Neuropsychological Impacts of Screen Use in Children

Impactos Neuropsicológicos do Uso de Telas na Infância

Impactos Neuropasicológicos del Uso de Pantallas em la Infancia

RESUMO

Objetivo: Verificar se o uso de telas é prejudicial para crianças e qual os impactos decorrentes dessa prática. **Método:** Foi realizada uma revisão de literatura, através das bases de dados Scielo, PubMed, BVSc e Google Scholars, onde foram selecionados artigos e capítulos de livro escritos em português, inglêss e espanhol, publicados entre 2018 e 2025. **Resultados:** Foram encontradas 135 publicações, das quais selecionou-se 35. **Conclusão:** Atualmente, considera-se que o uso excessivo de telas, se não for bem acompanhada, dosada e assistida, pode gerar malefícios, especialmente para as crianças. O uso indiscriminado e não supervisionado pode gerar impactos negativos no desenvolvimento neurobiológico, cognitivo, comportamental e na vida escolar da criança.

DESCRITORES: Crianças; Tempo de Tela; Desenvolvimento, Neuropsicologia.

ABSTRACT

Objective: Check whether the use of screens is harmful to children and what the impacts of this practice are. **Method:** A literature review was carried out, using the Scielo, PubMed, BVSc and Google Scholars databases, where articles and book chapters written in Portuguese, English and Spanish, published between 2018 and 2025, were selected. **Results:** 135 publications were found, of which 35 were selected. **Conclusion:** Currently, it is considered that the excessive use of screens, if not well monitored, dosed and assisted, can cause harm, especially for children. Indiscriminate and unsupervised use can have negative impacts on the child's neurobiological, cognitive, behavioral development and school life.

DESCRIPTORS: Children; Screen Time; Development, Neuropsychology.

RESUMEN

Objetivo: Comprobar si el uso de pantallas es perjudicial para los niños y qué consecuencias se derivan de esta práctica. **Método:** Se realizó una revisión de la literatura utilizando las bases de datos Scielo, PubMed, BVSc y Google Scholars, donde se seleccionaron artículos y capítulos de libros escritos en portugués, inglés y español, publicados entre 2018 y 2025. **Resultados:** Se encontraron 135 publicaciones, de las cuales se seleccionaron 35. **Conclusión:** Actualmente, se considera que el uso excesivo de pantallas, si no se controla, mide y vigila adecuadamente, puede producir daños, especialmente en los niños. El uso indiscriminado y no supervisado puede tener repercusiones negativas en el desarrollo neurobiológico, cognitivo y conductual del niño y en su vida escolar.

DESCRIPTORES: Niños; Tiempo frente a la pantalla; Desarrollo, Neuropsicología.

RECEIVED: 03/07/2025 **APPROVED:** 03/18/2025

How to cite this article: Costa LJR, Souza GS, Lacerda EMCB, Alves GS, Alves CHL. Neuropsychological Impacts Of Screen Use In Children. Saúde Coletiva (Edição Brasileira) [Internet]. 2025 [acesso ano mês dia];15(94):15211-15226. Disponível em: DOI: 10.36489/saudecoletiva.2025v15i94p15211-15226

DOI: https://doi.org/10.36489/saudecoletiva.2025v15i94p15211-15226

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INTRODUCTION

According to the International Telecommunication Union [1], in 2022, 66% of the world's population had access to the internet, in Brazil this rate is even higher, as according to the Continuous National Household Sample Survey [2] carried out in 2021, the internet is present in 90% of households and that the cell phone is the most used device for internet access (98.8% of the population), followed by Smart TV and computer. According to a 2022 study, administered by the Regional Center for Studies for the Development of the Information Society (3), 92% of children and adolescents between the ages of 9 and 17 in Brazil (24.4 million individuals) are internet users.

The social impacts related to the increased use of these media are associated with separation from social life, loneliness, and negative impacts on physical and mental health and on cognitive, emotional, motivational and behavioral development, especially in children.

There are an increasing number of children being diagnosed with anxiety, depression, hyperactivity, among others. There are theories that the reason for this may revolve around changes in social habits and better diagnostic coverage. It is also theorized that one of the reasons is the new reality of screen use.

METHOD

This is a qualitative, descriptive and narrative literature review study. The Scielo, PubMed, VHL and Google Scholars databases were consulted. The research was carried out using the descriptors 'screen time', 'child development' and key-words 'child cognitive development', 'child cognitive skills', 'technology, child brain development screens', 'brain changes children screen time', with the search operator AND. The criteria included publications in Portuguese, English and Spanish, between 2018 and 2025, having scientific publication identifiers, and being relevant to the topic.

RESULTS

A total of 135 publications were found, and after analysis, 31 articles were selected. Of these articles, 12 were in Portuguese, 17 in English and 2 in Spanish. Finally, four citations were used in the work: the Manual of 'Guidelines on Physical Activity, Sedentary Behavior and Sleep for Children Under 5 Years of Age', from the World Health Organization (WHO), the report 'Survey on Internet Use by Children and Adolescents in Brazil', from the Regional Center for Studies on the Development of the Information Society (Cetic.br), and the report on "Individual Internet Use" from the International Telecommunications Union (ITU) and the report of the 'Continuous National Household Sample Survey' (PNAD) on 'Access to the Internet and Television and Ownership of a Mobile Phone for Personal Use', from the Brazilian Institute of Geography and Statistics (IBGE).

DISCUSSION

The Use Of Technologies

When it comes to studies related to the use of screens, the term suggested by the American Pediatric Association (APA) is commonly used, 'Screen Time' (ST), which is the total sum of the time spent using screens, such as cell phones, television, computers, video games, laptops, among others, per day. [4-5]

When we talk about technology, we know that we are dealing with an inherent artifice of today's world that, depending on when, where and how it is used, can bring benefits or harm, helping in learning processes and enabling communications, or causing dependence and cognitive impoverishment. [6-7]

The WHO recommends that children under one year old should use screens for zero minutes per day, while children aged 1 to 5 should use 60 minutes per day, which does not always reflect the current reality. with 613 children, aged 1.5 to 12 years, indicated that ST is significantly higher

DOI: https://doi.org/10.36489/saudecoletiva.2025v15i94p15211-15226

than the recommendations of entities such as the World Health Organization (WHO), the American Pediatric Association (APA) and the Brazilian Society of Pediatrics (SBP), as it reveals that the average use is more than two hours per day, this average being corroborated by another study from 2022 [9], with the only caveat that the latter studied a population aged 2 to 5 years only; both corroborate that a ST of more than two hours is related to changes in the child's ability to optimally develop both motor and psychological skills and abilities. The 2021 study also shows that 47.5% of the population started using devices with screens before one year of age.

Neurological Impacts

Brain performance is linked to its volume. In the first two years of life, the human brain increases in size by more than twice the size it had at birth, due to the expansion of the cortex (149% in the first year) and white matter (which has a higher growth rate from the age of 3). [10 -11]

There is a relationship between ST and changes in gray and white matter, as well as early and accelerated thinning of the cortex in children, according to data from a study by 'Brain Cognitive Development', as cortical morphology undergoes dynamic changes during childhood, and this continuous sensory stimulation of digital stimuli affects brain development, increasing the risk of behavioral, emotional and cognitive disorders. [12]

Studies carried out [5, 13] with imaging systems using diffusion tensor imaging in magnetic resonance imaging and application of tests with parents of preschool children up to five years old, they identified, within the sample studied, that children exposed to screen-based media presented alterations in aspects of the white and gray matter in the brain.

The integrity of the white matter has been related [10] with cognitive capacity in children and adults, even though it is not yet known how emerging cognition is supported by the process of white matter maturation.

There are associations between increased screen use and lower microstructural integrity of portions of white matter, portions that are related to emergent literacy and language skills in preschool children. [13] It is important to note that the American Pediatric Association, as well as the World Health Organization (WHO), recommend a minimum exposure time, and the American Pediatric Association (APA) recommends that the level of exposure should not exceed 2 hours per day in children under 9 years of age, and they took into account in this study that abusive use of these devices would be ST beyond this limit.

Evidence was found related to lower Fractional Anisotropy (FA) and higher Radial Diffusivity (RD) in associations with higher ST in tracts related to executive and emerging literacy skills. [13] A decrease in Fractional Anisotropy (FA) and an increase in Radial Diffusivity (RD) were also found in Wernicke's and Broca's areas, respectively related to receptive and expressive language when there is greater ST.

Recent studies have associated an increase in Fractional Anisotropy (FA) and a decrease in Radial Diffusivity (RD) with emerging development, while a decrease in Fractional Anisotropy (FA) in the arcuate fasciculus, inferior longitudinal fasciculus and superior fasciculus have been associated with lower pre-reading skills, especially phonological ones; it is important to note that both associations are in preschool children.[13]

Preceded by the maturation of limbic areas, morphological changes in gray matter, such as cortical thickness (CT) and sulcal depth (SD), occur in childhood and reach their maximum expansion in adolescence. It has been suggested that cortical thickness (CT), which refers to synaptic density, may be a marker for higher or lower sensory processes. Changes related to decrease or increase in cortical thickness (CT) may be cumulative or reductive in nature (such as synaptogenesis or pruning, respectively) and reflect cortical remodeling in response to environmental stimuli. [5]

Greater use of digital media has been associated with lower cortical thickness (CT) in the right supramarginal gyrus, in the postcentral gyrus (related to abilities related to emotional processing and empathy, through the mirror neuron system). And greater ST has been associated, in higher order areas, in the lingual gyrus (area responsible for recognizing printed letters), with lower cortical thickness (CT), which may cause decreased episodic memory and social cognition in adults.

There is evidence of a negative correlation [14] of greater ST, to a lower level of functionality of the visual area related to word formation with right Brodmann areas 13 and 24 and left Brodmann areas 25 and 47 (responsible for cognitive control).

A study [15] with 284 children, it related the greater use of the internet with a decrease in the volume of regional gray matter (rGM) and the volume of regional white matter (rWM), correlated with a decrease in verbal intelligence; the areas in question involve regions related to the processing of attention, language, emotion, reward and executive functions. One of the main reasons pointed out by the research concerns the content that was consumed during internet use, which may be related not only to the quantity of digital stimuli, but also to their quality.

Cognitive Impacts

Four-year-old children who use

DOI: https://doi.org/10.36489/saudecoletiva.2025v15i94p15211-15226

screens to access entertainment-related content rather than age-appropriate educational content have shown lower scores on cognitive measures. [12]

Authors [12, 16] also mention that timely exposure to age-appropriate Digital Stimuli (DS) can promote cognitive enrichment; although others [17- 18] point out that Natural Stimuli (NS) bring more benefits than any type of cognitive stimulation from Digital Stimuli (DS); one of the possible justifications is that higher functions are not yet fully developed and there is a certain difficulty in adapting what was learned in 2D to the real world in 3D.

In the first five years of a child's life (emphasizing the first 3), priority should be given to cognitive enrichment and the development of cognitive skills through family and environmental interaction. Although cognitive processes are not understood, emotional processes in children should also be taken care of so that cognitive development is not impaired [19-21], since there are indications that children who grow up in environments where they are forced to remain in a state of alert for a long time (due to fear/stress) have a high risk of suffering changes/damage in neuronal and cognitive development. [22]

Furthermore, skills, both cognitive and socio-emotional, are influenced by environmental variables, not only in childhood, but throughout life. [21] Other authors [23], claim that the interaction between baby and parents/caregivers establishes a relationship of 'attachment', which allows for more competent exploration of the environment, playing an important role in organizing the child's behavior and promoting cognitive development.

The Brazilian Society of Pediatrics (SBP) states that the presence of parents and caregivers cannot be replaced by screens and technologies, since the first 1000 days after birth are important for neuropsychological development, as well as the subsequent period known as preschool and school. [7]

The use of screens can mainly compromise the amount of exposure to NS that the child will have contact with, through the screen-individual isolation, characteristic of the handling of this technology, since it is conventionally assumed that NS, especially when it comes to contact from parents/caregivers, contribute significantly to cognitive development, especially with regard to language, or in higher functions that are still being formed, such as one of the tripods of executive functions and inhibition. [6, 16, 19, 24 - 26]

According to two studies [7, 27] The human brain does not have sufficient adaptive mechanisms to cope with Digital Stimuli (DS), as it lacks sensory moderation, adequate sleep and nutrition, physical activity, human presence, and, using the term used by the author, adequate 'cognitive nutrition'. Without these, the brain continues to function, but with potential impairment, causing the loss of key periods of brain plasticity, which are difficult to recover at other times in life.

The authors also corroborate that the 'digital frenzy' seriously harms the intellectual development of the infant and generates 'cognitive impoverishment' due to the excessive hours of 'passive distraction'.

According to two studies [26, 28], there is a priority regarding the NS arising from interaction with objects, toys and people, in the development of skills related to the cognitive process (CP) attention, being fundamental in the first years of life, even going so far as to state that the abusive use of technologies may be related to deficits in this same CP.

There is a relationship between ST and impairments in memory acquisition and learning capacity, the authors also report increased risks of mental disorders. Regarding memory, a possible argument is the relationship of reduced need for effort to store information, due to easy access to it, by devices. [4]

One of the studies [27] emphasizes the weakening of the bond between parents/caregivers that screens/technology can cause, generating problems related to the development of language, attention and the ability to deal with imposed limits.

Regarding language, it was shown that in children aged 18 months, every half hour spent daily in front of screens increases the probability of delays in language development by 2.5 times, and in children aged 24 to 30 months, the longer the ST (limit of up to 1 hour) the greater the possibility of increased difficulties in verbal language development, being beyond 1h, specifically '1h-2h', '2h-3h' and '>3h' respectively represented an increase of '1.45', '2.75' and '3.05', in the probability of delay. [27] Other authors [29] corroborate the increased risk of developmental delay in the areas of communication.

Studies indicate that there is a relationship between greater ST and cases of cognitive and socio-emotional language delay, causing a problem that will have a greater impact on the future of this child, not only in terms of social adaptability, but also related to the deficit of necessary subsidies for the child to develop mechanisms of emotional regulation and/or skills related to inhibitory control. [6, 7, 12, 29,]

In general, childhood is a period of critical development, where personality foundations and development of essential cognitive skills such as language, interpretation, object recognition, executive planning, among others, are developed. If exposure to s is restricted and exposure to Digital Stimuli (DS) is exacerbated, irreversible damage may occur in Cognitive Processes (CP), memory, language and attention, in the ability to concentrate and sleep. [30]

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Behavioral Impacts

The literature indicates that the impacts arising from screen use also include the behavioral sphere and, more broadly, the child's performance and interaction in the environments in which they are inserted.

This reality has been a cause for concern due to the negative impact on children's lives, because as we will explain below, the main behavioral changes found in the literature regarding ST are related to changes in sleep patterns, hyperactivity, isolation, sedentary lifestyle and irritability, affecting not only behavioral patterns but also cognitive and emotional psychological processes. [6, 7, 8, 12, 26, 31]

When the increase in ST occurs at night, exposure to light contributes to the stimulation of the suprachiasmatic nucleus, which ends up interfering in the process of melatonin production (reducing secretion), which contributes to the greater difficulty for the child to sleep, also influencing the quality of sleep and its restorative capacity. Some authors mention that the stimulation resulting from the use of screens before bed can trigger episodes of night terrors; which can lead to daytime drowsiness, decreased memory and concentration capacity, and in some cases may be related to increased hyperactivity and anxiety episodes. [4, 7, 13, 14, 26, 30, 31, 32, 33]

In addition to the recommendations for limiting ST per day, it is also recommended not to use screens during meals, as this can be a contributing factor to greater caloric intake and reduce habitual control of food intake, as well as reduce satiety signals. [7] Some authors claim that there is a significant potential correlation between higher ST and the use of screens during feeding. [6, 24] Some authors claim that there is a significant potential correlation between higher ST and the use of screens during feeding. [14, 33]

When the use of devices with screens (> 5h/day), especially at night, is associated with a low supply and performance of physical activities, it can lead to worse psychosocial well-being and the appearance of depressive symptoms and/or anxiety; depending on the content accessed, it can corroborate a decrease in empathy (for example, violent content). [14, 30, 32, 34]

Furthermore, authors [7, 8, 14] corroborate that the excessive use of devices can generate behavioral problems related to episodes of screen addiction, episodes similar to those of addiction to psychoactive substances.

CHANGES IN SCHOOL LIFE

In general, all these impacts interfere globally in the child's life, especially in the school system, the second system in which the child is inserted after the family system. In this sense, dimensions such as cognitive, emotional or somatic are affected, compromising the child's school routine. [5]

Healthy integral development provides children with adaptive ease, a better knowledge acquisition process, among other characteristics that contribute to good school performance. Therefore, it is expected that children with excessive ST will have difficulty in the school journey. [7, 33].

Certain authors [30, 32], consider that as a consequence of high ST there is a decline in school performance, relating it to the losses related to the aforementioned behavioral changes, emphasizing the worsening of mental health and difficulties in concentration. There is emphasis on a breakdown of interpersonal exchanges, perceptive bombardment, changes in sleep patterns, amplification of behaviors related to sedentary lifestyle and insufficient intellectual stimulation, as an effect of screen use in childhood, and which may be directly related to the impairment not only of performance, but of the child's school life. [14, 27, 35]

Another factor that can negatively interfere with school life is called computer vision syndrome, which is understood as blurred and/or cloudy vision, eye irritation and long-term myopia, this being another factor of difficulty in school life related to learning. [7, 33]

CONCLUSION

It was observed that the manipulation of digital media (screens) by children shows a substantial amount of neuropsychological impacts, even more than initially conjectured.

The occurrence of recurrent digital stimulation above the ST recommended by the World Health Organization (WHO), American Pediatric Association (APA), and Brazilian Pediatric Society (SBP), represents a risk in relation to the appearance of damage in the neurological, cognitive, behavioral, and social dimensions of the child.

The main neuropsychological impacts found in the research were changes in the brain surface in preschoolers, evidenced by lower microstructural integrity of the white matter portions (related to literacy and language skills), lower cortical sulcal depth in the right supramarginal gyrus, in the postcentral gyrus, and in the lingual gyrus (responsible for recognizing printed letters). In addition, higher ST was related to 'cognitive impoverishment' due to 'passive distraction', compromising cognitive processes such as attention, memory, learning, and verbal and socioemotional language.

Regarding behavioral impacts, the main findings were changes in sleep patterns, hyperactivity, isolation, sedentary lifestyle and irritability, episodes of screen addiction, worse psychosocial well-being and the appearance of depressive symptoms and computer vision syndrome.

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Children's motor development is part of the necessary adaptive maturation process, so attention should be paid to the tendency towards isolation and sedentary lifestyle that excessive screen time can cause, in addition to other problems mentioned.

It is emphasized that, in addition to the screen time being controlled for the recommended scores, it is necessary to control the content of the interaction between the child and the screen device, paying attention to the need for co-viewing, that is, the child should be monitored regarding the use of devices for interactions with educational media that maintain the level of cognitive stimulation expected for this period. The 'ST/quality of digital stimulus' factor can be beneficial for the child if used at the appropriate time and for interaction with content that generates cognitive enrichment, such as educational media, and not just entertainment, where memory capacity and perceptive reasoning can be improved.

However, although there is a consensus that there are benefits arising from interaction with digital media, in relation to children, the preferred standard in the literature is still interaction with stimuli coming from non-digital sources and from affective socio-interactivity with parents/caregivers and peers.

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