

SYSTEMATIC REVIEW

Parental Intervention Strategies to Reduce Screen Time Among Preschool-aged Children: A Systematic Review

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ABSTRACT

Aims: Children below five years have been the target of screen time guidelines. The adverse health outcomes associated with it require focusing on prime strategies for reducing screen time. The current study reviews parental intervention strategies to reduce screen time among preschool-aged children. **Design:** Systematic review. **Data sources:** A total of five databases of the Cochrane register of controlled trials, CINAHL, Medline PubMed, and Scopus databases were searched from May 1 to 31, 2020. **Review Methods:** The keywords of “screen time”, “television”, “video”, “computer”, “mobile device”, “hand phone”, “media use”, “preschool-aged children”, “interventions”, and “strategies” used for search. The inclusion criteria are limited to specific study populations, intervention, comparison and outcomes (PICOs), language, and published study types. The quality of articles was assessed using the Cochrane Risk of Bias (RoB) tool. **Results:** A total of six studies that met the inclusion criteria were further analysed. It showed that besides providing knowledge and awareness regarding screen time, restrictive practices, offering alternative activities to parents and removing the screen from the child’s bedroom were the most common strategies used by successful studies. The duration of intervention between 6-8weeks was sufficient to observe screen time reduction, while face-to-face methods dominated the mode of delivery. Increasing parental self-efficacy, listing outcome expectations, and reinforcement strategies targeting both the parents and their home environment were beneficial in reducing screen time. **Conclusion:** Future screen time reduction studies could benefit from incorporating the above approaches for screen time reduction intervention among preschool children.

Malaysian Journal of Medicine and Health Sciences (2022) 18(6):295-304. doi:10.47836/mjmhs18.6.38

Keywords: Child, Preschool, Screen time, Parents, Interventions

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INTRODUCTION

Screen time (ST) is defined as any time spent on screen devices including television, handphones, tablets, computers, and video games (1). The World Health Organization (WHO) have published ST guidelines for children below 5 years in April 2019 (2) which does not recommend ST for children below 2 years of age. However, a limit of one hour per day is allowed for children aged between 2 and 5 years.

The global prevalence of not meeting screen time guidelines among children aged below 5 ranged between 70% to 90% (3-8). This alarming phenomenon of children using screen gadgets has captured the attention of various healthcare professionals. Screen time could have some positive implications to the children. When using well designed programmes, it

can assist in early literacy and acquisition of language (9). Besides, having parental company to explain the contents can not only help retain relevant information but strengthen the parent-child bond as well. However, age-appropriate limits still need to be in place as there are risks of multiple negative health effects in children (10-18).

Children who exceeded the recommended 1-hour screen time guidelines at 24 months were more likely to have lower physical motor skills (OR 1.07, 95% CI:1.02-1.13; p=0.01) as well as hyperactivity (OR:1.08, 95% CI: 1.02-1.14; p=0.01) (19). In addition, children who were exposed to more than 2 hours of ST per day were six times more likely to suffer from inattention problems compared to children who spent less than 30 minutes (AOR 5.9, 95% CI:1.6-21.5, p=0.01) (12).

Research have also associated excessive screen time with obesity. Children aged 2 years who had excessive screen time were more likely to be obese at age 4.5 (OR 1.11, 95% CI: 1.01-1.20; p=0.03) (20). In the European Childhood Obesity Project where child’s screen time

data and BMI z-score was assessed from 3 until 6 years, increased daily screen time was associated with higher BMI z score at age 6 ($p=0.002$) (21). The plausible explanations are as most children spend time on screens while sitting, it displaces the time that could have been spent on physical activity. Besides, children who eat while watching screens have a decreased focus on satiety cues which causes overeating (22). In addition, there is also an increased exposure to junk food advertisements that may allure them into unhealthy eating habits (23).

Parents have a dominant effect on their child's activities including the use of screen media. Furthermore, parents decide the type of gadgets their child has access to and the duration of screen activities (24). Therefore, interventions that focus on parental strategies can produce a significant impact. This systematic review aimed to identify effective parental intervention strategies to reduce ST among preschool-aged children which can be incorporated by the health care providers or programme planners into screen time reduction modules targeted at parents, in terms of settings of intervention, the theories used, mode of delivery, intervention providers, duration and frequency of interventions for control groups, and activities involved.

METHODS

This systematic review was registered with the International Prospective Register of Systematic Reviews (PROSPERO No: CRD42020199398) and reported based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Search strategy

The systematic search was conducted in May 2020 via Cochrane Central Register of Controlled Trials, CINAHL, Medline Complete, PubMed, and Scopus databases. The terms related to "screen time" like screen time, television, video, computer, mobile device, hand phone, media use with a combination of preschool-aged children, interventions, and strategies terms were used (Table I). Reference lists of selected articles were further searched to identify any potential studies.

Inclusion/exclusion criteria

All retrieved articles were examined using the population, intervention, comparison, and outcomes (PICO) approach, as below:

Population: Children between two to five years of age. Children below ten years old were also reviewed for partially overlapped cases.

Intervention: Randomised control trials and pilot studies targeting ST reduction as the primary outcome measure.

Comparison: Having either no or other types of other interventions. Outcomes: Intervention strategies based on the Template for Intervention Description and Replication (TIDiER) checklist (25), together with the positive results of the intervention.

Table I: Search strategy

Search	Search Items
1	Screen time OR television OR computer OR tablet OR mobile phone OR media use OR TV OR mobile gadget OR hand phone
2	Preschool-aged child* OR early childhood OR toddler* OR 2-5 years
3	Randomi*ed controlled trial OR RCT
4	Strateg* OR methods OR techniques OR interventions
5	1 AND 2 AND 3 AND 4

TV: Television; RCT: Randomised Control Trial

Only full-text articles published in English were sought to obtain credible sources of articles with a rigorous peer-review process. Unpublished journals and other literature like conference papers, books, and case studies were excluded from the search.

Data extraction

One author (DR) read the titles in the initial search to remove duplicate records. Three authors (DR), (HSM) and (NAMZ) then independently reviewed the selected abstracts. Abstracts were excluded when two of the three authors stated that the abstract did not meet the inclusion criteria. Dissent cases were discussed with a fourth author (NA) to resolve the discrepancies. All authors read the selected papers thoroughly and decided on the final suitable articles to be selected. The outcome measure was the strategies that included the participants' characteristics, country of study, sample size, intervention settings, duration of intervention and follow up, the theory used, components of intervention used, methods of delivery, intervention provider, description of the control group, and total ST reduction synthesised in a narrative form.

Quality & risk assessment

The quality of the research articles was assessed using the criteria developed and validated by the Cochrane Risk of Bias (RoB) tool. The domains of 'high risk', 'low risk', and 'unclear risk' of bias were assigned and evaluated in terms of random sequence generation, allocation concealment, selective reporting, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, and other sources of biases. The results were synthesised by converting to the Agency for Healthcare Research and Quality (AHRQ) standards, where the number of studies, the consistency of results, and methodological quality were taken into consideration. All assessment discrepancies among authors were discussed until a consensus was reached. Besides, selected studies were cross-checked against protocols to determine publication bias.

RESULTS

Description of study characteristics

The literature search yielded a total of 2757 hits. Fig. 1 shows the studies that were identified and excluded at each stage based on the PRISMA statement flow diagram.

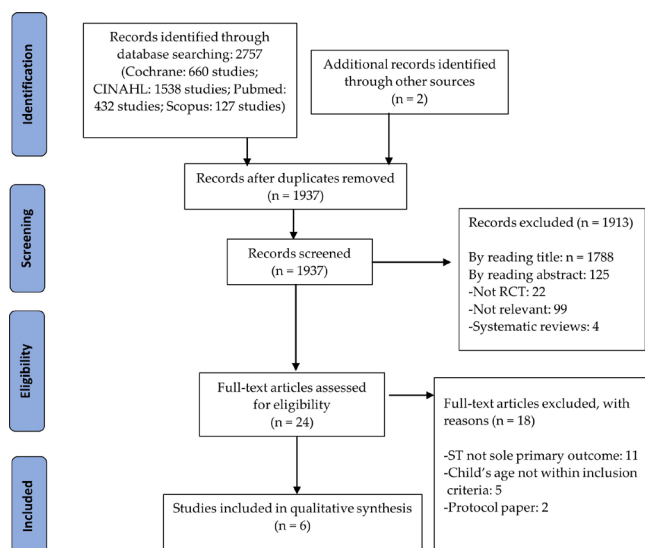


Figure 1: PRISMA flow diagram of RCT included in review

Duplicate studies were removed. The remaining studies were screened for eligibility and the full texts of 24 studies were retrieved for further evaluation. In total, six studies met the inclusion criteria of which four were individually randomised studies and remaining were pilot studies (26-27). The majority of studies were conducted in Western countries, particularly the United States of America (n=3), Australia (n=1), Canada (n=1), and Eurasia (Turkey=1). The sample size ranged from 160 (28) to 363 (29) among full studies whilst sample sizes among pilot studies ranged between 22-67 (26-27). With the exception of the study by Birken (28), the other five studies produced significant reduction in screen time among children.

Risk of bias in included studies

Fig. 2 outlines the results of the risks of bias in the six studies. Two authors in-dependently assessed the risk of bias of each study using the criteria outlined in the Cochrane risk of bias tool. Five studies provided a detailed description of random sequence generation and only two reported the allocation concealment methods. Next, two studies reported the blinding of the participants and personnel while three trials reported the blinding of the outcome assessment. One trial lost up to 50% of participants during the follow-up period (26) as parents were unable to attend scheduled sessions and preferred online delivery methods as the intervention. To address missing data, intention to treat analysis was used. All of the included trials were deemed to have a low risk of selective reporting, incomplete outcome data, and other sources of biases. Publication bias was not assessed as study protocols were unavailable for the included studies.

The participants and study characteristics are outlined in Table II. Strategies used in interventions aiming to reduce ST were explored with the TIDieR checklist and synthesized to obtain reliable and replicable strategies for future interventions (Table III). The strategies

Study	Random sequence generation	Allocation concealment	Selective reporting	Blinding (Participant & personnel)	Blinding (Outcome assessment)	Incomplete outcome data	Other sources of bias	Overall Quality
Hinkley, et al.(2015) (42)	Green	Green	Green	Green	Green	Green	Green	Good
Zimmerman, et al. (2012) (43)	Green	Yellow	Green	Yellow	Yellow	Green	Green	Poor
Yilmaz, et al. (2014) (45)	Green	Yellow	Green	Green	Green	Green	Green	Fair
Birken et al. (2012) (46)	Green	Green	Green	Yellow	Green	Green	Green	Fair
Demission, et al.(2004) (15)	Red	Yellow	Green	Yellow	Yellow	Green	Green	Poor
Mendoza, et al.(2016) (49)	Green	Yellow	Green	Red	Yellow	Green	Green	Poor

Figure 2: Risk of bias in included studies using Cochrane Risk of Bias Tool. Red: High Risk; Yellow: Unclear Risk; Green: Low Risk

are presented in narrative synthesis and range from appropriate theories/constructs being used, settings of interventions, mode of delivery, intervention provider, materials used, processes/activities, frequency and duration of intervention.

Location / Settings

Studies were conducted in various settings such as preschools/kindergartens (n=2) (30,31) and community-based setting (n=1) (26). While an additional two studies were conducted in the primary care setting such as government and private clinics (n=3) (27-29). Both studies conducted in pre-schools that targeted children required the involvement of parents at home.

Theory / Construct

Four out of the six studies used an established theory as the basis of their intervention. Two studies used single theories (29,31) while another two used a combination of theories (26,27). The study by Hinkley used a combination of social cognitive theory with family systems theory. The component of the transtheoretical model used in the study by Zimmerman (27) did not have a significant effect on the total amount of ST. Four studies used social cognitive theories (26,27,29,21). One study did not mention any specific theory but claimed to have used the embedded concepts of goal setting, positive reinforcement and cognitive restructuring (28). One study did not include any theory concepts (30). Two studies explained the link between the content delivered and the theoretical constructs (26,27). However, besides the study by Hinkley et al (26) the hypothesised mechanism of actions remained unclear.

Mode of delivery

All interventions were conducted face-to-face via a combination of dedicated sessions or home visits. In the study by Zimmerman (27), written materials were distributed at the initial interview followed by monthly newsletters linked to a website containing information on the intended behaviour change which was to reduce child's media time to 1 hour or less per day and to replace commercial viewing with educational viewing. Each family was also assigned to a case manager who would facilitate behaviour change through monthly

Table II: Participant & study characteristics

Author	Age (years)	Sample size (N)	Study design	Primary outcome	Secondary outcome
Hinkley et al. (2015) Australia [31]	2-3	N=22 IG:12; CG:10	Individual RCT (Pilot)	Diary reported ST	Acceptable time for the child to use ST Self-efficacy to limit ST/support active opportunities Perception of the importance of co-participating in activities Parents' belief of ST in health, developmental, and behavioural outcomes
Zimmerman et al. (2012) USA [32]	2.5-4.5	N=67 IG:34; CG:33	Individual RCT (Pilot)	Diary reported ST	Outcome expectation, Self-efficacy, Volitional control
Yilmaz et al. (2014) Turkey [34]	2.6-5.5	N=363 IG:187; CG:176	Individual RCT	Self-reported ST	BMI z score, aggressive behaviour, meals in front of Television (TV), parents' ST
Birken et.al (2014) Canada [35]	3	N= 160 IG:81; CG:79	Individual RCT	Self-reported ST	TV in child's bedroom, number of meals in front of TV, BMI
Dennison et al. (2004) USA [38]	2.6-5-5	N=176 IG:93; CG:83	Cluster RCT	Self-reported ST	BMI
Mendoza et al. (2016) USA [39]	3-5	N=184 IG:99; CG:84	Cluster RCT	Diary reported ST	BMI, parent acculturation, perception of neighbourhood disorder

IG: Intervention group; CG: Control group; RCT: Randomised Control Trial; ST: Screen Time; BMI: Body Mass Index

Table III: ST intervention strategies in included studies

Authors / Year/ Country / Design / Name/ Reference	Theory/ Construct	Setting (S) Mode of delivery (M) Intervention Provider (P)	Intervention's materials and activities	Duration (D) / Frequency (F) / Data collection time point (T)/ Results (R) / Intervention group (I) Control Group (C)
Hinkley, et al. (2015) / Australia / Individual RCT (Pilot) / Family @ Play (16)	Social Cognitive Theory (SCT)/Family systems Theory Personal: Knowledge Outcome Expectancies Motivation Reinforcement Self-efficacy Emotional coping response Behavioral Observational learning Self-control Goal setting Self-monitoring Self-regulation Behavior capability Environmental Physical environment	(S): Community-based (M): Face-to-face, SMS in between to support adherence to previously set goal, Data collection at family homes / convenient point (P): Trained facilitator not part of the research team	Time use diary Accelerometer Primary components Removing TV from the child's bedroom Setting rules/boundaries Displacing ST with other activities Key messages: 1. Knowledge, ST recommendations, negative outcomes 2. Awareness and implementation of strategies to use healthy level of ST 3. Teach families behavioural modifications such as planning & monitoring Control group: Waitlist control group	(D): 6 weeks (F): Weekly (T): Baseline/immediate post intervention (R): Successful I: -31.2 mins/day [-87.0,9.0] C: +3.0 mins/day [-40.9,46.9]
Zimmerman et al. (2012) / USA / Individual RCT (Pilot) / The value of SCT to reducing preschool TV viewing (18)	SCT Outcome expectancies Self-efficacy Volitional control Trans-theoretical model Stages	(S): Primary care (M): One face-to-face session and/ or monthly phone call/email/mail (post) (P): Case manager with health counselling experience	Written materials (at baseline) Website Monthly newsletters (5 pages on behavior, tips, link to website) Time diary Parents to reduce child's ST to ≤ 1 H Replace commercial viewing with educational viewing Encouragement to mother (self-efficacy) Positive & negative effects of ST (outcome expectancies) Strategies to modify the child's viewing time (volitional control Assessment & counselling on parent's stage of change (trans theoretical model) Control group: Injury prevention & preschooler safety	(D): 4 months (F): monthly (T): Baseline/ immediate post intervention. (R): Successful (I): -37 mins 95% CI: -68.7 to -5.6 [Regression coefficient] (C): Reference

Table III: ST intervention strategies in included studies (continued)

Authors / Year / Country / Design / Name / Reference	Theory / Construct	Setting (S) Mode of delivery (M) Intervention Provider (P)	Intervention's materials and activities	Duration (D) / Frequency (F) / Data collection time point (T) / Results (R) / Intervention group (I) Control Group (C)
Yilmaz et al. (2015) / Turkey / Individual RCT (22)	SCT Cognitive Environmental	(S): Primary care (M): Face-to-face (P): Not mentioned	Printed material Interactive Compact Disc (CD) Counselling call Read age-appropriate books Turn the TV off during mealtimes Alternative activities "No TV" sign on the TV screen Remove the TV from child's bedroom Counselling call: benefits of screen-free home, challenges Picture book: Increase conversation with family, consequences of increased ST Information on stories of families who able to reduce ST. Home visits to record BMI and answer questionnaire Control group: Similar intervention without counselling call	(D): 8 weeks (F): 2-weekly. (T): Baseline/ 2month/ 6month/ 9 month (R): Successful (I): -64.88 mins/day (SD:21.36) (C): +7.41 mins/day (SD: 2.79)
Birken et.al (2014) / Canada / Individual RCT / Target Kids (21)	Goal setting Positive reinforcement Monitoring Cognitive restructuring Environment	(S): Primary care (M): Face-to-face (P): Trained study personnel	Information on the health impact of ST Removing TV from the child's bedroom Eating without the TV Limiting the child's ST One-week TV turn-off (rewarded with stickers) Counselling on safe media use Managing media in the home (handout by Canadian Pediatric Society) Alternative activities: Berenstein Bear's "Too Much TV" story, creating a list of non-TV-related activities, Canadian Pediatric Society handout on good TV habits Control group: Counselling on safe media use, managing media in the home (handout by Canadian Pediatric Society)	(D): 10 mins (F): One time (T): Baseline/ 1 year post intervention (R): Not successful p=0.68 (C): Reference
Dennison et al. (2004) / USA / Cluster RCT / Brocodile the Crocodile (23)	Nil	(S): Preschool (M): Face-to-face with children, take-home material sent to parents (P): Program staff (early childhood teacher)	Weekly calendar with no TV stickers to reward the child American Academy of Pediatrics Brochure Parents to read stories to children & Blue-ribbon award for the best reader Mealtime TV off Children suggest alternative activities (eg. reading, eating meals together) Discuss Bernstein Bear book "No TV" signs made by children Children plan a party to celebrate surviving a week without TV Party with discussion on alternate activities done Booster session Control group: Safety & Injury prevention	(D): 7 weeks (F): Weekly (T): Baseline/ 8months post intervention (R): Successful (I) -3.1 hours/week (C): +1.6 hrs/week
Mendoza, et al. (2016) / USA / Cluster RCT / Fit 5 kids (F5K) (24)	SCT Observational learning Reinforcement	(S): Pre-school (M): Face-to-face, incorporated into the lesson plan for kids Printed material for parents (P): Study staff	7-day TV diary Accelerometers Newsletter to inform parents on lessons & optional home activities Cultural adaptation: Qualitative interview with parents, forward & backward translation. Practise trial of the curriculum (shortening duration of the lesson, substitute with songs, adapt to other devices besides TV) Modelling by preschool teacher--> Child rehearse modelled behaviour--> Feedback--> Reward & praise Intervention: (Incorporated into language, mathematics, music, arts & craft lesson) increase reading, discuss about the library, family mealtime, alternatives (poem/songs/art craft), Berenstein Bear's "Too Much TV" story, TV turn-off week, celebrate TV turn-off week, no more couch potato Control group: Usual curriculum	(D): 7-8 weeks (F): Weekly (T): Baseline/ 8mths post intervention. (R): Successful (I) -25.3 (95% CI: -45.2 to -5.4) [Regression coefficient] (C): Reference

phone calls and emails. In cases where a participant could not be reached, the case managers left a phone message or email containing content relevant to the intervention. Text messages were also applied as prompts to remind the participant to fill up time diary and to support adherence to previously set goals. The study by Dennison (30) includes interactive educational sessions for the children held at preschools. Materials and activities were also sent home to stimulate discussions between parents and children. Elsewhere, group sessions and discussions were held to deliver the content of the intervention while SMS messaging was used as the mode of giving support adherence to goals set (26). Audio-visual methods were used in the study by Yilmaz where an interactive compact disc (CD) which contained recordings of harmful effects of television, video and computer games was given to parents (29).

Intervention's Materials

Apart from Hinkley et al (26), the remaining studies delivered the intervention to parents via printed materials such as newsletters, worksheets, brochure, or handouts. Three studies distributed a time diary for parents to document the amount of ST spent (26-27,31) while the rest of the studies assessed ST via parent-reported measures. Two studies used calendars with stickers to reward children when they achieved the set target of ST reduction (28,30). Accelerometers were used in two studies to measure secondary outcomes (26) and exploratory outcomes (31).

Intervention's activities

All six studies provided knowledge and awareness of ST to the participating parents and children. All studies relied on parental rules or restrictive practices to ensure ST reduction was achieved. This included settling limits according to personal goals such as having a TV off week or TV off during mealtimes. With the exception of Zimmerman et al (27), the remaining five studies suggested alternative activities to substitute ST for children, with reading books being the most common alternative activity (29,30,31). One commonly read and discussed book mentioned was the "Berndt Bear Too Much Television". Other alternative activities include singing poems or songs, as well as arts and craft activity (31). The study by Mendoza incorporated modelling target behaviour where children observed and modelled behaviours such as turning off the television and doing alternative activities. This was followed by providing praise and positive affirmations when the behaviour was followed (31). One study encouraged parents to make 'no TV or screen' signs and place it on each screen device available at home (29). Other strategies include reducing the number of televisions at home or using radio/CD for background noise as well as requesting parents to reduce their own screen time (26). Almost half the studies encouraged the removal of television from their child's bedrooms as a strategy to reduce the ST (26,28-30).

Intervention Provider

The interventions at preschool were conducted by programme staff who were health educators (30,31) while the rest were conducted by trained facilitators (26-28). One study did not explicitly mention the intervention provider (29). Of all the studies, only one study included the training components given to case managers who delivered the intervention (27).

Duration/Frequency

The duration of the intervention ranged between 10 minutes to 4 months. In general, most interventions were delivered within an average of 6-8 weeks (26,29-31). However, ST measurement points varied between the six studies, including immediate post interventions (26,27,29), eight months post intervention (30,31) and one year post intervention (28). The average frequency of delivery was approximately four times throughout the whole delivery period.

Control groups

Control groups received either usual curriculum (31), other materials such as safety and injury prevention modules (27,30) or a modified version of the proposed intervention by excluding certain aspects (29). One study took the approach of waitlist by providing the intervention only after the completion of the study (26) whilst another study gave a handout regarding managing media in the home (28).

DISCUSSION

Summary of main results

This review aimed to identify parental intervention strategies to reduce ST among preschool children. Based on this objective, a total of six trials conducted in four developed countries were identified and contributed to the synthesis of results. Three out of the six studies were done in the United States. The number and location of trials indicated that the issue of ST among preschool children has not been adequately studied outside the developed Western countries even though in developing countries, the obesity epidemic that is often associated with ST is 30% higher than that of developed countries (2).

Our review found that studies conducted in various settings yielded a positive reduction in ST, except for one study that was conducted in the primary care setting (28). This could be attributed to the fact that such intervention might not be delivered in length as it would consume too much time during a scheduled health visit. In other words, the feasibility of certain interventions and the participants' adherence depends heavily on the settings of the healthcare system, whether it is private or publicly funded and availability of certain facilities such as home visit services by nurses. Thus, these details need to be taken into consideration when planning for future interventions.

In this review, two-third of the studies used a theory as a basis for their interventions with the social cognitive theory being the most popular choice. Based on the published evidence on the effectiveness of reducing ST in children, theory-based interventions were shown to be statistically significant in reducing ST in children as compared to non-theory-based interventions (32). In terms of the delivery methods, face-to-face session was the most common method used in all six studies. Although several studies reported that parents were in favour of accepting newer methods of delivery such as technology-based communication (26), online delivery of the intervention was not explored among studies for this age group. Additionally, the findings also showed the importance of having trained personnel to deliver the intervention. For example, trained paediatric nurses or health counsellors were the preferred choices of intervention providers, especially in primary care settings, possibly due to the trust and credibility (33). One distinct comparison observed among interventions that were successful and unsuccessful was the duration of intervention. An average of 6-8 weeks duration resulted in a significant reduction in ST. It was found that a short, one-off education given to parents was not an effective intervention for this age group (28). A longer duration including follow up was observed among trials that included BMI as a measure of secondary outcome (29-31).

Control groups in the included studies were given a variety of materials, possibly due to the different designs and goals of the behavioural intervention (34). Most studies used printed materials to complement the delivery of messages. This is in line with the most frequently used mode of delivery, i.e., face-to-face sessions where printed materials could be distributed in an easy and practical manner. However, a number of studies used a combination of materials including websites and text messages that managed to reduce ST as well. Our findings showed that besides providing knowledge and awareness regarding ST, the establishment of rules or restrictive practices, offering alternative activities to parents in place of ST, and removal of television from child's bedroom were the most common strategies used in studies that successfully reduce ST among preschool-aged children.

Overall completeness and applicability of evidence

This review included 972 participants who were mostly from western countries. Unlike previous reviews that included sedentary behaviours (35-37), our review included solely studies on ST to enable the extraction of focused strategies. It is also focused on children aged between 2 and 5 years, as compared to adolescents in which promising effects of intervention have been demonstrated by previous studies (38). In contrast to a previous review that revealed only a handful of successful interventions (39), this review recorded a higher percentage of success in ST reduction. One of the

possible reasons could be the inclusion of only studies that targeted ST reduction as a sole primary outcome. While most components of strategies were reported by the studies included in this review, a few of them lacked a description of the process, usual care in control groups, and supportive information required for replication.

Next, this review included studies done in various settings such as preschools, community, and primary care facilities compared to its predecessors that focused only on schools. Multiple methods of delivery were applied, including one-off face-to-face visits to monthly home visits, hands-on assistance to setting limits on screen devices, prompts and reminders using phone calls, emails, and text messages. Control groups received usual care/curriculum, waitlists, other unrelated material such as injury prevention modules, as well as incomplete intervention with the elimination of certain components.

Quality of the evidence

Overall, the quality of evidence among the included trials was a mixture of good, fair and poor studies only. One study was of good quality whilst two were fair and 3 were of poor quality. Most studies were rated fair were due to uncertainty on the re-reporting of the particular outcome. We graded incomplete outcome data, selective re-reporting, and other sources of bias to be low risk for all studies. A potentially important source of poor quality was the general unclear status of the blinding of outcome assessment and allocation concealment. Only one study mentioned the inability to avoid blinding. Another potential bias that could affect the quality is the issue of lost to follow up. Although attrition was unavoidable in most studies, intention to treat analysis should be conducted to avoid problems associated with attrition.

Potential biases in the review process

There were also potential biases during the review process. In order to minimise the bias, two authors independently screened all the studies for inclusion. Any disagreements were resolved by a third author. Data extraction and risk of bias assessment were performed by one reviewer and checked by the second reviewer. Similarly, the discrepancies were resolved with agreement from the third reviewer. However, it is important to note that the risk of bias assessment is subjective and can vary when assessed by a different team of authors. Language bias is another potential bias as only studies conducted in the English language were included. This review also included only studies that assessed strategies on ST reduction as their sole primary outcome. This could explain the huge rate of success among interventions whereby 83% of interventions were successful in reducing ST. Previous reviews have included studies whereby ST was either a primary or secondary outcome. However, they were unable to demonstrate any significant reduction in ST (38). While

attempts were made to identify the interventions that reduce ST among pre-schoolers, it was possible to have missed relevant research as some of the given keywords might have induced selection bias. However, cross-references were made with existing references to ensure the comprehensiveness of the search

Agreements and disagreements with other studies

The overall findings of this review showed that 90% of the studies resulted in a successful reduction of ST among preschool children. As the majority of studies were conducted in western countries, we agree with Mendoza (31) that it is vital to identify the strategies and characteristics that will be effective for children under 5 years in different circumstances and settings. This is especially applicable to those with different cultural backgrounds that require culturally adaptive interventions in the future. We concur with others (36,38) that interventions aimed at preschool children hold promise. Similar to a study by Schmidt (36), our review revealed that the delivery of interventions was done in various settings. Despite so, all the settings involved heightened parental involvement. Similar to the findings by Wahi et al. (38) most studies in this review relied on behavioural modification techniques including goal setting, self-monitoring, and rewards/reinforcement to reduce ST. However, this review outlined additional behavioural techniques being applied to the parents, such as delineating outcome expectations (27) as well as modifying the home environment of the child (26,28,29). Furthermore, our review also added evidence to the existing literature (39) by reporting the narrative details on the most commonly used mode of delivery, types of intervention providers, and control groups in successful studies. In contrast to a review by Downing et al. (39) who suggested at least six months of duration for ST interventions, our findings revealed that interventions targeted primarily at ST reduction can be completed within 6-8 weeks. The most prominent strategies for parents that were identified in this review included offering alternative activities, ensuring restrictive ST limits, and re-moving the TV from the child's bedroom. A recent study by Altenburg (40) recommended television turn-off week and standing desks in classrooms. The difference in the strategies could be due to the inclusion of a wider age group of children in both elementary and high schools between the ages of 0-18 years.

Limitations

The process of this review is not devoid of limitations. Firstly, the studies included in the review varied widely in their settings, modes of delivery, and duration of intervention, thus making it difficult to compare the findings. Furthermore, even though the majority of the studies were of fair and poor quality, they could not be excluded or there would be insufficient studies for the review. Other methodological limitations included the lack of blinding and small sample sizes. Lastly, there could also be a possibility of publication bias that was

not explored in this review as the study protocols were unavailable.

CONCLUSION

Implication for practice

Adequate and appropriate strategies incorporated into intervention studies can reduce the amount of time children spend on screens. Effective parent-led interventions should use outcome expectations as part of their constructs to reduce ST among preschool children. The constructs should also offer reinforcement of strategies, especially those that target both the individuals and their surroundings, such as the home environment. Interventions are more likely to be effective when provided by trained personnel in a face-to-face method with a focus on providing knowledge about the importance and methods of setting ST limits. These interventions should be implemented alongside the provision of alternative activities and the removal of screen devices from the child's bedroom. In short, intervention providers such as health care providers and preschool educators can refer to these strategies to complement the WHO ST guidelines in their efforts to help parents to reduce or regulate age-appropriate ST for their children.

Implication for research

Future studies should strive to describe the theoretical basis of the intervention approaches in greater detail. In-depth information should be provided with regard to the constructs of the theory that are related to the design of interventions. Furthermore, the details of the standards of care used in the respective countries should also be re-ported. This is imperative to ensure the production of high-quality studies that can contribute towards achieving substantial conclusions in this area of research. In addition, interventions in future studies should also consider the recommendation of alternative activities to ST that are applicable and culturally suitable in non-western countries. Lastly, another important area to be explored is the cost effectiveness of interventions in different settings as it will influence the feasibility of the interventions.

ACKNOWLEDGEMENTS

The authors would like to thank the Director General of Health Malaysia for permission to publish the manuscript. We also thank all the participating Health clinics under the guidance of the Petaling District health office and all parents who willingly participated and contributed towards this research.

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