

# ***Healthy Weights: Halton Takes Action:***

**A Report to the Community**



**July, 2011**

## **Healthy Weights: Halton Takes Action**

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### **Ethics approval**

Ethics approval for this research was initially received from Ryerson University and subsequently from Memorial University. Participants in the community consultation process were asked if they were willing to be contacted by researchers to complete the partnership self-assessment tool (PSAT). The research team decided against administering the PSAT because several Halton groups were concurrently administering it.

### **Notices and disclaimers**

The Regional Municipality of Halton assumes no responsibility or liability for the use or accuracy of any data provided by the Region.

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## Key Messages from Healthy Weights: Halton Takes Action

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In 2004, Ontario's Chief Medical Officer of Health expressed alarm that almost half of the province's adults were overweight. Worse, obesity in our children has become an epidemic. Why is this happening? There is a consensus among experts that genetics alone can't explain our rapidly rising rates of obesity. And there is a consensus that we should each take responsibility for managing our weight through a healthy diet and an active lifestyle. That is an especially important responsibility for parents, whose personal choices set the template for their children.

But do our social and physical environments get in the way of families who want to make healthy choices? Does it make a difference if a neighbourhood is "walkable," with lots of sidewalks and easy access to fruit and vegetable stores? Do school programs that offer a healthy breakfast make a difference? Researchers have come to believe that *social* and *ecological* factors – and there are many more of them – could play a part in solving the obesity problem. How can we measure their impact? And which environmental changes have the biggest impact on obesity rates?

An initiative taking place in Halton Region called Healthy Weights Halton Takes Action is working with community members, police, school officials, urban planners, local produce advocates – anyone with a stake in healthy weights. They have started to plan changes to Halton's environment that might affect obesity levels in the future.

Will these changes have a measurable effect? To answer this question, this study develops a baseline to inform program planning and future evaluations. The first step was to develop a model for collecting data about Halton's population and the various factors in the environment that might affect weight. Building a statistical model to examine the associations among all these factors is a complex exercise. To that end, Halton's health department partnered with Dr. Wendy Young, Canada Research Chair at Memorial University, and her research team, to develop the statistical model and research tools needed for the job. Their work was supported by the Canadian Institutes of Health Research. This report explains how they developed the tools, and what they've learned so far.

The preliminary or baseline findings, which drew data from a 2006 survey of Grade 7 students, confirmed that socio-economic status and an active lifestyle were still the most powerful predictors of healthy weight in children. Poverty within a neighbourhood, as measured by a mother's level of education, had a negative impact on children's weight. Whether a child ate breakfast seemed to be a key variable in maintaining a healthy weight. The amount of time a child spent in front of an electronic screen also mattered. In short, an active lifestyle, which includes physical activity, fewer hours spent in sedentary activity, and eating breakfast, was shown to be associated with healthy weight in Halton children.

Halton, whose residents live in suburban neighbourhoods for the most part, was not a friendly environment for active children when measured against the factors used in this study. However, the current study did not show an association between the built environment and the children's weights as predicted. It remains to be seen whether initiatives to enhance the environment in Halton will have as positive an impact on children's weights as is being increasingly suggested by research conducted elsewhere. Work on bringing about change to address the obesity epidemic in Halton is continuing. The Halton Region Health Department is committed to working with the community, with the intent to mobilize for action.

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# Executive Summary

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## The issue

In the first years of the 21<sup>st</sup> century, public health officials began to raise the alarm over rising obesity rates in both adults and children, and all the resultant health risks. Halton Region is a predominantly suburban regional municipality in southern Ontario with some rural populations; its family income levels are higher than average. Halton's Health Department acted quickly to respond to this challenge by bringing community stakeholders together to help forge an action plan. The network of stakeholders it consulted with included representatives from the health sector, governments, the food industry, the recreation industry, workplaces, schools, parents and caregivers, and youth.

The network of stakeholders developed three priorities:

- Develop walkable and bikeable communities.
- Increase the availability of healthy food choices in the community.
- Ensure community coordination of the Healthy Weights Initiative.

As a municipality, Halton is committed to applying evidence to its initiatives. To that end, the Health Department partnered with academic researchers to help clarify the relationships between the physical and nutrition environments and healthy weights in Halton.

## The approach

The purpose of this research project was to set a baseline against which Halton could measure its future initiatives. Drawing from data collected through a detailed survey of a large sample of Grade 7 Halton students in 2006, the researchers used sophisticated statistical tools to attempt to find associations between a range of lifestyle and environmental factors and the body mass index (BMI) of Grade 7 children across Halton neighbourhoods.

## The hypotheses

The research team developed five hypotheses:

**Hypothesis 1:** Walkability will be associated with self-reported levels of physical activity and ‘screen time’ (time children spend on the computer, watching TV, or playing video games).

**Hypothesis 2:** The nutrition environment (average distance to a fruit and vegetable store) will be associated with self-reported daily consumption of fruits and vegetables.

**Hypothesis 3:** Body Mass Index (BMI, an indicator of healthy weight) will be associated with level of daily physical activity and daily screen time, and daily consumption of fruits and vegetables.

**Hypothesis 4:** BMI will be associated with walkability and the nutrition environment, level of daily physical activity and screen time, and consumption of fruits and vegetables, controlling for neighbourhood socio-economic status (SES). Since low socio-economic status is known to be associated with overweight, we wanted to control this factor so that we could see what other factors were at play.

**Hypothesis 5:** Results will vary based on sex.

## The results

The relatively uniform suburban environment impacted the results. Grade 7 students in the neighbourhoods with the highest walkability scores—noting that the highest walkability scores in Halton fall well below walkability scores of denser urban environments—did not report being more physically active; nor did they have lower levels of ‘screen time’ than students in neighbourhoods with low walkability scores. Changes that Halton makes to the built environment

to promote higher physical activity and lower BMI in children will have to be mindful of the suburban setting's limitations.

Walking distance to a fresh food store was not associated with BMI for grade 7 students. This may be because Halton is a relatively prosperous municipality and most families use a car for grocery shopping. However, eating breakfast was associated with healthier weights, as has been found in other studies.

The most significant predictor of lower BMI levels in the Grade 7 children was their Active Lifestyle score—a combined score for physical activity, lower screen time, and eating breakfast. Students who reported an active lifestyle were less likely to be overweight or obese than were other Grade 7 students. The association between active lifestyle score and BMI held when accounting for both mother's education (socio-economic status) and the sex of the student.

### **The implications**

This study supports recommendations made by community stakeholders during Halton's initial consultation process to implement the Living School model in Halton, making the schools a hub for active living. For regional decision makers, the findings support the inclusion of active living for children as part of the municipality's vision for Halton official planning. For Halton's population, the findings underscore the need for further action to promote more active lifestyles.

## Part 1: Context

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*“We’ve got morbidly obese children whose lives are being threatened by this condition, an increasing number of those kids in hospitals across the country ... We are definitely mortgaging the health of a generation of our children by allowing them to become more overweight and more obese as time goes on.”*

Dr. Mark Tremblay  
Children’s Hospital of Eastern Ontario  
In an interview with Wendy Mesley, CBC National News<sup>1</sup>

### 1.1 Policy and practice issue

Across Canada, health officials have been reacting to some alarming findings:

- A 2004 report from Ontario’s Chief Medical Officer of Health expressed alarm that nearly half of the province’s adult population was overweight.<sup>2</sup>
- In just 15 years, from 1981 to 1996, the prevalence of childhood obesity in Canada increased almost fivefold.<sup>3</sup>
- By 2006, Canadian researchers had concluded that childhood obesity was a public health epidemic.<sup>4</sup>
- Obese children are at increased risk for serious health problems. These include coronary artery diseases, hyperlipidemia, hypertension, abnormal glucose tolerance, orthopaedic problems, and sleeping difficulties. The children also have lower self-esteem and more trouble with peer relationships.<sup>5</sup>
- Overweight children tend to become obese adults with chronic health problems.<sup>6, 7</sup> Treating these chronic conditions is difficult and costly.<sup>8, 9, 10</sup>

The 2004 report from Ontario’s Chief Medical Officer of Health commented on *obesogenic* environmental factors such as poor public transportation, car-centred urban design, and limited access to healthy food and recreational programs. The report examined how various groups can contribute to healthy weights. These included the health sector, governments, the food and recreation industries, workplaces, schools, parents and caregivers, communities, and individuals.

In response to the Chief Medical Officer of Health's report and the rising rates of obesity in Halton, the Halton Region Health Department organized a series of consultations, beginning in June 2007 that focused on reducing the childhood obesity epidemic.

Halton Region, located west of Toronto and Mississauga, covers almost 1,000 square kilometres stretching north from Lake Ontario. Halton has one of the fastest growing populations in Canada, an ethnically diverse population in 2006 of 450,000, the majority of whom live in small cities, towns, and suburban areas, with a small minority living in rural areas. Overall socio-economic status in Halton is above the Canadian average. Rates of obesity are lower than the Canadian average, but still a concern.

Representatives from the health sector, governments, the food industry, the recreation industry, workplaces, schools, parents and caregivers, and youth were asked to participate in two consultations. The goal was to determine priorities for community action. The partners explored the causes of and the possible solutions to the obesity epidemic in children. They discussed the programming that is currently offered within the region. In the end, the community stakeholders who took part in the consultations identified three priorities:

- Develop walkable and bikeable communities.
- Increase the availability of healthy food choices in the community.
- Ensure community coordination of the Healthy Weights Initiative.

The Halton Region Health Department made it a priority to evaluate any actions taken to combat obesity in the community. The Health Department partnered with academic researchers to help clarify the relationships between the physical and nutrition environments and healthy weights in Halton. The purpose of this research project was to set a baseline against which Halton could measure its future initiatives.

## 1.2 Research question and hypotheses

In the long term, the Health Department wants answers to two questions:

- If communities make it easier for children and their families to make healthy choices, will fewer become obese adults?
- Which healthy choices make the most difference?

As a first step, the researchers examined the relationship between physical and nutritional environments and weight before the community took action. We call this baseline data. We drew our data from the Halton Youth Survey, conducted in 2006. (See Appendix A.)

Before we started examining any data we made several predictions of what we might see. These predictions are called hypotheses. We had five working hypotheses about the associations we might see between healthy weights, individual behaviour, and factors in the environment.

**Hypothesis 1:** Walkability will be associated with self-reported levels of physical activity and ‘screen time’ (time children spend on the computer, watching TV, or playing video games).

**Hypothesis 2:** The nutrition environment (average distance to a fruit and vegetable store) will be associated with self-reported daily consumption of fruits and vegetables.

**Hypothesis 3:** Body Mass Index (BMI, an indicator of healthy weight) will be associated with level of daily physical activity and daily screen time, and daily consumption of fruits and vegetables.

**Hypothesis 4:** BMI will be associated with walkability and the nutrition environment, level of daily physical activity and screen time, and consumption of fruits and vegetables, controlling for neighbourhood socio-economic status (SES). Since low socio-economic status is known to be

associated with overweight, we wanted to control this factor so that we could see what other factors were at play.

**Hypothesis: 5:** Results will vary based on sex.

## 1.3 Earlier research

### 1.3.1 Modifiable, individual-level risks (physical activity, sedentary behaviour, nutritional intake)

In the past, attempts to reduce obesity have focused on individual lifestyle factors, such as lack of exercise and overeating. However, increasing numbers of studies are being published connecting obesity with environmental factors. The research has been inconclusive on the relationship between obesity and both physical activity and sedentary activity.<sup>11</sup> In Canada, Tremblay and Willms found that sedentary behaviour such as TV-watching and computer-gaming were associated with obesity;<sup>12</sup> others questioned that association.<sup>13, 14</sup> The evidence that overweight or obese children have a different nutritional intake from children with healthy weights is only now beginning to accumulate. In Canada, two studies have found that overweight or obese children consume fruits and vegetables much less frequently than children with healthy weights.<sup>15, 16</sup> However, after reviewing studies published between 2007 and 2009, Patro and Szajewska considered the evidence still to be inconclusive.<sup>17</sup>

It appears that childhood obesity may be associated with high levels of sugar-sweetened beverages, with frequent snacking, and with skipping breakfast. Canada's Food Guide to Healthy Eating reports that eating a healthy breakfast contributes to a healthy lifestyle.<sup>18</sup> A Canadian study indicated that children who skipped breakfast were less likely to have a healthy body weight. Diet quality was negatively associated with consuming meals outside the home, as well as skipping meals.<sup>19</sup>

It is important to note that many nutritional findings vary by sex and ethnicity, though these are not modifiable risk factors.<sup>20</sup>

### **1.3.2 Modifiable environmental risk factors (built environment or physical activity environment, nutritional environment)**

Recent studies, both in Canada and abroad, are moving beyond examining associations between obesity and individual lifestyle factors. Now, based on the *Social-ecological Model of Obesity* (see Appendix B), studies have begun to examine the relationship between obesity and the built environment. The built environment is defined as “environments that are human modified, including homes, schools, workplaces, highways, urban sprawl, and air pollution.”<sup>21</sup> Whether we walk or cycle to a park, store, or work may depend on the built environment. Most studies with adults have found significant associations between the built environment and weight status. Adults who live in walkable neighbourhoods tend to get around more by walking and cycling. They are more likely to be physically active and less likely to be overweight and obese.<sup>22</sup> A smaller number of studies have examined the relationship between children’s physical activity and walkable communities. One study cited by Bauman and Bull found that children were more active when there were sidewalks, destinations to walk to, public transport, few intersections, and low traffic density<sup>23</sup> However, the cited study did not address obesity. Faulkner et al., in their systematic review, did not find a compelling association between active transportation and healthy weights.<sup>24</sup>

In Canada, researchers have reported that children in Nova Scotia schools with some type of school nutrition program were significantly less likely to be overweight or obese than children in schools without nutrition programs.<sup>25</sup> Some studies have found that obesity rates were higher in areas with high numbers of convenience stores.<sup>26</sup> Obesity rates were lower in areas where there are many supermarkets.<sup>27</sup> Other research has shown that large supermarkets were more likely

than convenience stores and fast food restaurants to offer healthy options.<sup>28</sup> However, the evidence is inconclusive as to whether healthier weights are associated with being nearer to supermarkets, where there are healthy options at more affordable prices, though in some urban settings such an association has been shown.<sup>29</sup>

#### **1.4 This research project's contribution**

Much of the earlier research on the impact of modifiable, individual lifestyle factors (physical activity and eating patterns) has been inconclusive.<sup>30, 31, 32, 33, 34</sup> This is partly because it is largely limited to exploring simple relationships.<sup>35</sup> Some researchers have suggested that the inconsistencies may be due to differing measures of environmental factors.<sup>36, 37</sup> Results from a 2010 literature review concluded that “the lack of convincing evidence regarding the role of the environment in obesity development may be more a reflection of the quality of studies and the lack of consensus around appropriate measures, rather than the absence of a true relationship.”<sup>38</sup>

No previous research has examined the association between BMI and the following factors in a large population of Grade 7 children:

- modifiable individual-level risks (physical activity, sedentary activity, and nutritional intake)
- modifiable environmental risk factors (built environment, physical activity environment, and nutritional environment)
- neighbourhood educational levels.

Our research addresses this gap.

## Part 2: Implications

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We found the following in our sample of grade 7 students:

- Modifiable individual-level risk factors were significantly associated with BMI.
- Modifiable environmental-level risk factors were not significantly associated with BMI.
- Neighbourhood educational levels were significantly associated with BMI.

In interpreting these findings, we must be aware that the study has limitations, which we discuss later in this part of the report.

These findings mean that decision-makers should consider taking actions to promote an active lifestyle, especially in neighbourhoods with low educational levels. In addition, we need to keep up to date with research reported from elsewhere on the relationship between the built environment and obesity and consider if it is applicable to Halton. In sections 2.1 to 2.4, we discuss the key messages that these findings deliver to stakeholders in Halton Region. In section 2.5, we discuss the degree to which we can generalize from these findings, based on the Halton Region grade 7 context and study limitations.

### 2.1 Messages for school boards

While overall walkability in Halton is low, grade 7 students in each neighbourhood with some exceptions typically lived within walking distance of their schools. This finding supports recommendations that community stakeholders made during the consultation process.

Stakeholders said that school is the hub for children. They recommended that schools take a lead role in creating an environment where active living and healthy eating are the norm. Specifically, they suggested that:

- An advocacy plan be created for implementing the *Living School Model* in Halton: *“A healthy school involves a holistic approach where school administration, teachers, parents, students, and community agencies work together to create an environment that will have a positive impact on a child’s health and learning.”*<sup>39</sup>
- School boards consider mandating all schools to use the Living Schools model.

- School boards consider increasing their commitment to *Food for Thought – Halton*. This organization provides healthy breakfast programs at a majority of Halton’s public elementary schools. In November 2010 it announced that it is “facing a funding shortage that could see children go hungry.”<sup>40</sup>

## 2.2 Messages for parents and guardians

Our findings support the key messages for parents and guardians that community stakeholders made during the consultation process. They recommended that parents:

- Get their kids outside and playing. Parents do not need to have their children enrolled in structured programs as unstructured play is a good way to be active.
- Make and enforce rules and boundaries around active living and healthy eating.
- Not limit outside play as a punishment.

## 2.3 Messages for municipal government and planning division

Our findings support the key messages for the municipal government coming out of the consultation process. Stakeholders felt that regional programs serve as a foundation to build awareness, and that in Halton, there is tax base to draw from. They recommended that:

- *Sustainable Halton* and *Living Schools* be linked. (“*Sustainable Halton*” is *Halton Region’s growth management and land use response to the province’s Places to Grow Plan, the Provincial Policy Statement and the Greenbelt Plan.*<sup>41</sup>)
- The municipal government support the promotion of active living for children as part of Sustainable Halton.

## 2.4 Messages for the general public

Community stakeholders expressed many ideas about promoting active lifestyles in Halton during the consultation process. They recognized that obesity is complex and multi-factorial and the need to provide supportive environments for example:

- Celebrate what is already happening in Halton (spread the word).
- Lobby for an increase in the number of schools participating in the “living schools” initiative.
- Start “pedometer” challenges.

Childhood obesity rates have tripled in the past twenty-five years. This has prompted Canada's national broadcaster to introduce the "Live Right Now" initiative.<sup>42</sup> National statistics on activity levels have led the Public Health Agency of Canada to publish new physical activity guidelines for children.<sup>43</sup> Concerns about poverty and healthy eating were raised in December 2010 when a study from the Institute for Competitiveness and Prosperity was released. Researchers concluded that it was often cheaper to purchase unhealthy foods. The report states, "If almost 20 per cent of Ontarians living in poverty state that they cannot afford to eat fresh fruit and vegetables every day, this signals a failure to properly nourish our most vulnerable residents. Much needs to be done to overcome this problem."<sup>44</sup> The researchers conclude that this phenomenon has been noted in the rest of Canada.

## **2.5 To what extent can we generalize from this study's findings?**

Provided the jurisdictions are similar, we can generalize our findings on childhood obesity, low activity levels, and mothers' education level to Grade 7 children living elsewhere. Our findings are in line with the 2010 Active Healthy Kids Canada Report Card.<sup>45</sup> The report card showed that too many Canadian children are watching too much TV and are not active enough.

Our study adds to the body of literature that has been unable to demonstrate an association between the built environment and BMI in low density areas. This lack of association may, however, simply be due to the relative uniformity of the built environment in suburban areas. While international bodies such as the Institute of Medicine accept the association between built environments and physical activity, the evidence for the association is not strong.<sup>46, 47, 48, 49, 50</sup>

Kirk et al. (2010) conducted a scoping review to characterize the obesogenic environment, noting that "... *the evidence for a link between the obesogenic environment and obesity is rather weak,*" (p. 112), although this may be due to problems with the quality of the research included in

the review and the lack of widely-accepted, appropriate measures.<sup>51</sup> Similar conclusions are made by several other researchers. Dunton et al. (2009) conclude, *“For most environmental variables considered, strong empirical evidence is not yet available”* (p. 401).<sup>52</sup> Papas et al. (2007) say there is an urgent need for additional research in this area.<sup>53</sup> Moon (2009) concludes *“There is some way to go before we can definitively ascribe causality to the relationship between area effects and obesity.”*<sup>54</sup>

While the research between the built environment and obesity continues to evolve rapidly, especially in terms of establishing causal associations, the literature on the causal relationship between physical activity and health risk factors is clear. According to the US Centers for Disease Control and Prevention, *“Increasing energy output through increased physical activity plays an important role in preventing and reducing obesity-related illnesses and conditions such as hyperlipidemia, hyperinsulinemia, and elevated blood pressure, **even if weight is not reduced** [emphasis added].”*<sup>55</sup>

Our study has some limitations. First, our individual-level data were self-reported and did not include a comprehensive assessment of eating or activity behaviours. The children may not have accurately reported their height and weight, physical activity or fruit and vegetable consumption. However, for population-based natural experiments, Goodman et al. (2000) found that self-reported heights and weights correctly classified 96% of teenagers as to obesity status.<sup>56</sup> These researchers concluded that self-reported height and weight can be used in population-based studies to understand the factors associated with obesity. The survey questionnaire (Appendix A) also forced respondents to indicate that they were not physically active on any day that they did not have at least 90 minutes of physical activity. A child whose daily physical activity involved walking 20 minutes each way to and from school would not be considered to have been physically

active. This categorization of physical activity would cause the actual level of physical activity to be underestimated and diminish the ability to show gradation in the association between physical activity and factors thought to affect physical activity. We can also not be sure about the validity of the responses of Grade 7 children to the question, “How far did your mother go in school?”, which may affect our understanding of the impact of socio-economic status.

Second, our measurements of the built environment are based on adult concepts, which may not apply to children. It is unlikely that increasing access to sidewalks and the 16 “diverse uses” selected (aspects of the environment such as shopping, postal services, legal services, and so on), reflect destinations of 12-year-olds and would be enough to increase physical activity levels of children. On the other hand, when parents increase their own walking to local destinations, they may well take their young children along. However, “walkability” -- the way the environment facilitates getting places on foot -- may be less important for children than “playability”. There may be a stronger relationship with access, connectivity, and the quality of the facilities where children play, such as parks, open spaces, recreational centres, as well as the libraries they use and the schools they go to.

Third, the results are based on data collected at one point in time—before Halton began to take action on changing the environment to promote healthy weights—inhibiting the ability to draw conclusions on causality. This study does not address the impact of improvements to the built environment on children’s BMI. Follow-up data are needed.

Fourth, we should be cautious about generalizing the walkability data to the broader Halton population. Our study examines one age group, grade seven. The percentage of Grade 7s living close to diverse uses may be lower than the overall percentage of residents. This is because

families with children in Halton are more likely to live in single-family dwellings. Multi-family dwellings are more likely to be close to diverse uses.

We should also be cautious about generalizing to other regions. Density in Halton Region neighbourhoods is low and average access to diverse uses is poor. Of the children responding to the Halton Youth Survey in 2006, 98% indicated that their families had at least one vehicle. Moreover, incomes and education are generally high in Halton. Residents have the resources to overcome urban sprawl challenges that may affect BMI. They can more easily travel to purchase healthy food and have the money to purchase fresh fruits and vegetables. A lack of walkable environments can be offset by the ability of many Halton families to afford recreation programs for their children. The large neighbourhoods, which were selected to ensure sufficient sample size, may also have diluted the ability to determine the impact of all the factors that were averaged out at the neighbourhood level.

An international study, such as that currently being conducted by The International Physical Activity and Environment Network (IPEN), can overcome many of the limitations in the data. IPEN is examining both low and high-density countries. This will produce better evidence on the association between the built environment and obesity.

## Part 3: Approach

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This part of our report explains how we collected and analyzed information on Halton's children, their physical and eating behaviour, and their environment. We also describe our working relationship with Halton's decision-makers and our plans for the dissemination of this research.

### 3.1 Collecting information on Halton's children

In October 2006, Halton Our Kids Network conducted the first cycle of the Halton Youth Survey (HYS) with Grade 7 students. The survey questions, chosen with input from all partners, were taken mainly from previous national and provincial surveys. Please see Appendix A for a list of the survey questions that generated data for analysis in this research.

All schools in the Halton District School Board and the Halton Catholic District School Board were asked to participate in the survey. Of the 76 schools with grade 7 students, 73 schools (96%) agreed to take part.

The survey was administered through a computer-based system. Responses were entered directly into a data file. Participation was completely voluntary and students could choose to answer some or all of the questions.

### 3.2 Response Rate

Of the 5,803 eligible grade 7 students, 4,354 (75%) participated. Students with invalid or missing values for key items such as postal code were excluded. Complete information was available on 3,905 students, or 89.3% of respondents. The net response rate was 67.3%.

### 3.3 Analysis techniques

#### 3.3.1 Calculating Body Mass Index (BMI)

Body Mass Index, or BMI, is a number on a scale that indicates weight-related health risk. The higher the number is on the scale beyond the normal range, the greater the risk. The number is calculated using a person's height and weight, like this:

$$\text{BMI} = \frac{\text{weight (in kilograms)}}{\text{height}^2 \text{ (in metres)}} \quad \text{OR} \quad \frac{\text{weight (in pounds)} \times 703}{\text{height}^2 \text{ (in inches)}}$$

BMI is the key factor, or *dependent variable*, in this study. We were trying to identify other factors that show a strong *association* with BMI. We calculated the BMI for each student using the height and weight they reported in the HYS.

We used the International Obesity Task Force standard cut-off points, or *thresholds*, for determining if a person is overweight or obese for his or her age and sex.<sup>57</sup> For example, here are the BMI thresholds for 12-year-old boys and girls:

	BMI Thresholds	
Sex	Overweight	Obese
Male	21.22	26.02
Female	21.68	26.67

Overall, 14.1% or 550 of the respondents to the survey were in the overweight or obese category. This rate is considerably lower than the average for Ontario 12-year-olds (23.9%).<sup>58</sup>

We compared various factors to the student's BMIs to see which factors seemed to be more closely associated with healthier weights versus overweight.

### 3.3.2 Control variables

There are two factors that we know have a big impact on BMI.<sup>59</sup> One factor is sex – boys and girls of the same height have different average BMIs. The other factor is socio-economic status. We know that there will be more children who are overweight or obese in poorer neighbourhoods.

Since we already knew that these factors have a big influence, we wanted to *control* for them in our study. This is a way of neutralizing their statistical impact, so that the impact of other factors can emerge. For instance, we wanted to know how eating healthy foods affected BMI. We did not want socio-economic differences among neighbourhoods to affect these results.

Controlling the data for socio-economic status is the way we adjust for this.

This is how we obtained information about our control factors from the survey:

- **Sex:** Question 4 of the HYS asked the children “What is your sex?” The choices were “Male” or “Female”.
- **Socio-economic status:** We estimated the children’s socio-economic status based on their mother’s educational level. The information came from their responses to question 57 in Section J of the survey, “How far did your mother go in school?” We dropped children who answered “Don’t know” or “No mother” from the analysis. We controlled for socio-economic status at the neighbourhood level by taking the average of the educational levels of the students’ mothers for each neighbourhood.

### 3.3.3 Modifiable individual level risks (Level 1 variables)

Section F of the survey contained questions about physical activity, healthy eating, and unhealthy eating, such as junk food consumption. There were also questions about sedentary behaviour (watching TV, watching DVDs, playing video games, or using the computer). We referred to these sedentary activities as ‘screen time’.

We used a statistical technique called Principal Component Analysis (PCA) to group similar responses together, and each group was one component.

This allowed us to create two kinds of indices. The Active Lifestyle Index was a combination of physical activity, screen time, and breakfast consumption. The Healthy Food Consumption Index was a combination of fruit, vegetable, milk, and juice intake. We included breakfast consumption in the Active Lifestyle Index because it was more highly correlated with physical activity and screen time than it was with any of the Healthy Food Consumption factors and therefore may also be considered a marker for an active lifestyle.

We assigned a number or 'PCA score' to each student, based on their responses. The numbers were based on a six-point scale (-3 to 3). If the student reported making a healthier choice more frequently than the average student, his/her number for that variable would be above zero. If the student reported fewer than average healthy choices, his/her number would be less than zero.

We then used the PCA scores for our two components. We wanted to know if students with low active lifestyle scores or low healthy food consumption scores were more likely to have a high BMI than other students.

### **3.3.4 Modifiable environmental or neighbourhood factors (Level 2 variables)**

We looked at variables that have to do with patterns of human activity in the physical or *built environment* - things like urban design, land use, and the transportation system. We wanted to see if there was any relationship between these factors and the children's weights:

- Walkability Index: This index combines, into one neighbourhood score, variables that indicate the degree to which a neighbourhood is *walkable*. A walkable community is one that is friendly to the presence of people who are living, shopping, visiting, and otherwise spending time in the area. The variables we combined were: the percentage of roads with a sidewalk; the distance to a transit (bus) stop, and the distance to 16 diverse public uses (including schools).
- Average distance to a full-service grocery store or fruit and vegetable store.

### **3.3.5 Identifying Halton neighbourhoods**

We linked each student's postal code to the Statistics Canada Postal Code Conversion File. This gave us the latitude and longitude corresponding to that postal code. 'Geocoding' this

information enabled us to link each student’s data to one of 21 neighbourhoods in Halton. The neighbourhood boundaries were derived through a community stakeholder consultation process. Census tracts were joined to ensure that there were at least 30 senior kindergarten children in each neighbourhood. For a map of the Halton neighbourhoods, see Appendix C.

### 3.3.6 Calculating the Walkability Index

The Walkability Index is a seven-point scale that indicates how walkable a neighbourhood is. For instance, a score of -3 means the neighbourhood scores low on walkability. A score of 0 is average walkability, and +3 is the highest score. We derived the combined score from the following measures. It must be noted that a Halton neighbourhood with a score of +3 was nevertheless still much less walkable than a fully urban neighbourhood found in large, dense cities.

**Ratio of sidewalk to road length:** From Halton Region, we obtained 2006 sidewalk data and road data. We used Geographic Information Systems to calculate the ratio of sidewalk to road kilometre from these data.

**Average distance to 16 diverse public uses:** We found the locations for the following 16 diverse public uses, using the codes from the Enhanced Points of Interest file:

CODE	GROUP NAME
43	Postal Service (Canada for Canadian EPOI)
53	General merchandise stores
56	Apparel and accessory stores
57	Home furniture, furnishings, and equipment stores
58	Eating and drinking places
59	Miscellaneous retail
60	Depository institutions
61	Non-depository credit institutions
65	Real estate
76	Miscellaneous repair services
78	Motion pictures
79	Amusement and recreation services
80	Health services
81	Legal services
82	Educational services
84	Museums, art galleries, botanical and zoological gardens

**Average distance to a transit stop:** We obtained information on transit stops from Oakville Transit, Burlington Transit, and Milton Transit. (There is no public transit in Halton Hills.) We must note that in a relative wealthy, car-dependent suburban environment, the distance to transit may not be very relevant to the average 12-year-old.

### **3.3.7 Calculating the average distance to a full-service grocery or fruit and vegetable store**

Halton's Public Health Dietitian and Epidemiologist identified all grocery stores in Halton that offer a full line of grocery products. The definition of a grocery store was based on the Nutritious Food Basket Protocol from the Ontario Ministry of Health Promotion. Businesses identified as fruit and vegetable stores were added to the list. We used the 2006 Enhanced Points of Interest file to find the addresses for many of these. We geocoded the addresses of the stores. Using the latitude and longitude of the stores, and the latitude and longitude of each student's postal code, we calculated distances based on roads and pathways. Then we calculated the average distance within the neighbourhood.

### **3.3.8 Testing the hypotheses**

We tested our five hypotheses using hierarchical linear modelling (HLM). The analysis looked for patterns of association between variables such as walkability and the outcome of interest, BMI. HLM analysis was used because it allowed for both individual and neighbourhood values in the same model.

## **3.4 Working with decision-makers**

Halton Region's Health Department is focused on helping the community to move toward planning and decision-making based on evidence, within a collaborative environment. For example, in 2004, Halton partners created the Our Kids Network (OKN), which is a multi-sectorial, non-profit collaborative, working on behalf of children and youth in Halton. The vision of the OKN

is that “All children thrive”. There is a common understanding that children and their families will be more likely to make healthy choices if we can create positive environments.

*Healthy Weights: Halton Takes Action* was created in collaboration with the Our Kids Network and other community groups. Analysis of baseline data for the *Healthy Weights: Halton Taken Action* was done through a partnership with academic researchers formalized through the Memorial University of Newfoundland Research Office.

We hope our findings on the relationships between obesity and modifiable individual and environmental factors will help with planning for a healthy Halton.

### **3.5 Plans for sharing what we have learned from this study**

To date, the research team and our Halton partners have presented findings from this research at:

- the Canadian Public Health Association’s national conference held in Toronto in June 2010
- the 3rd International Congress on Physical Activity and Public Health, held in Toronto in May 2010.
- the 3rd Conference on Recent Advances in the Prevention and Treatment of Childhood & Adolescent Obesity: Families in Focus in Hamilton, October 2010.
- the 5<sup>th</sup> Nursing Research Day conference held in St. John’s in October 2010.

The results of our research will be publically available on the Region’s website. To ensure that the results of the research could be shared as widely as possible in the Halton community, the Research Team engaged Clear Language and Design editorial services to assist with this report.

The Healthy Weights Research Team recommends that the Healthy Weights: Halton Takes Action team continue to work with community stakeholders to mobilize the community to action.

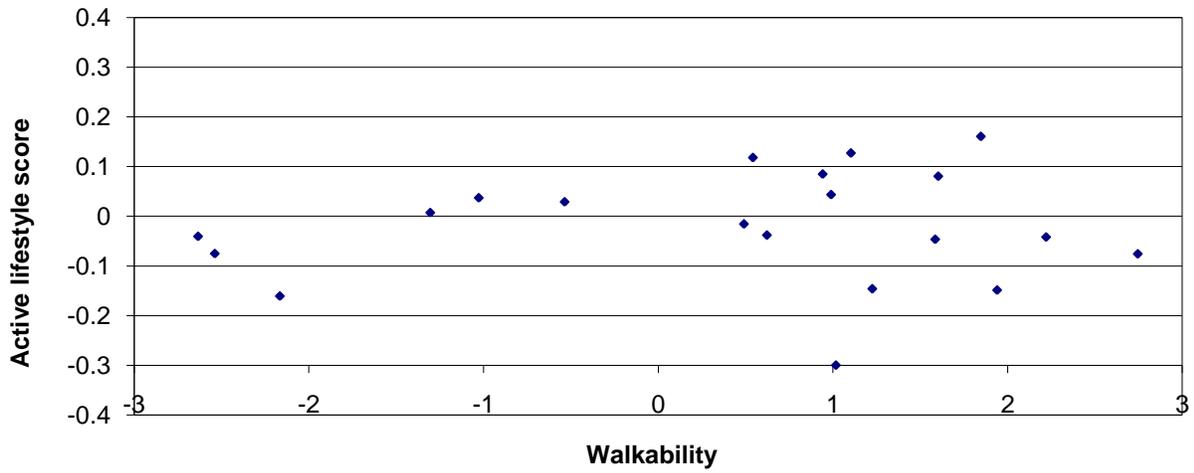
## Part 4: Results

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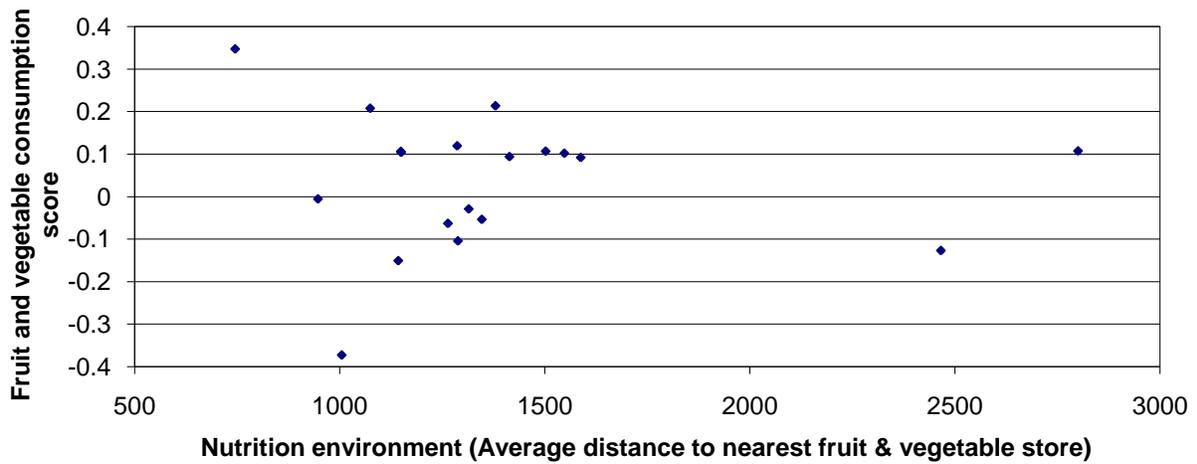
In this section, we report on results that directly relate to our conclusions. Detailed results on the participants and their neighbourhoods are in Appendix F.

### 4.1 Summary of our findings

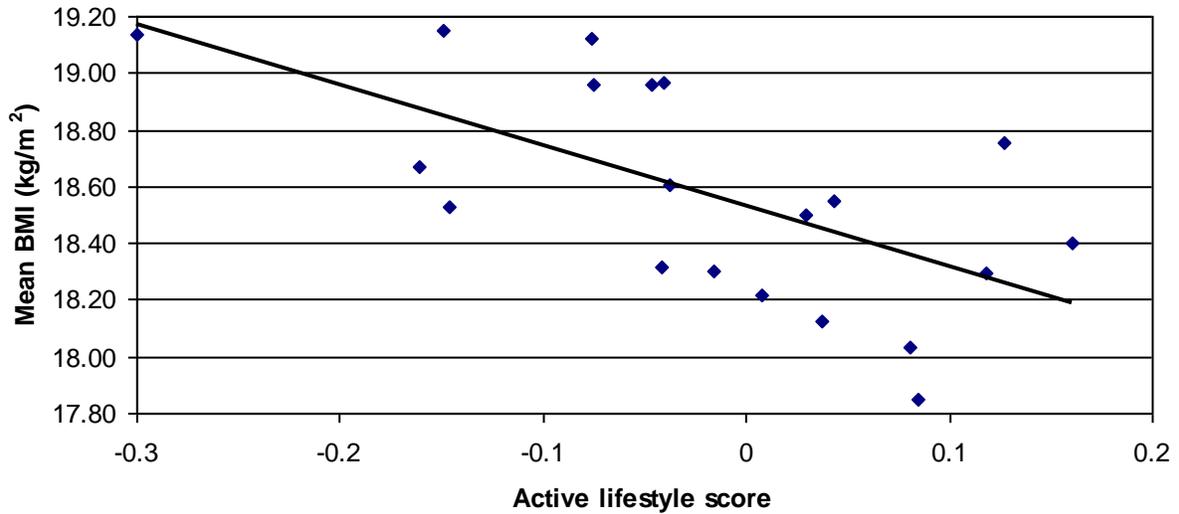
- Students who lived in a walkable neighbourhood were not more likely to have an active lifestyle than students who lived in a neighbourhood that was less walkable, though one must bear in mind that the differences in walkability between various Halton neighbourhoods was not very high. (See Figure 4.1.1)
- Students who lived close to a fruit and vegetable store were not more likely to eat fruits and vegetables than students who lived further from such a store. (See Figure 4.1.2)
- The students who had significantly lower BMIs had an active lifestyle. They were physically active, had low levels of screen time, and ate breakfast. (See Figure 4.1.3.)
- Students' fruit and vegetable consumption was not associated with BMI.
- Students who lived in a neighbourhood with higher socio-economic status (SES) had significantly lower BMIs ( $p=.003$ ). Mothers' education was used as proxy for SES. (See Figure 4.1.4.)
- BMI for girls was significantly lower than for boys ( $p<.001$ ). Of the 1,925 girls, 201 (10.4%) were overweight or obese, compared to 349 of the 1,980 boys (17.6%).



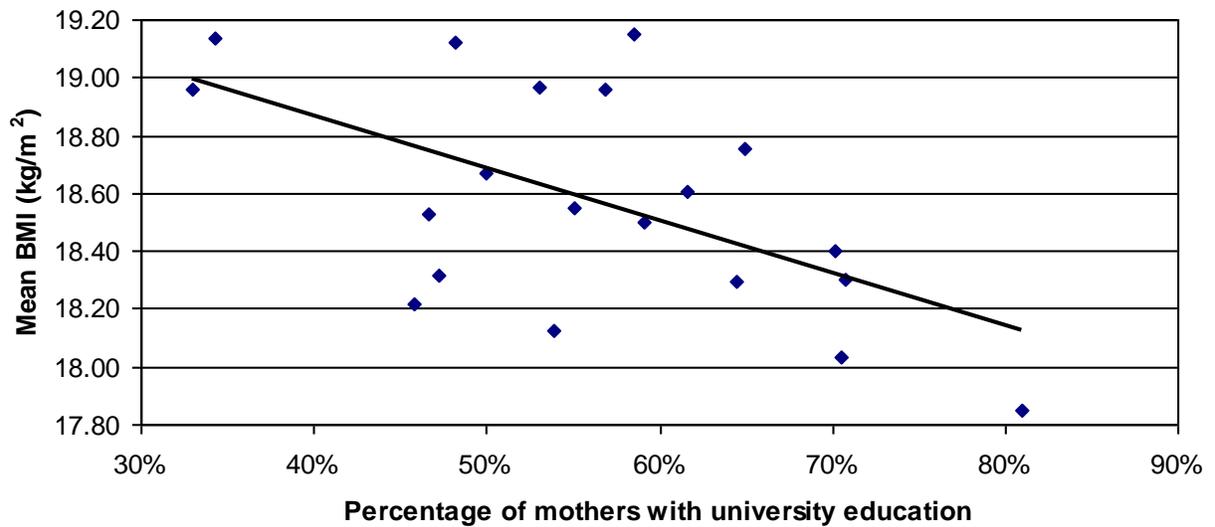
**Figure 4.1.1** This is a scatter plot diagram of the Walkability Index and Active Lifestyle score for Halton Region neighbourhoods in 2006.



**Figure 4.1.2:** This scatter plot diagram shows the lack of association between nutrition environment and fruit and vegetable consumption in Halton Region neighbourhoods in 2006.



**Figure 4.1.3** shows the association between active lifestyle score and BMI at the neighbourhood level in Halton Region in 2006 (not including Rural North Halton).



**Figure 4.1.4:** This scatter plot diagram shows the association between average BMI and the average educational level of students' mothers in Halton Region neighbourhoods (not including Rural North Halton) in 2006.

## Part 5: Further Research

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### 5.1 Gaps in our knowledge of individual-level risk factors

More studies are needed to examine the three most important modifiable individual-level risk factors contributing to the increase in childhood obesity:

- physical activity
- sedentary activity
- nutritional intake

Children today are more likely to be driven to school and are less likely to walk. Active outdoor games have been replaced with sedentary computer games. Eating in fast-food restaurants is commonplace. Junk food and food additives are everywhere. Which of the many changes that have taken place over a generation are most heavily implicated in the rising prevalence of childhood obesity? We do not yet know.

### 5.2 Gaps in our knowledge of the physical environment

More research is needed into the characteristics of both the physical and nutritional environments that are important for children of all ages. We know little about the association between “playability” and obesity. For example, what are the characteristics of the physical environments, such as parks, where children play? Which environments contribute most to healthy weights? We also know little about the environments that are important for children’s dietary patterns, such as homes and schools.

### 5.3 The need to evaluate population-level interventions

There is increasing evidence that population-level interventions based on the socio-ecological approach and the broad determinants of health can have a positive impact on obesity rates. Very few Canadian community-based programs have been evaluated using population-level outcomes. Additional research would address this gap.

## 5.4 Questions on management and policy issues

Halton Region Health Department wants to know more about the impact of its initiative, *Healthy Weights: Halton Takes Action*. Will this population-level intervention, based on the socio-ecological model of health promotion and the broad determinants of health, have a positive impact on childhood obesity rates?

We suggest further research to accomplish the following:

- 1) Refine the model we used to study the relationships between physical and nutrition environments and healthy weights. Refinements to the model would address some of the measurement issues raised in Part 2: Implications.
- 2) Compare, over time, changes in the built environment of neighbourhoods and changes in BMI. However, we acknowledge that changes in suburban environments are usually hard won and modest, making it difficult to establish observable effects on average BMI.
- 3) Examine how public policies that influence healthy weights develop and are implemented over time.
- 4) Evaluate how community stakeholders experience the process of collaborating across sectors.

This additional research would generate new information about the effects of Halton's population-level intervention. Moreover, lessons learned from Halton's experience will help other communities across Canada address population-level health problems, including obesity.

## Part 6: Additional Resources

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A listing of local (Halton), provincial (Ontario), national, and international publications, web sites, and other useful sources of information for decision makers.

### 6.1 Local – Halton

Choices 4 Health [www.choices4health.org](http://www.choices4health.org)

- A community of local groups and individuals committed to working for a healthy community in Halton region. The goal is to see people achieve optimum health by choosing healthy eating, physical activity, stress management, and tobacco-free living.

Our Kids Network <http://www.ourkidsnetwork.ca/index.html>

- A multi-sectoral collaboration on behalf of children and youth in Halton region. The Network represents Halton's commitment to the healthy development and well-being of all children in the community from the womb to adolescence.

Active Halton [www.activehalton.ca](http://www.activehalton.ca)

- A network for individuals and organizations with an interest in promoting active lifestyles for all ages in the Halton region. Members come from the fitness, recreation, physical activity, health, and education sectors.

Community Development Halton <http://www.cdhalton.ca/>

- A not-for-profit agency committed to social development as a desired state of community well-being and social change as a process for achieving and sustaining social development for all members of the community.

Halton Region Health Department – Healthy Nutrition

<http://www.halton.ca/cms/one.aspx?portalId=8310&pageId=9169>

- This Halton Region Health Department website outlines the programs and services offered to individuals and organizations to help create a healthy nutrition environment.

Halton Region Health Department – Physical Activity

<http://www.halton.ca/cms/one.aspx?portalId=8310&pageId=10768>

- This Halton Region Health Department website outlines the programs and services offered to support professionals in the promotion of physical activity.

Halton Food For Thought <http://www.haltonfoodforthought.ca/>

- This agency offers school nutrition programs to both feed students and build awareness of healthy food choices. Making health food accessible for students is their top priority.

Fresh Food Box <http://choices4health.org/pages/Projects/Halton+Fresh+Food+Box>

- This agency procures fresh fruits and vegetables from local farmers and distributors and makes the produce available once a month in Halton neighbourhoods at a reasonable cost.

Food for life <http://www.foodforlife.ca/>

- Food for Life picks up surplus perishable food from grocery stores and restaurants and distributes it to those in need throughout Halton seven days a week. The emphasis is on perishable goods such as bakery items and produce.

Creating Walkable and Transit-supportive Communities in Halton

[www.halton.ca/common/pages/UserFile.aspx?fileId=18644](http://www.halton.ca/common/pages/UserFile.aspx?fileId=18644)

- This technical report discusses how the built environment can affect air quality, climate change, and physical activity. It reviews the best available health evidence related to land-use planning. It also reviews best practices related to densities, diversity, and design in terms of the creation of walkable and transit-supportive communities. The report suggests direction on the parameters required for “walkable and transit-supportive communities” in Halton.

## 6.2 Provincial

2004 Chief Medical Officer of Health Report: Healthy Weights, Healthy Lives

[http://www.mhp.gov.on.ca/en/heal/healthy\\_weights.pdf](http://www.mhp.gov.on.ca/en/heal/healthy_weights.pdf)

- Dr. Sheela Basrur’s 2004 report outlines the epidemic of overweight and obesity that is threatening Ontario’s health and recommends action.

Ontario Professional Planners Institute <http://www.ontarioplanners.on.ca/>

- The recognized voice of the province’s planning profession provides leadership on policy related to planning, development, the environment, and related issues.

Physical Activity Resource Centre <http://parc.ophea.net/>

- This agency supports physical activity promoters and key community leaders working in public health, community health centres, recreation and sport organizations, and non-government organizations. The goal is to enhance opportunities for healthy active living.

Ontario Healthy Communities Coalition <http://www.ohcc-ccso.ca/en/healthy-communities-consortium>

- The mission of this registered charity is to work with communities to strengthen their social, environmental, and economic well-being.

Heart Health Resource Centre <http://www.hhrc.net/home.cfm>

- This project of the Ontario Public Health Association is funded through the Government of Ontario’s Ministry of Health Promotion. Their mandate is to enhance the capacity of public health professionals and community partners to coordinate community planning efforts and mobilize their communities towards the development of healthy public policy within the Healthy Communities Ontario approach.

The Health Communication Unit <http://www.thcu.ca/index.htm>

- Funded by the Ontario Agency for Health Protection and Promotion, this unit trains and supports health promoters in Ontario.

Ontario Physical & Health Education Association <http://www.ophea.net/>

- This organization partners with school boards, public health, government, non-government organizations, and private sector organizations to develop groundbreaking programs and services that support healthy active schools and communities.

Parks and Recreation Ontario <http://www.prontario.org/>

- This not-for-profit is dedicated to enhancing the quality of life for the people of Ontario. It collaborates with a range of stakeholders to influence decisions and policies that support the benefits of recreation. Activities include information, advocacy, and the research and development of innovative and relevant products and services.

Heart and Stroke Foundation of Ontario Spark Together for Healthy Kids

[http://www.heartandstroke.on.ca/site/c.pvI3leNWJwE/b.5109503/k.3FCB/Spark Together For Healthy Kids.htm](http://www.heartandstroke.on.ca/site/c.pvI3leNWJwE/b.5109503/k.3FCB/Spark_Together_For_Healthy_Kids.htm)

- Spark for Healthy Kids is the Heart and Stroke Foundation's response to the growing epidemic of childhood obesity. The Ontario-wide initiative helps to inspire individuals, families, communities, businesses, and government to spark change that helps children become more physically active and eat healthier foods.

Ministry of Health Promotion <http://www.mhp.gov.on.ca/en/>

- The Ministry's vision is to enable Ontarians to lead healthy, active lives and make the province a healthy, prosperous place to live, work, play, learn, and visit. Its fundamental goals are to promote and encourage Ontarians to make healthier choices at all ages and stages of life, to create healthy and supportive environments, lead the development of healthy public policy, and assist with embedding behaviours that promote health.

Cancer Care Ontario Nutrition, Physical Activity and Healthy Body Weight

<http://www.cancercare.on.ca/pcs/prevention/bodywtexer/>

- Cancer Care Ontario is one player in a powerful partnership to promote healthy eating and active living. The partnership includes the provincial government, primary care, public health, NGOs, and schools. Cancer Care Ontario does its part to intensify efforts to support healthy eating and active living, which it believes should be at least as aggressive as efforts to combat smoking.

Best Start [http://www.beststart.org/index\\_eng.html](http://www.beststart.org/index_eng.html)

- Ontario's Maternal Newborn and Early Child Development Resource Centre supports service providers across the province of Ontario who are working on health promotion to improve the health of expectant parents and their young children. The Centre provides workshops and conferences, resources, consultations, and subject-specific information.

Minding Our Bodies Physical Activity Tool kit for mental health

<http://www.mindingourbodies.ca/toolkit>

- Minding Our Bodies is an initiative of the Canadian Mental Health Association, Ontario, in partnership with the Mood Disorders Association of Ontario, the Nutrition Resource Centre, YMCA Ontario, and York University's Faculty of Health. It is supported by the Ontario Ministry of Health Promotion. The toolkit provides easy-to-use resources to help

organizations create sustainable physical activity programs for people experiencing or recovering from serious mental illness.

Sustain Ontario <http://sustainontario.com/>

- This Ontario-based cross-sector alliance promotes healthy food and farming. Sustain Ontario takes a collaborative approach to research, policy development and action. It addresses intersecting issues related to healthy food and local sustainable agriculture. They are working towards a food system that is healthy, ecological, equitable, and financially viable.

### 6.3 National

Active Healthy Kids Canada <http://www.activehealthykids.ca/>

- This is a trusted source for “powering the movement to get kids moving”. Active Healthy Kids is a ‘go to’ source for knowledge and insight that influences thinking and action among issue stakeholders. The goal is to help them build better programs, campaigns, and policies that increase physical activity among children and youth.

Canadian Obesity Network <http://www.obesitynetwork.ca/>

- This organization acts as a catalyst for addressing obesity in Canada. It fosters knowledge translation, capacity building, and partnerships among stakeholders such as researchers, health professionals, and policy makers. The goal is to help them develop effective ways to treat and prevent obesity.

Alberta Centre for Active Living <http://www.centre4activeliving.ca/>

- This Alberta-based organization advocates for both physical activity and physical activity expertise. It is a primary source of research and education on physical activity for practitioners, organizations, and decision-makers. The Centre's mandate is to improve the health and quality of life for all people through physical activity.

ParticipACTION <http://www.participaction.com/en-us/Home.aspx?lang=en-us>

- This organization is the national voice of physical activity and sport participation. Through leadership in communications, capacity building, and knowledge exchange, they inspire and support Canadians to move more.

Canadian Association for the Advancement of Women and Sport <http://www.caaws.ca/>

- The association provides leadership and education and builds capacity to foster equitable support, diverse opportunities, and positive experiences for girls and women in sport and physical activity.

Health Canada Food and Nutrition <http://www.hc-sc.gc.ca/fn-an/index-eng.php>

- This website of the Government of Canada provides information and resources on food safety and nutrition.

Health Canada Physical Activity <http://www.hc-sc.gc.ca/hl-vs/physactiv/index-eng.php>

- This website of the Government of Canada promotes the benefits of physical activity for overall health and well-being.

Canadian Centre for Sustainable Transportation

<http://www.centreforsustainabletransportation.org/>

- This membership-based, non-profit organization facilitates best practices for the movement of people and goods over the long term.

Canadian Paediatric Society <http://www.cps.ca/english/index.htm>

- The national association of paediatricians is committed to working together to advance the health of children and youth. It does this by supporting its membership in providing excellence in health care, advocacy, education, and research.

Dietitians of Canada <http://www.dietitians.ca/>

- Dietitians of Canada is the nation-wide voice of dietitians and the most trusted source of information on food and nutrition for Canadians. They bring the knowledge and skills of their members together to inform decisions that affect food, nutrition and health, with. They have an impact at the local, regional, provincial, national, and international levels.

8-80 Cities <http://www.8-80cities.org/>

- 8-80 Cities is a Canadian-based non-profit with an international outlook. Their goal is to help create vibrant cities and healthy communities, where residents live happier lives and enjoy great public places.

Vital Signs <http://www.vitalsignscanada.ca/local-reports-e.html>

- Vital Signs is an annual community check-up conducted by community foundations across Canada. It measures the vitality of our cities, identifies significant trends, and assigns grades in at least ten areas critical to quality of life.

Right to Play <http://www.righttoplay.com/canada/Pages/Home.aspx>

- This Canadian organization strives to improve the lives of children in some of the most disadvantaged areas of the world by using the power of sport and play for development, health, and peace.

## 6.4 International

International Physical Activity Environment Network <http://www.ipenproject.org/>

- This international collaborative of researchers seeks to better understand the determinants of physical activity, toward the goal of more effective interventions and public health policies. They are specifically interested in ecological models of health behaviour led with a research focus on particular physical activities, such as walking for transport and walking for exercise or recreation. They look at the attributes of environmental settings that might encourage or discourage these behaviours.

World Health Organization <http://www.who.int/topics/obesity/en/>

- The WHO is the directing and coordinating authority for health within the United Nations system. It is responsible for leading on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support, and monitoring health trends.

Exercise is Medicine <http://www.exerciseismedicine.org/>

- This United States-based organization seeks to make physical activity a standard part of a disease prevention and treatment in the United States.

Results Based Accountability Implementation Guide <http://www.raguide.org/>

- This guide is intended for those brave souls who are working to actually implement some form of results or performance accountability in their community, city, school district, region, province, or nation. Implementation is no small matter. The leap from theory to practice requires courage, time, discipline, and some knowledge about HOW to do the work. This guide is devoted to the last ingredient. It is an attempt to summarize what we know about implementation.

Results Leadership Group <http://www.resultsleadership.org>

- This United States-based organization supports organizations, partnerships, and collaborations. Their support is multidimensional — complementary strategies delivered over time to achieve sustained impact.

# Endnotes

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## Part 1: Context

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<sup>2</sup> Ontario Ministry of Health (2004). 2004 Chief Medical Officer of Health Report: *Healthy Weights, Healthy Lives* Retrieved January 19, 2010 from Ontario Ministry of Health Website: [http://www.health.gov.on.ca/english/public/pub/ministry\\_reports/cmoh04\\_report/healthy\\_weights\\_112404.pdf](http://www.health.gov.on.ca/english/public/pub/ministry_reports/cmoh04_report/healthy_weights_112404.pdf)

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<sup>4</sup> Flynn, M.A.T., McNeil, D.A., Maloff, B., Mutasingwa, D., Wu, M., Ford, C., & Tough, S.C. (2006). Reducing obesity and related chronic disease risk in children and youth: A synthesis of evidence with 'best practice' recommendations. *Obesity Reviews*, 7(1), 7-66.

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<sup>9</sup> Singhal, N., Misra, A., Shah, P., & Gulati, S. (2010). Effects of controlled school-based multi-component model of nutrition and lifestyle interventions on behavior modification, anthropometry and metabolic risk profile of urban Asian Indian adolescents in North India. *European Journal of Clinical Nutrition*, advance online publication, 1-10. Doi 10.1038/ejcn.2009.150

<sup>10</sup> Stamatakis, E., Zaninotto, P., Falaschetti, E., Mindell, J., & Head, J. (2010). Time trends in childhood and adolescent obesity in England from 1995 to 2007 and projections of prevalence to 2015. *Journal of Epidemiology and Community Health*, 64, 167-174. Doi:10.1136/jech.2009.098723

<sup>11</sup> Parker, L., Burns, A.C., & Sanchez, E. (Eds.). (2009). *Local government actions to prevent childhood obesity*. Retrieved January 19, 2010 from [http://www.kchealthykids.org/\\_FileLibrary/FileImage/20090901iomreportfull.pdf](http://www.kchealthykids.org/_FileLibrary/FileImage/20090901iomreportfull.pdf)

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