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until November 1, 2016

Aller de l'avant.

Interventions en milieu scolaire pour réduire l'inactivité physique et la sédentarité

Aperçu

- Seuls 9 % des enfants et des jeunes Canadiens âgés de 5 à 17 ans respectent la directive des 60 minutes d'activité physique modérée à vigoureuse par jour au moins six jours par semaine.
- Le milieu scolaire est un cadre idéal pour mener des interventions destinées à accroître l'activité physique et à lutter contre la sédentarité chez les enfants et les jeunes.
- Les ajouts au programme scolaire, les pauses durant les activités en classe, les modifications du milieu et la promotion de modes de transport actifs figurent parmi les interventions possibles.
- Des interventions globales et soutenues donnent parfois les meilleurs résultats à long terme.

Une version anglaise exhaustive de cette publication suit ce résumé en français.

RÉSUMÉ NOVEMBRE 2016

Résumé

Durant la majorité de leurs heures de veille, les enfants et les jeunes Canadiens âgés de 5 à 17 ans sont sédentaires et physiquement inactifs. Cela tient en partie à une évolution culturelle et sociétale des comportements qui fait que les jeunes sont maintenant assis la majeure partie de la journée.

Seuls 9 % des enfants et des jeunes Canadiens âgés de 5 à 17 ans font les 60 minutes recommandées d'activité physique modérée à vigoureuse par jour au moins six jours par semaine. Plus alarmant encore : la quantité de temps libre qu'ils passent assis devant un écran et qui dépasse largement les deux heures maximum par jour recommandées. Cette baisse de l'activité physique (AP) et l'accroissement de la sédentarité sont associés à une hausse de la prévalence de l'embonpoint et de l'obésité, ainsi qu'à un risque élevé de maladies chroniques plus tard dans la vie. Il est par conséquent impératif d'accroître les niveaux d'activité physique des enfants et de réduire leur sédentarité.

Le milieu scolaire offre une possibilité unique de changer les comportements liés à la santé, car les enfants et les jeunes passent à l'école une bonne partie de leurs heures de veille pendant 10 mois de l'année. Dans le cadre de ce rapport, nous avons examiné les interventions en milieu scolaire qui permettent de réduire la sédentarité ou d'accroître l'AP. Ces interventions ont été évaluées à différents égards : adaptabilité, rentabilité, faisabilité, possibilité de toucher le public cible et acceptabilité pour les enfants, les jeunes et les intervenants.

Il ressort d'une analyse documentaire que les interventions en milieu scolaire destinées à accroître l'AP se classent en cinq grandes catégories : programme d'éducation physique (EP), pauses durant les activités en classe, modes de transport actifs pour se rendre à l'école et en revenir, terrains de jeu modifiés ou une combinaison de ces approches. Les interventions en milieu scolaire destinées à lutter contre

la sédentarité peuvent se classer en interventions visant à réduire le temps passé assis devant un écran (principalement en dehors des heures de classe) et celles visant à réduire le temps passé assis, mais pas devant un écran (principalement en classe). Selon les conclusions de notre étude, les interventions les plus efficaces et les plus rentables pour les écoles – indépendamment de la taille, des ressources ou des caractéristiques démographiques des établissements – consistent à intégrer des programmes dans le cursus scolaire existant, notamment des matières différentes de l'éducation physique, ainsi que des pauses dans les activités prévues pendant les heures de cours.

Le réaménagement des salles de classe ou des terrains de jeu, quoiqu'efficace à court terme, peut se révéler coûteux ou moins efficace à long terme. Les interventions auxquelles participent les parents d'élèves ou leurs accompagnateurs, de même que celles qui comprennent un volet de formation des enseignants et confèrent plus de flexibilité dans la réalisation sont susceptibles d'être mieux adoptées et acceptées, tout en ayant une plus grande portée. Cependant, les décideurs doivent tenir compte des différences de taille, de capacités, de ressources et de caractéristiques démographiques dans leurs propres milieux scolaires lorsqu'ils choisissent, conçoivent ou adaptent une intervention à mettre en œuvre.

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Moving Ahead.

School-Based Interventions to Reduce Physical Inactivity and Sedentary Behaviour

REPORT NOVEMBER 2016

Moving Ahead: School-Based Interventions to Reduce Physical Inactivity and Sedentary Behaviour

Novella Martinello, Jenny Santos, and Jessica Brichta

Preface

Decreasing physical activity and increasing sedentary behaviour levels are associated with a rise in overweight and obesity prevalence as well as an elevated risk of chronic diseases later in life. The school setting offers a unique opportunity to help increase physical activity levels and reduce sedentary behaviour in Canadian children and youth.

This report identifies cost-effective and cost-efficient program characteristics, and evaluates school-based interventions based on their scalability, cost-effectiveness, feasibility, acceptability to children and youth and those delivering the intervention, and their potential to reach the target audience.

To cite this report: Martinello, Novella, Jenny Santos, and Jessica Brichta. *Moving Ahead: School-Based Interventions to Reduce Physical Inactivity and Sedentary Behaviour*. Ottawa: The Conference Board of Canada, 2016.

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Acknowledgements

This report was researched and written by The Conference Board of Canada's Novella Martinello, Jenny Santos, and Jessica Brichta.

The authors would like to thank the Conference Board's Abhi Bhandari, and Schwab Bakombo, for their assistance with the literature review, as well as the research team at the Healthy Active Living and Obesity Research Institute at the Children's Hospital of Eastern Ontario (CHEO) Research Institute for its research support. The authors would also like to thank the Conference Board's Carole Stonebridge, for the internal review, as well as the following expert advisors and external reviewers:

- Dr. John C. Spence, Associate Dean (Research) of the Sedentary Living Laboratory in the Faculty of Physical Education and Recreation, University of Alberta;
- Dr. Mark Tremblay, Director of the Healthy Active Living and Obesity Research Group, Children's Hospital of Eastern Ontario;
- Dr. Ian Janssen, Canada Research Chair in Physical Activity and Obesity, Queen's University;
- Katherine Janson, Director of Communications and Public Affairs, ParticipACTION;
- Jessica Jaques, Consultant, Manitoba Health, Seniors and Active Living;
- Rick Varden, Health and Physical Education/Social Sciences Department Head and Athletic Director, Sir Wilfrid Laurier Secondary School, Ottawa, Ontario.

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EXECUTIVE SUMMARY

Moving Ahead: School-Based Interventions to Reduce Physical Inactivity and Sedentary Behaviour

At a Glance

- Only 9 per cent of Canadian children and youth aged 5 to 17 get the recommended 60 minutes of moderate to vigorous physical activity per day at least six days a week.
- The school environment is an ideal setting to deliver interventions to increase physical activity and reduce sedentary behaviour among children and youth.
- Examples of interventions include additions to the curriculum, classroom activity breaks, environmental modifications, and promotion of active transportation.
- Comprehensive and sustained interventions may bring the greatest benefits in the long term.

The school setting offers a unique opportunity to change health behaviour.

Canadian children and youth aged 5 to 17 spend most of their waking hours being sedentary and physically inactive. This is due in part to a cultural and societal shift in routine behaviours, so that young people now sit for much of the day.

Only about 9 per cent of children and youth get the recommended 60 minutes of moderate to vigorous physical activity (MVPA) at least six days a week. More alarming is the increasing amount of leisure time they spend sitting in front of a screen, which well exceeds the recommended maximum of two hours per day. This decrease in physical activity (PA) and increase in sedentary behaviour (SB) are associated with a rise in overweight and obesity prevalence, as well as an elevated risk of chronic diseases later in life. Therefore, it is imperative that children increase their levels of physical activity and reduce the time they spend being sedentary.

The school setting offers a unique opportunity to change health behaviour, since children and youth spend a good portion of their waking hours over 10 months of the year in this setting. For this report, we reviewed school-based interventions that have been effective in reducing SB and/or increasing PA. These interventions were evaluated for their scalability, cost-effectiveness, feasibility, potential to reach the target audience, and acceptability to children, youth, and those delivering the intervention.

A literature review found that school-based interventions designed to increase PA fell into five broad categories: physical education (PE) curriculum, classroom activity breaks, active commuting to school, modified playgrounds, or a combination of these approaches. School-based interventions to reduce SB can be categorized as those aiming to reduce screen time while sitting (primarily outside of classroom hours) and those aiming to reduce non-screen sitting times (primarily in the classroom). This research found that the most effective and cost-efficient interventions for schools—regardless of a school's size, resources, or population characteristics—include programs that are integrated into the existing school curriculum, including subjects besides physical education, as well as activity breaks embedded into class time.

Modifying classroom or playground environments, while effective in the short term, may be costly or less effective over the long term. Interventions that involve the students' parents or caregivers of students, include a teacher-training component, and allow for flexibility in delivery may have better adoption, acceptance, and reach. Nevertheless, policy-makers must consider the varying sizes, capacities, resources, and demographics of their own school environments when choosing, designing, or adjusting an intervention for implementation.

CHAPTER 1

Introduction

Chapter Summary

- Physical inactivity and sedentary behaviour are linked to many chronic conditions, such as diabetes, heart disease, other cardiovascular and metabolic conditions, and cancer.
- Children and youth between the ages of 5 and 17 spend an average of nine hours—or 64 per cent of their waking hours—being sedentary every day, and almost one-third of today's children and youth are overweight or obese.
- Since children and youth spend most of their waking time at school, the school environment can help promote and provide opportunities for increased physical activity and decreased sedentary time.
- To address physical inactivity and sedentary behaviour on a large scale, interventions need to be practical and cost-effective, appeal to a variety of delivery agencies (including public health agencies, workplaces, schools, and health care institutions), and be consistent with strategic targets or objectives set by governments and other decision-makers.

Moving Ahead: Healthy Active Living in Canada Series

As part of The Conference Board of Canada's Canadian Alliance for Sustainable Health Care (CASHC) research series Moving Ahead: Healthy Active Living in Canada, this report identifies effective and sustainable interventions that promote healthy active living among children and youth in a school setting.

Previous research in this series includes a primer document[1] that provides an overview of the relationship between modifiable lifestyle risk factors and chronic conditions, and lays the groundwork for the overall series. The first phase of this healthy active living research focused on both physical activity (PA) and sedentary behaviour (SB).[2] PA is "any bodily movement produced by skeletal muscles that requires energy expenditure above the basal level."[3] Physical activities can range in intensity from light to vigorous and can be categorized as leisure, occupation, household, or transport. Physical inactivity is often defined as not meeting PA guidelines.[4] SB, although sometimes confused with physical inactivity, is a distinct class of behaviour defined by little physical movement and low energy expenditure—usually done while sitting, watching television, or playing video games.[5,6]

1 Dinh, *Moving Ahead: Making the Case for Healthy Active Living in Canada*.

2 Additional reports in the series include Bounajm, Dinh, and Thériault, *Moving Ahead: The Economic Impact of Reducing Physical Inactivity and Sedentary Behaviour*; Spence and Dinh, *Moving Ahead: Taking Steps to Reduce Physical Inactivity and Sedentary Behaviour*; and Chenier, *Moving Ahead: Workplace Interventions to Reduce Physical Inactivity and Sedentary Behaviour*.

3 U.S. Department of Health and Human Services, *Physical Activity and Health*.

4 Tremblay, "Letter to the Editor."

5 Canadian Society for Exercise Physiology, *Canadian Physical Activity Guidelines*, 2015.

6 Tremblay, "Letter to the Editor."

Today, almost one-third of children and youth are overweight or obese.

In the first research briefing of the series, The Conference Board of Canada offered an economic perspective on the health and economic benefits at the population level of improving PA and reducing SB. It reported that low levels of PA and high levels of SB in the adult Canadian population could have significant cost implications for the health care system, employers, and the economy. The briefing estimated that if just 10 per cent of Canadians who currently have suboptimal levels of PA and SB moved more and sat less, there could be cumulative estimated cost savings to the health care system of $2.6 billion by the year 2040 and a $1.6-billion boost to Canada's gross domestic product (GDP) over this time frame.[7]

Physical Inactivity and Sedentary Behaviour Among Children and Youth

"Children" and "youth" are those people aged 5 to 17 years, and are otherwise identified as "school-aged." Today, almost one-third of children and youth are overweight or obese.[8] Physical inactivity and SB, in this age group and across the lifespan, are linked to many chronic conditions, including diabetes, heart disease, other cardiovascular and metabolic conditions, and cancer.[9] Despite these health risks, levels of PA among children and youth remain low. Canadian children received a "D-" on this year's ParticipACTION Report Card on Physical Activity for Children and Youth, as only 4 per cent of girls and 9 per cent of boys accumulated 60 minutes of moderate to vigorous physical activity (MVPA) at least six days a week.[10] This report card essentially shows no change in PA levels in comparison to the previous year.[11]

7 Bounajm, Dinh, and Thériault, *Moving Ahead: The Economic Impact of Reducing Physical Inactivity and Sedentary Behaviour*.

8 Roberts and others, "Overweight and Obesity in Children and Adolescents."

9 Dinh, *Moving Ahead: Making the Case*.

10 ParticipACTION, *The 2016 ParticipACTION Report Card on Physical Activity for Children and Youth*.

11 ParticipACTION, *The 2015 ParticipACTION Report Card on Physical Activity for Children and Youth*.

The Canadian Society for Exercise Physiology (CSEP) guidelines for PA and SB recommend that children and youth aged 5 to 17 participate in at least 60 minutes of MVPA daily and that time spent being sedentary—specifically, recreational screen time—should be limited to no more than two hours per day.[12] CSEP and the Public Health Agency of Canada (PHAC) have identified SB as an important issue that is distinct from physical inactivity.[13] Unfortunately, data show that children and youth between the ages of 5 and 17 spend an average of nine hours—or 64 per cent of their waking hours—being sedentary every day.[14]

School as a Setting for Intervention

Taking a sub-populations and settings approach to interventions can have the greatest impact on reducing physical inactivity and SB at the population level. Schools, particularly elementary and high schools, are places where children and youth spend a significant amount of time, making them prime locations for intervention.

The World Health Organization's (WHO's) Global Strategy on Diet, Physical Activity, and Health identifies schools as a target setting for promoting PA among children and youth.[15] WHO defines school health interventions as a combination of curriculum development, educational policy and guideline development, and professional training opportunities for educators, as well as research, evaluation, and knowledge transfer for evidence-based policies, programs, and practices.[16]

12 Canadian Society for Exercise Physiology, *Canadian Physical Activity Guidelines*, 2015.

13 Tremblay and others, "Systematic Review of Sedentary Behaviour and Health Indicators in School-Aged Children and Youth."

14 Statistics Canada, *Directly Measured Physical Activity of Canadian Children and Youth, 2007 to 2011*.

15 World Health Organization, *Global Strategy on Diet, Physical Activity, and Health*.

16 Ibid.

Regular PA in adolescence can reduce the odds of becoming overweight in adulthood.

Creating a lifestyle that includes regular PA is the best strategy for improving the long-term health of children and adolescents.[17] Research has shown that youth PA participation declines with age[18] but that regular PA in adolescence can reduce the odds of becoming overweight in adulthood.[19] In addition, an active lifestyle contributes to more than just physical health among children and youth—it also helps decrease dropout rates and improve classroom and on-task behaviour, self-esteem, and overall classroom engagement.[20,21] Embedding opportunities for PA in school curricula increases reach and can benefit at-risk children (e.g., those of lower socio-economic status). It is, therefore, imperative to identify effective approaches to increase PA and reduce SB in the school setting.

Criteria for Selecting Interventions

The second briefing in CASHC's Healthy Active Living in Canada series, *Moving Ahead: Taking Steps to Reduce Physical Inactivity and Sedentary Behaviour*, outlines planning strategies and program criteria that decision-makers can use to promote PA and discourage excessive SB.[22] To be considered effective, a program or policy must have demonstrated some impact during rigorous research trials, and it must clearly show how practitioners can adopt, adapt, and implement it in different settings for various populations.

17 Telama and others, "Physical Activity From Childhood to Adulthood."

18 Centers for Disease Control and Prevention, "Youth Risk Behavior Surveillance—United States, 2008."

19 Menschik and others, "Adolescent Physical Activities as Predictors of Young Adult Weight."

20 Mahar and others, "Effects of a Classroom-Based Program on Physical Activity and On-Task Behavior."

21 Trudeau and Shephard, "Physical Education, School Physical Activity, School Sports and Academic Performance."

22 Spence and Dinh, *Moving Ahead: Taking Steps*.

To address physical inactivity and SB on a large scale (in other words, to be "scaled up"[23]), interventions need to be practical and cost-effective, appeal to a variety of delivery agencies (including public health agencies, workplaces, schools, and health care institutions), and be consistent with strategic targets or objectives set by governments and other decision-makers. Overall, the efficacy of interventions to increase PA has been well-established.[24] For example, interventions that use frequent short activity breaks to interrupt extended periods of sitting have improved cardio-metabolic health markers.[25,26]

Since children and youth spend most of their waking time at school, the school environment can play an important role in promoting and providing opportunities for increased PA and decreased SB.[27] One of the foundational *Moving Ahead* series briefings[28] lays out criteria that can be used when designing and selecting interventions to increase PA and reduce SB in different settings and populations. These criteria suggest that interventions must be scalable for a wider population to achieve maximum impact.[29] Potential for scale-up is affected by a number of factors, including acceptability, feasibility, reach potential, and adoption willingness among key stakeholders.

The acceptability and feasibility of an intervention relate to how useful individuals delivering the intervention believe it to be and how effectively they think it can be implemented, given cost and resource pressures. In schools, most of these individuals will be educators and school administrators. Reach reflects the engagement of the target

23 Interventions are "scaled up" when they are implemented among a broader population. See Milat and others, "The Concept of Scalability."

24 Hillsdon, Foster, and Thorogood, "Interventions for Promoting Physical Activity."

25 Peddie and others, "Breaking Prolonged Sitting Reduces Postprandial Glycemia in Healthy, Normal-Weight Adults."

26 Dunstan and others, "Breaking Up Prolonged Sitting Reduces Postprandial Glucose and Insulin Responses."

27 Pate and others, "Promoting Physical Activity in Children and Youth."

28 Spence and Dinh, *Moving Ahead: Taking Steps*.

29 Milat and others, "The Concept of Scalability."

population—in this case, the students involved in the intervention. Adoption willingness is an analogue to acceptability and feasibility, from an organizational perspective.

Research Aims and Approach

Objectives

Based on a literature review, this research aims to identify effective school-based interventions for children and youth that have been or can be leveraged to increase PA and reduce SB. Further, this report aims to present recommendations for action based on this evidence.

Methodology

Two researchers independently reviewed peer-reviewed studies—mainly systematic reviews and meta-analyses—to identify effective interventions aimed at increasing PA and reducing SB among children and youth in a school setting. The researchers retrieved systematic reviews and meta-analyses from a set of articles identified in a comprehensive search conducted by the Children's Hospital of Eastern Ontario's (CHEO's) Healthy Active Living and Obesity (HALO) Research Group in Ottawa for its work on the "Canadian 24-Hour Movement Guidelines for Children and Youth."[30] The first phase of screening consisted of a scan of article titles for those related to the research objective. The researchers considered abstracts if inclusion was not immediately obvious from the title alone. All articles identified as potentially relevant in this screening were then obtained for detailed review, and irrelevant articles were excluded. A limitation of this process is that The Conference Board of Canada used a rapid review approach. As a result, the researchers may have missed some relevant studies. Only selected studies were included in this report, with priority given to systematic reviews and experimental studies.

30 Tremblay and others, "Canadian 24-Hour Movement Guidelines for Children and Youth."

Retained systematic reviews and meta-analyses were used to locate high-quality and recent (within the last 10 years, and preferably within the last five years) randomized controlled trials. Data from these randomized controlled trial studies were summarized in tables related to the selection criteria for effective interventions identified in the previous briefing,[31] including scalability, effectiveness, cost-effectiveness, acceptability, feasibility, reach, and adoption. One researcher reviewed the literature for school-based PA interventions and the other reviewed the literature for school-based SB interventions.

Two researchers independently put essential information from all selected studies related to the selection criteria into summary tables. They then rated the interventions, based on the information in the studies, on their ability to adequately meet each of the selection criteria on a scale from 1 to 5. On that scale, 1 characterized an intervention that was unlikely to meet the selection criteria in a real-world application and 5 characterized an intervention that was very likely to meet the selection criteria. The researchers assigned a rating of "unknown" if they could find no information about a particular selection criterion. One of the limitations of this rating approach is that it is subjective and has not been tested for validity or reliability, although the use of two researchers to independently extract and rate interventions was meant to help reduce bias. Where their ratings differed, the two researchers discussed them and tried to reach a consensus. When they could not reach a consensus, a third researcher helped make a final decision on the rating(s). These findings were synthesized and described in narrative format and summary tables.

Eleven PA studies and nine SB studies were included in this review. Eight of the PA studies were randomized controlled trials (RCTs), two were cluster RCTs, and one was another type of experimental study.

31 Spence and Dinh, *Moving Ahead: Taking Steps*.

Only selected studies were included in this report.

Five of the PA studies were from the U.S., two were from the U.K., and the remaining were from Canada, Switzerland, Belgium, and Australia. Eight of the SB studies were RCTs and one was a cluster RCT. Two of the SB studies were done in the U.S., one in both the U.S. and the U.K., and one in both the U.K. and Australia. The remaining studies were from Australia, New Zealand, Finland, and Germany.

CHAPTER 2

School-Based Interventions

Chapter Summary

- This chapter highlights 11 types of school-based physical activity interventions and 9 effective interventions targeting sedentary behaviour.
- Although physical education and activity policies differ greatly across Canada, they promote daily physical activity among children and youth by enhancing physical activity levels and providing the required skills and knowledge.
- Interventions integrated into physical education curricula, classroom activity breaks, active commuting to school, modified playgrounds, and comprehensive approaches have increased physical activity levels in schools diverse in size, resources, and population characteristics.
- Flexibility in delivery and implementation allows schools of varying capacities and resources to effectively implement interventions. Consideration should also be given to the Canadian context.

Physical activity (PA) interventions fall into five broad categories: physical education (PE) curriculum, classroom activity breaks, active commuting to school, modified playgrounds, and comprehensive approaches that combine these approaches. (See "The Four Pillars of Comprehensive School Health.") Sedentary behaviour (SB) interventions aim to reduce either screen time or non-screen sitting time. These categories and their interventions are described in more detail in the subsequent sections.

The Four Pillars of Comprehensive School Health

The Pan-Canadian Joint Consortium for School Health outlines four separate but connected pillars that enable students to be healthy and productive learners, creating comprehensive school health.[1]

1. **Teaching and Learning:** This pillar involves supporting student and teacher training via existing resources, activities, and provincial/territorial curricula. Resources and activities should revolve around further developing school health policies and guidelines, including a culturally relevant context, and optimizing the use of school and community assets. Training gives students age-appropriate knowledge—building skills that improve their health, well-being, and learning outcomes—while teachers become more qualified to identify and address student PA needs.
2. **Social and Physical Environment:** The social environment includes the relationships and interactions among educators and students. It also extends beyond the school setting to include relationships among students, their families, and the greater community. It is an essential consideration for comprehensive school health plans, as the social environment shapes the emotional well-being

1 Pan-Canadian Joint Consortium for School Health, *What Is Comprehensive School Health?*

of children and adolescents. The physical environment includes—but is not limited to—the buildings, playgrounds, and equipment within school boundaries and in surrounding areas. It also includes basic amenities, such as sanitation, air cleanliness, access to healthy food (in vending machines or school cafeterias), and other spaces designed to promote student connectedness and decrease the risk of injury.

3. **Partnerships and Services:** Partnerships between the school and students' families create essential links for student achievement and well-being. They also enhance the range of services, supports, and opportunities for students, parents, and educators. Partnerships could also be developed between schools and with other community groups or sectors (e.g., public health). Service examples could include product or labour donations toward a school garden or lunch program, or contracts with fruit and vegetable growers for school fundraising programs.
4. **Healthy School Policy:** This pillar includes management processes that govern rules, policies, and guidelines promoting student wellness and achievement. Policies also aim to create a respectful, welcoming, and caring school environment.

Our systematic review search revealed 11 types of school-based PA interventions. Table 1 summarizes these interventions, describing each intervention, providing context (including population and location), listing measures of effectiveness and cost-effectiveness, and providing effective intervention selection criteria ratings. (See "Interpretation of Intervention Selection Criteria.") Our search also revealed nine effective school-based interventions aimed at reducing SB. (See Table 2.)

Interpretation of Intervention Selection Criteria

Adaptability is a critical aspect of any intervention program. An effective intervention is "scalable" if it can be implemented on a large scale. People must be able to adapt and change the program based on the health needs of the children and youth in a given school and community. Whether an intervention is adaptable (or scalable) depends heavily on other intervention selection criteria, including feasibility, acceptability, reach, and adoption.

Feasibility refers to the extent to which an intervention can be implemented with the available resources. Available resources could include monetary resources, human resources, or other items, such as materials and equipment.

Acceptability refers to the program's relevance to those delivering it. Delivery agents could include teachers, those associated with the school, or other stakeholders in the community.

Reach refers to the extent to which people are willing to participate in the intervention and how representative those willing individuals are of the target population (e.g., children and youth in the given community).

Adoption is the extent to which settings and delivery organizations are willing to initiate the program. In addition to individuals being willing, schools in the given community—as well as other organizations, such as community partners or equipment providers—need to be on board. For example, municipalities may need to partner with schools to provide facilities, such as access to a community pool.

Source: Spence and Dinh, *Moving Ahead: Taking Steps*.

Table 1
Summary of Physical Activity Interventions and Ratings
(scale from 1 to 5 or "?" if unknown or unclear)

Intervention	Context	Effectiveness/effect size	Cost or cost-effectiveness	Adaptability	Feasibility	Acceptability	Reach	Adoption
Fit-4-Fun: Eight-week health-promoting school curriculum program, home activity program, and daily break-time activity program[1]	Grades 5 and 6 students in Australia	"Intervention effects were evident in cardio-respiratory fitness (adjusted mean difference=+1.14 levels, p- value (p)<0.0001), body composition (BMI, -0.96 kg/m2, p<0.0001), flexibility (sit and reach mean, 1.52 cm, p=0.0013), muscular fitness sit-up, (0.62 stages, p=0.003), and physical activity (3,253 steps/day, p<0.001)."	Seems to require few resources as it is based on existing curriculum. Would need resources for development of materials.	3	3	4	4	3
Playground redesign using playground markings and physical structures[2]	Elementary schoolchildren in the U.K.	VPA increased. Intervention effect still apparent at 6 months but not at 12 months (95% confidence interval (CI)=0.1-2.7, p<-0.5). As age increased, PA during recess decreased.	May be low-cost approach; however, may not be ideal over the long term. Schools each received £20,000 for intervention.	2	2	?	?	2
SPARK: Physical education curriculum, behavioural self-management curriculum to promote PA outside of school, and extensive teacher training and support[3]	Elementary schools across the U.S.	Physical activity during PE, motor skill development, academic achievement, adiposity, and student enjoyment all improved.	Cost unknown; however, SPARK website offers funding and grant opportunities to interested schools.	5	4	5	5	5
Active and Safe Routes to School (includes several programs, such as School Travel Planning and a Walking School Bus program)[4]	Elementary schools across Canada	Increased physical activity with a 1.3% increase in walking and cycling to and from school.	A relatively low-cost intervention with an average cost per student of approximately $124 and benefits per student of $221 over 11 years.	4	4	5	5	5
KISS: Two physical education lessons (45 minutes each) taught by PE teachers (in addition to three regular PE lessons per week taught by teachers), three to five short activity breaks each day during class, and 10 minutes daily of PA homework[5]	Grades 1 to 5 students in Switzerland	Increased PA (Cohen's d=0.35) and aerobic fitness levels (z-score=0.373, 95% CI=0.157-0.590, p=0.001).	Unknown.	3	2	?	2	2
Accumulated brisk walking program during school time: 15 minutes in the morning and 15 minutes in the afternoon at least three times per week (90 minutes per week) over a 15-week intervention period[6]	5- to 11-year-olds in England	Significant reduction in body fat percentage and significant increase in mean daily PA (95% CI=89.3-183.9, z-score=4.085, p=0.000).	Low-cost intervention.	3	2	?	3	3
CATCH: At least 90 minutes of PE per week spread out over at least three sessions per week; teachers were taught to use appropriate teaching methods and model enthusiasm for an active lifestyle[7]	Grade 3 students in Texas	"Increased MVPA. VPA rate of increase for girls in CATCH schools was significantly lower (2%) than the rate for control girls (13%) (similar pattern for boys p≤0.05)."	CATCH schools received $3,500 for the first year, $2,500 for the second year, $1,500 for the third year, and $1,000 for the fourth year.	5	4	5	5	5
PAAC: Promoted 90 minutes per week of MVPA active academic lessons delivered intermittently throughout the day[8]	Grades 2 and 3 students in Kansas	"Increased PA (8%>, p=0.05) and MVPA (≥4 MET11). Schools with >75 minutes showed a significantly lower increase in BMI at three years versus schools that had <75 minutes of PA."	PAAC was designed to be a low-burden, minimal-cost intervention that would not decrease academic instruction time nor increase teacher preparation time.	5	5	5	5	5
M-SPAN: PE intervention consisted of teacher development sessions where staff members received sample materials and modelling/group rehearsing, peer feedback, and help in setting goals for active and health-related PE classes[9]	Grades 6 to 8 students in Southern California	"Intervention significantly improved the time students spent in MVPA by approximately three minutes or less (p=0.02). By year 2, intervention schools increased MVPA by 18%. Effect sizes were greater for boys (d=0.98; large) than girls (d=0.68; medium)."	Unknown.	4	5	5	5	5
Walking School Bus[10]	Grade 4 students in Texas	Increased both their weekly percentage of active commuting (mean +SD) from 23.8% ± 9.2% (time 1) to 54% ± 9.2% (time 2) p<0.0001) and daily minutes of MVPA from 46.6 ± 4.5 (time 1) to 48.8 ± 4.5 (time 2) p=0.29.	Low-cost intervention.	3	4	3	3	4
Modified SPARK program (including extracurricular program)[12]	Grades 4 and 5 students in Belgium	PA and MVPA significantly increased: PA (F=5.32, p<0.01) and MVPA (F=10.26, p<0.01). A trend toward significance was found for total PA engagement (F=3.57, p<0.06). Total PA engagement in intervention schools was greater than that in control schools.	Low-cost intervention.	3	4	?	3	?

[1]Eather, Moran, and Lubans, "Improving the Fitness and Physical Activity Levels of Primary School Children."
[2]Ridgers, Fairclough, and Stratton, "Long-Term Effects of a Playground Markings and Physical Structures on Children's Recess Physical Activity Levels."
[3]McKenzie, Sallis, and Rosengard, "Beyond the Stucco Tower: Design, Development, and Dissemination of the SPARK Physical Education Programs."
[4]Active and Safe Routes to School, *Programs*.
[5]Zahner and others, "A School-Based Physical Activity Program to Improve Health and Fitness in Children Aged 6–13 Years ("Kinder-Sportstudie KISS")."
[6]Ford, Perkins, and Swaine, "Effects of a 15-Week Accumulated Brisk Walking Programme on the Body Composition of Primary School Children."
Source: Compiled by The Conference Board of Canada.

[7]Heath and Coleman, "Adoption and Institutionalization of the Child and Adolescent Trial for Cardiovascular Health (CATCH)."
[8]Donnelly and others, "Physical Activity Across the Curriculum (PAAC)."
[9]McKenzie and others, "Evaluation of a Two-Year Middle-School Physical Education Intervention: M-SPAN."
[10]Mendoza and others, "The Walking School Bus and Children's Physical Activity."
[11]MET stands for metabolic equivalent of task.
[12]Verstraete and others, "A Comprehensive Physical Activity Promotion Programme at Elementary School."

Table 2
Summary of Sedentary Behaviour Interventions and Rating
(scale from 1 to 5 or "?" if unknown or unclear)

Intervention	Context	Effectiveness/effect size	Cost or cost-effectiveness	Adaptability	Feasibility	Acceptability	Reach	Adoption
Join the Healthy Boat: Health promotion program integrated into curriculum and delivered by teachers; activities included active breaks and weekly lessons about reducing screentime[1]	1,943 primary school children (7.1 ±0.6 years; 51.2% male) in Germany	The intervention reduced screen time in the intervention group among girls, children without immigrant background, and children with parents with a low education level (p≤0.05). Overall, there were no significant differences at follow-up in screen media use among members of the intervention group (OR=0.75, 95% CI: 0.53-1.06, p=0.10).	No direct cost-effectiveness assessment. However, the program was included in school curricula, which implies minimal cost associated with the intervention. There may be a need for resources associated with teaching materials.	4	3	4	4	3
Brocodile the Crocodile: School activities including information sessions with parents to get children to reduce screen time; weekly 20-minute sessions for a period of one year[2]	Children aged 2 to 5 years in the U.S.	Significant reduction in screen media use with the intervention (adjusted difference between groups of -4.7 hours per week, 95% CI: -8.4 to -1.0 hour per week, p=0.02). The percentage of children watching television/videos for more than two hours/day also decreased significantly (difference of -21.5%, 95% CI: -42.5% to -0.5%, p=0.046).	Cost-effective due to the use of existing school infrastructure and resources. May need resources for more teaching and interactive materials.	3	2	3	2	2
Reducing SB in school children through workshops, newsletters, and lessons for parents and students[3]	School-aged children and youth 6 to 19 years in the U.S. and U.K.	Significant reduction of sedentary time/screen time among members of the intervention group, as well as in anthropometric measures such as BMI, in numerous studies. Two studies show screen use reduction for boys and girls (=-0.40 and -0.58 hours/day; p<0.001); difference at six months in SB for intervention vs. control groups (15.9 versus 21.7 hours per week; p=0.01), respectively.	Low-cost intervention.	4	4	3	4	4
UP4FUN: One to two school lessons per week for a period of six weeks; breaking up sitting and screen time; self-assessment and participation in developing personal goals and solutions to decrease SB[4]	10- to 12-year-old children in Belgium, Germany, Greece, Hungary, and Norway	No significant effects of intervention observed (p>0.05), but intervention group reported a more positive attitude (β=0.25, 95% CI 0.11-0.38) and a greater preference (β=0.20, 95% CI 0.08-0.32) for breaking up sitting time than the control group did.	Unknown.	4	4	?	3	3
SMART: An 18-lesson, theory-based classroom curriculum to reduce screen time among third and fourth graders in the U.S.[5]	Third and fourth graders in the U.S.	Members of the intervention groups significantly reduced their screen time. Specifically, they reduced their weekday television viewing (adjusted differences -0.79, 95% CI (-1.22, -0.35), and weekday and Saturday video game playing, -0.18 (-0.42, 0.06) and -0.23 (-0.69, 0.23), respectively, compared to controls.	Low-cost intervention.	5	4	4	3	3
KIDS OUT!: Teachers are trained to deliver program; students do self-questionnaires and homework; teaching video shown in class; SMS messages sent to students and parents at 9:00 p.m. with reminders every night to reduce SB[6]	Eighth graders, 14 to 15 years old, in Finland	The intervention promises long-term effectiveness and a positive impact on SB, as seen in a reduction of SB time (final results yet to be published).	Unknown.	4	3	5	5	5
Reducing sitting time: Intervention consisted of replacing standard desks with sit-to-stand desks to reduce sitting time in class[7]	9- to 12-year-old primary school students in the U.K. and Australia	Studies showed a reduction of sedentary times in class; U.K.: -9.8 + 16.5% (52.4 + 66.6 minutes/day); Australia: -9.4 + 10% (-43.7 + 29.9 minutes/day).	Desks were donated to schools in this study. Other schools may require resources.	4	3	5	5	4
Traditional desks were replaced with standing workstations that had exercise balls; children used bean bags and mats when tired[8]	Third- and fourth-grade children in Auckland, New Zealand	Intervention group children sat less, stood longer, and engaged in fewer transitions from sitting to standing. Effect sizes ranged from small to large (-0.49, 95% CI (+ 0.64); 0.71 (0.48); to -0.96 (+ 0.54), respectively).	Desks were donated to schools in this study. Other schools may require resources.	4	3	5	5	4
Transform-Us!: 18 key learning lessons in class, one 30-minute standing class lesson per day, and a two-minute light-intensity activity break every 30 minutes within each two-hour teaching block; newsletters sent to parents supported key messages in lessons[9]	293 children, aged 7 to 9 years at baseline, from 20 schools in Melbourne, Australia	Combined SB and PA group spent 13.3 minutes/day less in weekday sedentary time than the control group at mid-intervention (p<0.05).	Unknown.	4	3	4	4	4

[1]Kobel and others, "Intervention Effects of a School-Based Health Promotion Programme on Obesity Related Behavioural Outcomes."
[2]Dennison and others, "An Intervention to Reduce Television Viewing by Preschool Children."
[3]Leung and others, "Intervening to Reduce Sedentary Behaviors and Childhood Obesity Among School-Age Youth."
[4]Vik and others, "Evaluation of the UP4FUN Intervention. "
[5]Robinson and Borzekowski, "Effects of the SMART Classroom Curriculum to Reduce Child and Family Screen Time."
[6]Jussila and others, "KIDS OUT! Protocol of a Brief School-Based Intervention to Promote Physical Activity and to Reduce Screen Time."
[7]Clemes and others, "Reducing Children's Classroom Sitting Time Using Sit-to-Stand Desks."
[8]Hinckson and others, "Acceptability of Standing Workstations in Elementary Schools."
[9]Carson and others, "Examination of Mid-Intervention Mediating Effects."
Source: The Conference Board of Canada.

Physical Education Curriculum

Physical education (PE) in schools offers an important opportunity to promote daily physical activity (DPA) among children and youth,[2] as it plays an important role in enhancing student PA levels[3] and providing the skills and knowledge that promote long-term PA.[4] Currently, school PE and activity policies differ greatly across Canada. (See Table 3.) Not all provinces and territories have daily PA requirements.[5] Ontario is unique, as its provincial guidelines require DPA of moderate to vigorous intensity. Challenges exist in other regions—including Alberta, the Northwest Territories, Nunavut, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador—in recruiting and training PE teachers and ensuring that PE programs are meeting policy requirements.[6]

2 Fairclough, Stratton, and Baldwin, "The Contribution of Secondary School Physical Education to Lifetime Physical Activity."

3 Stone and others, "Effects of Physical Activity Interventions in Youth."

4 Steinbeck, "The Importance of Physical Activity in the Prevention of Overweight and Obesity in Childhood."

5 Physical and Health Education Canada, *Across Canada*.

6 Ibid.

Table 3
Physical Education Across Canada

Region	Allocated PE time	Daily PA	Estimated actual PE time
British Columbia and Yukon Territory	• Kindergarten to Grade 7: 150 minutes per week • Grades 8 to 10: 10% of instructional time	Kindergarten to Grade 9: 30 minutes	• Kindergarten to Grade 7: Two to three sessions per week • Grades 8 to 10: Varies based on secondary school timetable
Alberta, Northwest Territories, and Nunavut	• Kindergarten to Grade 6: 150 minutes per week • Grades 7 to 9: 75 hours per year suggested • High school: Students must complete a three-credit Grade 10 course before graduation	Grades 1 to 9: Students are to be physically active for a minimum of 30 minutes daily through activities organized by the school	All grades: Varies across the regions; approximately 120 to 150 minutes per week
Saskatchewan	• Grades 1 to 5: PE 150 minutes, health education (HE) 80 minutes (per week) • Grades 6 to 9: PE 150 minutes, HE 100 minutes (per week) • Grades 10 to 12: One credit in Wellness 10, PE 20, or PE 30	N/A	N/A
Manitoba	• Kindergarten: 11% of instructional time, 99 minutes/six-day cycle (74 PE minutes and 25 HE minutes/six-day cycle) • Grades 1 to 6: 11% of instructional time, 198 minutes/six-day cycle (150 PE minutes and 48 HE minutes/six-day cycle) • Grades 7 and 8: 9% of instructional time, 178 minutes/six-day cycle • Grades 9 to 12: Four credits—one per year, 110 hours/credit (55 PE minutes and 55 HE minutes)	N/A	N/A
Ontario	• Kindergarten to Grade 8: 150 minutes per week • Grades 9 to 12: One credit required in high school for graduation—this credit can be taken in any grade	Grades 1 to 8: Minimum of 20 minutes of sustained moderate to vigorous PA each school day during instructional time	Physical Health and Education Canada's Quality Daily Physical Education (QDPE) standards call for a minimum of 30 minutes of daily PE (for a total of 150 minutes per week); actual instruction across the province varies widely, from 40 minutes per week to 200 minutes per week
Quebec	• Elementary: 120 minutes per week • Secondary: 150 minutes per week • CEGEP: Three mandated courses, 100 minutes in one class per week	N/A	• Elementary: 45 to 60 minutes per week; however, some schools have chosen to implement health or dance • Secondary: 150 minutes/nine-day cycle (usually over two or three classes) • CEGEP: 100 minutes in one class per week, OR an intensive course that lasts for seven to nine weeks with one to two weekend activities, such as a hiking, skiing, or a kayaking trip
New Brunswick	• Kindergarten to Grade 5: 100 minutes per week • Grades 6 to 8: 150 minutes per week • Grades 9 to 10: 45 to 135 hours in total between grades 9 and 10	N/A	• Kindergarten to Grade 5: 90 to 120 minutes (average 70 minutes); PE specialist-taught • Grades 6 to 8: 150 minutes per week; approximately 90 per cent PE-specialist taught • Grades 9 to 10: 74 to 112 minutes per week, averaged over two years; approximately 95 to 100% specialist-taught
Nova Scotia	• Primary to Grade 2: 100 minutes per week • Grades 3 to 6: 150 minutes per week • Grades 7 to 9: 150 minutes/six-day cycle • Grades 10 to 12: One credit for graduation (requirement introduced in 2008–09)	N/A	All grades: Varies across the province; 90 to 150 minutes per week
Prince Edward Island	• Elementary: 5% of instructional time (90 minutes/six-day cycle) • Intermediate: 4 to 6% of instructional time (72 to 108 minutes/six-day cycle) • Senior: Not compulsory; however, PE courses are available in most senior high schools	N/A	All grades: Varies across the province; 90 to 180 minutes/six-day cycle
Newfoundland and Labrador	• Elementary: 6% of instructional time • Intermediate: 6% of instructional time • High school: One credit for graduation	N/A	N/A

Source: Physical and Health Education Canada.

M-SPAN increased PA in PE classes by 18 per cent.

Our review found that interventions integrated into PE curricula have effectively increased PA and DPA in schools diverse in size, resources, and population characteristics. Examples of integrated PE curricula described in the literature include Sports, Play, and Active Recreation for Kids (SPARK), Coordinated Approach to Child Health (CATCH), and Middle School Physical Activity and Nutrition (M-SPAN). These programs are described below. Other resources are also available (see "Additional Resources").

SPARK is a behavioural self-management PE curriculum promoting PA outside of school.[7] It includes extensive teacher training and support, and schools across the U.S. have implemented and adapted it. SPARK has increased PA and students enjoy it.[8] Process data show that up to 80 per cent of schools that adopted SPARK sustained the program for at least four years in both socio-economically advantaged and disadvantaged schools.[9] The program includes numerous process evaluation strategies that are appropriately tailored to diverse settings and populations. Teachers were highly cooperative in adopting teacher training sessions, and this extensive support and training have increased SPARK adoption.[10] The cost of SPARK to participating schools is unknown; however, the SPARK website assists interested schools by identifying grant opportunities.[11]

The CATCH program consists of a minimum of 90 minutes of PE per week through at least three sessions per week. A three-year RCT found that this program increased MVPA in intervention schools, as compared to control schools, halfway through the school year. By the end of the school year, these levels evened out to some extent, and a similar trend occurred across observed grades.[12] However, CATCH schools

7 McKenzie, Sallis, and Rosengard, "Beyond the Stucco Tower."

8 Ibid.

9 Ibid.

10 Ibid.

11 SPARK, *The SPARK Grant-Finder.*

12 Coleman and others, "Prevention of the Epidemic Increase in Child Risk of Overweight in Low-Income Schools."

continued to have higher levels of MVPA than control schools. The program was first implemented in El Paso, Texas—an area that is 78 per cent Hispanic, primarily consisting of low-income families. Selected schools implemented CATCH program components in whatever way best suited their particular school environment. Each school received program supports amounting to $3,500 in the first year, $2,500 in the second, $1,500 in the third, and $1,000 in the fourth.[13] Based on positive reception, CATCH funding was provided for an additional 108 elementary schools in Texas and New Mexico. Ninety-four per cent of families from the intervention schools agreed to participate and all of the schools participated throughout the entire study. The population's above-average overweight and obesity risk, and limited community and school resources for PA, may have affected the sample population's high intervention responsiveness.[14]

M-SPAN is another program developed specifically for middle school children (aged 11 to 13). It consists of PE teacher development sessions that provide sample resources to help teachers increase student MVPA by revising existing programs and their personal instructional strategies.[15] An RCT over two years found significant increases in student MVPA among intervention middle schools in Southern California. The study was large, involving more than 25,000 students each year in 25 middle schools that differed in size, population, socio-demographic and ethnic characteristics, and facilities. Forty-five per cent of the students were non-Caucasian and over one-third were involved in free or low-cost meal programs.[16] No measure of cost or cost-effectiveness was conducted. Without increasing class frequency, duration, or staff, this development program increased PA in PE classes by 18 per cent. PE enjoyment levels remained consistent and teachers positively perceived session content and quality, although they did require a period of time to fully implement the new teaching methods and concepts, and make them habitual.[17]

13 Ibid.

14 Ibid.

15 McKenzie and others, "Evaluation."

16 Ibid.

17 Ibid.

Additional Resources

Other resources are also available, such as Move, Think, Learn—a free resource from Physical & Health Education (PHE) Canada that uses a Teaching Games for Understanding (TGfU) approach using tactical gameplay problems.[18] Designed for educators who work with students in grades 4 to 9, the program teaches students how to evaluate skills and options, and apply them to other gameplay situations. Although each resource focuses on one of 12 sports,[19] solutions are transferable and the overall series design increases knowledge, competence, and confidence, so students can increase their engagement with PA and/or sport.[20]

The Kahnawake School Diabetes Prevention Project (KSDPP) is a school-based intervention aimed at reducing Type 2 diabetes. In Kahnawake, a Mohawk territory on the St. Lawrence River, the Type 2 diabetes rate is twice as high as it is in the general Canadian population—affecting 12 per cent of 45- to 64-year-old adults—and 86 per cent of these diabetic patients are obese.[21] Forty-eight per cent of the population has coronary heart disease and the community suffers from the highest documented native community macrovascular complication rate.[22] Key aspects of the program include incorporating new health education program lessons, increasing PA, and improving school nutrition.[23] KSDPP's interactive, hands-on approach aligns with Aboriginal learning styles and culture, and emphasizes the teacher's role in improving community health.[24] Using activity calendars and a series of reward incentives, the program increased student PA and improved both attitudes and performances.[25]

18 Physical and Health Education Canada, *Move, Think, Learn*.

19 Archery, badminton, basketball canoe/kayak, curling, cycling, hockey, ringette, softball, squash, soccer, and team handball.

20 Physical and Health Education Canada, *Move, Think, Learn*.

21 Kahnawake Schools Diabetes Prevention Project, *About KSDPP*.

22 Ibid.

23 Kahnawake Schools Diabetes Prevention Project, *Intervention*.

24 Ibid.

25 Ibid.

Classroom PA breaks appear to have a high impact on increasing PA in school-aged children.

Classroom Activity Breaks

A systematic review by Basset and others shows that classroom PA breaks, either between or within lessons, appear to have a high impact on increasing PA in school-aged children.[26]

The Physical Activity Across the Curriculum (PAAC) program integrates 90 minutes of MVPA a week throughout academic lessons that are not part of the PE or DPA curriculum (e.g., by integrating MVPA into math class).[27] One study noted that this program resulted in a statistically significant increase in PA. The study also found that MVPA among second- and third-grade students was 27 per cent higher in the intervention schools than in control schools.[28] PAAC was designed as a low-cost, low-burden intervention that would not increase teacher preparation time nor decrease core subject curriculum time. For example, the program does not require additional materials and supplies, or change current curriculum. The intervention is highly adaptable to a wide range of contexts, populations, and student needs, as shown by the wide variety of ways that teachers implemented it in the classroom (e.g., in different academic subjects, at different times, and for different total durations).[29]

Most teachers in the study (63 per cent) did not experience barriers in increasing levels of PA in the existing curriculum, although 26 per cent did report time constraint barriers related to standardized testing, substitute teachers, and field trips.[30] Most teachers who had received training on implementing the intervention in their classroom indicated high levels of confidence in incorporating PA into the lessons. Focus group testing found that PAAC was well-received by the students, teachers, and school administrators. In evaluations, PAAC lessons were rated as “somewhat enjoyable” (57 per cent) or “very enjoyable” (36 per

26 Bassett and others, “Estimated Energy Expenditures for School-Based Policies and Active Living.”

27 Donnelly and others, “Physical Activity Across the Curriculum.”

28 Ibid.

29 Ibid.

30 Ibid.

cent). Nine months after completion of the RCT, 95 per cent of surveyed teachers from the intervention schools were still incorporating PAAC lessons at least one day a week.[31]

Ford and others assessed the effects of a 15-week brisk walking program during school time among 5- to 11-year-olds in England.[32] The researchers found that the DPA program of a 15-minute walk in the morning and a 15-minute walk in the afternoon at least three times a week not only significantly increased average daily physical activity, but also significantly reduced body fat percentage among participating students.[33] Teacher's assistants and the principal investigator of the study led the walking program. This intervention is inexpensive and highly replicable; however, indoor alternatives or shorter, more frequent outdoor activities may need to be considered for this intervention when outdoor conditions make it unsafe to go outside for long periods. To increase the program's adoption and acceptability levels, the researchers ensured they had school and parental support before implementing it. Low dropout rates among study participants reflect a high level of acceptability for this intervention.

Active Commuting to School

Research shows that active commuting to school—defined as walking or cycling to and from school—can meaningfully increase children's PA levels.[34] Active & Safe Routes to School, which includes programs such as the School Travel Planning (STP) model and Walking School Bus (see "Partnership to Improve Active Transportation: The Walking School Bus in Ottawa"), began in Canada in 1996 and has since been implemented in more than 120 schools across Canada.[35] Participating schools have found that students increased their PA and walked and

31 Ibid.

32 Ford, Perkins, and Swaine, "Effects of a 15-Week Accumulated Brisk Walking Programme."

33 Ibid.

34 Larouche and others, "Associations Between Active School Transport and Physical Activity, Body Composition and Cardiovascular Fitness."

35 Canadian Partnership Against Cancer, *Children's Mobility, Health and Happiness: A Canadian School Travel Planning Model*.

cycled longer.[36] The average cost of the STP program was estimated to be $124 per student over 11 years with an average cost of $6,929 per school, ranging from $3,057 to $12,235 for a 10-year follow-up period. However, economic modelling showed average benefits (both economic benefits, such as parking cost savings and energy conservation, as well as health benefits) of $221 per student over 11 years. Programs of this nature can be implemented with varying resource levels, making this model a relatively cost-effective intervention.[37] The study also found strong connections with other PE and health programs, strong stakeholder commitment and engagement, and dedicated community STP facilitators. An Ontario survey designed to determine the reach of the program found that almost half (46.5 per cent) of respondents had delivered or supported Active School Travel programming for at least five years.[38] These initiatives tend to be more effective among older students who live in neighbourhoods perceived as safe and within walking distance to school. Therefore, additional longitudinal data are needed for further analysis of long-term program impacts.

Partnership to Improve Active Transportation: The Walking School Bus in Ottawa

The Ottawa Student Transportation Authority partnered with Ottawa Public Health, the Ottawa Safety Council, and Green Communities Canada to implement the Walking School Bus (WSB) program. A paid leader who is screened, first aid certified, and trained by the Ottawa Safety Council walks children to school. The initiative began in 2014 and is now available in eight schools across Ottawa.

36 Ibid.

37 Metrolinx, Green Communities Canada, and the University of Toronto, *The Costs and Benefits of School Travel Planning Projects in Ontario, Canada*.

38 Luciani and Faulkner, *Active School Travel Stakeholder Survey*.

The cited benefits of this program include the following:[39]

- increased PA among participating students;
- enhanced parental and community engagement;
- improved air quality, as less motor vehicle usage reduced greenhouse gas emissions;
- reduced traffic congestion in school zones;
- increased traffic safety awareness among students;
- increased awareness of and connections with the outdoors.

The WSB program supports safe, active student commuting.[40] In the U.S., Mendoza and others[41] conducted a cluster RCT of a WSB program among fourth-grade students in Texas. Eight schools from the 15 that expressed interest were selected. Informal walking environment observations (e.g., the presence of sidewalks, street connectivity, and the distance from major roads) were used to determine which schools would be included in the study. Students also needed to live within one mile of the school or have a parent willing to drop them off within that zone. Based on student home addresses, one to three walking routes were created for each school. Trained staff led children along these routes up to five days a week to and from school. The study found a 38 per cent increase in weekly active commuting and a seven-minute-per-day increase in MVPA among participating students. A 36 per cent decrease in motor vehicle commuting (which decreases school-related traffic, motor vehicle injury risk, and air pollution) was another program benefit.[42]

39 Ottawa Safety Council, *Walking School Bus*.

40 Safe Routes to School, *The Walking School Bus: Combining Safety, Fun and the Walk to School*.

41 Mendoza and others, "The Walking School Bus and Children's Physical Activity: A Pilot Cluster Randomized Controlled Trial."

42 Ibid.

Modifying playgrounds may be a promising strategy to implement on a wider scale.

Modified Playgrounds

Strategies combining playground markings and coding, rotated playground use, and increased availability of non-fixed equipment significantly increase recess PA.[43] This suggests that modifying playgrounds may be a promising strategy to implement on a wider scale.

An RCT that included redesigning U.K. elementary school playgrounds with markings and physical structures found an increase in both MVPA and VPA after 6 months.[44] In the redesign, playgrounds were divided into three colour-coded areas: a red sports area, a blue multi-activity and skills area, and a yellow quiet play area.[45] Playground markings clearly identified each area's physical activity and social behaviour expectations. Physical structures (e.g., sports equipment, red area fencing, and yellow area seating) were provided to each school. However, the effects observed at 6 months were not as apparent at 12 months, indicating potential sustainability issues and the need for long-term research. Furthermore, as age increased, PA during recess decreased, indicating a need for different playground redesign strategies for older students.

Playground redesigns may be relatively inexpensive, although each intervention school received £20,000 (equivalent to C$34,000) for the redesign. Intervention schools in this RCT were low socio-economic and high-deprivation schools. No seasonal differences were noted in the research. However, this intervention would need to be adapted in a Canadian context, due to our considerably colder and snowier climate, which might decrease use of the redesign and increase indoor recess time.

Once implemented, this intervention requires little human capacity and few resources. Researchers noted that due to the lack of intervention effects at 12 months, other strategies could be put in place at this time

43 Parrish and others, "The Effect of School Recess Interventions on Physical Activity."

44 Ridgers, Fairclough, and Stratton, "Twelve-Month Effects of a Playground Intervention on Children's Morning and Lunchtime Recess Physical Activity Levels."

45 Ibid.

to sustain the positive effects, such as training supervisors, or altering or expanding playground structures. No assessments were done of student or teacher satisfaction with or attitudes toward the redesign.

Comprehensive Approaches

Fit-4-Fun is an eight-week intervention that includes school curriculum (60 minutes per week), home activity (three sets of 20 minutes per week), and daily break-time activity (recess and lunch) components. A cluster RCT of this program among grades 5 and 6 students in Australia found significant effects on PA levels, cardio-respiratory fitness, muscular fitness, flexibility, and body composition after six months.[46] No cost estimates were given for this program. Integrating it into existing PE curricula would require training and resources to develop program materials. Little information was given about the intervention context and population characteristics, which are important for program scalability and adaptability assessments. However, students and teachers reported high to very high satisfaction with the program, along with increased knowledge of fitness. Adherence was also high (94 per cent) for the curriculum sessions. Although recruitment and retention was high for the intervention, it required high teacher engagement, parental support, and adequate playground facilities, which has implications for the intervention's feasibility, acceptability, and adoption. In this RCT, some students noted difficulty in involving parents and other family members in the at-home sessions, and parental attendance at the pre-intervention information sessions was low. Break-time activity participation was also low (only 47 per cent of students completed it at least three times per week), particularly among older students.[47]

46 Eather, Morgan, and Lubans, "Improving the Fitness and Physical Activity Levels."

47 Ibid.

Active commuting to school was encouraged, and playground areas were improved or adapted.

KISS ("Kinder-Sportstudie") is a PE curriculum consisting of two 45-minute lessons per week taught by PE teachers, three to five short daily class activity breaks, and 10 minutes of daily PA homework.[48] A cluster RCT of this program among Grade 1 to 5 students in Switzerland, in addition to the students' regular three PE lessons per week taught by teachers, found significantly higher aerobic fitness and PA levels among participating students in a three-year follow-up. The study included a mix of urban and rural schools, and children of different ethnicities. Children with chronic diseases and severe motor handicaps were excluded from participating. The RCT did not indicate the costs or cost-effectiveness of the program; however, each class required a PE expert and lessons were individualized as much as possible, which may require significant capacity. At the three-year follow-up, the considerable assessment dropout rate included more obese children and those with a migrant background.[49] Throughout the intervention, active commuting to school was also encouraged, and playground areas were improved or adapted. There was no assessment of stakeholder satisfaction with the program. Cultural differences need to be taken into consideration when assessing the likelihood of success of a given program. It is possible that the culture in Switzerland is quite different from that in Canada when it comes to acceptance of daily integration of PA.

Verstraete and others tested an adapted version of the SPARK program among fourth- and fifth-grade students in Belgium that was expanded to include an extracurricular PA promotion program.[50] The results of the two-year RCT showed that intervention schools spent significantly more time on MVPA, increasing its share of total PE class time from 42 to 56 per cent.[51] No gender differences were found in the results. Evaluating the intervention in a larger number of schools (and regions) will confirm whether results can be generalized to the larger population

48 Meyer and others, "Long-Term Effects of a School-Based Physical Activity Program (KISS) on Fitness and Adiposity in Children."

49 Ibid.

50 Verstraete and others, "Effectiveness of a Two-Year Health-Related Physical Education Intervention in Elementary Schools."

51 Ibid.

of children and youth. The study did not discuss dropout or participation rates, or measure student or teacher satisfaction with or perception of the program. As all of the teachers in the study were PE teachers (rather than classroom teachers) who incorporated SPARK components into existing school programs, the intervention was less intensive than the original program.

In Nova Scotia's Annapolis Valley, seven elementary schools and one middle school participated in a three-year comprehensive program aimed at addressing diabetes risk factors, such as PA. The Annapolis Valley Health Promoting Schools Program (AVHPSP) used a community development approach to fostering partnerships between schools and students.[52] The program incorporated guiding principles of the population health approach, health promotion, and comprehensive school health.[53] Providing healthier choices in vending machines and cafeterias, and increasing PA opportunities, were among the key changes. Annual public costs to implement and maintain the program were relatively low—approximately $22.67 per student or $7,830 per school. AVHPSP students showed lower rates of overweight or obesity compared to students from other schools; they also reported more PA and less SB.[54]

Summary of School-Based PA Interventions

Interventions that aim to increase PA through additions or modifications to PE curricula or integration of PA throughout other curricula seem to be the most effective methods for increasing PA among students. These types of interventions also have the most flexibility in delivery and implementation. They also seem to demonstrate the most generalizability, scalability, and acceptability, allowing schools of varying capacities and resources to implement them effectively. Active transportation to school and interventions that include environmental

52 Ohinmaa and others, "Costs of Implementing and Maintaining Comprehensive School Health."

53 Ontario Ministry of Health Promotion, *School Health: Guidance Document*.

54 Ohinmaa and others, "Costs of Implementing."

Comprehensive approaches that include multiple strategies are effective.

modifications can work; however, the Canadian context must be taken into account for these types of interventions. Comprehensive approaches that include multiple strategies aimed at increasing PA are also effective; however, they seem to require the most resources, and studies offer little information about their short- or long-term cost-effectiveness. Teacher training and parental involvement are key aspects to improving the acceptability of school-based PA interventions and, therefore, their effectiveness in changing behaviour.

CHAPTER 3

Sedentary Behaviour

Chapter Summary

- As part of a larger effort to reduce sedentary behaviour, many school-based interventions targeting screen time have been integrated into school curricula.
- In-class sitting typically accounts for at least 63 per cent of daily class time, so reducing extended periods of sitting time is another important area of focus to reduce sedentary behaviour.
- Modifying classroom environments is another practical approach to reducing sitting time in schools, although it can be costly.
- Flexibility in delivery and implementation, appropriate teacher and administrator training, and additions to the curriculum seem to make interventions more scalable to a variety of contexts and populations.

The study of sedentary behaviour (SB) has been noted as a research gap,[1] as the majority of school-based interventions focus on physical activity (PA). However, effective school-based SB interventions are now emerging that focus on either screen time or non-screen sitting time.

The body of literature on SB reduction interventions among children and youth in school settings is currently not as substantive as that for PA interventions, but research in this area will increase over time as SB becomes a greater public health concern.

Screen Time

Screen time is a common leisure activity among children and youth.[2] It includes watching television, playing video games, or using a computer.[3] Many of the school-based interventions targeting screen time, as part of a larger effort to reduce SB, have been integrated into school curricula.

Kobel and others studied the Join the Healthy Boat program among 1,943 seven-year-old children in Southwest Germany. They found that giving children alternatives to sedentary time at school—such as active breaks, weekly lessons, tasks delivered by teachers, and school-parent activities—helped reduce sedentary time.[4] Teachers who had completed a training program delivered the intervention, which was based on teaching materials. Follow-up conducted a year after the intervention noted screen time tended to be lower among students in the intervention group than those in the control group. No information related to cost-effectiveness was provided. The researchers noted that, although the intervention was effective among children whose parents have low

1 World Health Organization, *Global Recommendations on Physical Activity for Health*.

2 Lipnowski and LeBlanc, *Healthy Active Living: Physical Activity Guidelines for Children and Adolescents*.

3 Tremblay and others, “Canadian 24-Hour Movement Guidelines.”

4 Kobel and others, “Intervention Effects.”

Children in the intervention group significantly reduced their screen time.

education levels, it was not as effective among immigrant children,[5] which may limit scalability. To reduce screen time, schools sent letters to parents asking them to spend a "screen-free weekend" with their children. This greatly improved the acceptability and the reach of the intervention; however, linguistic or cultural differences may have made it less effective among immigrant families.

In another study, Robinson and others evaluated the Student Media Awareness to Reduce Television (SMART) programs, which aimed to reduce screen time among children and youth aged 8 to 9 years.[6] The program consisted of 18 teacher-delivered, theory-based classroom lessons aimed at reducing screen time among U.S. third and fourth graders over a six-month period. Each classroom lesson was between 30 to 50 minutes long, and 5- to 10-minute "booster" lessons were also included each week for the final four months. Teachers and students were randomized into intervention and control groups before the study started. Parents were also involved, through interviews and newsletters. The majority of parents allowed their children to participate, demonstrating a high level of acceptability. Children in the intervention group significantly reduced their screen time—specifically, their weekday television viewing. As similar results occurred whether media use was analyzed in the morning or in the afternoon/evening, full-day estimates were presented.[7] Although cost-effectiveness was not explicitly detailed, the intervention seemed to require few resources, because existing resources and school curricula were used.

Dennison and others explored an intervention developed and tested in rural New York to reduce screen time among children aged 2 to 5 years. Eight pre-schools and day care centres participated in either the control or intervention group for the "Brocodile the Crocodile" health promotion program.[8] A one-hour teacher-led session was held each week for

5 Ibid.

6 Robinson and Borzekowski, "Effects of the SMART Classroom Curriculum."

7 Ibid.

8 Dennison and others, "An Intervention to Reduce Television Viewing."

39 weeks. Half of the session was allocated to musical activities, 10 minutes were allocated to eating a snack, and 20 minutes were allocated to participating in an interactive educational session. The health promotion curriculum was split into 32 sessions: 10 were completed in the spring of the first school year; and 22 were completed the following year. Throughout the year, seven sessions were devoted to reducing children's screen time.

Researchers found a significant reduction in screen media use among students in the intervention group—a reduction of 3.1 hours per week in television/video viewing, compared to an increase of 1.6 hours per week among the control group children. The percentage of children watching more than two hours per day also decreased, from 33 to 18 per cent; by contrast, that figure increased from 41 to 47 per cent among children in the control group.[9] Children participated by listing activities (other than television viewing) that they enjoyed.

Schools increased acceptability of the intervention among those involved by sending materials home that children could discuss with their parents. No cost analysis was associated with the intervention and additional community resources were used when possible. As the study only involved a small sample in a rural setting, a longer intervention period with a larger and more diverse sample is needed to ascertain the generalizability of this intervention.

Leung and others tested a curriculum-based intervention to reduce SB that included weekly two-hour workshops involving teachers and students, newsletters sent to parents, and multiple face-to-face lessons with students over a period of six months. This RCT found that screen time dropped among students in the intervention groups.[10] The costs associated with the intervention were not explicitly detailed; however, the intervention was delivered to large sample sizes of diverse backgrounds

9 Ibid.

10 Leung and others, "Intervening to Reduce Sedentary Behaviors."

in both the U.S. and the U.K., and the flexibility afforded to teachers in delivery of the intervention may speak to its scalability and feasibility in a variety of contexts.

A study of the Transform-Us! program in Melbourne, Australia, found that participants in a combined SB and PA intervention spent an average of 13.3 minutes less per day in sedentary time mid-intervention.[11] The 7- to 9-year-old children from 20 schools were of varying socio-economic levels, adding to the generalizability of results. The SB intervention aimed to reduce both uninterrupted sedentary class time and overall sedentary and discretionary screen time at home. Teachers delivered 9 out of 18 key learning messages during class, one 30-minute standing class lesson per day, and two-minute light-intensity activities every 30 minutes (in each two-hour lesson block).[12] Parents received nine newsletters outlining the key learning messages delivered in class. Overall, children reported enjoying the standing lesson. The intervention seems to be cost-effective, but school staff may need additional training on integrating it into their current school agenda.

Sitting Time

To effectively target SB, it is not enough to just decrease screen time—sitting for extended periods of time must also be discouraged.[13] In-class sitting accounts for at least 63 per cent of class time per school day.[14] Vik and others assessed the UP4FUN intervention designed to reduce and break up 10- to 12-year-olds' sitting time in Europe. The intervention was initially conducted for six weeks, with a focus on sitting and screen viewing behaviours in both the school and home environments. One to two lessons per week at school about the importance of reducing sitting time, along with efforts to encourage students to self-report

11 Carson and others, "Examination of Mid-Intervention Mediating Effects."

12 Ibid.

13 Katmarzyk and others, "Sitting Time and Mortality from All Causes, Cardiovascular Disease, and Cancer."

14 Clemes and others, "Reducing Children's Classroom Sitting Time."

Sitting for extended periods of time must be discouraged.

screen and total sedentary time, changed children's attitudes about SB. Each week, accelerometers registered breaks from sitting time, while pedometers recorded steps. Researchers found that asking students to write down personal sedentary time reduction goals and list fun non-sedentary activities helped change habits significantly. Members of the intervention group reported that they had a more positive attitude and liked breaking up sitting time.[15] This intervention has the potential to be cost-effective and adaptable, given the low resource requirement. Due to the combination of student participation, parental consent, and school personnel involvement, this type of intervention may have high adoption and acceptability rates.

Researchers in Finland tested an intervention called KIDS OUT! It was incorporated into school curricula through health education to address SB while increasing PA. Researchers conducted a two-year RCT among 14- to 15-year-olds in the city of Tampere.[16] Intervention participants included all 14 city-owned secondary schools. The intervention was integrated into the weekly school curriculum, guided by the Health Action Process Approach (HAPA) and delivered by teachers. The intervention consisted of a one-hour training session for teachers. Students had to complete three lessons involving a computerized questionnaire and a self-assessment of SB and other activities. Parents also received leaflets with information on the importance of reducing SB and increasing PA, and tips on encouraging youth to reduce SB and increase PA at home.

Students participated in weekly discussions about the results of the online questionnaire. They did home assignments, watched a YouTube video about the importance of reducing screen time, and participated in other activities. They then completed a survey outlining how they planned to increase their PA level and decrease their SB level, what self-selected methods they would use, and one action plan strategy, as well as other health information.

15 Vik and others, "Evaluation of the UP4FUN Intervention."

16 Jussila and others, "KIDS OUT!"

Children have an innate tendency to be active.

Students were involved in choosing an effective way to reduce SB. They then watched videos and discussed their personal action plans in small groups. At 9 p.m. every day, SMS messages were sent to participating students and parents with reminders to reduce SB. The cost associated with this intervention has not been assessed directly, yet the fact that the program is integrated into the existing curriculum using existing resources indicates that it is a cost-effective and adaptable intervention that could be adopted in Canada. Despite the positive results already observed, full follow-up results have yet to be released. They may shed more light on adoption and sustainability of this initiative over time.[17]

Classroom Modification

Children and youth currently spend most of their class time sitting. Children have an innate tendency to be active, yet most of the environments in which they live and grow cause them to become sedentary.[18] Another practical approach to potentially reducing sitting time in schools is the modification of classroom environments.

Clemes and others investigated the effects of providing sit-to-stand desks to 9- to 12-year-old primary school students in the U.K. and Australia for 10 weeks to reduce children's classroom sitting time. Control classrooms kept regular school desks. Baseline classroom sitting time and sitting time during the intervention were measured using the activPAL3 inclinometer. Researchers found that replacing standard desks with sit-and-stand desks significantly reduced sedentary time among students in the intervention group.[19] Levels of parental consent, as well as teacher and student participation, were high. Teacher and administrator training may be required so that they can properly adjust the sit-to-stand desks for students. Although costs for this intervention

17 Ibid.

18 Hinckson and others, "Acceptability of Standing Workstations."

19 Clemes and others, "Reducing Children's Classroom Sitting Time."

were low because the desks were donated, adaptations would need to be made for schools with fewer resources. Further assessments must be done to assess long-term intervention effectiveness.

A three-year New Zealand study also found that replacing traditional sitting desks with standing workstations for children aged 8 to 9 years can reduce sitting time.[20] Researchers replaced eight desks with standing workstations in third- and fourth-grade classrooms, and 30 students participated in the intervention. Equipment such as mats, exercise balls, and bean bags were made available for tired children. Focus groups with parents and students, as well as semi-structured interviews with school staff, revealed positive attitudes and reactions to the new workstations. Not only did parents notice changes in their children's energy levels at home, but sedentary time at school also decreased.[21] Like the previous intervention, longer follow-up periods are needed and adaptations would need to be made for schools with fewer resources, as the equipment for this intervention was donated.

Summary of School-Based SB Interventions

Interventions that aim to reduce screen or sitting time have decreased SB among students. Although none of the reviewed interventions were Canadian, interventions that included additions to the curriculum seem to be most scalable to a variety of contexts and populations. The majority of these types of interventions allowed for flexibility in delivery and implementation, and teachers and students were satisfied with them. Efforts should be made to train teachers and administrators regarding the importance of decreasing SB in addition to increasing PA. Interventions that include classroom modifications seem to be the most costly and may not be practical. Schools that have the resources, or are able to secure donations or funding, could consider these types of interventions.

20 Hinckson and others, "Acceptability of Standing Workstations."

21 Ibid.

CHAPTER 4

Conclusion

Chapter Summary

- Many school decision- and policy-makers are seizing the opportunities in school environments to facilitate healthy and active living habits among children and youth.
- As physical inactivity and a sedentary lifestyle are difficult behaviours to change, investments in sustainable and effective interventions are required to increase physical health literacy among children and youth, school administrators and educators, and parents.
- Clear and consistent messages are needed so parents understand the importance of physical activity to their children's physical, psychological, and academic well-being.
- School environments across Canada vary in size, capacity, resources, demographics, location, and climate, so careful consideration must be given to choosing appropriate interventions and tailoring them to the local context.

The health consequences of low physical activity (PA) and high sedentary behaviour (SB) levels on the lives of children and youth are vast and troubling; therefore, school decision-makers and policy-makers must seize the opportunities in schools to foster healthy and active living habits among students. As physical inactivity and SB are difficult behaviours to change—and positive health outcomes resulting from a decrease in these behaviours occur over time—investment in sustainable and effective interventions must be made now, while also increasing the health literacy of children and youth, school administrators, educators, and parents.

Effective intervention strategies include better integration of PA into the curriculum, activity breaks, environmental modifications, and active transportation. Across Canada, school environments vary in size, capacity, resources, demographics, location, and climate. Therefore, careful consideration must be given to choosing appropriate interventions and tailoring them to the local context. Engaging both parents and students in intervention design and delivery, and providing teacher and school administrator training, can ensure acceptability among those involved and bring these interventions to a wider audience. Flexibility in intervention delivery can further increase acceptability and adoption in the school setting. Paying attention to all of these factors in intervention design, delivery, and evaluation can help to sustain them over the long term and increase PA levels.

Variability in the type and number of contextual factors (e.g., age, ethnicity, and gender) was reported across studies. The most common variables were age and gender, which had limited influence on outcomes. Some studies reported an association between age groups or gender and PA levels, while others did not. Parent engagement

Interventions focusing on obesity prevention should aim to reach all children.

and advocacy is critical to fostering PA in schools. However, parental acceptance and support varied across interventions. For example, some families did not recognize the value of PA or understand how it relates to academics, which can be a more prominent issue for children of immigrant families. A clear and consistent message is needed so parents understand the importance of PA to their children's physical, psychological, and academic well-being.

Evidence suggests that children from higher socio-economic backgrounds often benefit more from interventions than others.[1] This raises special concerns for policy-makers and health practitioners aiming to ensure that obesity prevention and healthy living promotion via school-based programs do not deepen existing economic inequalities. Interventions focusing on obesity prevention should aim to reach all children.[2]

Schools across Canada vary in human and financial resources. Some schools have PA content experts, some have PE specialist teachers (see "Teaching Physical Education: Specialists or Generalists?"), and some ask teachers from other fields to teach PE. Each province has varying levels of support and training for teachers regarding PA and PE.

1 World Health Organization, *Population-Based Prevention Strategies for Childhood Obesity*.

2 Ibid.

Teaching Physical Education: Specialists or Generalists?

The types of teachers running PE classes in primary schools greatly affects the quality of education children receive, as well as the likelihood of students continuing to be physically active outside of the classroom.[3,4,5] Specialist education programs are led by teachers who have formal PE training, whereas non-specialist or generalist-led education is led by other classroom teachers who have no formal PE training.

A systematic review and meta-analysis found that using various teaching strategies, such as requiring students to participate in high-intensity sports and activities in addition to providing basic PA education, resulted in 24 per cent more physical activity compared with usual practice (only providing basic knowledge and opportunities for basic PA).[6] These strategies not only provide PA during the lesson and school hours, but they also help build self-management skills and confidence among students. Improved confidence and life skills increase the likelihood that students will continue to be active outside of school and later in life. The researchers also concluded that professional teacher training in PA would benefit both the teacher and students, while helping to keep overall PE class costs low, as programs would be taught in the most efficient manner.

Reducing SB is another crucial component of child and youth health, and numerous interventions aimed at reducing screen or sitting time in a classroom setting have been effective. Interventions that can be incorporated into existing curricula appear to be the most scalable, and most of the interventions outlined in this report allow for flexibility in implementation and delivery.

3 Lonsdale and others, “A Systematic Review and Meta-Analysis of Interventions Designed to Increase Moderate-to-Vigorous Physical Activity.”

4 Constantinides, Montalvo, and Silverman, “Teaching Processes in Elementary Physical Education Classes Taught by Specialists and Nonspecialists.”

5 Telford and others, “Outcomes of a Four-Year Specialist-Taught Physical Education Program.”

6 Lonsdale and others, “A Systematic Review and Meta-Analysis of Interventions Designed to Increase Moderate-to-Vigorous Physical Activity.”

Interventions aimed at reducing screen or sitting time in a classroom setting have been effective.

In closing, key actions to support PA and reduce SB include enhancing school curricula to support greater PA and less SB within the classroom setting; educating teachers about the health and cognitive benefits of these changes, and the resources available to help them engage students in increasing PA and reducing SB; and conducting parental outreach and education about PA and SB, so that efforts translate from school to home.

Additional research is needed to assess interventions that take barriers to PA participation and SB reduction into account, such as socio-economic status, ethnicity, and urban/rural location. Longer follow-up is also needed on effectiveness and cost-effectiveness, as well as analysis of vulnerable subgroups. Identifying and implementing evidence-based policies to improve PA and reduce SB among children and youth also needs to occur outside of the school environment. This is a significant concern for society, as today's children and youth are tomorrow's adults and seniors.

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APPENDIX A
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PUBLICATION 8360 | 8372
PRICE: Complimentary