

Screen time and effects on attention deficient hyperactivity disorder in children - A systematic review



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ABSTRACT

In recent years, screen time exposure and attention-deficit hyperactivity disorder (ADHD) symptom interrelations in children have garnered increasing attention. Understanding the screen time's impact on ADHD has become crucial due to its potential influence on socialization, neurobehavioral development, and the prevalence of ADHD among pediatric populations. Conforming to the guidelines of the preferred reporting items for systematic reviews and meta-analyses, a systematic examination was undertaken, centering on research investigating the correlation between screen time and ADHD symptoms in children. The search encompassed databases including MEDLINE (through PubMed), ScienceDirect, Wiley online library, PsycINFO, ERIC, JSTOR, and PsycArticles, utilizing descriptors such as "screen time" and "attention-deficit hyperactivity disorder." The initial search yielded 2480 articles, supplemented by an additional 10 articles from reference searches, resulting in a total of 2480 records. Excluding the duplicates, 1590 articles were screened based on abstracts, of which 130 underwent full-text examination. Ultimately, 15 studies included in this review met the inclusion criteria. These studies, conducted between 2013 and 2023, comprised cross-sectional, longitudinal, and interventional designs, presenting varying associations between screen time and ADHD symptoms across different age groups. The findings from the selected studies depict a complex relationship between screen time exposure and ADHD symptoms in children. While some studies highlight significant correlations between increased screen exposure and ADHD symptoms, others present conflicting results, indicating the need for further research. Understanding these nuances is crucial in formulating targeted interventions and delineating clearer guidelines to manage screen time concerning ADHD in children.

Key words: Screen time; Attention-deficit hyperactivity disorder symptoms; Multimedia exposure; Sociobehavioral aspects; Media exposure

INTRODUCTION

Screen time refers to the duration devoted to sedentary activities such as watching television, engaging in gaming activities, and utilizing computers and smartphones. As per the guidelines established by the American academy of pediatrics, children above 2 years of age should limit their screen time to <1 h daily. In addition, the World Health Organization guidelines advise against any screen exposure for children under 2 years old, and for children aged 2–4 years, screen time should not exceed 1 h.¹ Excessive

sedentary and isolated screen time diminishes opportunities for peer interaction, leading to a decrease in socialization and the cultivation of essential social skills. This further exacerbates challenges for a population already facing vulnerabilities, amplifying negative outcomes.²

Attention-deficit hyperactivity disorder (ADHD) is the most frequently occurring psychiatric condition and exhibits around 7.2% of an estimated global prevalence among the pediatric population.³ Frequently, it impacts an individual's academic performance and interactions within

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peer groups, correlating with heightened susceptibility to unfavorable life occurrences, including engagement in antisocial behavior and the use of illicit substances.⁴

The link between screen time and ADHD in children has become a prominent research area, generating widespread interest in its potential impact. Research suggests a correlation between screen time in school-age children and teenagers and problems with focus, impulsivity, and organization, which are all symptoms of ADHD.⁵ According to research examining sedentary behavior in adolescents, screen time is suggested as a potential risk factor for ADHD symptoms.⁶ Decades of research, analyzed in a major review, suggest a potential link between increased screen time and children exhibiting hyperactive behavior. However, the strength of this association is still considered relatively small.⁷ Hyperactive behaviors represent the primary clinical indications of ADHD⁸ and stand as prevalent neurobehavioral challenges in 3-year-old children. Furthermore, these behaviors impose a considerable long-term financial strain on both families and the wider society.⁹ These hyperactive tendencies often manifest early in childhood and may persist into adulthood, potentially leading to enduring functional impairments without adequate intervention or preventative measures.¹⁰ While the precise origins of hyperactive behaviors remain elusive, numerous epidemiological studies have indicated a link between these behaviors and prenatal exposure to environmental factors. Over the past two decades, the proliferation of screen options has been substantial, raising concerns regarding the potential adverse effects of screen time on mental health.^{11,12}

Distinct from prior systematic reviews that have investigated either ADHD or screen time in isolation, this review specifically centers on synthesizing existing evidence concerning the relationship between screen time exposure and the manifestation/severity of ADHD symptoms in children. This systematic review aims to comprehensively evaluate and synthesize existing evidence concerning the effects of screen time exposure on ADHD in children. By examining a range of studies encompassing diverse methodologies and age groups, this review endeavors to elucidate the relationship between screen time and ADHD, discern potential causal links or correlations, and address conflicting findings.

Aim

To investigate the relationship between screen time and attention deficit hyperactivity disorder (ADHD) in children through a comprehensive systematic review of existing literature.

Objectives

- To analyze the current body of research on the association between screen time and ADHD symptoms in children.

- To identify potential mechanisms underlying the link between screen time and ADHD.

MATERIALS AND METHODS

This review adheres to the established preferred reporting items for systematic reviews and meta-analyses framework, enhancing transparency and clarity in presenting the findings.

Literature search

A search across MEDLINE (PubMed), ScienceDirect, and Wiley Online Library focused on screen time and its effects on children with ADHD. The search also includes databases such as PsycINFO, ERIC, JSTOR, and PsycArticles. The descriptors used were “screen time” and “attention-deficient hyperactivity disorder”. The following connectors (screen time) attention-deficient hyperactivity disorder (AND) and OR (screen time and its effects) were used during the database search.

Eligibility criteria

Multiple eligibility criteria were considered before deciding on the pivotal inclusion and exclusion criteria. Only the articles that passed the inclusion criterion were selected for final review. No ethical approval was taken for this systematic review.

Inclusion criteria

1. Articles written in English
2. Human-based studies
3. Publications done between the time frame of 2013 and 2023
4. Articles having information about screen time and its effects on attention-deficient hyperactivity disorder in children.

Exclusion criteria

1. Non-English and regional language articles
2. Studies with insufficient information (e.g., abstract, editorial as well as comment)
3. Segments from books
4. Studies showing information only about screen time or ADHD.

Statistical analysis

According to the Cochrane review criteria, the tool RevMan 5.4.1 was used in this study to assess the risk of bias (Higgins 2011). The two-part tool addressed six key domains. Tables titled “Risk of Bias” were included for each domain. An entry for a study usually starts with a summary of what was said to have occurred while conducting the study. Second, the tool allows users to rate the bias risk of an entry as either low, unclear, or high.

RESULTS

Study selection

The current systematic review obtained 2480 articles from its initial search, and some extra records, i.e., 10 articles, were discovered through reference searches. After an initial search, 900 duplicate/triplicate publications were excluded. The titles and abstracts of 1590 publications underwent initial screening, resulting in the exclusion of 1460 due to incomplete data or irrelevance to the current study.

Subsequently, 130 articles met the inclusion criteria and underwent full-text scrutiny. Of these, 120 were discarded as they were not in English. Following meticulous screening and analysis, 15 studies were deemed suitable for inclusion in this systematic review (Figure 1). These studies were published between 2013 and 2023.

Study characteristics

Out of 15 studies included, 8 were cross-sectional studies, 3 were a longitudinal cohort study, 1 was a single group

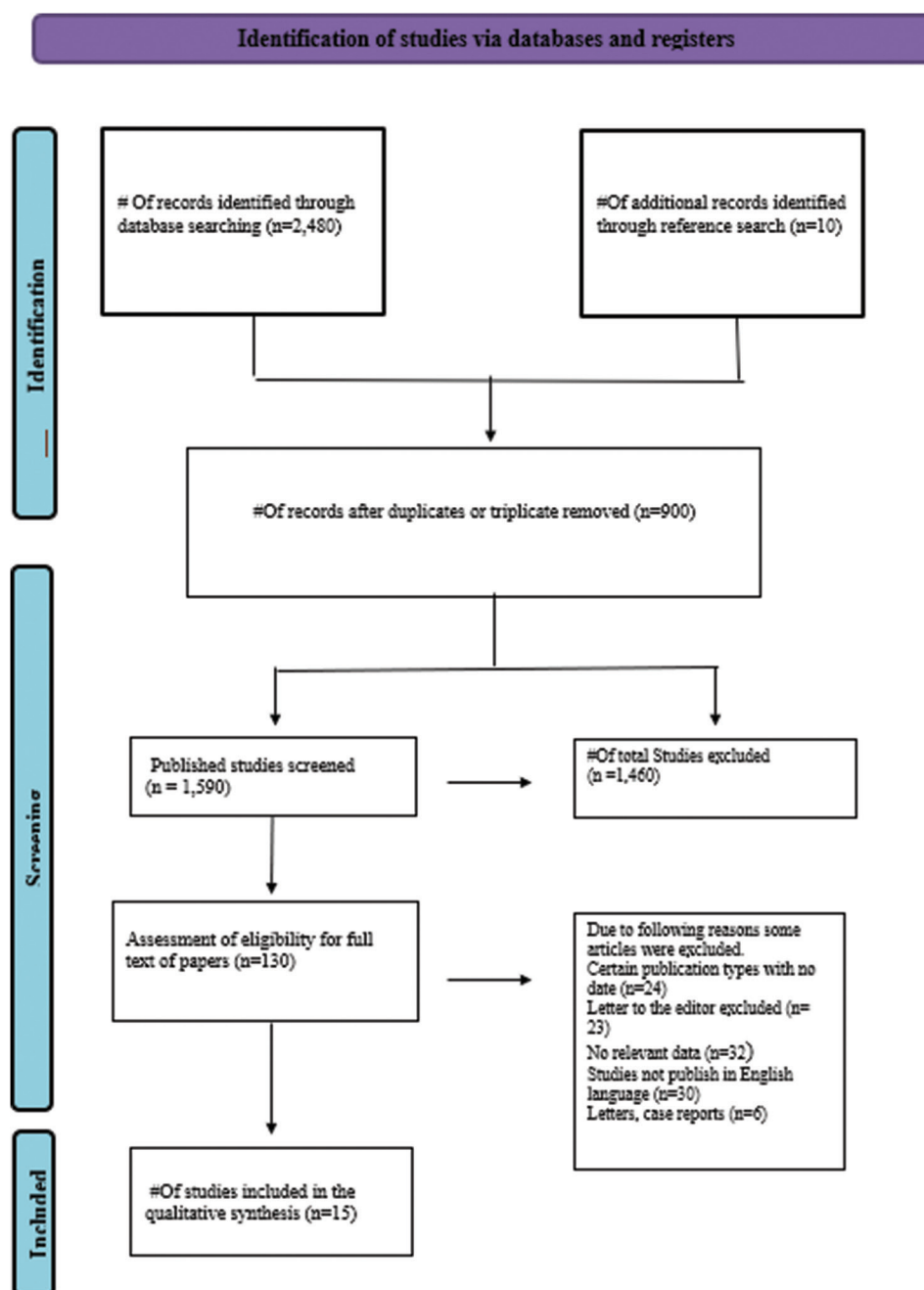


Figure 1: Preferred reporting items for systematic reviews and meta-analyses flow diagram for new systematic reviews which included searches of databases and registers only

Table 1: Data extraction table

S. no	Author/Year	Study design	Total participants	Age	Definition of screen time	ADHD diagnosis	Outcomes of study	Conclusion
1	Zhou et al., 2023 ¹³	Cross-sectional survey	2452 individuals surveyed	Preschool children	Not explicitly defined	Conners child behavior scale	Significant correlation between screen time and ADHD symptoms in preschool children	While this study hints at a potential link between screen time and ADHD, more robust evidence is crucial to guide policymakers in crafting effective recommendations
2	Shih et al., 2023 ¹⁴	Population-based birth cohort study	24,200 mother-child pairs at recruitment	6 months–8 years	Screen time for children and parents at 18 and 36 months	Diagnosed at follow-up interview at age 8	-Association between familial screen time and ADHD incidence -Impact of socioeconomic factors on ADHD incidence	Maternal screen time at age 3 is linked to increased ADHD incidence, further research is needed for validation and understanding of underlying mechanisms
3	Wallace et al., 2023 ¹⁵	Longitudinal cohort study	Nearly 4000 Canadian high school students	High school students (age not specified)	Relationship between screen time (including social media, television, video games, and computer use) and ADHD symptoms, influenced by behavioral and neuropsychological factors	Direct and indirect effects of screens on ADHD symptoms across individuals, concurrent effects within individuals, and lagged effects within individuals	Increased screen time within a year directly correlated with worse ADHD symptoms, suggesting a potential cause-and-effect link	These results hold clinical significance for screen time and underscore its importance in addressing and preventing ADHD symptoms among adolescents
4	Qu et al., 2023 ¹⁶	cross-sectional study	101,350 children	0–17 years old	Screen time on weekdays reported by parents/caregivers	logistic regression models	Excessive screen time among children aged 0–17 is linked to a range of developmental and behavioral issues, including ADHD	Urgent intervention to regulate digital media use is essential for mitigating the risks of ADHD
5	Yang et al., 2022 ¹⁷	Cross-sectionally and longitudinal study	11,000+children	9–11 years	Utilization of screen time	Polygenic risk scores for ADHD, ADHD traits, and ADHD symptoms assessed in participants	Children with higher ADHD polygenic risk scores show longer screen time and more severe ADHD symptoms	The study reveals shared neural overlaps between ADHD symptoms and prolonged screen time, highlighting the role of polygenic risk and the ADHD trait in the relationship with screen time

(Contd...)

Table 1: (Continued)

S. no	Author/Year	Study design	Total participants	Age	Definition of screen time	ADHD diagnosis	Outcomes of study	Conclusion
6	Wu et al., 2022 ¹⁸	Cross-sectional study	42,841 children from Longhua District, Shenzhen	>3-year	Children's annual screen time since birth	Hyperactive behaviors (Conners Parental Symptom Questionnaire)	Kids with early screen time may be at higher risk for hyperactive behaviors	Early screen exposure associated with hyperactive behaviors, intervention importance
7	Khalil et al., 2022 ¹⁹	Cross-sectional study	69 children (30 typically developing, 39 with ADHD)		Multimedia exposure, its association with ADHD severity and children's behaviors	questionnaire in Arabic designed to examine how the severity of ADHD correlates with children's level of exposure to multimedia	Children with mild ADHD demonstrated a noteworthy increase in their engagement with children's programs, cartoons, rhymes, and commercials compared to those with moderate and severe ADHD	A specially designed Arabic questionnaire, rigorously assessed for reliability and validity, shed light on the relationship between multimedia usage and ADHD
8	Zhao et al., 2022 ²⁰	Prospective birth cohort study	152 mother-offspring dyads	6-72 months	Continued low, late increasing, early increasing	Wechsler Intelligence Scale, Strengths and Difficulties Questionnaire	Children with late or early increasing screen time trajectories exhibited lower cognitive development scores and higher total difficulties scores compared to those with continued low screen time trajectories	Excessive screen time during early childhood is linked to poorer cognitive and social-emotional development, emphasizing the importance of monitoring and limiting children's screen time from an early age
9	Levelink et al., 2021 ²¹	Longitudinal cohort study	2768 mother-child pairs	8-10 years	Recreational screen time		Neither screen time nor sleep was associated with ADHD	Caution is advised when interpreting cross-sectional associations in early childhood with later ADHD diagnosis
10	Vaidyanathan et al., 2021 ⁰¹	Cross-sectional study	56 Children	2.5-6 years	Total duration of screen exposure, types of screen-based devices used, reasons for screen exposure	ADHD diagnosed	Increased screen time may be linked to worsened ADHD symptoms and higher parental stress levels	Structured parent training programs and interventions needed to curtail screen time exposure in preschool children with ADHD and address parental stress levels
11	Thoma et al., 2020 ²²	Case-community-based study	418 (375 healthy, 61 children)	12.72±2.83 years	Utilization of screen-based media		ADHD individuals reported delayed sleep and increased screen time. Adolescents with ADHD showed behaviors favoring delayed sleep	Longer media exposure and poor sleep routines raised ADHD-like symptom risks, highlighting the need for objective assessment and future interventions

(Contd...)

Table 1: (Continued)

S. no	Author/Year	Study design	Total participants	Age	Definition of screen time	ADHD diagnosis	Outcomes of study	Conclusion
12	Hill et al., 2020 ²³	Observational study	120 children	36 months	Utilization of video-based media viewing	Participants categorized into ASD (n=20), ADHD Concerns (elevated ADHD symptoms; n=14), or Comparison (n=86) groups ADHD diagnosed	Improvement in ADHD symptoms after educational intervention	Highlights a relationship between time and lower language development scores across different diagnostic groups
13	Starks, 2019 ²⁴	Single group pre-test, post-test interventional study	Parents/guardians of 30 school-aged children diagnosed with ADHD	5–12 years	screen time exposure on daily basis	ADHD diagnosed	Improvement in ADHD symptoms after educational intervention	Educational intervention associated with decreased parent-reported television exposure in school-aged children with ADHD, potential for improving ADHD symptoms through non-pharmacological interventions
14	Nikkelen et al., 2015 ²⁵		865 Dutch children aged 3–7 years	3–7 years	Screen time was evaluated through parents' reports on their children's television viewing habits, encompassing both overall screen time and specific content categories (violent/scary and educational)	ADHD-related behaviors were measured using surveys completed by parents, providing insights into the children's tendencies related to attention deficit hyperactivity disorder	ADHD behaviors showed no ties to overall TV or violent content viewing but were influenced by gender. Educational content viewing didn't correlate with ADHD behaviors	ADHD-related behaviors in children aged 3–7 are not universally associated with television viewing patterns. The moderation effect of sex is noteworthy, revealing specific links between ADHD-related behaviors and television habits, primarily for boys
15	Lo et al., 2015 ²⁶	Cross-sectional study	7024 youth with ADD/ADHD	6–17 years	Bedroom TV Presence and its association with Screenshot	Physician's diagnosis of ADD/ADHD (parent/guardian-reported)	Association of bedroom TV with daily screen time	More research needed on bedroom TVs and ADD/ADHD

ADHD: Attention-deficit hyperactivity disorder, ADD: Attention-deficit disorder

pre-test, post-test interventional study, and the remaining was a population-based birth cohort study. Many articles between the period of 2013 and 2023 collectively highlight varying associations between screen time and ADHD across different age groups, suggesting correlations and some potential causative relationships. All these attributes are summarized in Table 1.

Comprehensive insights from multiple studies on screen time and ADHD correlations

The collective studies on screen time and ADHD convey a complex relationship, showcasing correlations between increased screen exposure and ADHD symptoms across different age groups, yet yielding varied and nuanced findings.

While Zhou et al.,¹³ highlight significant associations between screen time and ADHD symptoms, particularly in preschool children, Shih et al.,¹⁴ emphasize the impact of maternal screen time during early childhood on later ADHD incidence. Nevertheless, Wallace et al.,¹⁵ and Levelink et al.,²¹ present conflicting longitudinal results, suggesting no direct link between early screen exposure and subsequent ADHD development. Specific content viewing and media usage also emerge as pivotal factors in ADHD severity, as suggested by Khalil et al.¹⁹ These collective findings underscore the pressing need for tailored interventions, parental education programs, and further comprehensive research by Vaidyanathan et al.,¹ Starks,²⁴ and Nikkelen et al.,²⁵ aiming to uncover causative mechanisms, discern the impact of diverse screen content, and establish clearer guidelines for managing screen time, particularly concerning ADHD.

Risk of bias in individual studies

Key domains including selection bias (random sequence generation and allocation concealment), performance bias (blinding), detection bias (assessor blinding), attrition bias (incomplete outcome data), and reporting bias (selective reporting) were pivotal in assessing and categorizing the overall bias as high, unclear, or low risk. Utilizing these domains and corresponding criteria, individual studies were categorized as presenting low, unclear, or high risk. Figure 2 displays the probability of bias among the 15 literatures analyzed for the present study. In this review, in 61.33% of the trials, randomization was with low risk, blinding of outcome assessors was high in 9.33% of trials, and the risk was clear in 29.33% of the trials (Figure 3).

DISCUSSION

This systematic review investigated the complex relationship between screen time exposure and ADHD symptoms in

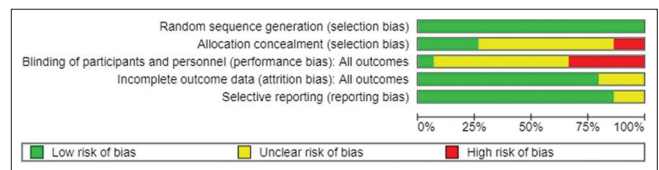


Figure 2: The authors' conclusions for each item of risk of bias for each incorporated study are summarized in the risk of bias review

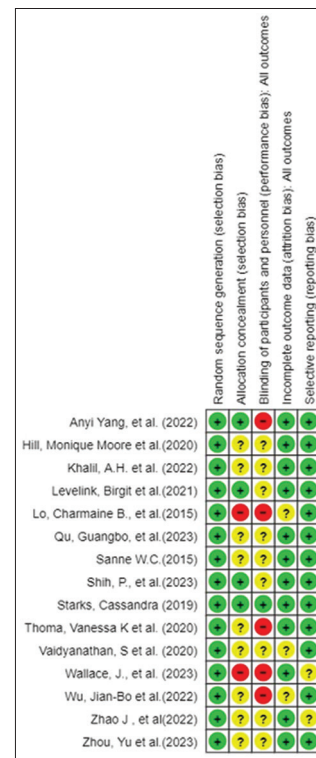


Figure 3: Author's assessments of each item of bias risk are expressed as percentages for all involved papers in the risk of bias graph review

children, analyzing 15 studies published between 2013 and 2023. This review offers a comprehensive evaluation of recent studies encompassing diverse age groups, methodologies, and screen content types. Several studies highlight correlations between increased screen time and ADHD symptoms, with preschoolers and young children exhibiting potential vulnerability. While some studies highlight significant correlations between screen time and ADHD symptoms, others emphasize the importance of considering factors such as maternal screen time, genetic predisposition, and socioeconomic status.

A study by Cheng et al.,²⁷ revealed a positive connection between ADHD symptoms observed at 30 months of age and the amount of time spent watching television at 18 months. Conversely, the study also showed a negative link between prosocial behavior and TV viewing time, even after adjusting for other factors. However, when assessing the strength and difficulty questionnaire subscale at 30 months, there was not a notable difference based on

the daily duration of TV watching. This study aligns with our findings, indicating that the impact of screen time on hyperactive behaviors is sensitive during developmental stages.

Zhou et al.,¹³ and Wu et al.,¹⁸ explored the associations between screen exposure and ADHD symptoms in preschoolers and hyperactive behaviors, respectively. According to Qu et al.,¹⁶ excessive screen time among children aged 0–17 is linked to developmental and behavioral issues, including ADHD.

Shih et al.'s¹⁴ study emphasizes the impact of maternal screen time during early childhood on later ADHD incidence, suggesting a potential intergenerational influence. This finding adds a new layer to the screen time-ADHD relationship, warranting further research.

Longitudinal studies suggest that excessive screen time during early childhood may lead to poorer cognitive and social-emotional development, underscoring the need for intervention and monitoring from an early age. Studies by Wallace et al.,¹⁵ Yang et al.,¹⁷ and Levelink et al.,²¹ present conflicting longitudinal findings, questioning a direct link between early screen exposure and subsequent ADHD development. These discrepancies suggest the need for larger, long-term studies with stricter controls.

Vaidyanathan et al.,¹ Starks,²⁴ and Nikkelen et al.,²⁵ emphasize the need for tailored interventions, parental education programs, and comprehensive research to understand underlying mechanisms, differentiate content effects, and establish clear screen time management guidelines, particularly for children with ADHD.

Overall, this review reinforces the need for a multifaceted approach to understanding the screen time-ADHD relationship, considering individual vulnerabilities, content, and potential interventions.

Limitations of the study

1. Varied methodologies utilized across the selected studies may impact result interpretation
2. Potential biases, including selection bias or measurement biases, could affect the validity of the conclusions
3. Discrepancies in findings among the studies may hinder the generalizability of the overall results.

CONCLUSION

This systematic review offers insights into the intricate relationship between screen time exposure and ADHD symptoms in children, encompassing studies from 2013 to 2023. The review highlights potential correlations between

increased screen time and ADHD symptoms, especially among preschoolers and young children.

Notably, conflicting findings in some longitudinal studies underscore the necessity for more extensive, longer-term investigations to understand this relationship better. The influence of maternal screen time on later ADHD incidence suggests an intergenerational aspect deserving further exploration.

The review emphasizes the importance of tailored interventions, parental education, and comprehensive research to comprehend underlying mechanisms, differentiate content effects, and establish clearer screen time management guidelines, particularly for children with ADHD.

Despite the limitations of varied methodologies and discrepancies in findings among studies, this review contributes to a comprehensive understanding of the screen time-ADHD relationship. Future research endeavors should focus on addressing these limitations and exploring practical implications for clinical practice and policy development.

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AG- Conceptualized and designed the study, literature search, prepared first draft of the manuscript, critical revision of the manuscript; **MISK-** Conceptualized the study, Interpretation, critical revision of the manuscript; **RO-** Concept of the study, literature search, review of the study.

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