Associations among fruit and vegetable intake, physical activity, sedentary behaviour, and EQAO scores in grade six students in Northern Ontario

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Associations among fruit and vegetables intake, physical activity, sedentary behaviour, and EQAO scores in grade six students in Northern Ontario

By

Kevin Mageto

A Master’s Thesis
Submitted to the Faculty of Graduate Studies through the Department of Kinesiology in Partial Fulfillment of the Requirements for the Degree of Master of Human Kinetics at the University of Windsor

Windsor, Ontario, Canada

2014

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ASSOCIATIONS AMONG FRUIT AND VEGETABLE INTAKE, PHYSICAL ACTIVITY, SEDENTARY BEHAVIOUR, AND EQAO SCORES IN GRADE SIX STUDENTS IN NORTHERN ONTARIO

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November 24, 2014
DECLARATION OF ORIGINALITY

I hereby certify that I am the sole author of this thesis and that no part of this thesis has been published or submitted for publication.

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ABSTRACT

The purpose of this study was to examine associations among fruit and vegetable intake, physical activity, sedentary behaviour, and Education Quality and Accountability Office (EQAO) scores in grade six students in Northern Ontario. Students from 26 schools in Porcupine and Algoma Public Health Units completed an online survey in May, 2014. Results suggested that EQAO scores (retrieved from the EQAO website; EQAO, 2014) were not associated with fruit and vegetable intake, physical activity, sedentary behaviour, gender, and/or school location [F(5,20) = 1.091, R² = 0.214, adj R² = 0.018]. EQAO scores were also not associated with knowledge of fruits and vegetables, knowledge of Canada’s Food Guide, knowledge of Canada’s Physical Activity Guidelines, gender, and/or school location [F(5,20)= .759, R² =0.160, adj R²= -0.051]. Although null results were observed, future research should investigate longitudinal and intervention based research to determine the nature of which EQAO scores are associated with health behaviours.
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CHAPTER ONE
RESEARCH ARTICLE
INTRODUCTION

The prevalence of childhood obesity has increased worldwide, including having doubled in Canada over the past 25 years. The rising rates of obesity have been associated with numerous health complications including cardiovascular diseases (Freedman, Dietz, Srinivasan, & Berenson, 1999; Owen et al., 2009; Raj & Kumar, 2010), hypertension (Raj, Sundaram, Paul, Sudhakar, & Kumar, 2010; Woodruff, Fryer, Campbell, & Cole, 2013), cancer (Caan et al., 1998; Leiba et al., 2012), and type 2 diabetes (Benson, Baer, & Kaelber, 2009). The increasing incidence of these diseases has put a significant strain on the Canadian government’s health budget (Birmingham et al. 1999; Katzmarzyk & Janssen, 2004). Factors such as poor eating habits (Garriguet, 2004; Hanning et al., 2007; Woodruff & Hanning, 2009), decreased physical activity (Colley et al., 2011), and increased sedentary behaviour (Andersen, Crespo, Bartlett, Cheskin, & Pratt, 1998; Colley et al., 2011) have been found to play a crucial role in the increasing rates of obesity. As a result, various interventions have focused on modifying one or more of these various factors in an effort to determine ways of preventing or curbing the spread of childhood obesity (Neumark-Sztainer, Hannan, Story, Croll, & Perry, 2003; Sonneville & Gortmaker, 2008; Witt & Dunn, 2012; Woodruff & Hanning, 2010).

Researchers have targeted children at various locations including family homes (Andanya, Arredondo, Alcaraz, Lindsay, & Elder, 2011), daycares (Borzekowski & Robinson, 2001), and schools (He et al., 2007; Story, Nanney, & Schwartz, 2009; Witt & Dunn, 2012). Other than families, schools and peers have the most meaning in a child’s
life and, therefore, are powerful aspects in the environment that can help form health behaviours (Bronfenbrenner, 1979).

Children spend more time at school than any other environment away from home (Frumkin, 2006). In Ontario, approximately 2.1 million students attend Ontario’s 4,850 publicly funded schools (Ontario Ministry of Education, 2014). The primary role of a school is to educate students in academic courses, social values, and civic responsibilities that will help them in their day to day lives (Frumkin, 2006). In addition, schools also provide opportunities where children can realize their full potential and develop knowledge and skills that will enable them to live a healthy and active life. For this reason, schools are identified as a key setting to promote healthy behaviours in children and adolescents (Frumkin, 2006). Through schools, more children (regardless of gender, ethnicity, and socioeconomic status) can be reached (Story et al., 2009). Part of Ontario’s mandate is to provide an environment where children will practice healthy living and develop positive influences on their attitudes, preferences, and behaviours (Ontario Ministry of Education, 2014). However, with the demands placed on schools, schools strive to maintain a healthy balance among academics, extracurricular activities, and health. Schools create an environment where physical activity, physical education, and sports can be accessed. Currently, the Canadian Physical Activity Guidelines for Children (aged five to eleven) and Adolescents (twelve to seventeen years of age) recommend that children and adolescents should engage in at least 60 minutes of moderate to vigorous intensity activities daily (also indicating that more time is better; Canadian Society for Exercise Physiology, 2014). Schools provide an avenue where these guidelines could be met through sports and activities during physical education classes and recess. In spite of
this, more schools are cutting time associated with physical activity to promote class instruction time, which may indirectly increase sedentary time. Trudeau and Shephard (2008) reported increased learning and memory capacity in children who engage in physical activity and sports in schools. In addition, better academic performances were observed in schools where time spent in class was cut short by an hour to increase time spent in physical activity (Trudeau & Shephard, 2008).

Schools also increase avenues where children can access nutritious offerings (e.g., snack programs). Nutritious offerings at school have been positively associated with vitamin B12 statuses (Arsenault et al., 2009), better linear growth (Arsenault et al., 2009), increased familiarity and consumption of fruits and vegetables (Tak et al., 2010), increased availability of fruit and vegetables to students from low socioeconomic families (Potter et al., 2011), well established eating patterns from childhood to adolescence (Perry et al., 1998), and academic performance (Florence, Asbridge, & Veugelers, 2008). In Northern Ontario, previous evaluations of school snack programs have reported an increase in the consumption of Milk and Alternatives (Gates, Hanning, Gates, McCarthy, & Tsuji, 2013), higher intakes of Vegetables and Fruit (He et al., 2007; Skinner, Hanning, Metatawabin, Martin, & Tsuji, 2012), and lower intakes of Other Foods (Skinner et al., 2012). However, none of the studies examined the associations among fruit and vegetable intake, physical activity, sedentary activities, and academic performance. Within Eastern Canada, two separate research studies have suggested positive associations between healthy food intake and academic performance (Florence, Asbridge, & Veugelers, 2008; MacLellan, Taylor, & Wood, 2008) and a more recent investigation of academic performance (measured through self-reported grades) across
Canada (students in grades 6-12) suggest the importance of fruit and vegetable intake for academic performance (Woodruff, Ahmed, Stefanczyk, & Manske, submitted). However, no study has examined the effects of health behaviours on academic performance, as measured by Education Quality Accountability Office (EQAO) scores. The EQAO score reflects the students’ reading, writing, and mathematical scores in relation to Ontario expectations (EQAO, 2012). It serves as an important objective and reliable assessment that adds to the current knowledge about student learning and serves as an important tool to make improvements at all levels of education (e.g., individuals, schools, school boards, and the province). The test is administered to grade 3 and 6 students across Ontario and is often used to make comparisons between schools and school boards. Despite the importance of EQAO scores in Ontario, most studies investigate ways to improve the scores through different learning strategies (EQAO, 2012). A study by Muirhead and Locker (2006) reported that better dental health was associated with high EQAO score in children in Toronto schools after controlling for extraneous factors. Perhaps health behaviours associated with good health (e.g., good nutrition, increased physical activity, and decrease sedentary behaviour) could be used to improve EQAO scores in Ontario. Given the associations among nutrition, physical activity, sedentary behaviours, and academic performance, it would be valuable to examine whether one of these factors is a better determinant of EQAO success.

Therefore, the purpose of this study is to (1) examine the associations among fruit and vegetable intake, physical activity, sedentary activities, and EQAO scores, and (2) the associations among knowledge of fruit and vegetables, Canada’s Food Guide, Canada’s Physical Activity Guidelines, and EQAO scores in grades six students in
schools in Northern Ontario. It was hypothesized that (1) fruit and vegetable intake, physical activity, and sedentary behaviour would have associations with EQAO scores, and that (2) knowledge of fruit and vegetables, knowledge of Canada’s Food Guide, and knowledge of Canada’s Physical Activity Guidelines would be associated with better EQAO scores. By establishing the associations, it was anticipated that the results would provide further evidence towards the importance of good nutrition (e.g., through school snack programs, nutrition curriculum, etc.), increasing physical activity (e.g., through physical education), and reducing sedentary time.

METHODS

As part of the University of Windsor Research Ethics Board approved study (REB #14-056) entitled *An Evaluation of the Northern Fruit and Vegetable Program*, with approvals from Porcupine Health Unit, Algoma Public Health Unit, all English and French school boards within the catchment areas of the Porcupine and Algoma Health Units, principals, parents, and participants the following study was conducted. Data were collected between the months of May and June, 2014.

Participants

Participants for the current study were taken from a larger study investigating the influence of a snack program on fruit and vegetable intake, likeability, knowledge, and self-efficacy among grade 5-8 students. Within the catchment area of the Porcupine Health Unit, all schools in 4 different school boards (English and French/Public and Catholic) and band authorities were invited to participate (n=50). Within the catchment area of the Algoma Public Health Unit, a representative sample of schools were chosen, based on sociodemographic variables, and invited to participate (n=14). Upon conclusion
of the data collection, 21 schools from Porcupine and 14 schools from Algoma participated. There were no differences in respondents by gender, age, ethnicity, urban/rural school status, between the health units, and so all data were combined. For the present study, only grade 6 students were chosen, as they also completed the EQAO testing in June, 2014.

Validity of sample size. Maxwell (2000) mentions that the rule of thumb for power to detect the regression coefficient of a single predictor with outcome with a total of \( p \) predictors (where \( p \) is the amount of predictors) at 80% power and a type one error of 0.05 is given by the formula \( 22 + p \). This research had 5 predictors meaning the minimum number of schools required to get a small effect would be 27 schools. Since 64 schools were requested to participate in the study (35 of which were available for this analysis), the sample was valid for a small effect size.

Apparatus and Materials

For this research study, a web-based survey was administered to students participating in the Northern Fruit and Vegetable Program Evaluation study (paper-based surveys were available for those schools not wanting to do it electronically and/or not able to do it electronically). The survey was hosted by Fluid Surveys (Fluid Surveys, 2014), as subscribed to by the University of Windsor at no charge. All survey questions were retrieved from previous surveys used in other health research studies in children and adolescents (see Appendix A for a list of all the questions and Appendix B for questions used in these analyses). All surveys and consent forms were available in both English and French (see Appendix C for a copy of the English consent form).
**Variables of interest.** The variables of interest, as taken from the student survey included fruit and vegetable intake, frequency of physical activity, frequency of sedentary behavior, knowledge of fruits and vegetables, knowledge of Canada’s Food Guide, and knowledge of Canada’s Physical Activity Guidelines, in addition to gender. School location was determined via school postal code (i.e., forward sortation code).

Fruit and vegetable intake was measured using questions developed and used by Statistics Canada on the Canadian Health Measures Survey (CHMS; Statistics Canada, 2004). The questions were validated in previous studies analyzing the efficiency of the 5 A Day for Better Health Program food frequency questionnaire (Baranowski et al., 1997; Di Noia & Contento, 2009). Physical activity and sedentary behaviour were measured from questions recently agreed upon as core indicators of health via a project led by the Propel Centre for Education Health Impact in an attempt to use consistent measures to generate reports and compare indicators across Canadian studies (Card et al., 2012). The two questions (one for physical activity and one for sedentary behaviour) were developed to be used in school settings for assessments of physical activity/extracurricular activities and time spent engaging in sedentary behaviour. The questions are to be used for children and adolescents (aged 10 to 19 years) regardless of their living, working, and playing environments. For the purpose of this study, physical activity is defined as the proportion of youth who report obtaining 60 minutes of moderate to vigorous physical activity for five out of the previous seven days (Card et al., 2012). Sedentary behaviour is defined as the proportion of youth who report their recreational screen time as no more than 2 hours per day on five out of the previous seven days (Card et al., 2012).
Participants were asked to indicate their knowledge of fruits and vegetables, and knowledge of Canada’s Food Guide, based on questions selected from the *Eating Habits of Children* survey (Adamo et al., 2013) and *Having Fun with Fruits and Vegetables* survey (He et al., 2007). The knowledge of fruit and vegetables questions were validated in a previous nutrition study analyzing the efficiency of the *5 A Day for Better Health Program* food frequency questionnaire (Baranowski et al., 1997; Di Noia & Contento, 2009). The question regarding knowledge of Canada’s Physical Activity Guidelines was adapted from the question about Canada’s Food Guide.

In addition to the student survey, school-level EQAO scores (2013-2014) were obtained from the EQAO website (EQAO, 2014). Table 1 describes the mean EQAO scores of schools used in these analyses. The EQAO scores are available in an individual basis, however, according to the website the results cannot be released due to the Freedom of Protection and Privacy Act. Therefore, only school-level scores are reported (EQAO, 2014). The scores are based on assessments that measure reading, writing, and mathematics comprehension of children across Ontario (EQAO, 2012). Individual (student) results are reported based on Ontario’s four levels of achievement (levels 1, 2, 3, and 4). School level results only indicate the percentage of students above level 3.

**Procedure**

**Parental consent.** Prior to data collection with the students, parental consent was obtained. Principals distributed the parental consent package to the teachers, who in turn distributed them to their students, at least one week prior to the survey data collection.

**Survey administration.** Once parental consent forms were obtained, participants were invited to the research study. Due to the location of the data collection, participants
received instructions from their classroom teachers who were briefed by the Porcupine and Algoma Public Health Units and researchers from the University of Windsor. Within the Algoma Public Health Unit area, school nurses were on site for data collection. Only students who had a signed parental consent form and who consented to participate took part in the current study. Students were reminded that they could choose not to participate in the research study, and/or answer only questions they wanted to.

Participants remained anonymous as all data collected used a coding system instead of any identifying information (i.e., name). Once all surveys were completed, participants had the chance to win a gift package (e.g., a cookbook and a reflective arm band).

**Data Analysis**

Collected data from the surveys were analyzed using IBM SPSS Statistics version 22.0 for Windows (IBM, 2014). The main objectives of this study included determining the associations among (1) fruit and vegetable intake, physical activity, sedentary activity, and EQAO scores and (2) knowledge of fruits and vegetables, knowledge of Canada’s Food Guide, knowledge of Canada’s Physical Activity Guidelines, and EQAO scores.

**Multiple regression.** Prior to running the multiple regression analyses, tests were run to ensure assumptions of linearity, independence of errors, homoscedasticity, unusual points, and normality of residuals were met. Combined reading, writing, and mathematics scores for each school for the 2013-2014 school year (released on September 17, 2014) were calculated. Since the EQAO score is a mean score of a particular school (EQAO, 2014), the mean scores of fruit and vegetable intake, physical activity, and sedentary activities for each school were calculated. Individual fruit and vegetable responses were
coded 1 to 4 (see Appendix B) and the averages of the responses taken to represent the school’s fruit and vegetable intake (i.e., higher numbers indicate higher intakes). Based on the Propel Centre for Education Health Impact (Card et al., 2012), physical activity and sedentary behaviour were coded as 0 (did not meet the guidelines) or 1 (met the guidelines). As these behaviours were measured over the previous 7 days, the average number of participants who met the guidelines on 7 days were calculated.

Multiple regression analyses were then used to determine if combined EQAO and individual EQAO (i.e., reading, writing, or mathematics) scores (dependent variable/s) were associated with school-level fruit and vegetable intake (independent variable), physical activity (independent variable), and sedentary behaviours (independent variable), along with various demographic information (i.e., gender and school location; urban vs. rural).

A multiple regression was also used to assess the second objective. The average score of knowledge of fruit and vegetables, Canada’s Food Guide, and Canada’s Physical Activity Guidelines (i.e., the percentage who correctly answered the questions) for each school were calculated. For knowledge of fruits and vegetables, the data from 3 questions were coded 1 to 5 (see Appendix B) and the mean scores were used (out of a possible 15 points). Knowledge of Canada’s Food Guide and Canada’s Physical Activity Guidelines were calculated using the percentage of students who correctly answered the question. A multiple regression was then used to determine if the EQAO score (dependent variable) could be explained by knowledge of fruits and vegetables (independent variable), knowledge of the Canada’s Food Guide (independent variable), knowledge of Canada’s
Physical Activity Guidelines, along with various demographic information (i.e., gender and school location; urban vs. rural).

RESULTS

Of the 35 schools that completed the survey only 26 were eligible for the analysis. Five out of the 35 schools did not have grade six students; therefore, they were excluded from the study. EQAO scores of four schools (out of the remaining 30) were not available publically because they had less than 15 students and need to ensure anonymity of the students (EQAO, 2014). Within the 26 schools (ranging geographically from Timmins, Cochrane, South Porcupine, Sault Ste. Marie, and Wawa, Ontario, Canada), 122 males and 147 females participated, representing students 10-13 years of age. Table 1 describes the mean fruit and vegetable intake, physical activity, sedentary behaviour, knowledge of fruits and vegetables, knowledge of Canada’s Food Guide, knowledge of Canada’s Physical Activity Guidelines, and EQAO scores.

The primary objective of this study was to determine associations among academic performance and fruit and vegetable intake, physical activity, sedentary activity, gender, and school location. After all regression assumptions were met, school-level fruit and vegetable intake, physical activity, sedentary behaviour, gender, and location were not associated with combined EQAO scores \[F (5,20)= 1.462 \ p > 0.05 \ R^2 = .268, \ adj R^2 = .085\]. For this reason, secondary analyses to investigate whether EQAO scores taken individually (i.e., reading, writing, or mathematics) would be associated with fruit and vegetable intake, physical activity, and/or sedentary behaviour were carried out. However, the results from the analyses indicated that fruit and vegetable intake, physical activity, sedentary activity, gender, and school location were not associated with reading
[F (5,20)= .797, P>.05, R² = .166, adj R² = -.042]; writing [F (5,20)= 1.438, P>.05, R² = .264, adj, R² = .081]; or mathematics scores [F (5,20)= 1.599, P>.05, R² = .286, adj R² = .107].

The secondary objective of this study was to determine if knowledge would be associated with combined EQAO scores. The multiple regression analysis revealed no associations among overall EQAO scores and knowledge of fruit and vegetables, knowledge of Canada’s Food Guide, knowledge of Canada’s Physical Activity Guidelines, gender, and/or school location F(5,20)= .759, R² = .160, adj R²= -.051. To check whether one or more of the combined scores (i.e., reading, writing, or mathematics) had an association with knowledge of fruits and vegetables, knowledge of Canada’s Food Guide, knowledge of Canada’s Physical Activity Guidelines, gender and school location, separate multiple regression tests were run. In spite of this, null results were still observed. Reading [F(5,20)= 0.899 p >0.05, R² = .184, adj R²= 0.027]; writing [F(5,20)= 0.757 p <0.05, R² = 0.159, adj R²= -0.051]; and mathematics [F(5,20)= 0.913 p <0.05, R² = .186, adj, R²= -.018] were not associated with knowledge of fruit and vegetables, knowledge of Canada’s Food Guide, knowledge of Canada’s Physical Activity Guidelines, gender, or school location.

Therefore, we failed to reject the null hypotheses for both objectives, indicating that EQAO scores are not associated with fruit and vegetable intake, physical activity, sedentary behaviour, knowledge of fruits and vegetables, and knowledge of Canada’s Food Guide or Physical Activity Guidelines.
DISCUSSION

This study examined the associations among daily fruit and vegetable intake, physical activity, sedentary behaviour, and EQAO scores, as well as, knowledge of fruit and vegetables, knowledge of Canada’s Food Guide, and knowledge of Canada’s Physical Activity Guidelines in grade six students in Northern Ontario. The results of this study indicate that EQAO scores (both combined and individual) were not associated with fruit and vegetables, physical activity, or sedentary behaviour. In addition, knowledge of fruits and vegetables, knowledge of Canada’s Food Guide, and knowledge of Canada’s Physical Activity Guidelines were not associated with academic scores.

Contrary to other Canadian studies on nutrition and academic performance (Florence, Asbridge, & Veugelers, 2008; MacLellan, Taylor, & Wood, 2008), this study indicated that fruit and vegetable intake was not associated with academic performance. Perhaps the methods used might help explain why this study failed to find associations among academics and fruit and vegetable intake. Although a standardized test was used to measure academic performance, Florence, Asbridge, and Veugelers (2008) used both individual and school-level data to conduct their analysis in order to preserve the 5,200 sample size. In the present study, only school-level data were available due to Ontario’s student privacy act (Cavoukian, 2011). For this reason, it is difficult to assess whether the lack of results was due to the reduced sample size at the school-level or the lack of associations among the variables studied. With group-level data alone, one generally cannot estimate individual-level associations (Haneuse & Bartell, 2011). In particular, concern lies where conclusions based on a group-level analysis differ from those that would have been drawn had an individual-level analysis been performed. Individual data
provides gains in power and efficiency, particularly if they represent large sample sizes (Haneuse & Bartell, 2011). The present study decreased a sample size of 269 individuals to 26 schools possibly explaining why the study lacked associations.

In another study, MacLellan, Taylor, and Wood (2008) utilized a similar measure of fruit and vegetable as the current study, however, academic achievement was measured through self-reported grades by students. Previous research on self-report versus measured data on behavioural studies indicate that self-report values are often under- or over-reported to emulate the desired outcome compared to measured data (Brener, Billy, & Grady, 2003; Goodman, Hinden, & Khandelwal, 2000); a factor that might have played a part in the results. However, due to the nature of the data, the current data set was not matched at the individual-level, but rather at the school-level.

On another note, most research on dietary intake relies on survey data (Florence et al., 2008; Maclellan et al., 2008). The surveys are based on recall of food intake, which relies on memory and could be subject to error (Dwyer et al., 1987). In order to recall, the brain has to understand what information is being asked for, search for the information needed in stored memory before responding to a particular question. Error can occur in any of these stages due to the respondent being unable to process the information at a particular stage (Dwyer et al., 1987). Research using recall methodology in children indicates that error might be prone to under reporting (Macdiarmid & Blundell, 1998), over reporting (Domel, Thompson, Baranowski & Smith, 1994) and/or misrepresentation of food (Rangan, Allman-Fairnelli, Donohoe, & Gill, 2013). The low levels of fruit and vegetable intake in this study could be attributed to recall error, thus limiting associations with academic performance. In the future, researchers should look into anonymized
individual EQAO scores compared to individual fruit and vegetable intake (recorded as children as soon as children consume them) across Ontario to ascertain whether an association exists between fruit and vegetable intake and academic performance.

In the past, the association between physical activity and academic performance has elicited mixed results in literature. Physical activity has been positively associated with academic performance (Shephard et al., 1984; Trudeau & Shephard, 2008; Miller, Melnick, Barnes, Farrell, & Sabo, 2006), while other studies reported a negative association (Tremblay, Inman, & Willms, 2000), or no associations (Ahamed et al., 2006; Stevens, Yen, Stevenson, & Lochbaum, 2008). A recurrent theme in the studies that found associations among physical activity and academics was the inclusion of a physical activity intervention (Shephard et al., 1984; Trudeau & Shephard) and/or being a longitudinal study (Miller et al., 2006). For instance, Miller et al., (2006) reported an increase in academic performance in children who participated in physical activity over time. Similarly, a six-year classical study by Shephard et al., (1984) included an intervention where physical activity time of the experimental group was increased by one hour a day while keeping the academic environment between the control and experimental group the same. The results indicated that although the control group had better grades in the first year, the experimental group outperformed their counterparts in later years of the study. The present study involved one question that asked students about their physical activity in the previous seven days. This limits conclusions to be drawn since other factors, such as self-esteem to engage in sports that week (Tremblay, Inman, & Willms, 2000), the weather conditions that would have limited physical activity and increased sedentary behaviour (Chan & Ryan, 2009), infrastructure around the school
(Macintyre, 2007), and socioeconomic status (Tremblay et al., 2000), could play a role in the physical activity participation of children. Furthermore, similar to nutrition studies, self-reported physical activity may have been overestimated in the present study.

Respondents usually report higher rates and/or more frequent activity on surveys compared to objectively measured physical activity (Brener & DeLamater, 2014; Wong, Leatherdale, & Manske, 2006). In the future, researchers should employ longitudinal studies with interventions to investigate associations between EQAO scores and physical activity.

This study did not find any associations between sedentary behaviour and EQAO scores. Research between academic performance and sedentary behaviour are variable (Haapala et al., 2014; Syvaoja et al., 2013; Tremblay, et al., 2011). For example, Syvaoja et al., (2013) reported an inverse relationship between academic performance and sedentary behavior, when sedentary behaviour was measured using a self-reported questionnaire that was similar to the one used in the present study. Opposing, Haapala et al., (2014) reported a positive association between sedentary behaviour and academic performance, likely due to the time spent in improving academic skills (e.g., reading and writing). A recent systematic review of sedentary behaviour (Tremblay et al., 2011), however, indicated that watching television for greater than 2 hours/day was significantly associated with decreased academic achievement. In the future, an intervention that includes encouraging students to read, write, and improve their arithmetic skills during sedentary time should be encouraged, rather than watching television.

The second aim of this research study was to highlight whether knowledge of fruit and vegetables, Canada’s Food Guide, and Canada’s Physical Activity Guidelines would
be associated with academic performance. Of interest, was whether knowledge imparted in the classroom through learning about the benefits of fruit and vegetables, different food groups in the Canada’s Food Guide, and the amount of time one is supposed to engage in physical activity would translate to better grades in the EQAO tests. To date, no research has investigated the links between academic performance, knowledge of fruit and vegetables, Canada’s Food Guide, and/or Canada’s Physical Activity Guidelines. The Ontario curriculum is set to help children understand the importance of physical fitness, health, and well-being and the factors that contribute to them (Ontario Curriculum, 2010). According to the curriculum, children are taught about benefits of fruit and vegetables, Canada’s Food Guide, and importance of physical activity every year from grade one to grade eight (Ontario Curriculum 2010). To this regard, an assumption was made that an association among these factors and EQAO scores would be found. However, this was not the case for this study. There are a number of limitations that may be influencing the lack of associations. Firstly, there is no way of telling whether the children were taught these subjects in their respective schools. Just because the topics are in the curriculum does not necessarily mean they are taught in school. Secondly, knowledge about nutrition and physical activity does not necessarily mean a transfer to knowledge in reading, writing, and mathematics. According to the Transfer of Learning Theory (Thorndike & Woodworth, 1901), learning occurs when learning in one context or with one set of materials impacts on performance in another context or with other related materials. For instance, learning to count servings in the Canada’s Food Guide or the amount of minutes one is supposed to be physically active each day would help in transferring simple arithmetic skills that can be used in the mathematics section of the
EQAO tests. In this case, learning that occurred in class was not associated with the standardized testing. Since little is known about the type of arithmetic, reading, or writing that children do in class compared to the EQAO testing, it is inconclusive to compare the two. On another note, behavioural studies show a low level of association or no associations at all among knowledge of behaviour and the behaviour itself (Cook & Bellis, 2001; Hammond, McDonald, Fong, & Borland, 2004). In nutrition studies for example, studies have failed to find strong associations between knowing the benefits of a healthy diet and the consumption of healthy foods (Shephard & Towler, 1992; Stafleu et al., 1996). For this reason, more studies are needed to investigate if associations do exist between knowledge of health behaviours and academic performance.

**Limitations**

During data collection, severe flooding in Northern Ontario led to certain schools being evacuated, thereby not being able to participate in the current study. This led to a decrease in the number of schools that would have added to the sample size.

Due to the location of the schools, it was expensive and hard for researchers to be present during data collection. Although researchers provided training and a script, the survey instructions may have been administered differently in each school and/or class causing different interpretation of the survey/questions. In addition, schools in Algoma had school nurses present during survey administration whereas schools in Porcupine had teachers administer the survey.

The overall sample size was 26 schools, which also may have limited the data analysis. Maxwell (2000) suggested a minimum of $22 + p$ predictors to attain an efficient sample size to obtain a small effect (i.e., 27 schools). Our sample size was 26, one less
than the recommended sample size, which may have limited the results increasing our chances of type II error.

Validation of the survey questions does not necessarily mean they are reliable. The survey questions used from CHMS (Statistics Canada, 2004) were previously used to access nutrition information from adults. Although they have been validated and continuously used for nutritional studies in children, Baranowski et al., (1997) and Di Noia & Contento (2009), expressed overestimation in children. For better and more credible results, new sets of questions geared specifically for children should be used.

A number of parents expressed lack of understanding of the consent form (due to language barrier and literacy rates). This limited the number of students who participated, therefore, limiting certain schools who would have added to the sample size.

Although school location and gender were controlled for in the analyses, socioeconomic status was not; a confounding factor that has been associated with physical activity and nutrition in previous studies (Florence et al., 2008; Tremblay et al., 2000). Higher family incomes tend to indicate better nutrition through covering the cost associated with food purchases and physical activity due to accessibility of after school programs and physical activity infrastructure especially in Northern Ontario where the weather is not always conducive (Neumark-Sztainer, 1996). Due to the large geographical distribution of the schools and the fact that the subjects were schools (and not individuals) it was difficult to control for socioeconomic status.

**Conclusion**

Although no associations were found among fruit and vegetable intake, physical activity, sedentary behavior, knowledge of fruit and vegetables, knowledge of Canada’s
Food Guide, and/or knowledge of Physical Activity Guidelines with EQAO scores, more research needs to be conducted to ascertain the findings of this research, specifically, a change in methodology. The analyses should ultimately be done with individuals, rather than at the school-level, to increase sample size and preserve the power and limit generalization of results. Since EQAO scores are not available at the individual level due to Ontario’s student privacy act (Cavoukian, 2011), an alternative solution would be to use grade seven or eight scores. For the first time in their academic careers, students in grade seven receive continuous percentage grades (e.g., 50-100% rather than A, B, C, and D; Ontario Curriculum, 2010). The percentage grades could then be anonymized by the teachers and used by researchers to match fruit and vegetable intake, physical activity, and sedentary behaviour levels. In addition, it is recommended to measure physical activity and sedentary behavior, through the use of pedometers or accelerometers, instead of using subjective methods (e.g., the use of surveys) to accurately compare physical activity, sedentary behaviour, and academic scores. Lastly, longitudinal and intervention studies could be completed to determine the benefits of various health behaviours/interventions (e.g., school snack program to increase fruit and vegetable intake, increased physical activity time) for academic success (e.g., EQAO scores).
REFERENCES


Module: *Indicators and Questions to use with Youth Respondents and/or School Setting Assessments*. St. John’s, Newfoundland and Labrador: Memorial University of Newfoundland.


Tak, N.I., Te Velde S.J., Singh, A.S., & Brug, J. (2010). The effects of a fruit and vegetable intervention on unhealthy snacks during mid-morning school breaks:
Results of the Dutch Schoolgruiten project. *Journal of Human Nutrition and Dietetics, 23*(6), 609-615.


Table 1: Grade 6 EQAO Scores by School Location.

<table>
<thead>
<tr>
<th>EQAO scores</th>
<th>Average (n=26)</th>
<th>Urban (n=17)</th>
<th>Rural (n=9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQAO Reading (range 27-100)$^a$</td>
<td>78.9 (16.8)</td>
<td>83.6 (10.2)*</td>
<td>74.1 (24.7)</td>
</tr>
<tr>
<td>EQAO Writing (range 19-100)$^a$</td>
<td>73.1 (74.3)</td>
<td>77.2 (12.3)*</td>
<td>68.9 (29.2)</td>
</tr>
<tr>
<td>EQAO Mathematics (range 9-94)$^a$</td>
<td>55.8 (21.9)</td>
<td>56.2 (19.2)</td>
<td>55.3 (27.5)</td>
</tr>
<tr>
<td>EQAO Overall (range 21-96)$^a$</td>
<td>69.2 (17.3)</td>
<td>72.3 (11.3)*</td>
<td>66.1 (25.5)</td>
</tr>
</tbody>
</table>

Notes: $^a$Higher scores indicate better outcomes, $^*$Urban scores are statistically different from rural, $p<0.05$. 


Table 2: *Individual-level Health Variables by Gender and School Location.*

<table>
<thead>
<tr>
<th>Health Variables</th>
<th>Average (n=269)</th>
<th>Male (n=122)</th>
<th>Female (n=147)</th>
<th>Urban (n=172)</th>
<th>Rural (n=97)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Fruit and Vegetable Intake (range 0-4)*</td>
<td>2.6 (0.5)</td>
<td>2.6 (1.2)</td>
<td>2.7 (1.1)</td>
<td>2.7 (0.6)</td>
<td>2.4 (0.4)</td>
</tr>
<tr>
<td>% Meeting Physical Activity Recommendations*</td>
<td>38.9 (0.5)</td>
<td>44.2 (0.5)*</td>
<td>33.6 (0.5)</td>
<td>38.4 (0.2)</td>
<td>39.4 (0.2)</td>
</tr>
<tr>
<td>% Meeting Sedentary Behaviour Recommendations*</td>
<td>64.4 (0.5)</td>
<td>60.6 (0.5)*</td>
<td>68.2 (0.4)</td>
<td>58.0 (0.3)</td>
<td>70.8 (0.2)</td>
</tr>
<tr>
<td>Knowledge of Fruit and Vegetables (range 1-15)*</td>
<td>13.1 (1.0)</td>
<td>12.9 (0.8)</td>
<td>13.3 (0.7)</td>
<td>13.2 (1.0)</td>
<td>12.8 (0.9)</td>
</tr>
<tr>
<td>% of Knowledge of Canada’s Food Guide</td>
<td>33.1 (0.5)</td>
<td>28.7 (0.5)</td>
<td>34.3 (0.5)</td>
<td>39.2 (0.3)**</td>
<td>27.0 (0.1)</td>
</tr>
<tr>
<td>% of Knowledge of Canada’s Physical Activity Guidelines</td>
<td>53.0 (0.5)</td>
<td>41.0 (0.5)</td>
<td>55.7 (0.5)</td>
<td>53.1 (0.3)</td>
<td>53.0 (0.1)</td>
</tr>
</tbody>
</table>

Notes: *Higher scores indicate better outcomes, *Meeting the guidelines on 7 days in the previous week.
*Males scores are statistically different from females, p<0.05, **Urban scores are statistically different from rural, p<0.05.
CHAPTER TWO

REVIEW OF LITERATURE

CHILDHOOD OBESITY

Over the past two decades obesity rates in children have significantly increased worldwide (World Health Organization [WHO], 2000). Historically, an overweight child was a healthy child able to withstand harsh environments including famine, starvation, and numerous infections (Guh et al., 2009). However, obesity is now thought to be associated with numerous health complications including cardiovascular diseases (Freedman, Dietz, Srinivasan, & Berenson, 1999; Owen et al., 2009; Raj & Kumar, 2010), hypertension (Raj, Sundaram, Paul, Sudhakar, & Kumar, 2010; Woodruff, Fryer, Campbell, & Cole, 2013), cancer (Caan et al., 1998; Leiba et al., 2012), and type 2 diabetes (Benson, Baer, & Kaelber, 2009) among others (Guh et al., 2009). Increased incidence of chronic diseases may result in a poor quality of life and reduced life expectancy, which in turn may cause increased expenditure in the health care sector (Guh et al., 2009).

In Canada, the prevalence of overweight and obesity among children has doubled over the last 25 years. According to data from the 2004 Canadian Community Health Survey (CCHS; Statistics Canada, 2004), 1.1 million boys and girls (aged 2 to 17 years) were classified as either overweight or obese; an 11% increase from the 1978/1979 Canadian Health Survey (Shields, 2006). A more recent CCHS survey (2011) indicated that 31.5% of Canadian children were either overweight (19.8%) or obese (11.7%; Roberts, Shields, de Groh, Aziz, & Gilbert, 2012). Childhood obesity has been seen to track into adulthood (Kedler, Perry, Klepp, & Lytle, 1994; Lobstein, Baur, & Uauy,
Thus, an increased number of overweight and obese children who are susceptible to developing obesity related complications later in adulthood pose a financial crisis in the public health sector across provinces (Birmingham, Muller, Palepu, Spinelli, & Anis, 1999). Overall, preventive measures need to be put in place in Canada as an attempt to minimize the comorbidities associated with childhood obesity in the future.

**Definition of Obesity**

Today, childhood obesity is one of Canada’s greatest health concerns. In Canada, the current acceptable method for measuring childhood obesity is the use of the body mass index (BMI; WHO, 2006). BMI measurements take into account the height and weight of an individual and can be defined as the weight of an individual (in kilograms) divided by the height (in metres) squared (WHO, 1995). BMI measurements have been widely accepted worldwide, and in Canada, as a measure of BMI with a cut-off point of 30 kg/m² defining adult obesity (WHO, 1995). In children, BMI changes substantially with age (Cole, Bellizzi, Flegal, & Dietz, 2000), therefore, a necessary age and gender specific refinement of BMI cut off points is needed to define overweight and obesity.

Currently, three sets of reference values are most frequently used to assess excess weight among children and youth. One set is based on the International Obesity Task Force (IOTF) recommended by an expert committee in 2000 (Cole et al., 2000). This set uses the 85th and 95th percentile of the adult definition of obesity, 30kg/m², to define childhood overweight and obesity, respectively. The data are based on analysis growth curves from the United States of America, Great Britain, the Netherlands, Brazil, Hong Kong, and Singapore and categorizes children as neither overweight nor obese, overweight, or obese (Cole et al., 2000).
Another set of BMI cut points is based on growth curves produced by the Centers for Disease Control and Prevention (CDC) in the United States in 2000 (Kuczmarski et al., 2002) from five nationally representative surveys (National Health Examination Surveys (NHES) II and III, and National Health and Nutrition Examination Survey (NHNES) I, II and III), in the United States between 1963 and 1994. An expert committee in the United States recommended that based on the 2000 CDC values, the cut off points for overweight and obesity should be 85th and 95th percentile, respectively (Krebs et al., 2007).

The final set, and the one currently accepted in Canada, is the WHO cut points. The WHO cut points are composed of two classifications; one for subjects five years of age or younger and the other for those six to nineteen years of age (WHO, 2006). The WHO curves for the five year olds and younger were generated from the Multicentre Growth Reference Study (MGRS), conducted between 1997 and 2003, based on a sample of children raised in desirable conditions from Ghana, Brazil, India, Norway, Oman and the United States (WHO, 2006). For those, six to nineteen years of age, data were generated from NHES II and III, and NHANES I. Based on these curves, the 84th percentile and above for age is considered overweight and the 97.7th percentile and above is considered obese.

In Canada, the adaptation of the WHO cut points are due the fact that the sample data collected was through direct measurements (WHO, 2006; De Onis, Garza, Onyango, & Borghi, 2007) versus self or parental report (Cole et al., 2000; Kuczmarski et al., 2002). Measurement data through self-report (Goodman, Hinden, & Khandelwal, 2000) and parental report (Davis & Gergen, 1994) have been shown to be inconsistent with
measured heights and weights. Due to the inconsistencies of self-report and parental report, measured data appears to be more credible.

Interestingly, Shields and Tremblay (2010) reported that the WHO cut points yielded higher percentages in girls and boys, within all age groups, classified as overweight and obese compared to CDC and IOTF cut points. Therefore, one must remember that comparisons across studies (especially using different classification systems) may be difficult. Shields and Tremblay (2010) reported that based on measured data, the WHO cut points describe how children should (when exposed to favourable conditions such as good diets, breastfeeding, non-smoking mother, basic immunization, and access to health care) grow versus how they do (absence of proper health care, good diet, a non-smoking mother or breastfeeding) grow. Regardless of which classification system was used, however, the rising rates of childhood obesity may pose significant impact on Canadians. The following subsection explores potential impacts of childhood obesity.

**Economic Impact of Obesity**

The increasing incidence of childhood overweight and obesity in Canada is likely to result in an increase in obesity-related diseases in Canada. In future years, this increase may threaten the overall health of Canadians and put the Canadian health system in jeopardy. Birmingham et al. (1999) found that the total direct cost for obesity in 1997 was estimated to be $1.8 billion, which accounted for 2.4% of the total health care expenditures for all diseases in Canada. Birmingham et al. (1999) revealed that the three largest contributors were hypertension ($656 million), type 2 diabetes mellitus ($423.2 million), and coronary artery disease ($346 million). However, these costs are
underestimated as the study only investigated the direct measures of obesity (e.g., drugs and physician costs) and did not include the indirect health care costs (e.g., absence from work; Birmingham et al., 1999). A more recent analysis in 2001 suggested the cost of obesity was estimated to be $1.6 billion for direct costs and $2.7 billion for indirect costs (Katzmarzyk & Janssen, 2004). In this case, health care costs associated with obesity represented 1.5% of total direct costs and 2.9% of indirect costs of the total health care expenditure (Katzmarzyk & Janssen, 2004).

An even more recent study suggests that the total expenditure of obesity has risen over time. Anis et al. (2010) analyzed data from the National Health Expenditure Database and found that $6.0 billion was spent on direct costs attributable to overweight and obesity in Canada in 2006. This corresponds to 4.1 percent of total health expenditures (a 50% increase from 2001). The addition of more comorbidity associated with obesity indicates an increase in health care expenditure in future. Interestingly, all the above data have used adult obesity rates. However, if childhood obesity tracks to adulthood (as observed in Kedler et al., 1994) then the expenditure associated with obesity and its comorbidities will affect the Canadian health care system even more so in the future. Obesity prevention and health programs, say at the school- and community-level, need to be put in place to reduce overweight and obesity, especially among children and adolescents.

**Health Impact of Obesity**

**Obesity and cardiovascular health.** Childhood obesity can affect major organs of the body and is associated with significant morbidity and mortality (Raitakari, Juonala, & Viikari, 2005). Cardiovascular disease processes begin to manifest during the early
childhood years and are influenced by genetic factors and modifiable risk factors (Raj &
Kumar, 2010). Several studies have shown a positive correlation between high BMI in
childhood and the incidence of cardiovascular diseases later in life (Bjorge, Engeland,
Tverdal, & Smith, 2008; Owen et al., 2009). A high BMI in middle to late adolescence
was positively associated with development of coronary heart disease (Owen et al.,
2009), ischemic heart disease (Bjorge et al., 2008), and pronounced cardiovascular risks
factors (Freedman et al., 1999) later in adulthood. With proper health interventions to
reduce childhood obesity, cardiovascular risk factors are likely to be reduced.

**Obesity and hypertension.** Several cross-sectional and longitudinal studies have
shown an association between increases in blood pressure and weight gain. Woodruff et
al., (2013) reported that participants were likely to have high systolic and diastolic blood
pressures if they were classified as overweight or obese in a study of seventh grade
students in Southwestern Ontario, Canada. McCrindle et al., (2010) also found that a high
BMI was significantly associated with increased blood pressure among grade nine
students in the Niagara region (Ontario, Canada). Interestingly, the longitudinal study by
McCrindle et al., (2010) followed grade nine students over a six year period and reported
that hypertension in overweight and obese teenagers also had an association with high
cholesterol levels and cardiovascular diseases.

The presence of hypertension among children has also been observed in other
countries. A longitudinal study by Raj et al. (2010) reported that children who had a BMI
reading of 25kg/m² and below were less likely to develop hypertension later in life than
their overweight and obese counterpart. Further, an examination of 3000 preschool
children in Sydney, Australia indicated that children with high waist to hip ratios, who
were overweight or obese, had a 26% higher chance of developing hypertension later in life than their normal weight counterparts. However, health interventions (such as Arsenault et al., 2009, which provided students with daily recommended intakes of milk) have been seen to improve blood pressure in children. Such interventions could be carried out to improve blood pressure in children and adolescents.

**Obesity and cancer.** Childhood obesity has been linked to the occurrence of certain cancers. Longitudinal studies have reported increased risk in the development of colorectal cancer (Caan et al., 1998) and urothelial cancer (Leiba et al., 2012) in adolescent males later in life. Overweight adolescent girls are also susceptible to cancer. Research suggests that obesity is inversely related to premenopausal breast cancer (Lahmann et al., 2004; Van den Brandt et al., 2000). However, postmenopausal women with a high BMI are more likely to develop breast cancer than postmenopausal women with a normal BMI (Lahmann et al., 2004). Substantial evidence has been found to link excess endogenous estrogen to the development of breast cancer in postmenopausal women (Key & Pike, 1988; Pike, Spicer, Dahmoush, & Press, 1993). Since childhood obesity is known to track into adulthood (Nicklas, Baranowski, Cullen, & Berenson, 2001), postmenopausal women who were overweight or obese as children are at a high risk of developing breast cancer. For this reason, initiatives targeting childhood obesity might help reduce the risk of different types of cancers later in life.

**Obesity and type 2 diabetes.** Type 2 diabetes has traditionally been seen as a disorder associated with middle aged adults and the elderly (Hannon, Rao, & Arslanian, 1995). However, with the increase in childhood obesity, children are developing complications associated with type 2 diabetes that were mostly seen in adults (children as
young as eight years of age are being diagnosed with type 2 diabetes; Benson et al., 2009). In Canada, cases are most often reported among First Nations people who comprise 3% of the Canadian population (Fagot-Campagna et al., 2000; Hanley et al., 2005; Young et al. 2002). Diabetes is more prevalent in girls, who may go on to be mothers with type 2 diabetes or gestational diabetes (Kim, Sharma, & Callaghan, 2012). Children of mothers with pre-gestational or gestational diabetes during pregnancy are more likely to develop diabetes and cardiovascular complications later in life themselves, which produces a vicious cycle of disease among families (Pollex et al., 2006). To decrease the rates of type 2 diabetes in children, preventative measures targeting children and adolescents both at the community- and school-levels are needed.

**Etiology of Obesity**

In order to have effective preventative measures to curb the spread of childhood obesity, it is important to understand what causes it. As stated before, obesity is measured using BMI (a measure that takes into account the height and weight of an individual; WHO 1995). This means that if BMI is low then the ratio of weight to height is low (as such if BMI is high the ratio of weight to height will be high). While height is not often thought of as a modifiable factor, weight is a reflection of energy balance (e.g., energy intake vs. energy expenditure; Koplan, Liverman, & Kraak, 2005). Energy intake is determined by the quantity of caloric intake (e.g., food and fluids) while energy expenditure includes basic metabolic functions (e.g., breathing), physical activity, exercise, and thermogenesis (Janssen, Katzmarzyk, Boyce, King, & Pickett, 2004). A positive imbalance between energy intake and energy expenditure leads to weight gain, which may eventually lead to overweight or obesity (Wang, Gortmaker, Sobol, & Kuntz,
2006). Thus, it is important to understand factors in today’s society that drive energy imbalance.

**Energy Imbalance**

Before the classical study of Mayer, Roy, and Mitra (1956), energy intake and energy expenditure were seen as two separate entities independent of each other. However, the study of 800 workers by Mayer et al., (1956) reported that a decrease in physical activity was not immediately followed by a decrease in food consumption. Since then, subsequent studies have shown that several sedentary activities such as television watching (Bellisimo, Pencharz, Thomas, & Anderson, 2007; Sonneville & Gortmaker, 2008) and playing video games (Robinson, 2001; Tremblay & Willms, 2003) not only lead to a low level of energy expenditure but may also increase food consumption in children. The decrease in energy expenditure and increase in food consumption disrupts the energy equilibrium and contributes to an increase in weight. Lifestyle modifications are thus a potential solution to decreasing/preventing the rates of obesity. One such modification is the consumption of healthy food and snacks such as fruits and vegetables. In the following section, the relationship between energy intake and expenditure in children, as it relates to the development of childhood obesity, will be examined. More specifically, the contribution of lifestyle factors such as physical activity patterns, screen time, and nutritional practices in children and adolescents will be discussed. An understanding of these factors provides us with a channel to develop and evaluate evidence-based interventions aimed at reducing the rates of childhood obesity in Canada.
PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR

Physical activity increases energy expenditure and is associated with health benefits in children and adolescents including an increase in (1) energy due to thermogenesis (Janssen et al., 2004), (2) resting metabolic rate (Speakman & Selman, 2003), and (3) aerobic and anaerobic fitness (Janssen & Leblanc, 2010). Caspersen (1989) defines physical activity for children as any activity that encompasses numerous behaviours such as chores, play, organized sport, or exercise. Therefore, a child who participates in any form of physical activity in a specified amount of time is physically active. Being physically active can be defined as meeting established guidelines for physical activity (usually reflected in achieving a threshold number of minutes of moderate to vigorous physical activity per day; Tremblay, Colley, Saunders, Healy, & Owen, 2010). Currently, the Canadian Physical Activity Guidelines for Children (aged five to eleven) and Adolescents (twelve to seventeen years of age) recommend that children and adolescents should engage in at least 60 minutes of moderate to vigorous intensity activities daily (also indicating that more time is better; Canadian Society for Exercise Physiology, 2014a). Although these guidelines are in place, the levels of physical activity are dismal with only 7% of Canadian children and adolescents (9% boys and 4% girls) engaging in 60 minutes of moderate to vigorous activities daily (Colley et al., 2011). The prevalence of children engaging in moderate to vigorous 60 minutes daily also declines with age (Colley et al., 2011). Perhaps, this could be attributed to the increased level of sedentary activities.

Confusion exits in literature in the definition of sedentary behaviour. Some research presents individuals as sedentary when they are not being physically active
(Sims et al., 2012), while others classify participants as being sedentary when they are engaging in particular activities characterized by low energy expenditure (e.g., sitting and activities that have a resting metabolic rate of typically ≤ 1.5 metabolic equivalents (METS); Tremblay et al., 2010; Owen, Healy, Matthews & Dunstan, 2010). The Canadian Sedentary Behaviour Guidelines for Children (aged five to eleven) and Adolescents (aged twelve to seventeen years of age) recommend that children should limit recreational screen time to no more than 2 hours per day, limit sedentary (motorized) transport, extended sitting, and time spent indoors throughout the day (Canadian Society for Exercise Physiology, 2014b). The guidelines further describe sedentary activities as sitting for long periods of time, watching television, playing passive video games, and/or playing on the computer. Since the research question to be used in the present study is developed based on these guidelines, the second definition (engaging in activities that have a resting metabolic rate of ≤ 1.5 METS) will be used to describe sedentary behaviour. This is also in accordance to the Sedentary Research Network (2012), which suggested the use of the second definition as the main definition for sedentary behaviour to improve clarity in literature.

Colley et al., (2011) reported Canadian children and adolescents spend 8.6 hours (62% of their waking hours) engaging in sedentary activities. Specifically, technological advances in the past half century have made it easier for individuals to decrease the level of energy expenditure. For example, household chores (e.g., washing dishes, washing clothes, sweeping floors, shoveling snow) that involved some considerable amounts of physical activity have been replaced with automatic washing machines, vacuum cleaners, and top of the line snow blowers. Moreover, leisure time activities (such as playing
unorganized sport) that were a common occurrence in children and adolescents are now becoming more sedentary with television watching, playing video games, and computing becoming the most popular pastimes (Andersen, Crespo, Bartlett, Cheskin, & Pratt, 1998). Sedentary behaviour is a fairly recent phenomenology, however, reducing the time spent sedentary clearly has health benefits, which make it an important variable to consider during childhood and adolescence.

**Active Transport**

Research indicates that there has been a decline in active transport in recent years with more students taking the bus or a car to and from school (Heelan et al., 2005). The rates of active transport of children and adolescents who walk or bike to school in the United States dropped from 42% in 1969 to 13% in 2001 coinciding with the increased rates of childhood obesity (Active Living Research, 2009). Children and adolescents who walk or bike to school have higher daily levels of physical activity and are more likely to meet physical activity recommendations than youth who travel to school by car or bus (Heelan et al., 2005). Sirard, Riner, Mclever, & Pate (2005) reported that children who walked to school five days a week had twenty four more minutes of moderate to vigorous activity than children who walked less than five days or who traveled by car. In addition, accelerometer data indicated that students who walked to school took 12,100 more steps than students who traveled by bus or car (Sirard et al., 2005).

**Screen Time**

Overweight and obesity has been associated with increased screen time in children and youth (Janssen et al., 2004). American children spend more time watching television, videos, and playing video games than any other activity other than sleeping
As a result, less time is spent moving around (e.g., physical activity) which is associated with energy expenditure. This, in turn, can cause weight gain (Wang et al., 2006). Several Canadian researchers have reported an increase in overweight and obesity rates with an increase in screen time (Bellisimo et al., 2007; Janssen et al., 2004; Janssen et al., 2005). Janssen et al. (2004) asked participants to state their level of sedentary activity, recorded as low (<1 hour), low-moderate (1-2 hours), moderate-high (2-3 hours) or high (≥ 3 hours) based on the average daily hours of television viewing and computer use within each gender, and reported that increased television watching and sedentary activities were positively associated with overweight and obesity cases (Janssen et al., 2004). For this reason, it is important to examine the association between various aspects of screen time (including television viewing and video games) and their relationship to overweight and obesity in children.

**Television viewing.** Watching television has been considered a likely contributor to the spread of overweight and obesity among children. Dietz and Gortmaker (1985) were the first to study the effects of television viewing on the occurrence of overweight and obesity, and reported an increase of 2% obesity prevalence for every additional hour spent watching television (among 6 to 12 year olds and 12 to 17 year olds). Since then, subsequent studies have reported associations of increased energy intakes (Bellisimo et al., 2007), poor food choices (e.g. consumption of high sugar and fat foods; Sonneville & Gortmaker, 2008), and an increase in BMI (Matheson, Killen, Wang, Varady, & Robinson, 2004). Not only is television watching usually a sedentary behavior, but also individuals may be exposed to numerous food advertisements (which are usually for high
calorie/low nutrient dense foods; Bellisimo et al., 2007) and/or is associated with the consumption of snack foods (Borzekowski & Robinson 2001).

**Food advertised during commercials.** Television viewing exposes children to advertisements and commercials for food products. Although parents are mostly responsible for the food selection in their homes, television commercials influence children’s food purchases. In the United States, children aged 14 years of age or younger purchase an estimated $14 billion in goods and influence a total of $190 billion in goods (McNeal, 1998). In addition, most food purchased by children is advertised during children’s television programming (Harrison & Marske, 2005). Borzekowski and Robinson (2001) suggested that children who were exposed to a 30 second commercial (vs. those not exposed) chose the advertised items when given items to pick from after the experiment. In addition, children who were exposed to two 30 second commercials encouraged their parents to purchase the products they saw on the commercials when they went shopping (Borzekowski & Robinson, 2001). The types of food advertised (i.e., during commercials) are mostly high fat, high sugar and low fiber foods (Sonneville & Gortmarker, 2008). Harrison and Marske (2005) videotaped 6-11 year olds watching television over a five week period and reported that most commercials advertised sweets, candy, soft drinks, and convenience foods more prominently than high fiber foods. Moreover, there were few health related messages, possibly because advertisers expect children to be more concerned with food’s flavours and colours rather than its disease fighting properties (Harrison & Marske, 2005). Some advertised commercials imply that their advertised products are healthy and beneficial, using a form of nutritionism (i.e., picking out one single nutrient and only promoting its’ health benefit), which may
confuse children and their parents as to what makes food healthy (Harrison, 2005). Kurabayashi, Roberts, and Johnson (2001) conducted a content analysis of network television shows that aired on Saturday mornings (children shows) and Saturday evenings (adult programming) and reported that 97.5% of advertisements in the morning and 78.3% of evening advertisements were of high sugar and high cholesterol foods with misleading messages. Thus, television seems to be a place of nutritional misinformation and children’s exposure to television may increase the risk of children becoming misinformed food consumers.

**Snacking and television viewing.** Snacking while watching television has been associated with increased energy intake and decreased energy expenditure (Bellisimo et al., 2007). Of interest, are the snacks that children consume while watching television. Recent studies have attempted to characterize whether eating in front of the television has adverse effects on energy intake. Ciccone, Woodruff, Fryer, Campbell, and Cole (2013) reported an increase in eating frequency and energy intake with an increase in television watching and computer use. The increase in energy intake could be attributed to delayed physiologic signals of satiety (Bellisimo et al., 2007). Three to five year old children consumed more total weight of food from a snack and meal while watching television compared to children who were not watching television (Francis & Birch, 2006). Moreover, children who reported a higher frequency of watching television during lunchtimes consumed more food, indicating that children may not be paying attention to their satiety cues (Francis & Birch, 2006). Sonneville and Gortmaker (2008) reported that children consumed excessive amounts of less healthy foods (e.g., salty and sugary foods) while watching television compared to when they are just snacking without watching.
television. In addition, the consumption of fruits and vegetables appears to be low (Ludwig, Peterson, & Gortmaker, 2001). Ciccone et al., (2013) reported that children and adolescents consumed higher amounts of sweet snacks than fruits and vegetables as part of their evening snack. Similarly, Cross, Babicz, and Cushman (1994) reported that taste was a major determinant of what kinds of snacks children chose, with fruits and vegetables less preferable (20.5%) compared to sweets, (28.4%) and foods from other categories (21.4%). However, exposure to fruits and vegetables has been associated with children’s snack choices in terms of taste (Korinek, Bartholomew, Jowers, & Latimer, 2013), which will be further explained in the next section.

**NUTRITION**

On the other side of the energy balance equation lies energy intake. Energy intake is determined by the dietary intake (e.g., food and fluids) of an individual measured in calories (Garriguet, 2004). The number of calories an individual requires is determined by the age, sex, weight, height, activity level, and growth in children and adolescents (Institute of Medicine of the National Academies, 2005). For example an active 12 year old boy who is 1.5 metres tall (4 feet 11) and weighs 46 kilograms (110 pounds) needs 2,625 calories a day (Institute of Medicine of the National Academies, 2005). Results from the 2004 CCHS 2.2 indicate that caloric intake is highest during adolescence (12 to 19 years) and it declines with age. This could be attributed to the fact that adolescence is the time between childhood and adulthood marked by rapid changes in body composition, insulin sensitivity, and growth during pubertal maturation (Alberga, Sigal, Goldfield, Prud’homme, & Kenny, 2012). Since nutrition habits have been seen to track
into adulthood (Nicklas, Yang, Baranowski, Zakeri, & Berenson, 2003), it is important to practice good nutrition to ensure healthy body weights in this critical period.

Good nutrition is favourable for the healthy growth of children (Nicklas, Johnson, Myers, Farris, & Cunningham, 1998), prevention of diseases (Arsenault et al., 2009), and is a possible solution to the rising rates of childhood obesity. Batcher and Nichols (1984) defined good nutrition as consuming foods with high nutrient density. Food choices determine the type of diet quality. Health Canada has been helping Canadians make healthy food choices since the publication of the first food guide (Canada’s Official Food Rules in 1942; Canadian Council on Nutrition, 1942). Since then, numerous modifications have been made to suit Canadians’ diet. Currently, Eating Well with Canada’s Food Guide (Health Canada, 2007) recommends 6 to 8 servings of Vegetables and Fruit, 6 to 7 servings of Grain Products, 3 to 4 servings of Milk and Alternatives, and 1 to 3 servings of Meat and Alternatives for children and adolescents. Despite the recommendations, Canadian studies show that children and adolescents are still not meeting their dietary needs (Garriguet, 2004; Hanning et al., 2007).

Consumption of Foods and Nutrients

**Food groups.** According to the 2004 CCHS 2.2 (the most recent national nutritional survey), 62% of girls and 68% of boys were under consuming Vegetables and Fruit (Garriguet, 2004). Milk and Alternatives were also being under consumed with 61% of boys and 83% of girls not meeting the minimum requirements (Garriguet, 2004). Similar to the Vegetable and Fruit and the Milk and Alternatives, the Grain Products were also under consumed with 33% of girls and 6% of boys not meeting recommended requirements (Garriguet, 2004). Eating Well with Canada’s Food Guide also recommends
a moderate consumption of *Other Foods* (Health Canada, 2007). *Other Foods* is a broad category that classifies beverages and food not included in the four food groups (e.g., high fat and high salt foods such as chips, fat and oils such as butter, foods that are mostly sugar such as jam and syrup, among others; Health Canada, 2007). However, the 2004 CCHS 2.2 reported that 25% of food consumed by adolescents was from this category (Garriguet, 2007). Given the high sugar and high fat content of the top 10 *Other Foods* (Health Canada, 2007), the macronutrient intake of children and adolescents will be examined in the next section.

**Nutrient intake.** Energy in the body is supplied by carbohydrates, proteins, and fat (the three macronutrients in the body; Institute of Medicine, 2005). An increased consumption of any of the macronutrients (more than the Acceptable Macronutrient Distribution Ranges; AMDR) could result in overweight and obesity (Institute of Medicine, 2005). The 2004 CCHS 2.2 reported a 13% overconsumption of fat among children and adolescents (Health Canada, 2012). Smaller Canadian studies have also supported nutrient evaluations on children and adolescents. A study of grade six, seven, and eight students from Southwestern Ontario found that 25% of the food consumed was from the *Other Food* group associated with high fat content (Hanning et al., 2007). Similarly, Phillips, Jacobs-Starkley, and Gray-Donalds (2004) reported an increased consumption of fat-related foods (e.g., cakes, cookies, and candy) among adolescents aged 13 to 17 years across five provinces in Canada.

The consumption of dietary fibre is also low among Canadian children and adolescents (Health Canada, 2012; Garriguet, 2004). Dietary fibre has been associated with an increase in satiety levels, as well as, a decrease in subsequent hunger (Howarth,
Saltzman, & Roberts, 2001). In addition, children who consume high amounts of fibre in their diet consume less saturated fats and total fat (Nicklas, 1995). One strategy to increase the consumption of fibre is to promote the consumption of vegetables and fruit in children and adolescents (Trumbo, Schlicker, Yates, Poos, & The National Academies, 2002). In addition, education and knowledge of fruits and vegetables (including preparation methods) may also help improve the quality of life of children and adolescents.

Consumption of sweetened beverages increases with age (Garriguet, 2008). According to the 2004 CCHS 2.2, the consumption of milk, water, and 100% fruit juices decreases when children become adolescents with the consumption of sweetened beverages (e.g., soft drinks and less than 100% fruit juice) accounting for 53% and 35% of beverages consumed by boys and girls, respectively (Garriguet, 2008). High consumption of sugar sweetened beverages provides extra calories, large amounts of rapidly absorbable sugars, and is associated with an increased risk of obesity in children (Hanning et al., 2007, Nicklas et al., 2003).

In order to understand why children choose the food they choose, it is important to examine different aspects around the nutritional habits of children. Individuals do not necessarily consume nutrients, as described above; therefore, it is important to understand food habits to better understand why people choose certain foods over others.

**Nutritional Habits**

Eating patterns developed during childhood may track to adolescence and adulthood (Kelder, et al., 1994, Nicklas, 1995). Participants from the Bogalusa Heart Study showed that every year the subjects were sampled, diets did not change in terms of.
macronutrient content and the food groups consumed (Nicklas, 1995). However, the
types of food consumed changed (as children aged), with saturated fat accounting for
most of the total fat consumed and low fibre diets constituting the majority of the
carbohydrates consumed (Nicklas, 1995). For this reason, it is important to practice and
nurture healthy eating habits when children are young to ensure healthy eating later in
life.

There are a few reasons why children choose the food they choose. Birch (1992)
explained that children choose food based on their familiarity, liking, and taste. Fat may
be preferred at an early age because children prefer flavours associated with high energy
density and fat content (Drewnoski, 1997). Children and adolescents (regardless of
gender and age) ranked food containing high fat content (e.g., cake; Cooke & Wardle,
2005) higher than fruits and vegetables (e.g., cauliflowers; He et al., 2007) showing that
children prefer high fat food to fruits and vegetables. Ross (1995) explained that children
picked the food they liked based on how well the food tasted, with the highest rated foods
being sweet and juicy (i.e., cake and chocolate) as opposed to vegetables that looked
unfamiliar and had a rough texture.

Likeability and exposure. Likeability and exposure of food can alter preferences
(Cooke, 2007). Early work by Birch (1979) investigated the preferences of childrens’
sandwich consumption, whereby children chose sandwiches that were ranked higher
(more likeable) and more familiar. Introducing new fruits and vegetables at a young age,
therefore, might increase their likeability as they grow. However, with the exception of
sweet and salty foods, acceptance of new food does not occur instantly (Birch & Fisher,
1998). Repeated opportunities to try new foods increases likeability, although, 5 to 10
exposures are likely needed to solidify taste preferences (Birch & Marlin, 1982). Exposure to certain foods is thought to enhance attitudes and positive effects which may make children more likely to develop preferences of these foods resulting in increased intake (Birch & Marlin, 1982). A school snack program would be a great avenue to expose children to different types of fruits and vegetables that they might have not seen and or tried before.

**Knowledge.** Knowledge about a particular food may also have an impact on consumption rates (Lautenschlager & Smith, 2007). Children may avoid certain types of food because they might not know the benefits associated with them (O’Dea & Wilson, 2006). For this reason, schools could be a viable platform to help educate children on the importance of healthy eating. A school snack program offering nutritious options would familiarize students with certain fruits and vegetables that they have not seen before, therefore, potentially increasing consumption.

Eating behaviours are not entirely shaped by an individual (Story, Neumark-Sztainer, & French, 2002). Formal and informal social networks and support systems including family, schools, work groups, and friendship networks may also help shape nutrition habits and behaviours.

**SOCIAL INFLUENCE AND FOOD INTAKE**

It is important to understand the dynamics that guide children to behave the way they do. Attitudes, beliefs, and knowledge about certain types of food could lead a child to decide which food he or she wants to try (Tak, Te Velde, Singh & Brug, 2010). Conceptual models or theories help explain the dynamics of eating behaviours, external influences on behaviours, and processes for changing those behaviours (McLeroy,
Bibeau, Steckler, & Glanz, 1988). A common theme in the models is how social, environmental, and personal factors shape an individual’s behaviour. One such model is the socio-ecological model (SEM). The SEM may help explain how all these factors determine the food selection of a child (Story et al., 2002).

**Socio-ecological Model**

The SEM provides a useful understanding of the multiple factors that affect child and adolescent dietary behaviour and can be used to explain and shape different nutritional strategies. These strategies, in turn, can be used to promote healthy eating behaviour. First developed by Urie Brofenbrenner in 1979, the SEM has been used to explain how personal, environmental, and social factors interact to shape an individual’s behaviour. Brofenbrenner (1979) divides the model into four interacting levels: the microsystem, mesosystem, exosystem, and macrosystem. All these levels interact together to influence a child’s behaviour. The microsystem involves the immediate people who have the greatest influence on an individual. These may include: family, teachers, and peers (Brofenbrenner, 1979). The mesosystem entails the interaction between two components of the microsystem, for instance, the interaction between a teacher and a parent in shaping the behaviour of a child. The exosystem refers to the larger scope beyond the control of a child that helps shape his or her behaviour, for example, the influence of the media in a child’s food selection. Lastly, the macrosystem refers to the culture that sets rules and policies that help shape a child’s behaviour.

A variation of Bronfenbrenner’s model has been used in the past to explain nutrition behaviour (McLeroy et al., 1988; Robinson, 2008; Story et al., 2002). The SEM explains that nutritional behaviour is determined by the following factors: intrapersonal
and interpersonal factors, institutional factors, community factors, and public policy (McLeroy et al., 1988; Story et al., 2002).

Intrapersonal factors influence eating behaviours of an individual (Robinson, 2008). These include (but are not limited to) attitudes, beliefs, knowledge, taste, and food preferences. This aspect of the SEM can be used to explain nutrition behaviour at the individual-level where children choose the food they choose. Interpersonal factors are formal and informal social networks and support systems that explain why the school and family play an important part in the nutrition behaviour of children and adolescents (Story et al., 2002). Institutional factors comprise of formal and informal rules (e.g., school-level policies) made at the community-level to shape behaviour. These factors together help explain nutrition behaviours of children and adolescents.

**Family Involvement**

**Role of families in food intake.** Families play an important role in nutrition behaviours of children. Birch (1999) indicated that children are born with innate predispositions to certain tastes compared to others. In addition, they also have biological inclinations to learn certain preferences for foods made available to them (Birch, 1999). The early years of a child’s life are particularly important because this is when food tastes and preferences are acquired (Birch, 1999). For that reason, the way the parents feed their children contributes to individual differences in how well children can regulate their food intake and what food they get accustomed to. Exposing children to nutritious food such as fruits and vegetables may increase the chances of children adopting fruits and vegetables as part of their diet in future.
Parents influence children and adolescent eating habits in several ways (Woodruff and Hanning, 2008). An interaction among family demographics (that determine the type and quantity of food available at home), behaviour modelling (modelling food preferences after a family member), the shared environment (which determines the quantity of food available at home) and parenting style (which determines the freedom of food selection at home) creates the adolescent’s food and behaviour attitudes (Woodruff & Hanning, 2008). Cooke et al., (2004) indicated that fruits or vegetables that parents themselves reported eating was a strong predictor of their children’s intake, with positive correlations between adult’s and child’s intakes of vegetables and fruit.

**Family meals.** An increase in family meal frequency has been associated with healthier diets among children and adolescents (Neumark-Sztainer, Hannan, Story, Croll, & Perry, 2003). Family meals have been associated with healthier diets including consumption of fruits and vegetables (Andaya, Arredondo, Alcaraz, Lindsay, & Elder, 2011), whole grains (Videon & Manning, 2003), calcium rich foods (Larson, Neumark-Sztainer, Hannan, & Story, 2007), and micronutrients (Larson et al., 2007). Woodruff and Hanning (2010) reported a positive association between frequent family dinner meals (versus less) and higher Healthy Eating Index (HEI-C) scores, an overall measure of healthy eating. While some research has focused on dinner (Woodruff & Hanning, 2009), others have included all meals (Neumark-Sztainer, Larson, Fulkerson, Eisenberg, & Story, 2010). Further, recent work investigating family breakfast (Andaya et al., 2011) suggests positive nutrition outcomes as well, which may be of benefit for families with evening commitments.
In addition to the nutritional benefits, family meals also have potential to improve emotional and psychological well-being of children (Fruh, Fulkerson, Mulekar, Kendrick, & Clanton, 2011). Snow and Beals (2006) reported that family meals provide an opportunity for children to improve their vocabulary and work on their arithmetic skills. Moreover, the conversations that take place during family meals become engrained in children and they practice what they learn. Encouraging family meals may discourage eating alone, a behaviour associated with poor eating habits (Fruh et al., 2011). This may have a cascading effect that may encourage children at school to practice social eating, which may influence the consumption of fruits and vegetables during school snack programs.

**Breakfast skipping.** As indicated above, family dinners may be protective against skipping breakfast, which has been associated with healthier diets (Andaya et al., 2011; Woodruff & Hanning, 2009). However, with the benefits associated with the consumption of breakfast, a study by Woodruff and Hanning (2008) reported that 27% of grade 9 and 10 students in Ontario and Alberta did not consume breakfast daily. Woodruff and Hanning (2009) reported that children who skipped breakfast and/or consumed breakfast purchased from a restaurant or a convenience store had a poor diet quality compared to children who consumed breakfast prepared at home. However, some children do not voluntarily skip breakfast. O’Dea and Caputi (2001) indicated that children from a low socioeconomic status were more likely to skip breakfast compared to children from a middle and upper economic status, perhaps due to lack of money by parents to provide for their children, absence of quality food during breakfast, and/or perceptions of being overweight or obese.
For this reason, some schools and/or school boards have developed and implemented school breakfast and/or snack programs. School breakfast programs have been associated with improved memory (Benton & Parker, 1998), school attendance (Benton & Parker, 1998), and test performance (Rampersaud, Pereira, Girard, Adams, & Metzl, 2005) in children and adolescents. However, since some students do not get breakfast at home, they might be at a disadvantage academically compared to their counterparts.

**School Involvement**

Various social, cultural, and behavioural factors play a role in the prevention of overweight and obesity among children. Other than families, schools and peers have the most meaning in a child’s life and, therefore, are powerful aspects in the environment that forms their nutrition behaviour (Brofenbrenner, 1979).

**School education policies.** Education success and health have a reciprocal relationship (Story, Nanney, & Schwartz, 2009). Students have to be healthy in order for them to be able to regularly attend school and benefit from education. On the other hand, schools are warranted to provide an environment where children will learn lifelong skills for healthy living, engage in physical activity, and practice healthy eating. For this reason, policy makers have attempted to set guidelines/policies that may help shape children’s health behaviours. Examples of such policies in Ontario are the Policy/Program Memorandums (e.g., P/PM 150 and P/PM 138).

**Policy/Program Memorandum 150 (P/PM 150).** On October 4th, 2010, the Government of Ontario passed amendments to the set of nutrition policies that outline food and beverages sold in publicly funded elementary and secondary schools in Ontario.
The policy, which took effect on September 1st, 2011, apply to food and beverages sold in all venues (i.e., cafeterias, vending machines, and tuck shops) and through all school programs and events (i.e., bake sales and sporting events; Ontario Ministry of Education, 2014). The memorandum prohibits the sale of candy, chocolate, energy bars, licorice, gum, gummies, and popsicles. However, this policy does not include food brought to school, only those sold on school grounds. This policy is an example of how schools can influence a child’s food selection; therefore, introducing different health strategies (e.g., a fruit and vegetable program) in school may help promote good nutrition. As this is a relatively new policy, little published research is available to determine its’ effectiveness. A recent evaluation of P/PM 150 by Hanning (2013) reported a decreased consumption of high sugar and fat foods after the implementation of the policy with students being forced to purchase healthier options at school or walk (thereby performing some sort of physical activity) to nearby restaurants to purchase junk food.

Policy/Program Memorandum 138 (P/PM 138). As part of its aim to promote healthy lifestyles in schools, the Ontario Government passed a legislation on October 5th 2005 mandating all school boards to ensure all students (including students with special needs) have a minimum of twenty minutes of sustained moderate to vigorous physical activity each school day during instruction time (Ontario Ministry of Education, 2014). The goal of the daily physical activity policy is to allow students to improve or maintain physical fitness, their overall health and wellness, and to enhance their learning opportunities (Ontario Ministry of Education, 2014). However, an evaluation of P/PM 138 by Patton (2012) indicated that children only averaged three minutes of moderate to vigorous physical activity within the allocated 20 minutes of daily physical activity.
Moreover, teachers do not always implement the policy in a similar fashion, for example, citing time as the biggest barrier to program delivery (Patton, 2012).

**School snack programs.** School snack programs have previously been used as an avenue to promote healthy eating behaviours in children and adolescents (Potter et al., 2011; Witt & Dunn, 2012). Healthy options offered in school snack programs have been positively associated with vitamin B12 statuses (Arsenault et al., 2009), better linear growth (Arsenault et al., 2009), increased familiarity and consumption of fruits and vegetables (Tak et al., 2010), increased availability of fruits and vegetables to students from low socioeconomic families (Potter et al., 2011), and well established eating patterns from childhood to adolescence (Perry et al., 1998).

In Ontario, snack programs vary in their stakeholders and operation. There are breakfast programs (e.g., the Jump Start program in Windsor-Essex) and fruit and vegetable programs (e.g., the Farm to School program in Chatham-Kent). Student snack programs across Ontario rely on the dedication and support of numerous volunteers (e.g., teachers, parents, principals, and community heroes) who ensure nutritious snacks are purchased, prepared, and distributed to every child (Ontario Student Nutrition Program, 2014). Some snack programs also include local farmers who supply local products to the regions they are affiliated with (e.g., as in the Farm to School program in Chatham-Kent). Although the daily operations vary, all strive to ensure that free nutritious snacks are available to all children.

An example of a school snack program is the Northern Fruit and Vegetable Program. The aim of the program is to increase awareness and consumption of fruits and vegetables (through provision of fruits and vegetables at no cost), as well as, promote
physical activity for elementary and intermediate school-aged children in northern communities (Algoma, Porcupine, and Sudbury). Previous evaluations of school snack programs in Northern Ontario have observed an increase in the consumption of *Milk and Alternatives* (Gates, Hanning, Gates, McCarthy, & Tsuji, 2013), higher intakes of *Vegetables and Fruit* (He et al., 2007; Skinner, Hanning, Metatawabin, Martin, & Tsuji, 2012), and lower intakes of *Other Foods* (Skinner et al., 2012). However, none of the studies examined the associations among nutrition, physical activity, sedentary activities, and academic performance. An understanding of whether good nutrition and physical activity habits are associated with academic performance may be beneficial in promoting the establishment of school snack programs in other parts of Ontario and Canada.

**Importance of schools in shaping behaviour.** Nutrition education can help young people attain useful knowledge and skills to make healthy food choices and develop lifelong eating patterns (Story et al., 2002). Although schools cannot be the only influence in children’s healthy lifestyle choices, they play an important role in shaping healthy habits and behaviours (Frumkin, 2006). Through schools, more children (regardless of gender and ethnicity) can be reached (Story et al., 2009). In addition to providing a venue to reach most children and adolescents, school staff can also play a role in modifying or influencing behaviour. School catering services can promote healthy eating by the food they make available in the cafeteria and the opportunity they get to reinforce nutrition education taught in classrooms (Frumkin, 2006). Teachers can promote healthy practices by incorporating healthy behaviour lessons in their lectures (Witt & Dunn, 2012). The school administrations and policy makers can improve school
nutrition practices by setting policies (e.g. P/PM 150) that promote healthy eating and limit the sale of high density food (Frumkin, 2006).

Children spend more time at school than any other environment away from home. In Ontario, approximately 2.1 million students attend Ontario’s 4,850 publicly funded schools (Ontario Ministry of Education, 2014). Schools provide opportunities where children can realize their full potential and develop knowledge and skills that will enable them to live a healthy and active life. Part of the mandate of schools in Ontario is to create a school environment where students practice healthy living and develop positive influences on their attitudes, preferences, and behaviours (Ontario Ministry of Education, 2014). No other institution has more influence on a child’s life than the school (especially in their first two decades of life; Story et al., 2009). For this reason, schools provide a platform where associations among physical activity, nutrition, sedentary activities, and academic performance (Education, Quality, and Accountability Office [EQAO] scores) can be generated. Very few studies, in Canada, have been conducted based on the associations among health behaviours and academic performance.

To date, most of the research on nutrition and academic performance focuses on malnutrition (Taras, 2005), hunger (Murphy et al., 1998), macronutrient deficiency (Wood, 2001), and the effects of breakfast programs in undernourished populations (Taras, 2005). The brain needs neurotransmitters to relay information to and from the brain to increase function (Rausch, 2013). Colby-Morley (1981) found that the brain needs neurotransmitters (e.g., choline and amino acids) from outside sources (e.g., dietary intake) in order to maintain the brain’s necessary amount of neurons to release other chemicals such as serotonin and norepinephrine. Serotonin controls sleep, memory, and
learning while norepinephrine controls attention (Hainer, Kabrnova, Aldhoon, Kunesova, & Wagenknecht, 2006). Addressing malnutrition, hunger, and macronutrient deficiency will ensure the brain gets enough neurotransmitters and attention and learning are increased. This, in turn, may lead to better academic scores in assessment tests.

Within Eastern Canada, two separate research studies have suggested positive associations between healthy food intake and academic performance (Florence, Asbridge, & Veugelers, 2008; MacLellan, Taylor, & Wood, 2008) and a more recent investigation of academic performance (measured through self-reported grades) across Canada (students in grades 6-12) suggest the importance of fruit and vegetable intake for academic performance (Woodruff, Ahmed, Stefanczyk, & Manske, submitted). Interestingly, Woodruff et al., (submitted) also suggest the importance of low levels of sedentary behaviour (which would typically occur outside of the school day) for academic performance, suggesting that there may be multiple health behaviours influencing academic performance.

Within Canada, physical activity has also been associated with better academic performance. Schools that increased physical activities reported an increase in grade point averages, test scores, and learning capacities in their students (Ahamed et al., 2007; Trudeau & Shephard, 2008), as well as, better school attendance (Trudeau & Shephard, 2008). However, mixed results are apparent. In a study of grade 6 students in New Brunswick, an increase in physical activity showed a decrease in academic performance (Tremblay, Inman, & Willms, 2000) while no associations between physical activity and academic scores were apparent in elementary school students in Southern Australia (Dollman, Boshoff, & Dodd, 2006).
Given that parents and schools are under increased amount of pressure to maximize academic performance (e.g., EQAO scores), allotting time for health promotion has become increasingly difficult for schools (Smith & Lounsbery, 2009). Schools are increasingly using classroom and extra-curricular activities time to make sure their students perform well in EQAO assessments. The EQAO score acts a medium to improve the success of Ontario students through measuring their performance in mathematics, reading, and writing in relation to Ontario curriculum expectations (EQAO, 2012). Through this, academic improvements can be made at all levels of education as an individual, in schools, school boards, and the province. The test is administered to grade 3 and 6 students across Ontario and is often used to make comparisons between schools and school boards.

Despite the importance of EQAO scores in Ontario, most studies investigate ways improve the scores through different learning strategies (EQAO, 2012). However, Muirhead and Locker (2006) reported that better dental health was associated with high EQAO score in children in Toronto schools after controlling for extraneous factors. Perhaps more health behaviours associated with good health (e.g. good nutrition, increased physical activity, and decrease sedentary behaviour) could be used to improve EQAO scores in Ontario. Therefore, an understanding of the associations between fruit and vegetable intake, physical activity, and sedentary behaviours and academic performance may provide further another avenue where schools and school boards could use to improve academic performance.
REFERENCES


aged youth from 34 countries and their relationships with physical activity and dietary patterns. *Obesity Reviews*, 6(2), 123-132.


Welcome to the Northern Fruit and Vegetable Program Survey! We are asking you to fill out a survey which asks questions about fruit and vegetables. The survey will take about 10 minutes.

We ask that you do it by yourself. Your parents have given you permission to participate, but please know, it’s up to you. It’s ok if you don’t want to answer any of the questions. If that’s the case, then go to the end of the survey without filling anything in. It’s also okay if you don’t want to answer a question - you can leave it blank.

But if you have any questions and/or do not understand what we are asking, then please raise your hand. Remember none of the questions asked will affect your grades in any way and the survey is completely up to you.

Do you agree to start the survey?

- Yes
- No
In order to keep track of your answers, please create this 6 digit ID code.

**Which month you were born? Keep to 3 letters**

- [ ] January
- [ ] February
- [ ] March
- [ ] April
- [ ] May
- [ ] June
- [ ] July
- [ ] August
- [ ] September
- [ ] October
- [ ] November
- [ ] December

**What day of the month were you born? Keep as is**

- [ ] 1
- [ ] 2
- [ ] 3
- [ ] 4
- [ ] 5
- [ ] 6
- [ ] 7
- [ ] 8
- [ ] 9
- [ ] 10
- [ ] 11
- [ ] 12
- [ ] 13
- [ ] 14
- [ ] 15
- [ ] 16
- [ ] 17
- [ ] 18
- [ ] 19
- [ ] 20
- [ ] 21
- [ ] 22
- [ ] 23
- [ ] 24
- [ ] 25
- [ ] 26
- [ ] 27
- [ ] 28
- [ ] 29
- [ ] 30
- [ ] 31

**What are the last 2 letters of your last name? Keep as is**

_____________________

**Are you?**

- [ ] a boy  0
- [ ] a girl  1
Would you consider yourself?

- White (for example, Canadian, English, French, Italian, Polish, etc)
- Aboriginal (for example, First Nations, Metis, Inuit, etc)
- Black (for example, African-Canadian, African-American, African, Nigerian, etc)
- Chinese
- Arabic (for example, Lebanese, Jordan, Palestinian, Egyptian, Iraqi, Syrian, etc)
- South Asian (for example, Irani, Indian, Pakistani, Sri Lankan, Nepali, etc)
- I don’t know
- Other, please specify _____________________

How old are you? Keep as is

- 8 years
- 9 years
- 10 years
- 11 years
- 12 years
- 13 years
- 14 years
- 15 years

What grade are you in? Keep as is

- Grade 5
- Grade 6
- Grade 7
- Grade 8

What’s the name of your school? Refer to NFVP School Codebook

________________________________________________________

______
<table>
<thead>
<tr>
<th>Fruit</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Dried cherries</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Blueberries</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Kiwis</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Melon</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Plums</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Clementines</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Strawberries</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Pineapple</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Cantaloupe</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
### Which of the vegetables do you like or dislike?

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>Have never tried/Don’t know 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparagus</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Broccoli</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Carrots</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Celery</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Cherry tomatoes</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Mini cucumber</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Snap Peas</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Green beans</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Spinach</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Squash</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

### How much do you agree or disagree with the following?

<table>
<thead>
<tr>
<th>Statement</th>
<th>I fully agree 5</th>
<th>I agree somewhat 4</th>
<th>Neither 3</th>
<th>I disagree somewhat 2</th>
<th>I fully disagree 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like to eat fruit everyday</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>I like to eat vegetables everyday</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Fruit tastes good</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Vegetables taste good</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>
How willing are you to try new foods?

<table>
<thead>
<tr>
<th></th>
<th>Very willing 4</th>
<th>Somewhat willing 3</th>
<th>Not willing 2</th>
<th>Not sure 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>How willing are you to try fruits you’ve never tried before?</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>How willing are you to try vegetables you’ve never tried before?</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

How much do you agree or disagree?

<table>
<thead>
<tr>
<th></th>
<th>I fully agree 5</th>
<th>I agree somewhat 4</th>
<th>Neither 3</th>
<th>I disagree somewhat 2</th>
<th>I fully disagree 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eating fruit every day makes me feel good</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Eating fruits and vegetables could help prevent cancer</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Eating fruits and vegetables could help prevent heart disease</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>
During the past month, how often did you?

<table>
<thead>
<tr>
<th></th>
<th>Never or less than once per month</th>
<th>1 to 3 times per month</th>
<th>1 per week</th>
<th>2 to 4 times per week</th>
<th>5 or more times per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eat fruit? Include fresh, frozen or canned fruit. Do not include juices.</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Eat a green leafy or lettuce salad, with or without other vegetables?</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Eat any kind of fried potatoes, including French fries, home fries, or hash brown potatoes?</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Eat any kind of potatoes, such as baked, boiled, mashed potatoes, sweet potatoes or potato salad?</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Eat other vegetables other than lettuce salads and potatoes?</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Have Mexican-type salsa made with tomato?</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Have tomato sauces such as with spaghetti or noodles or mixed into foods such as lasagna? (Please do not count tomato sauce on pizza)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>
### How much do you agree or disagree?

<table>
<thead>
<tr>
<th></th>
<th>I fully agree</th>
<th>I agree somewhat</th>
<th>Neither</th>
<th>I disagree somewhat</th>
<th>I fully disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>If I decide to eat fruit every day, I can do it</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>If I decide to eat vegetables every day, I can do it</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

### How many servings of fruit and vegetables (for example 1 whole fruit, ½ cup frozen/canned vegetables, 1 cup raw salad) do you think you should eat every day to stay healthy? Match by age and gender (0=incorrect, 1= correct)

- ○ 5 servings
- ○ 6 servings
- ○ 7 servings
- ○ 8 servings
Mark how many minutes of physical activity you did on each of the past 7 days. Include physical activity during physical education class, sports, lunch, after school, evenings, and spare time. Physical activities include skating, bike riding, running, rollerblading, and any other physical activities that cause you to sweat and to breathe harder or “be out of breath”.

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>1-15 minutes</th>
<th>16-30 minutes</th>
<th>31-59 minutes</th>
<th>1-2 hours</th>
<th>More than 2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tuesday</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wednesday</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Thursday</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Friday</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Saturday</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sunday</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
For each of the past 7 days, mark how many hours (outside of school) you spent sitting or lying down looking at a screen. Think about the time you spent watching TV and movies, playing video games, video chatting, text messaging, or surfing internet sites like Twitter or YouTube, for example.

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Less than 1 hour a day</th>
<th>1-2 hours a day</th>
<th>More than 2 hours but less than 5 hours a day</th>
<th>5 or more hours a day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuesday</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wednesday</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thursday</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friday</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saturday</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sunday</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If I were to be physically active during my free time on most days:

<table>
<thead>
<tr>
<th></th>
<th>Agree a lot</th>
<th>Agree</th>
<th>Disagree</th>
<th>Disagree a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>It would help me cope with stress</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>It would be fun</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It would help me make new friends</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It would make me feel good</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It would give me more energy</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It would make me hot and sweaty</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It would make me better in sports, dance, or other activities</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How much moderate-to-vigorous-physical activity (causes you to sweat and to breathe harder or “be out of breath”) do you think you should get every day to stay healthy?

- 15 minutes: 0
- 30 minutes: 0
- 60 minutes: 1
- 90 minutes: 0

I enjoy receiving fruit or vegetables in my classroom 2 times a week.

- Agree a lot: 4
- Agree: 3
- Disagree: 2
- Disagree a lot: 1

Being given 2 fruits/vegetables each week helps me:

<table>
<thead>
<tr>
<th></th>
<th>Agree a lot</th>
<th>Agree</th>
<th>Disagree</th>
<th>Disagree a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achieve my weekly intake</td>
<td>0</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Learn better in school</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Be more physically active</td>
<td>0</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

How much encouragement?

<table>
<thead>
<tr>
<th></th>
<th>Strongly encouraged</th>
<th>Encouraged</th>
<th>Discouraged</th>
<th>Strongly Discouraged</th>
</tr>
</thead>
<tbody>
<tr>
<td>How much did you encourage your classmates to try new foods?</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>How much did your teacher or principal encourage you to try new foods?</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
APPENDIX B

Associations among Fruit and Vegetables Intake, Physical Activity, Sedentary Behaviour, and EQAO Survey Questions and Codebook

Are you?

○ a boy 0
○ a girl 1

How old are you? Keep as is

○ 8 years  ○ 10 years  ○ 12 years  ○ 14 years
○ 9 years   ○ 11 years  ○ 13 years  ○ 15 years

What grade are you in? Keep as is

○ Grade 5   ○ Grade 7
○ Grade 6   ○ Grade 8

What’s the name of your school? Refer to NFVP School Codebook

_______________________________________________

________
During the past month, how often did you?

<table>
<thead>
<tr>
<th></th>
<th>Never or less than once per month</th>
<th>1 to 3 times per month</th>
<th>1 per week</th>
<th>2 to 4 times per week</th>
<th>5 or more times per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eat fruit? Include fresh, frozen or canned fruit. Do not include juices.</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Eat a green leafy or lettuce salad, with or without other vegetables?</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Eat any kind of fried potatoes, including French fries, home fries, or hash brown potatoes?</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Eat any kind of potatoes, such as baked, boiled, mashed potatoes, sweet potatoes or potato salad?</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Eat other vegetables other than lettuce salads and potatoes?</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Have Mexican-type salsa made with tomato?</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Have tomato sauces such as with spaghetti or noodles or mixed into foods such as lasagna? (Please do not count tomato sauce on pizza)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>
Mark how many minutes of physical activity you did on each of the past 7 days. Include physical activity during physical education class, sports, lunch, after school, evenings, and spare time. Physical activities include skating, bike riding, running, rollerblading, and any other physical activities that cause you to sweat and to breathe harder or “be out of breath”.

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>1-15 minutes</th>
<th>16-30 minutes</th>
<th>31-59 minutes</th>
<th>1-2 hours</th>
<th>More than 2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Tuesday</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Wednesday</td>
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<td>○</td>
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<td>○</td>
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<tr>
<td>Thursday</td>
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<tr>
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<tr>
<td>Saturday</td>
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<tr>
<td>Sunday</td>
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<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
For each of the past 7 days, mark how many hours (outside of school) you spent sitting or lying down looking at a screen. Think about the time you spent watching TV and movies, playing video games, video chatting, text messaging, or surfing internet sites like Twitter or YouTube, for example.

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Less than 1 hour a day</th>
<th>1-2 hours a day</th>
<th>More than 2 hours but less than 5 hours a day</th>
<th>5 or more hours a day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Tuesday</td>
<td>☐</td>
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<td>☐</td>
<td>☐</td>
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<td>Wednesday</td>
<td>☐</td>
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<tr>
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<td>Saturday</td>
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<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

How much do you agree or disagree?

<table>
<thead>
<tr>
<th></th>
<th>I fully agree (5)</th>
<th>I agree somewhat (4)</th>
<th>Neither (3)</th>
<th>I disagree somewhat (2)</th>
<th>I fully disagree (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eating fruit every day makes me feel good</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Eating fruits and vegetables could help prevent cancer</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Eating fruits and vegetables could help prevent heart disease</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
How many servings of fruit and vegetables (for example 1 whole fruit, ½ cup frozen/canned vegetables, 1 cup raw salad) do you think you should eat every day to stay healthy? Match by age and gender (0=incorrect, 1=correct)

- 5 servings
- 6 servings
- 7 servings
- 8 servings

How much moderate-to vigorous-physical activity (causes you to sweat and to breathe harder or “be out of breath”) do you think you should get every day to stay healthy?

<table>
<thead>
<tr>
<th>Time</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 min</td>
<td>0</td>
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<td>30 min</td>
<td>0</td>
</tr>
<tr>
<td>60 min</td>
<td>1</td>
</tr>
<tr>
<td>90 min</td>
<td>0</td>
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</tbody>
</table>
Consent Form (in English)

PARENT CONSENT TO PARTICIPATE IN RESEARCH

Dear Parent(s) or Guardian(s),

Researchers at the University of Windsor (Kinesiology department), in conjunction with the Porcupine Public Health Unit, are conducting a survey as part of the Northern Fruit and Vegetable Program at your child’s school. We would like to provide you with some information about the survey to help you decide if your son or daughter should be involved.

If you have any questions or concerns about the research, please feel free to contact Dr. Sarah Woodruff by phone (519)253-3000 ext 4982 or email at woodruff@uwindsor.ca.

PURPOSE OF THE STUDY
Fruit and vegetable intake among Canadian children/adolescents is currently lower than recommended values suggest. As part of the fruit and vegetable program offered at your child’s school, under the guidance of the Porcupine Public Health Unit, the school board, and the Ontario Fruit and Vegetable Growers Association, we want to evaluate changes in fruit and vegetable preferences, likability, knowledge, and intake based on exposure through the snack program and to determine students suggestions/excitability for the program. Through better understanding of eating patterns, and the variables that influence these patterns, we can help programs and families to better support healthy eating.

PROCEDURES
All the students in your child’s class are being invited to participate in the study during class time. The study involves a 15 minute survey which will ask your son or daughter about their exposure, likeability, and consumption of certain fruits and vegetables.

POTENTIAL RISKS AND DISCOMFORTS
There are no known or anticipated risks associated with participating in the current study. Your son or daughter will be answering questions based on their exposure, likeability, and consumption of certain fruits and vegetables. If for some reason they do not feel comfortable at any time they do not have to answer a question. They are able to withdraw from the study at any time. Each student will only be identified using a unique identification code and therefore their information will be anonymous.

POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY
Through participating in the study, your son or daughter will get to know what fruits/vegetables they prefer compared to others. Your son or daughter may have an increased awareness of fruits/vegetables after completing the survey.
PAYMENT FOR PARTICIPATION
Your child will not receive any payment for participating in the study. However, as a way to say thank you to the students, the students will be entered into a draw to win a package that contains a kinesiology research t-shirt, a cookbook from Sandi Richard (Anyone can cook Dinner), and a reflective arm band (to be visible during physical activity at dusk/night).

CONFIDENTIALITY
Any information that is obtained in connection with this study and that can be identified with you or your child will remain confidential and will be disclosed only with your permission. The information obtained from the study will not be used for any purpose other than research and the communication results. All surveys will only be accessed by the researchers of this study. Once the study is completed, the surveys will be shredded and only electronic data will be kept (with coded identification). Your child’s name will not be kept track of at all.

PARTICIPATION AND WITHDRAWAL
Participating in this research study will not affect your child’s grades or performance evaluations in any way. Participation in this study is voluntary. If your child volunteers to be in this study, he/she may withdraw at any time without consequences of any kind. In addition, data will not be retained upon withdrawal unless you or your child consents for it to be retained. Your child may also refuse to answer any questions he/she does not want to answer and still remain in the study.

FEEDBACK OF THE RESULTS OF THIS STUDY TO THE SUBJECTS
An information letter will be sent to the principals upon completion of the study. The principals will then distribute this information to the teachers, participants and their parents.

SUBSEQUENT USE OF DATA
This data may be used in subsequent studies.

RIGHTS OF RESEARCH PARTICIPANTS
You may withdraw your consent at any time and discontinue your child’s participation without penalty. If you have questions regarding your rights as a research participant, contact: Research Ethics Coordinator, University of Windsor, Windsor, Ontario, N9B 3P4; Telephone: 519-253-3000, ext. 3948; e-mail: ethics@uwindsor.ca

SIGNATURE OF RESEARCH PARTICIPANT/LEGAL REPRESENTATIVE
I understand the information provided for the study evaluating the school snack program as described herein. My questions have been answered to my satisfaction, and I agree to participate in this study. I have a copy of this study.

________________________________________
Name of Parent or Guardian

________________________________________
Signature of Parent or Guardian

_________ ______________________________
Date

SIGNATURE OF INVESTIGATOR
These are the terms under which I will conduct research.
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SIGNATURE OF INVESTIGATOR
These are the terms under which I will conduct research.

[Signature of Investigator]  April 9, 2014

___________________________________  __________________________
Signature of Investigator  Date
VITA AUCTORIS

<table>
<thead>
<tr>
<th>NAME:</th>
<th>Kevin Mageto</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLACE OF BIRTH:</td>
<td>Nairobi, KENYA</td>
</tr>
<tr>
<td>YEAR OF BIRTH:</td>
<td>1988</td>
</tr>
<tr>
<td>EDUCATION:</td>
<td>University of Windsor, BHK- in Movement Science, Windsor, ON, 2012</td>
</tr>
<tr>
<td></td>
<td>University of Windsor, MHK- in Applied Human Performance, Windsor, ON, 2014</td>
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