We acknowledge that this study has several strengths. First, it addresses an important and timely public health issue regarding the association between screen time exposure and ADHD related symptoms among preschool children. Second, the study used a structured seven-day diary questionnaire that captured multiple dimensions of screen exposure, including duration, type of device, content viewed, and parental supervision. Third, the sample size was adequate to support the statistical analysis and enhance the reliability of the findings. In addition, the study contributes evidence from an Indonesian setting, where data on screen time and behavioral outcomes in young children remain limited.

However, several limitations should be considered when interpreting the findings. As this was a cross-sectional study involving children aged 4–6 years, causal relationships between screen time exposure and ADHD symptoms cannot be established due to the simultaneous measurement of exposure and outcome variables. There is also a possibility of selection bias because participants were recruited from limited educational settings and may not fully represent the broader population of preschool children.

Information bias may have occurred because screen time exposure was assessed using a seven-day diary questionnaire completed by parents or caregivers. Although the instrument was relatively comprehensive, self-reported recording may introduce recall bias, social desirability bias, and inaccurate estimation of children's actual screen exposure. Parents may under-report screen duration or inconsistently record screen use episodes, particularly when children use multiple devices simultaneously or intermittently throughout the day. In addition, the categorization of content type such as "fast paced/interactive" or "slow paced/educational" may be subjective and vary across respondents, potentially affecting measurement consistency.

Furthermore, several unmeasured confounding factors related to ADHD risk may have influenced the observed associations, including family history of ADHD or other neurodevelopmental disorders, parenting style, sleep quality and duration, prenatal and perinatal factors, nutritional status, physical activity, psychosocial environment, parental mental health, and socioeconomic conditions. These factors may independently affect both screen time exposure and ADHD related symptoms, potentially leading to residual confounding. Future longitudinal studies with more representative samples and objective measurements of screen exposure are recommended to better clarify the direction and magnitude of these associations.

Given these limitations, future studies are recommended to use longitudinal or prospective cohort designs to better clarify the temporal and causal relationship between screen time exposure and ADHD related symptoms in children. In addition, future research should consider using more objective methods for measuring screen

exposure, such as digital tracking applications or device usage logs, to reduce recall and reporting bias. It is also important for future research to account for additional confounding factors associated with ADHD risk. Intervention based studies examining strategies to reduce excessive screen time and promote healthy digital habits among preschool children are also recommended to support evidence based public health policies and parenting guidance.

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AUTHOR CONTRIBUTIONS

Adnan Faris Naufal: Conceptualization, methodology, supervision, data analysis, writing – original draft, and final approval of the manuscript.

Anida Azkia Fitri: Data curation, investigation, writing – review and editing, and final approval of the manuscript.

Arif Pristianto: Methodology, validation, supervision, writing – review and editing, and final approval of the manuscript.

Laura Kirana: Data collection, formal analysis, visualization, writing – original draft preparation, and final approval of the manuscript.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest related to this study. All research activities were conducted independently, and the funding sources had no involvement in the study design, data collection, analysis, interpretation of data, or the decision to publish the results.

REFERENCES

Alhossein A, Abaoud AA, Becker D, Aldabas R, Bakhiet SF, Al-Jaffal M, Alsufyani M, Elrahim NMA, Alzrayer N (2022). Psychometric Properties of ADHD Rating Scale—5 for Children and Adolescents in Sudan—School Version. Front Psychol. 13:883578. https://doi.org/10.3389/fpsyg.2022.883578.

Baumgartner SE (2022). The effects of digital media and media multitasking on attention problems and sleep. In J. Nesi, E. H. Telzer, & M. J. Prinstein (Eds.), Handbook of Adolescent Digital Media Use and Mental Health (pp. 317-337). Cambridge University Press. https://doi.org/10.1017/9781108976237.017.

Chen Y, Yim H, Lee T (2023). Negative impact of daily screen use on inhibitory control network in preadolescence: A two-year follow-up study. Dev Cogn Neurosci. 60: 101218. https://doi.org/10.1016/j.dcn.2023.101218

Christakis DA, Ramirez JSB, Ferguson SM, Ravinder S, Ramirez JM (2018). How early media exposure may affect cognitive function: A review of results from observations in humans and experiments in mice. Proc Natl Acad Sci U S A. 115(40):9851–9858. https://doi.org/10.1073/pnas.1711548115.

Claussen AH, Holbrook JR, Hutchins HJ, Robinson LR, Bloomfield J, Meng L, et al. (2022). All in the family? A systematic review and meta-analysis

of parenting and family environment as risk factors for attention-deficit/-hyperactivity disorder (ADHD) in children. Prev Sci. 23(6):1040–1058. https://doi.org/10.1007/s11121-022-01358-4.

Faraone SV (2019). The pharmacology of attention deficit hyperactivity disorder. Mol Psychiatry. 24(4): 562–575. https://doi.org/10.1038/s41380-018-0070-0.

Gunawan R, Aulia S, Supeno H, Wijanarko A, Uwiringiyimana JP, Mahayana D (2021). Adiksi media sosial dan gadget bagi pengguna internet di Indonesia. Techno-Socio Ekon. 14(1):1–14. https://doi.org/10.32897/techno.2021.14.1.544.

Hinkley T, Brown H, Carson V, Teychenne M (2018). Cross sectional associations of screen time and outdoor play with social skills in preschool children. PLoS One. 13(4):1–15. https://doi.org-/10.1371/journal.pone.0193700.

Jia W, Deng X, Zeng H (2025). The association between screen exposure and social–emotional development in children and adolescents: A meta-analysis. Acta Psychologica. 261: 105818. https://doi.org/10.1016/j.actpsy.2025.105818.

Khanani MI, Khan MR, Farooqi MF, Fazal J, Aabideen Z, Alkuwaiti NS (2025). Digital media use and screen time exposure among youths: A lifestyle-based public health concern. Cureus. 17(7):e88373. https://doi.org/10.77-59/cureus.88373.

Liu J, Riesch S, Tien J, Lipman T, Pinto-Martin J, O'Sullivan A (2022). Screen media overuse and associated physical, cognitive, and emotional/behavioral outcomes in children and adolescents: an integrative review. J Pediatr Health Care. 36:99–109. https://doi.org/10.1016/j.pedhc.2021.06.003.

Madigan S, Browne D, Racine N, Mori C, Tough S (2019). Association between screen time and children's performance on a developmental screening test. JAMA Pediatr. 173(3): 244–250. https://doi.org/10.1001/jamapediatrics.2018.5056.

Muppalla SK, Vuppalapati S, Pulliahgaru AR, Sreenivasulu H (2023). Effects of excessive screen time on child development: An updated review and strategies for management. Cureus. 15(6):e40608. https://doi.org/10.77-59/cureus.40608.

Naufal AF, Safitri EF, Nurulinsani A, Putri H, Darojati I (2023). Hubungan durasi penggunaan gadget terhadap gejala attention deficit hyperactivity disorder (ADHD). Jurnal Kesehatan Masyarakat. 4(2): 152–160. https://10.0.93.-109/fisiomu.v4i2.22133.

Nurhidayah I, Salsabilla T, Hastuti EA (2026). Screen time matters: The impact of screen time on the risk of personal–social development outcomes among preschool children in Indonesia: A cross-sectional study. J Multidiscip Healthc. 19:582301. https://doi.org/10.2147/JMDH.S582301.

Oswald TK, Rumbold AR, Kedzior SG, Moore VM (2020). Psychological impacts of "screen time" and "green time" for children and adolescents: a systematic scoping review. PLoS One. 15:0. https://doi.org/10.1371/journal-.pone.0237725.

Sciberras E, Mulraney M, Silva D, Coghill D (2017). Prenatal risk factors and the etiology of ADHD: Review of existing evidence. Curr Psychiatr Rep. 19(1):1. https://doi.org/10.1007/s11920-017-0753-2.

Wallace J, Boers E, Ouellet J, Afzali MH, Conrod P (2023). Screen time, impulsivity, neuropsychological functions and their relationship to growth in adolescent attention-deficit/hyperactivity disorder symptoms. Sci Rep. 13:44105. https://doi.org/10.1038/-s41598-023-44105-7.

World Health Organization (WHO) (2019). Guidelines on physical activity, sedentary behaviour and sleep. Retrieved from https://iris.who.int/-server/api/core/bitstreams/bfce7d1e-43d8-4e28-ba1b-8f6cf9da2661/-content on April 21, 2026.