



## REVIEW ARTICLE

# Clinical and psychological effects of excessive screen time on children

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**Abstract:** Over recent years, screen time has become a more complicated concept, with an ever-expanding variety of electronic media devices available throughout the world. Television remains the predominant type of screen-based activity among children. However, computer use, video games and ownership of devices, such as tablets and smart phones, are occurring from an increasingly young age. Screen time, in particular, television viewing, has been negatively associated with the development of physical and cognitive abilities, and positively associated with obesity, sleep problems, depression and anxiety. The physiological mechanisms that underlie the adverse health outcomes related to screen time and the relative contributions of different types of screen and media content to specific health outcomes are unclear. This review discusses the positive and negative effects of screen time on the physiological and psychological development of children. Furthermore, recommendations are offered to parents and clinicians.

**Key words:** children; electronic media; health policy; screen time; television.

## Introduction

There is a general consensus among health authorities that excessive screen time has an adverse impact on childhood development. The current American Academy of Pediatrics (AAP) guidelines recommend that children under 2 years of age should not spend any time using electronic media, while children over 2 years of age should be restricted to less than 2 h per day.<sup>1,2</sup> The Australian Department of Health has stricter criteria, recommending less than 1 h of screen time per day for children aged between 2 and 5 years. However, data collected from the International Children's Accelerometry Database between 1997 and 2009 indicated that approximately two-thirds of children did not meet guidelines for screen time.<sup>3</sup>

### Key Points

- 1 Television viewing negatively affects locomotive skills, physical strength, dietary habits and adiposity.
- 2 Television viewing negatively affects the cognitive and socio-emotional development of children, and excessive screen time is associated with poorer mental health during adolescence.
- 3 Physical activity does not compensate for the adverse effects of screen time.

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The explosion of new technological devices over the last few years has led to electronic media becoming an integral part of life. As such, it may be presumed that adherence to screen time guidelines has further declined. Exposure to screens tends to start from very early infancy.<sup>4-6</sup> Studies estimate that children spend a substantial proportion of their daily waking hours on screen-based activities, about 8 h in many cases.<sup>7-9</sup> This was reflected in an AAP newsletter published in late 2015, which suggested that guidelines on screen time for children are outdated and need revision. Indeed, approximately 90% of parents appear to ignore the AAP's advice.<sup>10,11</sup>

Many parents continue their current behaviours because they believe that media content is educational. One survey found that 29% of the 1000 parents interviewed allowed their children younger than 2 years to watch television (TV) because it is 'good for their brains'.<sup>12</sup> Other parents admitted to not limiting their children's screen time to avoid conflict and social isolation or to entertain or distract children.<sup>13</sup> For example, one study of mothers confirmed that TV viewing by their children was useful in accomplishing household tasks, while another study found that parents commonly utilised mobile media to occupy their children when eating out.<sup>14,15</sup>

The use of screen time as an entertainer means that parents do not need to dedicate monetary resources that may not be available.<sup>13</sup> In fact, parents from a low socio-education background were significantly less likely to agree to the statement 'I feel confident that I can keep my child busy with activities that do not include exposure to TV' compared with parents from a higher household income or higher education level.<sup>16</sup> Thus, there is disparity between the reality of 'screen culture' and reducing screen usage as a health policy.

This review summarises the most recent evidence on the effects of screen time on the physiological and psychological

development of children. Based on the published evidence, recommendations for parents and clinicians to reduce children's screen time will be proposed.

## Physiological Development

### Physical strength and general health complaints

Regular physical activity is associated with improved health outcomes in children.<sup>17</sup> During early childhood, locomotive skills are gained through learning to crawl and walk, and playing; whereas in later childhood and adolescence, team sports and fitness classes play a role in the development of physical strength and co-ordination. The World Health Organization recommends that individuals aged between 5 and 17 years participate in at least 1 h of moderate-to-vigorous physical activity per day. Any additional time being physically active has accumulative health benefits.

However, research indicates that higher levels of physical activity do not compensate for the negative effects of screen time.<sup>9</sup> This is exemplified by the National Health and Nutritional Examination Surveys (NHANES) study conducted in over 1000 children from USA aged 6–15 years. The NHANES study evaluated the relationship between physical strength – assessed by grip, leg extension, modified pull-ups and plank – and screen time.<sup>17</sup> After controlling for gender, body mass index and days per week with at least 1 h of physical activity, TV viewing, but not computer use and video gaming, was inversely associated with physical strength. This study demonstrated that higher TV viewing was associated with lower physical strength, irrespective of physical activity. It also highlighted the idea that not all types of screen use are equal with respect to health effects.

The negative impact of TV viewing on physical development has been shown in children under 6 years of age. A prospective, longitudinal study that evaluated the relationship between TV watching at 29 months old and physical strength at 65 months of age in 1997 Canadian children reported that gross motor skills were reduced by high screen time.<sup>18</sup>

During early adolescence, time spent on screen-based activities contributes to the chance of reporting general physical complaints, in particular, headache and backache. Differences in symptoms according to screen type have been documented. For example, headaches were more frequent during TV viewing for more than 3 h, whereas backache and headache were more likely during computer use or video gaming for more than 3 h.<sup>19</sup> Furthermore, headache and backache associated with screen time do not appear to be ameliorated by physical activity.<sup>20</sup> The threshold for a suitable level of screen usage is difficult to set because the effects of different types of screen time on physical problems are accumulative.

### Diet and obesity

Due to the rapid increase in screen use by children, promoted by the vast array of electronic media devices that has become available, screen time has emerged as an important modifiable risk factor for childhood obesity. Data from the most recent NHANES study conducted between 2009 and 2012 demonstrated that children aged 2–4 years who exceeded 2 h of TV viewing per day were more likely to be obese.<sup>21</sup>

Results from a meta-analysis of 14 cross-sectional studies revealed a linear dose–response relationship between TV watching and obesity. A 13% incremental increase in obesity risk was reported for each hour per day of TV watching for both boys and girls.<sup>22</sup> The relationship between diet and screen time was evaluated by the World Health Organization Childhood Obesity Surveillance Initiative, a cross-sectional study in over 10 000 children aged 6–9 years from five European countries.<sup>23</sup> Each additional hour of screen time (watching TV or digital video discs (DVDs) and using a computer except for homework) was associated with increased consumption of high-fat/high-sugar foods – including sugar-sweetened drinks, candy bars or chocolate, and pizza, chips or hamburgers – and decreased consumption of vegetables and fresh fruits. Another large-scale study in children aged 2–9 years from eight European countries assessed the dietary impact of TV-viewing habits, defined as time spent watching TV, watching TV during a meal and having a TV in the bedroom.<sup>24,25</sup>

High-risk TV behaviours were associated with an increased chance of being overweight and increased consumption of high-fat/high-sugar foods. Interestingly, food choice did not appear to be mediated by taste preference, perhaps by passive over-consumption. In a population-representative Dutch cohort of over 1000 children aged 10–14 years, children who had at least 20 h of screen time per week, equating to an average of 2–3 h per day, consumed more snacks.<sup>26</sup> Screen time was directly associated with adiposity, but this relationship was independent of snacking. A study in adult females suggested that TV viewing affects several processes that normally assist the voluntary regulation of food intake, and food intake was dependent on the level of interest in TV content.<sup>27</sup>

One of the most compelling arguments for the link between electronic media use and food consumption is commercial advertising. In particular, a meta-analysis of 22 studies demonstrated that acute exposure to advertising of unhealthy foods increases energy intake in children, but not adults.<sup>28</sup> In a study of approximately 400 Australian children between 10 and 16 years old, there was strong evidence of an increase in unhealthy food and drink intake in parallel with commercial TV viewing.<sup>29</sup>

The link between TV viewing and poor diet was strongest for children who watched the most commercial TV and those who were exposed to advertisements embedded within programmes. These findings emphasise the vulnerability of children to advertising ploys. Policy-makers should consider the effects that this may have on dietary habit-forming for life.

### Sleep

Screen usage has been widely reported to diminish sleep duration and/or efficiency. In a Spanish study of 1000 children aged between 2 and 6 years, at least 1.5 h per day of TV viewing correlated with shorter sleep duration.<sup>30</sup> Longitudinal analysis of the same cohort revealed that increases in TV viewing from less than 1.5 h to at least 1.5 h led to reduced sleep duration at follow-up visits 2–3 years later. Another study in over 2000 children aged 8–12 years old indicated that TV/DVD watching and video or computer game playing were associated with shorter sleep duration and perceived insufficient rest or sleep.<sup>31</sup> In Slovak adolescents between 11 and 15 years old, working on a computer or playing computer games for more than 3 h was associated with

sleep difficulties. In contrast, TV viewing for more than 3 h was not associated with sleep difficulties.<sup>19</sup>

Adding to the complexity of analysing the impact of screen usage, a related issue is the presence of screens in children's bedrooms. The effect of the number and type of electronic screens available in bedrooms was assessed in 502 Canadian children aged 9–11 years.<sup>32</sup> Notably, children having a TV in their bedroom had higher adiposity than those having no screen at all. In contrast, the presence of a computer was not associated with higher adiposity compared with no screens in the bedroom.

The presence of at least two screens per room was related to sleep efficiency, but not sleep duration.<sup>32</sup> Another study found that screen time was associated with poor weight status and having either a TV or a computer in the bedroom.<sup>8</sup> The regulation of metabolism and sleep occurs through interconnected pathways.<sup>33</sup> Therefore, the effects of screen time on metabolism may indirectly alter sleep quality and vice versa, making it difficult to determine causality.

## Psychological Development

### Cognitive ability

A recent review discussed the importance of social rather than screen interaction for children under 2 years of age, and its necessity for the development of facial recognition and communication skills.<sup>34</sup> In particular, it was highlighted that the response of the developing brain to parental attention is different to that evoked by the use of electronic devices.

Although few data are available on the relationship between cognitive development and computer use/video gaming, these concepts are supported by psychological studies evaluating the effect of TV viewing. Research in Korean children from 24 to 30 months of age demonstrated that the risk of language delay increased proportionately with time spent in front of the TV.<sup>35</sup> Toddlers with 2–3 h of daily TV viewing had a 2.7-fold higher risk of language delay than those with less than 1 h, while toddlers with over 3 h per day had about a three-fold increase in the relative risk of language delay. Similarly, a longitudinal study reported that children with higher TV viewing at 29 months of age exhibited less school readiness at 65 months of age. This manifested as decreased vocabulary and number knowledge scores as well as lower classroom engagement.<sup>18</sup>

The anatomical features that underlie changes in cognitive development related to TV viewing have been scarcely investigated. This was addressed by a recent study that examined the association between duration of TV viewing and regional grey/white matter volume in Japanese children.<sup>36</sup> In both cross-sectional and longitudinal analyses, TV viewing was positively correlated with changes in the frontopolar and medial prefrontal regions, the former of which contributes to intellectual functioning. Furthermore, a negative correlation between TV viewing and intelligent quotient was confirmed.

However, some studies have suggested that cognitive development in relation to media use is highly content dependent. For example, playing video games has been shown to improve visual attention skills, but this effect was positive only for those games that were action-based, and playing prosocial video games, in

which game characters help and support each other, led to increases in prosocial behaviour.<sup>37–39</sup>

Moreover, some TV shows can help children learn numbers and letters. Several studies demonstrated that the viewing of specific TV programmes can have positive effects on language development in children aged 3–5 years.<sup>40,41</sup> In one study, the viewing of 'Dora the Explorer' resulted in 13.30 more vocabulary words acquired at the age of 30 months compared with non-viewers, in comparison with the viewing of 'Teletubbies', which was negatively related to vocabulary acquisition.<sup>42</sup> A similar study found the viewing of 'Sesame Street' to be educational for children at a certain age, yet it was associated with delayed language acquisition for younger children.<sup>42</sup>

The potential cognitive benefits are believed to originate from high-quality media contents that use strategies known to support language development, including the labelling of objects, characters speaking directly to the child and allowing opportunities for the child to respond.

What's more, co-viewing with an adult has been shown to increase the cognitive development benefits of suitable media content.<sup>43–46</sup> For example, when pre-schoolers viewed 'Barney & Friends' with an adult, they acquired 3.5 words, compared with an average of just one word when the programme was viewed alone.<sup>41</sup> Co-viewing increases parent-child interactions and offers opportunities for the adult to enhance the media content.

Nevertheless, a comprehensive review found that the majority of positive cognitive development claims made by the manufacturers of media products aimed at children were unsubstantiated.<sup>47</sup>

### Socio-emotional and mental health

Excessive screen time is thought to have an impact on socio-emotional functioning, although some confounding factors exist (e.g. poor mental health may trigger the desire to spend time alone using screens). A variety of environmental factors may also contribute to screen time and emotional health. For example, TV watching has been reported to be higher in offspring with a depressed mother.<sup>4</sup>

Nevertheless, studies in very young children suggest that screen usage is an independent risk factor for reduced psychological well-being. An analysis of Thai infants showed that increasing TV exposure from 6 to 18 months of age was associated with emotional reactivity, aggression and externalisation behaviours.<sup>6</sup> It has also been repeatedly documented that high TV viewing at 2–3 years old leads to an increased risk of peer victimisation during early school years.<sup>18,48</sup> This concerning finding prompts the assumption that children who experience victimisation by classmates have a higher risk of developing mental health problems.

Among over 8000 Australian youths aged 10–16 years, those who met screen time guidelines were less likely to report depression. Notably, this relationship was stronger for younger children.<sup>49</sup> Moreover, in adolescents, screen time has been inversely correlated with mental health, academic achievement, school disconnectedness and self-esteem, with the latter two being more frequent in males.<sup>3,49</sup> This correlation was independent of physical activity.<sup>3,49</sup> Data from almost 2500 Canadian students aged 12–18 years demonstrated that the duration of screen time was associated with the severity of depression and anxiety.<sup>50</sup>

With respect to the type of screen, computer use and video gaming, but not TV viewing, correlated with more severe depressive symptoms. Meanwhile, video gaming correlated with the severity of anxiety. Taken together, these results are in accordance with studies demonstrating that the effects of high screen time accumulate with age, with more obvious symptoms from early adolescence onwards.<sup>51</sup>

Nevertheless, a recent report from the AAP suggests that the use of social media may have some positive social effects.<sup>52</sup> In particular for teenagers, participation through social media can help individuals make friends, particularly with others from diverse backgrounds, be creative, exchange ideas and improve interpersonal skills including empathy,<sup>52,53</sup> with 19% of the 1030 teenagers aged 13–17 interviewed in a recent survey stating that the use of social networking sites made them more sympathetic to others.<sup>54</sup> Moreover, many schools are successfully using blogs as educative tools to improve written English, and the internet grants access to health resources, including information on sexually transmitted infections and mental health.<sup>52,55</sup>

## Recommendations

In the context of the AAP newsletter suggesting that the strict guidelines on screen use are antiquated, an important theme appears to be that young children in particular and children from potentially marginalised social groups are the most susceptible to the effects of excessive screen time. For example, several studies have identified that White children spend less time on average watching TV than Hispanic and African American children, and children from lower-income families are exposed to longer screen times and less likely to view educational TV shows or electronic content on mobile devices than children from higher-income families or those with more highly educated mothers.<sup>3,56,57</sup> This would suggest that children from social groups generally associated with poorer health outcomes – such as ethnic minority groups and low-income families – are the most at risk of excessive screen times. Clinicians should take into account the child's socio-economic background when identifying at-risk children. Also, the general health complaints and psychological issues become more prominent throughout childhood into adolescence.

Making efforts to limit screen time during mealtimes is important to promote a time for families to spend together and to encourage healthy eating behaviours.<sup>58</sup> Furthermore, there is considerable evidence that children with a TV in their bedroom are at increased risk of obesity, poor sleep habits, substance use and exposure to sexual content.<sup>1,59</sup> Media devices are best placed in common areas where their use can be monitored.

A growing body of evidence supports the role of health services in developing recommendations to limit screen time. The recommendations should be aimed at encouraging parents to set consistent limitations on screen time because studies have shown that the children of parents who control the length of screen time were more likely to engage in physical activities and time spent reading.<sup>60,61</sup> The recommendations should also encourage the parents of young children to co-view suitable media content to promote learning. Co-viewing allows parents to optimise the key messages by parent–child interaction and question asking, and the use of interactive media together with a parent or adult enhances its educational value.<sup>62</sup>

### Box 1: Practical suggestions for clinicians

- 1 Ask parents questions related to their children's media use, including:
  - i. How long does your child spend with electronic media a day?
  - ii. Do your children have a TV or computer in their bedroom?
  - iii. Do your children use electronic media during mealtimes?
- 2 Encourage parents to set consistent and age-appropriate limitations on screen time.
- 3 Encourage parents to limit screen time during mealtimes.
- 4 Discourage parents from allowing their children to have a TV in their bedroom.
- 5 Encourage the parents of young children to co-view suitable media content.

Such a widespread public campaign is of particular importance among parents of a lower socio-economic background whose children are more likely to require the attention of health services due to the negative clinical and psychological effects of excessive screen time (Box 1).

## Future Directions

Further research is urgently required to more accurately determine the age-related clinical and psychological effects on health outcomes associated with excessive screen time. However, future studies should change their research strategy towards the use of large multi-centred and cross-cultural cohorts. The lack of such international collaboration is currently an obstacle for research studies in this area, as is the need to differentiate between the different types of media use – including TV/DVDs, mobile phones and other hand-held devices, computers and video gaming – because not all screen time may cause the same effects. One particular challenge for researchers will be distinguishing the type of content viewed on devices, which is important in order to delineate the effects of media use on the changes in brain structure.

## Multiple Choice Questions

- 1 How many hours of screen time per day is recommendable for children less than 2 years of age according to the APA guidelines?
  - a) None
  - b) Less than 1 h
  - c) Less than 2 h
  - d) Between 2 and 8 h
  - e) Unlimited

Answer: a. The youngest children are the most susceptible to the adverse effects of screen time. (b) is incorrect. TV exposure at age 6–18 months has been demonstrated to have a negative impact on the behaviour of infants. (c) is incorrect. In the APA guidelines, children over 2 years of age may be permitted up to 2 h of screen time per day. In the stricter Australian guidelines, children over 5 years may be permitted up to 2 h of screen time per day. (d) is

incorrect. Although daily screen time tends to increase throughout childhood into adolescence, more than 2 h of leisure screen time is not recommended for children of any age. (e) is incorrect. Unlimited screen time is not recommended for children or adults.

2 What are the effects of TV watching on children's dietary habits?

- Reduced consumption of all types of foods
- Reduced consumption of all types of drinks
- Increased consumption of a variety of fruit and vegetables
- Increased consumption of high-fat/high-sugar foods and drinks
- Less snacking in-between meals

Answer: d. Time spent watching TV is associated with an increased likelihood of consuming high-fat/high-sugar foods and drinks. The susceptibility of young children to commercial advertising is considered to be one of the main causes of this phenomenon. (a) is incorrect. TV watching tends to increase calorie intake. (b) is incorrect. Time spent watching TV is associated with increased consumption of sugar-sweetened drinks, but not an increase in overall liquid intake. (c) is incorrect. Time spent watching TV is associated with a reduced likelihood of eating fruit and vegetables. (e) is incorrect. Studies suggest that snacking is more frequent in children who exceed 2 h of TV watching per day.

3 What are the effects of TV viewing and other types of screen time on children's cognitive and socio-emotional development?

- Earlier development of language skills
- An increased risk of peer victimisation during early school years
- Better classroom engagement and greater academic achievement
- A higher intelligent quotient score
- A lower likelihood of developing depression

Answer: b. TV viewing at about 2 years of age, but not other types of screen time, is associated with a higher risk of peer victimisation during early school years. (a) is incorrect. TV viewing at about 2 years of age, but not other types of screen time, is associated with delayed language development, as well as lower school readiness with a reduced vocabulary and numerical ability. (c) is incorrect. Screen time is associated with lower school disconnectedness, academic achievement and self-esteem, particularly in males. (d) is incorrect. TV viewing, but not other types of screen time, has been confirmed to negatively affect children's intelligent quotient score. (e) is incorrect. Children who do not meet screen time guidelines have an increased chance of reporting depression.

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