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REVIEW ARTICLE

Impact of Abusive Screen use on Childhood Neurodevelopment: Systematic Review

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ABSTRACT
The use of technology has been widely studied as an influential factor in children's learning and development; however, the neurodevelopment of early childhood goes through critical periods that are very sensitive to technological overexposure. The literature reviewed links their early and abusive use with difficulties and negative consequences on executive functioning, as well as on cognitive, linguistic, and socio-emotional areas. Consequently, a systematic review of 14 articles is presented, prepared under the PRISMA guidelines, to understand the impact of the abusive use of screens on neurotypical neurodevelopment between 0 and 12 years, especially on executive functioning. The results find significant relationships between exposure to screens and lower executive performance from 14 months to 9 years of age, especially on inhibitory control. There is a negative impact immediately, in the short and long term. Likewise, other exposure variables that affect executive performance have been identified. More experimental studies are needed to support the causality and directionality of the findings, as well as quantitative instruments that allow real-time exposure to screens to be measured more objectively.
Keywords: screens, impact, neurodevelopment, executive functioning, children.

1. Introduction

In the current Information Society, the use of Information and Communication Technologies is commonly integrated into the lives of children and adults. Its use in childhood is varied both in purposes and in time of consumption. Both factors have been studied as influential environmental elements in children's learning and development at Hsin and Tsai have reported[1] as well as others authors[2,3]. Likewise, its early, abusive, and disproportionate use has been linked to difficulties and negative consequences on executive functioning, as well as on cognitive, linguistic, and social abilities of child development at American Academy of Pediatrics[4], Huber et al[6] and Suárez Tipán[7] have conclude. Consequently, several international organizations[4,5] have published recommendations for their limited use.

The negative impact of abusive screen use on various components of children's executive functioning is scientifically based, but the scarcity of experimental studies and regressive observational studies makes it difficult to understand the causality and directionality of the findings. Likewise, [8]neuroimaging studies warn of unusual response patterns in children's executive functioning during exposure to screens as well as structural changes at a neurological level.

The studies reviewed focus on one or several executive components, especially highlighting inhibitory control, but it is difficult to find studies that review all children's executive functioning. In this sense, the previous search for systematic reviews that address the negative impact of abusive screen use on the entire executive functioning in childhood has generated few results on the date consulted, and even none in sources such as PROSPERO.

Given this reality, it is illuminating to carry out a systematic review to understand the impact that the abusive use of screens has on executive functions in children's neurodevelopment from birth to twelve years of age. A review like the one presented here allows us to know the current state and define the starting point for future lines of neuroeducation research that try to overcome the limitations found so far. Due to its PRISMA design, the possibility of replicating this review is guaranteed, thus providing greater transparency to the research. Furthermore, due to the relationship between executive performance and the different areas of neurodevelopment in which significant relationships have been found produced by the abusive use of screens (cognitive, linguistic, and socio-emotional).

1.1 EXECUTIVE FUNCTIONS

The Executive Functions (FFEE) is defined as a set of cognitive processes that work in a coordinated manner, allowing the control and regulation of behaviors directed toward a goal. They are necessary to plan, select and adapt the cognitive, motor, or socio-emotional response to the demands of the environment. The development of FFEE is the result of the continuous interaction between genetics, biological maturation, and interaction with the environment. Currently, as suggested Frejerman and Grañana[9], significant relationships have been established between FFEE, various neurodevelopmental disorders and learning processes, therefore they are considered decisive for social and academic performance.

1.1.1 Neural Bases of Executive Functions

Although they interrelate different brain areas, the FFEE has been mainly linked to the activity of the frontal cortex (dorsolateral, medial, and orbitofrontal) and the cingulate cortex. It is considered that there is a preformed biological component in the neonate from gestational sex to month, but its development and ability to apply executive performance depends on the frontal cortex corticalization and maturation during early childhood as well as the environmental stimulation received. For this, the processes of myelination and synaptogenesis are decisive; consequently, the 2-5-year stage is considered a sensitive period for the development of the FFEE.

1.1.2 Main Executive Functions

Following the pyramidal development model of executive functions proposed by Anderson[10], there are simpler executive functions that support the development of more complex ones. Early childhood is equivalent to the base of the pyramid, where risk-benefit detection and inhibitory control are found; both are related to attentional control and the establishment of goals or objectives. During second childhood, those functions of the second pyramidal level such as working memory, planning, and flexibility develop.

Inhibitory control refers to the ability to suppress, stop and control affective, cognitive, and behavioral responses depending on the task and context. A differentiation can be made between attentional inhibition (necessary to develop flexibility) and behavioral inhibition (necessary for decision-making, delaying gratification, adapting behavior to the norm, or developing reflexivity). Deficits in inhibitory control have been correlated with neurodevelopmental disorders such as ADHD or OCD. Wu et al[11] associated a screen time of more than 90 minutes a day with hyperactive behaviors between 0-3 years of age.

Regarding attention, two types are distinguished: passive and active. The second involves a conscious effort by the subject and can be of a directed and selective type (necessary to develop planning and flexibility) or of a sustained and divided type (necessary to develop working memory and decision-making). Jourdren, Bucaille, and Ropars[12] found significant correlations between overexposure to screens and deficits in selective and sustained attention in both early and second childhood.

The establishment of goals and objectives involves executive elements such as the temporal-space organization of behavior, controlling the sequence of action, maintenance of activity, and the mental representation of the objective. Arora and Arora[13] raised the possibility that the artificial intelligence components included in mobile devices had a negative impact on the long-term risk detection capacity in the child population.

Working memory serves to maintain and manipulate small amounts of information for a short period, therefore it is necessary to execute planning and decision-making functions. It has been linked to academic performance, being relevant to assimilate new information and accommodate it to previous knowledge.

Cognitive flexibility is the ability to change and adapt mental schemas and actions in the face of new challenges or unexpected situations, choosing the most appropriate and effective response from a set of options. It is essential in solving problems and in the practical application of knowledge. The deficit in cognitive flexibility gives rise to perseverative behaviors, causes a low tolerance for frustration and an increase in anxious behaviors. Cui, Li, and Dong[14] demonstrated that sedentary exposure time to recreational screens correlated with less cognitive flexibility.

Decision-making involves all the above executive functions. A certain degree of awareness about the decision-making process is seen from the age of six, although its development is intense until the age of eight and its consolidation occurs until the age of twenty-five. Manwell, Merelle, and Ciccarelli[15] point out that overexposure to screens during brain development causes neurological effects like those observed in adults diagnosed with cognitive impairment. They assume that there is a real risk that the current child and adolescent population will present accelerated neurodegeneration and that this will negatively influence their ability to make decisions and, consequently, their quality of life, autonomy, and social functioning.

1.1.3 Executive Functions and Language

Current literature suggests that the relationship between FFEE and language could be reciprocal and bidirectional since they involve interrelated brain areas and processes. Working memory is identified as the most determining function in linguistic development because it implies having attentional dominance and the ability to retain and evoke information[16]. Likewise, significant relationships have been found between the amount of lexicon, verbal fluency, and phonological awareness with executive functions such as inhibitory control, working memory and cognitive flexibility[17,18].

1.2 USE AND ABUSE OF INFORMATION AND COMMUNICATION TECHNOLOGIES

According to Zambrano[19], Information and Communication Technologies (ICT) refers to all those technological tools that store, process, and transmit information, generating a perceptible result in three formats: text, image, and audio. Today they are associated with devices such as television, video games, consoles, mobile phones, tablets, and computers, among others. In common, all of them show information to the surface through screens, which is why they are recognized under this term.

When these devices (ICT / screens) are consumed abusively, it means that the time, frequency or pattern of exposure and use is higher than what is recommended by health authorities, and therefore pose a danger to the user. In this sense, the American Academy of Pediatrics[5] recommends zero screen exposure for children before the age of two and 30-60 minutes a day between the ages of seven and twelve. Add a shared display with the adult, which is used as an opportunity for real social interaction, which preferably involves quality educational content, which is used interactively, and which never coincides with family leisure, eating or rest routines.

Despite health warnings, Pons et al[20] found that in 80% of cases the start of television consumption occurs before the age of two and that, in addition, 50% of the child population exceeds the recommended time limits, marking an average of 71 minutes per day. in children under two years of age. Along the same lines are the findings of Waisman, Hidalgo and Rossi[21], or those of Rodríguez Sas and Estrada[22], who found evidence of daily exposure to screens for 60 minutes in children under twelve months.

2. Materials and Methodology / Methods

A systematic review of the scientific literature published in the last ten years is presented, related to the effects that screens have on the neurodevelopment of early childhood. This study aims to know the impact that the abusive use of screens has on executive functions in children's neurodevelopment from birth to twelve years of age.

2.1 TYPE OF STUDY

The review process follows the PRISMA guidelines proposed by Page et al[23], for conducting systematic reviews and meta-analyses. Primary sources have been reviewed, specifically experimental studies and analytical observational studies.

2.2 PROCEDURE AND DATA COLLECTION

In the process of planning, procedure, data collection and analysis of this review, the online tool Parfisal was used, while the Mendeley tool was used for filing, organizing, and eliminating duplicate articles.

2.2.1 Terms used and databases

During the last week of April, a preliminary search was carried out combining the terms screen time, media exposure, and executive-functions with the Boolean operators OR and AND as links respectively, to establish an initial estimate of the feasibility of such a review. Subsequently, on May 16, 2023, the systematic search was carried out in the PubMed, Science Direct, Scopus and ProQuest databases using the same combination of terms mentioned and applying the filters available in each database, as detailed in Table 1. The search was limited to the period 2013-2023.

2.2.2 Search strings and study selection criteria

The search terms were adapted to the search advice of each of the databases, as shown in Table 2.

Table 1. Filters applied in the systematic search, according to the database consulted.

Data base	Filters applied
PubMed	*Articles published between 2013-2023; Access to the abstract and full text; Clinical studies; Clinical trial; Randomized clinical trial; Randomized controlled trial; Birth-1month; Children 1-23 months; Preschoolers 2-5 years; Children 6-12 years old.*
Science Direct	Articles published in the last 10 years; Research articles; Research areas: neuroscience, psychology, and social sciences; Open access to the text.
Scopus	Articles published between 2013-2023; Research areas: psychology, neuroscience, social sciences; Children, preschoolers; Controlled studies; Language: Spanish and English.
ProQuest	Articles published between 2013-2023; Access to full text; Published in scientific journals; Evidence based medicine; Clinical studies; Longitudinal studies; Investigation; Pediatrics; Children and young people; Preschools; Child's Health; Cognitive abilities; Exclude systematic reviews.

Table 2. Combination of terms used in the systematic search, according to the database consulted.

Data base	Filtres applied
Base Chain	*(Screen time OR media exposure) AND (executive functions)*
PubMed	*((screen time) OR (media exposure)) AND (executive functions)*
Science Direct	*((“screen time”) OR (“media exposure”)) AND (“executive functions”)*
Scopus	*(“screen time” OR “media exposure”) AND (“executive functions”)*
Proquest	***“Screen time” OR “media exposure” AND “executive functions”***

2.2.3 Eligibility criteria: inclusion and exclusion

After the automatic screening of the databases, the title and abstract of each study found were read to carry out a second manual and deliberate screening of those articles that differed from the object of study for this review. In this way, the number of articles to be included in the eligibility process was considerably reduced. Afterward, the full texts of these articles were analyzed in detail again to definitively screen them, based on different inclusion and exclusion criteria defined for each PICOC indicator shown in Table 3. Finally, a total of 14 articles were included in the systematic review.

Table 3. PICOC table. Inclusion and exclusion criteria for article eligibility.

	Inclusion criteria	**Exclusion criteria**
Population	*Age range 0-12 years.* *Male and female gender.* *Typical neurodevelopment.* *Probabilistic Yes/No Sample*	*Premature children.* *Age over 12 years.* *Atypical neurodevelopment / Diagnosed or suspected disorders.*
Intervention	*Screen usage time greater than recommended by AAP (2016b).* *Active or passive use of screens* *Use of Television, Tablet and/or Mobile.* *Measurement of executive functions through standardized tests*	*Not specified: screen time, and/or controlled variables in average exposure, and/or type of screens, and/or standardized tools to assess executive functions.*
Comparison	*Use of screens null or in accordance with the recommendations of the AAP (2016b).* *Medium exposure with controlled variables*	
Results	*Significant evidence on (one or more) executive functions, memory, language, inhibition, flexibility, attention.*	*Non-significant evidence.* *Significant evidence in other areas of neurodevelopment.*
Context	*International.* *Publication in Spanish or English.* *Access to full text.* *Period 2013-2023.* *Experimental studies.* *Analytical observational studies*	*Limited access.* *Publication before 2013.* *Descriptive studies.* *Study of cases.* *Review articles.* *Systematic reviews.*

2.3 CODING OF STUDIES

After the searches were carried out, a total of 172 articles were obtained: 6 in Pubmed, 21 in Science Direct, 103 in Scopus and 42 in Proquest. In the search, the following filters were applied commonly to all the databases consulted: publications from the last 10 years, open access, and only research articles. In each database, extra filters were added according to the options provided by the database, as specified in Table 1. Subsequently, the titles and abstracts of each result were read and those that included case studies, descriptive studies, and systematic reviews were discarded., as dissertations or theses. Likewise, all those that were not directly related to the object of study of this review were eliminated. In this way, 142 articles were excluded from the total obtained. Based on the results found in the databases, a total of 11 more articles, found in the bibliographic references of different reviews and publications, were also included in the identification and screening process. After eliminating duplicate articles, 38 articles were obtained as eligible, whose content was analyzed in its entirety and to which the inclusion and exclusion criteria in Table 3 were applied.

A total of 23 articles were excluded for the following reasons: 5 articles did not contemplate direct intervention on screen time and executive functions, with one or both variables being studied as covariates or consequences within a study with a different objective; 10 articles lacked access to full text; 5 articles presented a sample aged over twelve years; 2 articles were descriptive; and another 2 articles included samples from another larger study whose population presents diverse neurodevelopment, both typical and atypical. Finally, a total of 14 articles were included in the review: nine coming from databases and six from bibliographic references.

The process of identification, screening and inclusion of articles was carried out following rigorous analysis and control, in accordance with the PRISMA guidelines as described in the flow chart in Figure 1.

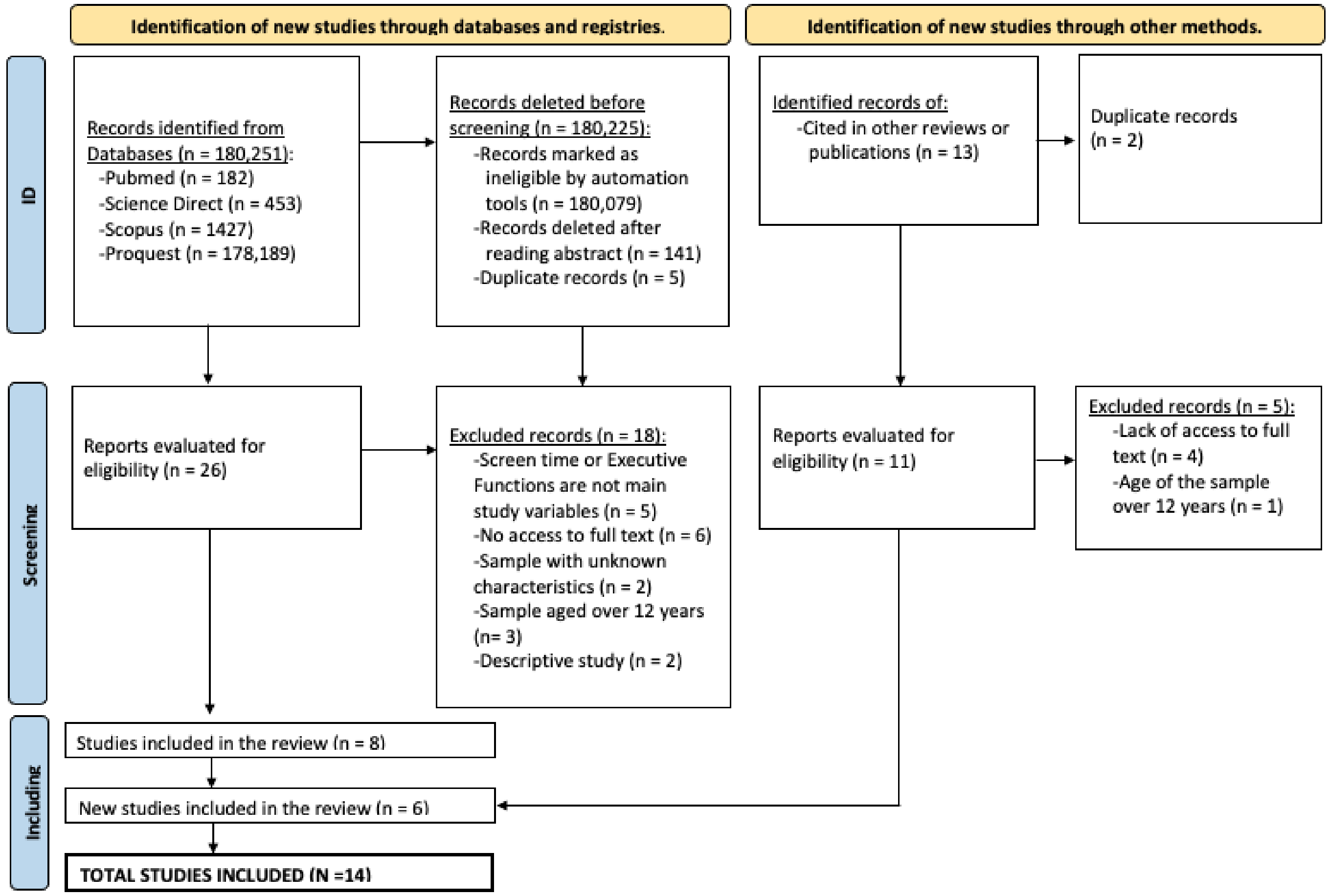

Figure 1. Flowchart according to PRISMA guidelines.

3. Results and Discussion

The objective set in this review is to know the impact that the abusive use of screens has on executive functions in children's neurodevelopment from birth to twelve years of age. A total of fourteen articles have been analyzed in this systematic review. Except for a single article, the rest have found negative impacts or relationships between the use of screens and one or more executive components, which supports the narrative described in the theoretical framework.

Unlike most articles, Lui et al[24], did not identify significant relationships between screen exposure time and inhibitory control capacity, nor with global executive performance (inhibitory control, working memory, flexibility, and regulation) at 10 months of age. The findings obtained differ from McHarg[25] who found a significant relationship between screen time at 4 months of age and inhibitory control months later. Both articles present the youngest sample of the systematic review, although it is true that while Lui et al[24], propose a cross-sectional study, that of McHarg[25] is longitudinal. Likewise, Lui et al[24], only carried out the measurement of inhibitory control in a laboratory situation through a prohibition task; The rest of the global executive score was obtained using the EEFQ scale completed by the parents. On the other hand, McHarg[25] carried out all the evaluations in a laboratory situation, using other types of tasks. Therefore, in addition to the age of the sample and the type of study, the standardization and objectivity in the evaluation procedure as well as the type of task used to evaluate inhibitory control may be influencing the results.

In most articles, a negative impact of exposure to screens on various executive functions has been found. Inhibitory control is the most studied function as it is contemplated in seven of the fourteen articles reviewed[24,25,26,27,28,29,30]. In all cases, it has been evaluated in a laboratory situation, mainly through the go/no-go task and the Stroop task. In children under one year old, no negate

ve results have been found between screen time and inhibitory performance in the present moment[24]. This result is repeated in children aged 3.5 years[28]. However, retrospectively, and longitudinally, a negative impact is seen in both 14-

month-old children and 3.5-year-old children[25,28]. In contrast, Portugal et al[29], found no relationship between screen time and executive performance longitudinally, but the negative relationship between the two was significant when consuming content not aimed at children. At older ages, 5 to 7 years, experimental evidence has been found of how the fantastic content and rhythm of viewing on screens leads to a lower inhibitory capacity immediately after exposure to screens[26,30]. It seems that the age of the sample is an important variable in the screens-inhibitory control relationship; medium-long-term effects are seen when the subject is smaller and immediate effects are seen when the subject is older. However, more experimental studies are required to infer causality and generalize these results. Likewise, exposure time and the type of content viewed are two other variables that stand out in the screens-inhibitory control relationship.

Working memory (WM) and attention are the second most studied executive functions, with results found in five and two of the articles reviewed respectively. All cases have been studied in a laboratory situation; to evaluate WM, the dimensional change card sorting task (DCCS) and various spatial localization tasks have been used mostly, while the CBCL child behavior measurement scale is recurrent to evaluate attention. Four of the five articles that address WM have found negative effects of screen use on it at ages between 3-6 years [29, 30, 31,32]. In them, significant relationships have been found concerning the total time of exposure to screens (harmful from 15 min./day) and with respect to the visualization of fantasy content (generates lower memory performance), both simultaneously and months later. The remaining article that has not found a direct relationship between screens and WM[25] differs from the previous ones in the age of the sample, which was much younger (4-14 months). Regarding attentional capacity, both mentioned articles[33, 34] find a negative impact between it and the total time of exposure to screens significant from 1h/day, both transversely and longitudinally, as well as in samples with very different ages (2-5 and 9 years, respectively). In the case of Axelsson et al[33], the relationship is significant when exposure to screens is for entertainment. All of this suggests that both age and type of content are important variables in the triadic screens-MT-attention relationship. It should be noted that WM involves the activation of sustained attention, therefore it is appropriate to think that if the impact of screens on sustained attention were explicitly studied, results like those found for WM could be expected.

The linguistic dimension is the third most studied area. It appears in four of the articles reviewed. In all cases, the screen-language relationship has been evaluated transversely, using a different linguistic evaluation test in each case. Three of them have found negative associations between screen time and communication skills, in a range of 8 months to 5 years of age and from an exposure time greater than 1.5h/day[33, 35, 36]. Up to 17 months of age, screen time is associated with lower mimic-gestural ability, while from 18 months onwards, an impact on the lexical quotient and global communicative score is observed, depending on the assessment test used. Zhang et al[32], are the only one of the four articles that find no relationship between screen time and expressive vocabulary. Unlike the previous ones, this study only evaluates a single component of language. Of all the articles reviewed on the screen-language relationship, some gaps stand out to be considered in future research: no causality is inferred in the results and therefore the directionality of the screen effect is not clearly determined, the linguistic evaluation tests have been different and the objectivity of the data varies depending on whether they have been applied in a laboratory situation[32,33], or have been completed by families through questionnaires [33,36]. Finally, there are no references to experimental or longitudinal studies.

Cognitive flexibility is also made explicit in four of the fourteen articles reviewed. It has been evaluated both transversely and longitudinally, studying its relationship with screen time and the type of content viewed in a laboratory situation. Two very different age groups are observed, with different results: from 4 to 14 months, there is no longitudinal relationship between screen time and flexibility, measured through the Run Ball task[25], nor have any studies been found that replicate this research in a cross-sectional manner. The rest of the studies have used the DCCS task to evaluate both variables, at ages from 3.5 to 5 years[29,30,31]. In these cases, significant negative associations are found from 15min/day of exposure, both transversely and longitudinally. Likewise, a negative association is also found between fantasy content and cognitive flexibility[30].

For its part, planning has only been specifically studied in a single article of all those reviewed, in children aged 5-6 years[30]. Negative relationships are evident between exposure to screens and processing speed, significant from very few minutes of exposure; however, there are no differences in planning precision depending on the content displayed (fantastic/realistic). It would be convenient to replicate this design to be able to study this relationship in more depth, also considering samples of different ages, different durations of exposure to screens and different types of content.

On the other hand, in addition to the time of exposure to screens, the articles reviewed also indicate that the context of exposure can be a relevant variable in the impact of screens on executive functions. In the covariates considered, significant relationships have been found with support during screen viewing[33], with sociodemographic factors[25,34], with the level of involvement active/passive of the viewer[24,29,37], with the purpose of using the screens[29,33,37] and with the content viewed[30]. More efforts are needed to unify the type of design and the variables/co-variables raised in the study,

When focusing the analysis of the results on the sample used, a greater presence of modest samples is observed. Eight articles have a sample of less than 100 subjects, five articles[24,25,28,34,36] have an intermediate sample between 100 and 500 subjects, and only a single article[37] presents a sample of more than 1000 subjects.
The age range of the sample ranges from 8 months to 9 years when considering all the articles reviewed. The most studied period is 2-6 years in nine articles[27,28,29,30,31,32,33,35,37], which is associated with the moment of maximum development of executive functions. Three articles[24,25,36] include a sample of less than 24 months, another two[26,34] that exceed 6 years, focusing on 7 and 9 years.

According to the research design, only two experimental studies appear[26,30]. Its sample is modest and its age ranges between 5-7 years. It should be remembered that their study variables focused on the content and rhythm of viewing on screens, but not on the time of exposure to screens. On the other hand, all studies that consider the variable of exposure time are studies with an analytical observational design, so their results cannot be generalized, or causality inferred. Likewise, within the twelve observational articles, eight carry out a cross-sectional analysis and four carry out a longitudinal analysis. These twelve articles have collected data about exposure time and screen use through parental questionnaires, therefore there is a certain subjective burden. Of those twelve, nine use questionnaires and three use diaries[29,34,37]. Among the articles that use questionnaires, there is one with a non-standardized questionnaire[24] and three others with non-specific questionnaires[25,27,28]; the remaining five do use standardized and specific questionnaires.

Therefore, the present review has revealed the following:

- 90% of the articles reviewed (13 of 14) find significant relationships between exposure to screens and lower global executive functioning and/or in specific areas thereof, in children from 14 months to 9 years.
- The relationships were found to denote a negative impact on executive performance immediately, in the short term and longitudinally.
- Inhibitory control is the most studied executive function in its relationship with exposure to screens. The age of the viewer appears to be an important variable in how long it takes for negative effects to manifest.
- Different variables of screen exposure have been found to affect executive performance, such as: content (entertainment / educational / relaxing / children / adult), duration of exposure, accumulated exposure time, viewing context (only / accompanied), rhythm of the image displayed (fast / slow) and attitude of the viewer (active / passive).
- Neuroimaging tests find significant relationships between screen time (greater than 1h/day), white matter integrity, and frontocentral and parietal cortical activity in children under 5 years of age. Furthermore, the rhythm of the image projected on screens produces unusual brain activation during inhibitory tasks.
- The majority design of the articles included in this review (observational correlative) makes it difficult to infer the causality and directionality of the findings. More experimental studies are needed.
- In 80% of the articles reviewed (12 out of 14), the methods for collecting information related to screen exposure time/consumption have been questionnaires and diaries completed by families. These methods involve subjective load and therefore only offer an estimate of time. Automatic measurement and recording tools are needed that provide real and objective consumption times.
- The study of the impact of screens on executive performance is an international concern and is mostly carried out in developed countries. This review only includes a single article from a developing country (Martins et al., 2020). Likewise, the absence of articles published in Spain stands out in this review.

4. Conclusions

The results obtained indicate that exposure to screens is negatively related to children's executive performance. Therefore, the recommendations of health organizations such as the Word Health Organization (WHO) or the American Academy of Pediatrics (AAP) regarding screen consumption time in childhood are justified. However, the lack of experimental studies makes generalization, causal inference, and directionality of these findings difficult.

The scarcity of experimental research that offers solid conclusions on longitudinal impact is justified by an ethical issue when establishing control groups: it is indecent to force a group of healthy subjects to excessive exposure to screens, considering the secondary and negative effects that can occur in their neurodevelopment. Furthermore, the possibility that these effects were irreversible must be considered. This element also explains that the few experimental articles included in the review[26,30] are cross-sectional and that they focus their independent variables on specific aspects of visualization (image rhythm and fantasy content, respectively) instead of in the exposure time.

This systematic review offers a synthesized collection of data and a deepening of knowledge of the most up-to-date scientific contributions regarding the object of study. On the one hand, it outlines the strengths and weaknesses of the reviewed literature. It also proposes a starting point for future research and to guide the design of educational interventions. On the other hand, it allows us to glimpse a current incidence of screen consumption in childhood that is much higher than health recommendations. In this sense, the present review can raise reader awareness about the negative effects of screen exposure on executive functioning. Lastly, this review favors a reflective climate for the educational and technological community, so that they can weigh the advantages and disadvantages of using screens in children's lives, taking into consideration not only the exposure time but other variables such as content, viewing context or the viewer's interaction with the screen; all of them are aspects in which the technological market and the teaching function can actively participate. Altogether, it is expected that these reflections will make it possible to adjust educational practice and provide a didactic use of technology that is much more in line with the needs and neurological maturation of children of infant age, reducing risks for neurodevelopment.

Among the limitations of this review, the exclusion of several experimental articles stands out due to the lack of access to full text. It is necessary for the scientific community to facilitate accessibility to new findings to promote the dissemination, transparency, and feedback of information. For example, the articles by Huber et al[38], Hutton[35] and Raya[39] are considered relevant to consider in future systematic reviews, as they also contain neuroimaging support. Regarding the limitations found here, it is also necessary that future research, regardless of its design, advocates for real timing of consumption time and exposure to screens, evaluating other more quantitative methods for collecting information that can complement each other, such as technological applications of facial recognition, content histories, time-of-use timing, etc. It would also be interesting, as part of multifactorial research, to compare the estimate of screen time that families perceive about their children with the actual consumption time. Again, it would be useful to raise awareness and guide educational intervention in the family environment.

Conflicts of interest statement.

The authors have no conflicts of interest to declare.

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