SUMMARY

Guideline questions
- What is the available evidence to explain the relationship between sedentary behaviour and health in school-aged children and youth (5-17 years)?
- Does a dose-response relationship exist between increased sedentary time and negative health outcomes?
- Does the relationship between sedentary behaviour and health differ depending on the specific health outcome?

The target population
The following guidelines apply to school-aged children (aged 5-11 years) and youth (aged 12-17 years).

The target users
The intended audience for the following guidelines is children and youth. In the case where the child or youth is unable to use the guidelines by themselves (i.e. too young), the target users of the guidelines become parents, teachers, caregivers and health care providers as a means of facilitating the use of the guidelines.

Methods
Relevant evidence was identified by a systematic search of the following electronic bibliographic databases: Ovid MEDLINE(R) (1950-2010), Ovid EMBASE (1980-2010), and Ovid psycINFO (1806-2010). To be included, studies had to examine the relationship between sedentary behaviour and one of six eligible health outcomes (body composition, fitness, metabolic syndrome or cardiovascular disease, self-esteem, pro-social behaviour, academic achievement). Grey literature and government documents were obtained through correspondence with content experts in the field and through government websites. Bibliographies of key studies and review papers were scanned to identify further studies. Studies looking at ‘active gaming’ (e.g., Dance Dance Revolution™, Nintendo Wii™, video arcades etc.) were excluded as previous work has shown large variability in the energy expenditure associated with these ‘active’ games (Biddiss 2010).

Evidence presented in the systematic review was reviewed and interpreted by national and international content experts. A consensus meeting was convened to discuss and debate the information presented in the systematic review and to draft recommendations for the Canadian Sedentary Behaviour Guidelines for Children and Youth.
External review of the draft guidelines was sought through stakeholders via an online survey. The survey was sent to health care professionals, academics, international content experts, governmental and non-governmental organizations and community members. Stakeholders were also encouraged to share the survey with their peers and colleagues. Over 200 stakeholders provided feedback. After the consultations, the Physical Activity Measurement and Guidelines Steering Committee re-convened to address the concerns and comments that were identified to adjust the guidelines accordingly.

Key Evidence
Key evidence to inform these guidelines comes from a systematic review examining the relationship between sedentary behaviour and 6 health indicators (body composition, fitness, metabolic syndrome and cardiovascular disease, self-esteem, pro-social behaviour, and academic achievement) in school-aged children and youth (5-17 years). This review has been submitted for publication in a peer reviewed journal.

A total of 232 articles met the inclusion criteria. The majority (n=213) of included studies were observational in nature (i.e. longitudinal or cross sectional). Most studies (n=152) examined the relationship between screen time (i.e. television viewing, computer use, and/or video game playing) and body composition. Observational studies showed a clear dose-response relationship between increased levels of sedentary behaviour and associated health risk. Meta-analysis was only possible with 4 randomized controlled studies examining television viewing and change in body mass index (BMI); of the 4 studies, all showed that decreasing time spent watching television was associated with improvements in body composition.

Future Research
Areas for future research were identified within the systematic review. The quality of studies examining sedentary behaviour in children and youth is generally low (i.e. observational and self-report); therefore, there is a need for higher quality randomized controlled trials in the pediatric population (i.e. larger and more diverse sample sizes, direct measures of sedentary behaviour, use of intent-to-treat analyses, reporting of adverse events). These larger studies should then be able to assess the impact of various demographic variables on different health indicators.

It is also very important that future research standardizes methods for data collection and analysis and implements direct (i.e. accelerometers) as well as indirect (i.e. self-report questionnaires for context) measures of sedentary behaviour. Standardized methods for assessing sedentary behaviour will also allow researchers to look specifically at different types of sedentary behaviours and the associated risks and/or benefits. Finally, future research needs to gain a better understanding of the long term health effects of ‘active video gaming’ (e.g., Nintendo Wii™, Microsoft Kinect™, Sony’s Playstation Move™) and the risks associated with sedentary multi-tasking (e.g., playing video games, watching television and using a cell phone at the same time).

GUIDELINE RECOMMENDATIONS

CHILDREN (5-11 years) AND YOUTH (12-17 years)

Preamble
These guidelines are relevant to all apparently healthy children (5-11 years) and youth (12-17 years), irrespective of gender, race, ethnicity or socio-economic status of the family. Children and youth are encouraged to limit sedentary behaviours and to participate in physical activities that support their natural development and are enjoyable and safe.

Children and youth should limit recreational screen time (television, computer, video games, etc.), motorized transportation, indoor time and extended sitting in the context of family, school and community (e.g. volunteer, employment) activities.
Following these guidelines can improve body composition, cardiorespiratory and musculoskeletal fitness, academic achievement, self-esteem and social behaviours. The benefits of reduced sedentary time exceed potential risks.

These guidelines may be appropriate for children and youth with a disability or medical condition; however, they should consult a health professional to understand the types and amounts of activities appropriate for them.

For those with screen time levels in excess of 2 hours per day it is appropriate to start to progressively reduce screen time as a stepping stone to meeting the guidelines.

For guidance on increasing physical activity please refer to the Canadian Physical Activity Guidelines for Children and Youth.

**Guidelines**
For health benefits, children (aged 5-11 years) and youth (aged 12-17 years) should minimize the time they spend being sedentary each day. This may be achieved by
- Limiting recreational screen time to no more than 2 hours per day; lower levels are associated with additional health benefits.
- Limiting sedentary (motorized) transport, extended sitting and time spent indoors throughout the day.

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FULL REPORT

Guideline Questions
- What is the available evidence to explain the relationship between sedentary behaviour and health in school-aged children and youth (5-17 years)?
- Does a dose-response relationship exist between increased sedentary time and negative health outcomes?
- Does the relationship between sedentary behaviour and health differ depending on the specific health outcome?

INTRODUCTION AND BACKGROUND
Over the past several decades, the physical activity and fitness of Canadians has decreased whereas overweight/obesity and their associated co-morbidities have increased (Colley et al. 2011a; Tremblay et al. 2010c). Engaging in regular physical activity is widely accepted as an effective preventative measure for a variety of health risks across all age, gender, ethnic and socioeconomic subgroups (Janssen and LeBlanc 2010; Warburton et al. 2010; Paterson and Warburton 2010; Physical Activity Guidelines Advisory Committee 2008; World Health Organization 2010; Warburton et al. 2007; Paterson et al. 2007; Janssen 2007; Timmons et al. 2007; Martin Ginis and Hicks 2007; Young and Katzmarzyk 2007). However, accumulating evidence shows that increased levels of sedentary behaviours, independent of physical activity levels, are associated with increased risk of cardio-metabolic disease, all-cause mortality, and a variety of physiological and psychological problems (Katzmarzyk et al. 2009; Owen et al. 2009; Tremblay et al. 2010a).

Since 1995, the Canadian Society for Exercise Physiology (CSEP) and the Public Health Agency of Canada (PHAC) have worked together on the development of Canadian Physical Activity Guidelines to promote healthy active living in the Canadian population. This began with the publication of Canada’s Physical Activity Guide for Adults (20-55 years of age) in 1998 (Health Canada and the Canadian Society for Exercise Physiology 1998), Older Adults (>55 years of age) in 1999 (Health Canada and the Canadian Society for Exercise Physiology 1999), Children (6-9 years of age) in 2002 (Health Canada and the Canadian Society for Exercise Physiology 2002a), and Youth (10-14 years of age) in 2002 (Health Canada and the Canadian Society for Exercise Physiology 2002b). These guides have been the PHAC’s most requested resource (Tremblay et al. 2007a).

This paper outlines the steps that were taken to arrive at the Canadian Sedentary Behaviour Guidelines for Children (aged 5-11 years) and Youth (aged 12-17 years). These guidelines are presented through a partnership between CSEP and ParticipACTION, with support from the PHAC, and made available to all Canadians. The following guidelines were informed by a rigorous scientific process, and are based on a systematic review of the scientific evidence. The CSEP Physical Activity Measurement and Guideline (PAMG) Steering Committee has worked to make this process as rigorous and as transparent as possible.

To date, public health agencies have focused on physical activity and have paid little attention to the mounting evidence to support sedentary behaviour as a distinct health issue. This was highlighted in previous work (Tremblay et al. 2007b, Janssen 2007, Tremblay et al. 2010b, Tremblay et al. 2010c) and in the recent Global Recommendations on Physical Activity for Health by the World Health Organization (2010). To date, there are no systematic, evidence-based sedentary behaviour guidelines for any age group; guidelines that do exist are largely based on expert opinion and not a rigorous scientific systematic review process (American Academy of Pediatrics, 2006).

In 2009, at the Physical Activity Measurement and Guideline (PAMG) Consensus Conference, the need for sedentary behaviour guidelines was highlighted (see the full report http://www.csep.ca/cmfiles/PAMGpdfs/2009PAMGConfSummaryPublic.pdf). The PAMG Steering Committee decided that the lack of evidence-based sedentary guidelines was a gap area, which led to the development of
a systematic review on the relationship between sedentary behaviour and health in school-aged children and youth. This systematic review would inform evidence-based sedentary behaviour guidelines (Tremblay et al. 2011b Submitted).

METHODS

Guideline Development

Figure 1 outlines the process that the PAMG Steering Committee has undergone to develop the Sedentary Behaviour Guidelines. The framework to develop the Canadian Sedentary Behaviour Guidelines for Children and Youth was similar to that used to update the Canadian Physical Activity Guidelines. Details on this process can be found elsewhere (Tremblay et al. 2007a, Tremblay et al. 2010b, Tremblay et al. 2011a In press). As with the development of the physical activity guidelines, the sedentary behaviour guidelines aimed to adhere to the rigorous process outlined in the Appraisal of Guidelines Research and Evaluation (AGREE) II instrument. Details on the AGREE II instrument can be found elsewhere (Brouwers et al. 2010a; Brouwers et al. 2010b; Brouwers 2010c). The AGREE II instrument can be found at http://www.agreecollaboration.org/instrument/. The guidelines were informed by a systematic review on sedentary behaviour and health in children and youth (Tremblay et al. 2011b Submitted). Conclusions from the systematic review were assigned a level of evidence based on the quality of study which supported them (Table 1). The level of evidence was used to help develop appropriate wording for the proposed guidelines. An AMSTAR assessment of the systematic review was completed to ensure rigour and Transparency (Table 2) (Shea et al. 2007).

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>Criteria</th>
</tr>
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<tbody>
<tr>
<td>Level 1</td>
<td>Randomized control trials without important limitations</td>
</tr>
<tr>
<td>Level 2</td>
<td>Randomized control trials with important limitations</td>
</tr>
<tr>
<td></td>
<td>Observational studies (non-randomized clinical trials or cohort studies) with overwhelming evidence</td>
</tr>
<tr>
<td>Level 3</td>
<td>Other observational studies (prospective cohort studies, case-control studies, case series)</td>
</tr>
<tr>
<td>Level 4</td>
<td>Inadequate or no data in population of interest</td>
</tr>
<tr>
<td></td>
<td>Anecdotal evidence or clinical experience</td>
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</tbody>
</table>

Adapted from: Lau DC et al. 2007
Table 2. AMSTAR methodological quality assessment of sedentary behaviour systematic review.

<table>
<thead>
<tr>
<th>Item</th>
<th>Answer</th>
<th>Location in manuscript</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Was an ‘a priori’ design provided?</td>
<td>Yes.</td>
<td>Methods</td>
</tr>
<tr>
<td>2. Was there duplicate study selection and data extraction?</td>
<td>Yes.</td>
<td>Methods</td>
</tr>
<tr>
<td>3. Was a comprehensive literature search performed?</td>
<td>Yes.</td>
<td>Appendix A</td>
</tr>
<tr>
<td>4. Was the status of publication (i.e. grey literature) used as an inclusion criteria?</td>
<td>Yes.</td>
<td>Methods</td>
</tr>
<tr>
<td>5. Was a list of studies (included and excluded) provided?</td>
<td>No, only included studies.</td>
<td>A list of excluded studies is available from the authors upon request</td>
</tr>
<tr>
<td>6. Were the characteristics of the included study provided?</td>
<td>Yes.</td>
<td>Table 2</td>
</tr>
<tr>
<td>7. Was the scientific quality of the included studies included and documented?</td>
<td>Yes.</td>
<td>Appendix B</td>
</tr>
<tr>
<td>8. Was the scientific quality of the included studies used appropriately in formulating conclusions?</td>
<td>Yes.</td>
<td>Results and Discussion</td>
</tr>
<tr>
<td>9. Were the methods used to combine the findings of the studies appropriate?</td>
<td>Yes</td>
<td>Meta-analysis used for randomized controlled studies. Qualitative review of other studies appropriate.</td>
</tr>
<tr>
<td>10. Was the likelihood of publication bias assessed?</td>
<td>Yes</td>
<td>Only for randomized controlled studies.</td>
</tr>
<tr>
<td>11. Was the conflict of interest stated?</td>
<td>Yes</td>
<td>Acknowledgments</td>
</tr>
</tbody>
</table>
Figure 1. Timeline and key events for developing Canadian Sedentary Behaviour Guidelines for Children and Youth

Canadian Sedentary Behaviour Guidelines for Children (aged 5-11 years) and Youth (aged 12-17 years)

**TIMELINE**

**JANUARY 2009**
Physical Activity Guidelines International Consensus Conference, Kananaskis, Alberta
- Recommendation to develop a guideline for this ‘gap’ area

**DECEMBER 2009**
Systematic Review research team established by Healthy Active Living and Obesity (HALO) Research Institute, CHEO

**SEPTEMBER 7-9 2010**
Physical Activity Guidelines Consensus Meeting, Toronto, Ontario
Preliminary results presented; debate on merits of linking with PA Guidelines or publishing separately

**NOVEMBER 3 2010**
International Sedentary Behaviour Guidelines Consensus Meeting, Toronto, Ontario
Sedentary systematic review results presented and discussed; Sedentary Behaviour Guidelines drafted by scientific experts

**NOVEMBER-DECEMBER 2010**
Online Stakeholder Survey on relevancy of draft Sedentary Behaviour Guidelines for Children (5-11) and Youth (12-17)

**FEBRUARY 2011**
Sedentary Behaviour Guidelines for Children (5-11) and Youth (12-17) released with new Canadian Physical Activity Guidelines for Children (5-11) and Youth (12-17)

**SYSTEMATIC REVIEW**

Reference

Questions addressed in the systematic review:
- What is the available evidence to explain the relationship between sedentary behaviour and health in school-aged children and youth (5-17 years)?
- Is there evidence to suggest minimal and optimal thresholds for amounts of daily sedentary behaviour children and youth should be exposed to?
- Does the relationship between sedentary behaviour and health differ depending on the specific health outcome?
METHODS

Literature Search Strategy
To be included, studies were required to have a measure of sedentary behaviour as an exposure variable and at least one of six identified health indicators as an outcome of interest. The search terms used to identify eligible studies included those with key words that included sedentary or sedentary lifestyle; chair or sitting time; automobile, car or bus time; indoor time; computer, video, television, or screen-based entertainment; low energy expenditure or physical inactivity. Sedentary behaviour was also often measured as a composite measure of all time engaging in sedentary behaviours including time spent watching television, playing video games, and using the computer outside of school hours. Time spent watching TV, playing games, or using the computer includes all time not related to school activities. The six eligible health indicators and search terms (in parentheses) included in this review were:

1. Body composition (overweight/obesity measured by BMI, waist circumference, skin folds, bio-impedance analysis, dual-energy x-ray absorptiometry);
2. Fitness (physical fitness, physical conditioning, musculoskeletal fitness, cardiovascular fitness);
3. Metabolic syndrome and cardiovascular disease risk factors (unfavourable lipid levels, blood pressure, markers for insulin resistance or type 2 diabetes);
4. Self-esteem (self-concept, self-esteem, self efficacy);
5. Behavioural conduct/pro-social behaviour (child behaviour disorders, child development disorder, pro-social behaviour, behavioural conduct, aggression);
6. Academic achievement (school performance, grade-point average).

Databases searched included:
- Ovid MEDLINE(R) (1950 to February Week 2 2010)
- Ovid EMBASE (1980 to 2010 Week 07)
- Ovid psycINFO (1806 to February Week 3 2010).

The search was limited to studies looking at ‘school-aged’ children and youth (mean age of 5-17 years). Grey (or unpublished) literature was obtained through correspondence with content experts. Twelve key content experts were contacted and asked to suggest what they thought was the most influential research examining sedentary behaviour and health. The full search strategy is available in Appendix A. Both British and American spelling for measures of sedentary behaviour and measured health outcomes were searched.

Inclusion Criteria
Using a-priori inclusion and exclusion criteria, authors identified potentially relevant citations by title and abstract, and retrieved full-text articles for detailed review. All study designs were included in this review. Studies were included only if there was a measurement of sedentary behaviour. No language or date limits were set.

Population based studies (observational studies, cross sectional, cohort studies, retrospective studies) were required to have a minimum sample size of 300 participants. Randomized controlled studies, and intervention studies were required to have at least 30 participants. Longitudinal studies were included if the participant data presented in the article was consistent with the age limits that were set (i.e. if the study looked at participants at age 10 and then again at age 30, only baseline measurements from age 10 were used).

Exclusion criteria
Studies looking at ‘active gaming’ (e.g., Dance Dance Revolution™, Nintendo Wii™, video arcades etc.) were excluded as previous work has shown large variability in the energy expenditure associated with ‘active’ games (Biddiss 2010). Often studies classify those who are not meet physical activity guidelines (i.e. participants that are active for less than 60 minutes per day) as ‘inactive’ or ‘sedentary’ as a proxy measure of sedentary
behaviour. This was not considered an eligible measure of sedentary behavior, and these studies were excluded from the review.

Statistical Analysis

Data extraction
Standardized data extraction tables were used and information was extracted regarding study characteristics (i.e. year, study design, number of participants, age), type of sedentary behaviour, health outcomes examined, measurement tool used, and main findings. Reviewers were not blinded to the authors or journals when extracting data.

Risk of bias assessment
As the purpose of this systematic review was to create a rigorous review of current evidence to inform the creation of sedentary behaviour guidelines, an important part of the process was the quality assessment of all included studies. The Downs and Black checklist was used to assess study quality (Downs and Black, 1998).

Qualitative synthesis
Quality of evidence was determined by the study design and by Downs and Black score. Randomized control studies were considered to have the highest level of evidence. Level of evidence was used to describe the quality of available studies. Level of evidence is based on the studies which inform the conclusions. Randomized control trials are ranked as having the highest quality of evidence and observational studies as the lowest quality evidence. See Table 1 for more information.

Quantitative synthesis
Meta-analysis was performed with the data that were sufficiently homogeneous in terms of statistical, clinical, and methodological characteristics. The only outcome for which this was possible was RCTs of body composition. Pooled estimates for the meta-analysis and their 95% confidence intervals were obtained using the random effects estimator of DerSimonian-Laird (1986). Studies were weighted by the inverse of their variance. Cochrane’s Q was used to test for heterogeneity among studies and the $I^2$ index was used to determine the degree of heterogeneity (Higgins and Thompson, 2002).

RESULTS
After de-duplication, the preliminary search of electronic databases, reference lists, and grey literature identified 5,291 potentially relevant articles (Figure 2). Of these, 3,299 were identified in MEDLINE, 1,016 in EMBASE, 912 in psycINFO, and 64 through key informants, government documents, and bibliographies. After a preliminary review of titles and abstract, 828 articles were included for detailed assessment of the full text article. Of these, 232 met the criteria for study inclusion. Of these, 8 were randomized controlled trials, 10 were intervention studies, 37 were longitudinal studies and 177 were cross sectional studies. Common reasons for excluding studies included: ineligible population age, ineligible sample size, absence of measured sedentary behaviour, ineligible health outcome, analysis focused on type of screen time versus duration of screen time, and analysis focused on active video gaming.
The majority of the studies included in this systematic review were cross-sectional or observational. In total, data from 983,590 participants were included in this review (Table 3). Intervention studies had as few as 30 participants while cross-sectional studies had as many as 62,876 participants. Articles were published over a 51 year period from 1958 to 2009. Participants in the studies ranged from 2-19 years of age. For an overview of the study results, please see Table 2 or contact the systematic review authors for further details.

Risk of bias was assessed for all included studies using the Downs and Black tool (Downs and Black, 1998). The range of scores from items on the Downs and Black tool was 16-26 (out of a possible 27) with a mean value of 20.7. Quality of study did not affect the outcome of the study; in other words, both lower quality and high quality studies showed a negative association between increased time spent being sedentary and health indicators. Inter-reviewer assessment agreement using the Downs and Black tool was very high (kappa = 0.98).

Data for each of the outcomes were assessed to determine if they were sufficiently homogeneous to make meta-analysis appropriate. The only outcome for which data were consistently collected and reported and for which the characteristics of the studies were similar enough to undertake a meta-analysis was body composition. However, this was only for the RCT's; the longitudinal, cross-sectional and intervention studies that examined body composition had too many inconsistencies to allow for a quantitative synthesis of results.

Change in mean BMI before and after the intervention (at the longest point of follow-up for each study) was used as the point estimate for the meta-analysis of the RCT data. Of the 8 RCT’s only 6 had data that could be used to calculate the change in BMI after the intervention. Of these, one examined standardized estimates of BMI only and one presented only median change in BMI and not a mean change. Study authors were contacted for missing information, but no additional data was made available. Meta-analysis of the 4 RCT’s that
remained revealed an overall significant effect of -0.89 kg/m² (95% CI of -1.67 to -0.11, p=0.03) indicating an overall decrease in mean BMI associated with the interventions. The Chi square test for heterogeneity was not significant but the I² was 46% indicating that there was low to moderate heterogeneity in the data. The funnel plot showed no indication of publication bias (data not shown).

**SUMMARY**

Meta-analysis of randomized controlled studies showed that reductions in sedentary time were associated with improvements in body mass index. Intervention studies to decrease sedentary behaviour showed a dose response relation with improvements in body composition; improvements in fitness; and improvements in self-esteem and self-worth. Many of the studies examined the relation between time spent watching television and body composition. This review has shown that increased time spent being sedentary is associated with many negative health indicators. There is evidence to show a dose response relationship between increased time being sedentary and unfavourable body composition, decreased fitness, decreased scores for measures of self-esteem and pro-social behaviour, and decreased academic performance. The relationships between time spent sedentary and metabolic syndrome and risk for cardiovascular disease are less clear. Those spending less than 2 hours per day being sedentary tended to have better health profiles.
Table 3: Summary table of results showing relation between sedentary behaviour and all outcome measures

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Studies included in the review</th>
<th>Total number of participants</th>
<th>Type of study</th>
<th>Summary of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body Composition</strong></td>
<td></td>
<td></td>
<td><strong>Randomized controlled studies:</strong> The review included 8 studies including 1,886 participants.</td>
<td>Meta-analysis was performed on randomized controlled studies that looked at change in BMI. They found an effect of -0.89 kg/m² (95% CI of -1.67 to -0.11, p=0.03) decrease in mean BMI in the intervention group.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Intervention studies:</strong> The review included 12 studies and 3,547 participants.</td>
<td>&gt;2 hrs of sedentary behaviour per day is associated with an increased risk for overweight/obesity. This risk increases in a dose-response manner.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Longitudinal studies:</strong> The review included 33 studies with 85,753 participants.</td>
<td>Each additional hour of TV viewing increased risk for obesity. &gt;2hrs/day significantly increased risk for overweight/obesity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Cross sectional studies:</strong> The review included 119 cross sectional studies with 691,759 participants.</td>
<td>Mean Downs and Black score = 20.9 (±1.9) [Level 2 evidence]</td>
</tr>
<tr>
<td><strong>Fitness</strong></td>
<td></td>
<td></td>
<td><strong>Intervention studies:</strong> The review included 1 study with 76 participants.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Longitudinal studies:</strong> The review included 2 studies with 561 participants.</td>
<td>Those watching less than 2 hours of TV a day showed higher results for fitness testing and more favorable bone health</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Cross sectional studies:</strong> The review included 12 cross sectional studies with 17,227 participants.</td>
<td>Mean downs and black score = 20.6 (± 2.1) [Level 3 evidence]</td>
</tr>
<tr>
<td><strong>Metabolic Syndrome and Cardiovascular Disease</strong></td>
<td></td>
<td></td>
<td><strong>Longitudinal studies:</strong> The review included 2 studies with 1,675 participants.</td>
<td>Increased screen time is associated with increased risk for markers of metabolic syndrome and cardiovascular disease. &gt;5hrs/day of screen time seems to present an elevated risk.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Cross sectional studies:</strong> The review included 9 cross sectional studies with 17,339 participants.</td>
<td>Watching &gt;5hrs of TV per day assoc with increases risk factors for MS and CVD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mean downs and black score = 21.7 (± 2.0) [Level 3 evidence]</td>
</tr>
<tr>
<td><strong>Self-esteem</strong></td>
<td></td>
<td></td>
<td><strong>Randomized controlled studies:</strong> The review included 1 study with 61 participants.</td>
<td>Each additional hour of TV viewing was associated with decreases in self-worth and self-concept</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Intervention studies:</strong> The review included 2 studies and 984 participants.</td>
<td>Mean downs and black score = 21.0 (± 2.4) [Level 3 evidence]</td>
</tr>
</tbody>
</table>

Mean downs and black score = 20.9 (±1.9) [Level 2 evidence]
<p>| | | |</p>
<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-esteem</strong></td>
<td>15</td>
<td>72,945</td>
</tr>
<tr>
<td>Randomized controlled studies: The review included 1 study with 61 participants.</td>
<td></td>
<td>Each additional hour of TV viewing was associated with decreases in self-worth and self-concept</td>
</tr>
<tr>
<td>Intervention studies*: The review included 2 studies and 984 participants.</td>
<td></td>
<td>Mean downs and black score = 21.0 (± 2.4) [Level 3 evidence]</td>
</tr>
<tr>
<td>Cross sectional studies: The review included 11 cross sectional studies with 71,068 participants.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pro-social Behaviour</strong></td>
<td>17</td>
<td>68,975</td>
</tr>
<tr>
<td>Longitudinal studies: The review included 1 study with 2,707 participants.</td>
<td></td>
<td>&gt;2hrs of TV per day is associated with poor pro-social behaviour Those watching less than 3 hrs of TV per day scored more positively in aspects of pro-social behaviour</td>
</tr>
<tr>
<td>Cross sectional studies: The review included 16 cross sectional studies with 91,684 participants.</td>
<td></td>
<td>Mean downs and black score = 19.9 (± 1.34) [Level 3 evidence]</td>
</tr>
<tr>
<td><strong>Academic Achievement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;2hrs of screen time per day is negatively associated with academic achievement</td>
</tr>
</tbody>
</table>

* Intervention studies included one-arm behavioural intervention trials.
DEVELOPMENT OF GUIDELINE RECOMMENDATIONS
The development of the sedentary behaviour guidelines occurred in three steps (described in detail below):

1. A consensus meeting was convened to draft guidelines based on the information presented in a systematic review.
2. Stakeholders were surveyed through online consultations for comments and concerns.
3. A second consensus meeting was convened to discuss changes to the draft guidelines and develop methods for dissemination to the general public.

The Canadian Sedentary Behaviour Guidelines for Children and Youth are presented alongside the new physical activity guidelines. Details on dissemination and messaging strategies for the physical activity guidelines are described by Latimer and colleagues (in development). The PAMG project has been guided by the AGREE II framework and was assessed by a methodologist familiar with the AGREE II process. The final AGREE II report can be found in Appendix B.

At both consensus meetings (i.e. to create a draft of the guidelines and then to finalize the wording of the guidelines) participants were asked to declare if they had any conflict of competing interests that may influence the development of the sedentary behaviour guidelines (“Yes, as a guideline development committee member I would like to declare that I have competing interests (i.e. to give myself a business or professional advantage) that may have influenced the development of the Canadian Sedentary Behaviour Guidelines for Children (5-11 years) and Youth (12-17 years)” OR “No, I have no competing or conflicting interests to declare.”) Declarations of conflict or competing interests can be found in Appendix B under the participant lists. One member of the guideline development committee wished to declare that they “received honorarium for methodological consultation” during the project. This honorarium came from CSEP and did not have an influence on the development of the wording of the sedentary behaviour guidelines. No other members had any conflicts or competing interests to declare.

1. CONSENSUS MEETING AND DRAFT GUIDELINES
In November 2010, a consensus meeting was convened to discuss and debate the information presented in the systematic reviews and to draft recommendations for the sedentary behaviour guidelines. A list of meeting participants can be found in Appendix C. Work from groups in the U.S. (Physical Activity Guidelines Advisory Report, 2008), the U.K. (Biddle In press), Australia (Okely et al. In press) and the WHO (2010) were also scanned to ensure harmonization of efforts.

During the development of the sedentary behaviour guideline recommendations, the group discussed risks of decreasing sedentary behaviour at length. As with all changes to habitual behaviour, there may be some risks associated with decreasing sedentary behaviour. Decreasing sedentary behaviour inherently leads to an increase in more active pursuits. As activity is increased, the likelihood for injury inherently increases as well (e.g., more likely to have an accident while moving around when compared to sitting down). This being said, the perceived risk for decreasing sedentary behaviour is extremely low. The potential risk of decreasing sedentary behaviour should not be perceived as a potential barrier to changing behaviour.

Based on the evidence described in the systematic reviews above, the PAMG Steering Committee, review authors, key informants, and representatives from partner organizations (i.e. CSEP, ParticipACTION, and Active Healthy Kids Canada) drafted the following recommendations:

Preamble
These guidelines are relevant to all apparently healthy children and youth 5-17 years, irrespective of gender, race, ethnicity or socio-economic status of the family. Children and youth are encouraged to limit sedentary behaviours and to participate in physical activities that support their natural development and are enjoyable and safe. These guidelines may be appropriate for children and youth with a disability or medical condition;
However, they should consult a health professional to understand the types and amounts of activities appropriate for them.

Children and youth should limit recreational screen time (television, computer, video games, etc.), motorized transportation, indoor time and extended sitting in the context of family, school, volunteer and community activities.

Following these guidelines can improve body composition, cardiorespiratory and musculoskeletal fitness, academic achievement, self-esteem and social behaviours. The benefits of reduced sedentary time exceed potential risks.

For those with screen time levels in excess of 2 hours per day it is appropriate to start to progressively reduce screen time as a stepping stone to meeting the guidelines.

For guidance on increasing physical activity please refer to Canada’s Physical Activity Guidelines for Children and Youth.

Guidelines
For health benefits, children and youth aged 5-17 years should minimize the time they spend being sedentary each day.
- Limit recreational screen time to no more than 2 hours per day; lower levels are associated with additional health benefits.
- Limit sedentary (motorized) transport, extended sitting and time spent indoors throughout the day.

2. STAKEHOLDER PROCESS (External review)
Based on the evidence presented in the systematic reviews and the draft recommendations presented above, feedback was sought from a wide range of stakeholders. This included national and international content experts, health professionals, governmental and non-governmental organizations, teachers, and caregivers. This was done through an online consultation process.

Methods for external guideline review
An online survey was sent out to stakeholders with interest in sedentary behaviours, physical activity and health promotion. A list of organizations initially contacted by CSEP can be found in Appendix D. CSEP made efforts to contact each organization and determine the best individual to receive the survey. The initial stakeholders were encouraged to share the survey link with their peers and colleagues. The survey consisted of 6 questions about the wording and level of agreement for the proposed Canadian Sedentary Behaviour Guidelines for School-aged Children and Youth and their associated preamble. Written comments were invited and respondents were told they would receive updated and refined guidelines when the survey process was completed. The results of the survey were reviewed by the CSEP PAMG Steering Committee.

Stakeholder consultation process
A total of 230 individuals completed the survey and 165 respondents provided additional written comments. Overall, the majority of respondents (90.8%) ‘completely agreed’ or ‘agreed’ with the proposed preamble and guideline for children and youth. A summary of the survey results can be found here: http://www.csep.ca/english/view.asp?x=882

The majority of stakeholders (87.9%) preferred that sedentary guidelines be presented alongside physical activity guidelines for children and youth. They also ‘completely agreed’ that guidelines for sedentary behaviour were not only important for children and youth (71.5%) but for all age groups (66.2%). The PHAC
has proposed funding to develop further sedentary behaviour guidelines; current guidelines will be updated to include other age groups as they become available.

The biggest concern identified from the written comments was with respect to dissemination and implementation of the new guidelines. There was some confusion regarding the difference between the Sedentary Behaviour Guidelines and the Physical Activity Guidelines. Work to clarify the definition of sedentary behaviour will be disseminated through the public facing messages.

3. **FINALIZATION OF GUIDELINES**

In December 2010, the PAMG Steering Committee re-convened to address the concerns and comments brought up through the stakeholder consultations and to adjust the guidelines accordingly. Table 3 outlines the draft guidelines, the concerns and comments by stakeholders and how they were addressed, and the final guidelines for each age group.

Table 3: Final guidelines following consultation process

<table>
<thead>
<tr>
<th>DRAFT GUIDELINE RECOMMENDATIONS</th>
<th>DISCUSSION AND COMMENTS FROM STAKEHOLDERS</th>
<th>FINAL GUIDELINE RECOMMENDATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Children and Youth (5-17 years)</strong></td>
<td>Stakeholder concern -what does ‘limit’ motorized transport mean. <strong>Response:</strong> this will be addressed in the public facing messaging that is associated with the guidelines.</td>
<td>For health benefits, children (5-11 years) and youth (12-17 years) should minimize the time they spend being sedentary each day. This may be achieved by:</td>
</tr>
<tr>
<td>For health benefits, children and youth aged 5-17 years should minimize the time they spend being sedentary each day.</td>
<td>• Age groups – for consistency with physical activity guidelines, ages for children and youth should be separated. <strong>Response:</strong> has been changed to “children (5-11 years) and youth (12-17 years)” in the final guidelines.</td>
<td>- Limiting recreational screen time to no more than 2 hours per day; lower levels are associated with additional health benefits.</td>
</tr>
<tr>
<td>- Limit recreational screen time to no more than 2 hours per day; lower levels are associated with additional health benefits.</td>
<td>• Stakeholder concern - some of the text is written at a high reading level. <strong>Response:</strong> public facing messaging will address this concern.</td>
<td>- Limiting sedentary (motorized) transport, extended sitting and time spent indoors throughout the day.</td>
</tr>
<tr>
<td>- Limit sedentary (motorized) transport, extended sitting and time spent indoors throughout the day.</td>
<td>• Stakeholder concern – how will these messages be disseminated? <strong>Response:</strong> sedentary behaviour guidelines will be disseminated through a large group of partner organizations across the country.</td>
<td></td>
</tr>
<tr>
<td>• Concern – grammar and structure of bullet points. <strong>Response:</strong> the phrase “this may be achieve by:” was added and grammar was corrected</td>
<td>• Concern – what does ‘limit’ motorized transport mean. <strong>Response:</strong> this will be addressed in the public facing messaging that is associated with the guidelines.</td>
<td></td>
</tr>
</tbody>
</table>

**DISSEMINATION AND IMPLEMENTATION**

The work to inform the development of these guidelines is published in the peer-review literature (Tremblay et al. 2007b, Tremblay et al. 2010, Tremblay et al. 2011 *Submitted*). Further, the methodological process, systematic review, and final recommendations have been and will be shared at scientific meetings and conferences.

Dissemination and implementation of these guidelines within the general public will occur through work with our partnership organizations (e.g. CSEP, ParticipACTION, Active Healthy Kids Canada) alongside the Canadian Physical Activity Guidelines. Public facing messages will be created through these partnership organizations and will be developed through a similarly rigorous process as used for the development of the guidelines. The framework for developing messaging strategies will be similar to that which was developed for Canadian Physical Activity Guidelines by Latimer and colleagues (in development). Information on materials for
messaging and disseminating the guidelines will be made available on the CSEP website (http://www.csep.ca/guidelines). This information will be updated regularly to reflect feedback from stakeholders.

The intended audience for the guidelines is school-aged children and youth; however, especially in the younger age groups, the majority of the resources will be targeted at parents, teachers, caregivers and health care providers. CSEP is working to produce a variety of online and hard copy resources to be made available to all Canadians. These resources will also be distributed to partner organizations so that they are further disseminated. These resources will be created over time and updated as feedback is received from stakeholders. The primary resource will be fact sheets for all age groups (i.e. what the guidelines are, health benefits of achieving guidelines and examples of ways to meet the guidelines). Additional resources will be made available in a timely manner. The PHAC has also provided funding for the promotion and dissemination of the new sedentary guidelines.

Some potential barriers for reducing sedentary behaviours include motivation to change, lifestyle habits (e.g. parents driving children and youth to school), and enjoyment (i.e. those who enjoy watching television); some potential facilitators include improved health and simplicity of change (e.g. may be easier to reduce sedentary behaviour than to increase physical activity). For more information on messaging and behaviour modification see Latimer et al. (2010) and Rhodes et al. (2010).

SURVEILLANCE
There are a variety of mechanisms that will be used for surveillance of adherence to the new guidelines. The primary Canadian studies that will be used and their affiliated organization are as follows:

- Canadian Health Measures Survey (CHMS, Statistics Canada)
- Canadian Community Health Survey (CCHS, Statistics Canada)
- National Longitudinal Survey of Children and Youth (NLSCY, Statistics Canada)
- Physical Activity Levels Among Youth (CANPLAY, Canadian Fitness and Lifestyle Research Institute)
- Physical Activity Monitor (PAM, Canadian Fitness and Lifestyle Research Institute)
- Health Behavior in School-aged Children Survey (HSBC, PHAC)

For example, the CHMS will directly measure (i.e. through accelerometry) the average amount of time Canadians engage in sedentary behaviours per week. This information will be used to determine the proportion of Canadian children and youth meeting the Sedentary Behaviour Guidelines. The CHMS is conducted in two year intervals and makes the information available to researchers in a timely manner. For recent, specific examples of CHMS surveillance activities see Colley et al. (2011a, 2011b). For further surveillance activities see the Canadian Fitness and Lifestyle Research Institutes CANPLAY results (Craig et al. 2010) and the Active Healthy Kids Canada Report Card Report Card on Physical Activity for Children and Youth (Active Healthy Kids Canada 2005, 2006, 2007, 2008, 2009, 2010). See each survey for specific examples of monitoring tools used and relevant operational definitions. The potential resources implications of implementing these guideline recommendations were beyond the scope of the PAMG project.

FUTURE RESEARCH
Areas for future research have been identified within the systematic reviews as well as through the stakeholder consultations. Studies examining sedentary behaviour in children and youth are generally low quality (i.e. observational), there is a need for higher quality randomized controlled trials in the pediatric population (i.e. larger and more diverse sample sizes, direct measures of sedentary behaviour, intent-to-treat analyses, reporting of adverse events). These larger studies should then be able to speak to the impact of various demographic variables. Finally, future research should focus on standardizing methods for data collection and analysis and work towards implementing direct (i.e. accelerometers) and indirect (i.e. questionnaires for context) measures of sedentary behaviour.
The information captured in the systematic review allowed the PAMG Steering Committee to develop evidence-based guidelines on the amount of time that children should engage in sedentary behaviours. Future work needs to focus on successfully messaging these guidelines so this information can be effectively disseminated to the public. Furthermore, this review was limited to school-aged children and youth. Similar work will have to be completed to inform sedentary guidelines for young children (0-4 years), adults (18-64 years), older adults (≥65 years), and information will need to be disseminated to the public in the form of public health guidelines with accompanying messages and support materials.

As the accessibility and popularity of multiple forms of technology increases among the pediatric population, future work needs to continue to focus on media engagement. Specifically, with increasing popularity for hand-held, portable devices, ‘sedentary multitasking’ is becoming increasingly common. Children and youth are able watch television, talk on the phone, and use the computer at the same time. This is a relatively new phenomenon and future research should assess what, if any, are the health effects associated with this high level of screen time. Work will also have to be completed to better understand the long term implications of ‘active video gaming’ on health. Finally, future work will have to focus on the context of the sedentary behaviour to determine if it changes any of the associations explained in this review.

**UPDATING THE GUIDELINES**
The PAMG Steering Committee realizes that updating the new guidelines is important and necessary to ensure that they remain true to the science that has informed them. Due to the immense amount of work required to update the systematic review, it is not feasible to update the guidelines every year. The immediate concern is to develop Sedentary Behaviour Guidelines for Young Children (0-4 years), Adults (18-64 years) and Older Adults (≥65 years). Once sedentary guidelines have been developed for all age groups, they will be updated in a cyclical fashion to harmonize with the updating of the Canadian Physical Activity Guidelines as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Age group to be updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>Young children 0-4 years (created)</td>
</tr>
<tr>
<td>2012</td>
<td>Adults 18-64 years (created)</td>
</tr>
<tr>
<td>2013</td>
<td>Older adults ≥65 years (created)</td>
</tr>
<tr>
<td>2014</td>
<td>Children and Youth</td>
</tr>
<tr>
<td>2015</td>
<td>Young children</td>
</tr>
<tr>
<td>2016</td>
<td>Adults</td>
</tr>
<tr>
<td>2017</td>
<td>Older adults</td>
</tr>
<tr>
<td>2018</td>
<td>Children and Youth</td>
</tr>
<tr>
<td>2019</td>
<td>Young children</td>
</tr>
<tr>
<td>2020</td>
<td>Adults</td>
</tr>
</tbody>
</table>

This will allow guidelines for each age group to be updated in a timely fashion. However, if important evidence emerges in the interim between updates, authors will work to include it in a timely fashion and the timeline for updates may change.
FINAL GUIDELINES

CHILDREN (5-11 years) AND YOUTH (12-17 years)

Preamble
These guidelines are relevant to all apparently healthy children (aged 5-11 years) and youth (aged 12-17 years), irrespective of gender, race, ethnicity or socio-economic status of the family. Children and youth are encouraged to limit sedentary behaviours and to participate in physical activities that support their natural development and are enjoyable and safe.

Children and youth should limit recreational screen time (television, computer, video games, etc.), motorized transportation, indoor time and extended sitting in the context of family, school and community (e.g. volunteer, employment) activities.

Following these guidelines can improve body composition, cardiorespiratory and musculoskeletal fitness, academic achievement, self-esteem and social behaviours. The benefits of reduced sedentary time exceed potential risks.

These guidelines may be appropriate for children and youth with a disability or medical condition; however, they should consult a health professional to understand the types and amounts of activities appropriate for them.

For those with screen time levels in excess of 2 hours per day it is appropriate to start to progressively reduce screen time as a stepping stone to meeting the guidelines.

For guidance on increasing physical activity please refer to the Canadian Physical Activity Guidelines for Children and Youth.

Guidelines
For health benefits, children (aged 5-11 years) and youth (aged 12-17 years) should minimize the time they spend being sedentary each day. This may be achieved by
- Limiting recreational screen time to no more than 2 hours per day; lower levels are associated with additional health benefits.
- Limiting sedentary (motorized) transport, extended sitting and time spent indoors throughout the day.
GLOSSARY
For a list of important definitions and explanations, see http://www.csep.ca/english/view.asp?x=890. Also provided are the following definitions adapted from Tremblay et al. (2010a) and used to guide the systematic review and the sedentary behaviour guidelines.

Sedentary: A distinct class of behaviours (sitting, watching television, playing video games) characterized by little physical movement and low energy expenditure (≤1.5 METs).

Sedentarism: Extended engagement in sedentary behaviours characterized by minimal movement, low energy expenditure, and rest.

Physically active: Meeting established guidelines for physical activity (see the accompanying report on physical activity for details on guidelines www.csep.ca/guidelines).

Physical inactivity: The absence of physical activity, usually reflected as the proportion of time not engaged in physical activity of a pre-determined intensity.

Active video gaming: Video games that are designed to promote movement and interaction from the participant(s). Some examples include the Nintendo Wii™, Microsoft Kinect™, Sony’s Playstation Move™, and arcade type video games.

LIST OF ABBREVIATIONS
The following is a list of common abbreviations used throughout this document.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHKC</td>
<td>Active Healthy Kids Canada</td>
</tr>
<tr>
<td>CAN PLAY</td>
<td>Physical Activity Levels Among Youth</td>
</tr>
<tr>
<td>CCHS</td>
<td>Canadian Community Health Survey</td>
</tr>
<tr>
<td>CFLRI</td>
<td>Canadian Fitness and Lifestyle Research Institute</td>
</tr>
<tr>
<td>CHMS</td>
<td>Canadian Health Measures Survey</td>
</tr>
<tr>
<td>CSEP</td>
<td>Canadian Society for Exercise Physiology</td>
</tr>
<tr>
<td>HALO</td>
<td>Healthy Active Living and Obesity research group</td>
</tr>
<tr>
<td>NLSCY</td>
<td>National Longitudinal Survey of Children and Youth</td>
</tr>
<tr>
<td>PAM</td>
<td>Physical Activity Monitor</td>
</tr>
<tr>
<td>PAMG</td>
<td>Physical Activity Measurement and Guidelines project</td>
</tr>
<tr>
<td>PHAC</td>
<td>Public Health Agency of Canada</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
</tbody>
</table>
REFERENCES


Active Healthy Kids Canada. Active kids are fit to learn - Report Card on Physical Activity for Children and Youth. Active Healthy Kids Canada, 2009. Toronto, Active Healthy Kids Canada.


APPENDIX A
Literature Database Search Strategies

MEDLINE Search Strategy
Completed on February 23rd, 2010
1. sedentar$.tw.
2. Sedentary Lifestyle/
3. ((chair or sitting or car or automobile or auto or bus or indoor or in-door or screen or computer) adj time).tw.
4. low energy expenditure.tw.
5. (computer game* or video game* or ((television adj watch*) or tv watch*)).tw.
6. television/ or computers/ or video games/
7. (screen based entertainment or screen-based entertainment or screen time).tw.
8. physical inactivit*.tw.
9. bed rest.mp.
10. sitting.tw.
11. or/1-10
12. exp obesity/
13. (obesit* or obese).tw.
14. exp overweight/
15. (overweight or over-weight).tw.
16. exp Body Fat Distribution/
17. exp body composition/
18. Waist Circumference/
19. waist circumference.tw.
20. Skinfold Thickness/
21. (skin folds or skin-fold*).tw.
22. (body composition* or BMI or body mass index).tw.
23. exp "body weights and measures"/
24. (bio-impedance analysis or BIA).tw.
25. Absorptiometry, Photon/
26. (absorptiometry or densitometry or photodensitometry or DXA or DEXA).tw.
27. Physical Fitness/
28. (physical conditioning or fitness).tw.
29. musculoskeletal fitness.tw.
30. cardiovascular fitness.tw.
31. metabolic syndrome x/
32. Insulin Resistance/
33. (metabolic cardiovascular syndrome or metabolic syndrome or syndrome x).tw.
34. exp cardiovascular diseases/
35. risk factors/
36. 33 and 34
37. ((cardiovascular disease$ or heart disease$ or vascular disease$) adj risk$).tw.
38. exp self concept/
40. exp child development disorders/
41. child behavio?r disorders/
42. (pro-social behavio?r or prosocial behavio?r or pro social behavio?r).tw.
43. exp *social behavior/
44. (behavio?r or ral conduct or behavio?ral conduct).tw.
45. (academic achievement or educational achievement).tw.
46. educational achievement/
47. School Admission Criteria/
48. (grade-point average or grade point average or GPA).tw.
49. or/12-33
50. or/36-49
51. 11 and 50
52. limit 51 to ("child (6 to 12 years)" or "adolescent (13 to 18 years")
53. (child* or adolescent* or youth* or pediatric* or paediatric*).tw.
54. 51 and 53
55. 52 or 54

Embase Search Strategy
Completed on February 23rd, 2010

1. sedentar$.tw.
2. ((chair or sitting or car or auto or automobile or bus or indoor or in-door or screen or computer) adj time).tw.
3. low energy expenditure.tw.
4. (computer game* or video game*).tw.
5. ((television adj watch*) or tv watch*).tw.
6. (screen based entertainment or screen-based entertainment or screen time).tw.
7. television viewing/ or computer/ or recreation/
8. sitting.tw.
9. bed rest.mp.
10. physical inactivit*.tw.
11. or/1-10
12. (obesit* or overweight or obese or over-weight).tw.
13. exp obesity/
14. exp body weight/
15. exp Body Fat Distribution/
16. (body composition or BMI or body mass index).tw.
17. waist circumference.tw.
18. Waist Circumference/
19. Skinfold Thickness/
20. (skin fold* or skin-folds).tw.
21. (bio-impedance analysis or bio impedance analysis or BIA).tw.
22. (absorptiometery or densitometry or photodensitometry or DXA or DEXA).tw.
23. photon absorptiometry/
24. fitness/
25. (physical conditioning or fitness).tw.
26. musculoskeletal fitness.tw.
27. metabolic syndrome x/
28. (metabolic cardiovascular syndrome or metabolic syndrome or syndrome x).tw.
29. exp cardiovascular disease/
30. risk factor/
31. 29 and 30
32. ((cardiovascular disease$ or heart disease$ or vascular disease$) adj risk$).tw.
33. exp child development/
34. developmental disorder/
35. behavio?ral conduct.tw.
36. exp *social behavior/
37. (pro-social behavio?r or prosocial behavio?r or pro social behavio?r).tw.
38. exp self concept/
40. (academic achievement or educational achievement).tw.
41. exp academic achievement/
42. (grade-point average or grade point average or GPA).tw.
43. or/12-28
44. or/31-43
45. 11 and 44
46. limit 45 to (school child <7 to 12 years> or adolescent <13 to 17 years>)
47. (child* or youth* or adolescent* or pediatric* or paediatric*).tw.
48. 45 and 47
49. 46 or 48

PsycINFO Search Strategy
Completed on February 23rd, 2010

1. sedentar*.tw.
2. ((chair or sitting or car or automobile or auto or bus or indoor or in-door or screen or computer) adj time).tw.
3. (computer game* or video game*).tw.
4. ((television adj watch*) or tv watch*).tw.
5. (screen based entertainment or screen-based entertainment or screen time).tw.
6. television viewing/ or computers/ or computer games/
7. physical inactivit*.tw.
8. bed rest.tw.
9. sitting.tw.
10. low energy expenditure.tw.
11. or/1-10
12. exp obesity/
13. exp body weight/ or Body Mass Index/
14. (obesit* or obese or overweight or over-weight).tw.
15. (body composition* or body mass index or BMI).tw.
16. waist circumference.tw.
17. (skin fold* or skin-fold*).tw.
18. (bio impedance analysis or BIA).tw.
19. (absorptiometery or densitometry or photodensitometry or DXA or DEXA).tw.
20. exp physical fitness/
21. (physical conditioning or fitness).tw.
22. musculoskeletal fitness.tw.
23. cardiovascular fitness.tw.
24. exp cardiovascular disorders/
25. risk factors/
26. 24 and 25
27. ((cardiovascular disease$ or heart disease$ or vascular disease$) adj risk$).tw.
28. (metabolic cardiovascular syndrome or metabolic syndrome or syndrome x).tw.
29. exp metabolic syndrome x/
30. exp cognitive development/
31. ((cognit* adj development) or (behavio?ral conduct or behavio?ral conduct)).tw.
32. exp bahavior problems/ or exp behavior disorder/ or conduct disorder/
33. (pro-social behavio?r or prosocial behavio?r or pro social behavio?r).tw.
34. exp prosocial behavior/
35. exp self-concept/
36. exp self-esteem/
37. (self esteem or self-esteem).tw.
38. (academic achievement or educational achievement).tw.
39. (grade-point average or grade point average or GPA).tw.
40. exp academic achievement/ or Academic Achievement Motivation/ or academic self concept/
41. exp behavior?r problems/ or exp behavior?r disorder/ or conduct disorder/
42. or/12-23
43. or/26-42
44. 11 and 43
45. limit 44 to (180 school age or 200 adolescence )
46. (child* or youth* or adolescent* or pediatric* or paediatric*).tw.
47. 44 and 46
48. 45 or 47
## APPENDIX B
AGREE II Reporting Grid – 2011 Canadian Sedentary Behaviour Guidelines for Children and Youth

<table>
<thead>
<tr>
<th>AGREE II Item</th>
<th>Reporting Location for Sedentary Behaviour Guidelines</th>
<th>Internal AGREE II Score</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Domain 1. Scope and Purpose</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. The overall objective(s) of the guideline is (are) specifically described.</td>
<td>• Clinical practice guideline development report Introduction, Background</td>
<td>7</td>
<td>Describes health intent, expected outcomes, and guideline targets.</td>
</tr>
<tr>
<td></td>
<td>• Clinical practice guideline paper - Background</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The health question(s) covered by the guideline is (are) specifically described.</td>
<td>• Clinical practice guideline development report – Summary, Guidelines questions</td>
<td>7</td>
<td>Describes target population, intervention, outcomes, and health care setting.</td>
</tr>
<tr>
<td></td>
<td>• Clinical practice guideline paper - Methods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.</td>
<td>• Clinical practice guideline development report – Summary, Guideline preamble, Final guidelines, preamble</td>
<td>7</td>
<td>Describes, target population, gender, ages, clinical conditions</td>
</tr>
<tr>
<td></td>
<td>• Clinical practice guideline paper – Results, preamble</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Domain 2. Stakeholder Involvement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. The guideline development group includes individuals from all the relevant professional groups.</td>
<td>• Clinical practice guideline development report – Appendix A</td>
<td>7</td>
<td>International multidisciplinary group, including scientists, guideline developers, government, and methodologists; describes each person’s name, expertise, affiliation, location, and role</td>
</tr>
<tr>
<td>5. The views and preferences of the target population (patients, public, etc.) have been sought.</td>
<td>• Clinical practice guideline development report – Table 2 – final guidelines following consultation process</td>
<td>7</td>
<td>Description of stakeholder consultation process (on-line surveys, in-person focus groups), information gathered, and how feedback informed final guideline recommendations</td>
</tr>
<tr>
<td></td>
<td>• Clinical practice guideline paper - Methods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. The target users of the guideline are clearly defined.</td>
<td>• Clinical practice guideline development report – Summary, Guideline preamble, Final guidelines, preamble</td>
<td>7</td>
<td>Describes the intended guideline audience, and describes how the guideline may be used by the target audience.</td>
</tr>
<tr>
<td></td>
<td>• Clinical practice guideline paper – Results, preamble</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGREE II Item</td>
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<td>Internal AGREE II Score</td>
<td>Rationale</td>
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</tr>
<tr>
<td>7. Systematic methods were used to search for evidence.</td>
<td>• Clinical practice guideline development report – Summary, Appendix A</td>
<td>7</td>
<td>Reports the databases, time periods, keywords searched, and full search strategy.</td>
</tr>
<tr>
<td>8. The criteria for selecting the evidence are clearly described.</td>
<td>• Clinical practice guideline development report – Summary, Methods</td>
<td>7</td>
<td>The guideline reports the target population characteristics, types of study designs included and excluded, language, and intervention inclusion/exclusion criteria. Outcomes of interest are well reported.</td>
</tr>
<tr>
<td>9. The strengths and limitations of the body of evidence are clearly described.</td>
<td>• Clinical practice guideline development report – Table 2, Discussion, Future research • Clinical practice guideline paper – Discussion, Future research</td>
<td>7</td>
<td>The systematic review reports study design, methodology limitations, relevance of outcomes, consistency and direction of results across studies, and applicability.</td>
</tr>
<tr>
<td>10. The methods for formulating the recommendations are clearly described.</td>
<td>• Clinical practice guideline development report – Method of Guideline Development: Development of Guideline Recommendations; Stakeholder process • Clinical practice guideline paper – Methods</td>
<td>7</td>
<td>Described development of guideline consensus recommendation process, results from stakeholder feedback, and final development of recommendations.</td>
</tr>
<tr>
<td>11. The health benefits, side effects and risks have been considered in formulating the recommendations.</td>
<td>• Clinical practice guideline development report – Summary, Guideline preamble, Final guidelines, preamble • Clinical practice guideline paper – Results, preamble</td>
<td>6</td>
<td>Reported supporting data and report of benefits. Where available, reported supporting data and report of harms/side effects.</td>
</tr>
<tr>
<td>12. There is an explicit link between the recommendations and the supporting evidence.</td>
<td>• Clinical practice guideline development report – Methods – summary of evidence</td>
<td>7</td>
<td>Specific citations to systematic review and summary tables of evidence.</td>
</tr>
<tr>
<td>13. The guideline has been externally reviewed by experts prior to its publication.</td>
<td>• Clinical practice guideline development report – Development of Guideline Recommendations, Stakeholder feedback, Appendix C or E • Clinical practice guideline paper – Methods</td>
<td>7</td>
<td>Description of external review purpose (feedback on draft recommendations), methods, methods, information gathered, and how the information</td>
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<tr>
<td>14. A procedure for updating the guideline is provided.</td>
<td>• Clinical practice guideline development report – Summary, Development of Guideline Recommendations</td>
<td>7</td>
<td>Described the guideline date, an explicit timeline for guideline updates, and mechanism for updates.</td>
</tr>
<tr>
<td>Domain 4. Clarity of Presentation</td>
<td>• Clinical practice guideline development report – Summary, Table 2</td>
<td>7</td>
<td>Explicitly states the recommended action, purpose of the recommended action, recommended population, and qualifying statements</td>
</tr>
<tr>
<td>15. The recommendations are specific and unambiguous.</td>
<td>• Clinical practice guideline development report – Summary, Table 2</td>
<td>7</td>
<td>Specific recommendations are grouped together in the Summary, Final Guidelines, and Results sections.</td>
</tr>
<tr>
<td>16. The different options for management of the condition or health issue are clearly presented.</td>
<td>• Clinical practice guideline development report – Dissemination and implementation</td>
<td>N/A</td>
<td>The sedentary behaviour guidelines focus on the use of sedentary behavior and health outcomes.</td>
</tr>
<tr>
<td>17. Key recommendations are easily identifiable.</td>
<td>• Clinical practice guideline development report – Summary, Final Guidelines</td>
<td>7</td>
<td>Description of potential barriers and facilitators to framing guideline recommendations, and messaging to improve guideline adherence in progress.</td>
</tr>
<tr>
<td>Domain 5. Applicability</td>
<td>• Clinical practice guideline development report – Summary, Dissemination and Implementation</td>
<td>2 (interim score)</td>
<td>Description of dissemination efforts (conference presentations, linkage with ParticipACTION and AHKC, media campaigns),</td>
</tr>
<tr>
<td>18. The guideline describes facilitators and barriers to its application.</td>
<td>• Clinical practice guideline development report – Summary, Dissemination and Implementation</td>
<td>2</td>
<td>Description of dissemination efforts (conference presentations, linkage with ParticipACTION and AHKC, media campaigns),</td>
</tr>
<tr>
<td>19. The guideline provides advice and/or tools on how the recommendations can be put into practice.</td>
<td>• Clinical practice guideline development report – Summary, Dissemination and Implementation</td>
<td>6</td>
<td>Description of dissemination efforts (conference presentations, linkage with ParticipACTION and AHKC, media campaigns),</td>
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</tr>
<tr>
<td>20. The potential resource implications of applying the recommendations have been considered.</td>
<td>Implementation</td>
<td>1</td>
<td>summary document, and plans for future tools. We do not discuss the potential resource implications of applying the recommendations.</td>
</tr>
</tbody>
</table>
| 21. The guideline presents monitoring and/or auditing criteria. | • Clinical practice guideline paper – Dissemination and Implementation  
• Clinical practice guideline development report – Surveillance  
• Clinical practice guideline paper - Surveillance | 6 | Identifies data sources and links that monitor guideline concordance. Provides an example of how one of the data sources will monitor guideline concordance. |

**Domain 6. Editorial Independence**

| 22. The views of the funding body have not influenced the content of the guideline. | • Clinical practice guideline development report – Summary  
• Clinical practice guideline paper - Acknowledgements | 7 | Funding sources identified, and statement that the funding sources did not influence guideline content. |
| 23. Competing interests of guideline development group members have been recorded and addressed. | • Clinical practice guideline development report – Development of Guideline Recommendations, Appendix A | 7 | Description of types and methods of data collection for competing interests. |

**Legend:**
Clinical practice guideline development report = Canadian Sedentary Behaviour Guidelines for Children (5-11 years) and Youth (12-17 years), Clinical Practice Guideline Development Report, *Canadian Society for Exercise Physiology*

APPENDIX C

List of organizations that were contacted for stakeholder consultation
Active Healthy Kids Canada
Active Living Alliance for Canadians with a Disability
Active Living Coalition for Older Adults
Alberta Centre for Active Living
Alberta Health Services
Alberta Recreation and Parks Association
Alzheimer Society of Canada
Arctic Health Research Network - Yukon
Asthma Society of Canada
Autism Society of Canada
BC Coalition of People with Disabilities
Be Fit For Life Centre, University of Calgary
Best Start
Boys and Girls Clubs - Alberta
Boys and Girls Clubs - Ontario
Boys and Girls Clubs of Canada
Canada Safety Council
Canadian Academy of Sport Medicine
Canadian Association for Community Living
Canadian Association for School Health
Canadian Association for the Advancement of Women in Sport and Physical Activity
Canadian Association of Cardiac Rehabilitation
Canadian Association of Family Resource Programs
Canadian Association of Gerontology
Canadian Association of Occupational Therapists
Canadian Association of Principals
Canadian Association of Retired Persons (CARP)
Canadian Association of Social Workers
Canadian Athletic Therapists Association
Canadian Cancer Society
Canadian Centre for Activity and Aging
Canadian Centre for Stress and Well-Being
Canadian Child Care Federation
Canadian Chiropractic Association
Canadian Diabetes Association
Canadian Ethnocultural Council
Canadian Fitness and Lifestyle Research Institute
Canadian Forces Personnel Support Agency
Canadian Healthcare Association
Canadian Home and School Federation
Canadian Home Care Association
Canadian Institute of Child Health
Canadian Institute of Planners
Canadian Intramural Recreation Association
Canadian Labour Congress
Canadian Medical Association
Canadian MedicAlert Foundation
Canadian Mental Health Association
Canadian Network for Leadership in Education and Early Learning & Care
Canadian Nurses Association
Canadian Organization for Rare Disorders
Canadian Orthopaedic Foundation
Canadian Paediatric Society
Canadian Parks and Recreation Association
Canadian Physiotherapy Association
Canadian Public Health Association
Canadian Red Cross
Canadian Senior Games Association
Canadian Sport Massage Therapist Association
Canadian Teachers Federation
Centre for Education and Research on Aging and Health
Children's Hospital of Eastern Ontario
Coalition for Active Living
College of Physicians and Surgeons of Ontario
Conseil communautaire en santé du Manitoba
Conseil scolaire acadien provincial
Culture, Heritage, Tourism and Sport, Government of Manitoba
Dept of Tourism, Culture and Recreation - Government of Newfoundland and Labrador
Dept of Tourism, Parks and Recreation - Government of Alberta
Dept. of Community Services, Sport and Recreation Branch - Government of Yukon
Dept. of Culture, Language, Elders and Youth - Government of Nunavut
Dept. of Culture, Language, Elders and Youth - Government of Nunavut
Dept. of Education - Government of Newfoundland and Labrador
Dept. of Health and Community Services - Government of Newfoundland and Labrador
Dept. of Health and Wellness - Government of Prince Edward Island
Dept. of Health Promotion & Protection - Government of Nova Scotia
Dept. of Human Resources, Labour and Employment - Government of Newfoundland and Labrador
Dept. of Municipal and Community Affairs, Sport, Recreation, Youth and Volunteerism - Government of Northwest Territories
Dept. of Municipal and Community Affairs, Sport, Recreation, Youth and Volunteerism - Government of Northwest Territories
Dept. of Wellness, Culture and Sport, Government of New Brunswick
Dieticians of Canada
Doctors Nova Scotia
Early Childhood Development Intercultural Partnership
Eastern Health
Ever Active Schools (Alberta)
Faculty of Physical Education and Recreation - University of Alberta
First Nations Child and Family Caring Society
Focus on Fathers Program - Catholic Community Services of York Region
Fondation Lucie et André Chagnon
Girl Guides of Canada
Healthy Indoors Partnership
Healthy Start for Mom and Me
High Five Program, Parks and Recreation Ontario
Hospital for Sick Children

Canadian Society for Exercise Physiology, February 2011
Industrial Accident Prevention Association
Institut Pacific
Institute of Musculoskeletal Health and Arthritis, Canadian Insitutes of Health Research
Invest in Kids
IWK Health Centre
Joint Consortium for School Health
Lawson Health Research Institute
Lets Go Green Canada
March of Dimes
Mi’kmaw Kina’matnewey, Nova Scotia
Ministry of Children and Youth Services - Government of Ontario
Ministry of Education - Government of Ontario
Ministry of Health Promotion - Government of Ontario
Ministry of Tourism, Parks, Culture and Sport - Government of Saskatchewan
Moncton Headstart
National Aboriginal Diabetes Association
National Aboriginal Health Association
National Association of Federal Retirees
National Association of Friendship Centres
National Indian & Inuit Community Health Representatives Organization
National Pensioners and Senior Citizens Federation
New Brunswick Gymnastics Association
New Brunswick Lung Association
Older Adults Centres’ Association of Ontario
One Voice, The Canadian Seniors Network
Ontario Public Health Association
Osteoporosis Canada
Pan-Canadian Public Health Network
Parkgate Community Services
Parks and Recreation Ontario
ParticipACTION
Physical Activity Coordinator, Richmond County, Nova Scotia
Physical and Health Education Canada
Physical Literacy Wapiti Project - Saskatchewan
Psychologists Association of Alberta
Recreation and Parks Association of the Yukon
Recreation Connections Manitoba
Recreation Newfoundland and Labrador
Recreation Newfoundland and Labrador
Recreation Nova Scotia
Registered Nurses Association of Ontario
Reh-Fit Centre
Right to Play Canada
Road Scholar (Elderhostel Inc)
Royal College of Physicians and Surgeons of Canada
Safe Kids Canada
Saskatchewan Parks and Recreation Association
Saskatchewan Seniors Mechanism
Scouts Canada
SmartRisk
Society of Obstetricians and Gynaecologists of Canada
Special Olympics Canada
Stanton Territorial Health Authority
The Arthritis Society
The Canadian Association of Naturopathic Doctors
The Canadian Centre for Occupational Health & Safety
The Canadian National Institute for the Blind
The College of Family Physicians of Canada
The Federation of Canadian Municipalities
The Heart and Stroke Foundation of Canada
The Lung Association
The Royal Canadian Legion
The Salvation Army
UNICEF Canada
United Way of Canada
Victorian Order of Nurses for Canada
Yellowknife Family Centre
YMCA Canada
YMCA Fitness / YMCA Calgary
YMCA Ontario
YWCA Canada
APPENDIX D
List of those who helped in the development of the Canadian Sedentary Behaviour Guidelines for Children and Youth.

Systematic Review
Submitted, 2011

<table>
<thead>
<tr>
<th>Paper</th>
<th>Author</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mark Tremblay, Ph.D.</td>
<td>Director, Healthy Active Living and Obesity research, Children’s Hospital of Eastern Ontario (Canada)</td>
</tr>
<tr>
<td></td>
<td>Allana LeBlanc, M.Sc.</td>
<td>Healthy Active Living and Obesity research, Children’s Hospital of Eastern Ontario (Canada)</td>
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<td></td>
<td>Michelle Kho, P.T., Ph.D.</td>
<td>Department of Physical Medicine &amp; Rehabilitation, Johns Hopkins University (U.S.A)</td>
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<tr>
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<td>Rachel Colley, Ph.D..</td>
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<tr>
<td></td>
<td>Travis Saunders, Ph.D(c)</td>
<td>Healthy Active Living and Obesity research, Children’s Hospital of Eastern Ontario University of Ottawa (Canada)</td>
</tr>
<tr>
<td></td>
<td>Richard Larouche, Ph.D (c)</td>
<td>Healthy Active Living and Obesity research, Children’s Hospital of Eastern Ontario University of Ottawa (Canada)</td>
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<tr>
<td></td>
<td>Gary Goldfield, Ph.D.</td>
<td>Healthy Active Living and Obesity research, Children’s Hospital of Eastern Ontario (Canada)</td>
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<tr>
<td></td>
<td>Sarah Connor Gorber, Ph.D.</td>
<td>Office of the Task Force on Preventive Health Care, Public Health Agency of Canada (Canada)</td>
</tr>
</tbody>
</table>

Consensus Meeting and Creation of Draft Sedentary Behaviour Guidelines
November 2010, Toronto, Ontario, Canada

<table>
<thead>
<tr>
<th>Panel Member</th>
<th>Affiliation</th>
<th>Role</th>
<th>Declaration of Conflict of interest</th>
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<tr>
<td>Mark Tremblay, Ph.D.</td>
<td>Director, Healthy Active Living and Obesity research, Children’s Hospital of Eastern Ontario (Canada)</td>
<td>Chair</td>
<td>No</td>
</tr>
<tr>
<td>Ian Janssen, Ph.D.</td>
<td>School of Kinesiology and Health Studies, Queen’s University (Canada)</td>
<td>Systematic Review Author, Content Expert</td>
<td>No</td>
</tr>
<tr>
<td>Mary Duggan, CAE</td>
<td>Manager, Canadian Society for Exercise Physiology (Canada)</td>
<td>Steering Committee</td>
<td>No</td>
</tr>
<tr>
<td>Audrey Hicks, Ph.D.</td>
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</tr>
<tr>
<td>Kelly Murumets, MSW, MBA</td>
<td>President and CEO, ParticipACTION (Canada)</td>
<td>Steering Committee</td>
<td>No</td>
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<tr>
<td>Rachel Colley, Ph.D</td>
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</tr>
<tr>
<td>Tony Okely, Ph.D.</td>
<td>Physical and Health Education, University of Wollongong (Australia)</td>
<td>Content Expert, International Representative</td>
<td>No</td>
</tr>
<tr>
<td>Ulf Ekelund, Ph.D.</td>
<td>MRC Epidemiology Unit, Cambridge University (U.K.)</td>
<td>Content Expert, International Representative</td>
<td>No</td>
</tr>
<tr>
<td>Tom Warshawski, M.D.</td>
<td>Kelowna General Hospital, BC Forum on Childhood Obesity and the Childhood Obesity Foundation (Chair)</td>
<td>Paediatrician and Childhood Obesity Foundation Representative</td>
<td>No</td>
</tr>
<tr>
<td>Michelle Mottola, Ph.D.</td>
<td>Exercise and Pregnancy Lab, University of Western Ontario (Canada)</td>
<td>Content Expert</td>
<td>No</td>
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</tbody>
</table>
Stephanie-May Ruchat, Ph.D.  
Exercise and Pregnancy Lab, University of Western Ontario (Canada)  
Content Expert  
No

**Final Sedentary Behaviour Guideline Development**  
December 2010, Ottawa, Ontario, Canada

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