



Review

The Digital Media Environment and Cardiovascular Risk in Children

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ABSTRACT

Children today are exposed to multiple forms of digital media including traditional (eg, televisions, computers) and newer mobile devices (eg, smartphones, tablets, etc). As the digital media environment evolves, it is important that health care providers and policymakers adapt to develop, implement, and evaluate strategies to ameliorate its effects on health. In this article we provide an overview of the literature on the relationship between the digital media environment and cardiovascular risk factors in childhood. Existing evidence on the relationship between digital media environment and cardiovascular risk in infants,

RÉSUMÉ

De nos jours, les enfants sont exposés à diverses formes de médias numériques, y compris les appareils traditionnels (p. ex. les télévisions et les ordinateurs) et les plus récents appareils mobiles (p. ex. les téléphones intelligents, les tablettes, etc.). Avec l'évolution de l'environnement des médias numériques, il est important que les prestataires et les décideurs des soins de santé s'entendent sur l'élaboration, la mise en place et l'évaluation de stratégies pour améliorer leurs effets sur la santé. Dans le présent article, nous donnons un aperçu de la littérature sur la relation entre l'environnement des médias

The digital world is an everyday part of the lives of most Canadian families. Children are increasingly exposed to multiple forms of digital media including traditional fixed screens such as televisions and desktop computers, and newer mobile screen media devices such as smartphones and tablets.¹ Each year, vast quantities of content tailored specifically for children are delivered via these digital platforms. Children today spend more time interacting with digital media than any other previous generation, with Canadian children age 5-17 years spending more than 3 hours of their day with digital media devices. Fewer than 1 in 3 children meet age-specific guidelines for screen time.² According to the recent Canadian Health Measures Survey,³ the overall proportion of 3- to 17-year-olds exceeding their age-specific digital media use guidelines was 71%. Time spent with these devices might translate into less time spent sleeping and being physical

active, as well as more time eating in front of screens and more frequent exposure to unhealthy food and beverage marketing. Today, the length of time children spend with digital media exceeds that of any other activity in which they engage apart from sleeping.⁴⁻⁶ As a result of these factors, children today might be increasingly at risk for obesity, cardiovascular disease, and related comorbidities.

The digital media environment encompasses more than time spent in front of screens. It includes the type of engagement (eg, active gaming vs passive watching), the content of those activities, the type of device (eg, television vs computer vs smartphone), the social context, and the frequency of engagement.⁷ Recent observational studies have linked exposure to the digital media environment to poorer health in children.^{8,9} Over the past 5 years, multiple digital media use guidelines have been published from a number of organizations including the Canadian Paediatric Society,^{10,11} the World Health Organization,¹² and the American Academy of Pediatrics (AAP).¹³ Strategic efforts are also under way by the Canadian federal government to restrict the marketing of unhealthy food and beverages to children,¹⁴ and several clinical trials are under way to reduce children's digital media exposure.¹⁵⁻¹⁷

On the basis of trends over the past decade,^{18,19} the digital media environment will continue to integrate itself into the

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children, and youth are reported. Potential mechanisms underpinning the relationship between the digital media environment and cardiovascular disease risk in children such as the displacement of movement behaviours, food and beverage marketing to children, and eating while viewing were explored. National and international guidelines aimed at addressing the digital media environment are highlighted, and suggestions for future research and guideline development are provided. Action-oriented professional recommendations for health care providers, families, and children are urgently needed. As the prevalence of screen use in childhood continues to exceed those of past generations, concern about the effects and strategies to reduce harm including cardiovascular outcomes must remain a top public health priority.

lives of children and families in Canada. As the digital media environment evolves, research, health, and education policy need to adapt to develop, implement, and evaluate strategies to ameliorate its effects on health. There is good reason to adopt a preventive approach to promoting a positive digital media environment for children, because behaviours that start in childhood tend to persist into adulthood and can have a significant effect on lifelong risk of chronic disease.²⁰ The purpose of this report is to provide an overview of the literature on the relationship between the digital media environment and cardiovascular risk factors in childhood. We will examine potential mechanisms between digital media use and cardiovascular disease risk in children, explore how national and international guidelines are aiming to ameliorate this risk, and provide suggestions for future research and guideline development.

The Digital Media Environment and Cardiovascular Health: Direct Links

Adiposity

Observational and interventional research has shown a relationship between greater time spent in front of screens and greater adiposity. In a 2019 systematic review of reviews Stiglic and Viner reported on 5 medium-quality reviews and 1 low-quality review that all reported associations between greater screen time and greater adiposity among children 0-18 years of age.²¹ Included was a systematic review by van Ekris et al.,²² who used evidence from 3 high-quality studies and reported that a positive relationship exists between television viewing time and overweight or obesity. The authors reported there was no evidence for a relationship between computer use and game time, but these conclusions were on the basis of 10 low-quality studies. A meta-analysis that included data from 4 randomized controlled trials conducted by Tremblay et al. showed that less television time postintervention was associated with a decrease in body mass index ($B = -0.89$; 95% confidence interval [CI], -1.67 to -0.11) among children age 5-17 years.²³ Accordingly, Stiglic and Viner concluded

numériques et les facteurs de risque cardiovasculaire durant l'enfance. Nous présentons les données probantes actuelles sur la relation entre l'environnement des médias numériques et le risque cardiovasculaire chez les nourrissons les enfants et les jeunes. Nous examinons les mécanismes sur lesquels se fonde possiblement la relation entre l'environnement des médias numériques et le risque de maladie cardiovasculaire, notamment le remplacement des comportements liés au mouvement, le marketing d'aliments et de boissons aux enfants, et la consommation d'aliments durant le visionnement. Nous présentons les lignes directrices nationales et internationales qui portent sur l'environnement des médias numériques, et donnons des suggestions pour des recherches ultérieures et l'élaboration de recommandations. Des recommandations professionnelles concrètes pour les prestataires de soins de santé, les familles et les enfants sont nécessaires incessamment. Comme la prévalence de l'utilisation des écrans durant l'enfance continue de surpasser celle des générations passées, les questions sur les effets et les stratégies pour réduire les méfaits, notamment les issues cardiovasculaires, doivent demeurer une priorité absolue de santé publique.

that these data supported policy action to reduce screen time in school-aged children.²¹

Extending into the early years, in a systematic review Poitras et al. included 60 studies of children age 0-4 years (randomized controlled trial [$n = 1$], longitudinal study [$n = 13$], case control study [$n = 2$], cross-sectional study [$n = 47$]).²⁴ Most of the evidence supported a relationship between greater screen time and greater adiposity. The authors suggested that current research lacks context about the types of digital media use (eg, passive vs interactive digital media use), which might have contributed to null findings in some studies.

Lipids

In their review of reviews, Stiglic and Viner identified 1 systematic review (van Ekris et al.) that reported on no evidence of a relationship between screen time and triglycerides (on the basis of 2 low-quality studies), low-density lipoprotein cholesterol (on the basis of 1 high-quality and 1 low-quality study), and ratio of total cholesterol to high-density lipoprotein cholesterol (HDL-C; on the basis of 2 low-quality studies).^{21,22} Limited studies on these relationships make it difficult to draw firm conclusions.

In contrast, van Ekris et al. reported strong evidence for an inverse relationship between "overall sedentary behaviour" (television viewing, computer use/games, screen time, and objective sedentary time) and HDL-C, which was driven by 2 high-quality studies.²² One of these studies was a longitudinal study ($n = 869$) which was conducted in Sweden and showed that adolescents (16 years) who watched a minimum of 1 show (30 minutes in length) per day or every other day had an increased odds of low HDL-C (defined as < 1.29 mmol/L for women and < 1.03 mmol/L for men) in adulthood (at 43 years; odds ratio [OR], 1.90; 95% CI, 1.17-3.06), as was watching several shows per day (OR, 2.23; 95% CI, 1.32-3.78), compared with watching ≤ 1 show per week.²⁵ The other study was a longitudinal study involving 554 Danish children age 8-11 years, which showed that sedentary time (defined as all minutes showing ≤ 100 vertical counts

per minute on accelerometry) was inversely associated with HDL-C ($B = -0.006$ mmol/L; 95% CI, -0.009 to -0.004).²⁶

Blood pressure

In their review of reviews, Stiglic and Viner's reported there was no consistent evidence of a relationship between screen time and systolic and diastolic blood pressure, citing 3 reviews (van Ekris et al.,²² Tremblay et al.,²³ and Carson et al.²⁷). van Ekris et al. showed there was no evidence of an association between television or computer screen time and systolic or diastolic blood pressure,²² whereas Tremblay et al. cited 1 longitudinal study and 4 cross-sectional studies that suggested that screen time and sedentary behaviour was associated with an increased risk of systolic and diastolic blood pressure.²³ Carson et al. reported inconsistent evidence for a relationship between blood pressure and screen time, TV, computer, or video game time.²⁷ In a systematic review that included children 0-4 years of age Poitras et al. identified only 1 low-quality cross-sectional study that examined the relationship between sedentary behaviour and cardiometabolic risk factors in preschool children.²⁴ There was no evidence of an association between television time ≥ 2 h/d and blood pressure in children aged 2-5 years (prevalence ratio = 0.9; 95% CI, 0.5-1.4; $P = 0.568$).²⁸

Metabolic syndrome

Using the "A MeaSurement Tool to Assess systematic Reviews" (AMSTAR) assessment tool in a high-quality systematic review and meta-analysis Oliveira and Guedes included 6 cross-sectional studies of adolescents ($n = 3881$) and reported there was no evidence of an association between use of screen time > 2 h/d and metabolic syndrome measured according to a cluster of risk factors for cardiovascular disease and type 2 diabetes mellitus which included: high blood pressure, higher triglyceride levels, lower HDL-C levels, impaired fasting glucose levels, and greater abdominal obesity (OR, 1.20; 95% CI, 0.91-1.59; $P = 0.20$; $I^2 = 35\%$, high quality).²⁹

Summary

Multiple systematic reviews support an association between higher rates of screen time and greater adiposity, and 1 systematic review suggested that an inverse relationship might exist between screen time and HDL-C. There is less consistent evidence of associations between screen time and other cardiometabolic risk factors such as diastolic or systolic blood pressure, triglycerides, low-density lipoprotein cholesterol, or metabolic syndrome, whereas high-quality prospective longitudinal studies are limited.

Systematic reviews have mainly focused on time spent in front of screens. It is possible that the type of device (television, tablet, phone, computer), setting (home, during meal times, in the car, at school), and/or content (educational programming, video streaming, games) of digital media might have more influence on cardiovascular health than the amount of time spent consuming digital media. A few studies have attempted to disentangle these relationships and have suggested more nuanced findings.³⁰ This might be because of challenges in measuring the device, setting, and content of

screen time, or might be a reflection of the rapidly changing digital media environment. Future studies that use embedded technology to directly measure digital screen time and its multiple varieties might help to overcome the limitations inherent to retrospective parent or self-report of children's digital media use.

Possible Mechanisms for the Relationship of the Digital Media Environment and Cardiovascular Disease in Children

A number of mechanisms have been proposed that might link exposure to the digital media environment and cardiovascular disease risk factors in children. Some of these mechanisms are explored in the following sections.

Displacement of physical activity and sleep

Early research on the digital media environment and cardiovascular disease risk focused on the displacement of physical activity as the main mechanism through which cardiovascular risk might be affected, a mechanism that been called "the displacement hypothesis."³¹ However, observational studies have shown inconsistent relationships between higher rates of screen time and lower rates of physical activity.⁹ Some studies have supported the displacement hypothesis.^{32,33} For example, one study of 4594 American grade 7 and 8 students showed that lower television time was associated with more time spent on leisure-time physical activity.³² Another study of 34,369 high school students in Hong Kong (mean age = 14.6 years) showed that adolescents who had a computer with internet at home were less likely to exercise for at least 30 minutes daily compared with those without (boys: OR, 0.48 [95% CI, 0.42-0.54]; girls: OR, 0.41 [95% CI, 0.34-0.49]).³³ Other studies have not shown evidence for the displacement hypothesis.³⁴⁻³⁶ One study from the United States of 6369 girls and 4487 boys showed that 1 hour per week more television viewing over the span of 1 year resulted in no substantive change in leisure-time moderate to vigorous physical activity ($B = 0.03$; 95% CI, 0.02-0.04).³⁴ Another study from the United States, which involved 305 predominantly African American or Latino adolescents showed no evidence of a relationship between nonactive video games or computer use and physical activity.³⁵ A very recent Canadian study of 719 children age 32-40 months showed no evidence of an association between screen time (all screen exposure) and physical activity (leisure and organized) in a typical week (Spearman $\rho = 0.07$; $P = 0.18$).³⁶ Inconsistent evidence for the displacement hypothesis suggests that physical activity might not be a strong contributor in the relationship between screen time and cardiovascular disease risk.

It has also been proposed that time spent viewing digital media might displace the amount of time children spend sleeping. A systematic review of 67 studies (13 prospective studies, 1 trial, and 53 cross-sectional studies) on children 5-17 years of age concluded that digital media time was associated with reduced sleep duration and delayed timing of sleep.³⁷ Thirty-two of 42 studies showed an association between television watching and adverse sleep outcomes. Twenty-nine of 31 studies showed an association between computer use and either decreased duration of sleep, delayed

bedtime, sleep onset latency, or increased daytime sleepiness.³⁷ Among deleterious effects, it has been proposed that shorter sleep duration might lead to more snacking outside of meal time,³⁸ and might influence children to choose unhealthy snacks over healthy foods.³⁹ Shorter sleep duration might also result in changes in hormones that regulate appetite such as ghrelin and leptin.⁴⁰

Social media and marketing

Adolescents are the largest consumers of social media such as Instagram, Facebook, YouTube, and Twitter. Social media is now seen as a key platform for marketing and advertisements, with audiences shifting away from commercial-sponsored television programming. In the United States, food and beverage companies spend \$15 billion per year to target youth through online advertising.⁴¹ One study examined 24 Web sites sponsored by companies that market products for children and showed that > 80% targeted children younger than 12 years of age.⁴² These marketing methods are effective in increasing consumption and encouraging peer endorsement of these food and beverage brands.⁴³ Moreover, children are less able to recognize online media as advertising compared with television advertising.⁴⁴

A systematic review by Smith et al. showed the detrimental effects of food marketing on children's attitudes, preferences, and consumption of unhealthy food products.⁴⁵ An examination of 71 studies that involved children ages 0-18 years identified several sophisticated marketing techniques aimed at children, including appealing packaging and advergames (internet games featuring marketed products) for unhealthy food. The authors showed that marketing through advergames was associated with higher consumption of unhealthy food ($P < 0.03$), and that advergames generated the most positive brand attitudes compared with television commercials ($P < 0.001$).⁴⁵

It has long been suspected that digital media content might also influence child food choices. In one trial from the Netherlands 125 children age 10-12 years were randomized to watch either video clips of cooking programs containing healthy foods, cooking programs containing unhealthy foods, or a Dutch children's program unrelated to food (control condition).⁴⁶ Children who watched the cooking program containing healthy foods were more likely to select healthy snacks after the intervention compared with children who watched the cooking program with unhealthy foods or the control condition.

Social media "influencers," individuals with a substantial online following, might also have an effect on children's food choices. In one randomized trial, 176 children (9-11 years) were randomly assigned to view 1 of 3 types of mock Instagram profiles of 2 popular YouTube vloggers: unhealthy snacks ($n = 59$), healthy foods ($n = 59$), and nonfood products ($n = 59$).⁴⁷ The study showed that children assigned to the "unhealthy snack" profile had higher overall caloric intake and higher caloric intake from snacks, which the authors suggested might be in part because of endorsement from influencers, as well as colourful packaging and child-friendly branding.⁴⁷ The appeal of unhealthy snack food packaging was supported by an eye-tracking study on 102 Austrian children aged 6 to 10 years, which showed that

children spent more time fixated on unhealthy foods (such as ice cream or candy) than nonfood objects.⁴⁸

Children's social media use might be a vehicle for unlimited and unregulated exposure to marketing of unhealthy food. In one small study, 21 Belgian adolescents age 12-18 years were instructed to take screenshots of food-related images they encountered on social media.⁴⁹ They reported that 67% of the images exclusively depicted unhealthy food such as soft drinks, fried foods, and sweets, and almost half of the images depicted branded food products. Of the branded food images, half appeared as unpaid word-of-mouth marketing but were suspected to be paid marketing efforts. A study of 1564 US adolescents age 13-17 years showed that 70% of participants reported interacting with at least 1 food or beverage brand on social media, with 53% engaging with at least 1 fast food brand, 45%-50% engaging with sugary drink, candy, and snack brands, and 35% engaging with 5 or more brands.⁵⁰

Eating while viewing

Eating while viewing digital media has also been proposed as a mechanism that might explain the association between digital media use and cardiovascular disease risk factors in children.⁶⁰ A recent meta-analysis, which included 20 observational studies involving > 84,000 children, showed a positive association between television viewing during mealtime and risk of overweight or obesity in children.⁵¹ The authors suggest that screen use during mealtime might increase cardiovascular risk through greater unhealthy food intake during mealtime, because of attenuated recognition of satiety cues (ie, the bombardment of unhealthy food images is likely to increase food intake among children regardless of "true" hunger), and exposure to unhealthy food advertisements while eating. Another recent systematic review showed that television use during mealtime was associated with lower dietary quality in children, including lower intake of fruits and vegetables, and higher intake of fat- and sugar-containing foods including sugar-sweetened beverages.⁵² Although these mechanisms have not been directly studied for cardiovascular disease risk in children, poor dietary quality has been associated with greater cardiovascular disease risk factors in numerous other studies.⁵³ Growing digital media use through handheld devices might also increase opportunities for eating with screens, which might encourage poor dietary quality.

Risk factors for digital media use in children and adolescents

Parents and health care providers who are concerned with reducing children's digital media exposure might consider risk factors that have been associated with digital media use. Although studies that have examined such risk factors are only beginning to emerge, they can be categorized into 5 main categories: (1) child biological and demographic factors; older children are more likely to use smartphones, tablets, and any media compared with younger children.⁵⁴ Carson and Kuzik concluded that for every 1-month older age, the use of any media increased by 9.3 min/d (95% CI, 2.8-15.8).⁵⁵ Older children are also less likely to co-use (or co-view) digital media use with their parents. (2) Family biographical

and demographic factors: mixed associations have been reported between family income and children's digital media use,⁵⁴ but there is stronger research emerging to suggest that low socioeconomic status is a predictor for higher screen use in children,⁵⁶ and more frequent eating while viewing digital media.⁵⁷ (3) Family structural factors: a positive association was identified between the number of children in a household and screen use. In addition, children who have parents who engage in high levels of screen-viewing themselves are more likely to engage in high levels of screen-viewing.^{56,58} (4) Behavioural factors: children's ability or skill with a device was shown to have a positive association with frequency and duration of device use.⁵⁴ This is an important area of study because screens are being introduced earlier in the lives of children, thus potentially increasing the cumulative effect of screens on children's health. (5) Sociocultural and environmental factors: children in parental care were more likely to watch more screens than children in childcare.⁵⁵ Similarly, higher levels of screen-viewing have been reported among children on weekends vs weekdays.⁵⁴ Parents' permissive attitudes toward screen use has been associated with higher rates of use by their children.⁵⁸ Access to media equipment, particularly in the child's bedroom, was associated with higher levels of screen-viewing.⁵⁸ To better understand the effect of multilevel factors on children's digital media use, future studies might examine the role of parental rules, the use of mobile screen devices as behavioural regulation tools, and the role of parents and siblings as role models.

Current Recommendations for Digital Media Use in Children and Youth

In the past 5 years, many guidelines have been published that provide health care providers and families with recommendations on how to address digital media use with children and youth. In 2017, the Canadian Paediatric Society (CPS) provided guidelines for health professionals regarding screen exposure for children younger than 5 years and for school-aged children and adolescents.^{10,11} Taking a more precautionary approach, the CPS recommended no screen time for children younger than 2 years and limiting screen time to less than 1 hour per day among children age 2-5 years. No specific thresholds were recommended for school-aged children and adolescents. For children younger than 5 years, the recommendations encourage parents to co-view screens with children whenever possible, to conduct a self-assessment of current screen habits, and to prioritize educational and age-appropriate programming. On the basis of evidence from the developmental, psychosocial, and physical health literature, the CPS recommendations included 4 principles: (1) minimize screen time; (2) mitigate the risks associated with screen time; (3) be mindful about screen time; and (4) model healthy screen use. For older children, the CPS recommendations also have 4 principles: (1) manage screen use; (2) encourage meaningful screen use; (3) model healthy screen use; and (4) monitor for signs of problematic screen use.

Recommendations from the 2019 Royal College of Pediatrics and Child Health report,⁵⁹ in which 940 abstracts

and 12 systematic reviews were reviewed, explicitly stated that a cutoff for children's daily screen time could not be made because of the lack of high-quality evidence to guide this threshold. Instead, they recommend that families "should negotiate screen time limits with their children," which should be on the basis of the child's individual needs, and the degree to which screen use reduced the child's time for social activities, physical activity, and sleep.⁵⁹

The AAP released 2 policy statements on digital media use for children in 2016.¹³ The first focused on infants, toddlers, and preschool children, which recommended that screen media other than video chatting should be avoided for children younger than 18 months of age. For children 18-24 months of age, the AAP recommended that parents choose "high-quality programming" for their children and that adults should interact with the child during media use, with no specific screen time cutoffs. For children 2-5 years of age, the AAP recommends ≤ 1 hour of screen time. The policy statement for infants, toddlers, and preschool children explains that although many studies use a 2-hour threshold to evaluate risk of obesity, one 2007 study showed that each additional hour per week of media exposure resulted in increases in body mass index among 2-year-olds,⁶¹ and several hours of sleep per night.⁶² The second AAP guideline, "Media Use in School-Aged Children and Adolescents," did "not support a one-size fits-all approach" and recommends that parents and clinicians work together to create a Family Media Use Plan, which tailors media use according to the child's developmental stage, sets boundaries for content, and provides consistent rules about media use.⁶³ Currently, the extent to which families have adopted a Family Media Use Plan is unknown.

Similar to the Canadian Paediatric Society, the World Health Organization in their guideline on physical activity, sedentary behaviour, and sleep for children younger than 5 years of age¹² recommend that children younger than 2 years of age should avoid sedentary screen time, and that children 2-5 years of age can have up to 1 hour per day of sedentary screen time, preferably with interaction from adults. They based their evidence on an update of systematic reviews conducted for the Canadian 24-hour Movement Guidelines of the Early Years (0-4 years),^{24,64-66} using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) framework to determine the quality of evidence.

Regulation on Advertising of Unhealthy Foods to Children

The self-regulatory Canadian Children's Food and Beverage Advertising Initiative (CAI) was initiated with the goal of limiting the advertisement of unhealthy foods and beverages.⁶⁷ On the 10 most popular children's (ages 2-11 years) Web sites in Canada, there were approximately 54 million food/beverage advertisements from June 2015 to May 2016.⁶⁸ Of these, 93.4% were identified as having excessive fat, salt, or free sugars. Signatory companies to the CAI were 2.2 times more likely to advertise foods that are excessive in fat, salt, or free sugars.⁶⁸ Advertisements from CAI-signatory companies were also higher in energy, sugar,

and salt per serving than non-CAI signatory companies. The authors suggest that these findings show that the CAI, which is “self-regulatory,” is not effective in reducing children’s exposure to advertising for unhealthy foods.⁶⁸ Other studies that have examined the effectiveness of “self-regulatory” strategies on food advertising to children younger than the age of 12 years have had similar findings. Such strategies include the European Union Pledge in Belgium and the Netherlands, where approximately 88.5% of signatory companies provided unhealthy food advertisement to children⁶⁹ and the CAI in the United States for which only 1 of every 45 brand exposures was a “healthful message.”⁷⁰ The failure of self-regulatory mechanisms to reduce children’s exposure to online advertisements for unhealthy foods indicates that mandatory regulations on digital advertising to children are needed.

Summary and Future Directions

Existing evidence supports an association between higher rates of digital media use in children and adolescents and increased adiposity. Although varied, there is some evidence to support similar associations with additional important cardiovascular disease risk factors (eg, blood pressure, cholesterol, metabolic syndrome, triglycerides, etc). Health research studies, including those on cardiovascular risk factors, have struggled to keep up with the ever-expanding role of the digital media environment in children’s lives. There is limited research on type of engagement, the content of those activities, the device through which digital media is consumed, and the setting (ie, context of use), which might affect associations with cardiovascular health outcomes. To identify children at highest risk for cardiovascular risk due to digital media consumption, it might also be necessary to explore the timing of exposure to digital media, and to further investigate family-level risk factors for problematic digital

media use. Action-oriented professional recommendations for families and health care providers that remain practical because of the ubiquity of digital media in childhood are needed. Screen-based policies and guidelines should also be developed for education settings to help regulate screen use among children during school and childcare hours. Developing and testing interventions to address the effect of the digital media environment on cardiovascular risk outcomes is imperative.

The rapid pace of evolution of the digital media environment presents challenges for understanding its effects on children’s cardiovascular health, but also opportunities. However, many questions still remain (see Fig. 1 for areas of future research).

In conclusion, the rise of the digital media environment is unquestionable. Unlike past generations, children and youth across the globe now grow up with computers, tablets, and smartphones, which are intertwined with their everyday lives, and likely affect their long-term cardiovascular risk. There is no doubt that much more time is spent online compared with previous generations and consequently, concern about the effects and strategies to reduce harm must be top priorities.

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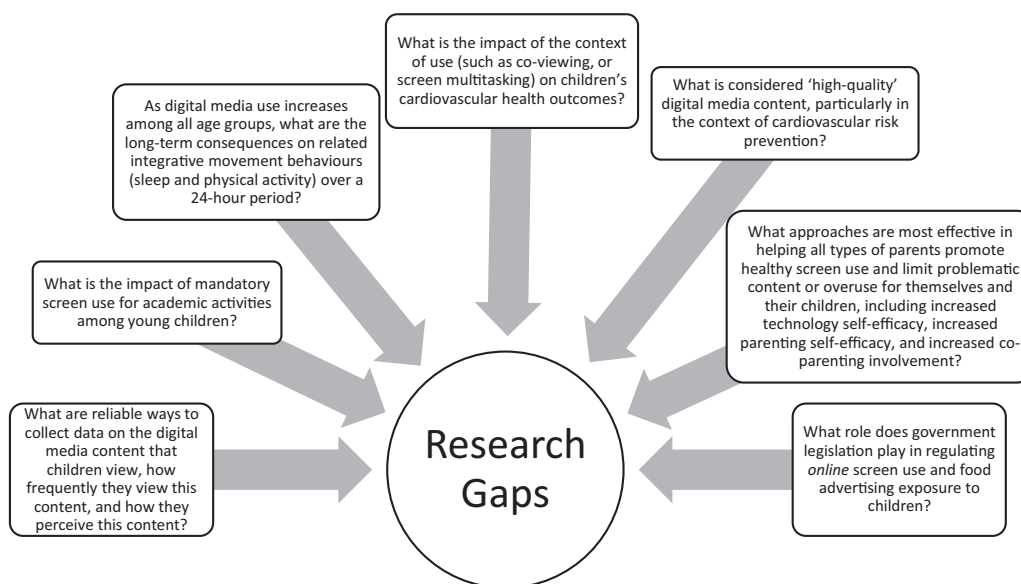


Figure 1. Future directions and investigative pursuits relating to digital media use in children and cardiovascular health.

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