Pacific Journal of Health

Volume 6 | Issue 1 Article 14

2023

Effects of Screen Time on Children's Brain Development: A Scoping Review

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Recommended Citation

Jannesar, Niloofar; Davenport, Todd E.; and Gietzen, Lindsay (2023) "Effects of Screen Time on Children's Brain Development: A Scoping Review," *Pacific Journal of Health*: Vol. 6: Iss. 1, Article 14.
DOI: https://doi.org/10.56031/2576-215X.1052
Available at: https://scholarlycommons.pacific.edu/pjh/vol6/iss1/14

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Abstract

In this scoping review, the effects of screen time on cognitive, linguistic, and social-emotional development in children were studied by examining peer-reviewed articles published between 2018 and 2023. A total of 17 peer-reviewed articles were used in the study. The research reported that screen media provide a learning avenue, though it could be detrimental when children spend their time watching more than appropriate screen media. Furthermore, the study indicated that excessive screen media use may harm children's executive function, which affects academic performance and language development. Related studies have also shown a correlation between excess screen use and problems like obesity, sleep disturbances as well as emotional challenges underscoring the importance of responsible screen practices and parental support. The study also contributes to what parents and educators should do to enable good screen habits in children and further research needs.

Keywords

Media; Screen Times; Child Developmental Domains

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Disclosure: Generative artificial intelligence (ChatGPT 3.5 large language model) was used to copyedit this manuscript according to English language grammar and diction. The final copy was reviewed by all authors to ensure adequate accuracy, validity, and criticality of the presented content.

Abstract

In this scoping review, the effects of screen time on cognitive, linguistic, and social-emotional development in children were studied by examining peer-reviewed articles that were published between 2018 and 2023. A total of 17 peer-reviewed articles were used in the study. The research reported that screen media provide a learning avenue though it could be detrimental when children spend their time watching more than appropriate screen media. Furthermore, the study indicated that excessive screen media use may harm children's executive function, which affects academic performance and language development. Related studies have also shown a correlation between excess screen use and problems like obesity, sleep disturbances as well as emotional challenges underscoring the importance of responsible screen practices and parental support. The study also contributes to what parents and educators should do to enable good screen habits in children and further research needs.

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Introduction

Today, children spend more time on the screens compared to early years. This poses important questions about the impact of this digital immersion on their cognitive, language, and socio-emotional development. To examine the persistent consequences of screen, use in the development of brains in children; taking into account amount of screen hours and various features of development is important. The key question driving our research is: What are the implications of extended digital screen exposure on the cognitive, linguistic, and socio-emotional development in children?

The impact of this research is emphasized since it educates the parents, caregivers, teachers, and policymakers on the major effects of screen exposure on child growth and development in a screen-age world (Przybylski & Weinstein, 2019; Understanding the dangers associated with excessive screen use becomes significant in ensuring that the right policies surrounding children's screen time are created based on age and developmental level. Understanding this study allows teachers to come up with appropriate means that will benefit them while in their learning environments and also address the health problems associated with screen time such as mental and physical health. Policies are also put in place which highlight the need for child digital literacy.

This study's main goal is to perform a thorough analysis of the body of material already in existence in order to establish a thorough knowledge of how children's development is impacted by digital displays. It aims to specifically:

1. Examine the effects of screen time on kids' cognitive capacities, which include executive functioning, memory, attention, and academic achievement.
2. Analyze how children's screen time affects their language development, paying particular attention to vocabulary growth, language proficiency, and communication skills.

3. Examine the connection between screen usage and children's social-emotional growth by evaluating the effects of screen time on behavior patterns, social skills, emotional well-being, and possible mental health hazards.

Method

A systemic review with qualitative literature synthesis was undertaken to evaluate the effects of digital screens on children's brain development. The literature search was conducted using the databases PubMed and EBSCO. The search focused on studies published between January 2018 and December 2023. Key search terms included "Technology," "Screen time," "Child development," "Cognitive development," "Language development," "Social-emotional development," and "Child health." These terms were combined using Boolean operators to refine the search.

This literature review included peer-reviewed articles and systematic reviews published in English and focusing on cognitive, linguistic, or social-emotional development among children 0-18 years old regarding the impact of screen time. Non-peer-reviewed articles such as editorials or commentaries and studies not directly addressing screen time's effects were also excluded from the analysis together with the studies on populations other than those specified in the study guidelines. In addition, during the data extraction, a detailed summary of each study's objective, methods, results and conclusion was carried out. This approach helped to have an integrative analysis of literature and identify patterns, inconsistencies, and the deficient knowledge, thus directing research towards these fields.

Results

The initial search yielded a total of 50 studies. After removing duplicates, 34 studies remained. Titles and abstracts were screened, leading to the exclusion of 2 studies that did not

meet the inclusion criteria. The remaining studies were subjected to a full-text review. Of these, no other studies were further excluded, leaving the 32 studies for detailed analysis.

Cognitive Development

The relationship between screen media and child cognitive development has both positive and negative implications. Interactive technological tools like digital books and other reading lesson apps based on researches conducted by Gottschalk 2019 have positive impact on development of literacy skills of children. Also, interactive technologies as stimulants and feeders for child's imagination are shown in Gottschalk (2019). Moreover, results support their educational value in terms of screen media. Many researches indicated that these exposures may cause executive functions, sensorimotor development, and schooling (Hutton et al., 2019; Kerai et al., 2022). For example, multitasking with media reduces the working memory of the adolescent, decreases inhibition, and weakens ability to switch tasks. Furthermore, the Quebec Longitudinal Study of Child Development reveals that exposure to screen time over a longer period leads to lower measures of intelligence (Hutton, et al., 2019). Fourth graders with additional TV exposure were more likely to have reduced participation in class activities and below average performance in mathematics (Hutton et al., 2019).

Electronic screen effects have been intensively studied in respect to the outcome of education. For instance, research conducted in Spain found out that prolonged screen time correlates with unfavorable examination results (Gottschalk, 2019). Second research in America revealed that multi-media tasks highly related to poor scores in standardized test used to determine student performance in mathematics and English (Gottshall, 2019). It should be noted, however, that the decrease in cognitive and academic performance can result from other multitasking activities rather than screen time alone. Understanding such a complex relationship will require more research. Secondly, while the effects of screen media

on language skills have been sufficiently discussed, studies to shed light on the connection between screen media and other cognitive abilities like executive skills are still needed (Ren, 2023).

Language Development

Screen media has a strong bearing on the childhood formation stage which is the reason why language development should be analyzed at this stage. According to Mulappa et al. (2023), second language acquisition process entails human interaction. However, the scholarly research is also concerned about the potential negative consequences arising from excessive screen time, including a reduction in the quantity and quality of those significant daily interactions. It points out the importance of in-depth assessment of the influence of overexposure to screens on children's language and proper remedies. According to Korte et al. (2020) and Ren (2023), there is a positive relationship between screen time and children's language competencies, when parents co-view content with their children. On the other hand, recent studies done by Gottschalk (2019) and Ren (2023) indicate that protracted screen time leads to speaking and language delay, low motor skills and many other issues associated with the cognitive sphere. On the other hand, Arabiat et al. (2022) claim that a child's language may be reduced when using television background noise and even affect their thinking and problem solving ability leading to negative thinking as well. They also observed that problems with language and reading could occur during toddlerhood when one spends a lot of time watching TV. This suggests that parents ought to be aware on how TV programs influence their children's and why it's important to control what their children are watching (Arabiat et al., 2022).

Social-Emotional Development

The fact that increased screen use has been linked to emotional reactions, externalizing behaviors, and aggression is disturbing as per Anderson and Subrahmanyam

(2020). Studies by Oswald and other scholars confirm that such negative emotional effects are linked with more TV time between six months and 18 months old. Moreover, lengthy screen time is linked with the symptoms of anxiety and depression, especially associated with playing video games according to Oswald et al. (2020). This means also that types of screen activity might be influencing children's emotional development and also it could differ according to gender. Screen time and its effect on socio-emotional development of children is complex. In fact, as screen- based technology is increasingly used, worries over the influence of these innovations on children's mental health and overall wellness (Oswald et al., 2020). Nevertheless, Oswald et al., 2020, linked screens with a number of adverse outcomes, including being educational and informed good sense.

Although screen time is educative, unhealthy application of screens, particularly the ones around small kids might have negative effects in developmental social and emotional area (Oswald et al., 2020). It stresses the importance of personal contacts in the development of social and emotional abilities of children in communicating with parents (Arumugam & Farid, 2021). To fully understand these areas of development as a potential risk, screen time should be considered (Oswald et al., 2020). Screen time can lead to sleep problems in childhood, which in turn may give rise to emotional problems and antisocial behaviors (Oswald et al., 2020). For instance, some sleep disorders among children include excessive screen time and exposure to fast-paced or violent content all of which may influence brain's reward system and dopamine pathways thus leading to behaviors similar to ADHD (Oswald et al., 2020). In addition, children may become prone to developing antisocial behavior as a result of early and frequent exposure to violent content (Oswald et al., 2020). High amounts of screen use especially when it is bordering on addiction is as compulsive as addiction and hinders social coping skills (Oswald et al., 2020). Marques et al., (2023) point out that appropriate sleep is linked with decreased body fat, better academic performances, and better

Quality of Life (QoL). These Guidelines are summarized in Table 1: Health Canada 24-Hour Movement Guidelines for the Promotion of Healthy Active Living among Canadian Children and Youth.

Table 1: Canadian 24-Hour Movement Guidelines for Children and Youth

Movement behaviors	**Toddlers (0-4)**	**Children (preschoolers)**	**Children and adolescents**
Physical activity	≥ 3 hours minutes per day	≥ 3 hours minutes per day	≥ 1 hour of moderate to vigorous intensity
Screen time	Not recommended (<1 year) < 1 hour (1-2 years)	< 1 hour	< 2 minutes
Sleep time	11 to 14 hours of good-quality sleep	10 to 13 hours of good-quality sleep	9 to 11 hours (5-13 years) 8 to 10 hours (14-17 years)

Source: https://csepguidelines.ca/

Evidence-based Strategies for Managing and Reducing Screen Time in Children

Researchers have carried out many studies on the effect of screen exposure on children's growth before the end of their fifth year. These case investigations have focused on the use of screen-based media and its association with different developmental domains among the children. A recent study by Kerai et al in Canada sheds light on the link between screen time and developmental health in young children. Korte commented in 2020 about the

global effects of the digital era on cognition and behavior. Psychological and emotional impacts among children as a result of digital technology especially in the context of the covid-19 pandemic. Lin et al (2020) studied the association between extended usage of touch screen devices upon emotional and behavioral difficulties in young children. Lastly, Madigan et al. (2020) examined the association between screen time and children's language abilities.

There is a substantial body of research that highlights the need for means of controlling and reducing children's screen-time. Research by Madigan, et al. (2020) emphasizes how parents awareness on the effects of screen time to their children coupled with simple steps helps them reduce screen usage. Additionally, early inclination towards more screen-time tends to persist and goes hand in hand with bad eating habits and inadequate sleep, as demonstrated in the Kerai et al study (2022). In order to address this, the interventions might include some aspects aimed at reducing screen time. For instance, such approaches could apply digital monitoring tools, the TV Turn-off challenge and education through mass or targeted media noted in Hutton et al., (2019) and Lin et al., (2020). Also, health workers, hospitals, schools, and maternity wards should involve themselves in promoting safe screen practices for children and give guidance on this issue according to Madigan et al. (2020), and Limone & Toto (2021). Collectively, these approaches are meant to reduce the adverse effects associated with too much screen exposure on children's development.

Role of Parents in Managing Screen Time

Many researches and organizations have shown that parental monitoring is key in controlling child's screen use. Research by Przybylski and Weinstein (2019) shows that parents often view screen time as both a reward and potential risk to their children's behavior, social skills, sleeping patterns, and physical activity. Parents are the biggest caregivers at

home who must ensure that screen time management takes place, setting norms and putting limits (Przybylski & Weinstein, 2019).

Researches from CDC and other studies (Qu et al., 2023) indicate that child screen time by limiting it through parental control and taking away screens from children's bedrooms can reduce children screen time. The advised amount of screen time depends on the age of the child and is as follows: not more than one hour a day for children aged three to seven; not more than one hour a day for children aged seven till twelve; not more than one and a half hours a day for children aged 12 but it should be noted that children tend to emulate their parents' screen behaviors For example, children watching television more often is likely to lead to their binge watching (Przybylski & Weinstein, 2019).

Table 2: Age Group and Recommended Screen Time Limit

Age Group	Recommended Screen Time Limit
3-7 years old	0.5-1 hour per day
7-12 years old	1 hour per day
12-15 years old	1.5 hours per day
16+ years old	2 hours per day

Adopted from: (Panjeti-Madan & Ranganathan, 2023)

Interventions and Education

There are plenty of interventions meant to reduce screen time that have shown varying degrees of success. Successful approaches include electronic tracking to establish limits of screen use, television turn off challenge, linking screen time to physical activity and distributing educational materials through different media (Gottschalk, 2019 & 46; Baron, 2022). Some of the interventions are illustrated below:

Table 3: Various interventions and expected outcome

Intervention	Explanation	Expected Outcome
TV Turn-off Challenge	Encouraging individuals to limit screen time for a set period	Reduction in screen time and engagement in alternative activities (Baron, 2022).
Electronic Tracking Tools	Use of software and apps to monitor and limit screen time	Increased awareness and control over screen usage
Screen Time Conditions	Linking screen time to physical activity or chores	Encouragement of physical activity and responsible screen use (Baron, 2022).
Educational Campaigns	Dissemination of educational materials through media	Improved knowledge and awareness about screen time effects
Family Screen Time Agreement	Establishing family rules and agreements on screen use	Enhanced family communication and balanced screen time (Baron, 2022)

Remaining Gaps in the Literature

Nonetheless, additional research especially in the form of longitudinal studies examining children's developmental trajectories linked to long-term screentime exposure must be conducted. Existing studies, on the other hand, shed light on short-term screen uses and their effects on cognitive, linguistic, and socio-emotional development during childhood growth. Przybylski and Weinstien emphasize the importance of longitudinal studies to understand the long-term effects of screen exposure on children. Moreover, research should also consider various combinations on how screen content is, where it is used and the child being studied (such as their age or socioeconomic status). Ren (2023) states that to have a

clear understanding of this issue, one must recognize the complex interplay of digital technology and the development of childhood.

Discussion

This systematic examination leads to a complex picture that it is evident from the findings regarding how these screens affect the brain development of infants. Some of these studies have shown positive results as well as a clear picture of screen time risks with respect to child development. Research shows that children can improve their language skills by watching TV that contains elements of entertainment and educational components. As an example, studies have proven that interactive reading with electronic books and educational software may lead to developing skills of early literacy and creativity. Nevertheless, other research works reveal that excessive screening may lead to cognitive difficulties, language retardation as well as other social and psychological issues (Hutton et al., 2019; Kerai et al., 2022). The strongest signal is regarding long-term viewing effects on executive function, attention, and grade achievement.

Additional nuances are evident in comparing these findings with studies that were not part of the review. For example, some investigation hints that the surrounding of screen employment, for example, parental co viewing and kind of content, substantially influence its impact on kids (Korte et al., 2020; Przybylski et al., 2019). It contrasts with many studies that have explored the duration of screen time as the sole or major factor (Lin et al., 2020). The literature reveals significant differences in the effect of screens on diverse elements of development. Some scholars focus on adverse cognitive and social-emotional effects (Guerrero et al., 2019, Oswald et al., 2020), while others point out possible gains under certain conditions (Korte et al., 2020). Such inconsistencies may be due to variations in study designs, age differences, and whether or not the studies only focused on general screen

activities. Longitudinal studies are also needed to examine the long-term consequences of early exposure to screen.

The results indicate that clinicians, and educators need to offer parental guidance on balanced screen time for children. Limiting the extent of screen time for duration and age appropriate content that is educative and parents monitoring during the exposure (Przybylski et al., 2019; Arabiat et al., 2022). In addition, physical activities and face-to-face interactions should be involved since they oppose the negative consequences of screen time on physical and social-emotional health (Bustamante et al., 2023). Longitudinal studies are needed to determine the long run effects of screen time beginning during early years. Further studies are also needed on the differential effects of disparate screen activities and content and parental mediations that can diminish the possible adverse outcomes. Examining successful initiatives and learning approaches as they relate to screen-time management will be equally critical in providing direction to parents, educators, and policy makers during this era of digital media.

Conclusion

This paper presents an exhaustive analysis on the effect of screen time on the cognitive, language, and socio-emotional development in children. It emphasizes on the existing associations that relate screen based media and these aspects of children's development. Some of these aspects are academic performance, health status, social skills, communication skill abilities, and emotional well-being (Przybylski & Weinsten, 2019; Qu et al., 2023). This research indicates that children's language skills have been impacted based on the amount of the screen time, considering the elements such as co-viewing as well as the kind of the material which was watched. It has also been found that the screens devices such as televisions, computers, tablets and smartphones have adverse effects in terms of socio-emotional challenges which could result to obesity, disrupted sleeping patterns and emotional understanding. In order to mitigate these issues, establishing maximum screen time limits,

utilizing parental control mechanisms, and exemplifying optimal screen use behaviors are advised (Przybylski & Weinstein). More research is required to identify interventions and alternative activities that will help in developing a balance approach towards screen use and digital literacy amongst children. However, this is particularly essential because of our fastly digitalizing society.

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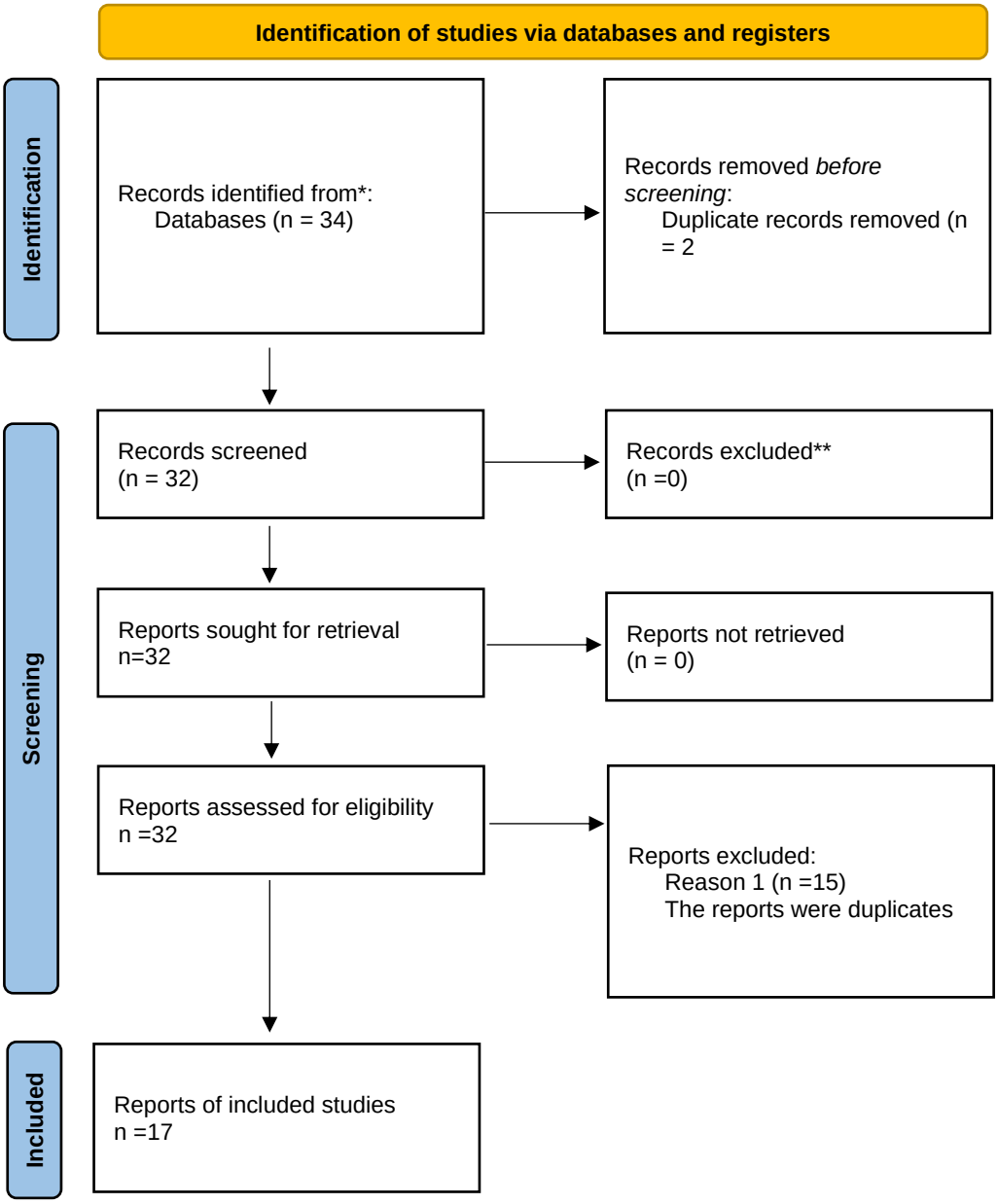
Appendix

PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only



Data bases used for data extraction

Database	**Keywords Used**
EBSCO	Technology, Screen time, Child development,
	Cognitive development, Social development,
	Emotional development, Well-being, Mental health,
	Physical health, Academic performance,
	Early childhood, Technology use, Digital devices,
	Media exposure, Internet, Parenting practices,
	Digital media, Video games, Television,
	Mobile devices
PubMed	Technology, Screen time, Child development,
	Cognitive development, Social development,
	Emotional development, Well-being, Mental health,
	Physical health, Academic performance,
	Early childhood, Technology use, Digital devices,
	Media exposure, Internet, Parenting practices,
	Digital media, Video games, Television,
	Mobile devices

The table displays the two databases (EBSCO and PubMed) and the shared keywords used for searching within those databases.