10-5-2017

AN ASSESSMENT OF FRUIT AND VEGETABLE INTAKE, PHYSICAL ACTIVITY, AND SEDENTARY BEHAVIOUR AMONG INDIGENOUS AND NON-INDIGENOUS STUDENTS FROM NORTHERN ONTARIO

Christian O'neil Paton
University of Windsor

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By

Christian Tré Paton

A 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

2017

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by

Christian Tré Paton

APPROVED BY:

_____

C. Beckford
Faculty of Education

_____

P.M. van Wyk
Department of Kinesiology

_____

S. Woodruff, Advisor
Department of Kinesiology

August 30th 2017

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ABSTRACT

The purpose of this study was to examine fruit and vegetable intake, physical activity (PA), and sedentary behaviour within Indigenous and Non-Indigenous students in grades 5-8 from northern Ontario, Canada. Students (N=872) from 34 schools within the catchment area of Porcupine Health Unit completed the *Northern Fruit and Vegetable Program Evaluation* survey in May, 2016. The odds of participants having a higher fruit and vegetable intake was lower among (1) those living in remote locations compared to urban locations (OR = -1.299 (95% CI: -2.336, -0.240), $p < 0.05$) and (2) Indigenous, compared to White, participants (OR = -.674 (95% CI: -1.336, -.0120), $p = 0.05$); in addition to no associations among ethnicity, location and PA/sedentary behaviour. Among Indigenous participants, those living in remote locations consumed statistically significant less fruit and vegetables (compared to urban and rural; $F(2, 128) = 3.780$, $p = 0.025$), and were less physically active (compared to urban and rural; $F(2, 121) = 4.724$, $p = 0.011$). There were no statistical differences observed by school location and meeting the sedentary behaviour guidelines for Indigenous populations. Although there were some statistically significant findings pertaining to fruit and vegetable intake among students in northern communities in Ontario, the health behaviours of all participants within this study were concerning. In the future, health interventions are needed to address low fruit and vegetable intake, PA, and sedentary behaviours of children and adolescents. Support through funding opportunities (pertaining to increasing the amount of fruit and vegetables provided to schools) is needed, and it is necessary to advocate for more PA and sedentary behaviour education.

ACKNOWLEDGEMENTS

Firstly, I would like to thank God for the opportunity to pursue and further my education in my Masters of Human Kinetics at the University of Windsor. I would then like to thank my supervisor Dr. Sarah Woodruff, for not only being my foundation, my pillar, and guide throughout this process, but also a life-long mentor with whom I look forward to continuing and building our relationship in the future. Your kind and caring perspective, paired with your honest and genuine personality, made this experience memorable. I would also like to thank Dr. Paula van Wyk and Dr. Clinton Beckford for being a part of my committee and for your helpful comments and suggestions throughout this process. Without the constant support of my lab-mates Sara Santarossa and Trish Dubé (who were both a constant positive spirit) and my housemates at 727 Rankin Ave. (Paul Leuty, Maggie Douglas, Sara Santos, and Lauren Breadner), I don't know how I would have gotten through the past 2 years!

I would like to thank my family, both immediate (Jennifer, Ainlsey, Grandma, Clayé, and Josiah) and extended for being my support system throughout this whole process, through moral, emotional, and/or financial support. Thank you and I love you very much! Lastly, I would like to thank the organizing bodies of my thesis, the University of Windsor, the students, teachers, the Porcupine Health Unit, the other professors at the University of Windsor, for either being a helping hand or teaching me invaluable information.

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CHAPTER ONE

RESEARCH ARTICLE

Introduction

There is a dearth of literature surrounding the health and wellness among those living in rural and/or remote areas in Canada. The paucity of information is greater with respect to children. It has been suggested that focusing on healthy eating and increasing physical activity (PA) (Trudeau & Shephard, 2008; Tremblay et al., 2016), especially in school settings (Tremblay et al., 2011; Tremblay et al., 2012; Vine & Elliott, 2013), are correlated with decreasing levels of obesity and can assist in a healthier lifestyle transition from childhood to adulthood (Colley et al., 2011; Dobbins, Husson, DeCorby, & LaRocca, 2013; Tremblay et al., 2011). Healthy eating includes reducing the intake of poor food choices (e.g., fast food) and increasing the intake of healthier food choices (e.g., fruits and vegetables). Unfortunately, the consumption of fast food has rapidly increased over the past decade (Rosenheck, 2008) and a large portion of children (59%) consume less than five fruit and vegetables a day (Lobstein et al., 2004; Koplan et al., 2005). Globally, low fruit consumption is ranked among the top 5 health-related causes of disability-adjusted life years, and accounts for 4.9 million deaths world-wide each year (Lim et al., 2013). Thus, it is essential to further understand the behaviours of children with respect to healthy food intake and PA to aid in healthier lifestyle transitions to prevent these behaviours from becoming widespread and prevalent.

Canadian children are consuming diets that have excessive amounts of sugar (Bronfenbrenner, 1977; Zoellner et al., 2016), high levels of unhealthy fats (Shang et al., 2015), and extremely high levels of sodium (Garriguet, 2007). For example, according to the Canadian Community Health Survey (CCHS) 2.2, Canadian children and adolescents consume

approximately 110.0 grams of sugar a day; which equates to 21.4% of their caloric intake per day (Langlois & Garriguet, 2011). As for sodium intake, males (aged 4-14 years) and females (aged 4-14 years) consumed >95% and >80% above the recommended amount, respectively (Garriguet, 2007). Coupled with poor dietary intakes, low levels of PA have been reported among Canadian children. Currently, only 9% of 5- to 17-year-old Canadians accumulate at least 60 minutes of moderate to vigorous physical activity (MVPA) on at least six days of the week (Colley et al., 2011), and 10% of 11-15-year-olds meet the sedentary behaviour recommendations outlined by the Canadian 24-Hour Movement Guidelines for Children and Youth (i.e., no more than two hours of sedentary time a day; Canadian Society of Exercise Physiology (CSEP), 2016). Due to the low levels of PA/sedentary behaviour among the adolescent and child population, it is important to address and implement strategies to overcome barriers to be active (Colley et al., 2011). Among rural/remote and Indigenous communities, health behaviours are often reported as more concerning (Willows Veugelers, Raine, & Kuhle, 2009; Saksvig et al., 2005), as many face additional barriers such as accessibility, affordability, and food insecurity (Willows et al., 2009; Saksvig et al., 2005).

In Canada, young Indigenous people have higher rates of overweight and obesity than non-Indigenous populations (41% vs. 32.7%; Shields, 2006). However, among all children and adolescents, overweight and obesity is higher among males (32.9%) compared to females (23.9%) and tends to increase with age, especially through adolescence (Rao et al., 2016). The high rates of obesity are thought to be correlated with type 2 diabetes (Gracey & King, 2009; King, Smith, & Gracey, 2009). Type 2 diabetes is one of the fastest growing pediatric chronic illnesses that the world is facing and disproportionately affects Indigenous peoples on all continents (Zimmet, Alberti, & Shaw, 2001; Pinhas-Hamiel & Zeitler, 2005). In Canada,

Indigenous adolescents compromise 50% of new cases of type 2 diabetes in pediatric endocrinology clinics (Amed et al., 2012). Regardless of ethnic background, however, children and adolescents who report low levels of both fruit and vegetable intake and PA are known to track these health behaviours into adulthood (Lock, Pomerleau, Causer, Altmann, & McKee, 2005; Maynard, Gunnell, Emmett, Frankel, & Smith, 2003; Ness et al., 2005) and have been associated with adverse health outcomes including diabetes (Delahanty et al., 2013; Vinicor, 1994), greater adiposity (Te Morenga, Mallard, & Mann, 2013), cardiometabolic risk factors (Ekeland et al., 2012), behavioural problems (Maynard et al., 2006; Telama, 2009), low mood (Ekeland et al., 2012), and poorer academic attainment (Janssen & LeBlanc, 2010). Research has shown that Indigenous populations have significantly lower rates of consuming five or more fruit and vegetables a day (Quadir & Akhtar-Danesh, 2010), which may be explained in part by the lack of healthy food availability. For example, Indigenous children tend to eat market food (i.e., purchased at a grocery store vs. traditional food that would be obtained via hunting and gathering) of poor nutritional quality (Pigford & Willows 2010). Examples of market food include soups, canned foods, candy, and soft drinks (Conner, Colasanti, Ross & Smalley, 2010); which tend to be more accessible and affordable than healthier food options (i.e., fruit and vegetables) (Power, 2008). Household food insecurity may also hinder families from purchasing healthy foods and may be influenced by: poverty, multi-child households, low levels of education achievement, labour force participation, reliance on social assistance and welfare, and many single parent households (Chen & Che, 2001; Willows et al., 2009). Further, Indigenous peoples may also experience inadequate housing, household overcrowding, food insecurity, geographic isolation, and lack of access to healthcare providers who are knowledgeable on Indigenous aspects of life to understand cultural beliefs/norms (Reading & Wein, 2009; Willows

Veugelers, Raine, & Kuhle, 2009; King et al., 2009). Moreover, Indigenous populations have the highest likelihood of developing long-term diseases as these health behaviours transition across the lifespan, compared to other ethnicities (Quadir & Akhtar-Danesh, 2010). With potential adverse health outcomes, it is important to consume fruit and vegetables, as well as be physically active during childhood and adolescence to allow the positive health behaviours to be translated into adulthood and throughout the lifespan (Janssen & LeBlanc, 2010; Slavin & Lloyd, 2012).

Within Canada, and more specifically Ontario, much of the population lives within the southern regions (Statistics Canada, 2016). In an attempt to increase the awareness of fruit and vegetables, PA, and sedentary behaviour among those living in the northern regions, the Ministry of Health and Long-Term Care implemented the *Northern Fruit and Vegetable Program*, which delivers 2 servings of fruit and/or vegetables, per student, per week in addition to educational material for healthy living (for a 20-week program). The northern region of Ontario lacks access to resources that encourage consumption of fruits and vegetables; in addition to participation in PA opportunities. However, to date, there is no research that has focused on area of residence (e.g., urban, rural, remote) as a factor of overall health pertaining to nutritional habits, PA, and sedentary behaviour within northern populations in Ontario, Canada.

Therefore, the primary purpose of this study was to investigate fruit and vegetable intake, PA, and sedentary behaviour of children in grades 5-8 living in northern communities of Ontario, Canada. This study was part of a larger investigation that focused on an evaluation of the Northern Fruit and Vegetable Program which assessed fruit and vegetable consumption, likeability, knowledge, and self-efficacy, in addition to PA and sedentary behaviours. The first objective, of this secondary data analysis, was to examine if there were any specific health behaviour variables (fruit and vegetable intake, PA, sedentary behaviour) that corresponded with

ethnicity and/or location of the school (urban, rural, remote). It was hypothesized that the highest intakes of fruit and vegetable intake, PA, and lowest sedentary behaviours would be observed among non-Indigenous participants, followed by Indigenous students living in rural/urban locations, and then Indigenous students living in remote locations. The second objective, specific to Indigenous participants, was to investigate whether school location was associated with fruit and vegetable intake, PA, and sedentary behaviour. It wass hypothesized that the lowest intakes of fruit and vegetables, PA, and highest sedentary behaviours would be observed among Indigenous populations attending schools in remote locations. The relevance of this investigation could help provide evidence to support funding opportunities pertaining to increasing the amounts of fruit and vegetables provided to schools, in addition to helping advocate for more PA and sedentary behavior education. Advocating for health programs within northern communities would allow the opportunity for the community to be more physically active and could potentially increase positive health behaviours.

Methods

The current data were taken from a larger 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, all English and French school board(s)/authority(ies) within the catchment area of the Porcupine Health Unit, principals, parents, and participants from the *Northern Fruit and Vegetable Program Evaluation*. The snack program runs from January to June (20 weeks), in which participating schools received weekly deliveries of 2 servings of primarily Ontario grown fruit and vegetables from the Ontario Fruit and Vegetable Growers' Association in combination with healthy eating and PA education.

Participants

The current data were taken from the participants of a larger study (involving the Algoma Public Heath, Porcupine Health Unit, and Sudbury and District Health Unit) investigating the influence of a snack program (the *Northern Fruit and Vegetable Program*) on fruit and vegetable intake, likeability (of fruit and vegetables), knowledge (of fruit and vegetables), self-efficacy (for eating fruit and vegetables), PA behaviours and attitudes, and sedentary behaviours among grade 5-8 students. The primary goal of the *Northern Fruit and Vegetable Program*, as funded by the Ontario Ministry of Health and Long-Term Care, is to increase the awareness and consumption of fruit and vegetables in the northern regions of Ontario (geographically remote) including the catchment areas of Algoma, Porcupine, and Sudbury Health Units, in addition to providing educational materials for PA, sedentary behavior, and other health behaviours. The *Northern Fruit and Vegetable Program* began in Porcupine (2006-07) and expanded to Algoma (2007-08), Sudbury (2014-15), and various Indigenous communities within the Porcupine catchment area (2014-15). Specific to this thesis and 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 (54 schools).

Apparatus and Materials

A web-based survey was administered to students participating in the *Northern Fruit and Vegetable Program Evaluation* (paper-based surveys were available for those schools not wanting to and/or not able to participate electronically). The survey was hosted by Fluid Surveys (Fluid Surveys, 2016) at no charge, as a subscription was held by the University of Windsor. All survey questions were retrieved from previous surveys used in other health research studies for children and adolescents. The surveys were available in both English and French. Two separate

surveys were created, one for the larger Porcupine population (Appendix A) and a separate survey for those in remote areas (schools in Moosonee and the east side of James Bay; Appendix B) as the produce delivered to the remote areas was slightly different based on availability and delivery requirements. All questions were identical for the two surveys with the exception of the likability question (and which fruit or vegetables were offered).

Variables of Interest. The variables of interest for this study included fruit and vegetable intake, frequency of PA, frequency of sedentary behaviour, ethnicity, gender, grade, and school location. To assess fruit and vegetable intake the question: '*On a usual day, how many of fruit and/or vegetables do you eat? Include fresh, frozen canned, and cooked items like apple, banana, carrot, salads, and 100% juice. Do not include chips, French fries, or other fried potatoes. Some examples of single servings: ½ cup of fresh, frozen, or cooked vegetables, 1 cup of raw leafy vegetables; like a small salad, 1 medium fruit; like an apple, pear, or banana, or ½ cup of 100% fruit or vegetable juice*' was asked with response options of '0 servings', '1-2 servings', '3-4 servings', '5 servings', '6 servings', '7 servings', and '8 or more servings'. Responses matched servings of *Vegetables and Fruit* (according to Eating Well with Canada's Food Guide), and were categorized into '0-2 servings/day', '3-4 servings/day', or '5+ servings/day'. For PA, the question asked was: '*Mark how many minutes of physical activity you did on each of the past 7 days [Monday-Sunday]. 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 care you to sweat and to breather harder or "be out of breath"*' with the response options of 'none', '1-15 minutes', '16-30 minutes', '31-59 minutes', '1-2 hours', 'more than 2 hours'. Responses were dichotomized into meeting the PA requirements, that is, anything over 60 minutes vs. not

meeting the PA requirements (according to the Canadian 24-hour movement guidelines for PA) for each day of the last week and then summed to form a weekly total. The weekly total was then further dichotomized into meeting the requirements on all 7 days vs. not. For sedentary behaviour, the question: '*For each of the past 7 days [Monday-Sunday], how many hours (outside of school) do you spend 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 You Tube, for example*' with the responses of 'none', 'less than 1 hour a day', '1-2 hours a day', 'more than 2 hours but less than 5 hours a day', or '5 or more hours a day' was asked. Responses were dichotomized into meeting the sedentary guidelines, that is, anything under 2 hours vs. not meeting the sedentary guidelines (according to the Canadian 24-hour movement guidelines for sedentary behaviours) for each day of the last week and then summed to form a weekly total. The weekly total was then further dichotomized into meeting the requirements on all 7 days vs. not. Ethnicity was asked through: '*Would you consider yourself?'* with response options of '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, Korean, Japanese', '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', or 'other, please specify', and were categorized as 'White', 'Indigenous', or 'Other'. Gender was asked with: '*Are you a'?* with response options of 'boy' and 'girl'. Grade was asked with '*What grade are you in?'* with a response of 'grade 5', 'grade 6', 'grade 7', and 'grade 8'. Lastly, as school name was collected, and the location of the school was categorized into rural, urban, or

remote which were based on the resources and infrastructures they had present in their communities.

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. The consent forms were available in English, French, or English/French/Cree. The school's teachers were then instructed to remind the students to bring consent forms signed for permission to participate in the study, up until the day of 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 Health Unit and researchers from the University of Windsor. Only students who had a signed parental consent form and who assented to participate took part in the current study. Students were reminded that they could choose not to participate in the research study, and/or only respond to questions they wanted to answer. 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

Data collected from the surveys were analyzed using IBM SPSS Statistics version 23.0 for windows (IBM, 2017), with a level of significance set at $p<0.05$. Separate chi square analyses were used to determine differences in fruit and vegetables (servings/day), PA (met the

guidelines on all 7 days of the previous vs. not), and sedentary behaviours (met the guidelines on all 7 days of the previous week vs. not) across demographic variables (gender, grade, ethnicity, and location). For Objective #1, an ordinal logistic regression analysis was used to determine if the odds of consuming higher amounts of fruit and vegetables was associated with ethnicity, school location, and/or an interaction between ethnicity and school location as the predictor variables, along with gender and grade. A binary logistic regression analysis was used to determine if the odds of meeting the PA guidelines on all 7 days of the previous week was associated with ethnicity, school location, and/or an interaction between ethnicity and school location as the predictor variables, along with gender and grade. Another binary logistic regression analysis was used to determine if the odds of meeting the sedentary guidelines on all 7 days of the previous week was associated with ethnicity, school location, and/or an interaction between ethnicity and school location as the predictor variables, along with gender and grade. For Objective #2, three separate a one-way ANOVAs were conducted, among only the Indigenous participants, to assess whether fruit and vegetable intake, PA (as a continuous variable), and sedentary behaviors (as a continuous variable) was associated with location of school (as the independent variable), which was followed up with a Fisher's LSD post-hoc test to determine differences. Appendix C outlines how the assumptions were met for each statistical procedure.

Results

Among the 54 schools that were within the Porcupine Health Unit catchment area, 34 schools participated the *Northern Fruit and Vegetable Program Evaluation* (63% school response rate). Out of a potential 2,319 students in grades 5-8 (within the 34 schools), 872 students participated (37% response rate). Males (n=380) and females (n=480) participated (12

did not report their sex), ranging in age from 9-15 years. Table 1 describes demographic characteristics by fruit and vegetable consumption, PA, and sedentary behaviour.

Objective #1 results (3 separate models) are depicted in Figure 1. The odds of participants having a higher fruit and vegetable intake was lower among (1) those living in remote locations compared to urban locations (OR = -1.299 (95% CI: -2.336, -0.240), Wald 5.805, p <0.05) and (2) Indigenous, compared to White, participants (OR = -.674 (95% CI: -1.336, -.0120), Wald 3.983, p = 0.05). The binary logistic regression analyses for PA and sedentary behavior did not result in any stastitical differences based on ethnicity or school location.

For Objective #2 specific to Indigenous participants (n=135), there were 67 males and 65 females attending schools in urban (n=22), rural (n=36), and remote (n=77) locations. The one-way ANOVA determined that there was a statistically significant difference between fruit and vegetable intake (F(2,128) = 3.780, p = 0.025). A post hoc test revealed that those Indigenous populations who lived in remote locations consumed statistically significant less fruit and vegetables, than participants living in rural and urban locations. Furthermore, an one-way ANOVA determined that there was a statistically significant difference for PA behavior (F(2,121) = 4.724, p = 0.11). A post hoc analysis revealed that Indigenous participants living in remote areas were less physically active than participants living in rural and urban locations. There were no statistically significant differences observed for school location and meeting the sedentary behaviour guidelines (p >0.05).

Discussion

This study examined the associations of fruit and vegetable intake, PA, and sedentary behaviour among Indigenous and non-Indigenous students in grades 5-8 from northern Ontario,

Canada. The frequency of fruit and vegetable intake in this study is similar to the evidence reported by He et al., (2009) and is believed that this is the first inquiry that has specifically investigated school location within this geographically diverse and remote population of northern Ontario. The prevalence rates for the health behaviours, as measured in this analysis, were similar for fruit and vegetable intake of previous research (Tjepkema & Shields, 2005; He et al., 2009). The frequencies for levels of PA and sedentary behaviour were more favourable for the participants of this study than findings reported by Colley et al., (2011) and CSEP (2016), respectively. The differences may be attributable to the age of our participants (slightly more narrow age range than national datasets), the self-reported nature of our data collection (vs. objectively measured PA/sedentary behaviour), and/or the absence of a researcher during the data collection. Unfortunately, the frequencies in this study relate to poor health behaviours and, thus, are still cause for concern.

Although most participants within the current study lack the access and affordability to purchase fruit and vegetables (due to the entire catchment area of Porcupine Health Unit), the participants attending schools in remote locations had an even lower fruit and vegetable intake. Potential reasons for the lower fruit and vegetable intake include limited access to grocery stores (Pigford & Willows 2010), transportation to the grocery store, affordability of healthy food (Power, 2008), and/or limited season for growing produce (Smit et al., 1989). There are some northern communities in Ontario that do not have grocery stores and communities are often isolated due to vast boreal forests and lakes (Larsen et al., 2008). Thus, access to organizations that provide healthy foods is limited as a result of geographical location (i.e., the stores either do not exist or transportation to reach the stores is limited). The inadequate access to healthy foods such as fruit and vegetables as a result of financial constraints is referred to as food insecurity

(Skinner et al., 2016). Power (2008) states that there needs to be more of a structured framework set in place, to combat food insecurity and subsidization for those living in remote locations and low-income households. Area of residence (i.e., remote), in conjunction with lower levels of socioeconomic status, can inhibit people from purchasing healthful foods (Larsen & Gilliland, 2008). Furthermore, due to weather climates and soil conditions in northern Ontario, the opportunity to grow healthy food, especially when access and affordability to fruit and vegetables are obstacles, are limited and thus further restrict the opportunity for individuals to adopt healthy behaviours. Although outside of the current analysis, it is plausible that food scarcity may have also influenced our results (Reading & Wein, 2009; Willows et al., 2009). Future research needs to focus on food scarcity as it could potentially lead to poorer health status, as well as an increased likelihood of becoming ill (Mitchell et al., 2015).

The presence of poor health behaviours is concerning for all participants in northern Ontario, particularly among individuals living in remote areas, and is not a novel finding to this study. Similar results were observed by Gates et al., (2011) who reported low levels of fruit and vegetables among children and adolescents within the Fort Albany community of northern Ontario. Further, Skinner et al., (2006) suggested that instead of consuming fruit and vegetables, children and adolescents in northern populations consumed foods high in sugar, salt, and fat; which was thought to be due to the lack of access to healthful foods. However, data from this study suggest a concentrated concern needs to focus on the Indigenous population. The analysis specific to Indigenous participants highlighted that the majority were living in remote locations (n=67 vs. n=22 urban and n=36 rural). When children in grades 5 through 8 were asked about the number of fruit and vegetables they consume on a daily basis, participants who self-identified as Indigenous (vs. White) and indicated that they lived in remote locations (vs. urban) were less

likely to consume fewer fruit and vegetables. This finding aligns with previous research that concluded dietary consumption among Indigenous peoples tend to include foods that are high in unhealthy fats (Gittelsohn et al., 1998), which have been shown to increase the likelihood of children and adolescents becoming obese/overweight (Hanley et al., 2000; Kolahdooz, Sadeghirad, Corriveau, & Sharma, 2017). In Canada, Indigenous peoples tend to experience greater food insecurity than non-Indigenous peoples (Chen & Che, 2001; Egeland et al., 2010; Willows et al., 2009). To give an example of food insecurity, the Nunavut Inuit Child Health Survey (2007-2008) reported nearly 70% of Inuit children aged 2 to 5 years old in 16 different communities resided in food-insecure households (Willows et al., 2012). Additionally, another 25.1% lived in homes with severe child food insecurity; many skipped meals, went hungry, or did not eat for a whole day (Egeland et al., 2010). Furthermore, 25% of First Nations children are estimated to live in poverty, which could imply food insecurity and lack of access to food in general and specifically food with adequate and appropriate nutrition (Willows et al., 2012). Having such high levels of food insecurity highlights the need for further research to assess the policies and practices implemented for Indigenous communities regarding food access (Willows et al., 2012).

Although there was a greater emphasis placed on the analysis of fruit and vegetable intake, health behaviours also consider levels of PA and sedentary behaviours. There was a lack of statistically significant associations observed for PA or sedentary behavior when ethnicity or location was considered. The low levels of PA observed among all participants could be attributed to the lack of access to participate in sports in all northern communities due to weather conditions (Audet, Smith, & Lemelin, 2016). Northern temperatures can be significantly lower than that of southern Ontario causing icy and slushy conditions (Carson, Spence, Cutumisu,

Boule, & Edwards, 2010) well into the spring season when the current data were collected. This could potentially inhibit or prevent participation of PA in all children living in all northern communities, especially when weather/environmental conditions do not permit engagement of PA opportunities outside (Carson et al., 2010). Further, children and parents may not want to go outside nor have adequate transportation, which leaves limited options to be physically active at home. Poorer levels of PA could also be attributed to a lack of resources, facilities, and higher amounts of sedentary behaviour (Skinner et al., 2006); in addition to educational components (Furgal & Seguin, 2006; Katzmarzyk, 2008).

Interestingly, neither analyses reported significant differences for sedentary behavior within the three areas of residence in northern Ontario (even though the overall observed rate was concerning). Although this study did not use accelerometers or pedometers to assess PA and sedentary behaviour(s), research has shown that it could be challenging to gain an accurate depiction of PA and sedentary behaviours using self-reported data due to the broad array of activities that encompass being sedentary (i.e., sitting in classrooms, watching television, reading, etc.; Colley et al., 2011). To gain a better understanding of sedentary behaviour, tools like accelerometers, could potentially be used in the future to help depict a more concise measurement.

Strengths and Limitations & Future Recommendations

A major strength of this analysis is the large, geographically diverse sample of participants from northern Ontario; especially a participant pool inclusive of Indigenous peoples. The study also provides insight on specific health behaviours on an under-researched population. However, several limitations exist. The low response rate (i.e., 37%) may suggest that the outcomes are not representative of the entire northern community. Other studies pertaining to

snack programs and nutritional intake within similar populations had comparable response rates (i.e., 37%-52%; He et al., 2009; Skinner, Hanning, Metatawabin, Martin, & Tsuji, 2012) and Indigenous populations tend to have lower response rates when using self-reported measures compared to other ethnicities (Southcott & Walker, 2015). Furthermore, the results may represent the responses of individuals who were more easily accessible and able to participate. Thus, the data presented in this study may be a conservative representation of the health behaviours in northern Ontario, which indicates a critical need for a greater research presence and focus on enhancing the education, access, and affordability of fruit and vegetables as well as PA and sedentary behaviour programming to this population.

Research using self-reported measures can be limited by respondents being able to process information, memory errors, and variability in response (Sallis & Saelens, 2000). For more accurate results, many nutrition and PA studies use retesting procedures to allow for more of a reliable means of assessments (Sallis & Saelens, 2000). Although all questions were taken from validated surveys, there could have been a lack of understanding of some of the questions by participants, in addition to, potential language and literacy barriers. Future recommendations are to include more than one specific question pertaining to each variable (albeit, this would depend on the overall time for survey administration within the classroom). Due to the location of data collection, there were no researchers present to oversee data collection with the schools. However, the researchers trained public health staff and provided guidance (i.e., in the form of formal instructions) to classroom teachers who implemented the survey. In the future, potentially having one of the researchers oversee data collection would be valuable, although this may not be possible due to the vast geographical area and limited resources to do so.

Further, the decision to interpret PA and sedentary behavior based on meeting the current guidelines over seven days may have been too strict, even though the current results were slightly more favourable than what was expected. Although there is a lack of health behavior studies in northern Ontario (Gates et al., 2013), looking at health behaviours and socioeconomic status of family income and its relevance to ethnicity, location is recommended for future studies. Furthermore, potentially investigating the specific area of residence, in addition to utilizing school(s), could help determine the resources needed for each community. For example, results of this study reported that remote communities had a lower fruit and vegetable intake which showcases the need to increase accessibility and affordability within those communities. Lastly, PA and sedentary behavior could be assessed and implemented using a more objective method like using pedometers or accelerometers to provide a more accurate account.

In order to gain a better understanding of health behaviours among northern populations within Ontario, an environmental scan of resources is recommended to better understand the facilitators and barriers to healthy living. Further, hands on demonstrations/interactions (e.g., cooking class, gardening, etc) with fruit and vegetables could also help children and adolescents become more educated about healthy foods (e.g., consumption, cooking and preparing, growing, etc). An educational intervention where both the child and the parent could engage and work together on cooking or grocery shopping together could also be very beneficial for the family as a whole. Lastly, a program where groceries are subsidized and/or free groceries are provided at the grocery store could also have positive results for the northern populations.

Conclusion

Although there were some significant findings pertaining to fruit and vegetable intake among students in northern communities in Ontario, more research could to be conducted in

relation to PA and sedentary behaviour to further understand how to address the low levels of fruit and vegetable consumption, PA, and high levels of sedentary behaviour. The results for both analyses for fruit and vegetable intake were statistically significant, which suggests a need to advocate for more fruit and vegetables for remote and/or Indigenous peoples to potentially allow for even greater health benefits. Further, Indigenous participants in particular, are in need of more support to aid with increasing PA. Although sedentary behaviour was not significantly associated with ethnicity or location, it must be promoted among the entire population in northern communities of Ontario.

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Table 1.
Servings of Fruit and Vegetables, Physical Activity, and Sedentary Behaviour According to Current Recommendations

		Servings of Vegetables and Fruit Consumed[a]			% Meeting Daily Physical Activity Guidelines[b]	% Meeting Daily Sedentary Behaviour Guidelines[b]
		0-2	3-5	6+		
Sex	Male (n= 359)	29.2%	50.0%	20.8%	**36.7%**	51.2%
	Female (n= 461)	25.7%	52.8%	21.5%	**24.0%**	53.0%
Grade	5 (n= 284)	**22.1 %**	**51.4%**	**26.5%**	**30.7%**	**65.6%**
	6 (n= 183)	**31.3%**	**45.8%**	**22.9%**	**34.4%**	**54.6%**
	7 (n=154)	**30.2%**	**54.7%**	**15.1%**	**17.3%**	**43.9%**
	8 (n= 188)	**34.2%**	**50.5%**	**15.3%**	**30.7%**	**37.2%**
Ethnicity	White (n= 641)	**23.8%**	**52.7%**	**23.5%**	75.8%	53.5%
	Aboriginal (n= 135)	**45.8%**	**44.3%**	**9.9%**	15.6%	48.4%
	Other (n= 73)	**31.5%**	**48.0%**	**20.5%**	8.6%	50.8%
Location	Urban (n= 386)	**23.8%**	**53.2%**	**23.0%**	**45.6%**	**46.5%**
	Rural (n= 323)	**24.9%**	**51.4%**	**23.7%**	**40.9%**	**41.3%**
	Remote (n= 104)	**55.2%**	**38.8%**	**6.0%**	**13.5%**	**12.2%**
All participants (n=872)		31.4%	49.4%	19.5%	29.1%	52.4%

[a] according to Eating Well with Canada's Food Guide

[b] according to the Canadian 24-Hour Movement Guidelines

Note. Bolded typeface indicates significant associations, $p<0.05$. All samples may not add up to full sample due to missing data

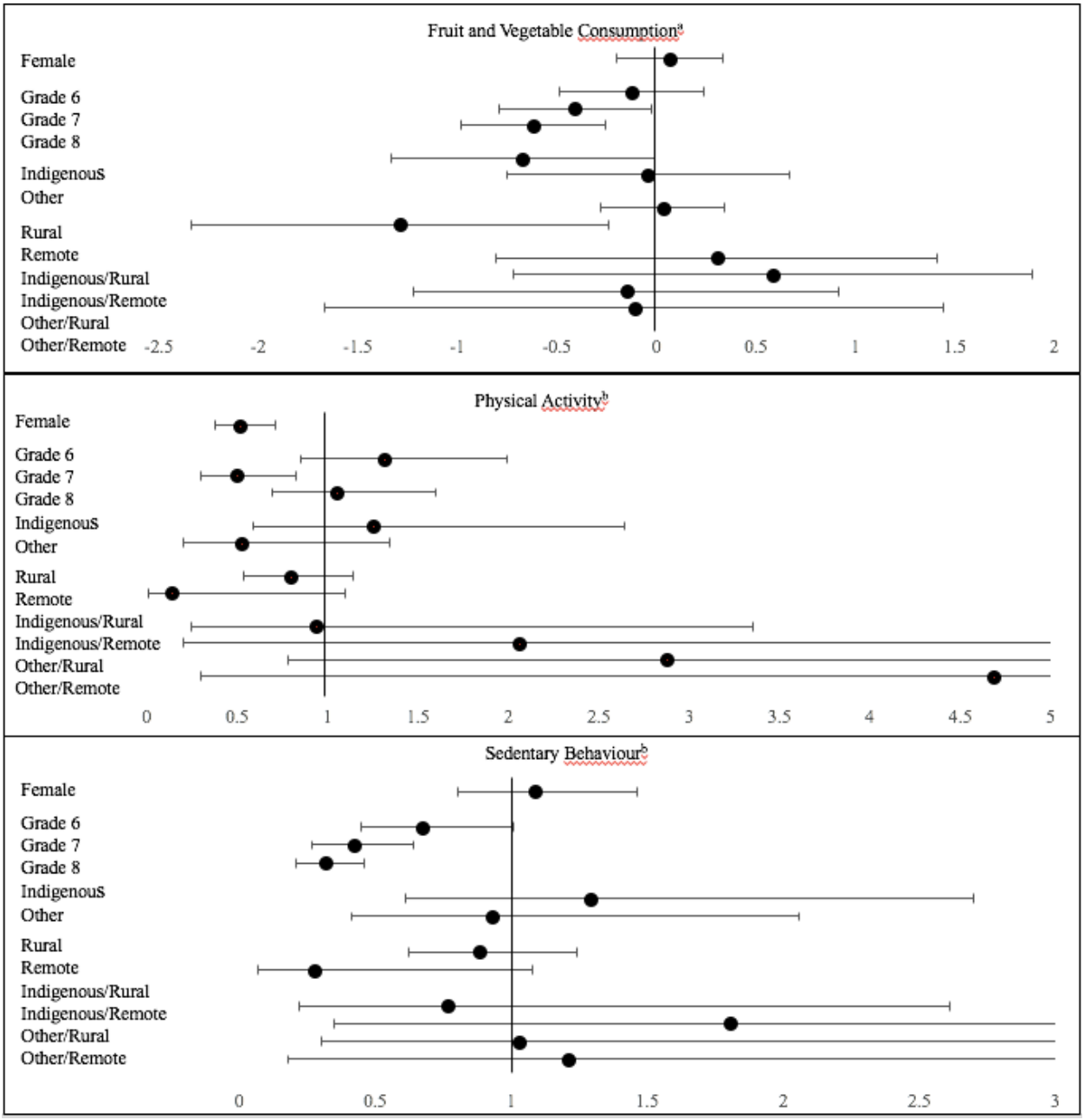

Figure 1. Regression Analysis of Fruit and Vegetable Intake, Physical Activity, and Sedentary Behaviour

[a] Forest-Plot of Ordinal Logistic Regression

[b] Forest Plots of Binary Logistic Regressions

Note. If the horizontal lines depicted on the Forest Plots do not cross the vertical line, the variable is deemed significantly different from the reference category, $p<0.05$. Reference categories include male, grade 5, urban, and White/urban.

CHAPTER TWO

REVIEW OF LITERATURE

The health of children and adolescents has become a very apparent issue when it comes to developing health strategies to help counteract concerns relating to obesity and cardiovascular disease (Vine & Elliott, 2013). There has been a variety of studies investigating various diseases and illnesses that correspond with the importance and regulation of healthy eating (Mitchell et al., 2015), forming and creating consistent nutritional habits (Evert et al., 2014), increasing levels of physical activity (PA) (Hansen, Kolle, Dystrad, Holme, & Anderssen, 2012; Sallis, Adams, & Ding, 2012), in adults. However, there has been a dearth of literature in comparison to children and adolescents; especially when considering Indigenous children and adolescents in northern communities of Ontario, Canada (Vine & Elliott, 2013). For example, although increasing prevalence rates of obesity among children and adolescents have drawn critical focus to the provision of interventions, the rate of obesity appears not to be declining (Janssen, 2013). It has been suggested that increased PA (Trudeau & Shephard, 2008; Tremblay et al., 2016) and focusing on nutritional components, especially in school settings (Tremblay et al., 2011; Tremblay et al., 2012; Vine & Elliott, 2013) are correlated with decreasing levels of obesity and can assist in a healthier lifestyle transition from childhood to adulthood (Colley et al., 2011; Dobbins, Husson, DeCorby, & LaRocca, 2013; Tremblay et al., 2011).

There is a particular lack of nutrition and PA research within children and adolescents in Canada, and research suggests that this is present particularly in northern and/or remote communities of Ontario, Canada (Gates et al., 2013). There is evidence to support that healthy eating, in particular consuming appropriate amounts of fruit and vegetables, and having adequate amounts of PA can reduce health risks like obesity and cardiovascular disease (Taylor et al., 2011). Being physically active increases energy levels (Mathias et al., 2012) and consuming fruit

and vegetables has been shown to enrich the body with various vitamins, minerals, and certain antioxidants necessary to maintain a healthy lifestyle (Slavin & Lloyd, 2012), particularly seen in Indigenous children and adolescents (Teegarden, 2003). Indigenous and non-Indigenous children and adolescents who report low levels of both PA and fruit and vegetable consumption in childhood and adolescence have been shown to track these health behaviours into adulthood (Lock, Pomerleau, Causer, Altmann, & McKee, 2005; Maynard, Gunnell, Emmett, Frankel, & Smith, 2003; Ness et al., 2005) and are associated with adverse health outcomes including diabetes (Delahanty et al., 2013; Vinicor, 1994), greater adiposity (Te Morenga, Mallard, & Mann, 2013), cardiometabolic risk factors (Ekeland et al., 2012), behavioural problems (Maynard et al., 2006; Telama, 2009), low mood (Ekeland et al., 2012), and poorer academic attainment (Janssen & LeBlanc, 2010). With these adverse health outcomes, it is important to consume fruit and vegetables, as well as be physically active during childhood and adolescence (Janssen & LeBlanc, 2010; Slavin & Lloyd, 2012). Although communities in northern Ontario tend to be grouped together as one, no investigations have been done that focus on the area of residence as a factor of overall health pertaining to diet intake, PA, and/or sedentary behaviour; specifically within Indigenous peoples (Furgal & Seguin, 2006). Overall, it is important to understand what factors influence obesity (Janssen & LeBlanc, 2010), consumption of fruit and vegetables (Slavin & Lloyd, 2012), and PA levels in Indigenous children and adolescents (Hansen et al., 2012; Sallis et al., 2012), and to further explore the external and internal factors that impact these negative health behaviours within this population (Robinson, 2008; Tehrani et al., 2016). The following review of literature highlights childhood obesity, diet intake, and PA among Canadian children and adolescents, and when sufficient evidence is available, among Indigenous peoples and/or remote communities.

Childhood Obesity

Within the United States of America, the American Medical Association classifies obesity as a disease for three reasons: (1) accepting obesity as a disease will benefit society by requesting/needing more resources for prevention, treatment, and research, (2) acknowledging obesity as a disease will encourage healthcare professionals to view treatment options as a priority, and (3) considering obesity as a disease will allow for a reduction in stigmatization and discrimination experienced of those individuals who are obese themselves (Allison et al., 2008). However, these three arguments have faced much controversy from clinicians, researchers, and the general population since its implementation. Canada has not adopted these guidelines, yet recognizes the importance of improving the health of children and adolescents through trying to improve dietary (e.g. fruit and vegetables) intakes, PA, and sedentary behaviours.

Obesity is a condition where excess body fat is accumulated to the extent that it can potentially cause adverse physical, mental, and/or social health complications (Janssen, 2014). Globally, there continues to be rising obesity rates. Overweight and obesity among Indigenous and non-Indigenous populations are associated with quality of life, education, and income potential (Kolotkin, Meter, & Williams 2001; McLaren, 2007; Puhl & Heuer, 2009).

There are varying contributing factors of different countries that have led to the world-wide childhood obesity epidemic (Janssen et al., 2005; Wang & Lim, 2012; Haug et al., 2009). Among adults, obesity is usually defined as having a Body Mass Index (BMI; weight kg/height m^2) greater than 25 kg/m^2 and a surplus of caloric intake vs. lower levels of energy expenditure (Twells, Gregory, Reddigan, & Midodzi, 2014). Typically, BMI cut off points of 25 kg/m^2 and 30 kg/m^2 are used to classify adult as overweight and obese, respectively (World Health Organization (WHO), 1995; Health Canada, 2016). Obesity can be further classified into class 1

(BMI 30.0-34.9 kg/m^2), class 2 (BMI 35.0-39.9 kg/m^2), and class 3 (BMI ≥ 40.0 kg/m^2) (Douketis, Paradis, Keller, & Martineau, 2005; WHO, 2000). The latter two classifications have been linked to increased levels morbidity (Flegal, Kit, Orpana, Graubard, 2013), increased healthcare demands (Lau et al., 2007), as well as premature mortality (Orpana et al., 2010). Additionally, Cole (1979) first proposed BMI use in children in the late 1970's, indicating that BMI thresholds could be adjusted for weight and height depending on the current age of the child. More specifically, the BMI formula (kg/m^2) was thought to adjust better for height during puberty (Cole, 1986). Shields and Tremblay (2010) highlighted that there are three classification systems, the WHO, International Obesity Task Force (IOTF), and the US Centers of Disease Control (CDC) that have been used to assess BMI in children/adolescents, yet each classification system may provide different results (especially when compared against each other). For example, using measured heights and weights, prevalence estimates of overweight and obesity were calculated for Canadians aged 2-17 years (n=8,661 in 2004 and n=1,840 in 1978/79; Shields & Tremblay, 2010) using the 3 different classification systems and the outcome suggested that using the WHO classification produced the highest rates of overweight/obesity (35%) compared to the IOTF (26%) and CDC (28%) (Shields & Tremblay, 2010). In past research, several health organizations in Canada (e.g., Health Canada, Dietitians of Canada) agreed to adopt the WHO classification scale in order to standardize measurements across studies potentially due to it being a more conservative method of assessing BMI (Dietitians Canada, 2010). From 2006 until 2015, BMI increased significantly among Canadian children and adolescents so substantially that the BMI measurements of children and adolescents have reached proportions exceeding adult levels with a BMI of 25 or 30 (Shields, 2006; Bancej et al., 2015). Other means of measuring obesity in children, adolescents, and adults include skinfold

thickness, bioelectrical impedance, dual energy X-ray absorptiometry, magnetic resonance imaging, and hydrostatic weighing, which is the current gold standard (Gibby, 2016). However, they are not used as often in population studies because they are more time consuming, expensive, require expertise, and at times, are invasive (McCrindle, 2015).

There has been a negative trend associated within economically developed countries and their increased prevalence of overweight and obesity; particularly observed in Canada (Lobstein, Bauer, & Uauy, 2004). Although there have been many attempts to counteract these rising levels world-wide, there have been very few successful efforts at reducing obesity; especially when it comes to changing health behaviours that relate to decreasing weight in obese children (Stein, Weinberger-Litman, & Latzer, 2014). Specifically, in northern communities in Ontario, very little research has been conducted to assess the economic factors associated with increasing the risk of obesity in Indigenous populations (Skinner, Hanning, & Tsuji, 2006).

Presently, there are 7 million obese adults and 600,000 obese school-aged children in Canada (Burns, 2016). The economic burden of obesity in Canada is estimated to be between $4.6 billion and $7.1 billion depending on the particular province (Anis et al., 2010; Public Health Agency of Canada, 2011). It has been suggested that healthcare costs associated with obesity contribute as much, if not more, than smoking (i.e., $5.8 billion dollars; Jia & Lubetkin, 2010). Some of the indirect and direct healthcare costs include drug costs (Degli Esposti et al., 2006), hospital costs (Vellinga, O'Donovan, & De La Harpe, 2008; Sichieri, Nascimento, & Coutinho, 2007), and disability pertaining to joint injuries (Dee et al., 2014).

Within most economically developed countries, socioeconomic status (SES) seems to be negatively correlated with BMI, as the highest prevalence of obesity is observed in the lowest SES groups (Janssen, 2013). SES affects lifestyle, including access to food (i.e., nutritional

intake) and patterns of PA (Wang & Lim, 2012). In contrast, Wang & Lim (2012) suggested that children and adolescents from higher SES tend to be heavier than those from disadvantaged backgrounds due to access to energy-rich foods, lower PA levels (Oude Luttikhuis et al., 2009), and higher consumption of processed foods (Monteiro, Moubarac, Cannon, Ng, & Popkin, 2013). This demonstrates the inconsistences among research and highlights that obesity is a multifaceted challenge, can affect people across the SES gradient, and requires a more in-depth approach to look at SES.

Overall, childhood obesity encompasses multiple complex interactions including behavioural, biological, and environmental factors that have been shown to improve through healthy dietary intake and PA (Katzmarzyk et al., 2015). Behavioural components of obesity are multifaceted, and relate to multiple levels of influence, including individual characteristics like self-efficacy and knowledge, local and national policies, the physical or built environment, numerous behavioural settings and domains, and local cultures (Sallis et al., 2006; Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008). Additionally, biological and environmental factors (i.e., school, home life) that provide exposure to key figures such as teachers and parents may also influence behaviours associated with obesity in children and adolescents. Research indicates that adolescence is a very sensitive time period for physical development due to habit formation and longitudinal studies indicate that overweight children become obese adults (Deshmukh et al., 2006) and that one third of normal weight children may become overweight as young adults (McCrindle, 2015).

Prevalence of Childhood Obesity

Childhood obesity in Canada is concerning. Within Canada, the prevalence of obesity, according to the WHO classification system (2016) is close to one third (31.5%) of 5- to 17-year olds (an estimated 1.6 million), as 19.8 were classified as overweight and 11.7% as obese in 2009-2011. To give an example of how overweight and obesity has increased in Canada, Rao et al. (2016) compared the prevalence of overweight and obesity among children from 1978/79 (23.3% were overweight or obese) to 2014 (31.4% were overweight or obese). This increase roughly equates to over half a million overweight and obese school-aged children that are obese living in Canada (Rao, Kropac, Do, Roberts, & Jayaraman, 2016). Overweight and obesity is even more problematic among Indigenous children and adolescents, with rates as high as 42% among northern populations in Canada (Egeland, Pacey, Cao, & Sobol, 2010). Among all children and adolescents, overweight and obesity is higher among males (32.9%) compared to females (23.9%) and tends to increase with age, especially through adolescence (Rao et al., 2016). Due to these high levels of obesity and overweight amongst Indigenous and non-Indigenous populations, it is important to look at the prevalence rates of certain chronic diseases like obesity, to create and implement prevention strategies that can assist in reducing prevalence rates and/or preventing it in its entirety (Rao et al., 2016).

Psychological Implications of Childhood Obesity

There have been a multitude of hypotheses to better understand the psychological factors contributing to childhood obesity. One factor that can influence the prevalence of obesity is the psychological aspect of children and adolescents (Whitaker & Orzol, 2006). Researchers and clinicians have arguably considered that obesity is not necessarily a psychological disorder, but may potentially have psychological components to it (Russel-Mayhew et al., 2012). However,

limited and contrasting research on longitudinal studies suggests that not all overweight/obese children experience psychological issues; and that some children are more concerned about the shape of their bodies, rather than their actual weight (Allen, Byrne, Blair & Davis, 2006; Jansen, van dr Looij-Jansen, de Wilde, & Brug, 2008; van den Berg & Neumark-Sztainer 2007). Of the longitudinal studies that assessed psychological components of obesity, two found that mental distress was a predictor of weight gain or being overweight (Anderson, Cohen, Naumova, & Must, 2006; Whitaker & Orzol, 2006), but others found no association between weight gain and mental health (Stice, Presnell, Shaw, & Rhode, 2005; Tanofsky-Kraff et al., 2006). Anderson et al., (2006) suggested that mental stressors were influential for unhealthy eating as a coping mechanism, yet, Stice et al., (2005) did not find an association between mental health and weight gain. The contrasts between different studies could potentially be related to the different treatment options (e.g., behavioural cognitive therapy vs. stress relieving techniques). Of these mental distresses, weight based-teasing was shown to cause an increase in weight among children and adolescents through lower levels of self-esteem (Eisenberg, Neumark-Sztainer, & Story, 2003). Children and adolescents may turn to unhealthy foods that are high in sugar and sodium; which have been shown to increase obesity as a coping strategy (Eisenberg et al., 2003).

Obesity has also been linked to certain bullying behaviours, where overweight/obese adolescents are more likely to be bullied compared to normal weight adolescents and are often victims of physical, verbal, and relational abuse (Janssen, Craig, Boyce, & Pickett, 2004; Farhat, Iannotti, & Simons-Morton, 2010). This provides evidence of how peers can have a direct impact on external social relationships children and adolescents form (Janssen et al., 2004; Farhat et al., 2010). Stigmatization of children and adolescents who are obese has been shown to have a

negative impact on self-esteem, self-worth, and mental health (Dobbins et al., 2013) and is, therefore, a noted factor/influence for childhood obesity.

Sex Differences Relating to Obesity

Obesity is one of the most prominent public health challenges facing all children. It is estimated that boys aged 5-11 years old were three times more likely to be classified as obese (using WHO's BMI cut off points) than girls (19.5% vs. 6.3%, respectively) (Roberts, Shields, de Groh, & Gilbert 2012). Coinciding with obesity, more boys (than girls) reported an increase in the likelihood of becoming a type 2 diabetic (Farsani, Van Der Aa,Van Der Vorst, Knibbe, & De Boer, 2013; Steinberger & Daniels 2003). Although there are differences and similarities between overweight/obese boys and girls, children (in general) are a large cause for concern due to the associated health risks and unhealthy self-perceptions that can arise from obesity (Rao et al., 2016; Singh, Mulder, Twisk, Van Mechelen, & Chinapaw, 2008).

Body size perceptions appear to be gender patterned; studies report that girls who are normal weight perceive their body size more accurately than boys (Edwards, Pettingell, & Borowsky, 2010; Viner et al., 2006; Yan, Zhang, Wang, Stoesen, & Harris, 2009; Abbot, Lee, Stubbs, & Davies, 2010) and girls who are overweight or obese underestimate their body size more than boys (Saxton, Hill, Chadwick, & Wardle, 2009). For example, Zeller et al. (2010) found that girls (7-10 years) who were obese and went for treatment at a hospital-based weight management program, found that nearly 40% of them did not perceive themselves as obese (compared to only 18% of boys). Zeller et al., (2010) also found that parents who misperceived their child's weight were almost 12 times more likely to have a child with obesity.

Body size misperceptions have also been linked with children who are obese engaging in unhealthy weight-control behaviours such as skipping meals and excessive dietary restrictions

(Alwan et al., 2011), use of laxatives, diet pills and self-induced vomiting (Abbot et al., 2010), and binge eating (Duncan, Duncan, & Schofield, 2011). Targeting distorted perceptions (i.e., body size awareness) has been suggested to help with reducing and managing weight patterns in children (Spurrier, Magarey, & Wong, 2006; Zeller et al., 2010) and allows for promotion of adopting and maintaining healthy behaviours (Duncan et al., 2011). A study by Barnes (2016) assessed health behaviours, such playing video games, television viewing, and food consumption and reported that boys participated in more binge eating behaviours (compared to girls) and that boys (compared to girls) are more like to develop cardiovascular diseases due to sedentary time (e.g., television watching and playing video games) (Barnes, 2016; McCrindle, 2015).

The implications of the sex differences observed within the literature suggest that treatment options need to be sex-specific. However, although there are differences among the sexes, it is important to address these issues among all children as potential health concerns (i.e., hypertension and diabetes) are apparent in both sexes (Farsani et al., 2013).

Children and Diabetes

Type 2 diabetes is a disease that is common in adults who are overweight or obese (Farsani et al., 2013) and can lead morbidity and mortality (Delahanty et al., 2013; Vinicor, 1994). Children have started to develop type 2 diabetes at a much earlier age now, which is most likely related to the increased obesity prevalence (Shields, 2006). Steinberger and Daniels (2003) discussed the association between obesity and insulin resistance, hypertension, and abnormal lipid profile in children and adolescents and reported that children and adolescents who had abnormally high levels of insulin levels were more likely to be diabetic in adulthood. With regards to weight loss, two longitudinal studies reported decreases in insulin concentration and increases in insulin sensitivity among adolescents who lost weight (Rocchini, Katch, Schork, &

Kelch, 1987; Delahanty et al., 2013). Insulin resistance, in particular, can encompass many other diseases that track into adulthood like elevated blood glucose concentrations, hypertension, high cholesterol, and diabetes (Steinberger & Daniels 2003). However, during the last two decades, there has been a very large increase in the occurrence of type 2 diabetes in adolescents due to insulin insensitivity (Pinhas-Hamiel et al., 1996; Shields, 2006). It has been suggested that a relationship between the increase in adolescents with type 2 diabetes and increasing levels of obesity are caused by poor nutrition intake and physical inactivity (Troiano, Flegal, Kuczmarksi, Campbell, & Johnson, 1995; Farsani et al., 2013). Research also suggests that the cardiovascular consequences of childhood obesity (i.e., early atherosclerosis, ventricular hypertrophy, and dilation dysfunction) not only continues into adulthood if there is no intervention, but may worsen with increasing age (McCrindle, 2015).

Type 2 diabetes is one of the fastest growing pediatric chronic illnesses that the world is facing and disproportionately affects Indigenous people of all continents (Zimmet, Alberti, & Shaw, 2001; Pinhas-Hamiel & Zeitler, 2005). In Canada, Indigenous adolescents compromise 50% of new cases of type 2 diabetes in pediatric endocrinology clinics (Amed et al., 2012). The causes of this may be the influence between the child and environment/lifestyle behaviour (Delahanty et al., 2013; Mcgavock, Sellers, & Dean, 2007).

Influential Factors on Obesity

Larkin and Rice (2005) argue that healthy lifestyle behaviours are significant determinants for obesity and that developing positive health habits early in life are critical. For example, a positive correlation between sedentary time (e.g., video games, television watching, and other means of viewing like browsing the internet) and excessive eating behaviours has been observed (Gortmaker et al., 1996; Ball & McCargar, 2003; Shields, 2006). Obesity is an outcome

of behaviours and environmental influences that encompass certain behavioural traits that encourage weight loss/gain so that a more holistic approach to treatment should be considered (Brownell, Schwartz, Puhl, Henderson, & Harris, 2009).

Parents and teachers, in particular, have an influence on children's behaviours and attitudes towards their bodies (Haines & Neumark-Sztainer, 2006). Some of the attitudes and behaviours have been shown to have a negative association on perception of body image in children and adolescents (Haines & Neumark-Sztainer, 2006). Demonstrating that parental influence is of importance to focus on the prominence of weight-bias attitudes in children, to create a healthier promotion of body image (Ogden, Carroll, Kit, and Flegal, 2012), and healthier weight loss strategies (Davis, Shuster, Blackmore & Fox, 2004). Having positive behaviours and attitudes emphasizes the importance of developing healthy relationships among peers, teachers, and adults (Russel-Mayhew et al., 2012) and demonstrates the significance of developing positive interpersonal relationships along with effective intervention strategies (Robinson, 2008; Tehrani et al., 2016).

Indigenous Children

In Canada, studies indicate a significantly higher percentage of young Indigenous people (off-reserve) are overweight or obese (41%), compared to non- Indigenous populations (32.7%) (Shields, 2006). Coupled with the high prevalence of obesity, type 2 diabetes is also significantly higher among Indigenous peoples, compared to the rest of Canada (Gracey & King, 2009; King, Smith, & Gracey 2009). A dearth of literature exists that assesses the PA of the Indigenous peoples and its relationship to obesity development directly (Downs et al., 2008; Katzmarzyk, 2008; Findlay &, Kohen, 2011). Further, Indigenous children tend to eat market food (i.e., purchased at a grocery store vs. traditional food that would be obtained via hunting and

gathering) of poor nutritional quality (Pigford & Willows 2010), such as soups, canned foods, candy, and soft drinks (Conner, Colasanti, Ross & Smalley, 2010) which tend to be more accessible than healthier food options (such as fruit and vegetables) (Power, 2008).

Indigenous peoples are also very distinct from the Canadian population when we consider the social determinants of health such as: poverty, inadequate housing, household overcrowding, food insecurity, geographic isolation, and lack of access to healthcare providers who are knowledgeable on Indigenous aspects of life to understand cultural beliefs/norms (Reading & Wein, 2009; Willows Veugelers, Raine, & Kuhle, 2009; King et al., 2009). Investigating location, specifically as a determinant of health and as a factor pertaining to health behaviours, has been a field that not many researchers have looked at specifically (Conner et al., 2010). Additionally, there is inadequate literature that discusses the relationship between the environmental and social determinants of obesity within Indigenous communities that have opportunities to be physically active (Moore, Roux, Nettleton, Jacobs, & Franco 2009). It is important to understand the community location as a potential influence of health behaviours and/or obesity, as the location may dictate access and resources to certain foods and PA opportunities.

Obesity Interventions

Due to the complex health issue of obesity, it is important to address potential influences through effective interventions (Sallis et al., 2008; Wang & Lobstein, 2006). Peer-led intervention strategies seem to be effective and can assist with many health-related aspects like PA levels and improved healthy living behaviours (Eskicioglu et al., 2014; Macaulay et al., 2003). Peer-led interventions have been shown to elicit healthy behaviours in children through positive role modeling of healthy behaviours like healthy eating and being physically active in

schools (Black et al., 2010; Santos et al., 2014; Stock et al., 2007). A systematic review (Oude Luttikhuis et al., 2009) highlighted three different intervention strategies that looked at children: (1) lifestyle (e.g., diet, PA and/or behavioural therapy interventions), (2) drug (e.g., orlistat, metformin, sibutramine, rimonabant), and (3) surgical interventions to assess which was the most effective in reducing obesity, and found that that the most effective intervention was lifestyle interventions (Oude Luttikhuis et al., 2009). The various behaviour changes related to lifestyle interventions consisted of weekly PA activity, food consumption, and behavioural interventions (Oude Luttikhuis et al., 2009). Further, the lifestyle interventions showed significant positive outcomes pertaining to weight loss and positive health maintenance over time compared to drug or surgical interventions (Oude Luttikhuis et al., 2009). Lastly, several other systematic reviews on childhood obesity prevention programs that investigated school-based interventions, indicated that school-based interventions with or without family and/or PA showed the most impact on reducing childhood obesity (Ng et al., 2014; Sung-Chan, Sung, Zhao, Brownson, 2013; Wang et al., 2013). All the systematic reviews expressed that it was important to engage family and community to assist in combating obesity and that community and family based interventions resulted in positive outcomes on lifestyle outcomes like diet, exercise, and PA. Using lifestyle as a prominent type of intervention technique could be utilized to produce more beneficial outcomes for positive health-related behaviours in children and adolescents (Ng et al., 2014).

Current Food and Beverage Intake of Children

Poor dietary intake among Canadian children and adolescents has been observed, including the excessive amount of sugar (Bronfenbrenner, 1977; Zoellner et al., 2016), unhealthy fats (Shang et al., 2015), and high levels of sodium (Bundrick, Thearle, Venti, Krakoff, & Votruba, 2014; Zheng et al., 2014). Foods high in sugar, sodium, and fat are associated with

higher levels of obesity and cardiovascular diseases in children (Lobstein et al., 2004; Koplan, Liverman, & Kraak, 2005), adolescents (Davis & Carpenter, 2009), and adults (Block et al., 2013). The recommended amount of sodium intake is 1,000 milligrams (mg) for children aged 1-3 years, 1,200 mg for children aged 4-8 years, and 1,500 mg for people aged 9-50 years of age (Garriguet, 2007; Institute of Medicine, 2005). For sugars, the Institute of Medicine (IOM) suggested that no more than 25% of calories come from added sugars (or artificial) (IOM, 2005), and the WHO recommends a daily maximum of 10% of calories from free sugars (artificial & natural) (WHO, 2003). For total fats, it is recommended that for children and adolescents to not exceed 25% to 35% of total calories consumed (Garriguet, 2007).

Canada does not have a national surveillance tool for monitoring nutritional trends among the population. However, the most recent national cross-sectional nutrition data comes from the 2004 Canadian Community Health Survey (CCHS) 2.2 which indicated that Canadian children consumed on average of 109 grams of sweetened sugar beverages (SSB) per day (Garriguet, 2008). Adolescent boys (aged 14-18 years) had the highest daily intake of sugar with 172 grams (41 teaspoons) a day (Langlois & Garriguet, 2011). The Canadian population consumes approximately 110.0 grams of sugar a day; which equates to 26 teaspoons and 21.4% of their caloric intake per day (Langlois & Garriguet, 2011). The diets of children tend to be filled with very-high levels of sugar, in the forms of SSB, fruit juices, and energy drinks (Battram, Piché, Beynon, Kurtz, & He, 2016). Furthermore, sugar from the *Vegetables and Fruit* and *Milk and Alternatives* food groups are more likely to be naturally occurring than food that comes from the *Other* foods according to Eating Well with Canada's Food Guide (Health Canada, 2016). The CCHS 2.2 reported that more than a third (35%) of the sugar that Canadians consumed came from the *Other* foods group and that the percentage peaked for adolescent boys at 46% (Langlois

& Garriguet, 2011; Murphy & Johnson, 2003). Having such high amounts of sugar consumption among children and adolescents can cause many health complications like dental carries (Armfield, Spencer, Roberts-Thomson, & Plastow, 2013), obesity, and other chronic diseases (Shields, 2006; Bancej et al., 2015).

According to the CCHS 2.2, the amount of sodium consumed in males (aged 4-14 years) and females (aged 4-14 years) was >95% and >80% above the recommended amount, respectively. Within a smaller study from southwestern Ontario, Woodruff et al., (2014) reported that 80% of males and 60% of females had a sodium intake above current adequate intake (1,500 mg/d) among 10-14 year olds (n=1,008). Levels of sodium are often correlated to high blood pressure and adverse health effects (Garriguet, 2007), yet not all have observed such effects (Woodruff et al., 2014). Processed foods are the highest source of sodium intake, accounting for over 77% of average daily sodium intake (Garriguet, 2007).

Unhealthy fats are a very large contributor to health complications like cardiovascular diseases (Dauchet, Amouyel, Hercberg, & Dallongeville, 2006; Pavia, Pileggi, Nobile, & Angelillo, 2006; Boeing et al., 2012) and obesity (Janssen et al., 2005; Katzmarzyk & Ardern, 2004; Wammes, Oenema, & Brug, 2007). According to the CCHS 2.2, individuals aged 4-18 years were consuming 30.7% more than the recommended amount of unhealthy (saturated) fat (Garriguet, 2007). Interestingly, among children and adolescents from varying SES environments, fat content remained relatively consistent across different household incomes (Garriguet, 2007). However, among adults, the highest (compared to lowest) income households were less likely to consume more than five daily servings of *Vegetables and Fruit* according to Eating Well with Canada's Food Guide (Health Canada, 2016). The CCHS 2.2 further reported that 59% of Canadian children 2-17 years of age consume less than five servings of *Vegetables*

and Fruit each day and the children who consume less than 5 servings, are more likely to be overweight or obese (Shields, 2005).

World-wide and in Canada, the prevalence of obesity and other nutrition-related risk factors for chronic disease have been steadily increasing in both children and adults (Janssen et al., 2005; Katzmarzyk & Ardern, 2004; Wammes et al., 2007). In particular, fruit and vegetables are widely recognized as a crucial food group to promote healthy weight and preventing chronic diseases (WHO, 2003). Research suggests that regular fruit and vegetable consumption is associated with reduction in the risk of chronic diseases such as cancer, cardiovascular disease, and obesity (Dauchet et al., 2006; Pavia et al., 2006; Boeing et al., 2012). However, world-wide, low fruit consumption is ranked fifth in terms of causes of disability-adjusted life years, and accounts for 4.9 million deaths and 4% of global disability-adjusted life years (Minaker & Hammond, 2016). Consumption of fast food has rapidly increased over the past decade, and a large portion of children (59%) consume less than five fruit and vegetables a day (Lobstein et al., 2004; Koplan et al., 2005) which could be a large contributor to the growing number of obese children (Davis & Carpenter, 2009; Minaker & Hammond, 2016).

Overall, negative correlations exist between health outcomes (Wiecha at al., 2006; Manios et al., 2009) and lower vegetable and fruit consumption (Scully, Dixon, White, & Beckmann, 2007; Barr-Anderson, Larson, Nelson, Neumark-Sztainer, & Story, 2009), higher SSB consumption (Scully et al., 2007; Kremers, van der Horst, Brug, 2007; Barr-Anderson et al., 2009), higher fast food intake (Weicha et al., 2006; Scully et al., 2007; Barr-Anderson et al., 2009), and higher snack and fried food consumption (Wiecha et al., 2006; Barr-Anderson et al., 2009). To further elaborate, Shang et al. (2015) categorized foods into two healthy groups (fruit and vegetables and dairy products) and two unhealthy groups (SSB and hamburger/hot

dog/pizza) that assessed nutrients including energy, total fat, added sugar, fiber, and sodium (Shang et al., 2015). The results suggested that children were consuming high in sugar and sodium and low in nutrient value foods (Shang et al., 2015), which all have shown to have a negative association with increased levels of obesity (Wang & Lim, 2012) and cardiovascular disease (Delahanty et al., 2013).

Breakfast Consumption

Research has shown that breakfast consumption has been related to decreasing levels of obesity in children and adolescents and has which has been a topic of numerous reviews to assist with increasing vitality levels (Chao & Vanderkooy, 1989; Miller, Forgac, Cline & McBean, 1998; Rampersaud, Pereira, Girard, Adams, & Metzi, 2005; Rampersaud, 2009). Reviews have indicated that breakfast consumption is frequently associated with higher energy, better nutrient intakes, and overall improved nutritional habits (Deshmukh-Taskar et al., 2010; Grieger and Cobiac 2012). Consuming breakfast is a very important meal for children and adolescents due to its relationship with positive health outcomes, growth and development, and academics (Szajewska & Ruszczyński, 2010; Busch et al., 2014). However, breakfast is the most skipped meal of the day for not only children and adolescents (Szajewska & Ruszczyński, 2010; Woodruff and Hanning, 2010), but adults as well (Smith, 2013). For example, a healthy breakfast was provided via an existing program that included fruit or vegetables, whole grains, protein sources, and milk at Peetabeck Academy (Fort Albany, Ontario, Canada; Gates et al., 2013). The results of the study showed that school nutrition programs can improve knowledge and intentions of nutritional habits, and educational components relating to health (Gates et al., 2013). Further, to give a different perspective on meal skipping, Woodruff et al., (2008) investigated weight concerns, dieting, and meal skipping among grade 9 and 10 students from

two Canadian provinces (Alberta and Ontario) to determine the association with overall diet quality. They found that females, compared to males, were more likely to skip meals (including breakfast), and that body weight concerns, dieting, and meal skipping were associated with lower diet quality ratings (Woodruff et al., 2008), thereby not making up the missed nutrients at other times during the day.

Lastly, an association between breakfast skipping and overweight/obesity status has been observed (Szajewska & Ruszczyński, 2010). For example, in a study involving 1,001 participants aged 12-14 years of age, Henríquez et al., (2008) reported a higher prevalence of children who were overweight/obese in the group that skipped breakfast compared to the group of breakfast consumers both for boys (overweight: 18.2% vs. 10.5%; obesity: 27.3% vs. 11.3%) and girls (overweight: 17.5% vs. 11.5%; obesity: 30% vs. 16.5%). A similar study also reported that participants who skipped meals had significantly higher levels of obesity (Vanelli et al., 2005). However, no fluctuations in weight were observed; which indicates contrasting results about consuming breakfast and body weight.

Socioeconomic Status & Nutrition in Children

An extensive amount of research has been conducted between SES and inadequate diet intakes of adults (Kirkpatrick & Tarasuk, 2003; Mushi-Brunt, Haire-Joshu, & Elliot, 2007; Shahar, Shai, Vardi, Shahar, & Fraser, 2005; Roos et al., 2008). However, there is limited research on children and adolescents (Attorp et al., 2014) as difficulties arise with SES research among children as they do not have a direct source of income, nor are they independent of their parents/guardians (Attorp et al., 2014). However, Riediger et al. (2007) conducted a cross-sectional study on Canadian adolescents using the CCHS 2.2 dataset, and reported that the proportion of adolescents consuming the recommended amounts of *Vegetables and Fruit*

(according to Eating Well with Canada's Health Canada, 2016) increased from 34.2% in the lowest categories of household income to 42.1% in the highest categories. Although studies outside of Canada have shown a positive relationship between SES and nutrition in pre-adolescent children (Laitinen, Räsänen, Viikari, & Akerblom, 1995; Wyatt & Tejas, 2000; Sandvik, Gjestad, Samdal, Brug, & Klepp, 2009), there is limited information on specifically Canadian children (Attorp et al., 2014). Researchers have indicated that social factors are also interrelated with fruit and vegetable consumption and children and their families (Rasmussen et al., 2006). Low SES may be a detrimental factor influencing children's health pertaining to weight-loss or gain (Grantham-McGregor et al., 2007), under physical development (Bradley & Corwyn, 2002), poor health (Mistry, Biesanz, Taylor, Burchinal, & Cox, 2004), underdeveloped cognitive functioning (Li, Dai, Jackson, & Zhang, 2008), as well as deficient care (Grantham-McGregor et al., 2007).

Indigenous Peoples & Food Insecurity

In Canada, Indigenous peoples tend to experience greater food insecurity than non-Indigenous peoples (Chen & Che, 2001; Egeland et al., 2010; Willows et al., 2009). Many sociodemographic risk factors for household food insecurity for Indigenous peoples include: poverty, multi-child households, low levels of education achievement, labour force participation, reliance on social assistance and welfare, and many single parent households (Chen & Che, 2001; Willows et al., 2009). To give an example of food insecurity, the Nunavut Inuit Child Health Survey (2007-2008) reported nearly 70% of Inuit children aged 2 to 5 years old in 16 different communities resided in food-insecure households (Willows et al., 2012). Additionally, another 25.1% lived in homes with severe child food insecurity; many skipped meals, went hungry, or did not eat for a whole day (Egeland et al., 2010). Furthermore, 25% of First Nations

children are estimated to live in poverty, which could imply food insecurity and lack of access to food in general and specifically food with adequate and appropriate nutrition (Willows et al., 2012). Having such high levels of food insecurity highlights the need for further research to assess the policies and practices implemented for Indigenous communities regarding food access (Willows et al., 2012).

To further elaborate, Skinner et al. (2014) assessed food insecurity among a remote First Nation community in northern Ontario, and reported that among individuals who were severely food insecure, 100% worried that food would run out and that they would not have enough money to buy more food, and at times could not afford to eat a balanced meal. Food insecurities are often related to cost in northern communities, as the price of food has been reported to be at least two times more expensive in northern Ontario compared to southern Ontario (Gates et al., 2013). To help assist with food insecurities and costs of food, Gates et al. (2013) suggested that the school be an appropriate place to help aid in the education and implementation of interventions to help combat food insecurity and to increase positive eating habits.

School Interventions within Indigenous Communities

Schools, in particular, have been identified as a very important setting to promote healthy eating through multicomponent, comprehensive programs (Veugelers & Fitzgerald, 2005). Certain programs like The Sandy Lake Health & Diabetes Project (Saksvig et al., 2005) and The Pathways Program (Caballero et al., 2003) resulted in successes in dietary behaviour, knowledge, intentions, and self-efficacy, pertaining to dietary intake among Indigenous peoples. The development of programs in schools that focus on providing educational practices that afford children access to healthy foods have been successful at reducing food insecurity (Gates et al., 2013). For example, Gates et al., (2013) created a program where children had access to servings

of *Milk and Milk Alternatives*, according to Eating Well with Canada's Food Guide (Health Canada, 2016), and reported an increase in calcium consumption through increased access. Research has indicated that less than half of Indigenous adolescents are meeting the recommended amount(s) of *Milk and Milk Alternatives* (Downs et al., 2009; Health Canada, 2016); which assists with healthy body growth, development, and maintenance (Teegarden, 2003). Improved adequate consumption of calcium has also been linked to reducing the high risk of bone fractures that are often observed among Indigenous peoples (Leslie et al., 2004).

The program by Gates et al., (2013) used principles of the Social Cognitive Theory including knowledge, intentions, self-efficacy, and intake of *Milk and Alternatives* (in First Nations youth from Fort Albany, Ontario), and were taught using goal setting and peer modeling by a senior high school student with teaching experience to act as a positive role model for the participants (Gates et al., 2013). The results of the study reported that having a peer model to emulate healthful behaviours were seen to be positively related to increased amounts of *Milk and Alternatives* (Gates et al., 2013), and suggested that there needs to a larger dose of intervention (e.g., education, instruction, parental involvement) to be a contributor for successful behaviour change. This coincides with previous research, stating that the more hours spent on nutritional education, the more receptive and more likely participants will adopt healthier behaviours (Hoelscher, Evans, Parcel, & Kelder, 2002; Fahlman, Dake, McCaughtry, & Martin, 2008). A school-based program, similar to Gates et al., (2013), targeted the lack of access to purchase foods, a common obstacle among the Indigenous populations (Shields, 2006). Results highlighted that although the intervention was successful in aiding with healthier food consumption, that further research needs to be conducted to combat the prominence of nutrient-dense foods in northern populations in Canada (Kuhnlein et al., 2004; Shields, 2006).

With schools remaining as an important target for nutrition interventions and environmental alterations for behaviour change to happen, the intervention must also have community, leadership, and policy involvement for them to be successful in the school setting (Story, Neumark-Sztainer, & French, 2002; Thompson & Subar, 2008; Vine & Elliott, 2013).

School Nutrition & Policy

Progress has been made in improving the school nutrition environment by limiting access to low-nutrient, energy-dense food and beverages like pop and sugary snacks (Cullen, Watson, & Zakeri, 2008; Spiegel & Foulk, 2006; Mullally et al., 2010), although findings are inconsistent with how the interventions are effective and sustainable (Blum et al., 2011; Jensen, Sato, McMurtry, Hart, & Jelalian, 2012). For example, Taylor et al., (2011) highlighted principals' perceptions of major factors that present as barriers to school nutrition policy implementation on Prince Edward Island; which included: lost revenue, higher costs of healthy foods, and the limited availability of policy-compliant foods. However, in Alberta, Canada, evidence suggested that having a school representative (i.e., principal) and financial support are both very important when adopting school nutritional guidelines (Downs et al., 2012). Minimal and inconsistent research suggests that school level policy and health behaviours is needed within the Canadian context.

Unfortunately, inconsistency among the success of nutritional policies regarding improving health outcomes in Canada indicate that the (pre-conceived notion of) increased cost of healthy eating combined with the availability of unhealthy food for sale in schools' act as barriers of conducting policy implementation (Rideout, Levy-Milne, Martin, & Ostry, 2007; McKenna, 2010; Downs, 2012; Taylor et al., 2011). Within the province of Ontario, Canada, Vine & Elliott (2013) used qualitative research methods (i.e., in depth interviews with key

figures of schools like principals, teachers, etc.) to help explore how local-level factors help shape and implement provincial-level policy in secondary schools, and how associated nutritional consumption in schools are influenced (grades 9-12). Authors revealed that there are numerous barriers that influence healthier school nutrition policies within schools; such as restrictive food policies, expensive costs for healthier foods, in addition to having close proximities to external fast food sources that allow for easy access to unhealthy foods (Vine & Elliott, 2013). These barriers highlight the issue that school nutrition policies have and elude to the many associated problems.

When examining the various factors of school influences on children, it is understood that the earlier an intervention is implemented the increased likelihood of positive outcomes (Reynolds, Temple, Robertson, & Mann, 2001). Education is one of the most prominent factors that affect early intervention methods and it has been shown that education is one of the most effective ways to intervene with learning disabilities, as well as aid in school readiness, health status, academic achievement, and reduced the need for grade retention (Karoly & Levaux, 1998).

In September 2011, the Ontario Ministry of Education implemented a school Food and Beverage Policy (PPM 150) (Government of Ontario, 2010) that extended across all twenty-two school boards within the province. The purpose of PPM 150 is to contribute to improve educational, attitudinal (i.e., preferences and eating behaviours), and health related outcomes, including reducing the risk of type 2 diabetes, cancer, and heart disease (Vine & Elliott, 2013). Some of the rationale behind the PPM 150 is elaborated further by the Government of Ontario (2010), when they expressed that the school environment influences students' attitudes, preferences, and behaviours relating to a healthier lifestyle, and that research has shown that

health and education work in conjunction with one another (Story, Nanney, & Schwartz, 2009). The nutritional standards of the memorandum embody the principles of healthy eating that is outlined in Eating Well with Canada's Food Guide (Health Canada, 2016) and are intended to ensure that the food and beverages sold promote healthy growth and development (Government of Ontario, 2010; Vine & Elliott, 2013). The overall objective of the program was designed to educate and make school aged students healthier, through acknowledging that there is a gap in the relationship between regional and provincial food policies that correlate to how children and adolescents are accessing healthy foods at school in Canadian provinces (Government of Ontario, 2010; Vine & Elliott, 2013). The nutritional standards for food groups that were created based on the PPM 150 were divided into *Vegetables and Fruit, Grain Products, Milk and Alternatives,* and *Meat and Alternatives* (following Eating Well with Canada's Food Guide; Health Canada, 2016); but also have *Mixed Dishes*, for products that contain more than one major ingredient (e.g., soup, salad), *Miscellaneous Items*, for items that are to be kept to a minimum (e.g., condiments, dressings), and *Confectionery*, which is not permitted for sale (e.g., candy & chocolate) (Government of Ontario, 2010). The nutritional standards for beverages are provided separately for elementary schools and secondary schools (Government of Ontario, 2010). The nutrition criteria for both foods and beverages are categorized into the following categories: *sell most*, which are the healthiest options and generally have higher levels of essential nutrients, and lower amounts of fat, sugar, and/or sodium (Government of Ontario, 2010). The *sell most* foods and/or beverages must make up at least 80% of food choices that are available for sale in all venues, through all programs, and at all events (Government of Ontario, 2010). The *sell less* category may have slightly higher amounts of fat, sugar, and/or sodium than food and beverages in the *sell most* category, and must not make up more than 20% of all food

choices that are available for sale in all venues, through all programs, and at all events (Government of Ontario, 2010). Lastly, the *not permitted for sale* category encompasses foods that generally contain few or no essential nutrients and/or contain high amounts of fat, sugar, and/or sodium (Government of Ontario, 2010). However, there are 10 exemption days (per school year) that are classified as special event days, where schools may be exempt from the nutrition standards outlined within the memorandum and do not have any restriction on the amount or type of food is provided/sold (Government of Ontario, 2010). Examples of the special event days would include classroom/schoolwide celebrations, birthday parties, etc. The overall reasoning for PPM 150 was to help combat the poor nutritional consumption of students in schools within Canada.

Children's Physical Activity

Early childhood development is very important for children and adolescents due to the importance of developing habits relating to sedentary lifestyle and PA (Hinkley, Salmon, Okely, Crawford, & Hesketh, 2012; Oliver, Schofield, & Kolt, 2007). An example of a study that highlights the importance of PA was conducted by Katzmarzyk et al. (2015), which compared more than 6,000 international children aged 9 to 11 years, and found that the participants who engaged in PA were less likely to be obese. Further, a systematic review indicated that PA during childhood is correlated with improved measures of adiposity, motor skill development, psychosocial health, and cardio-metabolic health indicators (Timmons et al., 2012). The current Canadian 24-hour Movement Guidelines suggests that children and adolescents (ages 5-17 years) accumulate 60 minutes of moderate to vigorous PA (MVPA) a day, in addition to sleeping without interruptions for 9-11 hours (ages 5-13 years) or 8-10 hours (ages 14-17 years), sitting for limited amounts of time, no more than 2 hours per day of recreational screen time, and

several hours of unstructured/structured light PA (Canadian Society for Exercise Physiology (CSEP), 2016). The 24-hour Movement Guidelines were developed to help encourage adolescents (aged 5-17 years) to live an active lifestyle that incorporates a reduction in sedentary time, increase physical inactivity, reduce sedentary behaviour, incorporate more sleep, and overall improve healthy lifestyle choices that help to increase overall better body composition and assist with prosocial (i.e., positive social engagement) behaviours (CSEP, 2016). Rates of PA among Indigenous peoples are significantly lower compared to the general population of Canada so it is important to look at their current PA levels to better understand how to address health concerns within this population (Ronsley, Lee, Kuzeljevic, & Panagiotopoulos, 2013). Currently, Indigenous children are significantly below the recommended amounts of 60 minutes of PA a day, and in turn have developed metabolic diseases like diabetes (Ronsley et al., 2013), and have shown unhealthy diet patterns, high amounts of being sedentary, and low amounts of PA in adolescence within some northern Indigenous communities (Skinner et al., 2006). SES can also be a factor in whether children participate in sporting activities (Eime, Charity, Harvey, & Payne, 2015) and can have an influence on how physically active they are (Baquet et al., 2014). Participating in sports and being physically active has been shown to have a positive impact on children and adolescent physical and mental development (Baquet et al., 2014).

Physical Activity Levels among Canadian Children

Research has shown that only 9% of 5 to 17-year-old Canadians accumulate at least 60 minutes of MVPA on at least six days of the week (Colley et al., 2011) and that percentage has remained stable since 2008 when only 7% of 5 to 17 year olds met the daily recommendation (Tremblay, Brownrigg, & Deans, 2008). Further, Lemstra et al., (2013) reported low levels of PA among children and adolescents living in First Nation communities from Canada where only

7% of children and adolescents from 204 on-reserve communities (10-16 year olds) accumulated at least 60 minutes of daily MVPA. Although the preferred method to measure PA among children and adolescents is through the use of objective measurements (e.g., accelerometers, pedometers) many large population studies rely on self-report. Objective measures are superior for smaller sample sizes and allow for more accurate results for PA. However, larger studies rely on self-reported data due to cost-effectiveness, convenience, and ease of administering (Sallis & Saelens, 2000; Shephard, 2003).

Although some studies have transitioned from self-report questionnaires to accelerometers to assist in deciphering sedentary behaviours and screen time, there has been no significant findings using accelerometers are associated with total sedentary time and negative health associations (LeBlanc et al., 2015). Accelerometers provide an accurate, reliable, and practical objective measure of PA in children and adolescents (Oliver et al., 2007; Rowlands, 2007). Self-reported measures of PA are still used by younger populations to decipher amounts of PA (Thompson, Arena, Riebe, & Pescatello, 2013). In cases where younger populations are used, self-reported data were deemed to be reliable due to its easy administration and collection of data (LeBlanc et al., 2015). Ensuring the self-reported questions themselves are easy to understand and are easy to administer are two very important components of using self-reported data (Thompson et al., 2013).

Sedentary & Screen Time

Sedentary behaviour (e.g., sitting or reclining while expending ≤ 1.5 metabolic equivalents; Cart, 2012) is independently associated with increased health concerns regarding cardio-metabolic risks in children and adolescents (Salmon, Tremblay, Marshall, 2011; Carson & Janssen, 2011; Tremblay et al., 2011; Ekelund et al., 2006). Sedentary behaviours are not simply

the lack of PA; they are separate and specific from PA and refer to waking hours that involve low energy expenditure in a sitting or reclining position (Barnes et al., 2012). Sitting in front of a screen whether it be television, playing video games, or using the computer has become a very common and concerning occurrence that happens on a daily basis (Colley et al., 2011; Shields, 2006). In Canada, only 10% of 11-15-year-olds meet the sedentary behaviour recommendations outlined by the Canadian 24-Hour Movement Guidelines for Children and Youth (CSEP, 2016). In relation, 76% of 5 to 19-year olds in Canada reported sedentary times through screen time, whether it be television, playing on a computer or video games, or reading during the afterschool period (CSEP, 2016). Research on sedentary behaviours in children and adolescents is related to potential risk factors for cardiometabolic disease such as type 2 diabetes and coronary heart disease (Maras et al., 2015). Research also suggests an association between screen time and anxiety (Maras et al., 2015) and depression (Liu, Wu, & Yao, 2015). Research among a sample of adolescent boys (10-16 years of age) reported an average of 20 hours per week of screen time (Barnes et al., 2012; Ekelund et al., 2012; Shields, 2006; Tremblay et al., 2011) which suggests extraneous amounts of being sedentary which research has suggested leads to many negative health consequences.

Further, Shang et al., (2015) reported that several cross-sectional studies described a co-occurrence of unhealthy eating behaviours with children who watched television. For example, longer television hours were associated with the consumption of more soft drinks and non-whole-grain products due to increased levels of binge eating (Biddle & Asare, 2011; Kremers et al., 2007; Ng, Young, Corey, 2010; Pearson & Biddle 2011; Scully et al., 2007). Shang et al., (2015) also suggested that among children who were overweight, that those who watched more

than 2 hours a day of screen time, had higher intakes of energy, lower intakes of fiber, fruit, and vegetables.

Health Outcomes and Physical Activity

Evidence on cognitive development in early childhood suggests there are benefits of PA (from birth to 5 years of age) (Carson et al., 2015) and children who are active for as little as 20 minutes daily have more active brain function (Hillman et al., 2009). On the other end of the spectrum, excessive sedentary time negatively influences brain health and may counteract benefits of activity (Voss, Carr, Clark, & Weng, 2014). PA in schools has been shown to be indirectly associated with academic achievement including: lower drop-out rates, better classroom behaviour, self-esteem, and engagement in school behaviour (Mahar et al., 2006; Trudeau & Shephard, 2008). Additional research on PA indicates that being physically active is positively correlated to lower anxiety and depression (Biddle & Asare, 2011; Larun, Nordheim, Ekeland, Hagam, & Heian, 2006; McPhie, & Rawana, 2015). Being active has also been shown to improve social relationships, and help improve emotional well-being; like minimizing anxiety, depression, and aggression, and increasing happiness (Janssen, 2014).

Physical Activity Interventions in Schools

Children spend approximately two decades in school and several strategies to address obesity issues have been used to target schools with nutrition/PA strategies, in addition to the structure of the schools' curriculum (Story et al., 2009). Interventions implemented through the school curriculum would theoretically ensure that 100% of the schools' populations would be exposed to the intervention, thereby increasing the reach and accessibility of the interventions themselves (Dobbins et al., 2013). According to a recent review, school-based PA interventions seem to have a positive impact on duration of MVPA, television viewing, blood cholesterol,

VO_2max, and had a positive effect on lowering blood cholesterol levels (Dobbins et al., 2013). Research also suggests that school-based PA interventions of longer duration may be needed to effect change in PA and VO_2max among grade school children (Kriemler et al., 2011). There have been school-based interventions that have shown that structured PA (with or without nutritional components) have had beneficial outcomes for anthropometric measures like skinfold assessments with calipers (Kain, Uauy, Vio, Cerda, & Leyton, 2004). Vreeman & Carrol (2007) conducted a school-based intervention program that enhanced opportunities for non-curricular PA combined with simple messages, promoting healthy eating, which resulted in a slower rate of excessive weight gain in primary school-age children.

There have also been studies that investigated teachers who have a specialization in physical education and who have been effective at increasing PA among students in their classes (Ridgers, Stratton, & Fairclough, 2006; Verstraete et al., 2007). Having an expert that specializes in physical education lessons has been shown to be effective in increasing aerobic fitness in children and adolescents aged 8-14 (DeCorby, Halas, Dixon, Wintruo, & Janzen, 2005; McKenzie & Lounsbery, 2009; Rowlands, 2007). The school environment is a very important setting for PA promotion in children and adolescents because there are opportunities to participate in PA and work on developing good nutritional habits (CSEP, 2016). In addition to increasing school-based PA, reducing school-based sedentary time is also important given that children and adolescents spend between 50% and 70% of their time at a school setting (Hinckson et al., 2015). Randall et al., (2014) believes that physical education can contribute to students' adoption of a healthy lifestyle that incorporates positive impacts on their physical, social, and emotional health well beyond graduation. Since the environment plays a crucial role in providing PA opportunities, it is important to utilize times in the school day like school recess and physical

education classes (Parrish, Okely, Stanley, & Ridgers, 2013); which can attribute to 40% towards PA recommendations (Ridgers et al., 2006).

Daily Physical Activity

Currently, only three Canadian provinces have government-mandated Daily Physical Activity (DPA) policies that require all students from grades 1-8 to engage in 20 or 30 minutes of PA (Alberta, British Columbia, and Ontario; Randall, Robinson, & Fletcher, 2014). Within Ontario, the DPA program states that all children at the elementary school level receive 20 minutes of PA each day (Ontario Physical and Health Education Assessment OPHEA, 2006). DPA does not have to be implemented when there is already a physical education class that day and is meant to increase heart rates to a MVPA (Patton, Overend, Mandich, & Miller, 2014). However, only 18% of the physical education teachers indicated that their school had a DPA policy and many teachers indicated that their schools did not institute it as it was planned or required (Randall et al., 2014). Researchers have come to realize DPA's limitations, including the heterogeneity of the intervention, the reluctance of the teachers for implementation, and the *quick fix* that DPA was not meant to be implemented as (Hickson, Robinson, Berg, & Hall, 2012; Ramanathan, Allison, Faulkner, & Dwyer, 2008; Robinson & Melnychuk, 2008; Sykes, 2011). Studies have also found that DPA has not been a very effective tool to increase levels of PA throughout the school day (Hickson et al., 2012) and there is a need for more concise regiments of DPA to be incorporated (Hickson et al., 2012; Robinson, & Melnychuk 2008; Sykes, 2011).

The implementation of DPA was to allow students to become more physically literate through physical, cognitive, and affective growth and development; not as a weight loss substitution (Randall et al., 2011). However, in Ontario, Canada, it has been suggested that DPA takes up time where other academic class material needs to be taught (Patton et al., 2014).

Similarly, Dwyer et al., (2003) reported that teachers (in the Toronto, Ontario, Canada area) stated physical education in the school system was not a priority and that DPA hindered other school subjects (i.e., math, social studies etc.,).

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APPENDIX A

Northern Fruit and Vegetable Survey

Northern Fruit and Vegetable Program Survey!

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

1

In order to keep track of your answers, please create this 6 digit ID code.

Which month you were born?

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

What day of the month were you born?

- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10
- ○ 11
- ○ 12
- ○ 13
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- ○ 19
- ○ 20
- ○ 21
- ○ 22
- ○ 23
- ○ 24
- ○ 25
- ○ 26
- ○ 27
- ○ 28
- ○ 29
- ○ 30
- ○ 31

What are the last 2 letters of your last name?

_____

Are you?

- ○ a boy
- ○ a girl

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, Korean, Japanese
- ○ 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?

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

What grade are you in?

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

What's the name of your school?

_____

Are you in a different school than you were last year (May, 2015)?

○ Yes

○ No

On a usual day, how many servings of fruit and/or vegetables do you eat?

Include fresh, frozen, canned, and cooked items like apple, banana, carrot, salads, and 100% juice.
Do not include chips, french fries, or other fried potatoes.
Some examples of single servings:

- 1/2 cup of fresh, frozen, or cooked vegetables
- 1 cup of raw leafy vegetables; like a small salad
- 1 medium fruit; like an apple, pear, or banana
- 1/2 cup of 100% fruit or vegetable juice

○ 0 servings

○ 1-2 servings

○ 3-4 servings

○ 5 servings

○ 6 servings

○ 7 servings

○ 8 or more servings

Which of the fruits do you like or dislike?

	😀	🙂	😐	☹	Have never tried/don't know	I am allergic
Apples	○	○	○	○	○	○
Blueberries	○	○	○	○	○	○
Cantaloupe	○	○	○	○	○	○
Dried cherries	○	○	○	○	○	○
Kiwis	○	○	○	○	○	○
Melon	○	○	○	○	○	○
Pineapple	○	○	○	○	○	○
Plums	○	○	○	○	○	○
Fruit Salad	○	○	○	○	○	○
Strawberries	○	○	○	○	○	○

Which of the vegetables to you like or dislike?

	😀	🙂	😐	☹	Have never tried/don't know	I am allergic
Asparagus	○	○	○	○	○	○
Green beans	○	○	○	○	○	○
Broccoli	○	○	○	○	○	○
Carrots	○	○	○	○	○	○
Cauliflower/Cauli florets	○	○	○	○	○	○
Celery	○	○	○	○	○	○
Mini cucumber	○	○	○	○	○	○
Spinach	○	○	○	○	○	○
Squash	○	○	○	○	○	○
Cherry tomatoes	○	○	○	○	○	○

How much do you agree or disagree with the following?

	I fully agree	I agree somewhat	Neither	I disagree somewhat	I fully disagree
I like to eat fruit everyday	○	○	○	○	○
I like to eat vegetables everyday	○	○	○	○	○
Fruit tastes good	○	○	○	○	○
Vegetables taste good	○	○	○	○	○

How willing are you to try new foods?

	Very willing	Somewhat willing	Not willing	Not sure
How willing are you to try <u>fruit</u> you've never tried before?	○	○	○	○
How willing are you to try <u>vegetables</u> you've never tried before?	○	○	○	○

How much do you agree or disagree?

	I fully agree	I agree somewhat	Neither	I disagree somewhat	I fully disagree
Eating fruit every day makes me feel good	○	○	○	○	○
Eating fruit and vegetables could help prevent cancer	○	○	○	○	○
Eating fruit and vegetables could help prevent heart disease	○	○	○	○	○

During the past month, how often did you?

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

How much do you agree or disagree?

	I fully agree	I agree somewhat	Neither	I disagree somewhat	I fully disagree
If I decide to eat fruit every day, I can do it	○	○	○	○	○
If I decide to eat vegetables every day, I can do it	○	○	○	○	○

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?

○ 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 care you to sweat and to breathe harder or "be out of breath".

	None	1-15 minutes	16-30 minutes	31-59 minutes	1-2 hours	More than 2 hours
Monday	○	○	○	○	○	○
Tuesday	○	○	○	○	○	○
Wednesday	○	○	○	○	○	○
Thursday	○	○	○	○	○	○
Friday	○	○	○	○	○	○
Saturday	○	○	○	○	○	○
Sunday	○	○	○	○	○	○

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.

	None	Less than 1 hour a day	1-2 hours a day	More than 2 hours but less than 5 hours a day	5 or more hours a day
Monday	○	○	○	○	○
Tuesday	○	○	○	○	○
Wednesday	○	○	○	○	○
Thursday	○	○	○	○	○
Friday	○	○	○	○	○
Saturday	○	○	○	○	○
Sunday	○	○	○	○	○

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

	Agree a lot	Agree	Disagree	Disagree a lot
It would help me deal with stress	○	○	○	○
It would be fun	○	○	○	○
It would help me make new friends	○	○	○	○
It would make me feel good	○	○	○	○
It would give me more energy	○	○	○	○
It would make me hot and sweaty	○	○	○	○
It would make me better in sports, dance, or other activities	○	○	○	○

APPENDIX B

Fruit and Vegetable Survey Among Remote Populations

Northern Fruit and Vegetable Program Survey!

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

1

In order to keep track of your answers, please create this 6 digit ID code.

Which month you were born?

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

What day of the month were you born?

- ○ 1
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- ○ 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?

_____

Are you?

- ○ a boy
- ○ a girl

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, Korean, Japanese
- ○ 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?

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

What grade are you in?

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

What's the name of your school?

_____

Are you in a different school than you were last year (May, 2015)?

○ Yes

○ No

On a usual day, how many servings of fruit and/or vegetables do you eat?

Include fresh, frozen, canned, and cooked items like apple, banana, carrot, salads, and 100% juice.
Do not include chips, french fries, or other fried potatoes.
Some examples of single servings:

- 1/2 cup of fresh, frozen, or cooked vegetables
- 1 cup of raw leafy vegetables; like a small salad
- 1 medium fruit; like an apple, pear, or banana
- 1/2 cup of 100% fruit or vegetable juice

○ 0 servings

○ 1-2 servings

○ 3-4 servings

○ 5 servings

○ 6 servings

○ 7 servings

○ 8 or more servings

Which of the fruits do you like or dislike?

					Have never tried/don't know	I am allergic
Apples						
Blueberries						
Kiwis						
Mandarin Orange						
Orange						
Pineapple						
Plums						
Red Grapes						
Fruit Salad/Platter						
Strawberries						

Which of the vegetables to you like or dislike?

					Have never tried/don't know	I am allergic
Green beans						
Broccoli						
Carrots						
Cauliflower/Cauli florets						
Celery						
Mini cucumber						
Snap peas						
Spinach						
Squash						
Cherry tomatoes						

4

How much do you agree or disagree with the following?

	I fully agree	I agree somewhat	Neither	I disagree somewhat	I fully disagree
I like to eat fruit everyday	○	○	○	○	○
I like to eat vegetables everyday	○	○	○	○	○
Fruit tastes good	○	○	○	○	○
Vegetables taste good	○	○	○	○	○

How willing are you to try new foods?

	Very willing	Somewhat willing	Not willing	Not sure
How willing are you to try fruit you've never tried before?	○	○	○	○
How willing are you to try vegetables you've never tried before?	○	○	○	○

How much do you agree or disagree?

	I fully agree	I agree somewhat	Neither	I disagree somewhat	I fully disagree
Eating fruit every day makes me feel good	○	○	○	○	○
Eating fruit and vegetables could help prevent cancer	○	○	○	○	○
Eating fruit and vegetables could help prevent heart disease	○	○	○	○	○

5

During the past month, how often did you?

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

How much do you agree or disagree?

	I fully agree	I agree somewhat	Neither	I disagree somewhat	I fully disagree
If I decide to eat fruit every day, I can do it	○	○	○	○	○
If I decide to eat vegetables every day, I can do it	○	○	○	○	○

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?

○ 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 care you to sweat and to breathe harder or "be out of breath".

	None	1-15 minutes	16-30 minutes	31-59 minutes	1-2 hours	More than 2 hours
Monday	○	○	○	○	○	○
Tuesday	○	○	○	○	○	○
Wednesday	○	○	○	○	○	○
Thursday	○	○	○	○	○	○
Friday	○	○	○	○	○	○
Saturday	○	○	○	○	○	○
Sunday	○	○	○	○	○	○

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.

	None	Less than 1 hour a day	1-2 hours a day	More than 2 hours but less than 5 hours a day	5 or more hours a day
Monday	○	○	○	○	○
Tuesday	○	○	○	○	○
Wednesday	○	○	○	○	○
Thursday	○	○	○	○	○
Friday	○	○	○	○	○
Saturday	○	○	○	○	○
Sunday	○	○	○	○	○

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

	Agree a lot	Agree	Disagree	Disagree a lot
It would help me deal with stress	○	○	○	○
It would be fun	○	○	○	○
It would help me make new friends	○	○	○	○
It would make me feel good	○	○	○	○
It would give me more energy	○	○	○	○
It would make me hot and sweaty	○	○	○	○
It would make me better in sports, dance, or other activities	○	○	○	○

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
- ○ 30 minutes
- ○ 60 minutes
- ○ 90 minutes

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

- ○ Agree a lot
- ○ Agree
- ○ Disagree
- ○ Disagree a lot

Being given 2 fruit/vegetables each week helps me:

	Agree a lot	Disagree	Agree	Disagree a lot
Achieve my weekly total	○	○	○	○
Learn better in school	○	○	○	○
Be more physically active	○	○	○	○

How much encouragement?

	Strongly encouraged	Encouraged	Discouraged	Strongly Discouraged
How much did you encourage your classmates to try new foods?	○	○	○	○
How much did your teacher or principal encourage you to try new foods?	○	○	○	○

APPENDIX C

Assumption Criteria for Statistical Analysis

Objective #1	Assumptions
Ordinal Logistic Regression	#1 Dependent Variable should be at the Ordinal Level Assumption met #2 One or more independent variables that are continuous, ordinal or categorical Assumption met #3 No multicollinearity Although the variables ethnicity and location were correlated, dummy variables were created for the categorical variables of location and ethnicity and its interactions #4 Proportional odds Assumption met via chi squared analyses
Binary Logistic Regression	#1 Dependent variable should be measured on a dichotomous scale Assumption met #2 One or more independent variables Assumption met #3 Independence of Observations Assumption met #4 Linear relationship between any continuous variables Assumption met through conducting a Box-Tidwell Test assessing the models interactions
Objective #2	
One-way ANOVA Fishers LSD	#1 Dependent variable should be measured at the interval or ratio level Assumption met #2 Independent variable should consist of two or more categorical independent groups Assumption met through running independent samples t-test

	#3 Independence of observations Assumption met through a differentiation of population specific participants to ensure that there were no two people appearing more than once, in addition to each group being independent #4 No significant outliers Assumption met through the robust nature of the one-way ANOVA, and assessment of data to ensure no outliers were present #5 Dependent variables should be normally distributed for each category of independence Assumption met through assessment of Shapiro-Wilk test to ensure normality #6 Homogeneity of variances Assumption met through a conduction of a Levene's test

VITA AUCTORIS

NAME:	Christian Tré Paton
PLACE OF BIRTH:	Brampton, CANADA
YEAR OF BIRTH:	1993
EDUCATION:	Nipissing University, BPHE North Bay, ON, 2011
	University of Windsor, MHK- in Applied Human Performance, Windsor, ON, 2017