

Interventions for Reducing Screen Time of Preschoolers: A Systematic Review of Randomized Controlled Trials

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Abstract

Preschool-aged children are growing up in an environment saturated with screens, which provokes a significant public health issue, given its potential associations with adverse physical, cognitive, and psychosocial outcomes. The present article aims to systematically summarize the interventions for reducing screen time in preschool-aged children. A systematic review of relevant articles was carried out using 5 main databases until October 15, 2023. From 71 studies initially found, eight were included in the qualitative synthesis. It was provided a methodological assessment of various studies based on 10 criteria, with scores ranging from 12 to 20 out of the total possible score, indicating the extent to which each study adhered to key methodological standards. Various interventions targeting preschool-aged children's screen time showed mixed results. While some, like the Parents' Screen Time Reduction Program, led to significant reductions in screen time and improved parental attitudes and behaviors, others, such as short counseling interventions, did not yield significant changes. Screen time among preschoolers can be effectively reduced by targeting parents' knowledge and attitude through comprehensive, parent-involved approaches involving repeated reinforcement and teaching them about the consequences of screen time and how they can proceed to reduce it for their children.

Keywords

childhood, television, computer, education, health

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Introduction

The rapid evolution of digital technology has drastically altered the lifestyle and habits of individuals across all age groups,¹ particularly the young generation.² Preschool-aged children, typically aged 3 to 5 years, are growing up in an environment saturated with screens, whether it be televisions, computers, or handheld devices. The concern surrounding excessive screen-time among this age group has emerged as a significant public health issue, given its potential associations with adverse physical,³ cognitive,¹ and psychosocial outcomes such as obesity, delayed language acquisition, and social-emotional problems.^{4–6} In this context, obesity in early childhood can predispose children to obesity later in life, and brings about a host of associated health problems including diabetes, cardiovascular diseases, and psychosocial issues.^{7,8} The relationship between screen time, physical inactivity, obesity, and the development of adverse habits in preschoolers has become

an area of concern for parents, educators, and health professionals alike.

Australia, Canada, South Africa, New Zealand, and the World Health Organization have released 24-h physical activity guidelines for children under 5 years of age,^{9–11} recommending a “best day” for children's sleep, physical activity, and sedentary behavior, including screen time. This “count throughout the day” approach places each behavior on a continuum, where a decrease in 1 behavior leads to an increase in another. The early years are also a critical period

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for the development of healthy behaviors, as screen time and physical activity appear to extend from early childhood into late childhood and adolescence, thus affecting later sleep.¹² Another negative effect is related to sleep, following showed that too much screen time affects the amount and quality of sleep, which can lead to high blood pressure, low cholesterol, and cardiovascular disease.¹³⁻¹⁵ Other profound effects include effects on vision, loss of bone density, depressive tendencies and suicidal thoughts, difficulty to focus, and attention deficit hyperactivity disorder, are possible consequences of excessive screen time.^{1,2,5} The American Academy of Pediatrics (AAP) has delineated guidelines suggesting that children aged 2 to 5 years should have no more than 1 h of screen-time per day.¹⁶ Prolonged screen time often displaces time that could be spent on physical activities,¹⁷ as preschoolers spend more time in front of screens, they engage less in physical play, which is crucial for their motor development and overall physical health.³ However, several studies have revealed that a substantial proportion of preschool-aged children exceed this recommended limit,^{2,14,18} thereby heightening the urgency to identify and implement effective interventions to mitigate excessive screen time.

Reducing screen-time in preschool-aged children is a complex, multifaceted challenge that necessitates a holistic approach encompassing various stakeholders including parents, educators, and policymakers.¹⁹ A plethora of interventions have been developed and evaluated in the literature, ranging from parental education and counseling, to environmental modifications in preschool settings, and policy-level initiatives.^{4,10,20} These interventions aim to foster a conducive environment for reducing screen-time and promoting alternative, healthful activities among preschool-aged children.

This systematic review endeavors to provide an overview of various interventions aimed at reducing screen-time among preschool-aged children, discussing their efficacy, implementation challenges, and implications for practice and policy. A comprehensive understanding of these interventions and their outcomes is crucial for devising effective strategies to tackle the issue of excessive screen-time, thereby contributing to the promotion of healthier developmental trajectories for preschool-aged children. Through a thorough examination of existing literature, this research aims to contribute to the broader discourse surrounding digital wellness among preschool-aged children, and provide actionable insights for stakeholders involved in early childhood education and health promotion.

Method

Experimental Approach to the Problem

The current systematic review adheres to the guidelines for conducting systematic reviews in the physical education and sport sciences²¹ and PRISMA.²²

Information Sources

Databases: PubMed, ProQuest Central (including 26 databases, eg, ERIC and Education Database), Scopus, Teacher Reference Center, and Web of Sciences databases were selected for running out this systematic review.

Search date: October 15, 2023.

Search Strategy

Search terms (following PICOS strategy): (preschool OR kindergarten OR toddler) AND (reduc*) AND (“screen time” OR television OR computer OR videogame) AND (“randomized controlled trial*”).

Eligibility Criteria

The authors followed these steps for performing eligibility criteria:

1. Running out the systematic review in each database.
2. Identify title, authors, date, and database of each of the included article and download to an Excel spreadsheet.
3. Remove duplicates.
4. Screen each of the remaining article according to inclusion/exclusion criteria (see the Table 1).

Assessment of Study Methodology

Using randomly selected experimental (EXP) and control (CON) groups, the methodological quality of pre-test-post-test studies was evaluated using the Physiotherapy Evidence Database (PEDro) scale. On a scale from 0 (poor methodological quality) to 10 (high methodological quality), the internal study validity is scored. The quality score assigned to each segment ranges from 0 (“no”) to 1 (“yes”), contingent upon the number of points earned. The scale has 10 measuring components (see Table 2).

Results

Identification and Selection of Studies

From the initial 71 articles (PubMed=20; ProQuest Central=18; Scopus=18; Teacher Reference Center=1; and Web of Sciences=14), the authors reviewed the titles and abstracts of the remaining 71 articles after eliminating 42 duplicates. Out of these, 7 articles were disqualified for not meeting the fifth inclusion criterion. About 3, 1, 8, and 1 articles from the remaining 22 were discarded because they did not satisfy the first, second, third, and fourth inclusion criteria, respectively. As a result, the qualitative

Table 1. Inclusion/Exclusion Criteria.

Topic	Inclusion	Exclusion	Search coherence
Population	Children from preschool or kindergartens	Children who do not attend preschool or kindergartens	Preschool*, kindergarten
Intervention or exhibition	Children involved in preschool-aged intervention	Children not involved in preschool-aged intervention	—
Results	Outcomes related to reduction of screen time	Results extracted from teacher's opinion, interviews, observations, perceptions, or experiences during a certain program. Program proposals without considering children in their studies. Study protocols.	(reduc*) AND ("screen time" OR television OR computer OR videogame)
Study design	Randomized controlled trials or parallel trials	Non-randomized controlled trials or parallel trials	"Randomized controlled trial**"
Other critics	Peer-reviewed, original, full-text studies	Articles written without peers, reviewing the complete original text studies.	—

Table 2. Methodological Assessment of the Included Studies.

Reference	1	2	3	4	5	6	7	8	9	10	Score
Birken et al ²³	2	2	2	2	2	2	0	2	2	2	18/20
Boonmun et al ²⁴	2	2	2	2	0	0	2	2	2	2	16/20
De Coen et al ²⁵	2	2	n/a	0	0	0	2	2	2	2	12/18
Dennison et al ²⁶	2	2	0	2	n/a	n/a	0	2	2	2	12/16
Lumeng et al ^{27a}	2	2	2	2	2	2	2	2	2	2	20/20
Raj et al ²⁸	2	2	2	2	0	0	2	2	2	2	16/20
Tuominen et al ²⁹	2	2	2	0	0	0	2	2	2	2	14/20
Yilmaz et al ³⁰	2	2	2	2	2	2	2	2	2	2	20/20

Item 1 = subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received); **Item 2** = allocation was concealed; **Item 3** = the groups were similar at baseline regarding the most important prognostic indicators; **Item 4** = there was blinding of all subjects; **Item 5** = there was blinding of all therapists who administered the therapy; **Item 6** = there was blinding of all assessors who measured at least 1 key outcome; **Item 7** = measures of at least 1 key outcome were obtained from more than 85% of the subjects initially allocated to groups; **Item 8** = all subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least 1 key outcome was analysed by "intention to treat"; **Item 9** = the results of between-group statistical comparisons are reported for at least 1 key outcome; **Item 10** = the study provides both point measures and measures of variability for at least 1 key outcome.

^aNo genuine no-intervention group.

synthesis of the systematic review contained 8 randomized controlled trials (Figure 1)

Quality Assessment

The quality assessment for this systematic review can be found in Table 2. Table 2 presents a methodological assessment of several studies based on 10 criteria. Each study was evaluated for factors such as random allocation of subjects, blinding, similarity of groups at baseline, data collection, and reporting of statistical comparisons.

Scores ranged from 12 to 20 out of the total possible score. Studies by Lumeng et al²⁷ and Yilmaz et al³⁰ scored the highest, meeting most criteria, while some studies, like De Coen et al²⁵ and Dennison et al,²⁶ scored lower due to missing data or lack of blinding. However, the studies

differed in quality, with scores ranging from 20/20^{27,30} to 14/20²⁹ and 12/18.²⁵ The most common shortcomings were Item 5 (there was blinding of all therapists who administered the therapy) and Item 6 (there was blinding of all assessors who measured at least 1 key outcome). Other shortcomings were Item 3 (the groups were similar at baseline regarding the most important prognostic indicators), Item 4 (there was blinding of all subjects), and Item 7 (measures of at least 1 key outcome were obtained from more than 85% of the subjects initially allocated to groups). Out of these, the Item 4 shortcoming is the most significant with regards to screen time outcome. Lack of blinding subjects might lead to confirmation bias by parents subconsciously or consciously reporting in line with whatever outcome they perceive to be expected. All of the studies that were able to demonstrate reduced screen time fulfilled Item 4, but 2 of the studies that

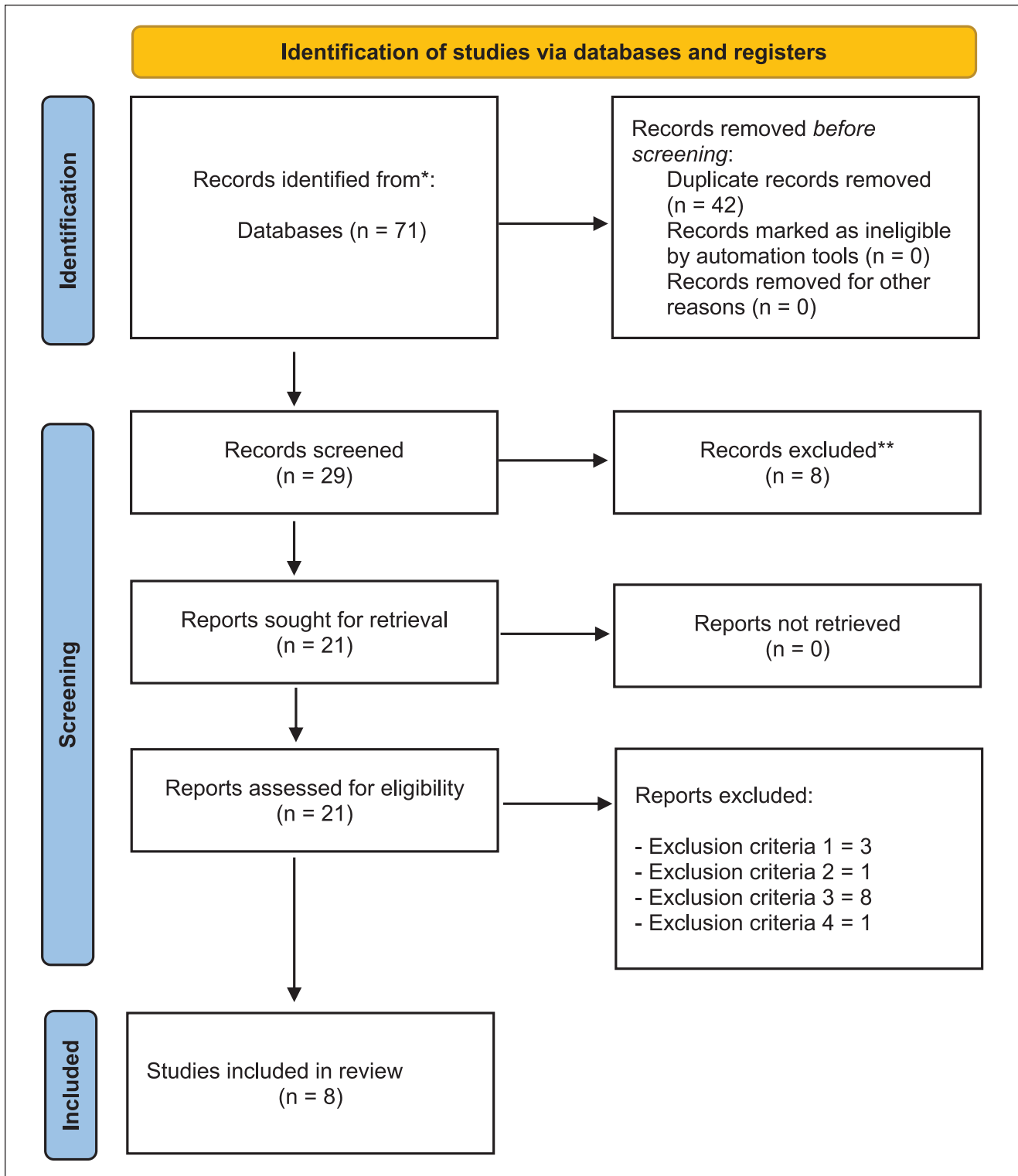


Figure 1. Flow diagram of the study.

were not able to demonstrate reduced screen time^{25,29} did not fulfill Item 4. Another potential weakness could be drop-out bias. Participants might have dropped out for various

reasons, for example because they were not allocated to the intervention group, or because they were unable to achieve the results they are hoping for.

Study Characteristics

Quantitative synthesis. The interventions varied in their effectiveness in reducing screen time among preschool-aged children. Birken et al²³ found no significant differences in screen time following a short counseling intervention. Boonmun et al²⁴ demonstrated significant reductions in children's screen time after implementing a parent-focused program. De Coen et al²⁵ reported no significant intervention effects on screen time but observed promising results in reducing excess weight gain in low-socioeconomic status communities. Dennison et al²⁶ significantly reduced screen time with a preschool-based intervention targeting television viewing. Lumeng et al²⁷ did not observe a reduction in screen time despite targeting emotional and behavioral self-regulation. Raj et al²⁸ effectively reduced screen time among preschoolers from low socioeconomic families with a digital parental health education intervention. Tuominen et al²⁹ found no effect on screen time with a movement-to-music video program for mother-child pairs. Yilmaz et al³⁰ reported reductions in screen time and aggressive behavior with a simple intervention in primary care settings.

Qualitative synthesis. The interventions highlighted various strategies, including behavioral counseling, parent training, multi-component interventions, preschool-based programs, digital health education, and simple interventions at health maintenance visits. While some interventions targeted parents, others focused on children or both. The findings highlighted the importance of considering parental and child factors in designing effective interventions. Additionally, the setting of the intervention, duration, and the use of different test instruments and variables varied across studies. Overall, the results suggest the need for comprehensive approaches tailored to specific contexts to effectively reduce screen time in preschool-aged children.

The characteristics of studies were extracted and clustered in Table 3.

Discussion

This paper investigated 8 studies aiming to reduce preschool-aged children's screen time by employing various interventions. The studies showed mixed results, as Boonmun et al,²⁴ Dennison et al,²⁶ Raj et al,²⁸ and Yilmaz et al³⁰ found reduced screen time, while Birken et al,²³ De Coen et al,²⁵ Lumeng et al,²⁷ and Tuominen et al²⁹ did not.

Studies that found reduced screen time had a few variables in common that seemed to be of significance, although these variables were not necessarily exclusive, as they could also be found in some of the studies that did not find reduced screen time. Repeatedly reinforcing the knowledge of and attitude toward screen time and its potential consequences,

and instruction on how to reduce screen time, seemed to be 2 central variables. The parents' knowledge and attitude were repeatedly reinforced with counseling and/or informative material. Instruction on how to reduce screen time included how to remove or discourage use of screen devices, and suggesting alternative activities for replacing screen time. Successful screen time reduction also seemed to happen in studies primarily focusing on this particular issue, while studies primarily focusing on other health issues such as obesity did not succeed.

Boonmun et al²⁴ included group discussion for parents in the intervention group, which could potentially have a motivational effect on the parents by increasing their team spirit, thus reinforcing their belief and loyalty to the intervention. The intervention of Tuominen et al²⁹ included sessions of exercise while watching and following along with video, thus adding to screen time. However, the authors did not find any significant change in screen time after the intervention, despite parents on average reporting 1.9 sessions lasting 17 min among 36 children. This suggests that, although the children didn't reduce their screen time, they replaced some of their usual screen time with exercise-centered screen time.³¹

As many of the interventions took place at home and/or at daycare/preschool, the studies were not necessarily conducted in a controlled environment. Additionally, screen time was reported in logs and/or questionnaires. This brings a degree of uncertainty to the subjects' enactment on the intended interventions, and to the recorded screen time data due to potential recall bias. The questionnaires could also differ in quality, and screen time could be estimated by different methods. The exact method studies used to quantify screen time is somewhat unclear, although, it seems like the methods entailed parents recording the children's screen time in various ways, ranging from extrapolating weekdays screen time from a single weekday's data to recording screen time on a day-by-day basis.

The duration of the interventions ranged from 2 months to 2 years. Baseline screen time was in some studies compared to screen time at multiple follow-up occasions, but was in others only compared to post-intervention screen time. In the latter case, the wrong conclusion might be drawn regarding interventions which yielded an initial but gradually diminishing effect (eg, due to lack of motivation because of insufficient repeated reinforcement). Shorter studies and/or studies with frequently repeated reinforcement could therefore have benefited with regards to recording a significant effect on screen time. It is also possible that seasonal habits might have been a confounding factor, as screen time could be more prevalent during winter than summer.

The studies spread across different eras. The oldest study (Dennison et al,²⁶ was conducted before the release of the iPhone, a historic moment considering our daily interaction

Table 3. Interventions for Reducing Screen Time in Preschool-aged Children.

Reference	Aim	Sample	Intervention				Results		
			Name/ Groups	Duration	Test instrument	Variables	Results	Conclusions	
Birken et al ²³	Determine if an intervention for preschool-aged children in primary care is effective in reducing screen time	Total number of children: 132 Schools: preschool Country: Canada (Mean age EXP 3.12 ± 1.19, CON 3.08 ± 0.12years) (Range n/a)	EXP (n=64) (10-min behavioral counseling intervention on strategies to decrease screen time and a hand-out delivery to parents) CON (n=80) (no intervention)	1-year follow-up	Parents' report	Screen time	There were no significant differences in screen time	Short interventions focused solely on reducing screen time implemented in the primary care practice setting may not be effective in this age group	
Boonman et al ²⁴	Examining the effects of the newly developed Parents' Screen Time Reduction for Preschool Children Program, a training program for parents' planned behaviors and the screen time reduction of their children	Total number of children: 67 Schools: preschool Country: Thailand (Mean age n/a) (Range 2-5years)	Parents must be concerned regarding the fact that a high screen time level negatively affects children's health outcomes and should promote good health and appropriate behaviors for their children	2 weeks + 2-month follow-up	Questionnaires employing Likert scale	Parents' attitudes, subjective norms, perceived behavioral control and intentions, and behaviors. Children's screen time	EXP parents' attitudes and behaviors were significantly higher than those in CON immediately after the intervention. EXP perceived behavioral control was significantly higher than that of CON 2 months after the intervention. EXP children's screen time decreased significantly more at 1 week and 2 months after the completion of the intervention than that of CON	Nurses and teachers can use this program among parents to perform appropriate screen time behaviors to promote development and health outcomes among children CON (n=32) (no intervention)	
De Coen et al ²⁵	Examining the effects of a 2-year multi-component intervention in local communities with different socio-economic characteristics on – among other effects – the reduction of screen time among 3- to 6-year-old children	Total number of children: 694 Schools: 31 preschools and primary schools Country: Belgium (Mean age 4.98 ± 1.30years) (Range 3-6years)	Schools are a natural setting for preventive interventions and are considered a suitable medium to reach parents	2 years including follow-up	Parental questionnaire	Screen time	No significant intervention effects could be found for screen-time	Although no significant effect was found for screen time in the total sample, this intervention had a promising effect of reducing excess weight gain among young children in the low-socio-economic status community	
Demmison et al ²⁶	Developing and evaluating an intervention to reduce television viewing by preschool children	Total number of children: 77 Schools: 16 preschool or day care centers Country: USA (Mean age EXP 3.9 ± 0.1, CON 4.0 ± 0.1 years) (Range 2.5-5.5 years)	Child care settings offer a unique and emerging opportunity to promote the development of healthy lifestyle behaviors such as limited television viewing	1 year	Parents' report	Screen time	EXP significantly decreased screen time	A preschool-based intervention can lead to reductions in young children's television/ video viewing	

(continued)

Table 3. (continued)

Reference	Aim	Sample	Intervention			Results			Conclusions
			Name/ Groups	Intervention main ideas	Duration	Test instrument	Variables	Results	
Lumeng et al ²⁷	Determining whether an intervention to improve emotional and behavioral self-regulation in combination with an obesity-prevention program could – among other effects – reduce screen time in preschoolers	Total number of children: 690 Schools: preschool Country: USA (Mean age EXP 4.12 ± 0.52, CON1 4.10 ± 0.52, CON2 4.12 ± 0.53 years) (Range n/a)	EXP (n=253) (an intervention to improve self-regulation + a federally funded preschool program for low-income children + an education program targeting evidence-based obesity-prevention behaviors) CON (n = 221) (a federally funded preschool program for low-income children [HS] + an education program targeting evidence-based obesity-prevention behaviors)	Improving children's self-regulation may be a novel strategy for preventing obesity	1 year	Parents' report	Screen time	There was no effect on screen time	An intervention for parents and children to improve HS preschoolers' emotional and behavioral self-regulation in combination with an obesity-prevention curriculum did not reduce screen time
Raj et al ²⁸	Developing, implementing and evaluating the effectiveness of Stop and Play, a digital parental health education intervention to reduce excessive screen time among preschoolers from low socioeconomic families in Malaysia	Total number of children: 360 Schools: preschool Country: Malaysia (Mean age n/a) (Range 3-4 years)	EXP (n=180) (whiteboard animation videos, infographics, and a problem-solving session delivered via WhatsApp) CON (n = 180) (no intervention) CON (n = 180) (no intervention)	Screen time interventions for young children must incorporate both parents and children, as opposed to child-oriented interventions alone	4 weeks + 3-month follow-up	Variables' self-recall Values	Child's screen time, mother's screen time knowledge, perception about the influence of screen time on the child's well-being, self-efficacy to reduce screen time and increase physical activity of the child, mother's screen time, and presence of screen device in the child's bedroom	At 3 months after the intervention, EXP showed significantly reduced child's screen time compared with CON. Mother's knowledge and perception about self-efficacy to significantly increased and influence of screen time on the child's well-being reduced. Mother's self-efficacy to reduce screen time and increase physical activity of the child increased and mother's screen time decreased	The Stop and Play intervention was effective in reducing screen time among preschool children from low socioeconomic families, while improving the associated parental factors

(continued)

Table 3. (continued)

Reference	Aim	Sample	Intervention				Results			Conclusions
			Name/ Groups	Intervention main ideas	Duration	Test instrument	Variables	Results		
Tuominen et al ²⁹	Determining whether a movement-to-music video program could – among other effects – reduce screen time in mother-child pairs	Total number of children: 203 Schools: preschool Country: Finland (Mean age n/a) (Range 5+7 years)	EXP (n= 102) (using the movement-to-music video program DVD) CON (n= 101) (no intervention)	The movement-to-music video program developed for mother-child pairs decreases the screen time of mothers and their children	8 weeks	Self-reported screen time via a questionnaire	Mothers' and children' screen time	No inter-group effect on screen time (screen time increased over time in CON children)	The movement-to-music video program did not change the screen time of the mother-child pairs.	
Yilmaz et al ³⁰	Determining whether a simple intervention applied at the health maintenance visits and in the primary care setting would be effective in reducing screen time	Total number of children: 363 Schools: n/a Country: Turkey (Mean age CON 3.49 ± 1.22, EXP 3.52 ± 1.28 years) (Range 2+6 years)	EXP (n= 187) (reading printed material, watching interactive CD, and counseling call) CON (n= 176) (no intervention)	Decreasing screen time at home, making home screen-free, showing family benefits due to living in screen-free home, and providing information about stories of families that managed to decrease screen time	8 weeks+ 9-month follow-up	Screen time recall, height and mass measurement. Child Behavior Checklist	Screen time, body mass index (BMI) z-score, and aggressive behavior	Screen time and aggressive behavior decreases, no BMI z-score change	A preschool-based intervention which can be applied in primary care setting can reduce children's reported aggressive behaviors	

Abbreviations: CON, control group; EXP, experimental group.

with screen devices. The most recent studies^{24,28} were conducted in the COVID and post-COVID era. Attitude toward, possession of, and habits surrounding screen devices might differ across the eras these studies were conducted. During the COVID pandemic in particular, people were mostly staying at home due to the extraordinary circumstances. It is reasonable to assume this would have an effect on children's daily screen time, as children at home have been shown to accumulate more screen time than children in day-care.³² The studies also spread across different geographical locations all over the world, including Canada, Thailand, Belgium, USA, Malaysia, Finland, and Turkey. The participants might therefore be of different socioeconomic status, which could be related to the number and types of screen devices present in a home. For example, children of families with high socioeconomic status are more likely to have a television in their own personal bedroom.⁶ Thus, the generalizability of the studies might be limited to a particular era or socioeconomic group.

Conclusion

Screen time among preschoolers can be effectively reduced by targeting parents' knowledge and attitude through comprehensive, parent-involved approaches involving repeated reinforcement and teaching them about the consequences of screen time and how they can proceed to reduce it for their children.

Declaration of Conflicting Interests

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