

Excessive Use of Digital Devices and Autism Spectrum Disorder (ASD): An Umbrella Review

Panteha Dabaghpour¹

¹ Institute for Cognitive and Brain Science, Shahid Beheshti University, Tehran, Iran

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Abstract

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by persistent deficits in social communication and interaction across multiple contexts, alongside restricted, repetitive patterns of behavior, interests, or activities. Recent studies investigating the role of screen time in the manifestation of autistic-like symptoms suggest that excessive early digital exposure may contribute to these symptoms in children. This umbrella review systematically examined existing systematic reviews that explored the relationship between the excessive use of digital devices and autistic-like symptoms. The initial systematic search yielded 219 records. After removing duplicates, 72 articles underwent rigorous title and abstract screening, leading to the exclusion of 66 non-qualifying articles. A full-text review of the remaining 6 articles resulted in the exclusion of 3 systematic reviews that did not specifically focus on the ASD-screen time association. Consequently, the final analysis included 3 qualifying systematic reviews. The findings of this umbrella review reveal a complex and nuanced relationship between screen time and Autism Spectrum Disorder. While some studies indicate a potential association and emphasize factors such as content, context, ASD assessment measures, and screen type, others report conflicting results or find no significant correlation.

Keywords: Autism, ASD, Digital Devices, Digital Nannyng

* Corresponding author

Email addresses: pdabaghpour@gmail.com



1. Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder defined by persistent deficits in social communication and interaction across various contexts, coupled with restricted, repetitive patterns of behavior, interests, or activities. These symptoms typically emerge during early developmental stages, though their full manifestation may not become apparent until social demands surpass an individual's limited capacities (American Psychiatric Association, 2022).

Individuals with ASD frequently experience a reduced quality of life compared to neurotypical individuals, primarily due to social isolation and diminished self-esteem, which can predispose them to anxiety and depression (Hymas, Badcock, & Milne, 2022). The escalating prevalence of ASD has become a substantial global health concern (Ophir, Rosenberg, Tikochinski, Dalyot & Lipshits-Braziler, 2023), intensifying scrutiny on potential contributing factors.

Although the precise etiology of autism remains elusive, research indicates that a combination of genetic and environmental interactions likely plays a significant role (Shanmugarajah, Rosenbaum & Di Rezze, 2022). Environmental factors, which may account for at least 50% of autism risk, can encompass prenatal or postnatal influences, such as hormonal exposure during gestation affecting fetal development (Tordjman et al., 2014) or maternal separation (Mansouri et al., 2021). Among these potential risk factors, excessive exposure to digital devices, particularly at an early age, warrants specific attention. Multiple studies have identified a correlation between extensive screen time and autism-like symptoms (Heffler & Oestreicher, 2016; Lewis, Tanimura, Lee & Bodfish, 2007).

While electronic devices offer undeniable advantages, excessive screen exposure can adversely impact a child's brain development (Tierney & Nelson, 2009). A 2019 study investigated the potential effects of increased screen time on white matter development in toddlers and preschoolers. White matter is critical for cognitive function, language, and literacy skills (Hutton, Dudley, Horowitz-Kraus, DeWitt & Holland 2020). These developmental delays may arise from alterations in white matter, as previously discussed, as well as from neurochemical disruptions.

Excessive exposure to screen light may diminish melatonin production, thereby negatively affecting sleep patterns. Furthermore, deficiencies in neurotransmitters such as dopamine, acetylcholine, gamma-aminobutyric acid (GABA), and serotonin (5-HT) have been observed in children with internet addiction, particularly in urban settings, leading to both physical and psychological symptoms (Aziz, Aljammas, Al-Allaf, 2023).

Heffler and Oestreicher (2016) proposed a developmental pathway for autism. Their model suggests that early exposure to screen-based audiovisual stimuli during infancy specializes neural pathways in processing sensory inputs in a non-social manner. These specialized pathways subsequently compete with social processing preferences, thereby impeding the development of higher cognitive and social functions.

Several theoretical explanations account for the bidirectional relationship between screen use and ASD. The displacement theory posits that excessive screen time may supplant critical real-life experiences, such as interpersonal interactions, physical activity, and educational engagement, potentially affecting individuals with ASD (Browne, Thompson & Madigan, 2020; Madigan, McArthur, Anhorn, Eirich & Christakis, 2020). The social isolation hypothesis suggests

that prolonged screen use can reduce social interactions with peers and family (Varni et al., 2014). Such interactions are fundamental for language development, communication, and socioemotional skills (Slobodin, Heffler & Davidovitch 2019).

Conversely, some reviews have explored the inverse relationship, proposing that children with ASD may exhibit a greater propensity for screen-based activities than their neurotypical peers. This hypothesis suggests that screen use functions as a coping mechanism to circumvent real-world social challenges (Slobodin et al., 2019; Stiller & Mößle, 2018).

While numerous studies have identified correlations between prolonged screen use and autism-like symptoms (Heffler & Oestreicher, 2016; Lewin, 2007), the precise causal relationship remains ambiguous. Some researchers, such as Slobodin et al. (2019), emphasize that methodological and population heterogeneity in existing studies constrain their findings, asserting: “There is no data to confirm or refute a causal link between ASD and screen use.”

Despite these observations, emerging evidence suggests a potential causal relationship between autism (or autism-like symptoms) and screen use, supported by both animal studies and human research. Investigators in this field have even coined the term “Digital Nannyng,” underscoring the necessity for further research into the link between ASD and excessive digital device usage. As articulated in a study by Pouretamad et al. (2022), “Digital Nannyng” describes the phenomenon where children lack genuine interaction with caregivers, instead being exposed to digital media devices for more than half of their waking hours.

This study represents the first umbrella review to examine the association between screen use and autism-like symptoms. The research questions guiding this study aim to consolidate evidence on the ASD-screen use relationship:

1. Is there an association between autism and screen use?
2. Does a causal relationship exist between the two?

2. Method

An umbrella review represents a comprehensive research approach that synthesizes and integrates findings from existing systematic reviews and meta-analyses. In this methodology, the primary units of analysis are systematic reviews and other review articles (Tsagris & Fragkos, 2016). For the current umbrella review, all the studies meeting The inclusion criteria, without imposing temporal restrictions on publication dates, were examined to rigorously address The two primary research questions.

Inclusion Criteria:

Publications were required to satisfy the following criteria for inclusion:

1. Must constitute a systematic review (with or without meta-analysis);
2. Must include at least one child or adult with ASD as operationally defined by the review authors;
3. Must be published in a peer-reviewed academic journal;
4. Must be published in English.

Exclusion criteria comprised: (1) failure to meet inclusion requirements, or (2) systematic reviews limited to specific geographic regions without broader applicability.

Systematic Search Strategy:

An exhaustive literature search was conducted across three major databases: Google Scholar, PubMed, and Scopus. The advanced Boolean search strategy employed the following parameters:

("Autism Spectrum Disorder"(Mesh) OR "Autism Spectrum Disorder"(tw) OR "autistic disorder"(tw) OR "Asperger syndrome"(tw) OR "autism"(tw) OR "disorder, autistic"(tw) OR "Asperger disease"(tw) OR "Asperger disorder"(tw)) AND ("Screen Time"(Mesh) OR "screen time"(tw) OR "Screen use"(tw) OR "video time"(tw) OR "electronic equipment"(tw) OR "electronic products"(tw) OR "multimedia equipment"(tw) OR "digital equipment"(tw) OR "Digital nannyng"(tw))

Quality Assurance Protocol:

To ensure methodological rigor, a dual-reviewer system was implemented. A trained graduate student in cognitive psychology independently conducted parallel data extraction. Any discrepancies between reviewers were resolved through consensus-based discussion following established protocols.

Structured Data Extraction:

We systematically extracted and cataloged the following key information:

- Author names and publication year
- Research methodology and design
- Significant findings relevant to the research objectives

The complete data extraction matrix is presented in the Results section.

Study Selection Process:

The systematic search yielded 219 initial records. After duplicate removal, 72 articles underwent rigorous title/abstract screening, resulting in the exclusion of 66 non-qualifying articles. A full-text review of the remaining 6 articles led to the exclusion of 3 systematic reviews that did not focus on the ASD-screen time association. The final analysis included 3 qualifying systematic reviews.

Overlap Analysis and Final Sample:

Analysis revealed:

- 14 overlapping studies across the 3 included reviews
- 73 total unique sources cited
- 59 non-redundant studies after overlap adjustment

Aggregate sample size of approximately 605,871 participants after accounting for overlaps

The complete study selection process, presented according to PRISMA guidelines, is detailed in Figure 1. Additionally, the characteristics of the included reviews are presented in Table 1.

Figure 1 *study selection process*

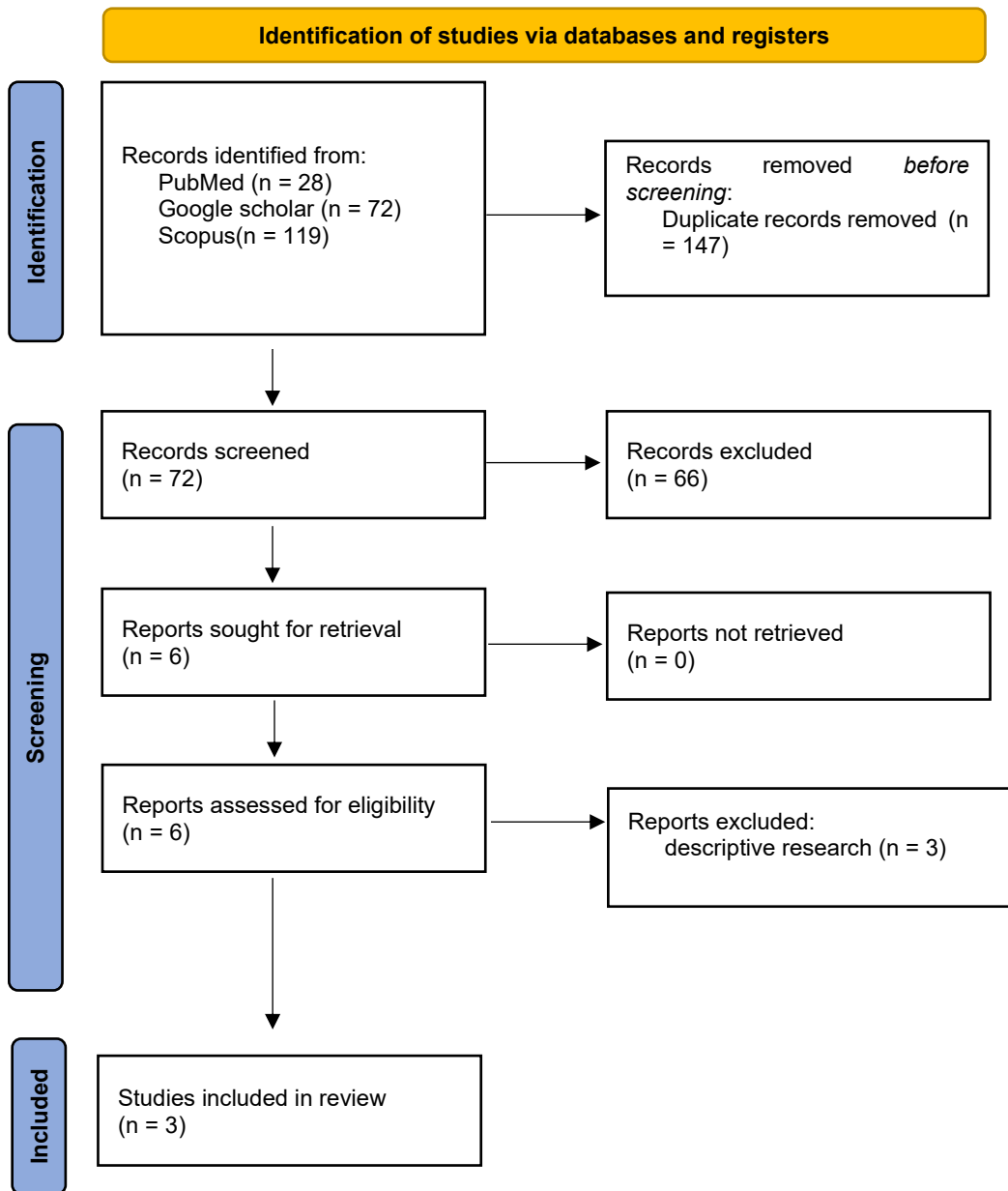


Table 1 Characteristics of included reviews

Author (year)	Characteristics of Systematic Review	Characteristics of Included Studies
Slobodin et al. (2019)	<p>Type: Narrative synthesis only</p> <p>Objectives: “to systematically review the important information about how ASD is associated with screen use and exposure.”</p> <p>Number of included studies: 16</p> <p>Search limit (years): from inception to April 2018</p> <p>Study designs: all included studies were cross-sectional.</p> <p>Quality of studies: Not specified</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Not specified</p>	<p>Participant characteristics</p> <p>Number of participants: Approximately 116722</p> <p>Age: 1.5 – 21 years</p> <p>Sex: All studies except 2 included both male and female participants. The ratio of male participants in the autism spectrum disorder (ASD) group ranged from 70% to 100%. The ratio of male participants in the comparison groups was usually lower and ranged from 49% to 100%.</p> <p>Description: ASD</p> <p>Increased likelihood of ASD: Not included</p> <p>screen type measured: television, video, video game, computer, cell phone, DVD, social media, nonsocial media, device use (laptop, desktop, smart phone, ipad, ipod, tablet)</p> <p>instrument used: parent report, self-report, parent-child report</p> <p>variables measured: early exposure, content, context</p> <p>Comparison: typically developing children and/ or other clinical groups, such as attention-deficit hyperactivity disorder or language difficulty</p> <p>Findings: children and adolescents with ASD are exposed to more screen time than their typically developing peers or other clinical groups and that the exposure starts at a younger age.</p>
Sarfraz et al. (2023)	<p>Type: narrative synthesis only</p> <p>Objectives: “to qualitatively analyze the literature available on early screen time exposure and its association with the risk of developing ASD. This.”</p>	<p>Participant characteristics</p> <p>Number of participants: 53182</p> <p>Age: 16 months to six years</p> <p>Sex: All studies included both male and female participants. The number of males with autism was reported in nine studies.</p>

	<p>Number of included studies: 11</p> <p>Search limit (years): 2016 - 2022</p> <p>Study designs: cross-sectional, cohorts, case report.</p> <p>Quality of studies: Included good and fair quality</p> <p>Sources of funding: Not specified</p> <p>Conflict of interest: Specified - No conflicts</p>	<p>Description: Autism Spectrum Disorder (ASD)</p> <p>Increased likelihood of ASD: included</p> <p>screen type measured: mobile phone, tablet, ipad, television, DVD, mixed use, video game, computer</p> <p>instrument used: Not specified</p> <p>variables measured: screen-time exposure (duration of exposure), early exposure</p> <p>Comparison: children who have never been exposed to screens, children with concerns for ADHD, children compared to children exposed later.</p> <p>Findings: main finding is that the number of hours of screen time exposure is significantly associated with the development of ASD.</p>
Ophir et al. (2023)	<p>Type: Meta-analysis with narrative synthesis</p> <p>Objectives: to “To conduct a systematic review and meta-analysis of the association between screen time and ASD.”</p> <p>Number of included studies: 46</p> <p>Search limit (years): 2011-2023</p> <p>Study designs: cross-sectional, longitudinal.</p> <p>Quality of studies: relatively low</p> <p>Sources of funding: Not Specified</p> <p>Conflict of interest: Not Specified</p>	<p>Participant characteristics</p> <p>Number of participants: 562131</p> <p>Age: 0 – 21 years</p> <p>Sex: Not specified</p> <p>Description: autism spectrum disorder (ASD)</p> <p>Increased likelihood of ASD: Not included</p> <p>screen type measured: general, television, video game, computer, smart phone, social media</p> <p>instrument used: Not Specified</p> <p>variables measured: screen type, age group, type of autism measure</p> <p>Comparison: Non-diagnosed groups</p> <p>Findings: statistically significant association was found between screen time and ASD.</p>

3. Results

Association Between Screen Time and Autism Spectrum Disorder

The study findings demonstrated variability, with some indicating a potential association between excessive screen time and increased autism risk, while others found no significant relationship.

Screen Time Exposure Analysis:

Two systematic reviews (Slobodin et al., 2019; Sarfaraz et al., 2023) examined screen time exposure. Slobodin, Heffler, and Davidovitch (2019) demonstrated in their systematic review that children and adolescents with ASD spend significantly more time using digital devices (particularly television) compared to neurotypical peers. Sarfaraz et al. (2023) found that increased exposure to various screen types correlated with a higher risk of developmental disorders, including ASD, whereas children with limited screen exposure showed a reduced autism risk.

Early Screen Exposure Assessment:

Two review studies (Sarfaraz et al., 2023; Slobodin et al., 2019) investigated this factor. Slobodin, Heffler, and Davidovitch (2019) noted that screen exposure begins earlier in children with ASD. Conversely, Sarfaraz et al. (2023) reported that while early screen exposure was associated with autism-like symptoms, this difference did not reach statistical significance.

Table 2 presents a synthesized comparison of the three systematic reviews included in this umbrella review.

Content Analysis:

One review study (Slobodin et al., 2019) revealed that children with ASD were more likely to watch adult television programming than their neurotypical peers. Additionally, social media use among autistic children was significantly lower than in neurotypical control groups.

Contextual Factors:

A systematic review (Slobodin et al., 2019) indicated that parental presence during screen time correlated with positive outcomes, including improved parent-child relationships and fewer internalizing behavior problems.

Screen Type Analysis:

In a systematic review (Ophir et al., 2023), effect sizes were found to vary significantly across different screen types. Ophir, Rosenberg, Tikochinski, Dalyot & Lipshits-Braziler (2023) demonstrated that the effect size for general screen use was particularly significant. Conversely, the association between social media use and autism showed a negative correlation.

Age Group Analysis:

The same review (Ophir et al., 2023) examined effect sizes across different age groups regarding the screen time-autism association. Notably, the effect size for children was significantly larger compared to either adult or heterogeneous age groups.

Autism measure:

Ophir and colleagues (2023) also investigated the effect size of autism symptom severity in relation to screen time. Results indicated that while the effect size was marginally larger for the clinically diagnosed autism group compared to those with autism-like symptoms, this difference did not reach statistical significance.

Table 2 presents a synthesized comparison of the three systematic reviews included in this umbrella review.

Table 2 *Comparative Summary of Systematic Reviews on Screen Time an Autism Spectrum*

Disorder (ASD)

Author (Year)	Research Methodology and Design	Number of Included Studies	Total Sample Size	Age Range	Main Outcome	Screen Type Studied	Effect Sizes Reported
Sarfraz et al. (2023)	Systematic review of cohort and cross-sectional studies	11	53182	16 months-6 years	Earlier and longer screen time linked to higher ASD risk	TV, tablet, mobile phone, video game	Not reported
Ophie et al. (2023)	Systematic review and meta-analysis of observational studies (cross-sectional and longitudinal)	46	562131	Mostly children <12 years	Small but significant association between screen time and ASD; diminished after bias correction	TV, computer, smartphone, video games, social media, general screen use	Log OR = 0.54; bias-corrected log OR = 0.22
Slobodin et al. (2019)	Systematic review of cross-sectional studies	16	Approximately 116722	1.5 – 21 years	Children with ASD used more screen media, started earlier, and viewed more adult content	TV, video games, computer, phone	Not reported

4. Discussion**Objective of the Study**

This study aimed to provide an updated and, to our knowledge, the first umbrella review of the research literature on the association between screen use and autism. This umbrella review examined 3 systematic review studies.

First Systematic Review Findings

The first systematic review found that children with autism tend to have greater exposure to

screens compared to their non-autistic peers or other clinical groups, and this digital screen exposure often begins at younger ages.

Various social, financial, and time-related barriers to physical and social activities may drive children with autism toward increased screen use (Must, Phillips, Curtin & Bandini, 2015). Additionally, children with autism show a greater tendency to consume adult-oriented content and less inclination to engage with social media. Furthermore, parental presence during screen time is associated with positive outcomes.

Parental Influence on Screen Use

Research literature suggests that parents may influence screen use in two contrasting ways: On one hand, parents of children with autism are aware of the risks associated with inappropriate screen media use and therefore implement effective rules and regulations. On the other hand, some parents are more likely to use screen media for its calming effects on their children and as a way to take breaks from the challenges of caregiving (Slobodin et al., 2019).

Second Systematic Review Findings

The second systematic review demonstrated that, for children who do not exhibit typical neurodevelopment compared to their peers, the amount of screen exposure is significantly associated with the development of autism. Multiple studies have found that increased hours spent on various types of screens are linked to a higher likelihood of developmental disorders, including autism spectrum disorder (ASD), and prolonged screen exposure is associated with a greater prevalence of autism symptoms.

Screen exposure of 1–2 hours per day may potentially impact children's neurodevelopment and increase the risk of autism. Consequently, it is recommended that children's screen exposure be limited, as any amount of exposure is associated with autism risk. One primary reason for screen exposure among children is busy parents seeking to entertain their children. However, significant improvements in symptoms were observed when these children stopped screen exposure.

Additionally, some studies indicate that early screen exposure is associated with an increased risk of autism compared to those exposed later or not at all during early childhood. This may be due to the heightened sensitivity of the developing brain to genetic variables that affect later development. Early exposure to digital screens also leads to sleep disturbances, which may exacerbate screen addiction and contribute to neurodevelopmental disorders.

However, it is important to note that some studies contradict these findings. For example, Duch et al. (2020) described the relationship between early screen exposure and autism as "Early and Excessive Digital Media Exposure Syndrome" but also concluded that autism symptoms may be reversible upon discontinuation of screen exposure.

Third Systematic Review and Meta-Analysis Recommendations

Based on the third systematic review and meta-analysis, adult caregivers are encouraged to carefully monitor their children's screen time and ensure they do not miss out on real-life experiences and positive relationships essential for developing communication and emotional

skills. Recent findings suggest that the potential negative consequences associated with screen use may not be as severe as commonly believed, particularly when other factors—such as the specific type of screen use—are considered.

Certain types of screen use, depending on the nature of the interaction, may either protect against autism or be avoided by users with autism. Distinguishing between different types of devices and screen-based activities is important because it may help explain conflicting findings in the existing literature and could aid in developing more nuanced guidelines for parents.

Content-Specific Effects

Recent studies on the relationship between digital device exposure and autism symptoms have placed greater emphasis on content among influential factors (e.g., context, content, game type, age, duration of exposure, timing of exposure, etc.). One systematic review found that the effects of different types of content on this relationship vary. For example:

- The effect sizes for television, video games, computers, and smartphones were not statistically significant.
- The association between social media and autism was negative.
- The association between general screen use and autism was positive (Ophir et al., 2023).

5. Conclusion

Findings of this umbrella review reveal a complex and nuanced relationship between screen time and autism spectrum disorder. While some studies indicate a potential association, others report conflicting results or find no significant correlation. Methodological differences, variations in study populations, and the rapid evolution of digital technology may contribute to the inconsistencies observed across studies.

Among studies supporting a relationship between autism and screen time, there are also those claiming a causal link, suggesting that digital device use may contribute to the emergence of autism-like symptoms in children. This highlights the need for future studies to further investigate this line of research through more rigorous review studies.

In conclusion, the association between screen time and autism remains an active and debated area of research. While some evidence points to a potential relationship, higher-quality studies are needed to clarify the nature of this association and its underlying mechanisms. Clinicians, parents, and policymakers should approach this issue cautiously, considering the broader context of screen use and its potential impact on child development.

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