



Screen exposure during early childhood: implications for child neurodevelopment

Exposure to screens during early childhood: implications for children's neurodevelopment

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SUMMARY

This study addresses the effects of excessive screen time during early childhood and its implications for child neurodevelopment. The digital revolution has introduced electronic devices into families' daily lives, introducing children to digital media at an early age. Early childhood, a period marked by intense neuroplasticity, relies heavily on sensory, social, and motor interactions for healthy brain development. The COVID-19 pandemic has intensified children's screen time, exceeding the recommendations of the American Academy of Pediatrics. The literature suggests that excessive screen time is associated with deficits in cognitive development, delayed expressive language, impaired executive function, and structural changes in the brain's white matter. Piaget's theories of neuroplasticity and sensory integration provide a theoretical basis for understanding how screen time can interfere with children's active knowledge construction.

Through a narrative review of the literature, based on DeCS descriptors and a selection of relevant studies, it was demonstrated that screen time replaces interactions that are fundamental to child development. Longitudinal and neuroimaging studies demonstrate changes in the brains of children with heavy digital media use. The conclusion is that screen use should be controlled and mediated by adults, especially in the first five years of life, to preserve the child's neurological health and overall development. The integrated action of health professionals, educators, and families is essential for the effective implementation of these recommendations.

Keywords: screen use. Early childhood. Neurodevelopment

ABSTRACT

This study looks at the effects of excessive exposure to screens during early childhood and its implications for children's neurodevelopment. The digital revolution has introduced electronic devices into families' daily lives, bringing children into early contact with digital media. Early childhood, a period marked by intense neuroplasticity, depends heavily on sensory, social and motor interactions for healthy brain development. The COVID-19 pandemic has intensified children's exposure to screens, exceeding the recommendations of the American Academy of Pediatrics. The literature shows that excessive screen use is associated with deficits in cognitive development, delays in expressive language, impairments in executive function and structural

changes in the white matter of the brain. Piaget's theories of neuroplasticity and sensory integration provide a theoretical basis for understanding how the use of screens can interfere with the active construction of children's knowledge. A narrative review of the literature, based on DeCS descriptors and the selection of relevant studies, showed that screen time replaces fundamental interactions for child development. Longitudinal and neuroimaging studies show alterations in the brains of children with high digital media use. It is concluded that the use of screens must be controlled and mediated by adults, especially in the first five years of life, to preserve the child's neurological health and overall development. The integrated action of health professionals, educators and families is essential for the effective application of these recommendations.

Keywords: use of screens. Early childhood. Neurodevelopment.

1. INTRODUCTION

This century is marked by an evolution in the digital context never seen before, so that reshape the entire world. Electronic devices such as tablets, smartphones, computers and televisions are increasingly becoming part of the family environment, encouraging children to digital world at an increasingly early age (MADIGAN et al. 2023). In this sense, the The concept of "screen time" was created and refers to the time a child spends exposed to electronic media, such as television, mobile devices, computers and video games. In recent years, there has been an exponential growth in the period in which children are dedicate themselves to technological devices.

In contrast, early childhood, which comprises the first five years of life, is characterized by significant neuroplasticity. During this phase of a child's life, brain is capable of developing 700 to 1,000 new synaptic connections per second, contributing to the development of neurological foundations for future learning (NATIONAL SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD, 2007). During this period, due to intense neuronal activity, neurodevelopment is largely influenced by environmental stimuli, especially digital stimuli.

Concern about the effects of screen time on child development is growing, and gained visibility during the COVID-19 pandemic, which resulted in an increase significant in children's exposure to digital devices due to remote learning and social distancing measures (CHOI; KING; DUERDEN. 2023). Recent data indicate that children between 2 and 5 years old spend, on average, more than 2.5 hours a day in front of screens, significantly exceeding the recommendations of the American Academy of Pediatrics.

Childhood brain development is a highly sequential and dependent process of experiences. A child's first sensory and social experiences literally shape the architecture of your developing brain (STICCA; BRAUCHLI; LANNEN, 2025). When screen time replaces face-to-face human interactions, physical play, and exploitation of the natural environment, there may be lasting consequences for development neurological. Thus, current scientific literature presents growing evidence that time excessive screen time during the first years of life is associated with negative outcomes in child development.

2 THEORETICAL FRAMEWORK

2.1 Theories of Child Neurological Development

Child neurological development is based on several theories that explain the brain maturation processes and their behavioral and cognitive implications. The theory of periods critics, proposed by Hubel and Wiesel in the 1960s and refined by contemporary studies, establishes that there are specific time windows during which the nervous system is particularly sensitive to environmental stimuli (Hensch, 2004). Neuroplasticity, a central concept in child development, refers to the brain's ability to reorganize itself structurally and functionally in response to experiences. During the first years of life, this plasticity is maximum, allowing extraordinary adaptations, but also creating vulnerabilities to influences inadequate environmental conditions (KOLB & GIBB, 2011). The theory of sensory integration, developed by Jean Ayres, postulates that neurological development depends on the nervous system's ability to organize and process sensory information efficiently. This theory is particularly relevant in the context of screens, as digital exposure can alter natural processing patterns sensorial (SCHAAF & MAILLOUX, 2015).

2.1 Cognitive Development and Piaget's Theory

Jean Piaget's constructivist theory provides a fundamental framework for understanding how children develop knowledge through active interaction with their environment. The period sensorimotor (0-2 years) and pre-operational (2-7 years) are characterized by the need for direct physical exploration and manipulation of concrete objects for appropriate cognitive development.

Piaget (1964) emphasized that cognitive development occurs through assimilation and accommodation of new experiences, processes that require active interaction with the physical and social environment. The passive exposure to digital stimuli can interfere with these natural processes of building knowledge, limiting opportunities for concrete exploration and active discovery (PIAGET, 1964).

3. MATERIAL AND METHOD

This work aims to elucidate the impact of screen use on neurodevelopment children. To develop the study, we opted for a narrative review of the literature, performed in the following databases: PubMed, SciELO and LILACS. The descriptors used were selected based on the vocabulary registered in DeCS (Descriptors in Health Sciences Health) and included: "Screen Exposure", "Early Childhood" and "Neurodevelopment". To optimize search results and scope, these terms were combined with the Boolean operators AND and OR. Inclusion criteria were: original articles, reviews, clinical trials, scientific communications and reports that address the impact of use screen time during early childhood, without language restrictions. The exclusion criteria included duplicate works, abstracts without access to the full text and materials whose focus had repercussions after the age of five. The selection process was carried out in a simple: after reading the titles and abstracts, potentially relevant studies were saved for reading in full.

4. RESULTS AND DISCUSSION

The studies analyzed unanimously present negative associations between excessive screen time and child neurodevelopment. Research conducted by Zhang et al. (2021) with a sample of 2,441 children revealed that each additional hour of screen time at 12 months was associated with a 0.3-point reduction in scores cognitive development at 24 months of age. Furthermore, the longitudinal study by Madigan et al. (2020) followed 2,178 children aged 24 to 60 months and identified that children older than 2 hours of screen time per day had lower scores on executive function tests, including working memory, cognitive flexibility and inhibitory control.

Furthermore, language development represents one of the most vulnerable areas to the effects of excessive screen time. Research shows negative associations between screen time and the development of physical and cognitive skills, with particular impact on language acquisition. The prospective study by van den Heuvel et al. (2019) examined 1,893 children and found that each additional hour of screen time at 18 months was associated with a 2.3-month delay in expressive language development at 30 months. Children exposed to more than 4 hours of screen time per day had a 2.7 times greater risk of delay significant in language. Furthermore, authors Zimmerman et al. (2021) compared children exposed to educational programs versus general entertainment, finding that only the exposure to non-educational content was associated with linguistic deficits.

Studies reveal that children with more screen time demonstrate worse mental health and well-being, neurodevelopment, and connection with nature. The research by Thompson et al. (2022) with 3,659 children found significant associations between excessive screen time and behavioral problems.

Research has identified the integration of the emotional processing-control network cognitive as a plausible biological pathway linking childhood screen time and competence later socioemotional development. This finding suggests that early screen exposure may interfere in the normal development of neural circuits responsible for emotional regulation.

Likewise, excessive exposure disrupts the typical development of the network neural and results in accelerated network integration, potentially impairing the extended neuroplasticity, which is advantageous for cognitive development. In this sense, Hutton et al. (2020) used magnetic resonance neuroimaging to examine structural brain differences in 3- to 5-year-old children with different screen use patterns. The results revealed significant differences in white matter integrity in regions associated with language and executive control. Children with more screen time presented less organization of white matter in tracts that connect areas of language processing.

FINAL CONSIDERATIONS

Therefore, it is concluded that excessive use of screens during the first years of life is associated with significant negative impacts on child neurodevelopment. The effects are observed cover the axes of development, including cognition, language, regulation socioemotional and brain structure. Studies show that excessive screen exposure in children can contribute to social difficulties, family problems and cognitive deficits.

Therefore, it is recommended that for children aged 18 to 24 months, use should be supervised by parents. For children aged 2 to 5, screen time should be limited to 1 hour per day. However, the application of such recommendations must be aligned between health professionals, educators and family members.

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