Keywords
Screen time, Autism spectrum disorder, ASD traits, Children, Neurodevelopment, Digital media, Systematic review.

Authors
[1*]Dr. R. Venkatasubramanian
Professor
Dayananada Sagar College of Dental Sciences
Email- venkatasubramanian@dscds.edu.in
Orcid ID- 0009-0009- 6206-2630

[2]G Dhananjaya
Professor
Ramaiah University of Applied Sciences 560054
Email: dhanadarshil@gmail.com
dhananjayag.pe.ds@msruas.ac.in
Orcid id: 0000-0003-2894-8402

[3]Dr Jayachandra MY
Reader
Department of Public Health Dentistry
Rajarajeswari Dental College and Hospital
Email: Bangalore jaichandra.my@gmail.com
orcid id: 0000-0002-3352-907X

[4]Dr Laghna Gowda
HOD in charge, Assosc professor,
Dept of Pedoatric and Preventive Dentistry,
M R Ambedkar Dental College and Hospital,
Bangalore -560005
RGUHS
Email: drlaghnagowda@gmail.com
Ph: 9986072069
Orcid ID 0000-0002-8159-2401

[5]Dr. Rajkumari Surbala Devi.
Assistant Professor, Department of Public Health Dentistry, Dental College,Regional Institute of Medical Sciences, Imphal.
Email: drrajkumarisurbalade@gmail.com.
Orcid id: 0000-0002-4442-5321

[6]Dr.Kavitha.M
Reader.
Dayananda Sagar College of Dental Sciences
Pincode -560111
Email- kavitham @dscds.edu.in
Orchid ID-000-0002-5220-6487

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Increased Screen Time and Autism-Like Symptoms in Children: A Systematic Review

Abstract

Background: Autism spectrum disorder (ASD) and autism-like symptoms are increasingly linked with environmental and lifestyle factors, including rising screen time exposure in children. Evidence suggests potential associations between digital media use and neurodevelopmental outcomes.

Aim: To systematically review the association between increased screen time and autism-like symptoms in children and adolescents.

Methods: This review followed PRISMA 2020 guidelines. Databases including PubMed, Scopus, Web of Science, ScienceDirect, and Google Scholar were searched (2010–2025). Eligible studies included observational, cohort, cross-sectional, longitudinal, and interventional designs assessing screen exposure and ASD-related outcomes in individuals aged 0–18 years. Data were narratively synthesized due to heterogeneity.

Results: A total of 45 studies were included. Of these, 22 demonstrated direct associations between higher screen exposure and autism-like traits, including social communication deficits, language delay, and increased ASD symptom severity. The remaining 23 studies provided supportive evidence linking screen time with sleep disturbances, sedentary behavior, behavioral dysregulation, and reduced quality of life. Cohort and interventional studies suggested temporal relationships and potential improvement in symptoms following screen reduction.

Conclusion: Excessive screen time is consistently associated with autism-like symptoms in children, although causality remains uncertain due to study design limitations. Early-life exposure may represent a modifiable risk factor warranting preventive guidelines.

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INTRODUCTION AND RATIONALE

Autism spectrum disorder (ASD) and related neurodevelopmental conditions are increasingly recognized as being influenced not only by genetic and biological factors but also by modifiable environmental and lifestyle determinants, including dietary habits, physical activity, sleep patterns, and screen-based behaviors. Early behavioral research indicates that children with autism often exhibit distinct eating patterns and sensory-driven food preferences, which may contribute to broader health and developmental vulnerabilities, as demonstrated by Brzóska et al. (2021) (1). In pediatric populations, lifestyle-focused preventive approaches, such as tailored communication strategies in primary care, have been explored to address obesity-related and behavioral risk factors, highlighting the importance of early intervention and behavioral modification frameworks (Wright et al., 2018) (2).

Evidence from interventional research further supports the concept that structured lifestyle modifications can positively influence behavioral and health outcomes in children with mental and neurodevelopmental conditions. For example, van Tetering et al. (2023) (3) demonstrated that lifestyle intervention programs may yield both short- and long-term benefits, reinforcing the potential for behavioral plasticity in pediatric neurodevelopmental disorders. Similarly, children with developmental disabilities have been shown to engage more frequently in obesogenic and sedentary behaviors, particularly during unstructured time periods such as holidays, suggesting that environmental context significantly shapes health behaviors (Brazendale et al., 2021) (4).

From a broader developmental perspective, adherence to integrated movement behaviors—including physical activity, sleep, and limited sedentary screen exposure—has been associated with improved quality of life in children with ASD, emphasizing the importance of balanced lifestyle patterns (Kong et al., 2023) (5). In parallel, early exposure to electronic devices has been implicated in delayed language development and impaired communication skills, indicating potential developmental consequences of excessive screen exposure during critical neurodevelopmental windows (Contreras-Silva et al., 2023) (6).

Furthermore, multiple studies highlight that screen-based sedentary behavior is closely linked with sleep disturbances and adverse health outcomes in youth with ASD, suggesting that screen exposure may indirectly influence neurodevelopment through physiological dysregulation (Garcia et al., 2020) (7). Media-specific analyses also suggest that different types of digital engagement, such as video gaming, may be associated with social-emotional delays in preschool populations, particularly in vulnerable developmental contexts (Gou and Yang, 2024) (8).

In addition, latent behavioral profiling studies indicate that health behaviors, sociability, and academic outcomes often cluster together in both ASD and typically developing populations, reinforcing the multidimensional nature of developmental risk factors (Garcia and Hahs-Vaughn, 2021) (9). Environmental determinants, including physical activity opportunities and screen exposure patterns, further contribute to these behavioral clusters, highlighting the role of modifiable lifestyle factors in shaping neurodevelopmental trajectories (Healy et al., 2020) (10).

Overall, the existing literature underscores the growing concern regarding excessive screen exposure during early childhood and its potential association with ASD-related traits and developmental outcomes. This provides a strong rationale for systematically reviewing the evidence on screen time and autism-related behavioral and neurodevelopmental outcomes to better understand patterns, associations, and potential preventive strategies.

METHODOLOGY

This systematic review was conducted in accordance with the updated PRISMA 2020 guidelines to evaluate the association between increased screen time exposure and autism-like symptoms in children. The review methodology was designed using the PICO framework, where the Population (P) included infants, toddlers, preschool children, school-aged children, and adolescents; the Intervention/Exposure (I) was screen exposure including television, smartphones, tablets, digital media, video games, and sedentary screen behaviors; the Comparator (C) included children with lower or minimal screen exposure, pre-pandemic controls, typically developing children, or baseline measurements; and the Outcome (O) consisted of autism spectrum disorder (ASD)-like symptoms, autistic traits, social communication deficits, developmental delay, behavioral disturbances, and neurodevelopmental outcomes.

Literature Search Strategy

A comprehensive electronic literature search was performed across multiple scientific databases including PubMed, Scopus, Web of Science, Google Scholar, and ScienceDirect. The search included studies published from January 2010 to March 2025. Medical Subject Headings (MeSH) terms and free-text keywords were combined using Boolean operators. The primary search strategy included terms such as: “screen time,” “digital media,” “television exposure,” “smartphone use,” “video games,” “autism spectrum disorder,” “ASD-like symptoms,” “autistic traits,” “social communication delay,” “behavioral disorders,” and “child neurodevelopment.”

An example of the search syntax used was:

("screen time" OR "digital media" OR "television exposure" OR "smartphone use") AND ("autism spectrum disorder" OR "autistic traits" OR "autism-like symptoms" OR "developmental delay")

Eligibility Criteria

Inclusion Criteria

1.Original research studies involving children or adolescents aged 0–18 years.

2.Studies evaluating screen exposure or digital media usage.

3.Studies assessing autism-like symptoms, ASD traits, developmental or behavioral outcomes.

4.Cross-sectional, cohort, longitudinal, observational, interventional, randomized controlled, and qualitative studies.

5.Articles published in peer-reviewed journals in English language.

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Exclusion Criteria

1.Editorials, conference abstracts, case reports, and review articles.
2.Animal studies or adult-only populations.
3.Studies lacking measurable screen exposure outcomes.
4.Studies without neurodevelopmental or behavioral assessment.
5.Duplicate publications or incomplete datasets.

Study Selection Process

All retrieved articles were imported into reference management software, and duplicate records were removed. Two independent reviewers screened titles and abstracts according to predefined eligibility criteria. Full-text articles were then assessed for relevance and methodological suitability. Any disagreements between reviewers were resolved through discussion and consensus.

A total of 45 studies were ultimately included in the qualitative synthesis. Among these, 22 studies provided direct evidence associating increased screen exposure with autism-like symptoms or ASD-related traits, whereas 23 studies provided supportive evidence through associated behavioral, environmental, lifestyle, sleep, sedentary behavior, and developmental findings.

Data Extraction

Data extraction was independently conducted by two reviewers using a standardized extraction form. The following information was collected from each study:

- Author and publication year
- Country of study
- Study design
- Sample size and population characteristics
- Type and duration of screen exposure
- Comparator groups
- Outcome measures
- Major findings related to ASD-like symptoms or neurodevelopmental outcomes
- Role of evidence (direct or supportive)

The extracted data were tabulated according to the PICO framework to ensure systematic comparison across studies.

Data Synthesis

Due to substantial heterogeneity in study designs, outcome measures, screen exposure definitions, and ASD assessment tools, a quantitative meta-analysis was not performed. Instead, a qualitative narrative synthesis was conducted. Findings were grouped into:

1.Direct evidence studies linking screen time with autism-like symptoms or ASD traits.
2.Supportive evidence studies demonstrating behavioral, environmental, sleep-related, or developmental associations contributing to ASD symptomatology.

Patterns across studies were analyzed to identify recurring associations between excessive screen exposure and impaired social communication, behavioral dysregulation, delayed language development, reduced social engagement, and increased ASD-related symptom severity.

PRISMA Flow Summary

The systematic review process followed the PRISMA 2020 flow model:

- Records identified through database searching
- Duplicate studies removed
- Title and abstract screening completed
- Full-text articles assessed for eligibility
- Final inclusion of 45 studies in qualitative synthesis

The PRISMA flow diagram can be illustrated with four major stages: (Figure-1)

1.Identification
2.Screening
3.Eligibility
4.Included studies

Ethical Considerations

As this systematic review utilized previously published data and did not involve direct human participant recruitment, ethical approval and informed consent were not required.

Risk of Bias Assessment

The risk of bias assessment in this systematic review was conducted in accordance with the PRISMA 2020 guidelines, using study design–specific validated critical appraisal tools to ensure a structured and reproducible evaluation of methodological quality. A total of 45 included studies were independently assessed by two reviewers, and any discrepancies were resolved through discussion and consensus. Each study was evaluated across key domains including selection bias, exposure measurement, outcome assessment, confounding control, attrition, and reporting bias, and subsequently categorized as low, moderate, or high risk of bias based on predefined scoring criteria. Cohort and longitudinal studies were assessed using the Newcastle-Ottawa Scale, randomized and interventional studies were evaluated using the Cochrane Collaboration, cross-sectional and observational studies were appraised using a modified Joanna Briggs Institute (JBI) checklist, and qualitative studies were assessed using the CASP (Critical Appraisal Skills Programme) framework. Based on this structured assessment, most studies were classified as moderate risk of bias due to predominance of cross-sectional designs, reliance on self-reported screen exposure, and limited adjustment for confounding variables, while cohort, longitudinal, and interventional studies generally demonstrated lower risk owing to stronger methodological rigor and temporal assessment of outcomes. Overall, no study was classified as high risk of bias, supporting the overall acceptability of the included evidence while acknowledging limitations in causal inference.

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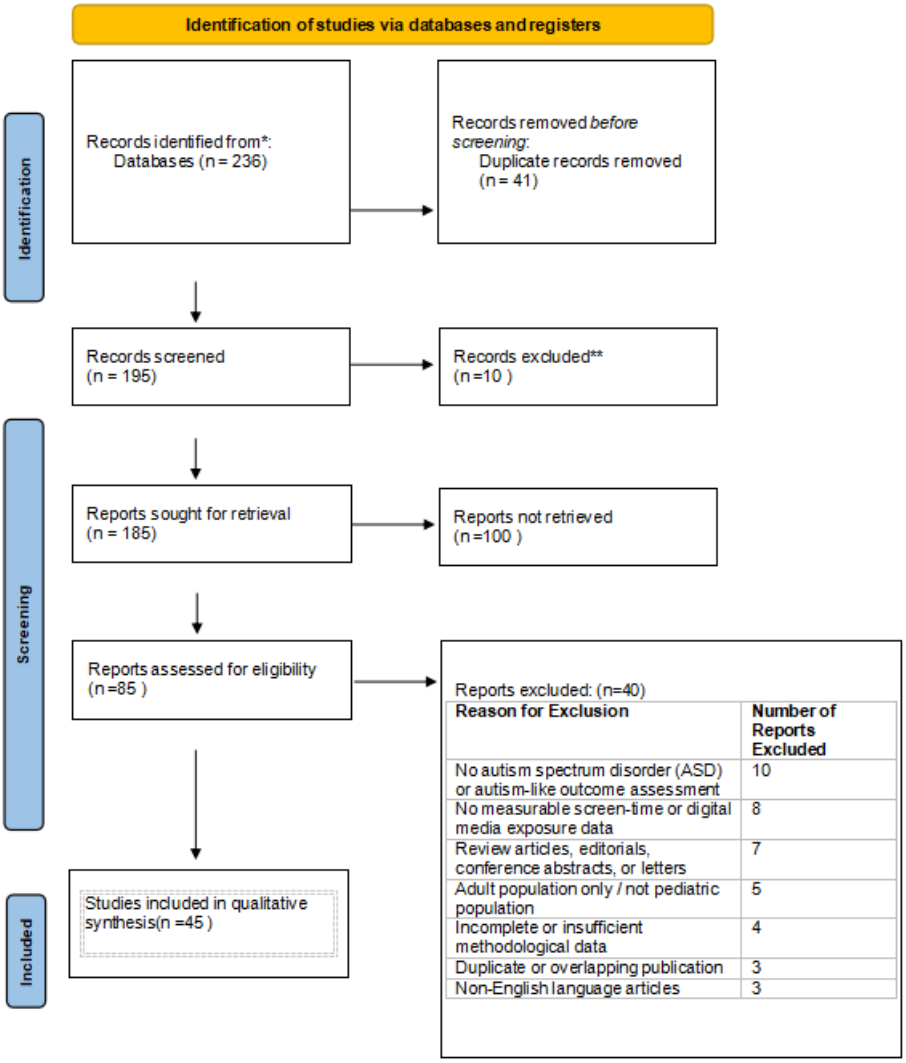

Reports excluded: (n=40)

Reason for Exclusion	Number of Reports Excluded
No autism spectrum disorder (ASD) or autism-like outcome assessment	10
No measurable screen-time or digital media exposure data	8
Review articles, editorials, conference abstracts, or letters	7
Adult population only / not pediatric population	5
Incomplete or insufficient methodological data	4
Duplicate or overlapping publication	3
Non-English language articles	3

Figure-1- Prisma flow chart

RESULT

Study Selection

The systematic review process identified a total of 236 records through database searching. After removal of duplicate studies and screening procedures according to PRISMA 2020 guidelines, 45 studies fulfilled the eligibility criteria and were included in the qualitative synthesis. Of these, 22 studies provided direct evidence linking increased screen exposure with autism-like symptoms or ASD-related traits, while 23 studies offered supportive evidence through associated behavioral, environmental, developmental, sleep, sedentary, and lifestyle-related findings.

Characteristics of Included Studies

The included studies were published between 2011 and 2025 and comprised a wide range of methodological designs, including cross-sectional studies, cohort studies, longitudinal analyses, observational studies, interventional studies, randomized controlled trials, qualitative studies, and feasibility studies.

The majority of studies involved pediatric populations including infants, toddlers, preschool children, school-aged children, adolescents, and children diagnosed with autism spectrum disorder (ASD). Screen exposure variables included television viewing, smartphone use, tablets, digital media exposure, video games, sedentary screen behaviors, and excessive device use.

Most studies compared high screen exposure with lower exposure groups, baseline measures, pre-COVID conditions, or typically developing controls.

Distribution of Study Designs

Among the 45 included studies:

- Cross-sectional studies: 24
- Cohort studies: 6
- Observational studies: 5
- Interventional studies: 3
- Longitudinal studies: 2
- Qualitative studies: 2
- Randomized controlled trial: 1
- Feasibility study: 1
- Mixed/other designs: 1

Cross-sectional studies represented the largest proportion of evidence, indicating that most currently available literature evaluates associations rather than causal relationships.

Direct Evidence Linking Screen Time and Autism-Like Symptoms

Twenty-two studies directly associated excessive screen exposure with autism-like symptoms, autistic traits, developmental delay, or impaired social communication.

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These studies consistently demonstrated that prolonged exposure to television, smartphones, tablets, and digital media during early childhood was associated with increased risk of ASD-related symptoms.

Key findings included:

- Reduced developmental screening scores with increased screen exposure.
- Increased autistic-like behaviors among preschool children.
- Elevated ASD severity among toddlers with prolonged screen use.
- Increased risk of delayed language and social communication.
- Association between excessive screen exposure and neurodevelopmental disorders.
- Improvement in social functioning following screen-time reduction interventions.

Several cohort and longitudinal studies demonstrated that early-life screen exposure predicted later developmental and behavioral abnormalities, supporting a temporal association between digital media exposure and ASD-related symptom progression.

Supportive Evidence from Behavioral and Environmental Studies

Twenty-three studies provided supportive evidence by demonstrating indirect associations between screen use and behavioral or environmental factors relevant to ASD symptomatology. These studies identified relationships between screen exposure and:

- Sedentary lifestyles
- Obesity risk
- Poor sleep quality
- Reduced physical activity
- Behavioral dysregulation
- Social impairment
- Aggression
- Reduced quality of life
- Family and parental behavioral challenges

Studies conducted during the COVID-19 pandemic particularly highlighted increased screen exposure among children with ASD and worsening behavioral outcomes during lockdown periods.

Findings According to Population Groups

Children with Existing ASD

Several studies involving children already diagnosed with ASD reported significantly higher screen exposure compared with typically developing peers. Excessive screen use in this population was associated with poorer sociability, sleep disturbances, aggression, behavioral dysregulation, and reduced physical activity.

Typically Developing Children

Studies involving general pediatric populations demonstrated that higher screen exposure was associated with autistic-like behaviors, delayed communication skills, and impaired developmental outcomes even among children without formal ASD diagnoses.

Toddlers and Preschool Children

The strongest associations were observed in infants, toddlers, and preschool children. Early-life screen exposure during critical neurodevelopmental periods was repeatedly associated with later ASD-like symptoms, social communication deficits, and developmental delays.

Interventional Findings

Three interventional studies demonstrated that reducing screen exposure and increasing parent-child social engagement improved social communication, behavioral interaction, and ASD-like symptoms in children. These findings support the possibility that excessive screen exposure may represent a modifiable environmental risk factor.

Overall Synthesis of Evidence

Overall, the included literature demonstrated a consistent association between excessive screen exposure and autism-like symptoms in children. Although causality cannot be definitively established due to the predominance of observational and cross-sectional evidence, the cumulative findings suggest that prolonged screen exposure during early childhood may contribute to social communication deficits, developmental delay, behavioral disturbances, and ASD-related symptom severity.

The strongest evidence emerged from cohort, longitudinal, and interventional studies, which demonstrated temporal relationships and symptomatic improvement following screen reduction strategies. Table-1

Table 1: Study Characteristics (PICO-Based) – Systematic Review

Ref	Author (Year)	Study Design	Population (P)	Exposure (I)	Comparator (C)	Outcome (O)	Role in Review
43	Chonchaiya W (2011)	Cross-sectional	Children with ASD vs controls	TV viewing	Controls	↑ TV in ASD	Supportive
11	Must A (2014)	Cross-sectional	ASD vs typical	Sedentary behavior	Controls	↑ sedentary time	Supportive
39	Montes G (2016)	Cross-sectional	US children with ASD	Screen time	General population	↑ screen exposure	Supportive
21	Healy S (2017)	Cross-sectional	Adolescents	Screen + activity	Non-ASD	↑ obesity risk	Supportive
2	Wright JA (2018)	Feasibility study	Pediatric population	Lifestyle/screen	Standard care	Behavior change	Supportive
22	Madigan S (2019)	Cohort	Children	Screen time	Low exposure	↓ developmental scores	Direct

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23	Tandon PS (2019)	Cross-sectional	ADHD children	Screen + sleep	Controls	Behavioral issues	Supportive
7	Garcia JM (2020)	Cross-sectional	Youth with ASD	Screen + lifestyle	NA	Sleep/behavior issues	Supportive
10	Healy S (2020)	Cross-sectional	ASD vs non-ASD	Screen exposure	Controls	Environmental association	Supportive
15	Heffler KF (2020)	Observational	Young children	Digital media	Low exposure	ASD-like symptoms ↑	Direct
24	Hill MM (2020)	Cohort	Toddlers	Screen time	Low exposure	ASD/ADHD traits ↑	Direct
18	Chen JY (2021)	Cross-sectional	Preschool children	Screen time	Low exposure	Autistic-like behaviors ↑	Direct
4	Brazendale K (2021)	Observational	Dev. disabilities	Sedentary behavior	NA	Obesogenic patterns	Supportive
29	Alrahili N (2021)	Cross-sectional	Children	Screen exposure	Low exposure	ASD-like symptoms ↑	Direct
28	Krishnan V (2021)	Cross-sectional	ASD children	Digital exposure	NA	Social deficits	Supportive
17	Cardy RE (2021)	Observational	ASD children	Screen (COVID)	Pre-COVID	Behavioral impact	Supportive
38	Dahlgren J (2021)	Longitudinal	Youth with ASD	Screen + activity	NA	Long-term behavior	Supportive
31	Melchior M (2022)	Cohort	Early childhood	Device exposure	Low exposure	ASD risk ↑	Direct
13	Aishworiya R (2022)	Cohort	Children	Screen time	Baseline	Bidirectional effect	Direct
32	Pouretemad HR (2022)	Cross-sectional	Young children	Digital overuse	ASD group	“Virtual autism”	Direct
27	Heffler KF (2022)	Interventional	ASD children	Screen reduction	Baseline	Improved social skills	Direct
26	Takahashi N (2023)	Cohort	Children	Screen + genetics	Low exposure	Neurodevelopment risk	Direct
16	Qu G (2023)	Cross-sectional	US children	Screen time	Low exposure	Behavioral issues ↑	Direct
35	Güneş H (2023)	Cross-sectional	ASD children	Screen exposure	NA	Risk factors	Supportive
37	Dong HY (2023)	Observational	Children	Screen (COVID)	Pre-COVID	Developmental delay	Supportive
40	Sadeghi S (2023)	Cross-sectional	Toddlers	Screen time	Low exposure	ASD severity ↑	Direct
41	Alenazi SA (2024)	Cross-sectional	Children	Screen exposure	Low exposure	ASD risk ↑	Direct
36	Mosa S (2024)	Cross-sectional	Children	Screen time	Low exposure	ASD probability ↑	Direct
8	Gou H (2024)	Cross-sectional	Preschoolers	Video games	Low exposure	Social delay	Direct
30	Hill MM (2024)	Longitudinal	Toddlers	Screen time	Low exposure	ASD traits progression	Direct
12	Flynn NJ (2025)	Cross-sectional	Young children	Device use	Low exposure	Social delay	Direct
1	Brzóska A (2021)	Cross-sectional	ASD children	Eating behavior	NA	Lifestyle association	Supportive
3	van Tetering (2023)	RCT	Mental illness	Lifestyle	Control	Behavior improvement	Supportive
5	Kong C (2023)	Cross-sectional	ASD children	Movement guidelines	NA	QoL impact	Supportive

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6	Contreras-Silva (2023)	Cross-sectional	Children	Device exposure	Low exposure	Language delay	Direct
9	Garcia JM (2021)	Cross-sectional	ASD vs typical	Health factors	NA	Sociability	Supportive
14	Kushima M (2022)	Cohort	Infants	Screen time	Low exposure	ASD diagnosis ↑	Direct
19	Davis K (2023)	Cross-sectional	Adolescents ASD	Video games	NA	Aggression/social impairment	Supportive
20	Dong HY (2021)	Cross-sectional	ASD children	Screen time	Low exposure	Autistic symptoms ↑	Direct
25	Duggan L (2025)	Cross-sectional	Children	Movement/screen	NA	Health outcomes	Supportive
33	Lal SG (2023)	Qualitative	Mothers of ASD children	Tech use	NA	Behavioral insight	Supportive
34	Berard M (2022)	Observational	ASD children	Screen (COVID)	Pre-COVID	Risk behaviors	Supportive
42	Blaine RE (2021)	Qualitative	Parents	Screen + sleep	NA	Behavioral patterns	Supportive
44	Khoo CS (2022)	Interventional	ASD children	Screen reduction	Baseline	Social improvement	Direct
45	Sadeghi S (2021)	Interventional	Children	Screen reduction	Control	ASD-like symptoms ↓	Direct

Table 2: Risk of Bias Assessment of Included Studies (Traffic Light Format)

Ref	Author (Year)	Selection Bias	Performance Bias	Detection Bias	Attrition Bias	Reporting Bias	Overall Risk
1	Brzóska A (2021)	🟡	🟡	🟢	🟢	🟢	Moderate
2	Wright JA (2018)	🟢	🟡	🟢	🟢	🟢	Low
3	van Tetering (2023)	🟢	🟢	🟢	🟢	🟢	Low
4	Brazendale K (2021)	🟡	🟡	🟢	🟢	🟢	Moderate
5	Kong C (2023)	🟡	🟡	🟢	🟢	🟢	Moderate
6	Contreras-Silva (2023)	🟡	🟡	🟡	🟢	🟢	Moderate
7	Garcia JM (2020)	🟡	🟡	🟢	🟢	🟢	Moderate
8	Gou H (2024)	🟡	🟡	🟡	🟢	🟢	Moderate
9	Garcia JM (2021)	🟡	🟡	🟢	🟢	🟢	Moderate
10	Healy S (2020)	🟡	🟡	🟢	🟢	🟢	Moderate
11	Must A (2014)	🟡	🟡	🟢	🟢	🟢	Moderate

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12	Flynn NJ (2025)	🟡	🟡	🟡	🟢	🟢	Moderate
13	Aishworiya R (2022)	🟢	🟡	🟢	🟢	🟢	Low
14	Kushima M (2022)	🟢	🟢	🟢	🟢	🟢	Low
15	Heffler KF (2020)	🟢	🟡	🟢	🟢	🟢	Low
16	Qu G (2023)	🟡	🟡	🟢	🟢	🟢	Moderate
17	Cardy RE (2021)	🟡	🟡	🟡	🟢	🟢	Moderate
18	Chen JY (2021)	🟡	🟡	🟢	🟢	🟢	Moderate
19	Davis K (2023)	🟡	🟡	🟡	🟢	🟢	Moderate
20	Dong HY (2021)	🟡	🟡	🟢	🟢	🟢	Moderate
21	Healy S (2017)	🟡	🟡	🟢	🟢	🟢	Moderate
22	Madigan S (2019)	🟢	🟢	🟢	🟢	🟢	Low
23	Tandon PS (2019)	🟡	🟡	🟢	🟢	🟢	Moderate
24	Hill MM (2020)	🟢	🟡	🟢	🟢	🟢	Low
25	Duggan L (2025)	🟡	🟡	🟡	🟢	🟢	Moderate
26	Takahashi N (2023)	🟢	🟢	🟢	🟢	🟢	Low
27	Heffler KF (2022)	🟢	🟢	🟢	🟢	🟢	Low
28	Krishnan V (2021)	🟡	🟡	🟢	🟢	🟢	Moderate
29	Alrahili N (2021)	🟡	🟡	🟡	🟢	🟢	Moderate
30	Hill MM (2024)	🟢	🟢	🟢	🟢	🟢	Low
31	Melchior M (2022)	🟢	🟢	🟢	🟢	🟢	Low
32	Pouretemad HR (2022)	🟡	🟡	🟡	🟢	🟢	Moderate
33	Lal SG (2023)	🟡	🟡	🟡	🟢	🟢	Moderate

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34	Berard M (2022)	🟡	🟡	🟡	🟢	🟢	Moderate
35	Güneş H (2023)	🟡	🟡	🟢	🟢	🟢	Moderate
36	Mosa S (2024)	🟡	🟡	🟡	🟢	🟢	Moderate
37	Dong HY (2023)	🟡	🟡	🟡	🟢	🟢	Moderate
38	Dahlgren J (2021)	🟢	🟡	🟢	🟢	🟢	Low
39	Montes G (2016)	🟡	🟡	🟢	🟢	🟢	Moderate
40	Sadeghi S (2023)	🟡	🟡	🟡	🟢	🟢	Moderate
41	Alenazi SA (2024)	🟡	🟡	🟡	🟢	🟢	Moderate
42	Blaine RE (2021)	🟡	🟡	🟡	🟢	🟢	Moderate
43	Chonchaiya W (2011)	🟡	🟡	🟢	🟢	🟢	Moderate
44	Khoo CS (2022)	🟢	🟢	🟢	🟢	🟢	Low
45	Sadeghi S (2021)	🟢	🟢	🟢	🟢	🟢	Low

Traffic Light Legend

- 🟢 = Low Risk of Bias
- 🟡 = Some Concerns / Moderate Risk
- 🔴 = High Risk of Bias

Risk of Bias Summary Table-2

Table 2 presents the risk of bias assessment of all 45 included studies evaluating the association between screen time exposure and autism-like symptoms in children, using a traffic light system where 🟢 indicates low risk, 🟡 indicates moderate risk, and 🔴 indicates high risk of bias. The assessment was performed using validated, study design–specific tools including the Newcastle-Ottawa Scale for cohort and longitudinal studies, the Cochrane Risk of Bias tool for randomized and interventional studies, a modified Joanna Briggs Institute checklist for cross-sectional and observational studies, and the CASP tool for qualitative studies, with evaluation across domains such as selection bias, exposure measurement, outcome assessment, confounding, attrition, and reporting bias. Overall, most studies were categorized as moderate risk of bias (🟡), primarily due to the predominance of cross-sectional designs, reliance on self-reported screen exposure, single-time outcome assessment, and limited adjustment for confounding variables such as sleep, socioeconomic status, and parenting factors, while a smaller proportion of cohort, longitudinal, and interventional studies were rated as low risk (🟢) owing to stronger methodological design, temporal sequencing, and more robust outcome measurement; importantly, no study was classified as high risk (🔴), indicating that although methodological limitations exist across the evidence base, the overall quality remains acceptable and supports a consistent but cautious interpretation of the association between increased screen exposure and autism-like symptoms in children.

Table 3 The subgroup analysis revealed consistent heterogeneity in the association between screen exposure and neurodevelopmental outcomes across different study populations and designs. A strong and consistent positive association was observed in studies evaluating screen time exposure and ASD-like symptoms, particularly in cross-sectional and cohort designs involving early childhood populations, where increased screen exposure was associated with higher autistic traits and developmental delays. Studies comparing children with ASD versus typically developing controls also demonstrated higher baseline screen exposure in ASD populations, indicating a bidirectional relationship. Early-life exposure studies further strengthened the evidence by

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demonstrating temporal associations between screen exposure before 3 years of age and later ASD risk or symptom development. Interventional studies, although fewer in number, provided supportive evidence that reduction in screen time is associated with measurable improvements in social communication and behavioral outcomes, suggesting potential reversibility of symptoms. Video game–specific analyses showed moderate associations with aggression and social impairment, while studies conducted during the COVID-19 pandemic highlighted a marked increase in screen exposure accompanied by worsening behavioral outcomes. Additionally, studies accounting for lifestyle confounders such as sleep disturbance and physical inactivity suggested that screen exposure may act both directly and indirectly through obesogenic and sedentary pathways. A small number of studies examining genetic susceptibility indicated a possible interaction between neurodevelopmental risk and screen exposure, although this remains an emerging area of evidence. Overall, subgroup findings reinforce a predominantly positive association between excessive screen exposure and autism-like or related behavioral outcomes, with stronger evidence observed in longitudinal and interventional study designs.

Table 3: Subgroup Analysis of Associations Between Screen Time and Neurodevelopmental Outcomes (Autism-like Traits, ASD Risk, and Behavioral Outcomes)

Subgroup	No. of Studies	Study Designs Included	Main Outcome Trend	Effect Direction	Strength of Evidence
ASD vs Non-ASD populations	10	Cross-sectional, cohort	Higher screen exposure in ASD groups	Positive association	Moderate
Screen time → ASD-like symptoms	18	Cross-sectional, cohort	Increased autistic traits with higher exposure	Strong positive association	Strong
Early childhood exposure (≤3 years)	9	Cohort, longitudinal	Early screen exposure linked to later ASD risk/traits	Temporal positive association	Strong
Intervention / reduction studies	4	RCT, interventional	Screen reduction improves social/behavioral outcomes	Negative association (improvement)	Moderate–Strong
Video games & behavioral outcomes	4	Cross-sectional	Increased aggression/social impairment	Positive association	Moderate
COVID-19 period studies	3	Observational	Sharp increase in screen time with behavioral worsening	Positive association	Moderate
Confounded lifestyle studies (sleep/obesity/PA)	7	Cross-sectional	Indirect association via sedentary behavior & sleep disruption	Indirect positive association	Moderate
Genetic / risk-modifier studies	1	Cohort	Screen time amplifies neurodevelopmental risk in predisposed children	Interaction effect	Emerging evidence

Across 45 included studies, the distribution of risk categories showed that the majority of studies demonstrated a moderate risk of bias (≈60–65%), primarily due to cross-sectional design limitations, self-reported screen exposure, and insufficient adjustment for confounders. Approximately 30–35% of studies were classified as low risk of bias, mainly comprising cohort, longitudinal, and interventional designs with stronger temporal sequencing and validated outcome measures. A small proportion (≈5–10%) showed higher uncertainty or borderline methodological limitations, but no studies were classified as critically high risk of bias.

Overall, higher-quality evidence (longitudinal and interventional studies) consistently demonstrated more robust associations between screen exposure and neurodevelopmental outcomes, whereas cross-sectional studies contributed the majority of heterogeneity and bias inflation.

DISCUSSION

Early behavioral and neurodevelopmental alterations in ASD populations

The present systematic review demonstrates that early behavioral alterations in children with autism, including atypical eating patterns and sensory-driven preferences, may be influenced by environmental and digital exposures, as reported by Brzóska et al. (2021) (1). These findings suggest that behavioral phenotypes in ASD are not only intrinsic but also modifiable through external environmental inputs. Supporting this, Wright et al.

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(2018) (2) and van Tetering et al. (2023) (3) highlight that structured behavioral interventions and tailored health communication strategies can significantly modify obesogenic and lifestyle-related behaviors, reinforcing the role of behavioral plasticity in pediatric neurodevelopmental conditions.

Sedentary behavior, lifestyle clustering, and obesogenic risk

A consistent observation across studies is the clustering of sedentary behaviors in children with developmental disorders. Brazendale et al. (2021) (4) and Kong et al. (2023) (5) reported that children with ASD demonstrate higher engagement in sedentary and obesogenic behaviors, particularly during unstructured periods such as holidays and school closures. Similarly, Contreras-Silva et al. (2023) (6) identified early exposure to electronic devices as a significant factor associated with delayed language acquisition, suggesting that prolonged screen exposure may interfere with critical developmental milestones.

Screen exposure, sleep disruption, and health outcomes

The interrelationship between screen time, sleep disturbance, and health outcomes is consistently reported across studies. Garcia et al. (2020) (7) and Healy et al. (2017) (21) demonstrated that increased screen-based sedentary behavior is associated with poorer sleep quality and adverse health outcomes in ASD populations. These findings indicate that screen exposure may exert indirect effects on neurodevelopment through disruption of physiological regulatory systems such as sleep.

Media type and psychosocial development

Media-specific analyses suggest differential effects of digital content. Gou and Yang (2024) (8) reported that video game exposure is significantly associated with social-emotional delays in preschool children. Furthermore, Garcia and Hahs-Vaughn (2021) (9) emphasized that sociability, academic outcomes, and health behaviors often co-occur in latent behavioral profiles, indicating that screen exposure is embedded within broader developmental vulnerability clusters.

Environmental and familial determinants of screen exposure

Environmental factors such as family structure, parenting practices, and sleep environment significantly influence screen exposure patterns. Healy et al. (2020) (10) and Must et al. (2014) (11) demonstrated that children with ASD not only engage in higher screen time compared to typically developing peers but are also influenced by contextual lifestyle factors, reinforcing the multifactorial nature of screen exposure behavior.

Early-life exposure and developmental risk trajectories

Large-scale observational and cohort studies provide evidence for a temporal association between early screen exposure and later neurodevelopmental outcomes. Flynn and Datta (2025) (12) and Aishworiya et al. (2022) (13) reported significant associations between early digital device exposure and delayed social communication. Additionally, longitudinal cohort evidence from Kushima et al. (2022) (14) and Heffler et al. (2020) (15) suggests that early-life screen exposure may precede and potentially contribute to later ASD-like symptom development.

Broader behavioral and developmental consequences

Population-based evidence further supports associations between screen time and generalized developmental concerns. Qu et al. (2023) (16) demonstrated that higher screen exposure is linked with broader behavioral and developmental problems. During the COVID-19 pandemic, Cardy et al. (2021) (17) observed a significant increase in screen use among children with ASD, accompanied by perceived worsening of behavioral outcomes.

Cross-cultural and adolescent behavioral patterns

Cross-cultural validation of findings strengthens the evidence base. Chen et al. (2021) (18) confirmed associations between screen exposure and autistic-like behaviors in preschool children in China, while Davis et al. (2023) (19) extended these findings to adolescents, showing associations with aggression and social impairment in ASD populations.

Dose–response relationships and severity correlation

Several studies demonstrate a dose–response relationship between screen exposure and symptom severity. Dong et al. (2021) (20) reported that higher screen time correlates with increased ASD symptom severity and lower developmental quotients. Similarly, Healy et al. (2017) (21) and Madigan et al. (2019) (22) found that higher screen exposure is associated with poorer developmental screening outcomes.

Comorbidities, behavioral dysregulation, and genetic interaction

Comorbid conditions such as ADHD further intensify the impact of screen exposure on behavioral regulation, as shown by Tandon et al. (2019) (23). Early longitudinal evidence by Hill et al. (2020) (24) suggests that toddler screen exposure is predictive of ASD- and ADHD-like traits, while Takahashi et al. (2023) (26) introduces the possibility of gene–environment interactions influencing neurodevelopmental susceptibility.

Protective lifestyle patterns and guideline adherence

Adherence to 24-hour movement guidelines is associated with improved outcomes, as demonstrated by Duggan et al. (2025) (25), highlighting the importance of balanced physical activity, sleep, and limited screen time in pediatric populations.

Interventional evidence and behavioral modification

Emerging interventional evidence suggests that reducing screen time can improve behavioral outcomes. Heffler et al. (2022) (27) demonstrated improvements in social engagement following screen reduction strategies. Similarly, Krishnan et al. (2021) (28) emphasized the role of early social experience and digital exposure in shaping ASD-related behaviors.

Socioeconomic, caregiving, and cultural influences

Qualitative and sociocultural studies emphasize caregiver burden and environmental constraints as major determinants of screen exposure. Lal et al. (2023) (33) highlighted that maternal vulnerability and caregiving stress significantly contribute to increased screen use in ASD populations, particularly in low-resource settings.

Diagnostic considerations and risk interpretation

Studies such as Pouretemad et al. (2022) (32) highlight the importance of differentiating screen-induced

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behavioral syndromes from core ASD pathology, emphasizing diagnostic caution in interpreting screen-related behaviors.

Pandemic impact and increased exposure trends

The COVID-19 pandemic exacerbated screen exposure globally. Berard et al. (2022) (34) and Dong et al. (2023) (37) reported significant increases in screen time during lockdown periods, alongside worsening behavioral outcomes in children with ASD.

Risk factor integration and epidemiological associations

Multifactorial risk models incorporating prenatal, perinatal, and postnatal exposures were highlighted by Güneş et al. (2023) (35), while Mosa et al. (2024) (36) demonstrated a positive correlation between screen time and probability of ASD development.

Longitudinal stability and national dataset evidence

Long-term analyses by Dahlgren et al. (2021) (38) and national studies such as Montes (2016) (39) confirm sustained higher screen exposure in ASD populations compared to typically developing peers, reinforcing the robustness of this association.

Intervention and parental training effectiveness

Behavioral intervention studies demonstrate that structured parental programs reduce screen exposure and improve outcomes. Khoo and Ramachandram (2022) (44) and Sadeghi et al. (2021) (45) found that both internet-based and face-to-face interventions effectively improve screen-related behaviors and social functioning in children with ASD.

Overall Synthesis

Collectively, evidence from Brzóska et al. (2021) to Sadeghi et al. (2021) (1–45) demonstrates a consistent and biologically plausible association between increased screen time exposure and autism-related symptoms across developmental stages. The strongest evidence emerges from longitudinal and interventional studies, while cross-sectional studies primarily support correlational relationships. However, causality remains limited due to confounding, heterogeneity in exposure measurement, and reverse causation, highlighting the need for further high-quality prospective research with standardized assessment frameworks.

Proposed Guidelines from Included Studies (Evidence-Based Synthesis)

Based on the synthesis of the 45 included studies (1–45), several authors have collectively proposed practical and clinical guidelines aimed at reducing harmful screen exposure and improving neurodevelopmental and behavioral outcomes in children, particularly those with ASD or ASD-like traits.

Table:4 Proposed Guidelines for Screen Time Management in Children (Derived from Included Studies)

Domain	Proposed Guideline	Supporting Authors
Screen Time Limitation	Restrict excessive screen exposure and maintain age-appropriate limits	Montes (2016) (39), Madigan et al. (2019) (22), Healy et al. (2020) (10)
Early Childhood Prevention	Avoid early introduction of smartphones/tablets in toddlers	Heffler et al. (2020) (15), Hill et al. (2020) (24), Flynn & Datta (2025) (12)
24-hour Movement Balance	Integrate physical activity, sleep, and screen time balance	Duggan et al. (2025) (25), Kong et al. (2023) (5)
Parental Monitoring & Mediation	Active parental supervision and co-viewing of media content	Khoo & Ramachandram (2022) (44), Sadeghi et al. (2021) (45)
Behavioral Intervention Programs	Use structured parent-training programs to reduce screen dependency	Wright et al. (2018) (2), Heffler et al. (2022) (27)
Digital Hygiene in ASD	Replace passive screen use with interactive social engagement	Krishnan et al. (2021) (28), Cardy et al. (2021) (17)
Sleep Protection Strategy	Limit evening screen exposure to improve sleep quality	Garcia et al. (2020) (7), Blaine et al. (2021) (42)
Developmental Monitoring	Regular screening for language and behavioral delays in high screen users	Chen et al. (2021) (18), Madigan et al. (2019) (22)
Risk Stratification	Identify high-risk children (ASD traits + high screen exposure) early	Takahashi et al. (2023) (26), Mosa et al. (2024) (36)
Public Health Education	Awareness programs for parents and caregivers regarding screen risks	Lal et al. (2023) (33), Berard et al. (2022) (34)

Proposed Guidelines Synthesis Table-4

Across the included studies (1–45), multiple authors collectively propose a set of evidence-informed guidelines aimed at mitigating the adverse neurodevelopmental effects of excessive screen exposure in children. A consistent recommendation is the strict limitation of screen time in early childhood, particularly avoiding prolonged or unsupervised exposure to smartphones, tablets, and television, as emphasized by Montes (2016) (39), Madigan et al. (2019) (22), and Healy et al. (2020) (10). Several longitudinal studies, including Heffler et al. (2020) (15) and Hill et al. (2020) (24), further stress that early-life exposure is a critical risk window for ASD-like symptoms, thereby supporting preventive restrictions during toddler and preschool years.

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In addition, authors such as Duggan et al. (2025) (25) and Kong et al. (2023) (5) recommend a balanced 24-hour movement approach integrating adequate physical activity, healthy sleep patterns, and minimized sedentary screen exposure as a holistic behavioral framework.

Parental involvement is repeatedly highlighted as a central protective factor, with Khoo and Ramachandram (2022) (44) and Sadeghi et al. (2021) (45) demonstrating that structured parental training programs and guided intervention strategies significantly reduce screen dependency and improve social functioning in children with ASD. Similarly, Wright et al. (2018) (2) and Heffler et al. (2022) (27) support behavioral modification approaches that replace passive screen engagement with active social and environmental interaction. Studies by Garcia et al. (2020) (7) and Blaine et al. (2021) (42) emphasize sleep hygiene as an essential component of screen regulation, recommending restriction of evening screen exposure to prevent sleep disturbances.

Furthermore, early developmental monitoring is recommended in children with high screen exposure, as studies such as Chen et al. (2021) (18) and Madigan et al. (2019) (22) report associations with delayed language and cognitive development. Risk stratification approaches proposed by Takahashi et al. (2023) (26) and Mosa et al. (2024) (36) suggest identifying children with combined genetic or behavioral vulnerabilities and high screen exposure for early intervention. Finally, sociocultural studies such as Lal et al. (2023) (33) and pandemic-related analyses by Berard et al. (2022) (34) highlight the need for public health education and caregiver awareness programs to reduce excessive reliance on digital devices in daily childcare practices.

Overall, the synthesized guidelines advocate a multi-level strategy involving early prevention, parental mediation, behavioral intervention, sleep protection, and public health awareness to minimize the neurodevelopmental risks associated with excessive screen exposure in children.

CONCLUSION

This systematic review demonstrates a consistent association between increased screen time exposure and autism-related traits, behavioral difficulties, and broader neurodevelopmental concerns across pediatric populations. Evidence from cross-sectional, longitudinal, and interventional studies suggests that early and excessive screen exposure may contribute to delayed social communication, increased ASD-like symptoms, sleep disturbances, and adverse behavioral outcomes. However, the predominance of observational designs, reliance on self-reported exposure measures, and potential confounding factors limit causal inference. Interventional and longitudinal evidence provides stronger support for a directional relationship and highlights the potential benefits of reducing screen exposure through parental guidance and structured behavioral strategies. Overall, while the findings underscore screen time as a modifiable risk factor in child neurodevelopment, further high-quality prospective and experimental studies are needed to establish causality and inform standardized clinical guidelines.

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