Student- and school-level characteristics associated with overweight and obesity among off-reserve Aboriginal students in Ontario

by

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A thesis

presented to the University of Waterloo

in fulfillment of the

thesis requirement for the degree of

Master of Science

In

Health Studies and Gerontology

Waterloo,Ontario,Canada,2013

AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

Abstract

Objective: This study characterized overweight and obesity among a sample of Canadian off-reserve Aboriginal (ORA) students in grades 9 to 12, identified between-school variability in overweight and obesity, and identified student-level characteristics associated with the weight status outcomes.

Methods: This cross-sectional study used student data collected from 29,433 students in grades 9 to 12 from 43 secondary schools as part of the 2012-2013 COMPASS Survey. Logistic regression analyses examined the association between student-level characteristics with overweight and obesity.

Results: Among this sample of Canadian students in grades 9 to 12, 14.0 % and 9.2% of ORA were overweight and obese respectively, while 13.7% and 6.0% of non-Aboriginal youth were overweight and obese respectively. While 56.9% of non-Aboriginal youth were normal weight, only 47.1% of ORA youth were normal weight. Between-school random variation in the odds an ORA student is overweight and obese was identified; school-level differences only accounted for 0.1 % of the variability in overweight and 1.0% of the variability in obesity among ORA. Male ORA students were more likely than female ORA students to be obese (OR 2.39, 95% CI 1.28-4.45). Among ORA, for every one unit increase in kilocalories per kilogram (KKD), the odds of being obese (versus normal weight) decreased.

Conclusions: Promoting healthy weight among Canadian ORA students is a public health priority, as a substantial number of ORA students are overweight or obese. Additionally, the data illustrates significant differences in the rate of overweight and obesity between ORA and non-Aboriginal students. Considering that KKD was associated with obesity among ORA youth, this helps to further support the notion that increasing physical activity levels among young

populations may be a valuable obesity prevention and control strategy. Rather than providing overall youth estimates that may lead to misinformed inferences, future surveillance that report direct comparisons between ORA and non-Aboriginal populations are valuable. These findings underscore the need for culturally appropriate policies and interventions that address the distinct needs of this at-risk population.

Acknowledgements

I owe my greatest appreciation to Dr. Scott Leatherdale- my supervisor, and mentor. Thank you for sharing your sincere passion in research and compelling me to write concisely. You have showed me continued support and encouragement in countless ways. I value all those helpful meetings and last but not least, thank you for helping me gain the confidence I need to grow as a researcher. You are a great role model and truly inspiring.

I would like to express my gratitude to my committee members, Drs. Rhona Hanning and Tara Elton-Marshall for sharing their thoughtful insights, providing constructive feedback and their assistance in the completion of this thesis project. The skills and learning experience I have gained through this project has given me the courage and enthusiasm to continue my career in health research.

I am grateful to the COMPASS staff at the Propel Centre for Population Health Impact for the use of the COMPASS dataset, as well as the school boards, schools and students for their participation in the COMPASS survey, as without them this study would not have been possible. Special thanks to Dina Dawoud for providing statistical advice and answering the many questions I had regarding SAS. Thanks to Adam Cole for his timely assistance with SAS coding to compute the intraclass correlation coefficients. Lastly, thanks to all my friends and colleagues in the HSG department for your assistance.

Thanks to my close friends for the positive attitude, support and always being there, whether it is in times of stress or for celebrating with me on the good days.

Finally, I would like to thank my family for their affection, support, and understanding. In particular, thanks to my Mother for sparking my interest in health as a child. My Brother for his witty and sarcastic remarks that somehow help me make the right decisions. And my Father

for being interested in all my endeavours and provoking the joy of learning from an early age. I am ever grateful for their prayers, encouragement and the opportunities they have given me through their sincere hard work.

And to Kesavan…thank you for always reminding me not to underestimate my capabilities, for your profound interest in my work, and for that "million dollar smile" that got me through.

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Chapter 1

Introduction and overview

1.1 Background

1.1.1 Overweight and obesity among adolescents in Canada

Research and policy makers have underlined obesity and overweight among youth as a significant public health concern in Canada, as the prevalence of adolescents who are overweight or obese has dramatically risen over the last 30 years with most of the change occurring among those between 12 to 17 years of age (Shields, 2006). In fact, the rate of measured adolescent obesity among Canadian youth aged 12 to 17 has tripled from 3% in 1979 to 9.4% in 2004, while the prevalence of overweight has doubled from 11% to 20% (Shields, 2006). The prevalence of measured obesity among youth aged 12-17 further increased to 10.5% according to the 2007-2009 Canadian Health Measures Survey (Statistics Canada, 2010). The most recent BMI data show that the rates of overweight/obesity are even higher among Canadian youth 5 to 17 years old, with approximately 31.5 % (representing 1.6 million) classified as being overweight or obese between 2009 to 2011 (Statistics Canada, 2012). This increase in prevalence over the last 30 years seems to be true across various systems of defining and measuring obesity. Most importantly, researchers have projected further considerable increases in obesity in Canada until 2019 (Sassi et al, 2009).

In Ontario, 27.5% of those aged 2 to 17 were obese/overweight in 2004, slightly higher than the national 26.2%. (Canadian Community Health Survey, 2004). More specifically, objective measures indicate that 11% of males and 7% of females aged 12-17 were obese in Ontario in 2004 (Statistics Canada, 2004).

Furthermore, the direct (including cost of hospital care, physician services, drugs, and research) and indirect (including costs to lost productivity of people due to short term and long term disability, discrimination, years of lives lost due to premature deaths) cost of overweight and obesity is a tremendous financial burden on the Canadian economy and healthcare system (Janssen & Katzmarzyk ,2004). In 2005, chronic conditions related to obesity had accounted for $4.3 billion in direct costs and $2.5 billion in indirect costs (Janssen & Diener, 2005). More recent data show that in 2006, the direct cost attributable to overweight and obesity was $6.0 billion (approximately $3.9 billion for obese individuals and $2.0 billion for overweight individuals), which accounted for 4.1% of the total health expenditures in Canada that year (Anis et al., 2010), while the indirect cost of being overweight and obese was $5.0 billion ($1.8 billion was attributable to overweight and $3.2 billion for obesity) in 2006 (Anis et al., 2010).

In Ontario, the economic burden associated with obesity was $4.5 billion ($1.6 billion in direct and 2.9 billion in indirect costs) in 2009 (Katzmarzyk, 2011). However, these figures may underestimate the total costs associated with excess weight in Canada, as it only includes the costs for those who are obese but not overweight. Further evidence from Ontario shows that obese men and women have physician costs that were approximately 15% and 18% higher respectively than their healthy-weight counterparts (Janssen, Lam & Katzmarzyk, 2009). Such a high burden on the economy and healthcare system reinforces the importance and urgent need to control the current epidemic of obesity in Ontario before it is too late (Katzmarzyk, 2011).

1.1.2 Consequences associated with overweight and obesity

The alarming prevalence of overweight and obese adolescents is extremely problematic since being overweight and obese during adolescence has the tendency to persist into adulthood. In fact, 80% of overweight adolescents will later become obese adults with both immediate and

long-term consequences (Daniels et al., 2005). Excess weight can additionally contribute to the early development of numerous chronic adverse health outcomes such as: type 2 diabetes, atherosclerotic heart disease, and high blood pressure (Singh et al., 2008), hypertension, cardiovascular disease, some forms of cancers (colorectal, kidney, breast, endometrial, ovarian and pancreatic cancers), asthma, gallbladder disease, chronic back pain and osteoarthritis (Guh et al., 2009; Pi-Sunyer, 2002; Morrison and Chanoine, 2007; Hramiak et al., 2007). Furthermore, research suggests that those who are severely obese (obesity class II or III; body mass index of 35 or more) have a higher risk of premature mortality compared to those in the normal weight and overweight ranges (Obesity in Canada, 2011). Overweight and obesity also has profound psychological implications. It is associated with low self-esteem, stigma and reduced psychological well-being which can further affect academic achievement and social development (Paxton, Neumark-Sztainer, Hannan, & Eisenberg, 2006).

Experts also strongly believe that obesity-associated diseases may counteract the progress made in the average life expectancy over the past century. This generation could be the very first to not have long lifespans and enjoy the same quality of life as their parents, due to obesity-related diseases (Standing Committee on Health, 2007; Public Health Agency of Canada, 2012). In fact, estimates indicate that if the present childhood obesity rates continue, children will live three to four years less than present-day adults due to obesity (Ontario Ministry of Health Promotion, 2010).

1.1.3 Differences between the Aboriginal and non-Aboriginal population

Available data suggests that the prevalence of overweight and obesity is not evenly distributed across the Canadian population. There appears to be distinct disparities among specific demographic groups. For instance, obesity rates are significantly higher among the

Canadian Aboriginals in comparison to the non-Aboriginal Canadian population (Obesity in Canada, 2011). According to the 2004 CCHS that used direct measurements, off-reserve Canadian Aboriginal youth had a disproportionately high combined overweight and obesity rate of 41%, in comparison to the general Canadian youth with a combined rate of 29% (Shields, 2005). Furthermore, 20% of off-reserve Canadian Aboriginal youth are obese, approximately 2.5 times higher than the general population with 20% being overweight and 9% being obese (Shields, 2005). Katzmarzyk (2008) also provided evidence of high prevalence of measured obesity among Canadian Aboriginal youth using a representative population sample. Therefore, a large body of literature recognizes Aboriginal youth as a vulnerable population with respect to obesity and overweight (Potvin et al., 1999*;* Willows, 2005; Young, Dean, Flett, & Wood-Steiman, 2000; Public Health Agency of Canada, 2012).

The Aboriginal population is quite distinct from the non-Aboriginal population with respect to factors such as poverty, substandard housing conditions, food insecurity, overcrowded living conditions, and inadequate access to health care or health care providers (Willows et al., 2009; King et al, 2009). Although Aboriginals comprise a small segment of the total Canadian population, they are challenged with a disproportionate health and social burden (Statistics Canada, 2006). Therefore, it is clear that further research needs to prioritize and focus on understanding obesity and obesity-associated factors among Canadian Aboriginal adolescents, the population that is at the greatest risk.

1.2 Overview

Given that prevalence rates have well exceeded epidemic proportions and the clear documentation of its adverse physiological outcomes, obesity is a critical public health concern. As adolescence is a critical period for the development and manifestation of obesity-related

comorbidities among both sexes (Morrison, Sprecher, Barton, Waclawiw, & Daniels, 1999; Pinhas-Harmiel et al, 1996; Amin, & Daniels, 2002), and past literature has identified Aboriginals as a vulnerable population, it is apparent that studies need to focus on Aboriginal youth.

Although past research has focused mainly on important individual-level characteristics associated with obesity among adolescents, recent research also suggests that the characteristics of a school a student attends are also important. While most of the variation in body mass index is at the individual-level, there is sufficient between-school variation to be of interest to researchers (Leatherdale & Papadakis, 2011; O'Malley et al., 2007; Veugelers & Fitzgerald, 2005). Most importantly, this underlines the potential impact schools can make in improving the health of the youth population. On the whole, recent literature suggests that although individual and school-level factors have been implicated in overweight and obesity, no studies have simultaneously examined the associations between these factors and weight status in the off-reserve Canadian Aboriginal youth population. This further suggests the need for future research to focus on identifying the factors that are associated with overweight and obesity among this population.

Off-reserve Aboriginals exhibit poorer health than their Canadian counterparts (Tjepkema, 2002). Likewise, even the prevalence of overweight and obesity among off-reserve Aboriginal (ORA) Canadian youth is significantly higher than among their non-aboriginal counterparts (Ng, Young & Corey, 2010). However, the majority of literature has predominately focused on studies among on-reserve Canadian Aboriginals (Young, 2002). Given that comparatively little is known about the obesity-associated factors among ORA population, this thesis fills an important gap in literature.

This current study will examine the student-and school-level characteristics associated with overweight and obesity among ORA students in grades 9 to 12 in a sample of 43 Ontario secondary schools.

2.1 Key Definitions

For the purpose of this thesis, the term youth and adolescents will be used interchangeably to refer to individuals between grades 9 to 12 from the population sample.

Aboriginals

For the purpose of this study, consistent with Elton-Marshall, Leatherdale & Burkhalter (2011), Aboriginal status will be determined by individuals who self-identify themselves as Aboriginal. That is, those who indicate Aboriginal descent (First Nations, Metis, and Inuit) for question 4 of the COMPASS survey (How would you describe yourself?) would be classified as Aboriginals.

Body Mass Index

Body mass index [BMI] is the ratio of weight in kilograms to the square of height in metres (BMI =kg/m^2). The International Obesity Task Force held a workshop to determine the most appropriate measurement to assess obesity in populations of adolescents across the globe and concluded that BMI is a valid and reasonable measure to assess obesity in adolescents (Dietz & Bellizzi, 1999).

In Canada and in other industrialized nations, despite the presence of several more accurate models that account for aspects of body composition and some limitations of BMI, the BMI indicator continues to be the most dominant method in delineating overweight and obesity as it is the most convenient, non-intrusive, cost-effective and practical method available for measurement of obesity for large population studies (Duncan et al., 2004). Moreover, as direct

measures of adiposity are clinically impractical, the body mass index (BMI) has been the widely used measure in the classification of overweight and obesity in young populations (Willows, 2005). In Canada, the national health surveys do not routinely and consistently measure waist circumference and waist-hip ratio, thus BMI-based standards are used to estimate the prevalence of obesity and overweight of the population. Most importantly, as it is a ubiquitous measure, and most commonly available indicator of overweight and obesity trends, it allows for comparisons across populations. BMI is a relatively simple and applicable body weight classification system. BMI also has high specificity as an indicator for overweight and obesity based on previous analyses of ethnically diverse adolescents (Maline and Katzmarzyk, 1999), is valid (Brener et al, 2003; Goodman et al, 2000), reliable for predicting obesity-related behaviours (Strauss, 1999) and has the ability to predict the presence of adverse health outcomes in adulthood as well (Skinner, Mayer, Flower, Perrin, & Weinberger, 2009).

Therefore, although there may be modest biases associated with self-reports, previous studies have concluded that values used for BMI calculated from subjects' self-reported height and weights are surely valid and adequate for the purpose of research. In the present study, BMI will be calculated using previously validated self-report measures of height (m) and weight (kg) (BMI=kg). The self-reported weight status measure from the COMPASS survey has been previously demonstrated to be reliable and valid when objective measures are not feasible (Leatherdale & Laxer, 2013). Therefore, the measure is a valid proxy measure of weight status that can be used in large school based studies such as the present study.

With respect to the Aboriginal population, although some researchers indicate a need for ethnic-specific standards (Ball and Willows, 2005), other researchers have demonstrated that the present thresholds are appropriate (Lear et al., 2007). Moreover, a vast number of Canadian

studies have used the BMI reference standards to assess adiposity in Aboriginal youth (Downs, Marshall, Ng, & Willows,2 008; Hanley et al., 2000; Horn, Paradis, Potvin, Macualay & Desrosiers, 2001; Katzmarzyk 2008). As such, the current study will use BMI as a marker for overweight and obesity.

The most commonly used BMI thresholds for youth are developed by the International obesity task force (Cole, Bellizzi, Flegal & Dietz, 2000). The International Obesity Task Force (IOTF) has a six category classification system to define overweight and obesity as BMI values ≥ 25 kg/m2 and ≥ 30 kg/m2, respectively. Although previous Canadian studies have used IOTF reference standards to assess overweight and obesity in Aboriginal youth (Gates, Hanning, Martin, Gates & Tsuji, 2013; Katzmarzyk, 2008), it appears that it underestimates the prevalence (Reilly, Kelly& Wilson, 2010).

The WHO Growth Reference 2007 is now recommended for individuals between 5 to 19 years of age (de Onis et al.,2007). This method provides more precise estimates than methods that were used in the past to estimate the prevalence of overweight and obesity within the Canadian population. In order to be consistent with the Canadian Health Measures Survey which now uses the WHO Growth Reference 2007, the following cut-offs will be used : less than or equal to 2 standard deviations below the mean to classify thinness, greater than 2 standard deviations below the mean and less than or equal to 1 standard deviation above the mean to classify normal weight, greater than 1 standard deviation and less than or equal to 2 standard deviations above the mean to classify overweight, and greater than 2 standard deviations above the mean to classify obesity. Therefore, for the purpose of this thesis, the WHO's BMI-for-age Growth References for children and adolescents aged 5 to 17 years old will be applied.

Chapter 2

Literature Review

2.1 Ecological Model

Given the complex etiology of obesity and obesity related behaviours, a model to understand excess weight also needs to multifaceted. In the past, studies have focused mainly on the individual characteristics associated with youth obesity (Shields, 2006). However, it is crucial to take a broader ecological approach that not only examines individual characteristics but also the influential contexts such as the school environment, where the individual is situated. This is particularly important among youth populations as they spend approximately 25 hours per week in school and a school represents an ecological environment that has the potential in being influential to their health-related behaviours. In fact, even the Canadian Population Health Initiative (2004) has stated that the school environment is the most rational setting to accommodate and develop health policies and programs for the prevention and management of obesity. Schools are an appropriate environment where changes can be made, specifically for the prevention of overweight and obesity, as adolescents spend a great amount of time within schools and will allow access to the greatest proportion of adolescents in Canada (Pate et al., 2000; Sallis, Bauman, & Pratt, 1998). As such, ecological theory examines individual behaviour within the context of multiple environments.

Ecological theories have evolved over a long period of time. Urie Bronfenbrenner (1979) original developed the Ecological Systems Theory, which states that complex "layers" of the environment surrounding individuals affect their development and growth. A variety of factors arising from various levels of context influence development (such as characteristics at the individual student level and characteristics of the school that the student attends) and these

factors from various levels of context exist in a relationship in which they interact and influence one another. Flay (2002) states that all health-related behaviours have common underlying causes, including individual (biological, personality, and character traits), social (family, school, peers and neighbourhood) and broader social environmental influences (economic, political, and religious).

This implies that an outcome such as adolescent obesity is the product of multiple, reciprocal relationships between the individual and their developmental contexts. An ecological approach to overweight and obesity acknowledges that adiposity is a function of not only individual characteristics but also context. The ANGELO Framework (Analysis Grid for Environments Linked to Obesity) was originally developed by Swinburn, Egger & Raza (1999) to analyse the influence of the various components of the surrounding obesogenic environments on adiposity. This includes both micro and macro sectors and four types of environments (physical, economic, policy and sociocultural). Youth interact with multiple micro settings, including schools, homes, work environment and their neighbourhoods. In turn, these micro-sectors are influenced by the broader macro-sector such as health care systems, governments and the food industry. This thesis will cover the micro-setting: school and physical environment (in other words, built environment). The other components, while important for youth, are not the focus of the thesis research. According to this framework factors such as: access to physical activity opportunities, availability of food sources, costs related to food and physical activity (PA), rules and policies on food and PA, and attitudes and beliefs related to food and PA of a society, all directly and indirectly impact adiposity. Although previous studies have examined how aspects of the individual and schools are related to overweight and obesity outcomes, none

has examined the potential influences of both individual and school level factors in the same study among Canadian Aboriginal youth.

With respect to the Aboriginal youth, ecological models help contextualize the underlying reasons for the high prevalence of obesity among Aboriginals, underlining the significance of the school environment, and providing a more effective approach in preventing obesity among this population. These models underscore the reciprocity among levels that influence healthy eating, and active lifestyles while recognizing that historical factors encompass and influence all ecological levels, an approach that has high cultural relevance to Aboriginals (Delomier, Hanley & Willows, 2012). Moreover, ecological approaches to obesity prevention do not merely concentrate on individual factors, for instance the focus of traditional knowledge-based classroom programs, but employ a more holistic approach reinforcing influences at the individual and environmental levels. Given that Aboriginal people have a holistic concept of well-being, (Durie, 2004), such a holistic approach is more appropriate for Aboriginals as it provides an effective way to frame health promotion strategies, especially for young populations (Ferris, 2011; Isaak & Marchessault, 2008). Thus, ecological models offer promising approaches in the understanding, prevention and management of obesity and interventions grounded on such ecological models provide a more comprehensive and effective approach for Aboriginal school-aged children (Willows et al., 2012).

In contrast to the ANGELO Framework, the ecological framework developed by Willows et al. (2012) is more specific to the Aboriginal population as it depicts the multiple influences on Aboriginal childhood obesity. This model was not tested but rather revised to organize and guide the research questions and present literature review. The factors are categorized as either school-level or student-level characteristics and sub-classified based on modifiable and non-modifiable

characteristics. Student-level characteristics related to adiposity include non-modifiable biological and demographic factors such as gender and Aboriginal status, individual behaviour such as PA, diet, sedentary behaviour, alcohol use, smoking status and bullying. School-level characteristics include the physical activity and food environment within the school and the built environment surrounding the school (i.e. presence of fast food restaurants).

Therefore, an ecological approach is constructive in guiding research and intervention efforts related to overweight and obesity due to its emphasis on multilevel linkages, the relationships among the various factors that impact adiposity and the focus on the relation between individuals and their surrounding environments (Swinburn, Egger & Raza, 1999; Sallis & Owen, 2002; Stokois, 1992). There is sufficient information from previous studies that have incorporated the ecological model in understanding adiposity to demonstrate its appropriateness and benefit. From an ecological perspective, the school environment has an important influence on overweight and obesity, further underlining the importance of examining school level factors as well as individual factors in comprehensively understanding the etiology of overweight and obesity and its related behaviours. By understanding these determinants simultaneously, they can be amended to constructively influence adolescents through programs and policies that promote healthier lifestyles and mitigate health inequities among the Canadian youth population.

2.2 School-Level characteristics associated with overweight and obesity

According to ecological models, factors from the environments surrounding an individual can considerably influence their behaviour. Traditional explanations for the shift toward higher obesity rates have focused on biology and individual lifestyle choices (Weinsier et al., 1998). However, researchers now acknowledge the importance of the built environment on obesity-

relevant behaviours including diet and PA, with some of the earliest work in the young population emerging in 2004 (Papas et al., 2007).

A broader definition of the built environment adapted from Health Canada, states that "The built environment includes our homes, schools, workplaces, parks, recreation areas, business areas and roads. The built environment encompasses all buildings, spaces, and products that are created or modified by people. It impacts indoor and outdoor physical environments as well as social environments and subsequently our health and quality of life" (Srinivasan, Liam, & Dearry, 2003). Influences of the surrounding environment are particularly relevant to adolescents as they have less autonomy than adults in their behavioural choices (Freedson, & Evenson, 1991). The built environment can either facilitate or impede adequate PA and diet.

With respect to obesity among youth, the built environment encompasses three main components: food environment, PA environment and urban form. However, due to the data available in the COMPASS host study, urban form will not be focused on within this thesis. Evidence indicates that there are school-level characteristics that are associated with youth obesity (O'Malley et al., 2007; Veugelers and Fitzgerald 2005). Additionally, given that youth spend a considerable amount of time at school where they can be influenced by the surrounding environment, and evidence suggests a modest variability in adiposity across secondary schools (Leatherdale and Papadakis 2009; Veugelers et al., 2008; O'Malley et al., 2007; Singh et al., 2007), the built environment within and surrounding the school will be the focus of the present study.

2.2.1 Food Environment

The food environment refers to both within a setting and the surrounding types of food available. An individual's surrounding food environment can influence their dietary choices and

eating behaviours. Although a large proportion of foods consumed by elementary students tend to come from home sources, the nutriotnal quality was more poor than food from school sources (Taylor et al., 2012). This suggests that improving student diet requires a collaborative effort from parents and the quality of school food. Moreover, since school-aged youth generally buy their lunch and snacks near school grounds (Johnston, Malley, Delva, Bachman, & Schulenberg, 2007; Nielsen, Siega-Riz, & Popkin,2002), the surrounding school food environment may also influence student diet and weight. In fact, numerous authors have suggested that preventing and controlling obesity among youth will entail addressing the food environment within and surrounding schools (Zenk and Powell, 2008; Sturm, 2008; Austin et al.,2005)

Therefore, the food environment both inside and outside schools is also an important environmental influence for understanding adiposity among youth. It includes: fast food restaurants, cafeterias, convenience stores, grocery stores, and availability of vending machines. In comparison to the physical environment, less research has examined the food environment and its influence on adolescent eating behaviour and excess weight in the Canadian context. With research confirming a widespread availability of nutrition deficient foods inside schools and the clustering of fast-food stores within walking distance of schools in both Canada and the US (Winson, 2008; Austin et al., 2005), it is important to examine whether the food environment within and surrounding schools is associated with adolescent weight status. This is particularly important among Canadian Aboriginal youth as there has been very minimal research conducted up to date.

2.2.1.1 Food environment within school

In Ontario, the government has issued a policy (PPM-150), to take effect from September 1, 2011 (Ontario Ministry of Education, 2010). The policy, which has been issued in attempt to

promote healthier eating habits and provide healthier learning environments, outlines specific nutrition standards that applies to all food and beverages sold within schools (including cafeterias, vending machines, catered lunch programs, and events on school property). However, these standards do not apply to food brought from homes.

The nutrition standards of PPM-150 divides all food and beverages into three categories. Products in the "Sell Most ≥80%" are the healthiest options and have higher levels of essential nutrients and lower levels of fat, sugar and sodium (Ontario Ministry of Education, 2010). These foods must make up at least 80% of all food and beverage choices within schools. Products in the "Sell Less ≤20%" can have slighter greater amounts of fat, sugar and sodium than the products in the "Sell Most" ccategory (Ontario Ministry of Education, 2010). Finally, products in the "Not Permitted for Sale" category are food and beverages that contain very few or no essential nutrients and high amounts fat, sugar and sodium (Ontario Ministry of Education, 2010). Given that school environment is considered to influence the preference and behaviour of students, the underlying rationale is that applying this policy in Ontario's public schools will help prevent students from developing chronic illnesses such as obesity, heart disease, and type 2 diabetes (Ontario Ministry of Education, 2010).

Previous research has shown that the school food environment influences student eating behaviours (Institute of Medicine, 2009; Templeton, Marlette and Panemangalore, 2005; Harnack et al., 2000). One American study examined the relationship between physical factors in the school environment (snack vending machines, a la carte programs) and the consumption of fruits, vegetables and dietary fat among grade 7 students using 24-hour dietary recall interviews (Kubik, Lytle, Hannan, Perry, & Story, 2003).The study found a negative adverse association between snack vending machines and fruit consumption. However, it is important to remember

the difference between US and Canandian context when it comes to school food. In contrast to the US, there is no nation-wide breakfast or school lunch program funded by the federal government in Canada (McKenna, 2010). Although the majority of the studies have examined the food environment with student diet, much less research has studied the school food environment influences on student weight status (Larson & Story, 2010).

The few studies that have examined the school food environment and adiposity have revealed mixed findings (Institute of Medicine, 2007). One Canadian study examined the associations between environmental variables in the school and weight status and dietary behaviours among a sample of 4,936 students from grades 7 to 10 in Alberta, (Minaker et al., 2011). Consistent with other studies, this study found a high prevalence of vending machines in schools. Subsequently, they found that the presence of beverage-vending machines in the school environment was significantly correlated with the students' overweight and obesity, whereas the presence of snack-vending machines in the school environment was not significantly associated with students' weight status. An interesting finding of this study was that presence of snack and beverage logos (not actual vending machines) in schools was positively correlated with both the frequency of pop, and unhealthy snack consumption, indicating the convincing nature of brand marketing. This was consistent with previous study by Briefel et al (2009). A study conducted by Anderson and Butcher (2006) found that a ten-percentage-point increase in the number of schools that offered unhealthy food was associated with a one percent increase in students' BMI. Similarly, Fox, Dodd, Wilson and Gleason (2009) also found that the availability of unhealthy food in school vending machines was associated with a higher student BMI. Contrary to expectations, the study also surprisingly found that unhealthy a la carte food was related with a lower BMI. Terry-McElrath, O'Malley, Delva and Johnston (2009) concluded that the

relationship with school food environment and student BMI-related outcomes is largely unclear as all associations between the school food environment and student adiposity were not found to be significant after controlling for the percentage of students eligible for free or reduced price lunch. Given the influence of the school food environment on student eating behaviours, and the limited number and mixed findings of studies linking the school food environment with student BMI, it is important for future studies to clarify the association between school food environment and student weight status.

2.2.1.2 Food environment surrounding school

Fast Food Restaurants

Research that has examined the relationship between fast food restaurants near schools and student adiposity has provided inconsistent evidence. In Ontario, Leatherdale, Pouliou, Church & Hobin (2011) found that the greater the number of fast-food retailers within 1km school distance, the more likely a student was to be overweight. Past studies conducted in London, Ontario demonstrated that the presence of fast-food and convenience stores within 1 km of school was associated with increased purchasing of junk food (He et al., 2011) and unhealthier diets among grade 7 and 8 students (He et al., 2012) . Similarly, a study by Davis and Carpenter (2009) found that 7th to 12th grade students who had one or more fast food restaurants within 800 m of their school had a greater relative odds of overweight and obesity compared to their counterparts with no close by fast-food restaurants. More recent research conducted by Gilliland et al (2012) examined the association between built environmental factors with high BMI levels among 966 youth aged 10-14 years in London, Ontario. They found that that only the presence of fast-food restaurants within the school walking distance was associated with higher BMI z-scores among the sample. This is consistent with findings from the previously mentioned study of grade

7-8 students in London, where the availability of fast-food stores within 1 km of school was associated with increased purchasing of junk food by the students and unhealthier diets.

On the contrary, other researchers did not find a significant association between fast food restaurants nearby schools and student adiposity (Powell et al; 2007; Howard, Fitzpatrick & Fu frost, 2011; Langellier, 2012). Stum and Datar (2005) also found no association between fast food restaurants near schools and BMI in a longitudinal study of elementary students. Another Canadian study examined the association between food retailers (including full-service restaurants, fast-food restaurants, sub/sandwich retailers, doughnut/coffee shops, convenience stores and grocery stores) surrounding schools and overweight among Canadian youth in 178 schools across the country (Seliske, Pickett, Boyce & Janssen, 2009). They found that an increased number of food retailers within 1 km of the school did not increase the likelihood of the students of that school being overweight. Contrary to predictions, the study further found that the total food retailer index was most strongly associated with overweight. That is, students attending schools with at least one food retailer within 1 km of school, were less likely to be overweight. However, it is important to note that they did not control for the PA opportunities in the environment. Harris et al (2011) also did not find a significant relationship between the proximity as well as the density of food stores around schools and risk of student obesity. Most interestingly, Grier and Brennan (2013) found that although school-fast food distance is negatively associated with student weight, specific subpopulations (minority black and Hispanic students in low-income and urban schools) have stronger associations between school-fast food distance and student body weight in comparison to others.

Therefore, contradicting findings indicate that further research is needed to substantiate the association between the presence of fast-food restaurants near schools and student weight status.

Convenience Stores

An American national study of grade 8 and 10 students found that each additional convenience store per 10,000 people within the school zip code was correlated with a 0.03 unit increase in BMI and a 0.2% increase in the prevalence of obesity (Powell, Auld, Chaloupka, O'Malley & Johnston, 2007). Similarly, Howard, Fitzpatrick & Fulfrost (2011) found that a convenience store being present within a 10-minute walking distance from a school was associated with a higher rate of overweight students in comparison to schools without nearby convenience stores. Although the association may seem to be relatively weak, introducing a single convenience store per 10,000 people may comprise a large area. In contrast, Leatherdale, Pouliou, Church & Hobin (2011) did not find a significant relation between the presence of convenience stores and BMI.

Grocery Stores

Leatherdale, Pouliou, Church & Hobin (2011) found that the greater the number of grocery stores within 1 km school distance, the more likely a student was to be overweight. In contrast, some studies show that students have a decreased likelihood to be overweight if their school neighbourhood has stores with affordable fresh produce (Veugelers, Sithole, Zhang & Muhajarine, 2008) and large chain supermarkets (Powell, Auld, Chaloupka, O'Malley & Johnston, 2007) whereas other studies have found no association between nearby supermarkets and student adiposity (Howard, Fitzpatrick and Fulfrost, 2011).

Given these findings, although it is plausible that the school food environment is associated with student weight status, there is a need for additional evidence, particularly among the Canadian Aboriginal youth.

2.2.2 Physical activity environment

Given the inverse relationship between PA and BMI among adolescents (Hohensee & Nies, 2012), it is important to focus on the school PA environment when examining adiposity. The physical environment refers to the surrounding availability of recreational facilities (such as gyms, pools, soccer fields, etc.) and parks within a particular geographic area.

Past research has found a positive association between both subjective and objective accessibility of parks, playgrounds, and recreation facilities, and PA levels among youth (Babey, Hastert & Brown, 2008;Gomez et al., 2004; Gordon-Larsen et al., 2006; Hume et al., 2005; Krahnstoever Davison and Lawson, 2006; Mota et al., 2005; Motl et al., 2005; Norman et al., 2006; Timperio et al.,2004; Utter et al., 2006 ;Powell, Chaloupka, Slater, Johnton & O'Malley, 2007). One national Canadian study found a moderate positive relationship between the number of recreational facilities within a school and the likelihood that students engage in PA (Nichol, Pickett, & Janssen, 2009), and this is further supported by international data (Haug, Torsheim & Samdal, 2008)

Although research has demonstrated that attributes of the built environment can facilitate or hinder PA (Giles-Corti et al., 2005; Heinrich et al., 2007;Kirby et al., 2007; Popkin et al., 2005) , there is significant between-school variation in the PA behaviours of students (Ma, 2000; Maes & Lievens, 2003) , and physical inactivity is an important predictor of obesity (Katzmarzk ,2008), very few studies have examined the link between school physical built environment and student BMI.

2.2.2.1 Physical activity environment within school

There has been many studies that have examined the relationship between the PA environment within the school and student PA levels. For instance, Fein, Plotnikoff, Wild and Spence (2004) found that the availability of sports equipment, and access to athletic facilities at school was associated with higher self-reported PA. Cradock, Melly, Allen, Morris & Gortmaker (2007) found that greater outdoor space per person was associated with greater PA in adolescents. Other studies have found a positive association between school physical education and programming and student PA (Nichol, Pickett, & Janssen, 2009; Hobin, Leatherdale, Manske, & Robertson-Wilson, 2010).

International data from Norway has also found that secondary students attending schools with larger number of outdoor facilities had also most three times higher odds of participating in daily PA compared to students with fewer facilities

However, much less research has examined the relationship between the school PA environment and student BMI. The few studies that have been conducted have typically resulted in mixed findings. Some studies have found a negative association between physical education classes at school and adiposity among the students. In fact, a study conducted by Veugelers & Fitzgerald (2005) found that among school-aged subjects in Nova Scotia, physical education classes two or more times a week at school decreased the risk of both overweight and obesity. Lowry, Lee, Fulton, Demissie, & Kann (2013) also found that student participation in school-based physical activities including varsity teams or daily physical education classes are associated with a slightly decreased risk of being overweight or obese. Moreover, Hobin, Leatherdale, Manske, Dubin, Elliot and Veugeler (2012) found that attending a school that has an alternative room for PA and offered daily physical education was associated with students

spending more time in moderate to vigourous physical activity (MVPA) in comparison to students who attended a school without these resources.

Other studies have found few significant associations between the school PA environment (length of PA classes, amount of time spent in PA) and student BMI (O'Malley, Johnston, Delva & Terry-McElrath, 2009). One indicator, number of days per week that students take physical education classes, showed a negative association with BMI score and student participation in intramural sports was associated with a lower percentage of students being overweight in grade 8, 10 and 12. Therefore, consistent with international data (Cleland et al., 2008), they concluded that variations in physical education in American high schools have only modest association with student BMI. Durant et al (2009) found that although the frequency of physical education classes and access to school recreation facilities after school were associated with overall PA among adolescents, none of the school variables (days of physical education class per week, school equipment accessibility, after-school supervised PA, and after-school field access) was associated with BMI. It is important to note that this study used self-reported measures of the school environment variables and a previous study that used direct observation found variables such as physical education equipment and PA supervision at school related to PA (Sallis, Conway, Prochaska, McKenzie, Marshall & Brown, 2001). Therefore, it is too early to completely dismiss the within school-level factors related to PA and future research is necessary.

Moreover, it is particularly important to examine school-level PA factors among Canadian youth as 20% of parents stated that their adolescent child did not receive any physical education and this percentage escalates as students continue through secondary grades (Craig, Cameron, Storm, Russell, & Beaulieu,2001). Once physical education becomes a non-

compulsory subject in secondary school, enrolment tends to dramatically decline (Craig & Cameron, 2004; Allison & Adlaf, 2000).

2.2.2.2 Physical activity environment surrounding school

Students have a decreased likelihood to be overweight if their school neighbourhood has accessibility to parks, playgrounds, and recreational facilities, (Veugelers, Sithole, Zhang & Muhajarine, 2008). Although park and playgrounds may play a significant role in PA levels (Ridgers et al., 2007; Colabianchi et al., 2009; Fernandes and Sturm, 2010; Haug et al., 2010; Loukaitou-Sideris and Sideris, 2010; McKenzie et al., 2010; Willenberg et al., 2010), the present study will not examine this factor, as the focus of the present study is adolescents.

Gilliland et al. (2012) examined the association between built environment factors with high BMI levels among 966 youth aged 10-14 years in London, Ontario. They found that the characteristics of the built environment around the schools have a modest yet significant effect on their BMI. Although the availability of recreation facilities in the home neighbourhood had a significant effect on the BMI z-scores (with those having at least one public recreation facility operating within a 500 m walk of their home more likely to have lower BMI z scores compared to their counterparts without a recreation facility close by), the availability of a public recreation opportunity within the school neighbourhood did not have a significant effect on their BMI z-scores. Trilk et al (2011) found grade 12 students who attended schools with 5 or more PA facilities within a 0.75-mile buffer had higher PA than those who attended schools with less than 5 facilities.

In comparison to the numerous studies that have examined the association between PA environment surrounding the homes and level of PA among adolescents (Gordon-Larsen, Nelson, Page & Popkin, 2006; Pate, Colabianchi, Porter, Almeida, Lobelia, & Dowda, 2008;

Dowda, Dishman, Porter, Saunders & Pate, 2009; Norman, Nutter, Ryan, Sallis, Calfras, & Patrick, 2006), very little research has studied the PA environment surrounding schools and BMI among adolescents. Moreover, the few studies that have been done have also yielded mixed findings, underscoring the need for future studies to clarify the associations.

2.3 Student-level characteristics associated with overweight and obesity

According to the ecological theory, individual-level factors also influence overweight and obesity. Past research has examined individual student characteristic associated with overweight and obesity among youth (Storey et al., 2003; USDHHS 2001; Veugelers & Fitzgerald 2005; Wong & Leatherdale 2009; Leatherdale & Wong 2008; Lowry et al., 2002; Forshee et al., 2004; Leatherdale & Papadakis 2009). These individual factors can be sub-categorized into modifiable and non-modifiable characteristics.

2.3.1 Non-modifiable characteristics

2.3.1.1 Gender

Canadian studies have consistently found that the prevalence rate of overweight and obesity are higher among boys than girls (Tremblay et al, 2010; Leatherdale et al., 2011; Gilliland et al, 2012; Janssen, Katzmarzyk, Boyce, King & Pickett , 2004; Leatherdale & Ismailovi,2010 ; Leatherdale & Papadakis 2009). In 2011, among youth aged 12 to 17, 24% of boys were overweight or obese in comparison to 17% among girls (Statistics Canada, 2012). Among ORA youth, according to the 2009 CCHS, 29% of males and 25% of females were overweight and obese (Statistics Canada, 2009). Previous studies indicate that the prevalence of overweight and obesity being lower among girls may possibly be due to the reason that girls are more likely than boys to underreport body mass (Strauss, 1999; Brener et al., 2003). However,

the measured values from the 2004 CCHS also indicates lower prevalence among females in comparison to males (Shields, 2006).

2.3.1.2 Aboriginal Status

There seems to be ethnic differences in the prevalence of overweight and obesity. In Canada, the prevalence of overweight and obesity is significantly higher for Aboriginals compared with Non-Aboriginals, specifically in Alberta, Manitoba, Ontario and Quebec (Public Health Agency of Canada, 2011). This seems to be true among younger populations as well, where the prevalence of obesity among Canadian Aboriginal youth was 15.8% in comparison to 8.0% among their non-Aboriginal counterparts, even after adjusting for several covariates (Katzmarzyk, 2008). The 2009 CCHS data indicates that approximately 20% of ORA youth reported being overweight and 7% being obese (Statistics Canada, 2009). This is higher than the prevalence reported in the 2004 CCHS, although both used measured values. This may be due to the 2004 CCHS having used the IOTF classification cut-offs, which underestimates the prevalence (Reilly, Kelly& Wilson, 2010).Whereas, the 2009 CCHS used the classification cut-offs established by the WHO Growth Reference 2007.

2.3.1.3 Socioeconomic Status

Past literature from industrialized nations has primarily found an association between obesity, poor diet, and physical inactivity with lower socioeconomic status (Daron & Drewnowski, 2008; Janssen et al., 2006; Smith et al., 1997; Stunkard, 1996; Haas, Lee et al., 2003; Wang, Monteriro, & Popkin, 2002: Wang, 2001). Although there are inconsistent findings regarding the relationship between weight status and socioeconomic status they are likely due to the differences in the population studied, and the specific socioeconomic status measures used. One study conducted by Janssen, Boyce, Simpson & Pickett (2006) on a large representative

sample of Canadian adolescents found both individual and area-level socioeconomic status indicators were negatively associated with obesity. Given the significant socioeconomic disparities between Canadian Aboriginals and non-Aboriginal populations, and the inverse association between socioeconomic status and excess weight, further studies need to examine the relationship among this vulnerable population.

2.3.2 Modifiable characteristics

2.3.2.1 Physical Activity

Previous studies that have examined the association between PA and adiposity among youth have found inconsistent findings. Some studies found an inverse association between PA and adiposity among Canadian youth (Yu, Protudier, Anderson & Fieldhouse, 2010; Gillis, Kennedy, Gillis, Bar-Or, 2002). Janssen, Katzmarzyk, Boyce, King & Pickett (2004) conducted a study on 5890 Canadian adolescents aged 11–16-year-olds and the findings demonstrated that independent of gender, PA levels were lower among overweight and obese adolescents than their normal-weight counterparts. Therefore, with increasing PA participation there were decreased odds of overweight and obesity among both genders. This association appears to be true internationally as well, as Janseen et al (2005) conducted a systematic review among 10-16 year olds across 34 countries and found that within most industrialized countries, PA levels were lower in among overweight youth compared to normal weight youth even after controlling for dietary predictors. However, in contrast, some studies did not find a clear association between PA and weight status (Van Der Horst, Paw, Twisk & Van Mechelen, 2007; Sallis, Prochaska, Taylor, 2000; Thompson et al, 2005; Naoko et al, 2006; Mota, Snatos, Guerra, Ribeiro & Duarte, 2002; Ekelund, Yngve, Brage, Westerterp & Sjöström, 2004).

With respect to the Canadian Aboriginal youth population, Katzmarzk (2008) found that physical inactivity was a predictor of obesity in both Aboriginal and non-Aboriginal adolescents. In fact, the lack of PA was associated with an increased risk of being obese independent of age, sex and ethnicity. Another study found that although PA participation was higher among Aboriginal youth in comparison to non-Aboriginal youth, PA was an important predictor of obesity only among Aboriginal Canadian youth (Ng, Young & Corey, 2010). In this study, daily energy expenditure was derived from subjects' reported participation in leisure time physical acitivties over the 3 months before the interview. Bernard, Lavalle, Gray-Donald & Delisle (1995) have also previously found that overweight Cree adolescents participate in significantly less PA than their normal-weight counterparts. In their study, the frequency of physical activity per week was measured, where physical activity was defined as within school and out-of-school exercise of at least 30 minutes and sufficient intensity to be out of breath and perspire.

According to the WHO and Canadian recommendations, adolescents should participate in at least an hour of moderate-to-vigourous PA daily (Canadian Society for Exercise Physiology, 2010; World Health Organization, 2010). However, the Active Healthy Kids Canada 2012 Report indicates that only 7% of children and youth (5- 19 years old) across Canada attain this level of recommended activity. Similarly, Leatherdale and Rynard (2013) found that 31.2% of Canadian youth did not meet the PA guidelines of performing hard PA a day for at least three out of the last seven days.

Of the PA variables, much of previous research has focused on and identified the failure to meet the 60 minutes per day of moderate to vigourous PA guidelines to be mainly associated with adiposity (Steele, van Sluijs, Cassidy, Griffin & Ekelund, 2009; Ruiz et al, 2006; Gutin, Yin, Humphries & Barbeau, 2005; Ekelund et al, 2004), with few exceptions (Thompson et al,

2005). Consistent with Chaput et al (2011) who found an inverse association between MVPA and adiposity indices independent of sedentary time, Patrick et al (2004) found that out of the seven dietary and PA variables they examined in their cross-sectional study, insufficient moderate to vigourous PA (VPA) was the only risk factor for higher body mass index for both adolescent boys and girls. Similarly, Colley et al (2011) found that overweight and obese males take part in 51 and 44 minutes of MVPA daily respectively, while on the other hand, males who are not overweight or obese take part in approximately 64 minutes of MVPA daily. However, this trend was not significant among girls as females on average participated in 44 to 48 minutes of MVPA daily, regardless of their BMI. Likewise, Belcher et al (2010) found that obese youth spent 16 fewer minutes per day in MVPA than their normal-weight counterparts. However, this was not observed uniformly across race/ethnic groups, implying that cultural or biological factors may moderate the association between PA and adiposity in youth. In contrast, Thompson et al (2005) found that although there were age and sex differences, there was no significant association between the average time spent in moderate to vigourous PA and BMI. Surprisingly, Lowry, Lee, Fulton, Demissie, & Kann (2013) found that obese adolescents were more likely than nonobese adolescents to take part in VPA. However, these unexpected findings may perhaps be because of obese youth being more likely to perceive MVPA as VPA compared to nonobese youth (Lowry et al., 2013). Some obese individuals may also have difficulty with ventilatory control during exercise because of the higher metabolic demand needed to move bigger limbs, and increased breathing from extra weight on thorax (Babb, 2013). Nonetheless, for adolescents the MVPA screening measure is recommended for use (Prochaska, Sallis, & Long, 2001). Overall, the majority of the findings suggest the MVPA is an important factor with respect to adiposity and in agreement with Canadian PA recommendations for youth.

Among Aboriginal Canadians, there seems to be only a handful of studies that have examined the role of PA in the development of obesity (Ng, Marshall & Willow, 2006; Katzmarzyk 2008; Findlay, 2011; Paradis et al., 2005). Therefore, given the inconsistent findings, cultural differences and lack of sufficient studies, further research is warranted to elucidate the association between PA and BMI in Aboriginal youth.

2.3.2.2 Diet

As youth obesity could be explained by factors which influence energy intake or expenditure, previous studies have implicated dietary habits in excess weight. Although some studies have reported significant associations among dietary habits and adiposity, other studies did not (Storey et al., 2003). For instance, Janssen, Katzmarzyk, Boyce, King & Pickett (2004) found no clear relationships between dietary habits and measures of overweight and obesity among a nationally representative sample of 11- 16 year old Canadians. It is important to note however, the respondents were asked how many times in a week did they consume each of the following food items: fruits, vegetables, sweets (candy or chocolate), nondiet soft drinks, cake or pastries and potato chips. The responses were "never" , "less than once a week," "once a week," "2-4 days a week," "5-6 days a week," " once a day," "and "more than once a day." Subsequently, for each of the food item the participants were categorized into "low (once a week), "low-moderate" (2-4 days/week), and "high" (once a day) consumer categories.

Thus, there seems to be inconsistent pattern in the observations and it may possibly be due to overweight and obese individuals tend to underreport food intake (Garaulet et al., 2000).

The Canada's Food Guide has guidelines on the specific number of servings from each food group individuals should consume daily (Health Canada, 1997). However, few Canadian adolescents meet the recommendations. One cross sectional study examined 2850 adolescents

aged 14 to 17 in Alberta and Ontario (Storey et al., 2009). Their findings indicated that Canadian adolescents have relatively low intakes of Canada Food Guide to Healthy Eating-recommended foods. More recent data indicates that 93.6% of Canadian youth reported inadequate fruit and vegetable intake from 2010 -2011(Leatherdale & Rynard, 2013).

The association between consumption of fruits and vegetables, and adiposity appears to be unclear. A systematic review conducted by Janseen et al (2005) found that the intake of fruits and vegetables was not associated with overweight status among 10-16 year olds across 34 industrialized countries. However, using a different measure the 2004 CCHS showed that Canadian adolescents who reported eating fruit and vegetables less than five times a day were significantly more likely to be overweight/obese in comparison to those who ate more fruit and vegetables (Shields, 2006). Furthermore, evidence from the Aboriginal population in Manitoba indicates that high fruit and vegetable consumption was associated with a lower prevalence of overweight and obesity among female youth ,but had little impact on the rates among male youths (Yu, Protudjer, Anderson & Fieldhouse, 2010). The association between unhealthy eating and adiposity is highly concerning given that a large body of literature indicates that Aboriginals typically have a less healthy diet in comparison to their non-Aboriginal counterparts. In fact, the findings from a study by Ng, Young & Corey (2010) indicate that the consumption of vegetables and dairy products were lower among Aboriginal youth compared to non-Aboriginal youth. Moreover, Bernard et al (1995) found that overweight Aboriginals consumed significantly fewer servings of fruits and vegetables than their normal-weight counterparts among a sample of 144 Aboriginal children and adolescents in James Bay Cree communities. However, after controlling for age, the association between diet and overweight remained significant only among the children (9 to 11 years old) and not among the 12 or older group. Hanley et al (2000)

found that vegetable intake was inversely related to overweight among Native Canadian youth; as those in the highest quartile of vegetable consumption had a decreased risk of being overweight than those in the lowest quartile. However, this association was not significant.

Given the significance of Canada's Food recommendations and the inadequate fruit and vegetable consumption among Aboriginals, the association between level of intake, and weight status needs to be further elucidated.

2.3.2.3 Sedentary Behaviour

Given that 89.4 % of Canadian youth exceeded sedentary behaviour guidelines from 2010-2011, it is important to examine sedentary behaviour (Leatherdale & Rynard, 2013). Past research has implicated sedentary behaviours with overweight and obesity among adolescents. Sedentary behaviours refer to behaviours that require low energy expenditure, such as sitting for prolonged periods of time, TV viewing, computer use, playing video games, and phone chatting. However, the term encompassing a broad range of activities makes it relatively difficult to assess (Tremblay, Esliger, & Colley, 2007). On average, adolescents spend approximately 8.5 hours of sedentary time and four hour of light-intensity PA during waking hours (Colley et al., 2011). Moreover, with age, sedentary time seems to increase (Colley et al., 2011). Given that a recent study indicates that the majority of Canadian adolescents exceed the recommended guidelines of less than two hours of screen time daily, it is important to focus on the link between sedentary behaviour and BMI (Leatherdale & Ahmed, 2011).

With a few exceptions (Janssen, Katzmarzyk, Boyce, King & Pickett, 2004; Chaput et al.,2011),the vast majority of studies have suggested that sedentary behaviours are positively associated with adiposity (Leatherdale and Wong 2008; Janssen et al. 2005; Storey et al. 2003; Lowry et al. 2002; Yu, Protudjer, Anderson & Fieldhouse, 2010; Tremblay et al., 2011; Must &

Tybor., 2005; Hills, King, & Armstorng, 2007; Crespo et al.,2001; Shields, 2005; Janssen et al., 2005;Leatherdale & Papadakis, 2011; Canadian Population Health Initiative, 2009). In fact, studies indicate that sedentary behaviour is associated with adiposity independent of MVPA (Janssen et al., 2004; Andersen et al., 1998; Crespo et al., 2001; Tremblay & Willms, 2003). Among adolescents aged 12-17, 23% of those who spent less than 10 hours a week in front of a screen (with screen time being defined as the amount of time spent watching TV or videos, playing video games, and using a computer) were overweight and obese while 35% of those who spend 30 or more hours a week were overweight and obese (Shields, 2006).

Television viewing, a sedentary behaviour, appears to be the strongest predictor of overweight and obesity among adolescents (Eisenmann, Bartee & Wang, 2002; Lowry et al., 2002). Similarly, Leatherdale & Ismailovi (2010) found that less TV watching was associated with a lower risk of obesity and overweight among grade 9 to 12 high school students in Ontario. This is consistent with other studies (Ness, Brradas, Irving & Manning, 2012) where less TV watching was associated with a lower risk of overweight and obesity. Janssen et al (2004) also found that in Canada, TV watching times were higher among overweight and obese 11-16 year olds in comparison to their normal-weight counterparts. However, there were gender differences, as males who watch four or more hours of TV per day were 20% less likely to be overweight compared to females who watched. International data seem to support the positive association between television and adiposity as Janssen et al (2005) conducted a systematic review among 10-16 year olds across 34 industrialized countries and found that television watching times were greater among overweight youth compared to normal weight youth even after controlling for dietary predictors among youth. Ng, Young, & Corey (2009) found that although TV watching was a strong predictor of excess weight for both non-Aboriginal and Aboriginal youth, it is

particularly concerning among Aboriginal youth as they were also times more likely to engage in more hours of TV viewing. In fact, nearly half of the Aboriginal adolescents watched TV at least 15 hours per week which was double the proportion estimated among the non-Aboriginal youth. Given that the positive relationship between screen time and obesity is well documented (Swinburn & Shelly, 2008), it is essential to give importance to this factor in understanding excess weight.

With respect the Canadian Aboriginal youth, Hanley et al (2000) found that among those aged 10-19 years old, those who, those who watched about 5 hours of television per day had 2.5 times the risk of being overweight as those who watched about 2 hours a day, indicating a significant inverse association between overweight and television watching. Moreover, both genders were more likely to be obese if they viewed 4 hours or more of TV per day.

Given that both lifestyle and sociodemographic risk factors associated with obesity differ between Aboriginal and non-Aboriginal youth (Ng, Young, & Corey, 2009), future research is warranted to elucidate the association between TV watching and BMI among Aboriginal youth.

2.3.2.4 Cigarette Smoking

The relationship between smoking and body weight has been researched more extensively among adults and studies generally suggest an inverse association between current smoking status and body weight (USDHHS, 2001). However, the link between adiposity and smoking among adolescents is inconsistent. Many of the studies related to body weight and smoking among adolescents included only males or females. Those that examined the association between smoking and obesity among both genders reveal mixed findings. Some studies indicate a positive association between BMI and smoking initiation (Cawley, Markowitz& Tauras, 2004; Lowry, Galuska, Fulton, Wechsler & Kann , 2002) and state that

youth who smoke are more likely to be overweight (Tomoe, Field, Berkey, Colditz & Frazier,1999; Potter , Pederson, Chan , Aubut & Koval, 2004). In fact, the results of a nationally representative sample of adolescents (grades 9-12) in America indicated that current smoking is associated with a higher BMI in both male and female students. Additionally, the association strengthened over time during the period of 1999-2005 so the more recent the cohort, the more strong the relationship between current smoking and BMI (Seo, Jiang, & Kolbe, 2009). However, it is important to note that although some studies suggested a higher BMI in adolescence being associated to smoking, there appears to be gender differences (Cavallo DA, Duhig AM, McKee S, Krishnan-Sarin; 2006; Caria MP, Bellocco R, Zambon A, Horton NJ, Galanti MR; 2009; Cawley J, Markowitz S, Tauras J.;2004; . Weiss JW, Merrill V, Gritz ER, 2007)). Other researchers have found a negative or no association between adiposity and smoking (Leatherdale, Wong, Manske & Golditz, 2008; Moussa, Skaik, Selwanes, Yaghy, & Bin-Othman, 1994; Kaufman AR, Augustson EM, 2008; O'Loughlin J, Karp I, Henderson M, Gray-Donald K, 2008; Strauss RS, Mir, 2001).

A summary of 19 primary research studies (Potter, Pederson, Chan, Aubut & Koval, 2004) assessed the relationship between smoking and weight status among adolescents, and found that approximately half (n=9) found a positive association, while the others indicated no association or a negative association (n=10). Moreover, the findings were inconsistent by gender as well. In fact, Farhat, Iannotti & Simons-Morton (2010) found frequent smoking to be significantly associated with weight status among only girls, while smoking experimentation was not related to weight status in any sex or age group. Even among longitudinal studies, some found adolescent smoking to predict an increase in body fat percentage after 2 years (Pasch, K. E., Velazquez, C. E., Cance, J. D., Moe, S. G., & Lytle, L. A., 2012) while others found

adolescent smoking to predict an increase in BMI after 2 years but not at a 3-year follow up (Cooper, Klesges, Robinson, & Zbikowski, 2003). Therefore, studies examining smoking and obesity typically suggest significant associations, but the inconsistent findings demonstrate a need for further studies to clarify. Moreover, there appear to be no studies on smoking and BMI among Canadian Aboriginal youth.

2.3.2.5 Alcohol Use

Given that adolescents who are overweight or obese are particularly vulnerable to health-risk behaviours, it is important to focus on the association between BMI and alcohol use. However, relatively few studies have examined the link between alcohol use and BMI among adolescents. Within the limited number of studies conducted, the majority of the studies have typically found a positive association between BMI and drinking alcohol (Pasch, Nelson, Lytle, Moe & Perry, 2008), with a few exceptions (Duncan et al., 2009). That is, heavy drinkers (anywhere between two and four alcoholic drinks per day) have a higher risk of obesity in comparison to moderate drinkers (Yeomans, 2004). Most importantly, heavy, but less frequent drinkers (binge drinkers) appear to have higher risk of obesity compared to moderate but frequent drinkers (Oesterle et al., 2004). This is in consistent with many studies that have shown that youth who report binge drinking have a greater risk of being overweight or obese (Must, Bandini et al. 2008; Croezen, Visscher et al. 2009; Fonseca, Matos et al. 2009). However, there seems to be gender differences, with some studies indicating alcohol use to be significantly related to overweight/obesity among females only (Farhat, Iannotti & Bruce, 2010) and other studies indicating that males are at greater risk (Barry & Petry, 2009).

Furthermore, the association between alcohol consumption and obesity/overweight appears to be long-lasting. Individuals who reported higher levels of alcohol consumption and

binge drinking during their adolescence were found to be at higher risk of obesity and related health problems in their early adulthoods (Osterle, Hill, Hawkins, Guo, Catlano & Abbott, 2004). This disparity remained true even after controlling for their current frequency of episodic drinking at age 24, other drug use, ethnicity, gender and family poverty (Osterle, Hill, Hawkins, Guo, Catlano & Abbott, 2004)

Given that 25.5% of grade 9 to 12 students in Ontario are current binge drinkers, binge drinking is linked with numerous adverse behaviours and outcomes (Nelson, Lust, Story, Ehlinger, 2009; Flegal, MacDonald & Hebert, 2011), binge drinking appears to be associated with overweight/obesity, and most importantly, there is a lack of studies among Canadian Aboriginal youth, it is therefore necessary to examine the relationship between binge drinking and BMI within this population.

2.3.2.6 Bullying

Previous studies that have examined the association between bullying and BMI have typically found a positive relationship (Janssen, Craig, Boyce & Pickett, 2004; Griffiths, Wolke, Page & Horwood, 2006), where overweight and obese school-aged individuals are more likely to be victims of bullying in comparison to their normal-weight peers. However, the majority of the studies have demonstrated positive associations between adiposity level and victimization, and have not examined weight status and perpetrating bullying (Pearce, Boergers, & Prinstein, 2002). These studies also failed to look at various forms of aggression. One Canadian study examined a large sample of 11-16 year old youth and found that overweight and obese males and females are more likely to be victims and perpetrators of verbal, relationally and physical bulling compared to their normal-weight counterparts (Janssen, Craig, Boyce & Pickett, 2004). However, the association between adiposity level and victimization was seen in 11 to 16 year olds, whereas the

association between adiposity level and perpetrating bulling was only seen among the older 15 to 16 year olds. Therefore, the study underlined that overweight and obese adolescents have an increased vulnerability to bullying behaviours. They are not only more likely to be the victims of verbal bullying but they also more likely to be perpetrators of verbal bullying as well.

However, there seems to be gender differences. For example, the rates of victimization were greater among 11-to 14 year old boys but decreased among the 15 to 16 year old boys (Janssen, Craig, Boyce & Pickett, 2004). On the other hand, the association between BMI and victimization was independent of age among girls. On the whole, there appears to be an increase in victimization as BMI increases. This implies that the likelihood of victimization is lower among normal-weight adolescents than among overweight youth. Subsequently, the overweight youth had lower likelihood of victimization compared to obese youth. However, there was one exception within overweight and obese boys. That is, they were not more likely to be victimized than their normal-weight peers, but this may be due to the confounding of boys who may have a high BMI because of their increased muscle mass rather than because of increased fat.

Nonetheless, these results are a concern as Aboriginal youth generally tend to believe that a healthy body comes in all sizes. For instance, Gittelsohn et al. (1996) found that in comparison to the Non-Aboriginal population, Aboriginal youth in an Ojibawy-Cree community in Northern Canada felt that bigger body shapes were ideal, although they were expressed dissatisfaction with their own body shape. Another survey of 450 Canadian Aboriginal youth aged 12-19 in a First Nation community in Northern Canada found that larger female participants felt that a heavier body was healthy(Hanley et al.,2000). Therefore, this suggests that Aboriginal youth may have a greater acceptance of heavier body shapes. In fact, Aboriginal youth express that their culture holds different beliefs on body shape and size in comparison to the mainstream

White culture (Fleming et al., 2006)l. They felt that Aboriginal culture was more accepting of larger body weight and in certain cases even discouraged them from being skinny. However, they stated that due to this conflicting cultural belief, they experienced body image in a different way depending on whether they were living in the city or in the reserve. When they were in the city schools they felt larger, but when they were ion reserve, they felt skinnier.

Therefore, it is important to elucidate the association between bullying behaviours and BMI in Aboriginal youth and fill this gap in knowledge.

2.4 Summary of Literature Review

The lack of evidence exploring the individual and school characteristics of being overweight and obese specific to Canadian Aboriginal adolescents continues to represent an important gap in the literature. The literature suggests that there is evidence of association between some measures of the built environment and obesity, however there seems to be uncertainty due to conceptual and methodological challenges (Booth, Pinkston & Poston, 2005; Papas et al., 2007). Most importantly, past research has primarily focused on built environment characteristics associated with obesity-related factors (i.e. PA level, healthy eating) instead of the BMI measure, warranting the need for future research to examine BMI. Moreover, past research examining the link between built environment and adolescent BMI has typically focused on the built environment characteristics relative to the student's residences rather than their school location. With regards to individual-level characteristics, sedentary behaviour, particularly television watching, has been consistently related to overweight and obesity among youth. On the other hand, the link between the other individual characteristics and adolescent BMI appears to be inconsistent.

Chapter 3

Study rationale and research questions

3.1 Study rationale

The lack of evidence exploring how student level and school level characteristics are associated with an Aboriginal student's risk of being overweight and obese continues to represent an important gap in the literature. The extent to which obesity varies across schools is also important as it will help understand how much school-level factors could explain the variation in individual-level obesity. As previous studies have not simultaneously examined both individual and school characteristics of being overweight and obese specific to Aboriginal adolescents, it is difficult to determine which characteristics are most strongly related to excess weight among this high-risk population. Within such population groups it is impractical to address all factors concurrently and more realistic to at least focus on the most important factors initially. Such a comprehensive understanding of the individual-level and school-level characteristics of overweight and obesity can further assist in the development and tailoring of effective public health policies and preventative interventions intended to decrease adiposity among adolescents .

Given that adiposity among adolescents is an important public health priority in Canada and numerous adverse conditions are associated with excess weight, there is a critical need for research that examines both the individual-level and school-level determinants in vulnerable populations. The study findings should inform obesity and overweight prevention initiatives, policy planning and decision making. The short-term goal is to provide new knowledge and understanding to this crucial area of population health, and the long-term goal is for these study

implications to contribute to the improvement of healthy weight among the Canadian youth population.

3.2 Research Questions

This research project will answer the following questions:

1. What is the prevalence of (i) overweight and (ii) obesity among ORA students in COMPASS in grades 9- 12 based on self-reported height and weight?
2. Is the prevalence of (i) overweight and (ii) obesity significantly different among the ORA students than among non-Aboriginal students in COMPASS in grades 9- 12?
3. Is there significant between-school variability in (i) overweight or (ii) obesity among ORA students in COMPASS?
4. What school-level characteristics are associated with (i) overweight (ii) obesity among ORA students in COMPASS?
5. Controlling for school-level characteristics, what student-level characteristics are associated with (i) overweight (ii) obesity among ORA students in COMPASS?

3.3 Hypotheses

Based on the existing theoretical and empirical literature presented, five outcomes below are proposed following analysis of the data:

1. Consistent with the 2009 CCHS data which also used the classification cut-offs established by the WHO Growth Reference 2007 , I expect the prevalence of self-reported (i) overweight to be about 20% (ii) obesity to be about 7% among ORA students in COMPASS in grades 9- 12.

2. I expect to find a significantly higher prevalence of i) overweight and (ii) obesity among the ORA students than in the general students in COMPASS in grades 9- 12.
3. I expect to find a significant between-school variability in i) overweight or (ii) obesity among ORA students in COMPASS.
4. I expect to find significant associations between numerous school-level characteristics and (i) overweight (ii) obesity among ORA students in COMPASS.
5. I expect to find significant associations between numerous student-level characteristics and (i) overweight (ii) obesity among ORA students in COMPASS

Scientific and Public Health Significance

This study will be the first to examine both student-level and school-level determinants/predictors of overweight and obesity among a sample of ORA (ORA) youth, a high-risk population. Studies of excess weight and its determinants among the Aboriginal youth have an important role in informing public health initiatives. Although previous studies have examining individual characteristics associated with overweight and obesity among adolescents, little is known about how obesity varies by school characteristics among this population and if there is any discrepancy with their non-Aboriginal counterparts. This signifies a crucial gap for scientific, program development, policy-related, and decision-making purposes. Therefore, this study can be an important starting point in instigating further needed research focusing on this topic among the Aboriginal population.

This current study will improve our understanding of the association between school and student characteristics and adolescent weight status. In addition, this will contribute to the existing body of knowledge by identifying school- and student-level characteristics that could contribute to the development of effective school-based policies, programs and interventions to

improve weight status. Determining whether overweight and obesity clusters by specific school characteristics can help focus future attention and resources on mechanisms by which these factors contribute to excess weight among the general young population and the Aboriginal population. Subsequently, all of this will provide direction for future research examining the individual and school characteristics associated with adolescent weight status and help develop and tailor interventions that can target these specific characteristics to prevent and reduce excess weight among the Canadian adolescent population.

Chapter 4

Methods

4.1 Data sources

4.1.1 The COMPASS Study

COMPASS is a prospective cohort study designed to collect hierarchical longitudinal data from a convenience sample of secondary schools and the grade 9 to 12 students attending those schools in Ontario (Canada).The study examines how changes in school environment characteristics (policies, programs, built environment) are associated with changes in youth health behaviours. Additional information is available online (http://www.compass.uwaterloo.ca). Baseline data were collected during the 2012-13 school year between October 2012 and June 2013. At the school-level, a cohort of secondary schools will be followed over time where annual school data will be collected pertaining to the program and policy environment within a school, the built environment characteristics within a school, and the built environment characteristics in the community immediately surrounding a school (up to 1 km). At the student-level, the cohort of grade 9 to 12 students who attend the studied secondary schools will be followed over time where individual student data on obesity, healthy eating, PA, sedentary behaviour, tobacco use, alcohol and marijuana use, school connectedness, bullying, and academic achievement will be collected using scientifically supported measures. It involves a basic 2-level nested structure, where students (level-1) are nested within schools (level-2). Data collected from the COMPASS student questionnaire will be used at the student-level, and school-level data collected from COMPASS School Environment Application (Co-SEA) tool and DMTI Spatial will be used at the school-level.

4.1.1.1 School Board and School Recruitment

Since the COMPASS study is not designed to be provincially representative, Ontario

school boards and schools were purposefully selected in September 2012. Inclusion criteria at the board-level included being an English-speaking secondary school board that permits the use of active-information passive-consent parental permission protocols (additional details on the COMPASS consent procedures are available) (Thompson, Bredin & Leatherdale, 2013). Inclusion criteria at the school-level included being a secondary school with students in grades 9 through 12 with a student population of at least 100 students or greater per grade that permits the use of active-information passive-consent parental permission protocols. Of the 83 school boards in Ontario (Ontario Ministry of Education, 2012), 40 school boards were considered eligible for COMPASS based on our inclusion criteria. A COMPASS board recruitment package (package including an invitation letter, a project summary, a summary of consent procedures, copies of questionnaires, sample consent letters and forms, and a template feedback report) or the board specific research application package were sent to the 40 school boards. Six of the 19 Public school boards (representing 37 eligible Public schools) and 11 of the 21 Separate school boards (representing 51 eligible Secondary schools) agreed to participate. Of these 88 schools that were sent a COMPASS school recruitment package, 13 Public schools and 26 Separate schools agreed to participate (XX %). Boards and schools declined primarily due to either competing research demands or due to teacher labour issues at the time of recruitment. Private schools were also added at this phase of the recruitment for COMPASS since they are independently operated and do not have specific board jurisdiction. We identified and approached 23 eligible Private schools to participate of which four agreed to participate. This resulted in a final sample of 43 COMPASS secondary schools in Ontario at baseline. Baseline data collection was completed June 2013. In this study, the COMPASS baseline data (collected during the 2012-2013 school year) will be analyzed. Ethics approval was obtained from the Office of Research Ethnics,

University of Waterloo, and subject consent was obtained at the school board, parent, and student level. Additional information is available online ([http://www.compass.uwaterloo.ca).

4.1.1.2 Student-Level Recruitment

Consistent with the study protocol approved for funding from CIHR and the University of Waterloo Office Of Research Ethics, active-information passive-consent permission protocols were used in COMPASS. In this approach, the parent(s) or guardian(s) of an eligible student were mailed an information letter about the COMPASS study and were asked to either (a) call the COMPASS recruitment coordinator using the 1-800 phone number provided in the information letter, or (b) email the COMPASS recruitment coordinator using the COMPASS email address provided in the information letter should they not want their child to participate. All eligible students whose parent(s) or guardian(s) did not withdraw their child were deemed eligible to participate. At any time during the consent process or during the data collection, an eligible student was allowed to decline to participate or withdraw from the study. The methodological appropriateness and ethical considerations of passive consent for longitudinal school-based research examining substance use have been described previously (Thompson-Haile, Bredin & Leatherdale, 2013; White, Hill & Effendi, 2004; Hollmann & McNamara, 1999). The University of Waterloo Office of Research Ethics and appropriate School Board and Public Health Ethics committees approved all procedures.

At baseline, there were 29,433 students enrolled in the 43 COMPASS secondary schools. Overall, 82.1% (n=24,173) of eligible students completed the student questionnaire. Missing respondents resulted from absenteeism on the day of the survey (18.8%), student refusal (0.1%), and parental refusal (0.9%). Of the 29,433 students, 1305 were Aboriginal students.

4.1.2 Data collection methods and tools

Given the hierarchical nature of the data, the COMPASS Student Questionnaire (C_q) was used to collect the student-level data, and the COMPASS School Programs and Policies Questionnaire (SPP), the COMPASS School Environment Application (Co-SEA), and the COMPASS Built Environment Data (C-BED) were used to provide the school-level program, policy, and built environment data. This thesis will focus only on the data collected from the COMPASS Student Questionnaire (C_q), the COMPASS School Environment Application (Co-SEA), and the COMPASS Built Environment Data (C-BED).

4.1.2.1 Student-Level Data Source

4.1.2.1.1 COMPASS Student Questionnaire (C_q)

The student-level questionnaire for COMPASS (C_q) was designed to facilitate multiple school-based data collections consistent with previous research (Elton-Marshall et al., 2011; Leatherdale & Papadakis, 2011; Leatherdale et al., 2005). The 2012-2013 COMPASS student questionnaire is included in Appendix A. The C_q collects individual student data pertaining to obesity (height and weight to calculate body mass index [BMI]), sedentary behaviours, PA and evidence-based correlates of PA, healthy eating and diet, tobacco use, alcohol and marijuana use, bullying, academic outcomes, amount of sleep, and demographic characteristics (e.g., age, gender, income, ethnicity). The questionnaire was developed using validated self-report measures from previous SHAPES questionnaires to address the outcomes and correlates examined in this study (Wong, Leatherdale, & Manske, 2006). The questionnaire contained multiple choice questions in a 12-page machine-readable booklet. Survey items were specifically chosen to reflect both science-based (e.g., obesity) and practice-based (e.g., bullying) concerns (Leatherdale et al., 2014). Because the C_q collects data from large whole-school samples during class time, it was purposefully made short (12-pages allows it to be completed in one ~30-40min

class), and inexpensive (machine-readable forms). Previous studies have assessed the test-retest reliability and criterion validity of self-reported measures of PA and sedentary behaviours in the C_q (Leatherdale, Lazer & Fulkner, submitted) and the reliability and validity of the weight status and dietary intake measures in the C_q (Leatherale & Laxer , 2013) . They have found that the self-reported measures of PA, sedentary behaviours, diet and BMI in the C_q provided a reliable and sufficiently valid measures for use in large scale school-based research (Leatherdale, Laxer & Faulkner, submitted) and are consistent with measures used in national surveillance tools or to measure current national public health guidelines (CSEP, 2013a; CSEP, 2013b; Health Canada, 2013; Elton-Marshall et al., 2011). The cover page of the C_q contains measures required to create a unique self-generated code for each respondent in a school to ensure the anonymity of the survey participants while still allowing COMPASS researchers to link each student's unique identifier data over multiple years. Eligible students completed the C_q in class on the day of the scheduled data collection for their school at a time coordinated by COMPASS staff and school administration.

Teachers were provided with the detailed instructions for the implementation of the survey to ensure consistency and protect student confidentiality. Although participants were not provided compensation, the schools were given $200 honorarium annually to compensate for data collection costs in addition to a comprehensive and easy-to-read School Health Profile. This report outlines the prevalence of a wide variety of health-related behaviours at the participating school and was provided 8-10 weeks after data collection.

4.1.2.2 School-Level data sources

On the survey date, COMPASS staff recorded observations about the school's indoor and outdoor facilities including: gyms, and vending machines using the *COMPASS School*

Environment Application (Co-SEA) tool. Consistent with previous research (Leatherdale, Manske, Faulkner, Arbour & Bredin, 2010; Chan & Leatherdale, 2011; Leatherdale , Dubin & Hammond, 2012), the COMPASS staff subsequently used Digital Mapping *Digital Mapping Technologies Inc.* to determine characteristics of the built environment surrounding the school.

4.1.2.2.1 COMPASS School Environment Application (Co-SEA) tool

For collecting the within-school built environment data, the COMPASS study used the *COMPASS School Environment Application (Co-SEA) tool.* This is a direct observation tool the COMPASS team developed to measure aspects of the built environment that are associated with obesity, eating behaviour, and PA (the student-behaviours that are the most influenced by the built environment within a school (Jones et al., 2010; Van der Horst et al., 2008).Co-SEA is a downloadable application for use on most mobile devices with an internal camera that: (a) contains an automated computer-based version of the previously validated audit measures from the ENDORSE study (measuring the school food environment) (Van der Horst et al., 2008), and the SPEEDY study (measuring the school PA environment) (Jones et al., 2010); (b) has the functionality of also being able to take pictures of the different observations being measured in the audit, and (c) automatically archives the photographs to the corresponding audit measures for future reference. COMPASS staff complete the Co-SEA audit on the same day as the COMPASS student-level data collection to measure the features of the build environment within the school pertaining to healthy eating and PA. Given that data collectors performing the within-school audits would also come across additional aspects of the built environment or facilities within a school that may be relevant for the other behaviours (e.g., smoking, alcohol or drug use) or issues (e.g., bullying) measured in COMPASS, Co-SEA was purposefully designed with the additional functionality of allowing the data collector to input additional miscellaneous

information via the hand held device's keyboard and to supplement that information with photographs. For instance, if prevention posters were located in the school (e.g., anti-bullying posters), they could be photographed and their location documented.

4.1.2.2.2 COMPASS Built Environment Data (C-BED)

Digital Mapping Technologies Inc. (DMTI) provides data on the built environment in the community environment surrounding each school using two geographic information system (GIS) data resources. The first DMTI Spatial data resource is CanMap RouteLogistics high quality street map data which includes information on: street road networks; road classifications including expressways, primary and secondary highways, major roads, local roads and trails; and, land use types including residential, industrial, institutional, parks and water bodies. The second DMTI Spatial data resource, which was used for this thesis, is the Enhanced Points of Interest (EPOI) 150 database of Canadian business and recreational points of interest, including: education facilities (e.g., schools and universities); golf courses; health care facilities (e.g., hospitals, dentist offices, etc.); police and fire stations; industrial facilities; food stores (e.g., grocery stores, mini-marts, alcohol and tobacco retailers); eating and drinking places (e.g. fast-food restaurants, bars); and, recreation facilities (e.g. fitness centres, movie theatres). For each participating school, a school-specific data file of these built environment data will be developed using three different buffer zones surrounding each school (1-km radius, 2-km radius, 5-km radius). The present study will use the data from the 2012-2013 EPOI file and use the 1-km radius buffer zone surrounding each school, as this is consistent with previous literature (Hobin et al.,2012; Leatherdale et al.,2011), and appears to best approximate the maximum distance that the majority of students would be able to actively commute to. Consistent with previous research (Pouliou and Elliott, 2010), the process of identifying and linking the DMTI built environment

data to 43 COMPASS schools involved the following three steps: (1) geocoding the address for each COMPASS school; (2) creating 1 km circular buffers (so the bounded areas surrounding each school in which the built environment structures were quantified); (3) linking the quantified built environment data for each school to the 1 km buffer. Arcview 3.3 (ESRI, 2002) software was used to geocode the school addresses and to create the 1 km buffers).Further information about DMTI-EPOI is available online (www.dmtispatial.com).

4.2 Measures

The following sections describe the response and explanatory variables of interest and the coding of these variables.

4.2.1 Response variables

Overweight and obesity: Consistent with research (Leatherdale & Papadakis, 2009), Body Mass Index (BMI) will be determined using previously validated (Leatherdale & Laxer, 2013) self-report measures of weight (kg) and height (m) (BMI=kg/m^2). Weight status was then determined using the BMI classification system of the WHO based on age and sex adjusted BMI-cut points (de Onis et al., 2007). Consistent with the WHO Growth Reference 2007 and Canadian Health Measures Survey (which now uses the WHO references), the following cut-offs will be used for the classification of weight status (de Onis et al.,2007;Statistics Canada, 2013) : less than or equal to 2 standard deviations below the mean to classify thinness, greater than 2 standard deviations below the mean and less than or equal to 1 standard deviation above the mean to classify normal weight, greater than 1 standard deviation and less than or equal to 2 standard deviations above the mean to classify overweight, and greater than 2 standard deviations above the mean to classify obesity. BMI was coded as missing (in SAS = .) if a

student was missing his/her height or weight data. Missing BMI was also excluded when calculating prevalence.

4.2.2 School-level explanatory variables

Co-SEA Data from the 2012-2013 will provide the within-school built environment measures as follows:

Food environment within school:

- *Number of Beverage vending machines*

- *Number of Food vending machines*

- *Presence of Healthy eating promotional materials (i.e., posters)*

Physical activity environment within school:

-Number of PA facilities (gym, fitness/weight room, squash court, swimming pool, dance studio, ice rink, fields, running track, baseball diamond, tennis courts, basketball court, rowing facilities, beach volley ball courts)

Consistent with previous research, data from the 2012-2013 EPOI file will provide:

Food environment surrounding school:

- *The number of fast-food restaurants within 1 km of the school (eating places)*

- *The number of convenience stores within 1 km of the school (variety stores)*

- *The number of grocery stores within 1 km of the school (grocery stores)*

Physical activity environment surrounding school:

--*The number of recreational facilities (including dance studios, fitness gym facilities, parks, sports and recreation clubs and golf course) within 1 km of the school*

4.2.3 Student-level explanatory variables

The COMPASS survey also collects sociodemographic and behavioural information which was used to determine student-level characteristics associated with overweight and obesity. Detailed information about each student-level characteristic is outlined below.

4.2.3.1 Sociodemographic characteristics

Gender: One question on the COMPASS questionnaire asked about gender: "Are you a female or male?" followed by a female and male response option. Respondents that selected "female" will be coded as "0" and act as the reference group, while those that selected "male" will be coded as "1".

Ethnicity: One question on the COMPASS questionnaire asked about ethnicity: "How would you describe yourself? (Mark all that apply)" followed by a list of ethnicities. Based on the number of students that selected each response, respondents that selected "White", "Black", "Asian", "Latin American/Hispanic", and "Other" will be coded as "O" and act as the reference group. Respondents that selected "Aboriginal (first Nations, Metis, and Inuit)" will be coded as 1.

Socioeconomic status: One question on the COMPASS questionnaire asked : "About how much money do you usually get each week to spend on yourself or to save?" followed by a list of options ($0,$1-5,$6-10,$11-20,$21-40,$41-100,more than $100, or don't know how much). Consistent with Elton-Marshall, Leatherdale & Burkhalter (2011), this will be used as a proxy measure for socioeconomic status. Respondents that selected "$0" will be coded as "0" and act as the reference group.

4.2.3.2 Behavioural characteristics

Physical activity: PA will be based on our validated self-reported measure of energy expenditure (KKD) (Leatherdale, Laxer & Faulkner, submitted). Question 11 and 12 on the

COMPASS questionnaire asked: "Mark how many minutes of vigorous PA (VPA) and moderate PA (MPA) you did on each of the last 7 days". Vigorous physical activities included jogging, team sports, fast dancing, jump-rope and any other physical activities that increased heart rate and made one breathe hard and sweat. Moderate physical activities include lower intensity activities such as walking, biking to school, and recreational swimming. The average KKD expended, assuming that the standard metabolic equivalent (MET) for VPA is 6 and MPA is 3, will be calculated as: KKD= [(Hours of VPA*6MET) + (Hours of MPA*3MET)]/7 days.

Diet: The COMPASS questionnaire asks four questions to measure respondent consumption of the four food groups outlined in the Canada Food Guide. However, only the serving of vegetables and fruits will be focused in this present study. Respondents were asked to report: "Yesterday, from the time you woke up until the time you went to bed, how many servings of vegetables and fruits did you have? *One 'Food Guide' serving of vegetables and fruit includes 125ml (1/2 cup) of fresh vegetable or fruit, salad or raw leafy greens, cooked leafy green vegetables, dried or canned or frozen fruit, and 100% fruit or vegetable juice.* Canada's Food Guide serving sizes of vegetables and fruits were made apparent from the picture caption on the questionnaire. The responses will be used as a continuous measure of servings given that the majority of Canadian youth do not meet the minimum number of fruit and vegetable servings (7 for females, and 8 for males). If the responses were classified as meeting the food guide recommendations based on the minimum number of servings, respondents that selected 6 or less for females and 7 or less for males will be coded as "0" and act as the reference group. Whereas, those that met the recommended minimum number of servings according to sex will be coded as "1". As majority of Canadian youth do not meet the minimum number of servings, the majority of the students would have been all classified into the reference group (despite as little as 1 to as

many as 7 or 8 depending on gender). Therefore, the continuous variable, the average number of fruit and vegetable servings per day was used for this study.

Sedentary Behaviour: One question on the COMPASS questionnaire asked about sedentary behaviour: "How much time per day do you usually spend doing the following activities?" followed by a list of relevant sedentary activities. Consistent with Leatherdale, Faulkner and Arbour- Nicitopoulos, the average screen time per day will be calculated based on the average time reported during the previous week for each construct. Consistent with previous research and national guidelines, (American Academy of Pediatrics, 2001; Wong and Leatherdale, 2009; Kurc & Leatherdale, 2009) the responses will be grouped into 3 categories: less than 1 hour per day (low screen time), 1 to 3 hours per day (moderate screen time), and more than 3 hours per day (high screen time). Respondents that were categorized into "less than 1 hour per day (low screen time)" were coded as "0" and acted as the reference group. Respondents that were categorized into "1 to 3 hours per day (moderate screen time) "were coded as "1". Respondents that selected "more than 3 hours per day (high screen time)" were coded as "2".

Smoking Behaviour: Consistent with previous research (Leatherdale & Rynard, 2013; Kaai, Leatherdale, Manske, & Brown, 2013; Youth Smoking Survey, 2010) and Health Canada`s definition of smoking status (2008), a current smoking is one who has smoked at least 100 cigarettes in his or her lifetime and has smoked at least one whole cigarette in the past 30 days. Among students who reported smoking 100 or more cigarettes in his or her life , those respondents who selected smoking "none" on the last 30 days will be coded "0" and acted as the reference group, while those who smoked cigarettes on at least 1 on the last 30 days will be considered as current smokers and be coded as "1".

Alcohol Use : Consistent with previous research (Leatherdale & Rynard, 2013), binge drinking (5 or more drinks on one occasion) alcohol use was assessed by asking the " In the last 12 months, how often did you have 5 drinks of alcohol or more on one occasion?". Those who reported binge drinking once a month or more were classified as current binge drinkers.

Bullying: In the last 30 days, how often have you been bullied by other students? Those who reported "I have not been bullied by other students in the last 30 days" and "less than once a week" will be coded as "0" and act as the reference group. Those who selected "about once a week", "2 or 3 times a week" and "daily or almost daily" will be coded as "1". Partaking in bullying was assessed by asking "In the last 30 days, how often have you taken part in bullying other students?" Those who reported "I did not bully other students in the last 30 days", "Less than once a week" will be coded as "0" and act as the reference group. Those who selected "About once a week", "2 or 3 times a week" and "Daily or almost daily" will be coded as "1".

Chapter 5

Statistical analysis

5.1 Descriptive Statistics

The following sections outline the descriptive statistics and the significance tests that will be conducted.

5.1.1 Descriptive Statistics for relevant student-level characteristics

Using student-level COMPASS data, the prevalence of (i) overweight and (ii) obesity among ORA youth will be calculated. To test for differences between Aboriginal youth and non-Aboriginal youth in COMPASS (and for differences by sex), a chi-square test will be used. The *t* tests will be used to determine the difference in the prevalence of overweight and obesity between ORA and non-ORA youth. These results will be used to answer research question 2.

5.2 Regression Analyses among Aboriginal youth

The analysis will use multilevel data collected from students (level 1, micro-level) nested within schools (level 2, macro-level) and a series of multi-level logistic regression analyses will be performed to examine the student –and school-level factors associated with being (i) overweight (ii) obese within this hierarchical data structure. Whenever there is a possibility that observations are cluttered into macro-level units, multilevel analyses will provide numerous advantages to multiple logistic regression analysis (Guo & Zhao, 2000). First of all, multilevel analyses will provide a systematic framework to examine how macro-level characteristics

influence a response at the micro-level (Guo & Zhao, 200). Moreover, multilevel models provide more precise parameter estimates, standard errors, confidence intervals and significance tests as they account for clustering within the data (Guo & Zhao, 2000). Most importantly, multilevel analyses provide estimates for the amount of variation that is attributable to each level of the data (Guo & Zhao, 2 000).Given that schools are a potential source of variability, it is crucial to initially determine whether BMI is variable across schools. If such school-level variability exists, it indicates that the student responses are not independent within a single school, implying that the characteristics of the school environment influence students such that they are more similar to each other (Guo & Zhao, 2000; Snijders & Bosker, 1999). Therefore, multiple logistic regression analyses will not be appropriate due to the multilevel nature of the data and multilevel logistic regression analyses will be performed to first determine the association between (i) overweight (ii) obesity and school – level characteristics, followed by the addition of student-level characteristics.

5.2.1 Multilevel regression analyses for the association between school- and student-level characteristics and BMI

Due to the hierarchical nature of these data (students nested within schools), a multilevel regression analysis will be used to evaluate the degree to which school environment variables associate with student BMI while controlling for student-level variables. Consistent with previous research (Elliott et al, 1993; Loucaides et al.2007; Leatherdale et al, 2005a; Leatherdale et al, 2005b; Murnaghan et al, 2007; Leatherdale et al, 2010), a three-step modelling procedure will be used. For step 1, a multilevel logistic regression model will be used to determine if the variability in students' BMI is random or fixed across schools. The school-level variance term from Step 1 (symbol) will be used to calculate the intraclass correlation (ICC), where the ICC represents the proportion of the total variance in student BMI that is due to differences across

schools. An ICC value that is close to 1 will indicate that the variability between individuals within a group is low, implying that individuals within a group are very similar to each other and school-level characteristics are important predictors of behaviour. On the other hand, an ICC value that is close to 0 will indicate that the variability between individuals within a group is high, implying that individuals within a group are not very similar to each other and student-level characteristics are important predictors of behaviour. The formula that will be used to calculate the ICC for these binomial variables is illustrated in Figure 1. The ICC will be used to answer research question 3.

In step 2, a series of univariate analyses will be performed to examine if each school-level variable is independently associated with students' BMI. Step 3 will investigate association between school-and student-level characteristics and BMI while modelling for between-school random variation using PROC GLIMMIX in SAS. Multivariate models will be developed using a blockwise modeling approach. Order of entering into the regression model will be based on ecological frameworks, where the multilevel factors influence BMI from the proximal factors (the student characteristics) to the more distal factor school environment variables). However, only the factors that will be identified as significant in Step 2 and at the $p<0.05$ level within the block will be retained in the multivariate analysis. This three step modelling process will be used to identify school-and student-level characteristics associated with (i) overweight (ii) obesity. Results of steps 2 and 3 will answer research question 4 and 5. Analyses will be conducted using PROC GLIMMIX in SAS version 9.2.

In order to address missing data, a sensitivity test will be conducted as ignoring the missing data especially if the missing data are not random can lead to biased inferences.

$$\rho_I = \frac{population\ variance\ between\ macro-units}{total\ variance} = \frac{\sigma_{\mu 0}^2}{\sigma_{\mu 0}^2 + \frac{\pi^2}{3}}$$

Figure 1: Formula to calculate the intraclass correlation coefficient for binomial variables

Chapter 6

Results

6.1 Descriptive Statistics

The following sections present the descriptive results for relevant student-level characteristics. The final sample consisted of 24 173 students in grades 9 to 12 from 43 secondary schools in Ontario after excluding missing BMI values.

6.1.1 Student-level Descriptive statistics

Sample characteristics are presented in Table 1. The sample was 94.6% non-Aboriginal (n=22869) and 5.4 % ORA (n=1304). There were ORA students present in all 43 of the schools, with the range of students per school being 3 to 150. Almost two thirds of the ORA youth in COMPASS were normal weight (66.2%), under a third were in grade nine (30.3%), two-thirds reported moderate screen time (68.7%), and most were never smokers (83.6%). There were significant ethnic differences with respect to all of the student-level characteristics, except KKD. ORA youth were more likely than non-Aboriginal youth to be binge drinkers (X^2=42.0, df=1, p<0.001), to have been bullied (X^2=13.3, df=1, p<0.001) and to have bullied others (X^2=13.2, df=1, p<0.001). More ORA youth than non-Aboriginal youth were current smokers (X^2=208.5, df=2, p<0.001) and had high screen time (X^2=33.9, df=2, p<0.001).The average number of sugar drinks per week was higher among ORA youth (2.06, ±1.76) than among non-Aboriginal youth

(1.79, ±1.75; *H*=34.0, p<0.001). The average number of fruit and vegetable servings per day was higher among non-Aboriginal youth (3.18, ±2.06) than among ORA youth (3.06, ±2.17; *H*=6.4, p=0.011). The average KKD was 11.51 (±16.08) among non-Aboriginal youth and 10.17 (±7.88) among ORA youth, however, the difference was not significant at the 0.05 level (*H*=0.4, p=0.542). See Appendix B Figure 2 and 3 for weekly consumption of sugar drinks and daily serving(s) of fruit and vegetable in grades 9-12 by Aboriginal status in COMPASS (Ontario, Canada, 2012-2013).

Table 1: Descriptive statistics for youth in grades 9-12 by Aboriginal status in COMPASS (Ontario, Canada, 2012-2013)

Student-level Characteristics	**Aboriginal (n=1304) % (n)**	**Non-Aboriginal (n=22869) % (n)**	**Chi square/ H-statistic**
Weight status			
Underweight	1.4 (13)	1.8(328)	X^2=39.4, df=3, P<0.001
Normal weight	66.2 (615)	73.0(13015)	
Overweight	19.7(183)	17.5(3126)	
Obese	12.9 (120)	7.7 (1369)	
Missing	28.6(373)	22.0(5031)	
Grade			
Grade 9	30.3(394)	26.0(5911)	X^2=15.7, df=3, P<0.001
Grade 10	25.8(335)	25.7(5844)	
Grade 11	23.5(306)	24.5(5588)	
Grade 12	20.4(265)	23.9(5434)	
Screen time			
Low	3.9(51)	2.4(552)	X^2=33.9, df=2, P<0.001
Moderate	68.7(890	75.5(17174)	
High	27.4(355)	22.1(5035)	
Smoking status			
Current smoker	14.7(191)	5.4(1224)	X^2=208.5, df=2, P<0.001
Former smoker	1.8(23)	0.8(188)	
Never smoker	83.6(1090)	93.8(21457)	
Alcohol status			
Non-binge drinker	69.1(896)	76.9 (17522)	X^2=42.0, df=1, P<0.001
Binge drinker	30.9(401)	23.1(5259)	

Spending money			
Zero	14.1(181)	15.9(3594)	X^2=20.1,df=7, P<0.005
1-5 dollars	6.3(81)	6.6(1501)	
6-10 dollars	8.5(109)	8.4(1906)	
11 to 20 dollars	15.2(196)	15.6(3532)	
21 to 40 dollars	17.0(219)	13.2(2995)	
41 to 100 dollars	14.7(189)	13.6(3072)	
> 100 dollars	13.4(173)	14.4(3253)	
I do not know	10.9(140)	12.4(2817)	
Been bullied			
No	78.4(988)	82.4(18333)	X^2=13.3, df=1, P<0.001
Yes	21.7(273)	17.6(3920)	
Bullied others			
No	85.9(1082)	89.2(19819)	X^2=13.2,df=1, P<0.001
Yes	14.1(177)	10.8(2392)	
	Mean (SD)	Mean (SD)	
Consumption of Sugar Drinks			
Average number of days per week[a]	2.1(1.8)	1.8(1.8)	H=34.0, df=1, P<0.001
Physical Activity			
Average KKD[a]	10.2(7.9)	11.5(16.1)	H=0.4, df=1, P=0.542
Fruit and vegetable intake			
Average number of fruit and vegetable servings per day[a]	3.1(2.2)	3.2(2.1)	H=6.4, df=1, P=0.011
****Missing values were excluded from the denominator**			

[a]Kruskal-Wallis Test

*Mean (SD) presented for continuous variables

6.1.1.1 Descriptive statistics by ethnicity (ORA vs. non-ORA)

As presented in Table 1, 19.7 % (n=183) and 12.9% (n=120) of ORA youth were overweight and obese respectively, while 17.5% (n=3126) and 7.7% (n=1369) of non-Aboriginal youth were overweight and obese respectively. While 73.0% (n=13015) of non-Aboriginal youth were normal weight, 66.2% (n=615) of ORA youth were normal weight. Missing BMI data accounted for 28.6% (n=373) and 22.0 % (n=5031) among ORA and non-Aboriginal students

respectively. As shown in Table 1, ORA youth were more likely to be overweight or obese compared to non-Aboriginal students (X^2=39.4, df=3, p<0.001).

6.1.1.2 Descriptive statistics among ORA by gender (female vs. male)

Table 2 presents the gender-specific sample characteristics of ORA in COMPASS. Among ORA youth, 50.3% were females (n=646) and 49.7% were males (n=639). There was a small difference in missing BMI data between ORA males and females, with 26.3% (n=168) and 28.8 %(n=186) of missing BMI data respectively. Females were more likely than males to been bullied (X^2=14.2, df=1, p<0.001), and less likely to have partaken in bullying others (X^2=8.0, df=1, p<0.0047). Males were more likely to be overweight or obese compared to females (X^2=17.6, df=3, p<0.001). The average number of sugar drinks per week was higher among males (2.24, ±1.79) than among females (1.88, ±1.71; *H*=13.2, p<0.001). The average number of fruits and vegetable servings per day was also higher among males (3.25, ±2.31) than among females (2.89, ±1.99; *H*=4.9, p=0.027). The average KKD was higher among males (11.64, ±8.91) than among females (8.71, ±6.33; *H*=37.7, p<0.001).

Table 2: Descriptive statistics for ORA youth in grades 9-12 by gender in COMPASS (Ontario, Canada, 2012-2013)

Student-level Characteristics	Female (n=646) % (n)	Male (n=639) % (n)	Chi square/ H-statistic
Weight status			
Underweight	1.5(7)	1.3(6)	X^2=17.6,df=3, P<0.001
Normal weight	71.1(327)	61.2(288)	
Overweight	18.9(87)	20.4 (96)	
Obese	8.5(39)	17.2(81)	
Missing	28.8(186)	26.3(168)	
Grade			
Grade 9	29.6(191)	31.4(200)	X^2=2.5,df=3, P<0.481
Grade 10	27.8(179)	24.0(153)	

Grade 11	23.3(150)	23.8(152)	
Grade 12	19.4(125)	20.9(133)	
Screen time			
Low	3.3(21)	4.4(28)	X^2=5.8,df=2, P<0.054
Moderate	66.6(429)	71.1(451)	
High	30.1(194)	24.5(155)	
Smoking status			
Current smoker	13.6(88)	15.7(100)	X^2=1.6,df=2, P<0.456
Former smoker	1.6(10)	2.0(13)	
Never smoker	84.8(548)	82.3(526)	
Alcohol status			
Non-binge drinker	69.2(445)	69.3(440)	X^2=0.0011, df=1, P=0.974
Binge drinker	30.8(198)	30.7(195)	
Spending money			
Zero	12.5(80)	15.9(97)	X^2=22.4,df=7, P<0.002
1-5 dollars	6.6(42)	6.0(38)	
6-10 dollars	8.4(54)	8.6(54)	
11 to 20 dollars	16.4(105)	14.3 (90)	
21 to 40 dollars	19.5(125)	14.7(92)	
41 to 100 dollars	16.0(103)	13.0(82)	
> 100 dollars	9.5(61)	16.9(106)	
I do not know	11.1(71)	11.0(69)	
Been bullied			
No	74.0(464)	82.8(510)	X^2=14.1,df=1, P<0.001
Yes	26.0(163)	17.2(106)	
Bullied others			
No	88.8(556)	83.3(512)	X^2=8.0, df=1, P<0.005
Yes	11.2(70)	16.8(103)	
	Mean (SD)	Mean (SD)	
Consumption of Sugar Drinks			
Average number of days per week[a]	1.9(1.7)	2.2(1.8)	H=13.2, df=1, P<0.001
Physical Activity			
Average KKD[a]	8.7(6.3)	11.6(8.9)	H=37.7, df=1, P<0.001
Fruit and vegetable intake			
Average number of fruit and vegetable servings per day[a]	2.9(2.0)	3.3(2.3)	H=4.9, df=1, P=0.027
****Missing values were excluded from the denominator**			

[a]Kruskal-Wallis Test

*Mean (SD) presented for continuous variables

6.2 Intraclass correlation coefficients for overweight and obesity among ORA

Table 3 presents a summary of the intraclass correlation coefficients for the likelihood of an ORA youth being overweight and obese. As shown in Table 3, the variance of the random effect was 0.0027 ([SE] ± 0.0484) for overweight and 0.0346 (standard error [SE] ± 0.0841) for obesity. The pseudo intraclass correlation (ICC) coefficient was then estimated based on the Snijders-Bosker (2012) formula shown in Figure 1 as ICC= $\sigma^2_{\mu 0}$ / ($\sigma^2_{\mu 0}$ +3.29) = 0.0001 for overweight and 0.0101 for obesity. This suggests that school-level differences only accounted for 0.1 % of the variability in overweight and 1.0% of the variability in obesity among this specific COMPASS ORA sample. The insignificant ICCs suggested that the multi-level models examining school-level characteristics are not required as there is no significant school-level variance to explain. See Appendix B Table 4 for descriptive statistics of the school-level characteristics for the 43 COMPASS schools.

Table 3: Intraclass correlation coefficients for overweight and obesity, among ORA students (grades 9-12), 2012-2013 COMPASS Survey, Ontario

Weight Status	**$\sigma^2_{\mu 0}$**	**Intraclass Correlation Coefficient**
Overweight	0.00 (0.05)	0.00
Obesity	0.03 (0.08)	0.01

[a]All models based on data from 43 secondary schools

Given that there was no significant between-school variability identified for being overweight or being obese among this COMPASS ORA youth sample , logistic regression with student-level data were used. All potential predictors associated with weight status were entered into the model as independent variables and (i) overweight (=1) (ii) obesity (=1) was the dependent variable. The important predictors in the final model had to be significant at the $p<0.05$ level. Hosmer and Lemeshow goodness-of-fit tests were then applied to assess the

goodness of fit of the models. The results of the Hosmer and Lemeshow tests indicated that there is no evidence of a lack of fit in the selected models for overweight (p=0.6563) and obesity (p=0.7859).

6.3 Logistic regression model results for relevant student-level characteristics associated with overweight and obesity among ORA

Table 5 presents the results of the logistic regression analyses examining overweight (Model 1), and obesity (Model 2) among ORA respondents in grades 9 to 12 in COMPASS. As shown in Model 1 (Table 5), none of the student-level factors were significant at the 0.05 level. As shown in Model 2 (Table 5), male ORA students were more likely than female ORA students to be obese (OR 2.54, 95% CI 1.57-4.10). For every one unit increase in KKD, the odds of being obese (versus normal weight) decreased (refer to Figure 4).

Figure 4: Relationship between KKD and the predicted probability of being obese, among ORA students (grades 9-12), 2012-2013 COMPASS Survey, Ontario

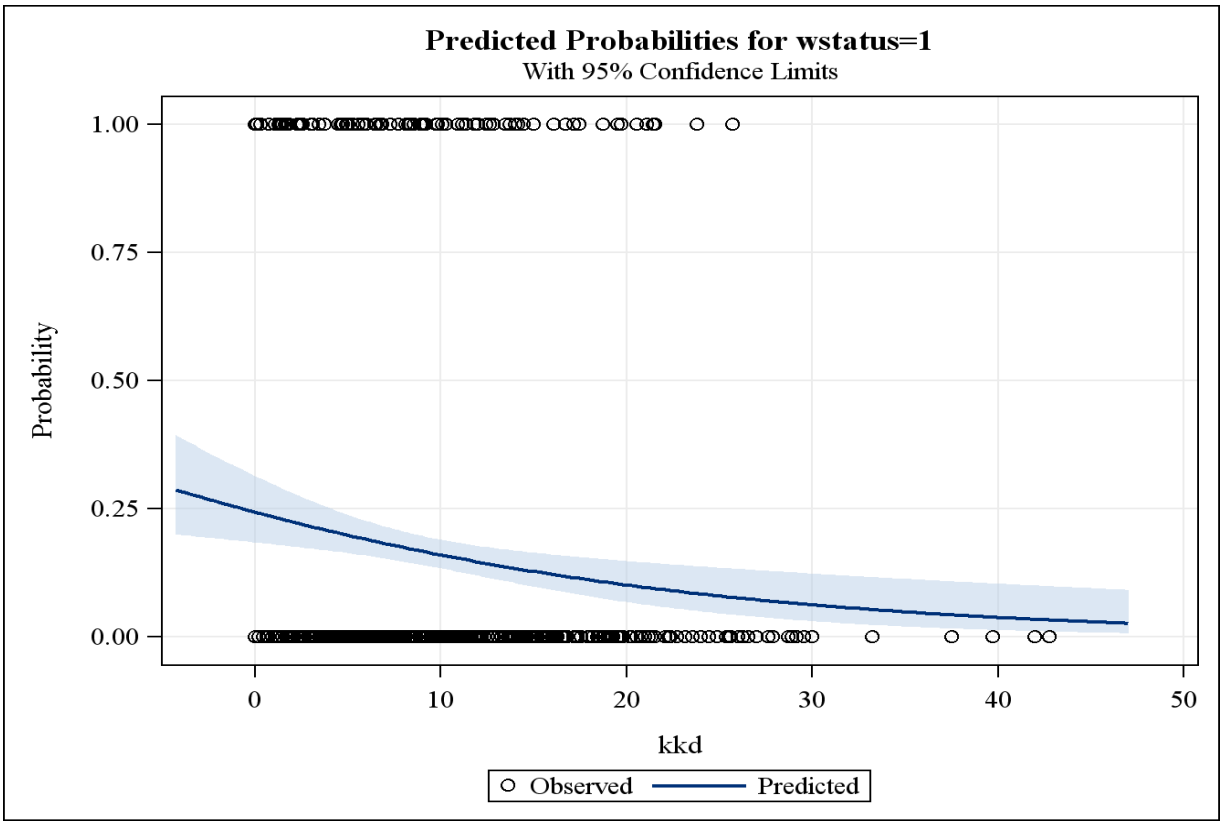


Table 5: Logistic regression analyses examining student-level factors associated with overweight and obesity among ORA in grades 9 to 12 in COMPASS (Ontario, Canada, 2012-2013)

Parameters		**Adjusted Odds Ratio[a] (95% CI)** Model 1 **Overweight vs. Normal Weight**	Model 2 **Obese vs. Normal Weight**
Student-level characteristics			
Sex			
	Female	1	1
	Male	1.29(0.88,1.90)	**2.54 (1.57,4.10)***
Grade			
	Grade 9	1	1
	Grade 10	0.86 (0.53,1.41)	0.79(0.45,1.40)
	Grade 11	0.82(0.48,1.38)	0.43(0.22,0.85)

	Grade 12	0.78(0.44,1.37)	0.54(0.27,1.06)
Alcohol Status			
	Non-binge drinker	1	1
	Binge drinker	1.03(0.68,1.55)	0.96(0.56,1.64)
Spending Money (per week)			
	Zero spending money	1	1
	1-5 dollars	1.46(0.59,3.63)	0.47(0.15,1.49)
	6-10 dollars	1.26(0.57,2.76)	0.25(0.08,0.82)
	11-20 dollars	1.15(0.55,2.38)	0.93 (0.43,1.99)
	21-40 dollars	1.25(0.61,2.55)	0.91 (0.43,1.94
	41-100 dollars	0.99(0.47,2.06)	0.56(0.24,1.29)
	More than 100 dollars	1.11(0.52,2.36)	0.87(0.38,2.01)
	Do not know	1.01(0.46,2.23)	0.68(0.28,1.63)
Screen time			
	Low	1	1
	Moderate	1.25(0.41,3.84)	0.65(0.21,1.98)
	High	1.71(0.54,5.47)	1.02(0.32,3.23)
Smoking Status			
	Never	1	1
	Former	0.55(0.12,2.65)	1.64 (0.41,6.62)
	Current	0.55(0.80,2.27)	1.10(0.57,2.14)
Bullied Others			
	No	1	1
	Yes	1.48(0.88,2.50)	1.42(0.73,2.77)
Been Bullied			
	No	1	1
	Yes	1.17(0.74,1.86)	0.99(0.54,1.82)
Fruit and Vegetable Intake		1.00(0.91,1.09)	0.99(0.89,1.10)
Sugar Drink(s)		1.00(0.90,1.11)	1.06(0.93,1.20)
KKD		1.00(0.98,1.03)	**0.93(0.90,0.97)***

Model 1: 1= overweight (n=159), 0= normal weight (n=552).

Model 2: 1=obese (n=106), 0=normal weight (n=552).

[a] Odds ratio adjusting for all other variables in the table

* p<0.05.

Chapter 7

Discussion

Aboriginal-specific investigations in weight status research are critical due to the well-established Aboriginal ethnic discrepancies in overweight and obesity among the Canadian youth population and the need to inform the development and targeting of effective and culturally appropriate programs and policies designed to prevent and reduce adiposity among ORA youth population. The primary purpose of this thesis was to characterize overweight and obesity in a sample of secondary school ORA youth in Ontario. The student and school-level characteristics associated with overweight and obesity were examined, and the prevalence of overweight and obesity among ORA youth in the sample of secondary schools in Ontario was examined.

7.1 Overweight and obesity among ORA students (grades 9-12)

The present study identified that, even though many of the ORA students in our sample were considered a healthy body weight, it was apparent that a substantial number of ORA youth were overweight or obese. While the self-reported 2007/08 CCHS indicated that 6.7% of Aboriginal youth aged 12 to 17 were obese, our data revealed that a higher 12.9% of ORA youth being obese. According to the more recent 2009 CCHS, 20% of ORA youth were overweight (in comparison to 19.7% of ORA youth in this study sample) and 7% obese (Statistics Canada, 2009). It is important not to overlook however, that self-reported data underestimates overweight and obesity, and the prevalence may in fact be higher than indicated (Gorber, Shields, Tremblay & McDowell, 2008). Nonetheless, the self-reported measures for BMI in COMPASS have demonstrated validity (Leatherdale & Laxer, 2013), so these high rates of overweight and obesity identified are cause for concern.

As expected, significant differences in the rate of overweight and obesity between ORA and non-Aboriginal students were identified. Consistent with previous research (Shields,2006; Statistics Canada, 2013), we identified that ORA youth had higher rates of overweight and obesity in comparison to their non-Aboriginal counterparts, highlighting the need for healthy weight initiatives among ORA youth as an obesity prevention priority.

In this sample of ORA students, males were more likely to be overweight or obese than females. This is consistent with the results of previous research, that have found overweight and obesity to be higher among boys than girls (Tremblay et al, 2010; Leather dale et al., 2011; Gilliland et al, 2012; Janssen, Katzmarzyk, Boyce, King & Pickett , 2004; Leatherdale & Ismailovi,2010 ; Leatherdale & Papadakis 2009). Likewise, among ORA youth, males were more overweight than females (Statistics Canada, 2009). Past literature indicates that the prevalence of overweight and obesity being lower among girls may possibly be due to the reason that girls are more likely than boys to underreport body mass (Strauss, 1999; Brener et al., 2003). However, such gender biases in self-reported height and weight identified in past studies are unlikely among this study sample, as Leatherdale & Laxer (2013) demonstrated no significant differences in the concurrent validity of the COMPASS weight measures by sex. In fact, as illustrated in Table 2, there was very minimal difference in missing data between male and female ORA youth.

7.2 School-level characteristics associated with overweight and obesity among ORA (Grades 9-12)

A key finding of the study is that school-level differences did not account for a significant amount of the variability in being overweight (0.01%) or obese (1.0%) among this specific COMPASS ORA youth sample. This implies that ORA individuals within a school are

not very similar to each other and student-level characteristics may be more important predictors of weight status than school characteristics among this particular COMPASS youth sample. This finding is inconsistent with previous empirical research not specific to ORA youth which suggests that characteristics of the secondary school a student attends can have significant impact on their weight status (Leatherdale and Papadakis 2009; Veugelers et al., 2008; O'Malley et al., 2007; Singh et al., 2007). However, to the best of our knowledge, no other study has examined this among ORA secondary students and thus, no comparisons can be made. Additional investigations revealed that the ICC value among ORA was less than among the entire population and among only non-Aboriginals, further indicating the importance of the student-level factors being predictors of weight status among the ORA youth population. Nonetheless, as as this was the first study to examine this among ORA youth, future research needs to re-examine the issue using future COMPASS waves of data.

Given the significance of the school context for potentially impacting weight status among youth, this finding may be initially surprising. According to the ecological model, it is necessary to take a broader approach that not only examines individual characteristics but also the influential contexts in which the individual is situated in. It would not be merely individual characteristics or school characteristics alone that is influential, but rather the interplay of different factors simultaneously influencing weight status. Therefore, the ecological model helps interpret the present study findings, as the ecological data we examined in this study came from the school built environment and it is possible for the characteristics of other ecological contexts (such as the home environment) which may also be imperative to consider. Taking such an ecological approach this highlights the role of other ecological context (i.e. family/home/community environment) potentially being more important than the school for

weight status among ORA youth. This should be taken into account for future studies among ORA youth. Another possibility is that perhaps the school an ORA attended was not significantly associated with BMI, but rather with obesity-related factors such as PA or diet, which was beyond the scope of this study. For example, a vast number of studies have revealed relationships between the school built environment characteristics with student PA and diet (Nichol, Pickett, & Janssen, 2009;Institute of Medicine, 2009; Templeton, Marlette and Panemangalore, 2005; Harnack et al., 2000; Fein, Plotnikoff, Wild & Spence , 2004 ; Hobin et al., 2010). It is also possible that perhaps the students did not live close to the schools, thus depending on where they lived they may possibly be exposed to different neighbourhood and home built environments. However, the schools in COMPASS were distributed across the province, so they were not all in rural areas so this is unlikely. Although, it is also important to note that this sample consisted of secondary students, where their secondary school may likely be farther from their homes.

Therefore, since the school an ORA attended was not associated with their likelihood of overweight and obesity among this specific COMPASS sample, school-level factors were not examined in his study. Nonetheless, as this was the first study to examine these factors within ORA youth, a need exists for future multilevel studies with subsequent COMPASS data that considers the influence of school- and student-level characteristics among this population to further confirm these findings. It is also important to note however, although the between-school variability in overweight and obesity identified in this study appears modest, even small changes on large numbers of individuals can have substantial effects (Rose, 1985).

7.3 Student-level characteristics associated with overweight and obesity among ORA students (grades 9-12)

Further investigation indicated that PA was a significant predictor of obesity among the sample of secondary school ORA youth in COMPASS. This finding is consistent with previous research demonstrating physical activity to be a predictor of obesity among Aboriginal adolescents (Katzmarzk, 2008; Ng, Young & Corey, 2010 ;) as well as among non-Aboriginal youth (Janssen, Katzmarzyk, Boyce, King, & Pickett, 2004). However, unlike Ng, Young & Corey (2010), we did not find PA participation to be higher among ORA students than non-Aboriginal students. Ng, Young & Corey (2010) also found that PA was an important predictor of obesity only among Aboriginal Canadian youth. Contrary to our expectations, although ORA youth were more overweight and obese than their non-Aboriginal counterparts in this study, there was no significant difference in energy expenditure via PA between the two groups. Therefore, this new insight suggests that PA may influence Aboriginal weight status in a differential manner than among non-Aboriginals. However, this must be interpreted with caution and future studies need to confirm this.

Furthermore, although male ORA were more overweight and obese than their female-counterparts, PA was higher among ORA males than ORA females. Therefore, as suggested by these study findings, there may be gender and ethnic differences in the way weight status interacts with PA among youth (Hobin et al., 2012; Belcher, Berrigan, Dodd, Emken, Chou, & Spuijt-Metz, 2010). Past evidence demonstrates gender differences among high school students in Ontario, where overweight and obese females were not significantly less active compared to their normal weight counterparts (Hobin et al., 2012). Previous studies also suggest that these ethnic differences may be due to factors such as genetic predisposition to obesity, socioeconomic status, and cultural variations in behaviour (Belcher et al., 2010; Yang, Kelly, & He, 2007). Given the findings of this study indicate no significant difference in PA between ORA and non-

Aboriginal youth, yet ORA students were more overweight and obese than ORA students, and PA was associated with obesity among ORA youth, it is apparent that school PA promotion initiatives should be designed to address the needs of ORA youth and ensure interventions are culturally appropriate to this vulnerable group.

7.4 Additional findings

In addition to answering the primary research questions, the study results revealed further important findings. For instance, consistent with Elton-Marshall, Leatherdale & Burkhalter (2011), this study highlighted that ORA youth in Canada are at significantly increased health risk due to their behavioural profile in comparison to their non-Aboriginal counterparts. ORA youth were more likely than non-Aboriginal youth to be current smokers, to engage in binge drinking, to have been bullied, to have bullied others, have high screen time, consume higher number of sugar drinks weekly, and consume lower number of fruit and vegetable servings per day. However, in contrast to Elton-Marshall, Leatherdale & Burkhalter (2011), female ORA did not appear to be at increased risk for smoking and alcohol use compared to their male counterparts. This maybe because female ORA were not older on average than male ORA within this study sample. Whereas in their ORA sample, females were older than males on average and adolescents take part in more risky behaviours as they get older.

Additionally, it is apparent from the study findings that both ORA and non-Aboriginal youth in the sample did not meet Canada's dietary recommendations for fruit and vegetable servings per day. The sample consumed on average about three servings of fruit and vegetables per day, considerably less than the recommended minimum number of servings (seven for females, and eight for males). This is in line with previous research that have also found Canadian youth reporting inadequate fruit and vegetable consumption (Leatherdale & Rynard,

2013; Leatherdale & Laxer, 2013; Janssen, Katzmarzyk, Boyce, King, & Pickett, 2004). The insufficient fruit and vegetable consumption among ORA youth in this study is similar to those reported for other off-reserve and on-reserve Aboriginal populations (Gates, Hanning, Gates, Skinner, Martin, & Tsuji, 2012; Shields, 2006; Di Noia, Shinke, & Contento, 2005). Although, a significant association was not found between fruit and vegetable consumption and overweight and obesity, this is possibly because individuals who are overweight and obese are more likely than their normal weight counterparts to misreport food intake (Garaulet et al., 2000; Heitmann & Lissner, 1995). However, considering that evidence has previously demonstrated that the intake of fruit and vegetable of both off-reserve and on-reserve Aboriginal youth are lower than non-Aboriginal youth (Gates, Hanning, Gates, Skinner, Martin, & Tsuji, 2012; Ng, Young & Corey, 2010), and our data indicated comparable findings, this highlights the importance of tailoring prevention interventions that are also culturally appropriate and address the specific needs of Aboriginal students who appear to be at the greatest risk.

Although Canadian Aboriginals are the fastest growing population and are much younger than rest of the Canadian population, there is a lack of research on the health risk behaviours among Aboriginal youth in this country. The study findings illustrate that similar to previous studies on Aboriginals living on-reserve, ORA youth are at increased health risk as well. In fact, as suggested by these findings, it is apparent they are even more so than their non-Aboriginal counterparts.

7.5 Study strengths

The present study has several notable strengths. First, this study explored the influence of both student- and school-level characteristics with weight status among ORA youth, a novel area of research. As earlier studies did not look at both individual and school characteristics

simultaneously, the associations seen in these studies may have been influenced by confounding. This study investigated associations not yet examined among ORA Canadian youth - the consideration of both student- and school-level characteristics with overweight and obesity. To our knowledge, this is the first study to examine individual and school characteristics associated with overweight and obesity specific to Canadian ORA youth. Considering that there is little evidence among Canadian ORA youth and there is even less evidence simultaneously examining how student-level and school level characteristics are associated with weight status, the findings provide new and valuable preliminary insight. Additionally, this study not only provided information on the recent trends of weight status outcomes among off-reserve Canadian Aboriginal youth, but also allowed direct comparisons with the non-Aboriginal population. This is constructive in providing the Canadian context for health-related and lifestyle behaviours, and helps demonstrate the magnitude of disparities that Aboriginal Canadians are disproportionately challenged with (Tjepkema, 2002). The differences recognized can be utilized to establish specific targets for improvement.

Another strength is that COMPASS used an active-information passive-consent permission protocols for student-level recruitment. This helps ensures that the population in a school is representative.

Finally, the questions on COMPASS allowed valuable assessment of important issues of concern. Unlike previous studies that asked about the number of times of fruit and vegetables were consumed per day, the COMPASS question asked about the portion size/servings, therefore permitting the sample's compliance with the daily fruit and vegetable intake recommendation by Canada's Food Guide to be assessed. Such a comparison can help guide future Aboriginal-focused interventions.

7.6 Study limitations

However, the present study has several limitations that warrant recognition. First, as this was a cross-sectional study, casual relationships could not be inferred with respect to the variables of interest and weight status. Therefore, the findings of the analysis of the factors associated with weight status should be interpreted with caution, given the cross-sectional nature of the associations. Moreover, longitudinal data are needed to identify the temporal relationships between the predictors and weight status.

Second, self-reported data may be subject to recall bias. However, the self-reported measures in COMPASS have been previously demonstrated to be reliable and valid for population-level studies (Leatherdale, Laxer & Faulkner, submitted; Leatherdale & Laxer, 2013) and honest reporting was encouraged by ensuring confidently during data collection. Moreover, it is likely that this recall bias is non-differential, since there is no reason to think that recall should differ between ORA and non-Aboriginal students. Moreover, although the COMPASS measures have been previously validated, the specific use among Aboriginals has not been assessed. Additionally, due to the use of secondary data in this study, data were not available for all measures of interest. For example, there were no data on student socioeconomic status and therefore, a proxy measure (weekly spending money) was used. In contrast to expectations based on previous SES differences across Aboriginal and non-Aboriginal populations, the study finding indicated a lack of significant difference between ORA and non-Aboriginal youth. This finding may be partially attributed to the limitations of the proxy measure, as the cost of living differs depending on whether they live in rural or urban areas amongst many other considerations.

Third, 28.6% and 22.0 % of ORA and non-Aboriginal students did not report height or weight respectively, preventing from calculating their BMI. This is consistent with previous literature on adolescent populations that have also reported large amounts of missing self-

reported BMI data (Leatherdale & Rynard, 2013; Himes & Faricy, 2001; Brener, McManus, Galuska, Lowry, & Wechsler, 2003; Tiggemann, 2006). As approximately one fourth of the participants in the present study had missing BMI, it makes it difficult to robustly understand the association between the factors of interest and weight status among this sample. Thus, some of the results may be possibly biased as a function of missing BMI data. For example, there was no significant association between BMI and fruit and vegetable intake, despite previous evidence demonstrating a relationship between fruit and vegetable consumption and weight status among Aboriginals (Yu, Protudjer, Anderson, & Fieldhouse, 2010; Bernard et al., 1995; Hanley et al., 2000). More specifically, Yu, Protudjer, Anderson, & Fieldhouse (2010) measured the frequency of fruit and vegetable consumption daily (dichotomized as five or more or fewer than five times daily), not quantity, and found that consumption of fruits and vegetables five or more times daily helps maintain a healthy weight in females only. It is important to note however, after controlling for age, Bernard et al., (1995) identified that the association identified between diet and overweight was only significant among children (9 -11 years old) and not among those 12 or older. Their diet measure was a continuous variable of the number of fruit and vegetable serving derived from 24-hr recall. Finally, Hanley assessed the frequency of vegetable consumption over the last three months, and found that it appears to be inversely related to overweight among 242 Aboriginal subjects (10-19 years old). That is, subjects in the highest quartile of vegetable consumption had a decreased risk of overweight than those in the lowest quartile. However, it is important to note that this association was not significant.

Therefore, due to missing data, it is important to interpret the results identified with caution. Nonetheless, exploratory analyses revealed no significant differences in the sample characteristics of ORA students with BMI and missing BMI data, with the exception of

sedentary behaviour (Appendix B Table 5). ORA youth with missing BMI data were more likely to have high screen time. This is in line with a study conducted by Arbour-Nicitopoulous, Faulkner, & Leatherdale (2010) where Ontario elementary students with missing BMI data were more likely to be highly sedentary. However, their sensitivity analyses results were nearly identical to the results they obtained through primary analyses.

Lastly, it was beyond the scope of the current study to include the school-level policy information. Consequently, it was not possible to evaluate the relationship between school-level policies and weight status.

7.7 Implications

Promoting healthy weight during adolescence is a public health priority, especially among those who appear to be at the greatest risk. Limited research has investigated obesity and overweight relevant-factors among ORA youth in Canada, and none has simultaneously examined student and school-level characteristics associated with BMI. As this study is the first, there is a need for future studies to replicate these findings, in order to confirm whether the identified relationships are consistent and build upon the results of this study.

Identification of the temporal relationships between weight status and these health behaviours would provide insight to the population of youth that would most benefit from prevention programming. Given the low ICC values that indicated marginal variation in overweight and obesity across schools, future studies also should consider examining both home and school environments within the same sample, in order to find variation and provide a more comprehensive investigation. Such knowledge of the ecological context in which these health behaviours occur is valuable, as it has the potential to be modified appropriately through directed

interventions. This can subsequently benefit not only the targeted group, but also reach other large populations as well.

Results from the present study highlight the need to develop surveillance tools and collect data on weight status outcomes including factors that influence weight (physical activity levels, food consumption). Such sustained monitoring and reporting will allow to measure progress and modify approaches as needed, to curtail overweight and obesity. As the prevalence of overweight, obesity and other health risk factors among Canadian ORA youth is significantly higher than non-Aboriginal youth, this highlights that surveillance reports that only provide overall youth estimates may be inaccurate. This can lead to misinformed inferences and thus, future direct comparisons between the two populations are valuable. Such comparisons can not only help illustrate the substantial health disparities experienced by the vulnerable Aboriginal Canadians (Tjepkema, 2002), but also be used to target prevention interventions to specific groups within a school, address their distinct needs, and tailor programs and policies appropriately.

Although the school-level variation in overweight and obesity observed in this thesis are modest, potential implications are significant given that even small changes applied on large number of schools can have a considerable population-level impact (Rose, 1985). Moreover, modifying the built environment in order to promote healthy weight will not only benefit the youth population, but will also benefit all other age groups as well.

Considering that KKD was associated with obesity among ORA youth, this finding helps to further support the notion that increasing physical activity levels among young populations may be a valuable obesity prevention and control strategy. Additionally, given the alarmingly inadequate fruit and vegetable consumption among ORA youth, it is clear both PA and diet

represent the most modifiable with respect to preventing future disease burden. This underscores the need to focus on these risk factors as priority areas for ongoing and improved interventions to promote healthy weight among Canadian youth.

Findings from this study underscores the need for culturally appropriate prevention programs that target Aboriginal youth, as ORA youth are at significantly increased health risk due to their behavioural profile in comparison to non-Aboriginal youth. ORA youth were more likely than non-Aboriginal youth to be current smokers, to engage in binge drinking, to have been bullied, have high screen time, consume higher number of sugar drinks weekly, and consume lower number of fruit and vegetable servings per day. Based on these findings and past studies that have demonstrated comorbid use of alcohol and tobacco among Canadian youth (Leatherdale & Ahmed, 2010), it may be more beneficial for coordinated prevention efforts to address the multiple risk factors and distinct needs of Aboriginal youth. As this has been done in the past with the treatment of solvent abuse, it indicates potential to do so in this area as well.

7.8 Conclusions

Gaining a better understanding of the school- and student-level characteristics associated with weight status among Canadian ORA youth is critical to inform intervention programs and policies designed to promote healthy weight status among this vulnerable population. This was the first study to explore school and student-level characteristics among a sample of secondary school ORA youth in Ontario. Given that we identified that Aboriginals have higher rates of overweight and obesity than their non-Aboriginal counterparts and KKD is associated with obesity, schools should play an important role in promoting physical activity to reduce youth obesity among Aboriginals in Canada. Since ORA youth have higher rates of overweight and obesity compared to non-Aboriginal youth, this further suggests that current school-level policies

may be insufficient for preventing and managing adiposity among ORA youth. The study results further illustrated the importance of prioritizing ORA youth with respect to health behaviours that puts them at an increased risk. Overall, these findings indicate that there is an urgent need to improve the health profile of Canadian ORA secondary students in order to curtail a future burden of preventable chronic diseases. As this study is the first analysis that examined school and student level characteristics associated with weight status among the Canadian ORA youth population, replication of these findings is warranted.

Appendix A

2012-2013 COMPASS Student Questionnaire

Compass

- **This is NOT a test.** All of your answers will be kept **confidential.** No one, not even your parents or teachers, will ever know what you answered. So, please be honest when you answer the questions.
- Mark only **one option per question** unless the instructions tell you to do something else.
- Choose the option that is the **closest** to what you think/feel is true for you.

Please, use an HB pencil

●○○○ **Proper Mark**

⊗✓◒⊙ **Improper Marks**

START HERE

Please read each sentence below carefully and write the correct letter or number for each question on the line and then fill in the corresponding circle.

The first letter of your **middle** name (if you have more than one middle name use your first middle name, if you don't have a middle name use "Z"):___	The first letter of the month in which you were born: ___	The last letter of your full **first** name: ___	The second letter of your **last** name: ___	The number of older brothers you have (alive and deceased):___
Ⓐ Ⓗ Ⓞ Ⓥ Ⓑ Ⓘ Ⓟ Ⓦ Ⓒ Ⓙ Ⓠ Ⓧ Ⓓ Ⓚ Ⓡ Ⓨ Ⓔ Ⓛ Ⓢ Ⓩ Ⓕ Ⓜ Ⓣ Ⓖ Ⓝ Ⓤ	Ⓙ Ⓕ Ⓜ Ⓐ Ⓢ Ⓞ Ⓝ Ⓓ	Ⓐ Ⓗ Ⓞ Ⓥ Ⓑ Ⓘ Ⓟ Ⓦ Ⓒ Ⓙ Ⓠ Ⓧ Ⓓ Ⓚ Ⓡ Ⓨ Ⓔ Ⓛ Ⓢ Ⓩ Ⓕ Ⓜ Ⓣ Ⓖ Ⓝ Ⓤ	Ⓐ Ⓗ Ⓞ Ⓥ Ⓑ Ⓘ Ⓟ Ⓦ Ⓒ Ⓙ Ⓠ Ⓧ Ⓓ Ⓚ Ⓡ Ⓨ Ⓔ Ⓛ Ⓢ Ⓩ Ⓕ Ⓜ Ⓣ Ⓖ Ⓝ Ⓤ	⓪ ① ② ③ ④ ⑤ ⑥ ⑦

SHAPES

○○○○○○○○○○○○○○○○○○○○○○○○ [serial]

About You

1. What grade are you in?

- ○ Grade 9
- ○ Grade 10
- ○ Grade 11
- ○ Grade 12

2. How old are you today?

- ○ 13 years or younger
- ○ 14 years
- ○ 15 years
- ○ 16 years
- ○ 17 years
- ○ 18 years or older

3. Are you female or male?

- ○ Female
- ○ Male

4. How would you describe yourself? *(Mark all that apply)*

- ○ White
- ○ Black
- ○ Asian
- ○ Aboriginal (First Nations, Métis, Inuit)
- ○ Latin American/Hispanic
- ○ Other _____

5. About how much money do you usually get <u>each week</u> to spend on yourself or to save?
(Remember to include all money from allowances and jobs like baby-sitting, delivering papers, etc.)

- ○ Zero
- ○ $1 to $5
- ○ $6 to $10
- ○ $11 to $20
- ○ $21 to $40
- ○ $41 to $100
- ○ More than $100
- ○ I do not know how much money I get each week

6. How do you <u>usually</u> travel to and from school?

<u>To school</u>	<u>From school</u>
○ By car (as a passenger)	○ By car (as a passenger)
○ By car (as a driver)	○ By car (as a driver)
○ By school bus	○ By school bus
○ By public bus	○ By public bus
○ By walking	○ By walking
○ By bicycling	○ By bicycling
○ By subway or streetcar	○ By subway or streetcar
○ Other_____	○ Other_____

7. How tall are you <u>without</u> your shoes on? (Please write your height in feet and inches **<u>OR</u>** in centimetres, and then fill in the appropriate numbers for your height.)

○ **I do not know how tall I am**

"My height is ____feet ____ inches"

OR

"My height is _____centimetres"

Height	
Feet	Inches
0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7 8 9

OR

Height
Centimetres
0 1 2 3 4 5 6 7 8 9

***Example*:**
My height is <u>5 ft 7 in</u>

Height	
Feet	Inches
0 1 2 3 4 ● 6 7	● 1 2 3 4 5 6 ● 8 9

8. How much do you weigh <u>without</u> your shoes on? (Please write your weight in pounds **<u>OR</u>** in kilograms, and then fill in the appropriate numbers for your weight.)

○ **I do not know how much I weigh**

"My weight is _____pounds"

OR

"My weight is _____kilograms"

Weight	
Pounds	
0 1 2 3	0 1 2 3 4 5 6 7 8 9

OR

Weight
Kilograms
0 1 2 3 4 5 6 7 8 9

***Example*:**
My weight is <u>127 lbs</u>

Weight	
Pounds	
0 ● 2 3 4 5 6 7 8 9	0 1 ● 3 4 5 6 ● 8 9

9. How much time <u>per day</u> do you *usually* spend doing the following activities?

For example: If you spend about 3 hours watching TV each day, you will need to fill in the 3 hour circle, and the 0 minute circle as shown below:

	Hours	Minutes
a) Watching/streaming TV shows or movies	0 1 2 ● 4 5 6 7 8 9	● 15 30 45

	Hours	Minutes
a) Watching/streaming TV shows or movies	0 1 2 3 4 5 6 7 8 9	0 15 30 45
b) Playing video/computer games	0 1 2 3 4 5 6 7 8 9	0 15 30 45
c) Doing homework	0 1 2 3 4 5 6 7 8 9	0 15 30 45
d) Talking on the phone	0 1 2 3 4 5 6 7 8 9	0 15 30 45
e) Surfing the internet	0 1 2 3 4 5 6 7 8 9	0 15 30 45
f) Texting, messaging, emailing **(note: 50 texts = 30 minutes)**	0 1 2 3 4 5 6 7 8 9	0 15 30 45
g) Sleeping	0 1 2 3 4 5 6 7 8 9	0 15 30 45

○○○○○○○○○○○○○○○○○○○○○○○○ [serial]

Physical Activity

HARD physical activities include jogging, team sports, fast dancing, jump-rope and any other physical activities that increase your heart rate and make you breathe hard and sweat.

MODERATE physical activities include lower intensity activities such as walking, biking to school, and recreational swimming.

10. Mark how many minutes of HARD physical activity you did on each of the last 7 days. This includes physical activity during physical education class, lunch, after school, evenings, and spare time.

	Hours					Minutes			
Monday	○ 0	○ 1	○ 2	○ 3	○ 4	○ 0	○ 15	○ 30	○ 45
Tuesday	○ 0	○ 1	○ 2	○ 3	○ 4	○ 0	○ 15	○ 30	○ 45
Wednesday	○ 0	○ 1	○ 2	○ 3	○ 4	○ 0	○ 15	○ 30	○ 45
Thursday	○ 0	○ 1	○ 2	○ 3	○ 4	○ 0	○ 15	○ 30	○ 45
Friday	○ 0	○ 1	○ 2	○ 3	○ 4	○ 0	○ 15	○ 30	○ 45
Saturday	○ 0	○ 1	○ 2	○ 3	○ 4	○ 0	○ 15	○ 30	○ 45
Sunday	○ 0	○ 1	○ 2	○ 3	○ 4	○ 0	○ 15	○ 30	○ 45

For example: If you did 45 minutes of hard physical activity on Monday, you will need to fill in the 0 hour circle and the 45 minute circle, as shown below:

	Hours					Minutes			
Monday	● 0	○ 1	○ 2	○ 3	○ 4	○ 0	○ 15	○ 30	● 45

11. Mark how many minutes of MODERATE physical activity you did on each of the last 7 days. This includes physical activity during physical education class, lunch, after school, evenings, and spare time. Do not include time spent doing hard physical activities.

	Hours					Minutes			
Monday	○ 0	○ 1	○ 2	○ 3	○ 4	○ 0	○ 15	○ 30	○ 45
Tuesday	○ 0	○ 1	○ 2	○ 3	○ 4	○ 0	○ 15	○ 30	○ 45
Wednesday	○ 0	○ 1	○ 2	○ 3	○ 4	○ 0	○ 15	○ 30	○ 45
Thursday	○ 0	○ 1	○ 2	○ 3	○ 4	○ 0	○ 15	○ 30	○ 45
Friday	○ 0	○ 1	○ 2	○ 3	○ 4	○ 0	○ 15	○ 30	○ 45
Saturday	○ 0	○ 1	○ 2	○ 3	○ 4	○ 0	○ 15	○ 30	○ 45
Sunday	○ 0	○ 1	○ 2	○ 3	○ 4	○ 0	○ 15	○ 30	○ 45

For example: If you did 1 hour and 30 minutes of moderate physical activity on Monday, you will need to fill in the 1 hour circle and the 30 minute circle, as shown below:

	Hours					Minutes			
Monday	○ 0	● 1	○ 2	○ 3	○ 4	○ 0	○ 15	● 30	○ 45

12. Were the last 7 days a typical week in terms of the amount of physical activity that you usually do?

- ○ Yes
- ○ No, I was *more* active in the last 7 days
- ○ No, I was *less* active in the last 7 days

13. Your closest friends are the friends you like to spend the most time with. How many of your closest friends are physically active?

- ○ None
- ○ 1 friend
- ○ 2 friends
- ○ 3 friends
- ○ 4 friends
- ○ 5 or more friends

14. Are you taking a physical education class at school this year?

- ○ **Yes**, I am taking one **this term**
- ○ **Yes,** I will be taking one or have taken one this school year, **but not this term**.
- ○ **No**, I am not taking a physical education class at school this year

15. Do you participate in before-school, noon hour, or after-school physical activities organized by your school? *(e.g., intramurals, non-competitive clubs)*

- ○ Yes
- ○ No
- ○ None offered at my school

16. Do you participate in competitive school sports teams that compete against other schools? *(e.g., junior varsity or varsity sports)*

- ○ Yes
- ○ No
- ○ None offered at my school

17. Do you participate in league or team sports outside of school?

- ○ Yes
- ○ No
- ○ There are none available where I live

18. On how many days in the last 7 days did you do exercises to strengthen or tone your muscles? *(e.g., push-ups, sit-ups, or weight-training)*

- ○ 0 days
- ○ 1 day
- ○ 2 days
- ○ 3 days
- ○ 4 days
- ○ 5 days
- ○ 6 days
- ○ 7 days

19. How do <u>you</u> describe your weight?

- ○ Very underweight
- ○ Slightly underweight
- ○ About the right weight
- ○ Slightly overweight
- ○ Very overweight

20. Which of the following are you trying to do about your weight?

- ○ **Lose** weight
- ○ **Gain** weight
- ○ **Stay** the same weight
- ○ I am **not trying to do anything** about my weight

21. How much do your parents, step-parents, or guardians encourage you to be physically active?

- ○ Strongly encourage
- ○ Encourage
- ○ Do not encourage or discourage
- ○ Discourage
- ○ Strongly discourage

22. How much do your parents, step-parents, or guardians support you in being physically active? *(e.g., driving you to team games, buying you sporting equipment)*

- ○ Very supportive
- ○ Supportive
- ○ Unsupportive
- ○ Very unsupportive

○○○○○○○○○○○○○○○○○○○○○○○○ [serial]

Healthy Eating

23. If you do not eat breakfast every day, why do you skip breakfast? *(Mark all that apply)*

- ○ I eat breakfast every day

- ○ I don't have time for breakfast
- ○ The bus comes too early
- ○ I sleep in
- ○ I'm not hungry in the morning
- ○ I feel sick when I eat breakfast
- ○ I'm trying to lose weight
- ○ There is nothing to eat at home
- ○ Other _____

24. In a *usual* school week *(Monday to Friday),* on how many days do you do the following?

	None	1 day	2 days	3 days	4 days	5 days
a) Eat breakfast	○	○	○	○	○	○
b) Eat breakfast provided to you **as part of a school program**	○	○	○	○	○	○
c) Eat lunch at school - lunch packed and brought from home	○	○	○	○	○	○
d) Eat lunch at school - lunch purchased in the cafeteria	○	○	○	○	○	○
e) Eat lunch purchased at a fast food place or restaurant	○	○	○	○	○	○
f) Eat snacks purchased from a vending machine **in your school**	○	○	○	○	○	○
g) Eat snacks purchased from a vending machine, corner store, snack bar, or canteen **off school property**	○	○	○	○	○	○
h) Drink sugar-sweetened beverages (soda pop, Kool-Aid, Gatorade, etc.) Do not include diet/sugar-free drinks	○	○	○	○	○	○
i) Drink high-energy drinks (Red Bull, Monster, Rock Star, etc.)	○	○	○	○	○	○
j) Drink coffee or tea **with sugar** (include cappuccino, frappuccino, iced-tea, iced-coffees, etc.)	○	○	○	○	○	○
k) Drink coffee or tea **without sugar**	○	○	○	○	○	○

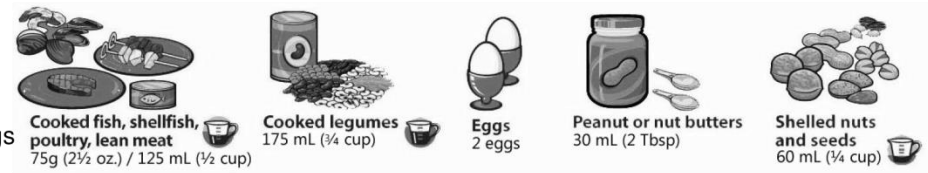
25. On a *usual* weekend *(Saturday and Sunday),* on how many days do you do the following?

	None	1 day	2 days
a) Eat breakfast	○	○	○
b) Eat lunch	○	○	○
c) Eat foods purchased at a fast food place or restaurant	○	○	○
d) Eat snacks purchased from a vending machine, corner store, snack bar, or canteen	○	○	○
e) Drink sugar-sweetened beverages (soda pop, Kool-Aid, Gatorade, etc.) Do not include diet/sugar-free drinks	○	○	○
f) Drink high energy drinks (Red Bull, Monster, Rock Star, etc.)	○	○	○
g) Drink coffee or tea **with sugar** (include cappuccino, frappuccino, iced-tea, iced-coffees, etc.)	○	○	○
h) Drink coffee or tea **without sugar**	○	○	○

26. YESTERDAY, *from the time you woke up until the time you went to bed*, how many servings of meats and alternatives did you have? *One 'Food Guide' serving of meat and alternatives includes cooked fish, chicken, beef, pork, or game meat, eggs, nuts or seeds, peanut butter or nut butters, legumes (beans), and tofu.*

- ○ None
- ○ 1 serving
- ○ 2 servings
- ○ 3 servings
- ○ 4 servings
- ○ 5 or more servings

***Canada's Food Guide* Serving Sizes of Meats and Alternatives**



27. YESTERDAY, *from the time you woke up until the time you went to bed*, how many servings of vegetables and fruits did you have? *One 'Food Guide' serving of vegetables and fruit includes pieces of fresh vegetable or fruit, salad or raw leafy greens, cooked leafy green vegetables, dried or canned or frozen fruit, and 100% fruit or vegetable juice.*

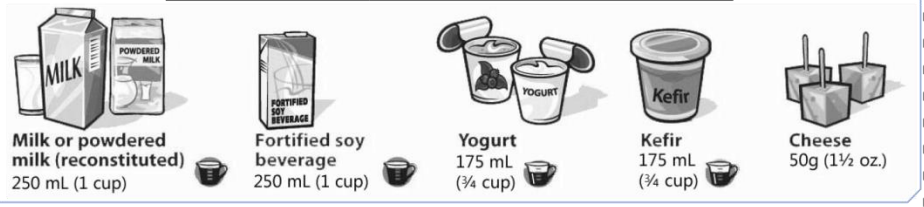
- ○ None
- ○ 1 serving
- ○ 2 servings
- ○ 3 servings
- ○ 4 servings
- ○ 5 servings
- ○ 6 servings
- ○ 7 servings
- ○ 8 servings
- ○ 9 or more servings

***Canada's Food Guide* Serving Sizes of Vegetables and Fruits**

28. YESTERDAY, *from the time you woke up until the time you went to bed*, how many servings of milk and alternatives did you have? *One 'Food Guide' serving of milk or milk alternatives includes milk, fortified soy beverage, reconstituted powdered milk, canned (evaporated) milk, yogurt or kefir (another type of cultured milk product), and cheese.*

- ○ None
- ○ 1 serving
- ○ 2 servings
- ○ 3 servings
- ○ 4 servings
- ○ 5 servings
- ○ 6 or more servings

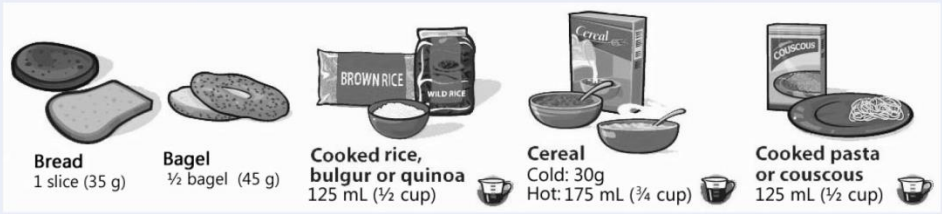
***Canada's Food Guide* Serving Sizes of Milk and Alternatives**



29. YESTERDAY, *from the time you woke up until the time you went to bed*, how many servings of grain products did you have? *One 'Food Guide' serving of grain products includes bread, bagels, flatbread such as tortilla, pita, cooked rice or pasta, and cold cereal.*

- ○ None
- ○ 1 serving
- ○ 2 servings
- ○ 3 servings
- ○ 4 servings
- ○ 5 servings
- ○ 6 servings
- ○ 7 servings
- ○ 8 servings
- ○ 9 or more servings

***Canada's Food Guide* Serving Sizes of Grain Products**



Your Experience with Smoking

30. Have you ever tried cigarette smoking, even just a few puffs?

- ○ Yes
- ○ No

31. How old were you when you first tried smoking cigarettes, even just a few puffs?

- ○ I have never done this
- ○ I do not know

- ○ 8 years or younger
- ○ 9 years
- ○ 10 years
- ○ 11 years
- ○ 12 years
- ○ 13 years
- ○ 14 years
- ○ 15 years
- ○ 16 years
- ○ 17 years
- ○ 18 years or older

32. Do you think in the future you might try smoking cigarettes?

- ○ Definitely yes
- ○ Probably yes
- ○ Probably not
- ○ Definitely not

33. If one of your best friends was to offer you a cigarette, would you smoke it?

- ○ Definitely yes
- ○ Probably yes
- ○ Probably not
- ○ Definitely not

34. At any time during the next year do you think you will smoke a cigarette?

- ○ Definitely yes
- ○ Probably yes
- ○ Probably not
- ○ Definitely not

35. Do you think it would be difficult or easy for you to get cigarettes if you wanted to smoke?

- ○ Difficult
- ○ Easy
- ○ I do not know

36. Have you ever smoked a whole cigarette?

- ○ Yes
- ○ No

37. Have you ever smoked 100 or more whole cigarettes in your life?

- ○ Yes
- ○ No

○○○○○○○○○○○○○○○○○○○○○○○○ [serial]

38. Have you ever smoked every day for at least 7 days in a row?

- ○ Yes
- ○ No

39. On how many of the last 30 days did you smoke one or more cigarettes?

- ○ None
- ○ 1 day
- ○ 2 to 3 days
- ○ 4 to 5 days
- ○ 6 to 10 days
- ○ 11 to 20 days
- ○ 21 to 29 days
- ○ 30 days *(every day)*

40. Thinking back over the last 30 days, on the days that you smoked, how many cigarettes did you usually smoke each day?

- ○ None
- ○ A few puffs to one whole cigarette
- ○ 2 to 3 cigarettes
- ○ 4 to 5 cigarettes
- ○ 6 to 10 cigarettes
- ○ 11 to 20 cigarettes
- ○ 21 to 29 cigarettes
- ○ 30 or more cigarettes

41. Your closest friends are the friends you like to spend the most time with. How many of your closest friends smoke cigarettes?

- ○ None
- ○ 1 friend
- ○ 2 friends
- ○ 3 friends
- ○ 4 friends
- ○ 5 or more friends

42. Have you ever tried to quit smoking cigarettes?

- ○ I have never smoked
- ○ I have only smoked a few times
- ○ I have never tried to quit
- ○ I have tried to quit once
- ○ I have tried to quit 2 or 3 times
- ○ I have tried to quit 4 or 5 times
- ○ I have tried to quit 6 or more times

43. In the last 30 days, did you use any of the following? *(Mark all that apply)*

- ○ Pipe tobacco
- ○ Cigarillos or little cigars (*plain or flavoured*)
- ○ Cigars (not including cigarillos or little cigars, *plain or flavoured*)
- ○ Roll-your-own cigarettes (tobacco only)
- ○ Loose tobacco mixed with marijuana
- ○ Bidis (little flavoured cigarettes that are hand-rolled in leaves and tied at the ends with string)
- ○ Smokeless tobacco (chewing tobacco, pinch, snuff, or snus)
- ○ Nicotine patches, nicotine gum, nicotine lozenges, or nicotine inhalers
- ○ Hookah (water-pipe) to smoke tobacco
- ○ Hookah (water-pipe) to smoke herbal sheesha/shisha
- ○ Blunt wraps (a sheet or tube made of tobacco used to roll cigarette tobacco)
- ○ I have not used any of these things in the last 30 days

Alcohol and Marijuana Use

*Please remember that we will keep your answers **completely confidential**.*

A DRINK means: 1 regular sized bottle, can, or draft of beer; 1 glass of wine; 1 bottle of cooler; 1 shot of liquor (rum, whiskey, etc); or 1 mixed drink (1 shot of liquor with pop, juice, energy drink).

44. In the last 12 months, how often did you have a drink of alcohol that was more than just a sip?

- ○ I have never drunk alcohol
- ○ I did not drink alcohol in the last 12 months
- ○ I have only had a sip of alcohol
- ○ Less than once a month
- ○ Once a month
- ○ 2 or 3 times a month
- ○ Once a week
- ○ 2 or 3 times a week
- ○ 4 to 6 times a week
- ○ Every day

45. How old were you when you first had a drink of alcohol that was more than just a sip?

- ○ I have never drunk alcohol
- ○ I have only had a sip of alcohol
- ○ I do not know
- ○ 8 years or younger
- ○ 9 years
- ○ 10 years
- ○ 11 years
- ○ 12 years
- ○ 13 years
- ○ 14 years
- ○ 15 years
- ○ 16 years
- ○ 17 years
- ○ 18 years or older

46. In the last 12 months, how often did you have 5 drinks of alcohol or more on one occasion?

- ○ I have never done this
- ○ I did not have 5 or more drinks on one occasion in the last 12 months
- ○ Less than once a month
- ○ Once a month
- ○ 2 to 3 times a month
- ○ Once a week
- ○ 2 to 5 times a week
- ○ Daily or almost daily

47. In the last 12 months, have you had <u>alcohol</u> mixed or pre-mixed with an energy drink such as Red Bull, Rock Star, Monster, or another brand?

- ○ I have never done this
- ○ I did not do this in the last 12 months
- ○ Yes
- ○ I do not know

48. In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash)

- ○ I have never used marijuana
- ○ I have used marijuana but not in the last 12 months
- ○ Less than once a month
- ○ Once a month
- ○ 2 or 3 times a month
- ○ Once a week
- ○ 2 or 3 times a week
- ○ 4 to 6 times a week
- ○ Every day

49. How old were you when you first used marijuana or cannabis?

- ○ I have never used marijuana
- ○ I do not know
- ○ 8 years or younger
- ○ 9 years
- ○ 10 years
- ○ 11 years
- ○ 12 years
- ○ 13 years
- ○ 14 years
- ○ 15 years
- ○ 16 years
- ○ 17 years
- ○ 18 years or older

50. Do you think it would be difficult or easy for you to get marijuana if you wanted some?

- ○ Difficult
- ○ Easy
- ○ I do not know

○○○○○○○○○○○○○○○○○○○○○○○○ [serial]

Your School and You

51. How strongly do you agree or disagree with each of the following?

	Strongly Agree	Agree	Disagree	Strongly Disagree
a) I feel close to people at my school.	○	○	○	○
b) I feel I am part of my school.	○	○	○	○
c) I am happy to be at my school.	○	○	○	○
d) I feel the teachers at my school treat me fairly.	○	○	○	○
e) I feel safe in my school.	○	○	○	○
f) Getting good grades is important to me.	○	○	○	○

52. In the last 30 days, in what ways were you bullied by other students? *(Mark all that apply)*

- ○ I have not been bullied in the last 30 days
- ○ Physical attacks (e.g., getting beaten up, pushed, or kicked)
- ○ Verbal attacks (e.g., getting teased, threatened, or having rumours spread about you)
- ○ Cyber-attacks (e.g., being sent mean text messages or having rumours spread about you on the internet)
- ○ Had someone steal from you or damage your things

53. In the last 30 days, how often have you been bullied by other students?

- ○ I have not been bullied by other students in the last 30 days
- ○ Less than once a week
- ○ About once a week
- ○ 2 or 3 times a week
- ○ Daily or almost daily

54. In the last 30 days, in what ways did you bully other students? *(Mark all that apply)*

- ○ I did not bully other students in the last 30 days
- ○ Physical attacks (e.g., beat up, pushed, or kicked them)
- ○ Verbal attacks (e.g., teased, threatened, or spread rumours about them)
- ○ Cyber-attacks (e.g., sent mean text messages or spread rumours about them on the internet)
- ○ Stole from them or damaged their things

55. In the last 30 days, how often have you taken part in bullying other students?

- ○ I did not bully other students in the last 30 days
- ○ Less than once a week
- ○ About once a week
- ○ 2 or 3 times a week
- ○ Daily or almost daily

56. How supportive is your school of the following?

	Very supportive	Supportive	Unsupportive	Very unsupportive
a) Making sure there are opportunities for students to be physically active	○	○	○	○
b) Making sure students have access to healthy foods and drinks	○	○	○	○
c) Making sure no one is bullied at school	○	○	○	○
d) Giving students the support they need to resist or quit tobacco	○	○	○	○
e) Giving students the support they need to resist or quit drugs and/or alcohol	○	○	○	○

57. What academic level was your current or most recent Math course?

- ○ Applied
- ○ Academic
- ○ Other _____

58. In your current or most recent Math course, what is your approximate overall mark?
(Think about last year if you have not taken math yet this year)

- ○ 90% - 100%
- ○ 80% - 89%
- ○ 70% - 79%
- ○ 60% - 69%
- ○ 55% - 59%
- ○ 50% - 54%
- ○ Less than 50%

59. In your current or most recent English course, what is your approximate overall mark?
(Think about last year if you have not taken English yet this year)

- ○ 90% - 100%
- ○ 80% - 89%
- ○ 70% - 79%
- ○ 60% - 69%
- ○ 55% - 59%
- ○ 50% - 54%
- ○ Less than 50%

60. What is the highest level of education you <u>would like to get</u>?

- ○ Some high school or less
- ○ High school diploma or graduation equivalency
- ○ College/trade/vocational certificate
- ○ University Bachelor's degree
- ○ University Master's / PhD / law school / medical school / teachers' college degree
- ○ I don't know

61. What is the highest level of education you <u>think you will get</u>?

- ○ Some high school or less
- ○ High school diploma or graduation equivalency
- ○ College/trade/vocational certificate
- ○ University Bachelor's degree
- ○ University Master's / PhD / law school / medical school / teachers' college degree
- ○ I don't know

62. In the last 4 weeks, how many days of school did you miss because of your health?

- ○ 0 days
- ○ 1 or 2 days
- ○ 3 to 5 days
- ○ 6 to 10 days
- ○ 11 or more days

63. In the last 4 weeks, how many classes did you skip when you were not supposed to?

- ○ 0 classes
- ○ 1 or 2 classes
- ○ 3 to 5 classes
- ○ 6 to 10 classes
- ○ 11 to 20 classes
- ○ More than 20 classes

64. How often do you go to class without your homework complete?

- ○ Never
- ○ Seldom
- ○ Often
- ○ Usually

○○○○○○○○○○○○○○○○○○○○○○○○ [serial]

Appendix B

Additional Figures and Table

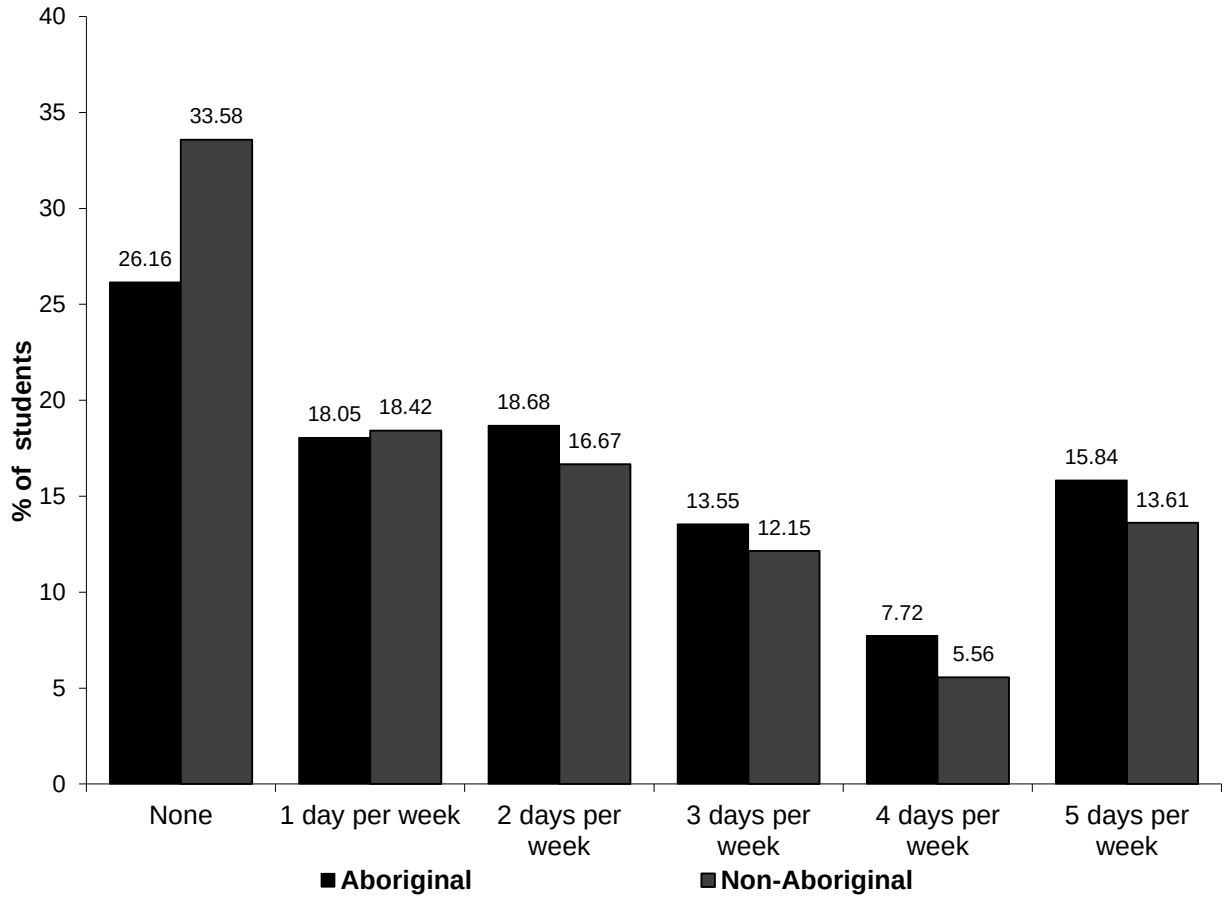


Figure 2: Weekly consumption of sugar drinks in grades 9-12 by Aboriginal status in COMPASS (Ontario, Canada, 2012-2013)

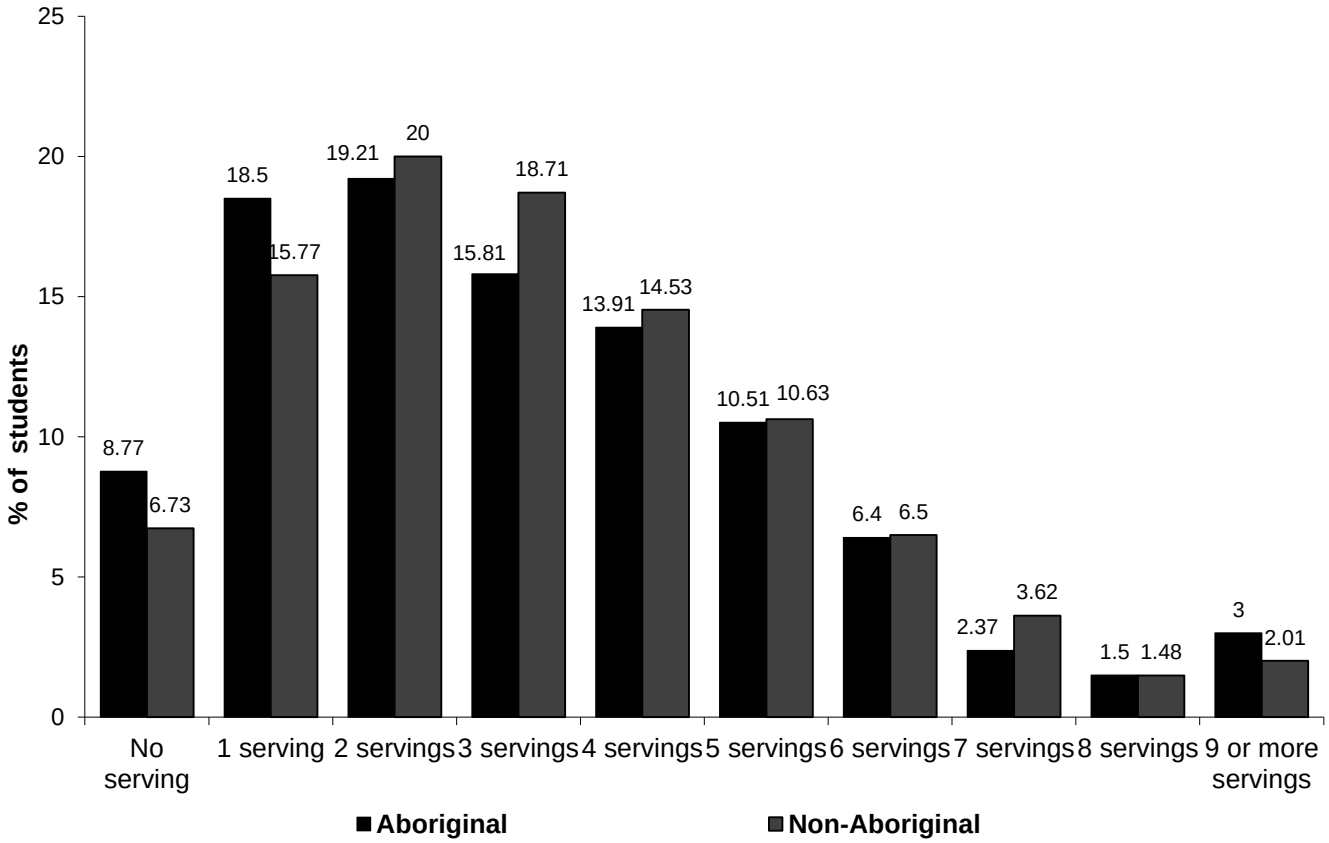


Figure 3: Daily serving(s) of fruit and vegetable in grades 9-12 by Aboriginal status in COMPASS (Ontario, Canada, 2012-2013)

Table 4: Descriptive statistics for the school-level characteristics among the 43 secondary schools in COMPASS (Ontario, Canada, 2012-2013)

School-level Characteristics	Entire Sample of Schools (n=43) Mean (SD)
Surrounding school	
Average number of fast-food places	10.1(12.2)
Average number of convenience stores	0.7(1.0)
Average number of grocery stores	2.9(3.4)
Average number of recreational facilities	4.8(4.8)
Within school	
Average number of beverage vending machines	2.8(1.5)
Average number of food vending machines	1.1(0.8)
Average number of PA facilities	5.4(2.9)
	% (n)
Presence of healthy Posters[a] Yes No	 58.5(24) 41.5(17)

[a]n=41

*% (n) presented for categorical variable

Table 5: Participant descriptive statistics of ORA youth with (n=354) and without (n=929) BMI data among 43 secondary schools in COMPASS (Ontario, Canada, 2012-2013)

Student-level Characteristics	**No BMI data (n=354) n (%)F**	**BMI data (n=929) n (%)**	**X^2/F**
Sex			
Female	186(52.5)	460(49.5)	X^2=1.0, df=1, P=0.332
Male	168(47.5)	469(50.4)	
Grade			
Grade 9	128(34.6)	266 (28.7)	X^2=5.6,df=3, P=0.133
Grade 10	83(22.4)	251 (27.1)	
Grade 11	88(23.8)	218 (23.3)	
Grade 12	71(19.2)	193 (20.8)	
Screen time			
Low	19(5.2)	31(3.3)	X^2=14.2,df=2, P<0.001
Moderate	224(61.0)	665(71.7)	
High	124(33.8)	231(24.9)	
Smoking status			
Current smoker	58(15.6)	132(14.2)	X^2=0.4,df=2, P=0.801
Former smoker	6(1.61)	17(1.83)	
Never smoker	309(82.8)	780(84.0)	
Alcohol status			
Non-binge drinker	270(72.6)	624 (67.6)	X^2=3.1,df=1, P=0.079
Binge drinker	102(27.4)	299 (32.4)	
Fruit and vegetable intake			
No servings	38(10.7)	73 (8.0)	X^2=11.0,df=9, P=0.279
1 serving	79(22.3)	155(17.1)	
2 servings	60(17.0)	183(20.1)	
3 servings	57(16.1)	142(15.6)	
4 servings	50(14.1)	126(13.9)	
5 servings	29(8.2)	104(11.4)	
6 servings	20(5.7)	60(6.60)	
7 servings	7(2.0)	23(2.53)	
8 servings	5(1.4)	14(1.54)	
9 servings or more	9(2.5)	29(3.19)	
Consumption of Sugar Drinks			
No servings	38(10.7)	73 (8.0)	

1 day	79(22.3)	155(17.1)	
2 days	60(17.0)	183(20.1)	X^2=5.3,df=5, P=0.380
3 days	57(16.1)	142(15.6)	
4 days	50(14.1)	126(13.9)	
5 days	29(8.2)	104(11.4)	
Spending money			
1-5 dollars	29(7.9)	52(5.7)	
6-10 dollars	28(7.7)	81(8.8)	
11 to 20 dollars	55(15.0)	141 (15.3)	
21 to 40 dollars	61(16.7)	157(17.1)	X^2=7.6,df=5, P=0.372
41 to 100 dollars	46(12.6)	142(15.4)	
> 100 dollars	45(12.3)	128(13.9)	
I do not know	40(10.9)	100(10.9)	
Been bullied			
No	285(80.7)	701(77.4)	X^2=1.7,df=1, P=0.193
Yes	68(19.3)	205(22.6)	
Bullied others			
No	314(89.0)	766(84.7)	X^2=3.7, df=1, P=0.068
Yes	39(11.1)	138(15.3)	
	Mean (SD)	Mean (SD)	
Physical Activity			
Average KKD[a]	9.7(8.1)	10.4(7.8)	F=1.7, df=1, P=0.194

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