

The relationship between screen time, physical activity, dietary intake and healthy weights in children and youth

Literature review and recommendations for intervention

This page is intentionally left blank.

Table of Contents

Summary	5
<i>What did we want to know?</i>	5
<i>What did we do?</i>	5
<i>What did we find?</i>	6
<i>What do these findings mean for HPP and the IWK?</i>	7
Introduction and Rationale	8
<i>Purpose</i>	9
<i>Objectives</i>	9
Methodology	

Contents

Summary	5
<i>What did we want to know?</i>	5
<i>What did we do?</i>	5
<i>What did we find?</i>	6
<i>What do these findings mean for HPP and the IWK?</i>	7
Introduction and Rationale	8
<i>Purpose</i>	9
<i>Objectives</i>	9
Methodology	10
<i>Literature review</i>	10
<i>Intervention review</i>	10
Results of the Literature Review	12
<i>Defining screen time and sedentary behaviour</i>	12
<i>Sedentary behaviour, screen time and healthy weights in children and youth</i>	12
<i>Displacement: does it exist?</i>	14
<i>All screens are not created equal</i>	15
<i>Beyond screen time: what other factors matter?</i>	16
<i>Measurement issues</i>	17
<i>Evidence-based recommendations for intervention</i>	18
Screen Time and Related Interventions for Children and Youth	20
<i>Most Effective Intervention</i>	20
<i>SWITCH (what you do, view and chew)</i>	20
<i>Most Promising Intervention</i>	20
<i>Student Media Awareness to Reduce Television (SMART)</i>	20
<i>Switch-PLAY</i>	21
<i>Unplugged and Media Savvy</i>	22
<i>Promising Practices</i>	22

<i>Do More Watch Less</i>	22
<i>Healthy Kids, Healthy New York After-school Model Guidelines</i>	22
<i>Live and unplugged</i>	23
Intervention Recommendations	24
Concluding Remarks: The Complex Relationship between Sedentary Behaviour and Healthy Weights in Children and Youth	27
Appendix A: Review of the evidence	33
<i>Meta-analyses Results: Strongest evidence</i>	33
<i>Systematic Review Results: Promising evidence</i>	33
<i>Non-Systematic Results: Trends and descriptive evidence</i>	35
<i>Primary Study Results: Potential mediating and moderating variables</i>	36
Appendix B: Screen Time Interventions	38
<i>Clinical interventions</i>	38
<i>Specialty and primary care interventions</i>	38
<i>Community and school-based</i>	39
Appendix C: Intervention Matrix	40
Appendix D: Screen Time Initiatives	45
Appendix E: Intervention and Initiative Details	49
<i>SWITCH</i>	49
<i>SMART</i>	50
<i>SWITCH-Play</i>	51
<i>Unplugged and Media Savvy</i>	52
.....	10
<i>Literature review</i>	10
<i>Intervention review</i>	10
Results of the Literature Review	12
<i>Defining screen time and sedentary behaviour</i>	12
<i>Sedentary behaviour, screen time and healthy weights in children and youth</i>	12
<i>Displacement: does it exist?</i>	14
<i>All screens are not created equal</i>	15
<i>Beyond screen time: what other factors matter?</i>	16
<i>Measurement issues</i>	17
<i>Evidence-based recommendations for intervention</i>	18
Screen Time and Related Interventions for Children and Youth	20
<i>Most Effective Interventions</i>	20
<i>SWITCH (what you do, view and chew)</i>	19
<i>Most Promising Interventions</i>	20
<i>SMART</i>	21
<i>Switch-PLAY</i>	20
<i>Unplugged and Media Savvy</i>	221
<i>Promising Practices</i>	22
<i>Do More Watch Less</i>	22
<i>Healthy Kids, Healthy New York After-school Model Guidelines</i>	22

<i>Live and unplugged</i>	23
Intervention Recommendations	24
Concluding Remarks: The Complex Relationship between Sedentary Behaviour and Healthy Weights in Children and Youth	27
Appendix A: Review of the evidence	33
<i>Meta-analyses Results: Strongest evidence</i>	33
<i>Systematic Review Results: Promising evidence</i>	33
<i>Non-Systematic Results: Trends and descriptive evidence</i>	35
<i>Primary Study Results: Potential mediating and moderating variables</i>	36
Appendix B: Screen Time Interventions	38
<i>Clinical interventions</i>	38
<i>Specialty and primary care interventions</i>	38
<i>Community and school-based</i>	39
Appendix C: Intervention Matrix	40
Appendix D: Screen Time Initiatives	45
Appendix E: Intervention and Initiative Details	49
<i>SWITCH</i>	50
<i>SMART</i>	51
<i>SWITCH-Play</i>	49
<i>Unplugged and Media Savvy</i>	50

Summary

What did we want to know?

It is well established that low levels of physical activity, along with unhealthy eating, are contributing to the temporal increase in overweight prevalence among children. One disturbing trend over recent years is the increase in leisure time spent watching television, playing video games and surfing the internet, particularly among children and youth. These activities, collectively known as “screen time” influence the opportunities for children and youth to participate in active leisure opportunities, as the majority of such activities are sedentary. With fewer opportunities to participate in physical activity, and more time spent engaging in sedentary behaviours such as screen time, children are more likely to be at risk for becoming overweight or obese.

The purpose of this report is to describe the findings of a comprehensive literature review and research synthesis on how screen time affects children’s health and wellbeing, in particular focusing on how screen time may influence physical activity, dietary intake and body weight. In conducting this review, we used “sedentary behaviour” as a broader construct to incorporate screen time, since this is more widely used in the literature. We also identified strategies and initiatives that are promoting reduced screen time for children and youth and highlight examples of best or promising practices that may be applicable to Nova Scotia.

What did we do?

This review had three objectives:

1. To search and appraise the academic literature for research on the relationship between screen time (sedentary behaviour) and the health of children and youth, focusing on physical activity, dietary intake and body weight.
2. To search the academic and grey literature (including websites, government and non-government reports) for interventions, strategies and initiatives that promote reduced screen time (sedentary behaviour) in children and youth and to highlight examples of best or promising practices that may be applicable to Nova Scotia.
3. To make recommendations and propose a potential intervention to support the implementation of the Physical Activity Strategy for the Halifax Region and other provincial healthy eating, active living initiatives.

To support objective one, a synthesis review was conducted to identify academic literature regarding the relationship between screen time (defined more broadly as sedentary behaviour) and the health of children and youth, focusing on physical activity, dietary intake and body weight. To support objective two, the academic and grey literature (including websites, government and non-government reports) were reviewed for interventions, strategies and initiatives that promote reduced sedentary behaviours (screen time) in children and youth and to highlight examples of best or promising practices that may be applicable to Nova Scotia. Finally, to support objective three, we provided guidance on developing a contextualized intervention for the Halifax Region, based on evidence-based recommendations.

What did we find?

Review of the literature (objective 1): Our narrative review of the literature on screen time and healthy weights in children found little disagreement that a strong relationship between sedentary behaviours and child and youth weight and health exists. However, when the size of the effect of this relationship is assessed, it is found to be quite small, meaning that an intervention, targeting sedentary behaviours like screen time in isolation, could provide only a small amount of impact. This highlights, as one would expect, that the etiology of child and youth weight and health is much more complex than how much time is spent engaged in low intensity activities. Instead, other lifestyle factors, such as dietary intake, are also important. Consequently, the collective impact of each lifestyle behaviour is likely to substantially improve the overall impact of intervention efforts. We also found evidence from one meta-analytical review that interventions, which aim to reduce unhealthy behaviours, are more successful than those promoting healthy behaviours, with the largest impact being delivered by using both approaches. This provides strong evidence for the use of interventions that are multi-component (i.e. targeting more than one lifestyle factor, such as diet *and* sedentary behaviour) in order to maximize the impact of intervention investment. It also provides an argument for the importance of addressing poor behaviours (i.e. sedentary behaviours and poor diet) directly and not simply focusing on the reinforcement of positive behaviours (i.e. physical activity and healthy diet). Therefore, it is important that interventions target multi-level factors, including increasing children’s awareness, promoting parental awareness and involvement in healthy behaviours and creating environments that discourage sedentary behaviours. These findings also emphasize the role that governments can play in supporting multi-leveled strategies to addressing the twin epidemics of physical inactivity and unhealthy eating and provide evidence toward introducing controls related to advertising to children, as part of this comprehensive approach

Our review also identified several themes that are important to consider when exploring the relationship between sedentary behaviour and healthy weights of children and youth. These include the challenge of defining screen time and sedentary behaviour, and the existence of related phenomena including displacement (which relates to whether interventions to reduce sedentary behaviour actually lead to an increase in physical activity), the type of screen used and myriad other social and environmental factors, including parental factors. ‘Screen time’ is a subset of sedentary behaviour, of which television viewing is the most researched component. However, sedentary behaviour is not yet a clearly defined concept, hence there are often varying definitions used across studies and academic discussions. There is an important need to provide a clear definition so measurement and evaluation of the impact of sedentary behaviour on health can be comparable to previous research and accurate recommendations can be made regarding intervention.

Review of interventions (objective 2): The second objective was to use the evidence from our review to scan for best and promising practice interventions which might assist with supporting healthy weights in children and youth through targeting different lifestyle factors, including dietary intake and physical activity. The results from our search of interventions were compared with the recommendations identified for objective one. One intervention, *SWITCH*, was judged to be most effective because it demonstrated positive changes in behaviour *and* used both multi-component (i.e. were interventions that included a dietary component and a physical activity component) *and* multi-level (i.e. were interventions that were directed at the individual and their school or neighbourhood) intervention approaches. The next two most promising interventions, *SMART* and *SWITCH-play*, demonstrated positive changes in behaviour and were either multi-component *or* multi-level. Finally, *Unplugged and Media Savvy*, is also presented as a promising intervention as it is multi-level but results are not yet available. Our search of screen time initiatives found that many initiatives had not been properly evaluated. Our promising practices section provides a description of several initiatives of interest, most of which have been evaluated in some way. This section includes a local initiative called *Live and Unplugged*.

Intervention recommendations (objective 3): To address our third objective, we provided guidance on developing a contextualized multi-component, multi-leveled intervention for Nova Scotia children and youth. Comprising four streams, designed to both reduce sedentary behaviour and unhealthy eating, while also promoting physical activity and healthy eating, our recommendations are designed to be evidence-based, practical, achievable, realistic and cost-effective. By contextualizing to Nova Scotia, they can build upon existing initiatives and infrastructure and offer opportunities to embed an intervention within the community and school system.

Based on the best evidence from our review, we make the following recommendations:

** Ensure intervention is multi-component (i.e. physical activity and diet) for the highest likelihood of positive impact*

** Ensure intervention is multi-leveled in order to influence important related factors for highest likelihood of positive impact:*

- Individual factors (e.g. gender, depression, ethnicity, socio-economic status)*
- Parental relationship (e.g. parental education, physical activity modeling, support, family rules)*
- School and community (e.g. physical education, sports participation, school programs)*
- Built environment (e.g. access to television and video games)*
- Policy (e.g. food advertising)*

** Target desirable as well as undesirable behaviours, do not rely on the ‘displacement effect’ by targeting only sedentary behaviour, without also incorporating support for an increase in physical activity*

** Incorporate television viewing as the most potent sedentary behaviour because of the low activity level, poor dietary behaviours and food advertising inherent in watching TV*

** Screen time type (i.e. television, computer, cell phone) is affected by age, with children having the most experience with television, expanding to include other screens (i.e. computer, cell phones etc.) with increasing age. Adolescents also tend to use multiple screens at the same time, complicating measurement*

What do these findings mean for HPP and the IWK?

The results of this work are intended to inform and guide an initiative within the Physical Activity Strategy for the Halifax Region, which targets a reduction of screen time among children and youth. Specific details of the resulting initiative, including target age, gender and setting should be decided based on the evidence presented in this report, along with consideration of the Nova Scotia context and availability of resources. It is important that we acknowledge that complex problems require complex solutions and although targeting a subset of sedentary behaviours (i.e. screen time) has been shown to reduce those specific behaviours, it has not been found to have large secondary effects that improve physical activity or reduce weight. Therefore, the key finding of this report is that multi-component, multi-leveled interventions targeting a range of behaviours, not just screen time, are the most promising way to improve child and youth health in HRM and beyond.

Introduction and Rationale

Healthy eating and physical activity significantly contribute to the prevention of chronic disease. Yet, in Canada and globally, a twin epidemic of unhealthy eating and physical inactivity is leading to rising rates of childhood obesity and its associated health consequences. Conditions such as type 2 diabetes and cardiovascular disease, once considered adult onset conditions, are increasingly occurring in childhood (1). The 2004 Canadian Community Health Survey (CCHS) identified that 26.3% of children aged 2 to 17 years were overweight, with 8.2% considered obese (2). Moreover, this survey identified that the prevalence of overweight increases with age. There are regional differences in the prevalence of childhood overweight and obesity, with greater disparity experienced among the Atlantic Provinces. In Nova Scotia, research has demonstrated the significance of this issue among our school-aged children. The 2003 Children’s Lifestyle and School Performance Study (CLASS) found that 32.9% of Grade 5 children were overweight and 9.9% were obese (3).

It is well established that low levels of physical activity, along with unhealthy eating, are contributing factors in the temporal increase in overweight prevalence among children (4). In 2001 and 2005, the Physical Activity in Children and Youth (PACY) study investigated children and youth in Grades 3, 7 and 11 and identified important trends in physical activity behaviours. Although a high percentage of children in Grade 3 met the standard for activity rates in 2001 and 2005 (60 minutes of accumulated moderate to vigorous physical activity five days per week); rates of physical activity declined from 2001 to 2005 to 16.9% in Grade 7 boys and 20.7% in Grade 7 girls meeting the provincial recommended activity level (5). Furthermore, the study found that children and youth reported an increase in leisure time spent watching television, playing video games and surfing the internet. Specifically, it was found that children and youth spent an average of 4.79 hours per day on such activities, collectively known as “screen time”. The current guidelines are that screen time in children and adolescents should be limited to no more than two hours per day (6). While television time was found to remain constant, the use of video games and computers had increased (5). Engaging in screen time activities may limit the opportunities for children and youth to participate in active leisure opportunities, as the majority of such activities are sedentary. With fewer opportunities to participate in physical activity, and more time spent engaging in sedentary behaviours like television viewing, children are more likely to be at risk for becoming overweight or obese. CLASS found that sedentary activity of more than one hour per day, or eating supper in front of the television, was associated with a significantly increased risk of overweight, adjusted for other factors (3).

Active Kids, Healthy Kids is a strategic and comprehensive multi-year plan, by the Nova Scotia Department of Health Promotion and Protection, for improving physical activity opportunities and participation rates for children in Nova Scotia. This strategy identifies the issue of screen time as a potential opportunity to develop an intervention at the individual level. At a local level, the Physical Activity Strategy for Halifax Region is a call to action to address the serious problems associated with physical inactivity. The Strategy recognizes that this issue must be addressed through a coordinated and collective community response. Responding to objective 2A, *to expand opportunities for informal, unorganized physical activity in the lives of Halifax Region residents*, the IWK Health Centre has been identified as the lead agency to respond to the issue of screen time. The action plan for this objective is to “Develop a program to replace screen time with physical activity.”

Purpose

The purpose of this report is to describe the findings of a comprehensive literature review and research synthesis on how screen time affects children's health and wellbeing, in particular focusing on how screen time may influence physical activity, dietary intake and obesity. In conducting this review, we used "sedentary behaviour" as a broader construct to incorporate screen time, since this is more widely used in the literature. This literature review also identified strategies and initiatives that are promoting reduced screen time to children and youth and highlighted examples of best or promising practices that may be applicable to Nova Scotia. The results of this work are intended to inform and guide an initiative within the Physical Activity Strategy for the Halifax Region, which seeks to target a reduction of screen time among children and youth.

Objectives

In conducting this review, we had three objectives:

1. To search and appraise the academic literature for research on the relationship between screen time (sedentary behaviour) and the health of children and youth, focusing on physical activity, dietary intake and body weight.
 2. To search the academic and grey literature (including websites, government and non-government reports) for interventions, strategies and initiatives that promote reduced screen time (sedentary behaviour) in children and youth and to highlight examples of best or promising practices that may be applicable to Nova Scotia.
 3. To make recommendations and propose a potential intervention to support the implementation of the Physical Activity Strategy for the Halifax Region and other provincial healthy eating, active living initiatives.
-

Methodology

Literature review

To support objective one, a synthesis review was conducted to identify academic literature regarding the relationship between sedentary behaviour (incorporating screen time) and the health of children and youth, focusing on physical activity, diet and body weight. A search in major electronic databases, including PubMed (National Library of Medicine's Biomedical Database), Web of Science and PsycInfo was employed for the years 2001-2009. Literature was included if it addressed the issue of sedentary behaviour, including television watching, video game playing, computer use, reading and internet use, in children or adolescents in relation to their weight.

The initial search strategy was designed to be broad, in recognition of the need to capture information of relevance to children, youth, healthy weight and sedentary behaviour. Our search terms were:

(body mass index OR weight OR obesity OR bmi OR weight loss) AND (screen time OR sedentary OR activ OR television OR TV OR video OR computer OR internet OR book OR read*) AND (child* OR youth OR adolesc*)*

Dietary intake and physical activity were not included in the search terms as this area of research can be large and complex, therefore the direct relationship between sedentary behaviour and child and youth weight was the focus. Abstracts of retrieved articles were screened for relevance (TLP), and then classified across two levels of rigour; meta-analytical reviews, systematic reviews, non-systematic reviews and primary research (summaries are available in Appendix A). These levels of rigour were also used as a basis to determine variables that are the strongest correlates with respect to sedentary behaviour and healthy weights in children and youth. Non-systematic reviews and primary studies were also included in order to identify potential variable trends and possible mediating (i.e. explaining the relationship between sedentary behaviour and weight) or moderating variables (i.e. influencing the strength of the relationship between sedentary behaviour and weight). As previously mentioned, for the purpose of this review, and to be consistent with the scientific literature, screen time was included as part of a broader category of sedentary behaviours including television and computer use, video game playing and reading time (although no studies that included reading time were identified in the above search). The resulting factors identified through this process were then used to cross-reference intervention study variables (objective 2) in order to guide the best possible recommendations for a planned intervention in Nova Scotia (objective 3).

Intervention review

To support objective two, the academic and grey literature (including websites, government and non-government reports) was reviewed for interventions, strategies and initiatives that promote reduced sedentary behaviours (such as screen time) in children and youth and to highlight examples of best or promising practices that may be applicable to Nova Scotia. First, a search of in major electronic databases, including PubMed (National Library of Medicine's Biomedical Database), Web of Science and PsycInfo was employed. Literature was included if it described an intervention with an objective to reduce screen time behaviour (including television watching, video game playing, computer use and internet use) in children or adolescents in relation to their weight or health behaviours.

Our search terms were:

(intervention OR program) AND (screen time OR sedentary OR activ OR television OR TV OR video OR computer OR internet) AND (child* OR youth OR adolesc*)*

Abstracts of retrieved articles were screened for inclusionary criteria (JLL), and if deemed appropriate classified according to the level of intervention, which included clinical, specialty and primary care, community and school-based (see Appendix B for a list of interventions). It was assumed that broader population level interventions would be most relevant for this review. Such interventions were described according to the theory used, level of intervention (i.e. school, family, individual), components (i.e. reducing screen time, increasing consumption of fruit and vegetables, etc.) intervention and evaluation design and results (see Appendix C for description of interventions).

To search the grey literature (including websites, government and non-government reports), the Google search engine was employed. This search was targeted at screen time initiatives, local, national and international, that were not published in the academic literature. Initiatives were included if they incorporated a strategy to reduce screen time behaviour (including television watching, video game playing, computer use and internet use) in children or adolescents in relation to their weight or health behaviours.

Our search terms were:

(intervention OR program) AND (screen time OR sedentary OR activ OR television OR TV OR video OR computer OR internet) AND (child* OR youth OR adolesc*)*

(reduce screen time OR sedentary behavior) AND (program OR intervention)

Upon scanning websites for inclusionary criteria (JLL), the initiatives and the associated evaluation (if applicable) were described (see Appendix D for a description of initiatives).

Results of the Literature Review

This section comprises a narrative summary of the results of the literature review to provide context and clarity surrounding relevant issues that should be understood when discussing the relationship between screen time and child and youth health. This narrative summary is organized into important themes, or areas of research, that emerged from the structured review. Each theme discussed below belongs to extensive realms of investigation in and of themselves, hence the information presented here is not exhaustive but does present an overview of current issues relating to sedentary behaviour and child and youth health. Themes include the challenge of defining screen time and sedentary behaviour, the complexity of the relationship which exists between sedentary behaviour and child and youth health and the existence of related phenomena, including displacement, the type of screen used and myriad other social and environmental factors.

This section concludes with a summary of best evidence recommendations, ordered according to rigour (meta-analysis having the most rigour and non-systematic review having the least) for developing interventions to improve child and youth health and weight status, which was then used to guide the next section of this report “*Screen time related interventions for children and youth*”.

Defining screen time and sedentary behaviour

Sedentary behaviour is not yet a clearly defined concept, hence there are often varying definitions used across studies and academic discussions. However, there is an important need to provide a clear definition so measurement and evaluation of the impact of sedentary behaviour on health can be comparable to previous research and accurate recommendations can be made regarding intervention. For the purposes of this report, sedentary behaviour refers to activities that do not increase energy expenditure substantially above the resting level and includes activities such as sleeping, sitting, lying down, and watching television, and other forms of screen-based entertainment.¹ Light physical activity, which often is combined with sedentary behaviour has been found to be a distinct activity construct² and includes activities such as slow walking, sitting and writing, cooking food, and washing dishes (7). Some research uses the term physical inactivity to describe sedentary behaviour as well as light physical activity, however we prefer to keep these concepts separate and make a clear distinction between physical inactivity/low physical activity and sedentary behaviour.

Within the realm of sedentary behaviours are those that are related to ‘screens’. Television, computer, video games and even cell phones and personal digital assistants (PDAs) are now included in the set of sedentary activities called ‘screen time’. Sedentary behaviours, including screen time, are often measured in hours. The most researched device is television, with less evidence regarding computer use and video games and very few related to other personal electronic devices. Therefore, screen time is defined as a subset of the broader construct of sedentary behaviour.

Sedentary behaviour, screen time and healthy weights in children and youth

The relationship between sedentary behaviour and healthy weights in children and youth is seemingly intuitive. As part of the energy balance equation, home and school activity, leisure time and transportation each have an

¹ Operationally, sedentary behaviour includes activities that involve energy expenditure at the level of 1.0-1.5 metabolic equivalent units (METs). (One MET is the energy cost of resting quietly, often defined in terms of oxygen uptake as 3.5 mL/kg/1min/1).

² Energy expenditure at the level of 1.6-2.9 METs

important role to play in energy expenditure, as does the amount of time spent being sedentary. Therefore it is important to understand the complex relationship between sedentary behaviour, physical activity and healthy weights for children and youth.

There is consensus surrounding the existence of a positive relationship between sedentary behaviour and body weight in children and youth, which has been repeatedly found and discussed in observational studies (8). Work to determine the dose-response relationship has found that children spending less than two hours/day in screen time (independent of physical activity or dietary intake) compared to those who spent three to four hours/day were less likely to be classified as overweight by waist circumference; this likelihood increased substantially among those spending more than four hours/day in screen time (9). Also, a recent study examined the combined influence of physical activity and screen time (television and video games) on the odds of being overweight in 7-12 year old children (10). The authors found that children meeting physical activity and screen time recommendations were the least likely to be overweight. Approximately 10% of the boys and 20% of the girls meeting both recommendations were overweight, in contrast to 35% and 40% of those who did not meet either recommendation. This study showed that children not meeting the proposed amounts of physical activity or screen time were 3-4 times more likely to be overweight than those complying with both.

However when this relationship is tested for the size of the effect (amount of body mass index directly explained by sedentary behaviour), the impact remains quite small. One meta-analysis examined lifestyle factors including 1) dietary changes i.e. increasing health dietary behaviour and decreasing unhealthy dietary behaviours and 2) changes in physical activity i.e. increasing physical activity and decreasing sedentary activity behaviours. Each component showed a small effect on each lifestyle behaviour as well as body mass index. However, the collective impact of each lifestyle behaviour could substantially improve the overall impact. Activity and diet behaviours are likely to interact when impacting obesity and effective interventions will target more than one behaviour, having a potential synergistic effect on obesity prevention. It has also been found that interventions which aim to reduce unhealthy behaviours are more successful than those promoting healthy behaviours, with the largest impact being delivered by using both approaches (11). It is important to recognize that the direct link between lifestyle behaviours and obesity, which were not found to be significant in this meta-analysis, likely involves a much more complex relationship than was discernable (i.e. through not controlling for possible mediating and moderating factors) (11). This provides strong evidence for the use of interventions which are multi-component (i.e. targeting more than one lifestyle factor, such as dietary intake *and* sedentary behaviours) in order to maximize the impact of intervention investment and have the best chance of improving child and youth health and weight. It also provides an argument for the importance of addressing poor behaviours (sedentary behaviours and poor dietary intake) directly and not simply focusing on the reinforcement of positive behaviours (physical activity and healthy diets).

There is strong evidence for interventions that are multi-component having the best chance of improving child and youth health and weight.

As discussed above, ‘screen time’ is a subset of sedentary behaviours, of which television viewing is the most researched component. In another meta-analysis, a small relationship was found between television viewing in children and youth and body fatness. This means that body fatness was only minimally explained by TV viewing, again leaving room for other potential factors including dietary behaviours, physical activity behaviours, or even sleeping patterns (discussed further in “*Beyond Screen Time: What other factors matter?*”). The authors could not make a definitive conclusion regarding video/computer use and body fatness, as this is a

much less researched area and studies were few (12). Intensity of activity is another important point to consider. Physical activity intensity can act as a moderator, with only vigorous activity being significantly negatively associated with TV viewing. The authors stated that there could be evidence to support a displacement view of physical activity (also discussed further in “*Displacement: does it exist?*”) and TV viewing, or weaknesses in self-reported measures because vigorous activity is more easily recalled (also discussed in “*Measurement issues*”). Final conclusions by the authors emphasized the small effect that TV viewing might have on body fatness and also further highlight the fact that, although multiple sedentary activities may reduce total daily energy expenditure, the relationship between sedentary behaviour and health are unlikely to be explained using single markers of inactivity such as TV viewing or video/computer game use. This provides further support for implementing multi-component interventions to address child and youth health (12). Addressing sedentary behaviour, or screen time alone, is therefore unlikely to have a substantial impact. Thus, it is important to consider broader approaches.

Displacement: does it exist?

When trying to understand the relationship between screen time, sedentary behaviour and child and youth weight it is important to recognize that an intervention which targets a reduction in sedentary behaviour may not necessarily lead to an increase in physical activity. For example, if an intervention intends to decrease TV watching (i.e. a sedentary behaviour), there is no guarantee the child will replace TV viewing time with playing soccer (i.e. a physical activity). Displacement of one behaviour with another behaviour would mean that the two activities were related, so that, as you decreased sedentary behaviour, physical activity would increase. In this scenario we think of physical inactivity/sedentary behaviour as the low level of physical activity, meaning that we are always active unless we are asleep, and that sedentary behaviours occur during our most inactive times. Therefore many objective measures consider inactivity as the ‘low end’ of the physical activity continuum.

In fact, instead of being viewed as on a continuum with physical activity, sedentary behaviour should be approached as a separate construct, reflecting the notion that inactivity is not merely the opposite of activity (13) and that the type of sedentary behaviour (i.e. how a child is inactive, watching television versus talking on the phone) will have different impacts (14). A systematic review of cross-sectional studies was conducted by van der Horst et al (2007) regarding child (ages 4-12) and youth (ages 13-18) physical activity, inactivity and sedentary behaviours in order to better understand these

Depending on how you define and measure sedentary behaviour, there is little evidence to suggest that addressing one lifestyle behaviour in isolation will have the desired impact on overall child and youth health.

concepts to support the development of effective interventions that promote physical activity and prevent inactivity and sedentary behaviours (15). This review found no association between television watching/video game playing and physical activity for children or adolescents and emphasized the lack of available evidence related to sedentary behaviour and physical inactivity compared to physical activity. This suggests that variables that are consistently associated with physical activity (such as self-efficacy) do not always have the opposite association with sedentary behaviour, which reinforces the notion that physical activity and sedentary behaviours have their own unique determinants. A potential explanation for this lack of displacement is that sedentary behaviours like watching TV and playing video games replace only low intensity physical activity (walking and playing) rather than moderate to vigorous activity (running and sports). Those activities included

in this review were mainly moderate to vigorous. This lack of association between increases in physical activity and decreases in sedentary behaviour (displacement theory) has been shown in other reviews as well (16).

Although it is difficult to determine the existence of displacement, it is safe to say that, depending on how you define and measure sedentary behaviour, there is little evidence to suggest that addressing one lifestyle behaviour in isolation will have the desired impact on overall child and youth health.

All screens are not created equal

Early research into the area of sedentary behaviour found that television viewing was, and remains, a potent predictor of weight status across age groups. As a result, television viewing is often used as a proxy for all sedentary behaviour in many studies. Three main mechanisms behind this predictive relationship have been proposed. These are: 1) being sedentary (i.e. low metabolic rates and displacement of physical activity); 2) having poor dietary intake during viewing, and 3) being exposed to advertisements. Early speculation that television viewing actually lowered resting metabolic rates below that of other sedentary activities has not been empirically shown (17). Likewise, the belief that TV viewing displaces physical activity has not been well supported by research evidence (18). The theory that has the most support is that TV viewing may operate predominantly through its impact on energy intake rather than by displacement of high-energy-expenditure activities (for example, as discussed above in “Displacement: does it exist”, sedentary behaviour and physical activity do not show a consistent relationship). Associations between TV viewing and excess energy intake have been observed (19-21). These can be through direct or indirect pathways, including the delay of satiation signals during TV watching (direct) and exposure to commercials advertising energy-dense food products (indirect). This trend to use TV viewing as a proxy is evolving to incorporate other screen-based opportunities for sedentary behaviour in the term ‘screen time’ (the sum of all phones, video games, computers and combined devices like the Blackberry or iPhone which have email, chat, internet, cell phone and games) (22).

There is strong evidence to suggest that child and youth weight status and television viewing show a stronger association than other media uses including video game playing and computer use.

Despite this evolution, there is evidence to suggest that child and youth weight status and television viewing show a stronger association than other media uses including video game playing and computer use (23). Further, a review by Rey-Lopez et al (2008) discussed the theories that have attempted to explain this relationship, including those compounding factors mentioned above, such as reduced resting energy expenditure during TV watching, the replacement of physical activity resulting in a lower total energy expenditure, a higher consumption of unhealthy foods during viewing and that obesity itself increases TV viewing (16). To date the relative contribution of these factors have not

been determined and as stated above, some of these theories are losing support with respect to television viewing. For videogame use, the authors found that most cross-sectional and longitudinal studies do not find an association between playing video games and obesity. This has been said to be due to less time being devoted to video games than TV, that it is not as easy to consume calories because the video controller requires both hands and that there is a higher energy expenditure compared to television viewing, which is a more passive activity. Specific to energy expenditure, they found evidence supporting the claim that if video game playing was substituted for regular physical activity weight could increase, however if video game playing was used as a substitute for TV watching or resting, the impact on weight could be positive. The final category was

computer use, but this category has the least amount of research conducted, something that should be a high priority in future research.

Beyond screen time: what other factors matter?

The relationship between sedentary behaviour and child and youth health and weight is complex. This complicated association is inherent in many lifestyle-related determinants of weight status and health, as individuals behave within a particular demographic, family, school and community, and in response to policies, which all impact health. Hence, individual level factors, including gender, BMI, ethnicity, socioeconomic factors, developmental stage, and various psychological variables have been found to be associated with sedentary behaviour. Sedentary behaviour has also been found to be more prevalent in ethnic minority groups, in students from more deprived backgrounds, and in those with behavioural problems. Girls who were more advanced developmentally and who reported emotional symptoms also engaged in more sedentary behaviours. Specifically, psychological variables, including depression and self-efficacy, have shown to be associated with sedentary behaviours (15,24). This area of research is large and further review and research could help to discern any causal roles that might exist for these and other individual factors.

Parental factors are also critical in explaining the relationship between sedentary behaviour and child and youth health. Sedentary behaviour and screen time aside, parental weight is consistently shown to be the strongest predictor of childhood weight status (25,26) and appears to exert a moderating effect on the sedentary behaviour-weight relationship (27). A possible mechanism for this is through family support, parental education, and rules regarding time spent on television/video use, as well as if there is a TV in the child or youth's room. Twenty-four hour access to a TV has also been proposed as a possible explanation for the relationship between hours of sleep and obesity by delaying sleep and creating a cycle of tiredness and sedentary behaviours (22,28). Research looking at implementing television viewing rules has found that barriers include parental need to use television as a safe and affordable distraction, parental heavy television viewing patterns, the role that television plays in the family's day-to-day routine, and a belief that children should spend their weekend leisure time as they wish. Further, families communicated a lack of concern that television viewing was a problem for their child (29), highlighting the importance of further research related to family factors.

Beyond the individual and the immediate family environment, children and youth operate within a wider environmental context. An important factor influencing child and youth weight and health is the advertisements they are exposed to during television viewing, as explained above. It has been found that a significant association exists between the proportion of children who are overweight and the numbers of advertisements per hour on children's television, specifically those advertisements that encourage the consumption of energy-dense, micronutrient poor foods. A weaker, negative association has been found between the proportion of children who are overweight and the number of adverts encouraging healthier diets. These findings emphasize the role that governments can play in supporting multi-leveled strategies to promote healthy behaviours and provide evidence toward introducing controls related to advertising to children, as part of this approach (30).

It is important that public health interventions target multi-level factors, including increasing children's awareness, promoting parental involvement in healthy lifestyle pursuits, and creating environments that discourage sedentary behaviour.

An extension of exposure to advertising is incorporating other environmental levels. He et al., 2009 sought to explore the full spectrum of potential contributing factors related to children's screen-related, sedentary behaviours (31). Results were multi-leveled; at an intrapersonal level, protective factors included being female, belonging to a sports team inside or outside of school; having a negative attitude toward screen-related, sedentary activities and having a positive attitude toward physical activity. At the interpersonal and social levels, parental leisure screen-related, sedentary behaviours were positively associated, whereas strict parental rules on computer use and family income were inversely correlated. At the environmental level, the presence of TVs in children's bedrooms and owning videogame devices increased the risk of screen-related, sedentary behaviours, whereas after school programs and schools' participation in the 'Turn Off the Screen Week' campaign (described in Appendix D) decreased the risk. Therefore, it is important that public health interventions target multi-level factors, including increasing and children's awareness, promoting parental involvement in healthy lifestyle pursuits, and creating environments that discourage sedentary behaviour (31).

Measurement issues

Measurement issues regarding sedentary behaviour and screen time originate due to the lack of a widely used and operationalized definition of sedentary behaviour. It is suggested that the definition put forth in this review be used for any measurement or evaluation of interventions used. Secondly, it is recommended that sedentary behaviour be treated as a distinct construct to physical activity and that it be recognized that the *type* of sedentary behaviour matters.

Another measurement issue relevant to sedentary behaviour is that it has been found to be easier to recall vigorous physical activity compared to light to moderate activity. This may account for a lack of association between physical activity and sedentary behaviour if light physical activity is not included in the measurement. Also, measuring TV time through parental self-report has known issues, for example the distinction between the TV being simply turned-on versus being watched. Additionally, parents are spending less time with their children, with children spending increasing amounts of time in their rooms or at friends' houses – especially in adolescents, and youth multi-tasking to engage in multiple electronic media forms such as phone, TV and computer simultaneously (14).

Another important measurement issue is that as the age of children increases, the relationship between screen time and physical activity seems to change as well. One study found no relationship between screen time and weight status for children aged 0-6 year olds and a small relationship for 7-18 year olds, suggesting that age selection is important and can inform what 'screens' are chosen to target (12). Another review of observational studies found that decreases in sedentary behaviour protected against relative weight gain and fatness during childhood and adolescents, however the results were less substantive during adolescence than childhood, and the authors speculated that this finding could also be due to the changing technology and media sources across child to adolescent development (14). We must therefore recognize that sedentary behaviours change over childhood, and range from 'stroller time,' to time sitting in the classroom at school, doing homework, listening to music, surfing the Internet, talking on the phone, or reading. Screen time, which refers to the time spent watching television or videos, playing video games, and using a computer, represents a major source of inactivity that changes over childhood and adolescence. Whereas television and video viewing dominate during early and mid-childhood, other screens become more prominent during adolescence. Increasingly, people, particularly youth, do many things simultaneously (22).

Evidence-based recommendations for intervention

The purpose of this section is to introduce the state of the literature with respect to screen time, sedentary behaviour and child and youth health and weight. It is based on varying levels of evidence that are summarized in Table 1 and described in more detail in Appendix A. Based on the above literature review, it is suggested that the definition given in this document be used for any measurement or evaluation of sedentary behaviour. It is also recommended that sedentary behaviour be treated as a distinct construct to physical activity and that it be recognized that the *type* of sedentary behaviour is important.

The following are evidence-based recommendations, derived from the highest level of evidence available, for an intervention to improve child and youth health and weight:

** Ensure intervention is multi-component (i.e. physical activity and diet) for the highest likelihood of positive impact*

** Ensure intervention is multi-leveled in order to influence important related factors for highest likelihood of positive impact:*

- Individual factors (e.g. gender, depression, ethnicity, socio-economic status)*
- Parental relationship (e.g. parental education, physical activity modeling, support, family rules)*
- School and community (e.g. physical education, sports participation, school programs)*
- Built environment (e.g. access to television and video games)*
- Policy (e.g. food advertising)*

** Target desirable as well as undesirable behaviours, do not rely on the ‘displacement effect’ by targeting only sedentary behaviour, without also incorporating support for an increase in physical activity*

** Incorporate television viewing as the most potent sedentary behaviour because of the low activity level, poor dietary behaviours and food advertising inherent in watching TV*

** Screen time type (i.e. television, computer, cell phone) is affected by age, with children having the most experience with television, expanding to include other screens (i.e. computer, cell phones etc.) with increasing age. Adolescents also tend to use multiple screens at the same time, complicating measurement*

Table 1: Summary of relationship found related to sedentary behaviour and healthy weight in children meta, systematic and non-systematic reviews, listed according to level of rigour (meta-analysis being highest and non-systematic review being lowest)

Study Title	Primary Author	Year	Study Type / Outcome variable / No. Studies	Test Variables	Relationship found	Important variables and main finding
1. Behavioral Interventions to Prevent Childhood Obesity: A Systematic Review and Meta-analysis of Randomized Trials	Kamath, C. C., et al.	2008	Meta analysis / BMI / 43	physical activity , sedentary activity, healthy dietary habits and unhealthy dietary habits	Small but statistically significant Trivial to small effects on BMI	All lifestyle factors showed some association
2. Relationships between media use, body fatness and physical activity in children and youth : a meta-analysis	Marshall, S. J., et al.	2004	Meta analysis / Body fatness, Physical activity / 52	TV viewing, video/computer game use	Small significant positive effect	TV viewing
3. A brief review on correlates of physical activity and sedentariness in youth	Van der Horst, K., et al.	2007	Systematic review of correlates / Physical activity, Sedentary Behaviour (and inactivity) / 60	ethnicity (Caucasian), socioeconomic status, and parent education [adolescents]	Significant relationships	SES, parental education and ethnicity
4. Sedentary behavior and sleep: paradoxical effects in association with childhood obesity	Must, A., et al.	2009	Narrative Review / child obesity	sleep	Negative relationship	Sleep
5. Do interventions to limit sedentary behaviours change behaviour and reduce childhood obesity? A critical review of the literature	DeMattia, L., et al.	2007	Review / child weight / 6 population based	sedentary behaviour, BMI	Positive effect of interventions	n/a
6. Physical activity and sedentary behavior: a review of longitudinal studies of weight and adiposity in youth	Must, A., et al.	2005	Review / measure of weight / 20	physical activity, inactivity, sedentary behaviour, BMI	direct associations	Decreased sedentary behaviour, increased physical activity protect against obesity
7. Sedentary behaviour and obesity development in children and adolescents .	Rey-Lopez, J. P., et al.	2008	Review / child and adolescent obesity	television viewing, video game playing, computer use, BMI	Positive relationship	TV viewing (not video game or computer use)

Screen Time and Related Interventions for Children and Youth

Appendix C provides an overview of all the population level interventions found in the search that satisfy the recommendations made for addressing objective 1. Based on these recommendations, we have chosen to highlight one successful intervention that met the criteria for an evidence-based intervention. Specifically, the intervention defined the type of sedentary behaviour, targeted a specific age-group (which facilitated reliable and valid measurement); were multi-component by including both desirable and undesirable behaviours; *and* were multi-level by involving the community, school and home environments; and demonstrated positive results in changing behaviours.

Most Effective Intervention

SWITCH (what you do, view and chew)

The SWITCH intervention (36) in the United States was designed to decrease screen time, increase fruit and vegetable consumption and increase physical activity in children in grades 3, 4 and 5 (approximately aged 8-11 years), by targeting three ecological levels: family, school and community. Parents and children were provided with materials and resources to facilitate the adoption of the healthy target behaviours. Monthly packets containing behavioural tools were provided to assist parents and children in modifying their behaviours. The school helped to reinforce key messages and facilitate the family component of the intervention. Teachers were provided with materials and ways to integrate key concepts into their existing curricula. Teachers were not required to participate as this was not designed as a school based intervention. The community was used to promote awareness about the importance of healthy lifestyles and the prevention of childhood obesity in the targeted communities, and included paid advertising and unpaid media emphasizing the key messages (see Appendix C and E for more information).

Parents in experimental group reported significant decreases in children's screen time and fruit and vegetable consumption, while child reported fruit and vegetable consumption was marginally significant. At 6 month follow-up, parents in the experimental group reported significantly decreased screen time and parents and children in the experimental group reported significantly increased fruit and vegetable consumption. There were no significant effects on physical activity or body mass index.

Most Promising Intervention

Based on the recommendations from the literature review, we have also chosen to highlight three interventions that met the criteria of a most effective intervention. Specifically, these interventions focused on a specific measurement of sedentary behaviour and were either multi-level or multi-component.

Student Media Awareness to Reduce Television (SMART)

The SMART intervention (32) aimed to decrease screen time (television and video-game use) of children in grades 3 and 4 (approximately 8-10 years old). The intervention focused on personal behavioural factors of children (using social cognitive theory) and on the environment of schools and homes. Specifically, personal factors were assumed to be influenced by the value systems of children, parents and teachers, expectations about the consequences of different behaviours and personal abilities to perform behaviours; behavioural factors included the skills and the associated degree of competence of

performing these skills; and environmental factors consisted of the ways in which people model various attitudes and behaviours related to screen time and other household/community factors.

A classroom curriculum was delivered by trained teachers weekly in all third and fourth grade classrooms in the intervention schools over a six-month period. This curriculum consisted of eighteen, 30-50 minute lessons plus 5-10 minute boosters in the last four months of the intervention. The curriculum consisted of four sections, which were delivered in the following order: TV awareness, TV turn off, staying in control and helping others (see Appendix E for additional information). In addition, 14 parent newsletters were sent to parents of students in the intervention school. The newsletters were designed to inform parents of the potential benefits of reducing their children's television, videotape, and video game use; motivate parents to help their children reduce their media use; suggest strategies to help their child and the entire family; offer ideas for implementing selective viewing policies; teach contingency management skills to help them support their children's behaviour changes; provide public recognition for children staying under their budgets; and create a stronger connection with their children's school and classroom by updating parents on the SMART classroom activities (see Appendix C and E for more information).

This intervention was evaluated using a matched control group and found significant reductions in children's TV time, video game use and frequency of children eating meals in a room with the TV on in intervention schools compared with controls. Children in the intervention group also had a statistically significant relative decrease in BMI, triceps skin fold thickness, waist circumference and waist to hip ratio.

Switch-PLAY

This intervention (33-35) aimed to decrease sedentary behaviour (specifically television viewing) while increasing physical activity. Intervention components were based on principles from social cognitive theory and behavioural choice theory using self-monitoring and behavioural contracting to 'switch off' the TV for increasing durations, reinforcement and skill building. There were two intervention components: a behavioural modification (BM) condition and fundamental motor skills (FMS) condition. These intervention components were delivered in addition to the usual physical education and sports classes. Each of the intervention conditions consisted of 19 lessons (40-50 min each), which were delivered by one qualified physical education teacher. Classes were randomly allocated to a BM only condition, an FMS only condition, a combined BM/FMS condition or a control (usual curriculum) group. The BM lessons were delivered in the classroom (See Appendix E for more information). The FMS lessons were delivered either in the indoor or outdoor physical activity facilities at each school. Through games and activities developed for this intervention these lessons focused on mastery of six FMS. The interventionist taught the skills with an emphasis on enjoyment and fun through games and maximum involvement for all the children (see Appendix C and E for more information).

Adjusting for food intake and physical activity, there was a significant intervention effect from baseline to post intervention on age and sex-adjusted BMI in the BM/FMS group compared with control; this was maintained at six and 12 months. Children in the BM/FMS group were less likely than controls to be overweight/obese between baseline and post intervention; this was maintained at 12 months. Compared with controls, FMS group children had increased levels and greater enjoyment of physical activity and BM children recorded increased levels of physical activity and TV across all time points.

Unplugged and Media Savvy

This multi-level intervention in the United States focused on reducing sedentary behaviour and minimizing the impact of media promotion of food focuses on policy, environmental and behavioural changes to reduce the use of TV, video games and computer entertainment by individual children, families and schools (37). The intervention brings together five innovative initiatives: *30 Days Live!*, a media literacy curriculum, family education, school wide events and a school-wide focus on policy change for food marketing and the use of TV and video at school. Focus groups will be conducted with teachers and families and interviews with school administrators to explore intervention themes, and develop classroom and family curriculum using an iterative process. Model school policies will be developed in collaboration with school administration. Five intervention schools from diverse school districts will be selected to test the feasibility of each of the components of the intervention. Teachers will be trained and supported so that they can implement the classroom curricula, families will receive six *Unplugged* kits during the school and administrators and parent groups will continue to be consulted to facilitate the implementation the school-wide components of the intervention (see Appendix C and E for more information). *This intervention is currently being implemented.*

Promising Practices

Upon searching the grey literature, it was found that there were many recommendations and strategies for screen time. However, many initiatives that focused on reducing screen time did not appear to follow the evidence based recommendations found in our review. That is to say they were not multi-level or multi-component. Appendix D provides an overview of local, national and international initiatives. This is not an exhaustive list as the search revealed that many initiatives were not described in-depth and most were not evaluated. We have chosen to highlight several initiatives that are thought to be a promising practice based on the findings from our review. URLs and additional information can be found in Appendix D.

Do More Watch Less

Do More Watch Less is funded by the California Obesity Prevention Initiative (California Department of Public Health) and targets 10-14 year-olds in after school programs and other youth-serving organizations. The sessions aim to help youth incorporate more screen-free activities into their day while reducing the time they spend on screen-based activities, such as watching TV, surfing the internet, or playing video games. Over the course of the project, youth will be given the chance to track their time spent on screen-based activities, challenged to cut out screen-based activities for three days and subsequently challenged to spend no more than two hours a day in front of a screen. The tool kit includes a recommended timeline for the challenge, sample activities and tracking forms and information for parents/guardians. Analysis of national data (Youth Styles Survey), youth focus groups, key informant interviews with experts and research from Tom Robinson (Stanford University) was used to inform the tool kit.

Healthy Kids, Healthy New York After-school Model Guidelines

The Healthy Kids, Healthy New York After-school toolkit (Funded by the National Governor's Association) was designed to help after-school providers easily create healthy after-school environments. The program focuses on nutrition, physical activity and screen time and provides a range of resources including key recommendations, self-assessment tools, sample program schedules and tips for after-school program staff, program implementation resources (specific to nutrition, physical activity and screen time) and parent resources.

Live and unplugged

Live and Unplugged is a local initiative that is continuing to gain interest in Nova Scotia. The South Shore and Valley regional offices of Nova Scotia Health Promotion and Protection had been running a *Spring into Action* campaign for a number of years, which was a two-week physical activity campaign for students in grades 4-6. Following the release of findings from regional research on screen time, the regional offices decided to add a twist by building a "turn off the screen" component. This became *Live and Unplugged*. The focus of the initiative is to both decrease "screen time" such as using a computer, playing video games and watching TV, and increase physical activity time. Ideally, each student will decrease their screen time by 30 minutes per day (outside of school commitments) and replace it with 30 minutes of being active. After schools register, they received a package that includes user-friendly tally sheets; a prize for each participant to motivate them; additional student prizes to give away in draws for each week; a brochure with information on physical activity levels and activity ideas for teachers, parents and guardians; two Teacher's Guides to Physical Activity; and a feedback form for teachers. After the two weeks are over, teachers are asked to send back the checklists. Prizes are drawn for each participating class and for an inspiring teacher. In 2008/2009, Tri-County, South Shore, Halifax Regional, Conseil Scolaire, Annapolis Valley and Chignecto-Central were involved in the challenge. A total of 101 schools, 642 classes and 9724 students participated across Nova Scotia.

Media Smart Youth: Eat, Think and Be Active

Media Smart Youth is an interactive after-school education program for young people aged 11 to 13 years. The program is designed to help teach them about the complex media world around them, and how it can affect their health, especially in the areas of nutrition and physical activity. A facilitator's guide is available that provides detail on the curriculum, which consists of 10 lessons and a major project that helps young people acquire knowledge and skills in four key areas: media awareness, media production, nutrition, physical activity.

Intervention Recommendations

This section represents our conceptualization of a multi-component, multi-leveled intervention for Nova Scotia children and youth, as outlined in objective 3. In Nova Scotia, the Halifax Regional Municipality has a diverse population with many ethnicities and socio-economic backgrounds. As a municipality, we also have a mix of rural and urban residents. Challenges for our province and community include our high rates of sedentary behaviour, food insecurity and obesity. However, we are also fortunate to have existing initiatives and strategies in place which can enhance our influence on child and youth health and provide a strong foundation for any interventions or programs and increase the likelihood of a sustained impact.

Based on our best-evidence review and scan of effective interventions, the proposed intervention for HRM should adopt a multi-component, multi-leveled approach. Interventions can maximize the infusion of health promotion messages into the individual’s social environment while simultaneously impacting on larger social and governmental factors that influence individual health behaviour. This intervention has been founded upon generalizable evidence and principles and is proposed to start at a local level (i.e. Halifax Regional Municipality). Most of the effective interventions reported here targeted children ranging from ages 8-11 years; however, the proposed lunch-time and after school programming uses education and experiential learning that could be extended to children of all ages. Identifying partners and current initiatives will help to minimize the existing burden on school environments. In line with our recommendations, the proposed multi-level, multi-component intervention includes four streams:

1) Reduce sedentary behaviour

The two most effective interventions previously described are assumed to provide good intervention strategies to reduce sedentary behaviour in HRM. As previously described, *SMART* (32) used a curriculum that was delivered weekly over six months in four different sections: 1) *TV Awareness* included self-monitoring exercises, in-class monitoring and self identifying non-screen time activities; 2) *TV Turnoff* encouraged students to turn off their screen for 10 days and lessons helped to build their perceived self-efficacy; 3) *Staying in Control* was aimed at supporting students to set and adhere to a modest goal of screen time; 4) *Helping others* involved students participating in advocacy activities to help students at another school overcome their reliance on screen time. *SWITCH-play* (33-35) also used a curriculum, and had a behavioural modification condition that focused on encouraging children to ‘switch off’ the TV. *SMART* (36), described as a most promising intervention, also provides an intervention strategy that focuses on reducing sedentary behaviour by specifically targeting the community and family level. Local promising practices, specifically the Live and Unplugged initiative, should be considered as an asset for the intervention to build upon.

2) Reduce unhealthy eating

The Nova Scotia government and schools have already been addressing this second stream through implementing *The Food and Nutrition Policy for Nova Scotia Public Schools* (38). This policy outlines standards for foods and beverages that can be served and sold in schools. In addition, it promotes nutrition education in the curriculum, encourages community partnerships, and provides a supportive environment for healthy choices. It is designed to complement the efforts of other settings, including those of the home and larger community, to support healthy eating. The policy contains 12 directives related to: Food and Beverages Served and Sold in Schools, Special Functions, Promotion and Advertising, Clean Drinking Water, Use of

Food as a Reinforcer, Food and Nutrition Programming, Students Who May be Vulnerable, Portion Sizes, Pricing, Food Safety, Fundraising and Nutrition Education. It also provides five guidelines related to time to eat, use of Nova Scotia produce and products, food packaging and environmental considerations, role models, and school partnerships and commitment. The policy has been phased in beginning September 2006, with full implementation by June 2009. Reinforcing this policy in schools is assumed to provide a good strategy for reducing unhealthy eating (39-40).

3) and 4) Increase physical activity and healthy eating

To increase both physical activity and healthy eating, we recommend using strategies from the *SWITCH-play* and The Phunkyfoods Programme (the latter has not been previously described in this review since this program deals with healthy eating and active living in its broader sense, but is discussed below). The *SWITCH-play* intervention (33-35) also had a fundamental motor skills condition that delivered lessons that focused on mastery of these six FMS. The interventionist taught the skills with an emphasis on enjoyment and fun through games and maximum involvement for all the children. Combining the BM and FMS conditions was found to be most effective on improving children's weight.

The PhunkyFoods Programme (41) is a comprehensive program in the United Kingdom that teaches primary school children key healthy eating and physical activity messages through art, drama, music, play and hands on food experience. The PhunkyFoods program (PFP) is a subsidiary company of Purely Nutrition Ltd, a nutrition consultancy that specializes in training techniques for the incorporation of healthy eating and physical activity messages into daily life. PFP was designed by health professionals (Registered Nutritionists) while checked for both quality and content by a specialist teacher, and comes with all resources and training needed to run the program in schools. Lesson plans are available to teach a one-hour lesson of healthy eating and a one-hour lesson of physical activity every week to every primary year group, although schools can deliver the PFP in a variety of ways (in different curriculum contexts and/or during out of hours school clubs) and for varying lengths of time. Staff delivering the program in schools does not require specialist knowledge as all lesson plans are scripted. This allows for implementation by existing staff, such as supervisors or classroom assistants, rather than teachers themselves. An evaluation of PFP showed that schools found the PFP easy to use and sufficiently flexible to allow delivery in different ways and by staff with varying levels of experience (42).

Recommendations for Implementation

Along with continued implementation of the Food and Nutrition Policy, this intervention would aim to decrease screen time and unhealthy eating, while increasing physical activity and healthy eating. Acknowledging the current burden on curricula in schools, we do not suggest that any multi-component, multi-level program be implemented in the classroom during existing teaching time. However, non-teaching time in schools might provide an opportunity for the HRM Physical Activity strategy to partner with schools and support student's healthy eating and physical activity behaviours. Specifically, as of September 2009, the Halifax Regional School Board (HRSB) provides supervision of students during the lunch break at no cost to the student. This will likely increase the number of children remaining at school during lunch time and may provide an opportunity for programming that could be incorporated into a lunch time intervention. After-school programs, such as the EXCEL child care program through HRSB, also provide an opportunity for intervention as many students remain at school and participate in activities during this time. Recommendations from this report could be used to develop a specific evidence-based initiative in lunchtime and after-school settings that require ongoing programming for students.

Mapping existing assets within Halifax Regional Municipality will provide potential avenues for collaboration and capacity building. For example, Live and Unplugged is an initiative that promotes decreased “screen time”, and increased physical activity and this could be expanded to incorporate the other important variables identified in this review. In particular, acknowledgment of the role that our environments play in health should also be a key component of this intervention.

Concluding Remarks: The Complex Relationship between Sedentary Behaviour and Healthy Weights in Children and Youth

This report has addressed three objectives. First, a review of the evidence describing the relationship between sedentary behaviour and children and youth health was conducted to meet objective One. Findings showed little disagreement that a strong relationship between sedentary behaviours and child and youth weight and health exists. However, when the size of the effect of this relationship is assessed it is found to be quite small, meaning that an intervention, targeting sedentary behaviours like screen time in isolation, could provide only a small amount of impact. This highlights, as one would expect, that the etiology of child and youth weight and health is much more complex than how much time is spent engaged in low intensity activities.

Physical activity, sedentary behaviours and diet all contribute to child and youth health in a synergistic manner that has not yet been fully elucidated. However, evidence is mounting to support the notion that these are complex problems that cannot be addressed through a focus on the individual, without also addressing broader societal, environmental and political factors (43). This means that the most successful approach to improving child and youth health will be to target the most important contributing lifestyle behaviours within the context in which they are found, and it is repeatedly recommended to ‘think big’ in the literature. Factors related to sedentary behaviours exist within the individual, family, school and wider social and built environments. It is important that we acknowledge that complex problems require complex solutions and, although targeting a subset of sedentary behaviours (i.e. screen time) has been shown to reduce those specific behaviours, it has not been found to have large secondary effects that improve physical activity or reduce weight. Therefore, the key finding of this report is that multi-component, multi-leveled interventions are the most promising way to improve child and youth health in HRM and beyond.

The key finding of this report is that multi-component, multi-leveled interventions are the most promising way to improve child and youth health in HRM and beyond.

The second objective was to use the evidence from our review to scan for best and promising practice interventions that target different lifestyle factors, including diet and physical activity. The results from our search of interventions were compared to the recommendations identified in objective one. Two interventions, *SMART* and *SWITCH-play*, were judged to be most effective because they demonstrated positive changes in behaviour and used both multi-component and multi-level intervention approaches. The next two most promising interventions, *SWITCH* and *Unplugged and Media Savvy*, were also multi-component and multi-level; however, results of these interventions were either not published or not yet available. Our search of screen time initiatives found that many initiatives had not been properly evaluated; our promising practices section provided a description of several initiatives of interest, most of which have been evaluated in some way.

Finally, to address our third objective, we provided guidance on developing a contextualized multi-component, multi-leveled intervention for Nova Scotia children and youth. Comprising four streams, designed to both reduce sedentary behaviour and unhealthy eating, while also promoting physical activity and healthy eating behaviours, our recommendations have been designed, not only to be evidence-based, but also to be practical, achievable, realistic and cost-effective. By contextualizing to Nova Scotia, our recommendations build upon existing initiatives and infrastructure and offers opportunities to embed an intervention within the school system as the best approach to improve child and youth health now and in the future.

References

- (1) Biddle SJH, Gorely T, Stensel DJ. Health-enhancing physical activity and sedentary behaviour in children and adolescents. *J Sports Sci* 2004;22(8):679-701.
- (2) Shields M. *Overweight Canadian Children and Adolescents*. Ottawa: Statistics Canada; 2006.
- (3) Veugelers PJ, Fitzgerald AL. Prevalence of and risk factors for childhood overweight and obesity. *CMAJ* 2005;173(6):607-613.
- (4) Willms JD, Tremblay MS, Katzmarzyk PT. Geographic and demographic variation in the prevalence of overweight Canadian children. *Obes Res* 2003;11(5):668-673.
- (5) Thompson AM, Campagna PD, Rehman LA, Murphy RJL, Rasmussen RL, Ness GW. Physical activity and body mass index in grade 3, 7, and 11 Nova Scotia students. *Med Sci Sports Exerc* 2005;37(11):1902-8.
- (6) Committee on Public Education. American Academy of Pediatrics: children, adolescents, and television. *Pediatrics* 2001;Vol. 107.
- (7) Pate RR, O'Neill JR, Lobelo F. The evolving definition of "sedentary". *Exerc Sport Sci Rev* 2008;36(4):173-8.
- (8) DeMattia L, Lemont L, Meurer L. Do interventions to limit sedentary behaviours change behaviour and reduce childhood obesity? A critical review of the literature. *Obes Rev* 2007;8(1):69-81.
- (9) Hume C, Singh A, Brug J, Mechelen W, Chinapaw M. Dose-response associations between screen time and overweight among youth. *Int J Pediatr Obes* 2009;4(1):61-4.
- (10) Laurson K, Eisenmann JC, Moore S. Lack of association between television viewing, soft drinks, physical activity and body mass index in children. *Acta Paediatr* 2008;97(6):795-800.
- (11) Kamath CC, Vickers KS, Ehrlich A, McGovern L, Johnson J, Singhal V, et al. Behavioral interventions to prevent childhood obesity: a systematic review and metaanalyses of randomized trials. *J Clin Endocrinol Metab* 2008;93(12):4606-4615.
- (12) Marshall SJ, Biddle SJ, Gorely T, Cameron N, Murdey I. Relationships between media use, body fatness and physical activity in children and youth: a meta-analysis. *Int J Obes Relat Metab Disord* 2004;28(10):1238-1246.
- (13) Dietz WH. The role of lifestyle in health: the epidemiology and consequences of inactivity. *Proc Nutr Soc* 1996;55(3):829-840.
- (14) Must A, Tybor DJ. Physical activity and sedentary behavior: a review of longitudinal studies of weight and adiposity in youth. *Int J Obes* 2005;29 Suppl 2:S84-S96.
- (15) van der Horst K, Oenema A, Ferreira I, Wendel-Vos W, Giskes K, van Lenthe F, et al. A systematic review of environmental correlates of obesity-related dietary behaviors in youth. *Health Educ Res* 2007;22(2):203-226.

- (16) Rey-Lopez J, Vicente-Rodriguez G, Biosca M, Moreno LA. Sedentary behaviour and obesity development in children and adolescents. *Nutr Metab Cardiovasc Dis* 2008;18(3):242-251.
- (17) Cooper TV, Klesges LM, Debon M, Klesges RC, Shelton ML. An assessment of obese and non obese girls' metabolic rate during television viewing, reading, and resting. *Eat Behav* 2006;7(2):105-114.
- (18) Vandewater EA, Shim MS, Caplovitz AG. Linking obesity and activity level with children's television and video game use. *J Adolesc* 2004;27(1):71-85.
- (19) Matheson DM, Killen JD, Wang Y, Varady A, Robinson TN. Children's food consumption during television viewing. *Am J Clin Nutr* 2004;79(6):1088-1094.
- (20) Halford JC, Boyland EJ, Hughes G, Oliveira LP, Dovey TM. Beyond-brand effect of television (TV) food advertisements/commercials on caloric intake and food choice of 5-7-year-old children. *Appetite* 2007;49(1):263-267.
- (21) Halford JC, Boyland EJ, Hughes GM, Stacey L, McKean S, Dovey TM. Beyond-brand effect of television food advertisements on food choice in children: the effects of weight status. *Public Health Nutr* 2008;11(9):897-904.
- (22) Must A, Parisi SM. Sedentary behavior and sleep: paradoxical effects in association with childhood obesity. *Int J Obes* 2009;33 Suppl 1:S82-S86.
- (23) Biddle SJ, Gorely T, Marshall SJ, Murdey I, Cameron N. Physical activity and sedentary behaviours in youth: issues and controversies. *J R Soc Health* 2004;124(1):29-33.
- (24) Brodersen NH, Steptoe A, Williamson S, Wardle J. Sociodemographic, developmental, environmental, and psychological correlates of physical activity and sedentary behavior at age 11 to 12. *Ann Behav Med* 2005;29(1):2-11.
- (25) Reilly JJ, Armstrong J, Dorosty AR, Emmett PM, Ness A, Rogers I, et al. Early life risk factors for obesity in childhood: cohort study. *BMJ* [serial on the Internet]. 2005 May 20; [cited 2009 Aug 11]; 330: [about 7 screens]. Available from: <http://www.bmj.com/cgi/content/abstract/330/7504/1357>
- (26) Agras WS, Hammer LD, McNicholas F, Kraemer HC. Risk factors for childhood overweight: a prospective study from birth to 9.5 years. *J Pediatr* 2004;145(1):20-25.
- (27) Vandewater EA, Huang X. Parental weight status as a moderator of the relationship between television viewing and childhood overweight. *Arch Pediatr Adolesc Med*. 2006;160(4):425-431.
- (28) Norman GJ, Schmid BA, Sallis JF, Calfas KJ, Patrick K. Psychosocial and environmental correlates of adolescent sedentary behaviors. *Pediatrics* 2005;116(4):908-916.
- (29) Jordan AB, Hersey JC, McDivitt JA, Heitzler CD. Reducing children's television-viewing time: a qualitative study of parents and their children. *Pediatrics* 2006;118(5):E1303-E1310.
- (30) Lobstein T, Dobb S. Evidence of a possible link between obesogenic food advertising and child overweight. *Obes Rev* 2005;6(3):203-208.

- (31) He M, Harris S, Piche L, Beynon C. Understanding screen-related sedentary behavior and its contributing factors among school-aged children: a social-ecologic exploration. *Am J Health Promot* 2009;23(5):299-308.
- (32) Robinson TN, Borzekowski DLG. Effects of the SMART classroom curriculum to reduce child and family screen time. *J Commun* 2006;56(1):1-26.
- (33) Salmon J, Ball K, Crawford D, Booth M, Telford A, Hume C, et al. Reducing sedentary behaviour and increasing physical activity among 10-year-old children: overview and process evaluation of the 'Switch-Play' intervention. *Health Promot Int* 2005;20(1):7-17.
- (34) Salmon J, Timperio A, Telford A, Carver A, Crawford D. Association of family environment with children's television viewing and with low level of physical activity. *Obes Res* 2005;13(11):1939-1951.
- (35) Salmon J, Ball K, Hume C, Booth M, Crawford D. Outcomes of a group-randomized trial to prevent excess weight gain, reduce screen behaviours and promote physical activity in 10-year-old children: switch-play. *Int J Obes* 2008;32(4):601-612.
- (36) Eisenmann JC, Gentile DA, Welk GJ, Callahan R, Strickland S, Walsh M, et al. SWITCH: rationale, design, and implementation of a community, school, and family-based intervention to modify behaviors related to childhood obesity. *BMC Public Health* [serial on the Internet]. 2008 Jun 29; [cited 2009 August 11];8 [10 screens]. Available from: <http://www.biomedcentral.com/content/pdf/1471-2458-8-223.pdf>
- (37) Podrabsky M. *Unplugged and Media Savvy*; 2009.
- (38) Government of Nova Scotia. *Food and Nutrition in Nova Scotia Schools* [Homepage]. Province of Nova Scotia; [updated 2009 August 11; cited 2009 August 11]. Available from: http://www.ednet.ns.ca/healthy_eating/.
- (39) Samuels SE, Lawrence S, Woodward-Lopez G, Clark SE, Kao J, Craypo L, et al. To what extent have high schools in California been able to implement state-mandated nutrition standards? *J Adolesc Health* 2009.
- (40) Samuels S, Craypo L, Boyle M, Stone-Francisco S, Schwarte L. *Improving school food environments through district level policies: findings from six california case studies*. Oakland, Cal :Samuels and Associates; 2006.
- (41) Purely Nutrition Ltd. *PhunkyFoods* [Online]. Phunky Foods. 2009 [cited 2009 July]; Available from: <http://www.phunkyfoods.co.uk/>.
- (42) Teeman D, Reed F, Bielby G, Scott E, Sims D. *Evaluation of the phunky foods programme: final report*. Naitonal Foundation for Educational Research; 2008 september.
- (43) Shiell A, Hawe P, Gold L. Complex interventions or complex systems? Implications for health economic evaluation. *BMJ* 2008;336(7656):1281-1283.
- (44) Epstein LH, Valoski AM, Vara LS, McCurley J, Wisniewski L, Kalarchian MA, et al. Effects of decreasing sedentary behavior and increasing activity on weight change in obese children. *Health psycho* 1995;14(2):109-115.

- (45) Epstein LH, Paluch RA, Raynor HA. Sex differences in obese children and siblings in family-based obesity treatment. *Obes Res* 2001;9(12):746-753.
- (46) Epstein LH, Paluch RA, Gordy CC, Dorn J. Decreasing sedentary behaviors in treating pediatric obesity. *Arch Pediatr Adolesc Med*. 2000;154(3):220-226.
- (47) Faith MS, Berman N, Heo M, Pietrobelli A, Gallagher D, Epstein LH, et al. Effects of contingent television on physical activity and television viewing in obese children. *Pediatrics* 2001;107(5):1043-1048.
- (48) Roemmich JN, Gurgol CM, Epstein LH. Open-loop feedback increases physical activity of youth. *Med Sci Sports Exerc* 2004;36(4):668-673.
- (49) Maloney AE, Bethea TC, Kelsey KS, Marks JT, Paez S, Rosenberg AM, et al. A pilot of a video game (DDR) to promote physical activity and decrease sedentary screen time. *Obesity (Silver Spring)* 2008;16(9):2074-2080.
- (50) McGarvey E, Keller A, Forrester M, Williams E, Seward D, Suttle DE. Feasibility and benefits of a parent-focused preschool child obesity intervention. *Am J Public Health* 2004;94(9):1490-1495.
- (51) Ford BS, McDonald TE, Owens AS, Robinson TN. Primary care interventions to reduce television viewing in African-American children. *Am J Prev Med*. 2002;22(2):106-109.
- (52) Shapiro JR, Bauer S, Hamer RM, Kordy H, Ward D, Bulik CM. Use of text messaging for monitoring sugar-sweetened beverages, physical activity, and screen time in children: a pilot study. *J Nutr Educ Behav* 2008;40(6):385-391.
- (53) Johnson DB, Birkett D, Evens C, Pickering S. Statewide intervention to reduce television viewing in WIC clients and staff. *Am J Health Promot* 2005;19(6):418-421.
- (54) Salmon J, Hume C, Ball K, Booth M, Crawford D. Individual, social and home environment determinants of change in children's television viewing: the Switch-Play intervention. *J Sci Med Sport* 2006;9(5):378-387.
- (55) Muller MJ, Asbeck I, Mast M, Langnase K, Grund A. Prevention of obesity--more than an intention. Concept and first results of the Kiel Obesity Prevention Study (KOPS). *Int J Obes Relat Metab Disord*. 2001;25 Suppl 1:S66-74.
- (56) Plachta-Danielzik S, Pust S, Asbeck I, Czerwinski-Mast M, Langnase K, Fischer C, et al. Four-year follow-up of school-based intervention on overweight children: the KOPS study. *Obesity* 2007;15(12):3159-3169.
- (57) Goldfield GS, Mallory R, Parker T, Cunningham T, Legg C, Lumb A, et al. Effects of open-loop feedback on physical activity and television viewing in overweight and obese children: a randomized, controlled trial. *Pediatrics* 2006;118(1):e157-e166.
- (58) Robinson TN, Killen JD, Kraemer HC, Wilson DM, Matheson DM, Haskell WL, et al. Dance and reducing television viewing to prevent weight gain in African-American girls: the Stanford GEMS pilot study. *Ethn Dis* 2003;13 Suppl 1:S65-77.

- (59) Robinson TN, Kraemer HC, Matheson DM, Obarzanek E, Wilson DM, Haskell WL, et al. Stanford GEMS phase 2 obesity prevention trial for low-income African-American girls: design and sample baseline characteristics. *Contemp.Clin.Trials* 2008 Jan;29(1):56-69.
- (60) Chin A Paw MJ, Singh AS, Brug J, van Mechelen W. Why did soft drink consumption decrease but screen time not? Mediating mechanisms in a school-based obesity prevention program. *Int J Behav Nutr Phys Act* [serial on the Internet]. 2008 Aug 11 [cited 2009 August 11];5 [about 11 screens]. Available from: <http://www.ijbnpa.org/content/pdf/1479-5868-5-41.pdf>
- (61) Singh AS, Chinapaw MJM, Brug J, van Mechelen W. Process evaluation of a school-based weight gain prevention program: the Dutch Obesity Intervention in Teenagers (DOiT). *Health Educ Res* [Advanced Access Online] 2009 March 20; [cited 2009 August 11]; [6 screens]. Available from: <http://her.oxfordjournals.org/cgi/reprint/cyp011v1>
- (62) Gortmaker SL, Peterson K, Wiecha J, Sobol AM, Dixit S, Fox MK, et al. Reducing obesity via a school-based interdisciplinary intervention among youth: planet health. *Arch Pediatr Adolesc Med* 1999;153(4):409-418.
- (63) Dennison BA, Russo TJ, Burdick PA, Jenkins PL. An intervention to reduce television viewing by preschool children. *Arch Pediatr Adolesc Med* 2004;158(2):170-176.
- (64) Harrison M, Burns CF, McGuinness M, Heslin J, Murphy NM. Influence of a health education intervention on physical activity and screen time in primary school children: 'Switch Off--Get Active'. *J Sci Med Sport* 2006;9(5):388-394.
- (65) Robinson TN. Can a school-based intervention to reduce television use decrease adiposity in children in grades 3 and 4? *West J Med*. 2000;173(1):40.
- (66) Robinson TN. Reducing children's television viewing to prevent obesity a randomized controlled trial. *JAMA* 1999;282(16):1561-1567.
- (67) Singh AS, Chin A Paw MJ, Kremers SP, Visscher TL, Brug J, van Mechelen W. Design of the Dutch obesity intervention in teenagers (NRG-DOiT): systematic development, implementation and evaluation of a school-based intervention aimed at the prevention of excessive weight gain in adolescents. *BMC Public Health* [serial on the Internet]. 2006 December 16; [cited 2009 August 11]; 6 [15 screens]. Available from: <http://www.biomedcentral.com/content/pdf/1471-2458-6-304.pdf>
- (68) Gentile DA, Welk GJ, Eisenmann JC, Reimer RA, Walsh DA, Russell DW, et al. Evaluation of a multiple ecological level child obesity prevention program: Switch © what you Do, View and Chew. *BMC Med* 2009;7:49-61.

Appendix A: Review of the evidence

Meta-analyses Results: Strongest evidence

Study 1 This meta-analysis examined the efficacy of lifestyle interventions that promote behaviours that are able to prevent pediatric obesity. Studies included those published up to February 2006 with interventions including children and adolescents between the ages of 2–18 years. Lifestyle factors included 1) dietary changes i.e. increasing health dietary behaviour and decreasing unhealthy dietary behaviours and 2) changes in physical activity i.e. increasing physical activity and decreasing sedentary activity behaviours. Each component showed a small, but statistically significant effect on each lifestyle behaviour except increasing healthy dietary behaviour which was found to be non-significant. Also, there was a trivial to small, non-significant effect of each lifestyle factor on body mass index compared with control. Findings included preliminary evidence to support the assertion that lifestyle factor interventions can have significant effects on physical activity, sedentary and dietary behaviours. The authors also stated that interventions that aim to reduce unhealthy behaviours are more successful than those promoting healthy behaviours. They also suggest that the link between lifestyle behaviours and obesity, not found to be significant here, likely has a much more complex relationship than this meta-analysis was able to examine (i.e. not controlling for possible mediating and moderating factors). They further recommend that activity and diet behaviour were likely to interact when impacting obesity and that effective intervention would change more than one behaviour, having a potential synergistic effect on obesity prevention (11).

Study 2 This meta-analysis examined evidence of associations between television viewing, video/computer use and 1) body fatness and 2) physical activity. Studies included were searched from 1987 from a variety of databases and included primary studies with participants aged 3 to 18 years. This examination showed that a very small, but statistically significant, relationship exists between television viewing in children and youth and body fatness. This means that body fatness was only minimally explained by TV viewing, leaving room for other potential factors. The authors could not make a definitive conclusion regarding video/computer use and body fatness because of possible sampling error. A statistically significant, negative effect for TV viewing, video/computer use and physical activity was also found. This was also reviewed by age, finding no relationship for children aged 0-6 year olds, a small relationship for 7-18 year olds (no gender differences). It was also found that physical activity intensity acted as a moderator with only vigorous activity being significantly negatively associated with TV viewing. The authors stated that this could be evidence to support a displacement view of physical activity and TV viewing, or weaknesses in self-report measures because vigorous activity is more easily recalled. Final conclusions by the authors emphasized the small effect that TV viewing might have on body fatness and also further highlight the fact that although multiple sedentary activities may reduce total daily energy expenditure, the relationship between sedentary behaviour and health are unlikely to be explained using single markers of inactivity such as TV viewing or video/computer game use (12).

Systematic Review Results: Promising evidence

Study 3 This systematic review of cross-sectional studies was conducted regarding child (ages 4-12) and youth (ages 13-18) physical activity, inactivity and sedentary behaviours in order to better understand these concepts to support the development of effective interventions that promote physical activity and prevent inactivity and

sedentary behaviours. This review examined various demographic, psychological, behavioural, social and built environment variables.

Correlates for children's physical activity and sedentary behaviours:

- Strong associations were found between self-efficacy and physical activity
- No association was found between television watching/video game playing and physical activity.
- Positive association between parental physical activity modeling and boys physical activity.
- Positive association between parental support and children's physical activity.
- No built environment associations were found (access to facilities, perceived access to play space, perceived access to sporting and/or fitness equipment at home) and children's physical activity.
- Could not assess relationships between childhood and sedentary behaviour for lack of number of studies

Correlates of adolescent physical activity and sedentary behaviours:

- Gender and parental education was associated with physical activity and sedentary behaviour
- Attitude, self-efficacy, goal-orientation/motivation were positively associated with physical activity
- Physical education and school sports and physical activity
- No association between sedentary behaviours (television watching and video game playing) with youth physical activity
- Positive association between family influences and friend support and physical activity
- No association between built environment (observed and perceived) variables and youth physical activity
- Positive associations were found for BMI and sedentary behaviour (television and video game)
- Positive association between depression and sedentary behaviour

The authors highlighted the lack of built environment correlates found in this review and discussed possible reasons including measurement and definitions of terms as potential explanation. They also emphasized the lack of available evidence related to sedentary behaviour and physical inactivity compared to physical activity. Stating that variables which are consistently associated with physical activity (such as self-efficacy) do not always have the opposite association with sedentary behaviour, reiterating that physical activity and sedentariness have their own unique determinants. Evidenced by the lack of finding of an association between sedentary behaviour and physical activity, this review further shows that this is not consistent with the hypothesis that sedentary behaviours replace physical activity (displacement). A potential explanation for this lack of displacement is that sedentary behaviours like watching TV and playing video games replaces only low intensity physical activity (walking and playing) rather than moderate to vigorous (running and sports). Those included in this review were mainly moderate to vigorous. Another limitation is the definitions for sedentary behaviour. It is sometimes defined as low level of physical activity, or insufficient physical activity according to guidelines, in other studies the amount of TV was used as an indicator of sedentary behaviour. Only one study used a composite measure for sedentary behaviour including TV, video/computer use, reading, listening to music and chatting with friends. Must use a more comprehensive definition and therefore measurement of sedentary behaviour. All studies were cross-sectional (15).

Non-Systematic Results: Trends and descriptive evidence

Study 4 This non-systematic review was conducted regarding the relationship between sleep and childhood obesity. The purpose of this work was to explore the state of the evidence and also to describe evidence around potential mechanisms that might explain this relationship. The authors recognize that although the association between sedentary behaviour and weight has been consistently shown in observational studies, the effect sizes are small and it is evident that multiple mechanisms are at work. They discuss the complex interaction between screen-time (television, video game, computer, phone etc.), sleep weight status for children and youth, emphasizing that although these relationships have been found it is important to recognize the wider factors including parental and genetic predispositions. The authors recommend that interventions related to screen time could have an effect, but that the effect would be small alone, thereby supporting broader approaches (22).

Study 5 This review revealed that across a variety of intervention approaches were successful at reducing sedentary behaviour and improving weight status in children and adolescents. Interventions were assessed based on validity criteria; this produced six clinic-based interventions and six population based interventions (8).

Study 6 This extensive review found that in general, prospective observational studies support the assertion that decreases in sedentary behaviour protect against relative weight gain and fatness increase during childhood and adolescence. These results were less substantive during adolescence than childhood; the authors speculated that this finding could be due to the changing technology and media sources over child development (14).

Study 7 This review looked at published studies from 1990-2007 and was conducted to evaluate the relationship between sedentary behaviour and body composition in children and adolescents. Three categories were used to describe relationships, TV viewing and obesity risk. The authors found a strong relationship between TV viewing and adiposity in children younger than 10 years at baseline, however older children and adolescents showed mixed results, suggesting that other factors become more important with age. The review reinforced previous findings that TV viewing is the most important sedentary behaviour. They also discuss theories that have attempted to explain this relationship including the reduced resting energy expenditure during TV watching, the replacement of physical activity resulting in a lower total energy expenditure, a higher consumption of unhealthy foods during viewing and that obesity itself increases TV viewing. To date the relative contribution of these factors has not been determined. The second category was videogame use where the authors found that most cross-sectional and longitudinal studies do not find an association between playing video games and obesity. This has been said to be due to less time being devoted to video games than TV; it is not as easy to consume calories because the video controller requires both hands, and that there is a higher energy expenditure. Specific to energy expenditure, they found evidence supporting the claim that if video game playing was substituted for regular physical activity the impact on obesity could be negative, however if video game playing was used as a substitute for TV watching or resting the impact of weight could be positive. The final category was computer use which has the least amount of research conducted. What was done did not find a relationship to weight. Also there was no relationship between increases in physical activity and decreases sedentary behaviour providing no evidence for the 'displacement' theory (16).

Primary Study Results: Potential mediating and moderating variables

Study 1 This study examining the potential link between food advertising and child weight was conducted. The main data source included surveys of advertising on children's television and estimates of the prevalence of overweight among children in the USA, AUS and eight countries in Europe. A significant association was found between the proportion of children overweight and the numbers of advertisements per hour on children's television, specifically those advertisements that encourage the consumption of energy-dense, micronutrient poor foods. A weaker, negative association was found between the proportion of children overweight and the number of adverts encouraging healthier diets. The authors emphasize the role that governments can play in supporting multi-factorial strategies to addressing the obesity epidemic and argue that this paper provides evidence, toward introducing controls related to advertising to children, as part of this approach (30).

Study 2 This recent study examined the combined influence of physical activity and screen time (television and video games) on the odds of being overweight in 7-12 year old children. The authors found that children meeting physical activity and screen time recommendations were the least likely to be overweight. Approximately 10% of the boys and 20% of the girls meeting both recommendations were overweight, in contrast 35% to 40% of those who did not meet either recommendation. This study showed that children not meeting the physical activity or screen time recommendations were 3 to 4 times more likely to be overweight than those complying with both recommendations (10).

Study 3 This very interesting study sought to explore the full spectrum of potential contributing factors related to children's screen-related, sedentary behaviours. Results were multi-leveled, at an intrapersonal level, protective factors included being a girl; belonging to a sports team inside or outside of school; having a negative attitude toward screen-related, sedentary behaviours activities and having a positive attitude toward physical activity. At the interpersonal and social levels, parental leisure screen-related, sedentary behaviours were positively associated, whereas strict parental rules on computer use and family income were inversely correlated. At the environmental level, the presence of TVs in children's bedrooms and owning videogame devices increased the risk of screen-related, sedentary behaviours, whereas after school programs and schools' participation in the Turn Off the Screen Week campaign decreased the risk. The authors argued that public health interventions should target multilevel factors, including increasing and children's awareness, promoting parental, involvement in healthy lifestyle pursuits, and creating environments which discourage sedentary behaviours (31).

Study 4 This study sought to determine correlates of sedentary behaviours in adolescents. Results included psychosocial and environmental correlates including for girls: family support, television/video rules, and hills in the neighbourhood were associated with sedentary behaviours. Furthermore, psychological constructs such as self-efficacy, enjoyment, change strategies, and pros and cons of change emerged as correlates of sedentary behaviours. A moderator effect revealed that the proportion of girls in the low-BMI group decreased with increased self-efficacy, whereas the proportion of girls in the high-BMI group did not vary significantly by self-efficacy. For boys, age, ethnicity, BMI, and self-efficacy were associated with sedentary behaviours (28).

Study 5 This study comprised a qualitative exploration of how a recommendation to limit television viewing might be received and responded to by a diverse sample of parents and their school-age children was conducted. Results showed that although virtually all of the parents reported having certain guidelines for

children's television viewing, few had specific restrictive rules regarding television time. Reasons for difficulty implementing a 2-hour limit included: parents' need to use television as a safe and affordable distraction, parents' own heavy television viewing patterns, the role that television plays in the family's day-to-day routine, and a belief that children should spend their weekend leisure time as they wish. Further, families communicated a lack of concern that television viewing was a problem for their child (29).

Study 6 This study sought to investigate the multidimensional correlates of physical activity and sedentary behaviour in 11 to 12-year-olds. Firstly, the authors found that days of vigorous physical activity and hours of sedentary behaviours over the past week were uncorrelated. Ethnicity, socioeconomic factors, developmental stage, environmental factors, and psychological variables were associated with physical activity and sedentary behaviour. Sedentary behaviour was greater in ethnic minority groups, in students from more deprived backgrounds, and in those with conduct problems. Girls who were more advanced developmentally and who reported emotional symptoms also engaged in more sedentary behaviours. Vigorous physical activity was associated with good self-rated health, pro-social psychological characteristics, and (in boys) with low emotional symptoms. The authors argue strongly for a multidimensional approach to understanding the context of physical activity and emphasize that physical activity and sedentary behaviours are distinct in this age group, and there are also important gender differences (24).

Study 7 This study also examined the dose-response associations between screen time and overweight, independent of physical activity and dietary intake. Results did not show a significant relationship for boys. Compared with girls spending less than two hours/day in screen time, those who spent three to four hours/day were more likely to be classified as overweight by waist circumference, and this likelihood increased substantially among those spending more than four hours/day (9).

Appendix B: Screen Time Interventions

Clinical interventions	
(44), (45)	Family based weekly treatment meetings on diet, exercise with contingent reward for meeting goals for reduction of sedentary behaviour
(46)	Program included dietary, and behaviour change information but differed in whether sedentary or physically active behaviours were targeted and the degree of behaviour change required.
(47)	TV viewing was contingent on pedaling a stationary cycle ergometer for experimental participants but was not contingent on pedaling for control participants.
(48)	Open-loop feedback that used pedometer activity counts to gain access to sedentary alternatives doubled physical activity. This study evaluated the influence of open-loop feedback and reinforcement on physical activity and television (TV) time in a small clinical trial.
(49)	Examined the feasibility of Dance Dance Revolution (DDR) in participants' homes, to increase physical activity (PA) and to decrease sedentary screen time (SST).
Specialty and primary care interventions	
(50)	Clients attend educational groups once every 2 months and an individual session with a WIC nutritionist every 6 months. 6 key messages: (1) increase physical activity, (2) monitor mealtime behaviour, (3) limit household television viewing, (4) drink water instead of sweetened beverages, (5) consume 5 fruits or vegetables daily, and (6) increase family activities to promote fitness.
(51)	Families were randomized to receive counseling alone or counseling plus a behavioural intervention that included an electronic television time manager.
(52)	Children and parents participated in a total of 3 group education sessions (1 session weekly for 3 weeks) to encourage increasing physical activity and decreasing screen time and sugar-sweetened beverage consumption. MAIN
(53)	The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides nutritious foods, education, and health and social services referrals to the families of almost half of the infants and one-fourth of all children ages 1 to 5 in the United States. Healthy Habits is a statewide campaign in Washington State that was designed to enhance the capacity of local WIC programs and partner agencies to promote healthy lifestyles in families with young children

Community and school-based	
Switch what you do, view and chew (36)	Designed to decrease screen time, increase fruit and vegetable consumption and increase physical activity by targeting three levels: family, school and community
Switch-Play (54), (34), (35)	This study aimed to investigate the contribution of individual, social and home environment factors among 10-year-old Australian children to change in TV viewing over a 21-month period.
Kiel Obesity Prevention Study (KOPS) (55), (56)	KOPS is an ongoing 8 y follow-up study, using a school and family-based intervention. The same behavioural and educational messages are given to all children and their parents: (i) eat fruit and vegetables each day, (ii) reduce the intake of high fat foods, (iii) keep active at least 1 h a day, and (iv) decrease TV consumption to less than 1 h a day.
Open-loop feedback (57)	Evaluated the effects of open-loop feedback plus reinforcement versus open-loop feedback alone on physical activity, targeted sedentary behaviour, body composition, and energy intake in youth.
Stanford GEMS (58,59)	Girls are randomized to a culturally-tailored after-school dance program and a home/family-based intervention to reduce screen media use versus an information-based community health education Active-Placebo Comparison intervention. Interventions last for 2 years for each participant.
DOiT (60,61)	School based obesity prevention program implemented in Dutch prevocational secondary schools applying the Intervention Mapping protocol. The intervention program consisted of an individual classroom-based component, and an environmental component.
Planet Health (62)	Students participated in a school-based interdisciplinary intervention over 2 school years. Planet Health sessions were included within existing curricula using classroom teachers in 4 major subjects and physical education. Sessions focused on decreasing television viewing, decreasing consumption of high-fat foods, increasing fruit and vegetable intake, and increasing moderate and vigorous physical activity.
(63)	Children attending intervention centers received a 7-session program designed to reduce television viewing as part of a health promotion curriculum, whereas children attending the control centers received a safety and injury prevention program.
'Switch Off-Get Active (64)	The 10-lesson, teacher-led intervention, conducted in spring 2003, emphasized self-monitoring, budgeting of time and selective viewing.
Student Media Awareness to Reduce Television (SMART) (32,65,66)	An 18-lesson, theory-based classroom curriculum to reduce screen time.

Appendix C: Intervention Matrix

It was assumed that broader population level interventions would be most relevant for this review; as such, this Appendix describes population level interventions from Appendix B according to the theory used, level of intervention, components, intervention and evaluation design and results.

- i. Behavioural change (BC), Intervention mapping (IM), Social cognitive theory (SCT), Social ecological (SE), Social marketing (SM), Transtheoretical model of behaviour change (TTM)
- ii. Classroom (Cl), Community (Co), Individual (I), Environment (E), Family (F), Policy (P), School (S)
- iii. Energy dense snacks (EDS), Family meals (FM), Family physical activity (FPA), Fruit and vegetables (FV), High fat foods (HFF), Media promotion of foods (MPF), Physical activity (PA), Screen-time (ST), Sedentary behaviours (SB), Skills, enjoyment and participation (SEP), Sugar-sweetened beverages (SSB), Television viewing (TV)
- iv. Control (C), Intervention (I)
- v. Behavioural modification (BM), Body mass index (BMI), Fundamental motor skills (FMS), Sugared beverages consumption (SBC), Self-efficacy (SE), WC (waist circumference), Weight gain (WG), WH (waist to hip ratio)

	Theory ⁱ	Levels ⁱⁱ	Components ⁱⁱⁱ	Description of Design	Evaluation Design ^{iv}	Results ^v
DOiT (67)	IM	I, Cl, E	↓SSB, EDS, SB ↑ PA	Educational (11 lessons for biology and physical education) and environmental (school specific advice on the assortment of the school canteen, posters, encouragement of PA options) program	8 C, 10 I schools (n=1108, 12-13 years)	Intervention reduced SBC in girls and boys but did not affect other examined behaviours
GEMS (Girls health Enrichment Multi-site Studies) Stanford (58)	SCT	F, Co	↓ ST and WG	Formative research guided design. Incorporate African-American culture into intervention emphasized elements: The GEMS Jewels Dance (after-school dance classes are offered 5 days per week, 12 months per year, at community centers near the selected neighbourhoods); Sisters Taking Action to Reduce Television (START, African-American female	1 I and 1 C (n=61, 8-10 years African-American girls and their parents/guardians)	Girls in the treatment group, exhibited trends toward lower BMI and WC, ↑ after-school PA; and ↓ TV, videotape, and video game use compared to controls. Treatment group reported significantly ↓ household TV and ↓ dinners eaten while watching TV. Treatment group girls also reported less concern about

SCREEN TIME AND HEALTHY WEIGHTS - A REVIEW AND RECOMMENDATIONS

	Theory ⁱ	Levels ⁱⁱ	Components ⁱⁱⁱ	Description of Design	Evaluation Design ^{iv}	Results ^v
				mentor schedules visits to meet with the family in their home to deliver each lesson). It includes 24 monthly newsletters each for girls and their parents/guardians, and quarterly community center health lectures (Family Fun Nights).		weight and a trend toward improved school grades.
Kiel Obesity Prevention Study (KOPS) (55) (56)	None	F, S	↓ HFF, ST (TV) ↑FV, PA	School intervention was delivered within their first year in three representative schools in Kiel. An 8 h course of nutrition education including ‘active breaks’ was offered by a skilled nutritionist together with a teacher. Messages were also addressed to their parents on a school meeting (parents evening). The family intervention consisted of three to five home visits organized by a nutritionist.	3 C schools 5 - 7 years 8 year follow up study	Intervention had no effect on mean BMI. The effect on prevalence was significant in children from families with high socioeconomic status and marginally significant in children of normal-weight mothers. The intervention had minor but favorable effects on lifestyle.
Planet Health (62)	BC and SCT	S	↓ST (TV), HFF, ↑FV, PA	Teacher training workshops, classroom lessons (total of 16 core lessons each in year 1 and year 2), PE materials (Lessons were organized into thirty 5-minute micro units) that were designed to be repeated with extensions in school-year 2), wellness sessions, and fitness funds.	5 I, and 5 C schools (n=1295, ~ aged 11-12, four communities)	The prevalence of obesity among girls in intervention schools was ↓compared with controls, controlling for baseline obesity with no differences found among boys. Greater remission of obesity among intervention girls vs. control. Intervention ↓TV among both girls and boys, and ↑FV and resulted in ↓in total energy intake among girls. Reductions in television viewing predicted obesity change and mediated the intervention effect.

SCREEN TIME AND HEALTHY WEIGHTS - A REVIEW AND RECOMMENDATIONS

	Theory ⁱ	Levels ⁱⁱ	Components ⁱⁱⁱ	Description of Design	Evaluation Design ^{iv}	Results ^v
Preschool based (63)	None	S	↓ST (TV)	Seven weekly 20 minute interactive, educational sessions led by program staff (day care staff encouraged to participate). Materials and activities were sent home with each child to foster discussion between parents and children	8 I and 8 C (n= 163, 2.6 to 5.5 years)	Children in the intervention group ↓TV and video 3.1 h/wk, whereas control ↑ by 1.6 h/wk. % watching TV and video > 2 h/d decreased significantly from 33% to 18% among the intervention group, compared with an increase of 41% to 47% among the control group.
SMART (Student Media Awareness to Reduce Television) (32, 66)	SCT	S, F	↓ST	Eighteen lessons of 30 to 50 minutes (during first 6 months) plus weekly 5-10 minutes boosters (over the course of the last four months). More frequent and intensive activities focusing on maximizing attention and motivation for participating in early mastery experiences to promote enhanced self-efficacy for initial adoption and generalization of behaviour changes. Followed by a combination of brief, regularly scheduled reinforcing activities and moderately intensive, intermittently scheduled activities over the rest of the school year to promote self-efficacy for maintaining changes or reinstating lapsed behaviours	2 matched schools (n=181, ~ aged 8-10)	Children in the intervention group had statistically significant relative ↓ in BMI, triceps skin fold thickness, WI and WH; ↓ in children's reported TV and meals eaten in front of the TV compared to controls. Intervention significantly ↓: children's TV, compared with controls; ↓ in video game use; ↓ frequency of children eating meals in a room with the TV on.
State-wide intervention for Women, Infants, and Children (53)	SM, SE, TIM	F, Co	↓ST ↑ FM, FPA	Television-reduction messages and delivery methods have been developed to address the key components of social marketing: product, price, place, and promotion. Individual handouts	Pre-experimental evaluation of first 6 months. 10,204 clients	Statistically significant change in reported meeting recommendations of 2 hours or less of TV

SCREEN TIME AND HEALTHY WEIGHTS - A REVIEW AND RECOMMENDATIONS

	Theory ⁱ	Levels ⁱⁱ	Components ⁱⁱⁱ	Description of Design	Evaluation Design ^{iv}	Results ^v
				and education approaches are based on the client's stage of change. Staff encouraged to use the materials to meet local needs, adopt healthy behaviours themselves, and to share materials and messages with local partners.	at baseline, 8977 clients at follow up	
SWITCH (36)	SE	S, Co	↓ST ↑PA, FV	Community intervention included a public educational intervention. The school component used classrooms as one channel for reaching families and maintaining SWITCH message.	5 I, 5 C (n= 1,323 children and their parents), ~ aged 8-10	<i>Results are not published:</i> Parents reported significant ↓ in children's ST and F. Children reported marginally significant ↑. At 6 month follow-up parents reported significantly ↓ ST, parents and children significant ↑ in FV. No effect on PA or BMI
SWITCH OFF (64)	SCT	S	↓ST ↑PA	Ten lessons of 30 minutes each as part of the existing Health Education curriculum. Continuous aspect of the intervention was the self-monitoring, budgeting and goal setting practiced to decrease screen time and increase physical activity. An 'activity points system' in conjunction with a project diary to keep track of the time spent in active and screen pursuits.	4 I and 2 C schools (n= 312 aged 10.2+/-0.7 years) Schools in areas of social disadvantage	Differences existed between intervention and control children at follow-up for self-reported PA and SE for PA but not self-reported ST or BMI.
Switch-PLAY (33) (34)	SCT, BC, SE	S	↓SB ↑SEP of PA	Education and awareness-raising, self-monitoring; role playing, goal setting and behavioural contracts, social support and feedback and reinforcement. Behavioural modification and fundamental motor skills (focused	Four conditions, BM (n=69), FMS (n=73, BM/FMS (n=90) and C (n=61)	Adjusting for food intake and PA, significant intervention effect from baseline to post intervention on age- and sex-adjusted BMI in the BM/FMS group compared with control (maintained at 6- and 12-months). Children in the

SCREEN TIME AND HEALTHY WEIGHTS - A REVIEW AND RECOMMENDATIONS

	Theory ⁱ	Levels ⁱⁱ	Components ⁱⁱⁱ	Description of Design	Evaluation Design ^{iv}	Results ^v
(35)				on six skills) were taught across three school terms, delivered by intervention specialist teacher.	10 year old children	BM/FMS group were less likely than controls to be overweight/obese between baseline and post intervention (maintained at 12-months). Compared with controls, FMS group children had ↑levels of enjoyment of PA; and BM children recorded ↑ levels of PA and TV across all time points. Gender moderated intervention effects for participation in and enjoyment of PA, and fundamental movement skills.
Unplugged and Media Savvy (37)	SCT	F, S	↓SB, MIF	Brings together five innovative initiatives, (1) <i>30 Days Live!</i> , a program in which students journal as they give up television for a month as a class, (2) a media literacy curriculum based on a teacher-driven developmental model derived from previous work with other children’s health issues, (3) family education based on family goals for student success, (4) a school wide introduction to the importance of reducing the impact of screen time and media exposure in the fall and a celebration of Turn off the TV Week in the spring, and (5) a school-wide focus on policy change for food marketing and the use of TV and video at school	5 I, 5 C classrooms ~ aged 9-11	None yet

Appendix D: Screen Time Initiatives

Program	Program Aim	Evaluation
30 days live	Students were challenged children to go for a month without spending time in front of screens of any sort—televisions or computers. Journal was used to record activities and snacks. Motivational quotations were inscribed in the journals and space was given for students to describe their experiences. Small prizes were given to students who remained in the challenge. Surveys (student, parent and teacher) were completed and heights and weights measured.	6 month follow-ups revealed that nearly 80% of children were watching less TV than before taking part. Recently completed a two year grant with the University of Washington. Program was very viable part of the intervention at 6 schools in three states.
<u>Active Bodies, Active Minds</u>	Web site and tool kit were developed to ensure that environments for preschool children encourage minimum screen time and maximum physical activity. A diverse advisory group of early childhood professionals provided input on the content and design. The colorful, user-friendly site and materials offer access to field-tested tools and information on: The importance of limiting screen time and encouraging physical activity and resources for limiting screen time and encouraging physical activity in child care and in homes.	Tool kits were found to be useful, and together with trainings positively impacted screen environments and the provision of parental education on screens. Currently being evaluated using an online survey and web statistics to assess the site’s reach and most useful resources.
<u>CHILD Profile</u>	Health promotion materials provide parents with age-specific information about growth, development, safety, nutrition, and other parenting issues including smart screen time. Materials are sent to all parents in Washington prior to each American Academy of Pediatrics (AAP) recommended well-child checkup. Working with Common Sense Media and provides smart screen time resources in selected mailings.	All new CHILD Profile materials are tested through focus groups and pretested. In addition, parent satisfaction surveys have been conducted.
<u>Children’s Obesity Action Team (COAT)</u>	COAT offers information and resources for professionals who care for children with overweight and obesity and their families. COAT's web site and toolkits for health care professionals and families include counseling strategies, screen time recommendations, information on the link between screen time and health, and smart screen time strategies.	None
<u>Dairy Council of Washington State</u>	Online and printed catalog of posters, brochures and handouts includes materials on screen time recommendations, the link between screen time and health, and smart screen time strategies for families. The Dairy Council's <i>Think Outside the Box, Think Inside the Bag</i> booklet is included in the 6th year CHILD Profile mailing to all Washington Parents.	None
<u>"Do More, Watch Less"</u>	Targeted towards 10 to 14-year-olds in <u>after school programs</u> and other youth-serving organizations. The sessions aim to help	The tool was based on three research methodologies:

<p>California Obesity Prevention Initiative, California Department of Public Health.</p>	<p>youth incorporate more screen-free activities into their day while reducing the time they spend on screen-based activities such as watching TV, surfing the internet, or playing video games.</p>	<p>segmentation analysis of national data (Youth Styles Survey), “tween” focus groups, and key informant interviews with experts on tweens. The tool was also based on the research of Tom Robinson, MD of Stanford University and was field-tested with, and designed specifically for tweens.</p>
<p>Healthy Kids, Healthy New York After-school Model Guidelines. Funded by the National Governor’s Association</p>	<p>Launched in July 2007. The goal of the initiative is to fight childhood obesity and create healthy <u>after-school</u> environments. The program focuses on three areas – nutrition, physical activity and screen time. The toolkit was designed to help after-school providers easily implement the program.</p>	<p>None</p>
<p>Live and Unplugged Various school boards in Nova Scotia</p>	<p>"Spring into Action" (2-week physical activity campaign for students in grades 4-6) organized by the South Shore and Valley regional offices of Nova Scotia Health Promotion and Protection was recently changed by building a "turn off the screen" component. The focus of the initiative is to both decrease “screen time” such as using a computer, playing video games and watching TV, and increase physical activity time. Registered schools receive a package with information with details of how to participate.</p>	<p>A total of six school boards participated in 2009, with another 2-3 hoping to come on board this coming year. No formal evaluation</p>
<p>Live Outside the Box Alberta Tourism, Parks and Recreation Halton Region Health Department</p>	<p>Media campaign to encourage children and youth to be more active. Website provides information on where to go to get information about being active.</p> <p>Challenge disseminated to school boards once years, during TV turn off week, in a mail-out package format. Health department promoted, created and disseminated information packages and incentive prize packs to all schools that would register for the <i>Challenge</i>. New project was created to change the format to be: physical activity focus only, web-based, year round, easy accessibility.</p>	<p>None</p> <p>New project was evaluated. Most teachers were satisfied with the <i>Challenge</i>. First time challenge participants were more likely than previous participants to prefer the new format.</p>

<u>Seattle & King County</u>	<p>Public education campaign to inform families about the impact of television viewing on kids’ health. Radio public service announcements, a series of posters, and the “Live outside the box” toolkit were developed in English and Spanish to promote activities families can do together instead of watching TV and offer strategies to reduce TV viewing in their homes. Over 5,000 tool kits were distributed. The kit contains: 1) Facts about television and health; 2) A tool to assess how much television families are really watching; 3) A “Live outside the box” challenge to go “No TV for a Week!”; 4) Alternatives to watching television, including 25 indoor activities, 25 outdoor activities; and 5) and fun, easy recipes for families</p>	<p>Limited evaluation results.</p>
<u>Media Smart Youth: Eat, Think and Be Active</u>	<p>Interactive after-school education program for young people ages 11 to 13 is designed to help teach them about the complex media world around them, and how it can affect their health--especially in the areas of nutrition and physical activity. Consists of 10 lessons and a major project that help young people acquire knowledge and skills in four key areas: media awareness, media production, nutrition, physical activity. Facilitator's Guide for curriculum includes a video tape or DVD featuring a program summary and tips for facilitators, plus youth-focused video segments for use in summarizing key concepts for each lesson.</p>	<p><u>Implementation and program outcome evaluation complete.</u></p>
<u>National Turnoff Week</u>	<p>Takes place at the end of April. Weeklong event began in 1994, formerly TV Turnoff Week, and encourages people to turn off their televisions, computers, and electronic games in order to read, create, learn, play and connect with their communities and families.</p>	<p>None</p>
<u>NW Center for Excellence in Media Literacy</u>	<p>Training, activities, and curriculum resources on media literacy for teens, educators, health professionals and other disciplines involved in serving children and youth.</p>	<p>None</p>
<u>Parent Education Course in Child Development</u>	<p>Provides an opportunity to share, discuss, and learn about parenting concerns. Screen time topics include recommendations, health impacts, analyzing media messages, and smart screen time strategies.</p>	<p>None</p>
<u>Pause to Play</u>	<p>Collection of program materials developed by public health units across Ontario for Pause to Play Week (also called No Screens, TV turnoff, Turn off the Screens, Go Outside the Box etc.). Provides a centralized sharing and learning area for PA promoters working on this initiative to minimize duplication, and to facilitate the provincial coordination of Pause to Play Week across Ontario</p>	<p>None</p>

<p><u>We Can! Ways to Enhance Children’s Activity & Nutrition</u></p>	<p>A national education program designed for parents and caregivers to help children 8-13 years old stay at a healthy weight. Offers parents and families tips and fun activities to encourage healthy eating, increase physical activity and reduce sedentary or screen time. Offers community groups and health professionals resources to implement programs and fun activities for parents and youth in communities around the country.</p> <p><i>Wean the Screen</i> is the screen time component of this program that has produced a variety of useful, evidence-based materials and information, including: a screen time log, short articles, curricula and programs, <u>Student Media Awareness to Reduce Television</u>, <u>Media-Smart Youth: Eat, Think, and Be Active!</u>, <u>The We Can! Energize Our Families: Parent Program</u>, Audio News Release</p>	<p>None</p>
<p>Women, Infants and Children (WIC) Healthy Habits</p>	<p>The Healthy Habits project was developed to augment the tools available to WIC in its efforts to promote healthy lifestyles. The purpose of Healthy Habits was to provide training, materials and support to local WIC staff so that staff could more effectively promote healthy behaviours in WIC families and in their communities. As part of the multi-component project, Nutrition education modules were developed and tested with local agencies and community partners to promote family meals or family physical activity. The Healthy Habits bookmarks, handouts, posters and lesson plans include screen time recommendations and strategies for families.</p>	<p>The impact of the Healthy Habits nutrition education modules was assessed using a survey of participants and staff at WIC clinics before and after six months of statewide implementation, statistics on contacts and exposures on a clinic-wide basis, and project summaries prepared by project coordinators at each local agency.</p> <p><u>Healthy Habits Final Report</u></p>

Appendix E: Intervention and Initiative Details

SWITCH

Community component

The *Community Awareness Strategy* consisted of a public education intervention to increase the targeted communities overall awareness and knowledge about preventing childhood obesity. The first phase of the project established a coalition of community leaders to give the project high visibility, and to advocate for and sustain the project. The leadership group included leaders and project grantors from education, health care, government, business and the faith communities (36). Various community wide activities happened throughout the year:

- Community wide event with coalition members and organizations to launch event
- Public service advertising campaign in local newspapers and media outlets.
- Produce/distribute posters to all types of organizations in the participating school district.
- Printed materials in community and private family practice and pediatric clinics.
- Public education/training workshops for parents, teachers, health care providers, religious leaders and business leaders in the community at large.
- Offer employee presentations to employers in the community.
- Add the project web page to granting organizations web sites.
- Provide information to local newspapers for monthly columns and features.
- Solicit local businesses to provide incentives and supporting events throughout the project timeline.
- Switch Days provided students and families with opportunities to engage in community activities centered around project goals. (i.e. Swimming, scavenger hunt at local grocery store, roller skating)
- Provide public education to existing groups of parents, educators, school boards, etc.
- Four hundred randomly selected households in each community were surveyed to ascertain their baseline awareness of the key messages that were included in the community awareness strategies. At the end of the project, a second random set of 400 households were surveyed to measure changes in awareness and/or behaviours in response to the project strategies at the community level.

School component

The *School Strategy* was a targeted intervention for children in grades 3 through 5 (and their parents or families). Schools provided a focused population and environment to exchange information, reinforce positive behaviours in both parents and children, and gather data. Incentive packages for each school and the participating grades were agreed upon. An orientation for teachers and parent volunteers occurred and a school-wide kick-off event was held in participating schools as part of the community wide awareness week. Families were sent a letter of information about the study and included a parental consent form. The classroom served as one channel for reaching the families and maintaining the Switch message. Teachers were also provided with a monthly teacher's packet which included: posters for the classroom; bulletin board ideas; activity/puzzle handouts for children to do during free time in classroom;

a copy of the monthly calendar sent to families. Again, although we provided teachers with examples of curricula integration it was up to the teacher to integrate the ideas into their classroom.

Family component

The goal of the family-involvement component was to introduce the child and the adult caregivers to the SWITCH intervention and to assist them in creating a supportive environment for healthy behaviours. The family component is essential in the development of an environment that supports children's efforts to implement changes in their food choices and levels of physical activity and screen time. To accomplish these goals, the family component consisted of monthly packets which included new materials each month for both the child and the parents. Among the materials included were: a printed brochure describing the project and highlighting the timeline; a printed calendar for the month to help motivate and remind parents about their progress on screen time, activity and nutrition goals designed to easily track each goal; a packet of screen time tickets for the child/parent to track screen time; an activity jar with tips for increasing physical activity; a screen time box with tickets to track the amount of screen time; a meal planner which the families could plan meals and make a grocery list; and recipes that primarily focused on increasing fruits and vegetables in creative and enticing ways that interested children were also provided. Also provided families with *SWITCH* trackers which allowed families to track their Do, View, and Chew goals on a daily basis over the 8 months.

SMART

The more frequent and intensive activities delivered at the beginning of the intervention focused on maximizing attention and motivation for participating in early mastery experiences. This was followed by a combination of brief, regularly scheduled reinforcing activities and moderately intensive, intermittently scheduled activities over the rest of the year to promote self-efficacy for maintaining changes or reinstating lapsed behaviours (32).

Teacher preparation consisted of a 3-hour group curriculum orientation session with all classroom teachers. Four regular classroom teachers taught all classroom lessons, but the research assistant prepared materials and provided ongoing advice and feedback to facilitate implementation.

TV awareness. Five lessons included self-monitoring exercises, in-class reporting and self-identifying activities they liked to do when not watching television, reading a story about TV taking over a child's life, and inventing individualized endings to model potential outcomes and stimulate children to form their own outcome expectations for reducing screen time, and a lesson "The world really wants to know: Are American kids addicted to TV?" to excite the students about participating in their own scientific "experiment" and the challenge of the upcoming TV Turnoff to boost intrinsic motivation. These lessons helped children form expectations regarding anticipated positive and negative outcomes of either maintaining current levels of screen time or reducing their screen time.

The TV Turnoff. These five lessons occurred during a 10-day TV Turnoff where children attempted to watch no television or videotapes and play no video games for 10 days. This included an excitement-filled "kick-off ceremony," in which children assembled and committed to take the challenge of the 10-day TV Turnoff. Subsequent lessons included role-plays of specific tough situations to build perceived self-efficacy, drawing their own "portrait of a TV Junkie" to reinforce negative expected outcomes of excessive screen time, and a "closing ceremony" where school officials and community leaders acknowledged the students for trying and/or succeeding in meeting the 10-day TV-Turnoff challenge.

Staying in control. The next four lessons helped children set and adhere to a more modest goal of 7 hours per week of media use. To promote perceived choice and control among children, we recommended that teachers guide their students into coming up with the 7 hours per week budget, “by themselves.” All classrooms did choose 7 hours for their goal budget. Students also learned about and received the TV Allowance, which is a set-top electronic television time manager that monitors and controls television use with a personal identification number (PIN) for each member of the family. The TV Allowance allows parents to set weekly time budgets for their children, and also can block use during certain times of the day or week. Because it controls electrical power to the TV set, it also controls VCR and video game use. When a child’s weekly budget expires, the television set turns off and cannot be turned on again with his/her PIN until the budget replenishes at the beginning of the following week. This section of the curriculum also introduced an incentive system for children who maintained their weekly media-use budget. Every Friday during the intervention, there was a 5- to 10-minute “SMART Talk,” when children reported their successes and received peer recognition for turning in a “SMART Slip.” The SMART Slip was a form signed by parents, confirming that the child adhered to his or her budget over the past week. Thus, the weekly SMART Slips produced opportunities for parental awareness and reinforcement of goals and achievements by their children. The SMART Talks created a classroom environment of teacher and peer recognition and social support for achievement of goals.

Helping others. After several months of using the TV Allowance and engaging in “SMART Talks,” four more lessons occurred which intended to (a) support children’s positive attitudes about reducing time spent using media, (b) reinforce children’s perceived self-efficacy for the skills they were engaging in, and (c) help motivate children to maintain their behaviour changes. Advocacy to help peers was thought to be a highly motivating activity for school age children. Students were enlisted to help third- graders at another school overcome their “addictions” to television, videotapes, and video games. Children wrote two-paragraph letters to the other students to persuade them to reduce their screen time and tell them which methods work best. Children then read out the letters to their own classmates before they were mailed. Children also painted a mural to publicly display all the fun things they found themselves doing (and planned to do) because of their reduced screen time.

SWITCH-Play

Behavioural Modification Condition

The BM condition aimed to reduce the time spent on TV viewing by 20% (e.g. from 2.5 to 2 hours/day) (33-35). The BM intervention comprised 19 sessions of 40–50 min duration taught across three school terms by the intervention specialist teacher.

- 1, 2 and 4 aimed to increase children’s awareness of time-use, including time spent watching TV, playing electronic games, using the computer and being physically active. Health benefits of physical activity were also covered.
- 3 and 5 involved the children self-monitoring the time they spent in sedentary behaviours (TV viewing, electronic games and computer use) and physical activity, respectively.
- 6 and 7 raised children’s awareness of the home and community environments in relation to their sedentary and physical activity choices and opportunities, through map drawing and photographic techniques.
- 8 involved teaching the children decision-making skills, such as weighing up the positives and negatives of choosing between being active or sedentary in a variety of different scenarios.

- 9 and 10, the children developed their own physical activities and games in which they could participate as an alternative to being sedentary.
- 11 involved teaching children about ‘intelligent viewing’, where the child selects the TV programmes that he/she wants to watch and limits viewing to those programmes. This is to encourage children to engage in selective, rather than ‘vegetative’ viewing or channel surfing.
- Children were given their first ‘Switch-off Challenge’ that involved completing and signing a contract pledging to switch off one TV programme per week over the next 4 weeks.
- 12 focus was on increasing children’s awareness of the purpose of advertisements on TV.
- 13 to 16 focused on advocacy, with children writing their own scripts, performing plays and designing posters about choices to be active or sedentary based on real life situations
- 17 reinforced the children’s awareness of their physical activity through the use of pedometers. Each child wore a pedometer for the whole lesson and walked to various destinations in the school grounds
- 18, children participated in the ‘Switch-Play Games’ with all the other BM classes in the school. The children participated in physical activities that they could easily perform at home on their own, or with friends or siblings using inexpensive equipment or recycled items
- 19, the children presented their advocacy posters to children in the younger grades

Fundamental motor skills condition

The FMS intervention comprised 19 sessions of 40–50 min duration taught across three school terms by the same intervention specialist teacher that delivered the BM intervention. The FMS intervention focused on six skills, including three object control skills(overhand throw, kick and strike) and three loco motor skills (run, dodge and vertical jump). The skills were taught with an emphasis on fun through games and maximum involvement for all the children. Most lessons focused on at least two skills, and each skill was a focus lesson in at least six or more sessions.

Unplugged and Media Savvy

This intervention includes the following initiatives (37):

- *30 Days Live!*, a program in which students journal as they give up television for a month as a class
- a media literacy curriculum based on a teacher-driven developmental model derived from previous work with other children’s health issues
- family education based on family goals for student success
- A school wide introduction to the importance of reducing the impact of screen time and media exposure and a celebration of Turn off the TV Week
- a school-wide focus on policy change for food marketing and the use of TV and video at school