Correlates of physical activity in Interlake youth

by

Tannis Erickson

A Thesis submitted to the Faculty of Graduate Studies of

The University of Manitoba

in partial fulfillment of the requirements of the degree of

MASTER OF SCIENCE

Department of Community Health Sciences

University of Manitoba

Winnipeg

Copyright© 2014 TannisErickson

Abstract

A social ecological framework is used in this study to identify health behaviours that have the potential to affect physical activity levels in Interlake youth. Data from two cycles of the Interlake Regional Health Authority (RHA) Youth Health Survey (YHS) were used to identify which demographic, individual, social and environmental factors were associated with physical activity levels of youth and to determine whether physical activity levels differed over time.

All variables in this study were developed from two cycles of the Interlake YHS (n=10,774). Physical activity levels of youth were assessed based on a self-reported record of their physical activity over a 7-day period. A measure of metabolic equivalent (MET) was assigned to each level of physical activity and daily KKDs (kilocalories per kilogram of body weight per day) were calculated. Risk ratios were calculated to investigate changes in physical activity levels over time. Bivariate correlations and hierarchical logistic regression was conducted to identify correlates of physical activity. A generalized estimating equation (GEE), including both individual- and group-level effects, was used to adjust for the correlations created by having two time periods in the study and the clustering of students at the school level, to answer the research questions.

Boys were found to have higher rates of physical activity than girls. As students got older their physical activity rates declined. Sex, active transportation to school, screen time, healthy eating, self perception of body image, feelings of hopelessness and feeling close to people at school were significantly associated with physcial activity levels.

Important differences have been identified between the individual, social and environmental factors that can potentially affect physical activity levels of youth based on

the data produced by the Interlake YHS. Individual factors have the strongest association with physical activity levels, followed by environmental factors.

These study results will guide the development of programs aimed at improving the physical activity levels of Interlake youth. Future studies aimed at examining a larger number of social ecological factors will further inform program and policies at a population level.

Acknowledgements

I wish to express my sincere thanks and gratitude to my supervisor, Dr. Patricia Martens for her guidance and encouragement during the course of this thesis. I also wish to thank the other members of my advisory committee Dr. Jane Griffith, Dr. Mariette Chartier and Dr. Elizabeth Ready for their guidance, recommendations and feedback.

Thank you to all of the Interlake students who took the time to complete the youth health surveys and to Interlake-Eastern Regional Health Authority for allowing me access to this dataset.

Though I sometimes doubted that this thesis would ever be finished, my husband and children were my inspiration and motivation. Thank you Brad, Lauren and Brett – you are the best thing that has ever happened to me.

Table of Contents

Chapter 1 - Introduction 1
1.1 Problem Statement 1
1.2 Study Location 4
1.3 Research Questions 5
1.4 Ethical Considerations 7

Chapter 2 - Review of Literature 8
2.1 Social Ecological Model of Health Behaviours 8
2.2 Physical Activity Guidelines for Youth 12
2.3 Measurement of Physical Activity in Youth 13
2.4 Costs of Physical Inactivity 17
2.5 Benefits of Physical Activity 18
2.6 Correlates and Predictors of Physical Activity 21
2.7 Changes in Physical Activity Levels 24

Chapter 3 - Methods 26
3.1 Study Design 26
3.2 Youth Health Survey Tool 28
3.3 Study Variables 30
3.4 Calculation of Derived Variables 32
3.5 Overview of Analysis Methods 35

Chapter 4 - Results 37
4.1 Descriptive Statistics 37
4.2 Changes Over Time 44
4.3 Reduction in Number of Independent Variables 50
4.4 Univariate Regression 51
4.5 Multiple Imputation of Body Mass Index 54
4.6 Multinomial Logistic Regression 54

Chapter 5 - Discussion and Conclusion 62
5.1 Physical Activity Levels of Interlake Youth 62
5.2 Relationship of Physical Activity Level to Student Sex and Time 63

5.3 Individual, Social and Environmental Variables Associated with Physical Activity Levels 64
5.4 Strengths and Limitations 69
5.5 Implications and Policy Recommendations 70

Appendix 1 – Ecological Model of Four Domains of Active Living 74

Appendix 2 – 2005 Youth Health Survey 75

Appendix 3 – 2009 Youth Health Survey 79

Appendix 4 – Youth Health Survey Question Sources, Reliability and Validity Reference and Scores 85

Appendix 5 – Study Variables (including type and range of values) 87

References 90

List of Tables

Table 1: Initial list of independent variables **28**

Table 2: Descriptive Statistics of Interlake Students by Sex - Individual Level Variables **37**

Table 3: Descriptive Statistics of Interlake Students by Gender - Social Level Variables **41**

Table 4: Descriptive Statistics of Interlake Students by Gender - Environmental Level Variables **41**

Table 5: Descriptive Statistics of Interlake Students by Gender - School Level Variables **43**

Table 6: Relative Risk of being active versus moderately active/inactive between 2009 and 2005 for various grades and grade groupings **44**

Table 7: Relative Risk of being active versus moderately active/inactive between 2009 and 2005 to illustrate changes over time in groupings of students **46**

Table 8: Relative Risk of being active versus moderately active/inactive between 2009 and 2005 to illustrate changes over time in groupings of students **49**

Table 9: Final List of Independent Variables **51**

Table 10: Univariate associations between study variables and physical activity for all students **52**

Table 11: Fully adjusted odds ratios for active versus moderately active/inactive for all independent variables - Final Model **57**

Table 12: Independent Variables that attained statistical significance and identification of variables that also have program significances **68**

List of Figures

Figure 1: Map of Manitoba with the Interlake region highlighted **4**

Figure 2: Map of Canada with Manitoba highlighted..... **4**

Figure 3: Social ecological framework for health behaviours..... **9**

Figure 4: Physical Activity Guidelines for Youth 12 - 17 years **13**

Figure 5: Association between adolescent physical activity and health: possible pathways **21**

Figure 6: Percentage of Active Students by Grade for 2005 and 2009 ..... **46**

Figure 7: Changes over time in the percentage of active students (2005 compared to 2009) for grade groupings **48**

Figure 8: Change over time in the percentage of active/moderately active students (2005 compared to 2009) for each grade grouping..... **50**

Chapter 1 - Introduction

1.1 Problem Statement

Chronic diseases are diseases of long duration and generally slow progression. Chronic diseases, such as heart disease, stroke, cancer, chronic respiratory diseases and diabetes, have reached epidemic proportions and are by far the leading cause of mortality in the world, representing 63% of all deaths. Worldwide, 36 million people died from chronic disease in 2008 (World Health Organization, 2011).

A risk factor is "an aspect of personal behaviour or lifestyle, an environmental exposure, or an inborn or inherited characteristic that, on the basis of scientific evidence, is known to be associated with meaningful health-related condition(s)" (Porta, 2008, p. 218).

Several chronic diseases share the common behavioural risk factors of physical inactivity, tobacco use, harmful use of alcohol and an unhealthy diet; therefore, a large percentage of chronic diseases could be prevented through a reduction of these behavioural risk factors (World Health Organization, 2011). For the remainder of this study all categories of risk factors will be referred to simply as "risk factors" for simplicity of writing.

Approximately 80% of Canadian adults have at least one chronic disease risk factor. The Public Health Agency of Canada has reported that over 70% of Canadian youth between the ages of 12 and 19 have at least one chronic disease risk factor (Public Health Agency of Canada, 2010) with a small percentage exhibiting all chronic disease risk factors.

Physical inactivity alone accounts for approximately 3.2 million deaths each year worldwide. People who are physically inactive have a 20% to 30% increased risk of mortality from all causes and regular physical activity (PA) has been found to reduce the risk of cardiovascular disease as well as high blood pressure, diabetes, breast cancer and colon cancer, and depression (World Health Organization, 2011).

The physical activity levels of Canadian children and youth fall well below the established guidelines. The Canadian Health Measures Survey reports that approximately 7% (CI not available in reference) of Canadian children and youth accumulate at least 60 minutes of moderate-to-vigorous physical activity at least 6 days a week (Colley et al., 2011). The 2012 cycle of the Canadian Community Health Survey reported that 71% of Canadian youth between the ages of 12 and 19 were physically active in their leisure time (95% CI 70% - 73%) and 73% of Manitoba youth (95% CI 67% - 79%) were physically active (Statistics Canada, 2013). The Manitoba Youth Health Survey 2009 reported that 48% (95% CI not available in reference) of Manitoba students are active enough to achieve health benefits (Partners in Planning for Healthy Living, 2010). While these rates differ greatly due to different survey tools, methodologies, samples and measurement techniques, the main message is consistent - a majority of children and youth are not active enough to support optimal growth and development and to maintain a healthy lifestyle.

It is due to rates such as these that the Active Healthy Kids Canada Report Card of Physical Activity for Children and Youth has given Canada a “D-” for physical activity levels (Active Healthy Kids Canada, 2013). Research has also shown that there is a

gradual decline in physical activity levels between childhood and adolescence (Sallis, Prochaska, & Taylor, 2000, p. 538).

Since 1995, the Canadian Society for Exercise Physiology (CSEP) and the Public Health Agency of Canada (PHAC) have worked together to create the Canadian Physical Activity Guidelines that promote healthy, active living in Canada. In 2011, they released a revised set of guidelines. The guidelines for youth ages 12 to 17 state that they should strive for at least 60 minutes of moderate to vigorous intensity physical activity each day (Canadian Society for Exercise Physiology, 2011).

Canada's Physical Activity Guidelines are based on numerous research studies that have identified "the important role of physical activity in the growth, development and physical health of young people, owing to its numerous physical and psychological benefits" (Hills, King, & Armstrong, 2007, p. 533). Physical activity is an important part of a healthy lifestyle. Short-term benefits of physical activity are improved bone and mental health and improved educational outcomes. Long-term benefits include these plus a reduced risk of developing chronic diseases (De Cocker et al., 2011; Janssen & LeBlanc, 2010; Suhrcke & dePazNieves, 2011). Physical activity levels have also been shown to directly affect weight status (Jimenez-Pavon, Kelly, & Reilly, 2010), which is another of the primary risk factors for chronic disease.

The primary purpose of this research study is to identify the individual, social and environmental factors that are associated with physical activity levels through an examination of the results of the 2005 and 2009 Interlake Youth Health Survey (YHS) in order to improve these levels and ultimately improve the long-term health outcomes of the population.

1.2 Study Location

Figure 2: Map of Canada with Manitoba highlighted

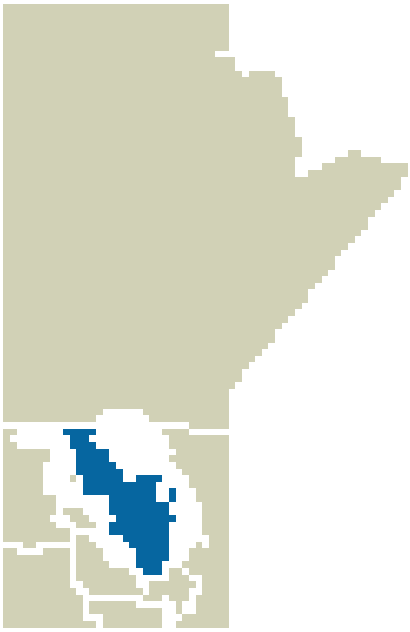


Figure 1: Map of Manitoba with the Interlake region highlighted

The data used in this study were collected from students in grades 6 to 12 who reside in the Interlake region of the province of Manitoba, Canada. Manitoba is one of the Prairie Provinces in Canada and the Interlake region is an expansive geographical area that is situated between the two largest lakes and north of the city of Winnipeg. The Interlake encompasses approximately 26,000 square kilometers and is home to over 88,000 people.

1.3 Research Questions

Over the last several years there has been a growing body of research into the causes and outcomes of chronic disease risk factors. This research has extended to children and youth as it has been shown that health behaviours adopted during adolescence often continue into adulthood (Jose, Blizzard, Dwyer, McKercher, & Venn, 2011; Kwan, Cairney, Faulkner, & Pullenayegum, 2012). An important benefit of this research is to inform the design and implementation of "programs in schools and communities that are more likely to be associated with an actual change in physical activity" (Motl, 2007, p. 350). In other words, "by identifying those segments of the populations with high levels of these risk factors, public health personnel can target their efforts and better allocate resources to prevent various chronic diseases" (Public Health Agency of Canada, 2010, p. 2).

The physical activity level of youth was chosen as the topic of this study because of the link between it and other risk factors, namely obesity and mental health and the ability of health practitioners to make meaningful changes in the physical activity levels based on the results of this study. Physical activity impacts both physical health and mental wellbeing.

There is a lack of understanding of the levels and correlates of physical activity among Manitoba youth, especially at the regional health authority level. The Interlake Regional Health Authority (RHA)[1] was in the unique position of having repeated the Youth Health Survey (YHS) twice, whereas other RHAs in the province had only undertaken this survey once at the time of this study. The Interlake RHA was interested

[1] Interlake RHA is now known as the Interlake-Eastern RHA

in conducting in-depth analyses of these two survey cycles to gain greater understanding of the health behaviours of the youth and the multitude of factors that may impact these behaviours. Youth physical activity levels are of primary importance to the Interlake RHA and its partners in order to facilitate appropriate regional, school and community level interventions to promote healthy living as well as to inform provincial policy development.

The purpose of this research is to quantify the current physical activity levels of Interlake youth and to identify the individual, social and environmental factors that are associated with these physical activity levels by examining the results of the 2005 and 2009 Interlake YHS. It will also seek to determine if there is a change in physical activity levels of adolescents as they age or over time and what factors might be associated with these changes. The specific research questions are:

1. What are the physical activity levels of Interlake youth?
2. Do these levels vary by gender or over time (i.e. between 2005 and 2009)?
3. What individual, social and environmental factors (i.e. which independent or explanatory variables) are uniquely associated with physical activity levels in Interlake youth?

It is hypothesized that at the individual level, males are more physically active than females, active transportation to school and positive health behaviours (i.e. healthy eating) will be positively associated with physical activity whereas poor mental health status (i.e. feelings of hopelessness), increased BMI and perceived BMI, increased sedentary behaviour, grade, age, tobacco use, drug and alcohol use will be negatively associated with physical activity. At the social level, parental encouragement and

support, school connectedness and number of peers who are physically active will be positively associated with physical activity. At the physical level feeling safe at school will also be positively associated with physical activity levels. Additionally, it is hypothesized that at the school level, a school environment that encourages physical activity will be positively associated with individual physical activity levels.

1.4 Ethical Considerations

Ethical approval was obtained from the University of Manitoba Health Research Ethics Board (#HS14176 (H2011:374)). Consent to conduct secondary analyses on previously collected data (2005 and 2009 cycles of the Interlake YHS) was obtained from the Interlake RHA. The results of all analyses performed have been stored in a secure and locked location. The raw data collected by the Interlake Regional Health Authority has consistently remained under the control of the Youth Health Survey Information Manager, CancerCare Manitoba, and will be destroyed according to previously established provincial YHS protocols. No attempts have been made to identify or contact the students who completed the surveys and the data was not linked to any other databases.

Chapter 2 - Review of Literature

2.1 Social Ecological Model of Health Behaviours

"Our societies are complex and interrelated. Health cannot be separated from other goals. The inextricable links between people and their environment constitutes the basis for a socioecological approach to health" (World Health Organization, 1986). The social ecological approach to health promotion has been very evident in national and international documents since 1986 including the Center for Disease Control and Prevention Model for Health Promotion (Centre for Disease Control, 2011), the WHO Framework Convention on Tobacco Control (World Health Organization, 2003), the World Health Organization's (WHO) strategy for diet, physical activity, and obesity (World Health Organization, 2004a), and Active Canada 20/20 (Active Canada 20/20).

As a result of foundational documents such as these, social ecological models of health behaviour have consistently appeared in the literature since the 1990's as a mechanism for focussing on the individual and environmental determinants of behaviour (Elder et al., 2007; Gorely, Marshall, Biddle, & Cameron, 2007; Grzywacz & Fuqua, 2000; McLaren & Hawe, 2005; Motl, 2007; Sallis et al., 2006; Sallis, Owen, & Fisher, 2008; Schneider & Stokols, 2009; Stokols, 1996; Woods, Nelson, O'Gorman, Foley, & Moyna, 2009).

The central tenant of the social ecological model is that behaviour has multiple levels of influence (individual, inter/intra-personal, organizational, community, environmental and policy) (see Figure 3) and these levels interact with each other to impact health. A distinct characteristic of the ecological model is the inclusion of environmental and

policy variables that are expected to influence behaviour (Sallis et al, 2006). It is this inclusion of the environment that differentiates social ecological models from the earlier behavioural models of health found in health behaviour research.

Figure 3: Social ecological framework for health behaviours

Source: ActiveCanada 20/20. *Social-ecological-model* (http://www.activecanada2020.ca/sections-of-ac-20-20/appendix-a/appendix-b/appendix-c-1/appendix-d)

Social ecological models "provide comprehensive frameworks for understanding the multiple and interacting determinants of health behaviours" (Sallis et al., 2008, p. 466) which can then lead to the development of comprehensive and targeted policies and

programs. Social ecological models of health are guided by four underlying principles (Sallis et al., 2008):

1. there are multiple influences on health behaviours (personal, organizational, community and policy levels);
2. behavioural influences interact across these different levels;
3. ecological models should be behaviour-specific to identify the most relevant influences at each level; and
4. Multi-level interventions should be most effective in changing behaviour.

The social ecological model has been particularly useful in the area of physical activity due to the fact that physical activity takes place in specific settings (i.e. home, school, community). Physical activity programs or studies of physical activity that incorporate a social ecological model include variables at the individual, social, environmental and policy levels as well as the interactions that can occur between these variables.

In 2006, Sallis and colleagues published an influential work relating the social ecological model to physical activity. In this article, the authors synthesized findings and concepts from the fields of health, behavioural science, transportation and city planning, policy studies and economics, and leisure sciences to create the ecological model shown in Appendix 1. Sallis' main premise is that "multilevel interventions based on ecological models and targeting individuals, social environments, physical environments, and policies must be implemented to achieve population change in physical activity" (Sallis et al, 2006, p. 297). Sallis' ecological model is built around four domains of active living (active transport, occupational activities, household activities and active recreation) each

with multiple levels of influence (intrapersonal, perceived environment, settings and policy environment).

Additionally, works by many researchers (Eder, Ege, & Von Mutius, 2006; Grzywacz & Fuqua, 2000; Stokols, 1996; Woods et al., 2009) focus on the use of a social ecological model for the development of programs while others (Gorely et al., 2007; McLaren & Hawe, 2005; Motl, 2007; Sallis et al., 2008; Schneider & Stokols, 2009; Stokols, 1996) focus on the social ecological model as a mechanism for understanding behaviour. In both program development and studies of health behaviour, the social ecological model allows for an equal focus on the individual and the environmental factors that affect health behaviours. This ensures that attention is paid to the resources and characteristics of the individual as well as that person's social context and environment (Grzywacz and Fuqua, 2000) and also the relationships between the individual and their environment (Stokols, 1996).

Motl (2007) sums up the need for the use of theory in the study of physical activity in youth as follows, "theory offers a systematically organized body of knowledge that is applicable in a relatively wide variety of circumstances. This body of knowledge provides assumptions, accepted principles and rules that provide a blueprint for analyzing, predicting, or explaining behaviour. Hence, theory is essential for well-formulated examinations of physical activity behaviour." (p. 350).

In summary, "ecological models direct attention to environmental and policy factors that may be root causes of the epidemic of sedentary lifestyles" (Sallis et al., 2006). A strength of the social ecological model is its' focus on the many levels of influences on health behaviours and this allows for broader options in considering behavioural factors

and in developing interventions. Having individual and environmental factors incorporated into one framework or model helps to illustrate that the causes of health behaviours are widely distributed across all levels and spheres of influence, not just the individual sphere. It can lead to a more comprehensive understanding of health and provide a basis for effective programs for real people in real environments. Individual health status does not develop in a vacuum. The conditions and environments that people find themselves in ultimately affect their health status. It is necessary to consider this when seeking to understand the risk factors for chronic disease. The social ecological model allows for the establishment of programs and services that are more likely to lead to actual behaviour change. A challenge faced by those who wish to adopt a social ecological model is the necessity to reduce the lengthy list of potential correlates or predictors of health behaviours.

2.2 Physical Activity Guidelines for Youth

Since 1995, the Canadian Society for Exercise Physiology (CSEP) and the Public Health Agency of Canada (PHAC) have worked together to create the Canadian Physical Activity Guidelines that promote healthy, active living in Canada. In 2011, they released a revised set of guidelines (Figure 4: Physical Activity Guidelines for Youth 12 – 17 years). Canada's Physical Activity Guidelines are based on numerous research studies that have identified "the important role of physical activity in the growth, development and physical health of young people, owing to its numerous physical and psychological benefits" (Hills et al., 2007, p. 533).

Figure 4: Physical Activity Guidelines for Youth 12 - 17 years

Canadian Physical Activity Guidelines

For Youth 12 – 17 years

- For health benefits, youth aged 12-17 years should accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity daily. This should include:
- Vigorous-intensity activities at least 3 days per week.
- Activities that strengthen muscle and bone at least 3 days per week.
- More daily physical activity provides greater health benefits.

Source: Canadian Society for Exercise Physiology. (2011). *Canadian physical activity guidelines background information*

2.3 Measurement of Physical Activity in Youth

Wilcox and Ainsworth identify four major reasons to measure physical activity levels (2009, p. 327):

1. to examine the role of physical activity as a risk or protective factor in the development of disease;
2. to monitor changes in physical activity over time (surveillance);
3. to examine the associations between physical activity and individual, social and environmental factors to aid in the development of interventions; and
4. to determine if interventions at the individual, social and population levels are effective.

There are various methods of measuring physical activity levels available to researchers. These methods can be divided into two major categories, indirect and direct

methods. Indirect methods include questionnaires, records and logs. Direct measures include motion detectors such as pedometers, accelerometers and other physical measures. The overall goal of physical activity measurement is to get a sense of frequency, duration, intensity and type. Each of these elements is important in the study of physical activity.

One of the most commonly used methods in physical activity research is the self-reported survey, which is considered an indirect measure. This is by far one of the most frequently used methods, for practical reasons including low cost and ease of use (Wilcox & Ainsworth, 2009), as well as the ability to assess activity levels, setting, mode and determinants of activity (Corder, Ekelund, Steele, Wareham, & Brage, 2008) . Other advantages of self-reported measures are that they are non-invasive, are generally reliable and valid, can be administered either in print or on the internet, do not require a lot of support in survey completion and can be targeted to specific populations depending on the focus of the research questions (Bates, 2006).

There are also disadvantages faced when using self-reported questionnaires and these important issues need to be considered when determining which physical activity measure to use. These include issues of: test-retest reliability, construct validity, criterion validity, sensitivity to change, feasibility, reactivity, social desirability, demand characteristics and potential sources of bias (Wilcox and Ainsworth, 2009).

Data measuring reliability and validity of self-reported measures are commonly available to users of pre-existing tools but many other issues have not been thoroughly investigated and reported on. The potential for bias is often the greatest concern when using self-reported measures and can arise from any of several areas: the way the

questions are designed, the way the questionnaire as a whole is designed and how the questionnaire is administered or completed (Choi & Pak, 2005). Being aware of the potential sources of bias faced by self-reported questionnaires will allow the careful researcher to ensure these biases are mitigated or at least minimized.

Self-reported measures of physical activity are commonly used in surveillance activities as the goal of surveillance is to categorize people into activity groups (i.e. inactive, moderately active, active) and to provide information for policy and program development rather than providing an individual assessment of physical activity level. The length of recall time in surveillance tools can vary from a very short time (past 24 hours) to a much longer time (in the past year). The advantage of shorter recall times is the reduction of recall bias as people are much more likely to have a better recollection of what they did in the past day or past week as opposed to the past year. Another important consideration in surveillance is to match the domain measured (e.g. leisure time physical activity, sport, exercise, work, etc.) in the survey with the primary interest of the study.

In order to calculate the physical activity level of study participants using self-reported questionnaires, the reported frequency, duration and level of physical activity are converted into an overall measure of physical activity, kilocalories per kilogram of body weight per day (KKD). KKD are calculated by multiplying the number of hours of each type of physical activity, moderate or vigorous, by the average number of metabolic equivalents (METs) expended in each type of activity as follows:

<u>Daily KKD</u> = (hours of moderate PA x 3 METS)

+ (hours of vigorous PA x 6 METS) divided by 7 days

METs represent the energy cost of physical activities as multiples of the resting metabolic rate. One MET is the energy expended by an average adult while sitting quietly (Spadano, Must, Bandini, Dallal, & Dietz, 2003). The MET values assigned to activities are generalized estimations based on literature and expert opinion (Harrell et al., 2005). Commonly used values of METs are 3 or 4 for moderate physical activity and 6 for vigorous physical activity (Ekelund, Tomkinson, & Armstrong, 2011; Leatherdale & Wong, 2008; Ridley & Olds, 2008; Wong, Leatherdale, & Manske, 2006).

The above calculations were first developed for use with the adult population. Significant research has been done to extend the use of self-reported questionnaires to measure physical activity in the child and adolescent population. Harrell et al (2005) found that the resting energy expenditure of children is higher than that of adults. Using the METs developed by Ainsworth and colleagues (2000) will generally lead to the underestimation of the energy expenditure of children. Ekelund (2011) found that the number of hours of physical activity recorded in self-reported questionnaires is usually overestimated. This underestimation and overestimation tend to balance each other out in the overall calculations of KKD. Spadona (2003) and Ridley (2008) have found that the use of average adult MET values is a good approximation of the energy costs of children, especially by ages 15 or 16, if measured values are not available.

Therefore, for the purposes of this study, the use of self-reported questionnaires and standard KKD calculations are considered a good estimation of the physical activity of Interlake youth.

2.4 Costs of Physical Inactivity

The World Health Organization has estimated that in 2005 Canada lost $500 million in national income due to premature deaths resulting from chronic diseases. These loses, which include lost productivity, direct and indirect health care costs[2], are expected to increase significantly and by 2015 the 10-year cumulative total loss is estimated to be $9 billion (World Health Organization, 2005).

In 2010 it was estimated that chronic diseases cost Canadians at least $190 billion annually in direct and indirect costs. This represents more than half (58%) of all annual health care spending in Canada. This economic impact goes beyond the health care sector. The indirect costs alone are expected to be $122 billion annually, which includes productivity losses (Public Health Agency of Canada, 2011).

In 2008 a group of organizations in Manitoba, coordinated by Heart and Stroke Foundation (Manitoba) and including CancerCare Manitoba, the Alliance for the Prevention of Chronic Disease, and Health in Common, contracted with Dr. Hans Krueger to conduct a similar economic analysis (Kreuger, 2010). This study found that the total direct health care costs in Manitoba associated with physical inactivity alone was $99.8 million and the total indirect health care costs were $227.5 million. This translates to a total economic burden of physical inactivity in Manitoba of $327.3 million.

A subsequent economic analysis conducted in the Interlake Regional Health Authority using the same methodology estimated that in 2008 the combined economic burden (direct and indirect costs) of smoking, physical inactivity and overweight/obesity

[2] Direct health care costs are the cost of care received in the health care system such as hospitals, emergency rooms, physicians, nurses and home care. Indirect health care costs are comprised of items such as lost productivity, inability to perform daily activities and premature death.

was $125 million for the residents of their region. This translates to over $6,000 for each person diagnosed with a chronic disease. Of this total, physical inactivity accounted for $19.3 million in health care costs annually (Interlake Regional Health Authority, 2011).

This analysis also estimated potential savings in health care costs if the prevalence of chronic disease risk factors was reduced. A 1% reduction in risk factor rates would result in $15 million of savings and a 2% reduction would result in $30 million in savings by 2026.

2.5 Benefits of Physical Activity

Physical activity plays a highly beneficial role in the health of individuals and the prevention of disease. Evidence shows that physically active people have higher levels of fitness, lower risk profiles for developing a number of medical conditions and lower rates of chronic diseases than those who are inactive (Physical Activity Guidelines Advisory Committee, 2008). Participation in regular physical activity has been shown to decrease the risk and incidence of cardiovascular disease, diabetes, osteoporosis, depression, obesity, breast cancer and colon cancer in adults (Marcus et al., 2006). Physical inactivity is also closely related to other risk factors for chronic disease, such as overweight and obesity, high blood pressure, high blood cholesterol and metabolic syndrome (Heart and Stroke Foundation of Canada, 2011; Janssen & LeBlanc, 2010).

Marcus (2006) states that "sedentary behaviour has been identified as one of the leading preventable causes of death and an inverse linear relationship exists between the volume of physical activity behaviour and all-cause mortality" (p, 2739). In a review of the health benefits of physical activity, Janssen and LeBlanc (2010) found a dose-

response relationship between physical activity and health benefits: the more physical activity, the greater the benefit. They also found that even modest amounts of physical activity can have health benefits for youth and that aerobic based physical activity had the greatest health benefit (Janssen & LeBlanc, 2010).

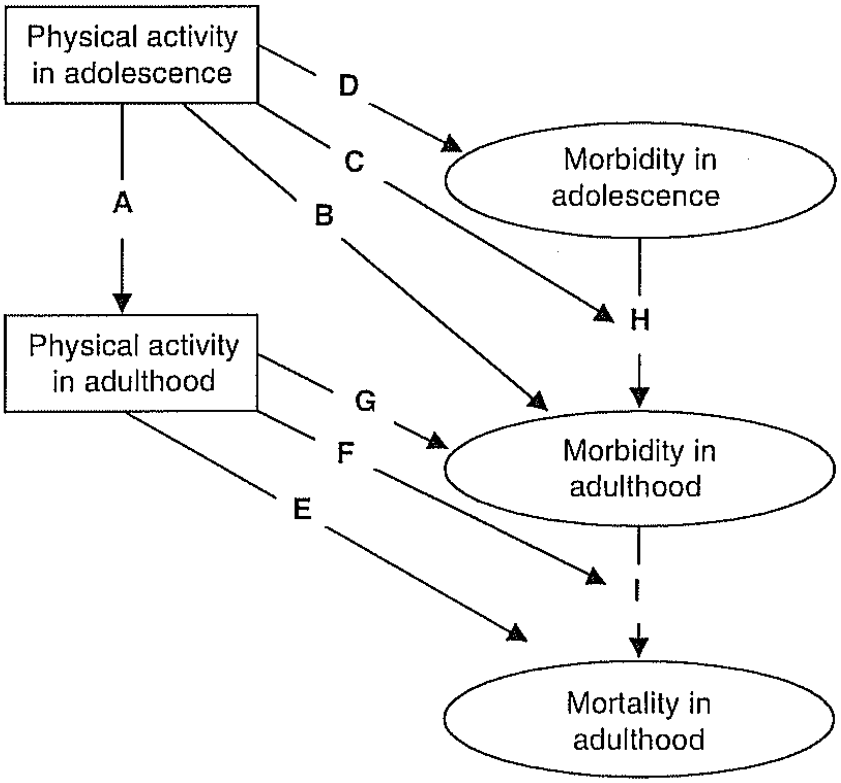
Regular physical activity in adolescence provides the greatest likelihood of impact on mortality and longevity (Centres for Disease Control and Prevention, 1997; Hallal, Victoria, Azevedo, & Wells, 2006; Hills et al., 2007). Evidence also suggests that a healthy lifestyle in adolescence will lessen the development of the chronic disease and their risk factors in adulthood (Centres for Disease Control and Prevention, 1997; Craggs, Corder, van Sluijs, & Griggin, 2011; Hallal et al., 2006; Heart and Stroke Foundation of Canada, 2011; Hills et al., 2007; Loprinzi, Cardinal, Loprinza, & Lee, 2012). Hills et al (2007) found conclusive evidence that "physical activity is conducive to a healthy lifestyle and prevention of disease" and that "habitual physical activity established during the early years may provide the greatest likelihood of impact on mortality and longevity" (p. 534).

Numerous research studies have demonstrated "the important role of physical activity in the growth, development and physical health of young people, owing to its numerous physical and psychological benefits" (Hills et al., 2007,p. 533). Short term benefits of physical activity that are realized during adolescence are improved bone health (Centres for Disease Control and Prevention, 1997; Craggs et al., 2011; De Cocker et al., 2011; Hills et al., 2007; Loprinzi et al., 2012; Physical Activity Guidelines Advisory Committee, 2008; Suhrcke & dePazNieves, 2011), improved self-esteem (Centres for Disease Control and Prevention, 1997; Hills et al., 2007; Loprinzi et al., 2012), improved

mental health (Centres for Disease Control and Prevention, 1997; Hills et al., 2007; Loprinzi et al., 2012; Physical Activity Guidelines Advisory Committee, 2008), improved concentration and educational outcomes (Hills et al., 2007; Suhrcke & de Paz Nieves, 2011), improved aerobic endurance, muscle strength and energy levels (Centres for Disease Control and Prevention, 1997; Hills et al., 2007; Loprinzi et al., 2012; Physical Activity Guidelines Advisory Committee, 2008), reduced body mass index (Centres for Disease Control and Prevention, 1997; Heart and Stroke Foundation of Canada, 2011; Hills et al., 2007; Loprinzi et al., 2012; Physical Activity Guidelines Advisory Committee, 2008; Tremblay & Willms, 2003), and improved sleep (Hills et al., 2007) .

The association between adolescent physical activity and health is complicated and multi-faceted. Hallal and colleagues (2006) created a graphic to summarize this association (Figure 5 - Adolescent Physical Activity and Health). This graphic clearly shows how physical activity in adolescence has the potential to affect overall mortality in varying ways and points in time. It is important to understand this trajectory when planning programs and services that are aimed at increasing physical activity levels in adolescents.

Figure 5: Association between adolescent physical activity and health: possible pathways



Source: Hallal, P.C., Victoria, C.G.,Azeveda, M.R., & Wells, J.C.K. (2006). Adolescent physical activity and health: A systematic Review. *Sports Medicine, 36(12),* 1019-1030.

2.6 Correlates and Predictors of Physical Activity

The identification of factors that influence physical activity levels of youth (i.e. correlates of physical activity) is an important precursor to the development of effective interventions aimed at improving these physical activity levels. Physical activity levels, as well as influences on and determinants of, need to be well understood in order for organizations to address the important public health challenge of improving physical activity levels in youth (Sallis et al., 2000).

Over the past several years numerous studies have been conducted to determine which individual, inter/intra-personal, organizational, community, environmental or policy factors have the most effect on physical activity levels. Several of these studies have been summarized in systematic reviews, most notable among these is the 1999 review published by Sallis and colleagues (Sallis, Prochaska, Taylor, Hill, & Geraci, 1999). There have been many similarities found in these studies, and certain characteristics have consistently shown a relationship to the physical activity levels of children and adolescents.

Student demographic characteristics such as age and maturation level (Kohl & Hobbs, 1998; Norman, Schmid, Sallis, Calfas, & Patrick, 2005; Rodrigues et al., 2010; Sallis et al., 2000) and overweight and obesity (as measured by body mass index) (Barr-Anderson et al., 2008; Hilland, Ridgers, Stratton, & Fairclough, 2011; Jimenez-Pavon et al., 2010; Leatherdale, Manske, Faulkner, Arbour, & Bredin, 2010; Sallis et al., 1999) has shown a negative association with physical activity levels. Characteristics such as ethnicity (Caucasian) (Sallis et al., 2000), gender (male) (Hilland et al., 2011; Kohl & Hobbs, 1998; Leatherdale & Wong, 2008; Leatherdale et al., 2010; Sallis et al., 2000; Van Der Horst, Paw, Twisk, & Van Mechelen, 2007), socioeconomic status of the family (Ferreira et al., 2006; Gadalla, 2012; Jekauc, Reimers, Wagner, & Woll, 2012; Kohl & Hobbs, 1998) and parental education level (Van Der Horst et al., 2007) have all shown positive relationships to physical activity levels.

Psychological and emotional factors such as level of self-efficacy, goals and motivations and perceived ability (Barr-Anderson et al., 2008; Kohl & Hobbs, 1998; Lytle et al., 2009; McNeill, Wyrwich, Brownson, Clark, & Kreuter, 2006; Van Der Horst

et al., 2007), mental health (i.e. self-esteem) (Sallis et al., 2000), intention to be physically active (Sallis et al., 2000), perceived benefits of being physically active (Sallis et al., 2000) and knowledge and attitudes towards physical activity (Barr-Anderson et al., 2008; Hallal et al., 2006; Hilland et al., 2011; Van Der Horst et al., 2007) have shown a positive relationship with physical activity. Depression (Sallis et al., 2000) and perceived time barriers (Sallis et al., 1999) have also shown a negative relationship with physical activity.

Family and peer support has been shown to positively influence physical activity levels (Allender, Cowburn, & Foster, 2006; Beets, Cardinal, & Alderman, 2010; Castelli & Erwin, 2007; Kohl & Hobbs, 1998; Sallis et al., 1999; Sallis et al., 2000; Van Der Horst et al., 2007). This support can include parental encouragement, parents buying the necessary equipment and driving children to their events (Beets et al., 2010; Lytle et al., 2009; Sallis et al., 2000) as well as the number of peers who are physically active (Leatherdale et al., 2010; Sallis et al., 2000). Other family characteristics shown to affect youth physical activity levels include parent overweight/obesity (negative impact) and parental and sibling physical activity levels (positive impact) (Sallis et al., 1999; Sallis et al., 2000).

Overall health status and the presence or absence of other positive health behaviours such as tobacco use (Koezuka et al., 2006; Sallis et al., 2000), and sedentary behaviour (Sallis et al., 2000; Leatherdale et al., 2010; Rodrigues et al., 2010; Perez, 2003) have been shown to have a negative relationship with physical activity levels. Having a healthy diet (Leatherdale & Wong, 2008; Leatherdale et al., 2010; Perez, 2003; Sallis et al., 1999; Sallis et al., 2000), regular participation in physical activity and sports (Castelli

& Erwin, 2007; Kirby, Levin, & Inchley, 2012; Leatherdale et al., 2010; Leatherdale & Papadakis, 2011; Lemstra, Neilson, Rogers, Thompson, & Morasos, 2012; Lowry, Kann, Collins, & Kolbe, 1996), previous physical activity (Sallis et al., 2000) and use of active transportation (Hobin et al., 2012), have all shown to have a positive relationship with physical activity levels.

Physical and environmental factors also play a role in developing physical activity habits, as shown in the development of social ecological models of physical activity. Factors such as attending a school with a separate room for physical activity class (Hobin et al., 2012), overall school climate and the number of sporting and related activities that are available at school (i.e. intra-murals and varsity sports) (Barr-Anderson et al., 2008; Hobin, Leatherdale, Manske, & Robertson-Wilson, 2010; Hobin et al., 2012; Kirby et al., 2012; Leatherdale et al., 2010; Leatherdale & Papadakis, 2011; Lowry et al., 1996), access to facilities and programs (including those at school) (Hobin et al., 2010; Leatherdale et al., 2010; Sallis et al., 2000; Van Der Horst et al., 2007), participation in community sports (Sallis et al., 2000), having a safe environment for physical activity (Allender et al., 2006; Ferreira et al., 2006; Lowry et al., 1996) , the season (i.e. summer) (Sallis et al., 2000), and time spent outdoors also have a positive impact on physical activity levels (Sallis et al., 2000).

2.7 Changes in Physical Activity Levels

Investigations into changes in physical activity levels over time have shown a marked decline in physical activity levels as children progress from childhood to adolescence and into adulthood (Brodersen, Steptoe, Boniface, & Wardle, 2007; Craggs et al., 2011;

Rodrigues et al., 2010). Sallis has even called this decline a "robust epidemiological phenomenon" (Sallis et al., 2000). This decrease is seen more predominantly in females as opposed to males (Brodersen et al., 2007; Craggs et al., 2011) and has been linked by some researchers to the effect of biologic maturation (Rodrigues et al., 2010). Decreased physical activity levels as children age has also been linked to an increase in overweight and obesity (Broderson et al., 2007).

A systematic review by Craggs and colleagues (Craggs et al., 2011) set out to identify the factors that might be associated with the observed decline in physical activity levels. Their review indicated that for adolescents over the age of 14, higher levels of perceived behavioural control, social support, self-efficacy, socioeconomic status, perceived competency, self-worth, goal setting, physical activity attitude, intention, enjoyment of physical activity, previous physical activity, parental support for physical activity, parental physical activity, peer attitudes and availability of infrastructure and equipment were all negatively associated with declines in physical activity levels.

Additional research in the area of physical activity decline in adolescence has also found that being overweight (Rangul et al., 2011), dissatisfied with life (Rangul et al., 2011), smoking (Kwan et al., 2011; Rangul et al., 2011), and alcohol consumption (Kwan et al., 2012; Rangul et al., 2011) were positively associated with the decline in physical activity rates.

Chapter 3 - Methods

3.1 Study Design

This study is a secondary analysis of data derived from a cross-sectional school-based survey conducted by the Interlake Regional Health Authority (IRHA) in the Interlake region of the province of Manitoba. The survey instrument is the "Youth Health Survey" (YHS) and was implemented in 2005 (n=5436 students in 42 schools) and 2009 (n=5275 in 53 schools). All publicly funded schools in the Interlake region participated in the YHS.

This observational study has both cross-sectional and longitudinal components. An analysis of the cross-sectional data collected by the IRHA was conducted to determine what the physical activity levels of Interlake students is and to determine which individual, social and environmental factors are uniquely associated with these physical activity levels. The longitudinal component consists of measuring the changes over time (i.e. between 2005 and 2009) in physical activity levels.

Although the individual students could not be followed over time to determine individual changes in physical activity levels, a significant portion of the student population who were in grade 6 to 8 in 2005 were resurveyed as grade 10 to 12 students in 2009. This allowed us to compare these students in grade groups to determine what, if any, change could be observed between the two cycles of the survey. As an example, the grade 6 students from 2005 would have completed the survey in 2009 as grade 10 students. Comparisons can be made between grade 6 in 2005 and grade 10 in 2009 to determine if a change in overall physical activity had occurred.

The YHS, a cross-sectional health behaviour survey, is repeated approximately every four years. A census approach to sampling is utilized (i.e. all students are targeted for data collection). The target population for both cycles of the YHS was all Interlake students in grades 6 to 12 attending school. Invitations to participate were extended to all public, private, faith based, independent, Hutterian and First Nations schools. Unfortunately, a small number of Interlake students were not included in the survey due to logistical difficulties involved in facilitating their participation. Under-represented groups include students attending some of the faith-based and private schools, some Hutterian schools, some schools in First Nations communities and home-schooled children and accounts for less than 5% of all of the grade 6 to 12 student population of the Interlake.

The total sample size for this study is 10,774 surveys, therefore this study has sufficient power to find genuine differences if they exist. Also, the study will have the required minimum number of students in each category of responses (n=10) for each independent variable, which will ensure that the results of the logistic regression analysis can be relied upon (Chateau, 2011). The smallest cell size in this study was 272.

The following list of variables will be included in the initial phases of the study:

Table 1: Initial list of independent variables

Individual	Social	Environmental
• Grade • Gender • Age • Transport to school • Sedentary time • Alcohol use • Healthy eating • Drug use • Smoking status • Perception of BMI • Self-reported BMI • Feelings of hopelessness	• Parental support & encouragement of PA • Peer support of PA • School connectedness	• Feel safe at school • School curriculum includes content on physical activity • School setting
		School Level
		• School SES • School level average for importance of PA

3.2 Youth Health Survey Tool

The survey tool was developed by the Interlake RHA in order to gather community level data on the health behaviours of school-aged children within their region. The data collected in this survey was used to facilitate planning of healthy living and health promotion programs within the RHA and amongst their community partners. The data was provided to the schools and school divisions in a report format to facilitate their planning activities. It was also included in the Interlake RHA 2009 YHS Report (Interlake Regional Health Authority, 2009).

The self-administered survey tool is comprised of questions from validated surveys, such as the University of Waterloo's SHAPES Youth Survey Modules, Statistics Canada's Canadian Community Health Survey (CCHS), and the Youth Risk Behaviour Survey (YRBS) from the Center for Disease Control and Prevention (CDC), as well as regionally developed local content. Copies of the 2005 and 2009 surveys are attached as

Appendix 2 and 3, respectively. A summary of the survey questions used in this study and their originating source is located in Appendix 4.

Information on health behaviors are routinely collected using self-reported surveys, an indirect measure, and this method was chosen by the Interlake RHA. Self-reported surveys are by far the most frequently used methods for practical reasons including their low cost and ease of use (Wilcox & Ainsworth, 2009).

Reliability and validity testing has been conducted on a majority of the questions and derived variables from each survey tool. Acceptable reliability and validity scores were achieved on many of the items in each survey (Brener et al., 2002; Centres for Disease Control and Prevention, 2004; Wong et al., 2006). Kappa values greater than 0.41 show moderate strength of agreement between tests and values greater than 0.61 show substantial strength of agreement (Landis & Koch, 1977). Appendix 4 includes kappa scores and correlation values for many of the pre-existing survey questions that were included in the YHS. Reported kappa scores range in value from 0.50 for school connectedness to 0.80 for smoking status.

Both cycles of the survey were conducted using anonymous, paper based surveys, which were completed by the students during a class period. Students were not provided any compensation to complete this survey. The Interlake RHA used passive consent to reduce demands on the schools and to increase student participation rates. Consent was achieved by the Interlake RHA at the school division level to allow students to complete the surveys. Completed surveys were scanned by the Interlake RHA and the data was sent to the Epidemiology Unit at CancerCare Manitoba for preliminary analysis and reporting back to the RHA and schools. The analysis included the production of basic

descriptive statistics, which were then included in reports prepared at the school, school division and regional levels. Both surveys included questions on physical activity, healthy eating, tobacco, drugs and alcohol, mental health and school connectedness. The 2009 survey had an enhanced mental health section and also included questions on safety and injury prevention.

3.3 Study Variables

The dependent variable under study is physical activity levels of Interlake youth between the ages of 11 and 18. The physical activity level used in this study was an estimation based on calculations derived from responses to question on the YHS, as described in Section 2.3 – Measurement of Physical Activity in Youth. Physical activity is presented as a binary categorical variable with "active" and "moderately active/inactive" as outcome categories. Moderately active and inactive were added together into one category (moderately active/inactive) because there were 3310 responses in the moderately active category and 1658 responses in the inactive category compared to 5806 responses in the active category. After the combination of categories, the final two categories were more comparable in size (active = 5806 and moderately active/inactive = 4968). Having the two categories more comparable in size will ensure that the logistic regression models will converge. Also, as discussed in more detail in Section 3.5 – Overview of Analysis Methods, the statistical software used (SAS version 9.2) requires a binary outcome variable in order to proceed with generalized estimating equations in the GENMOD procedure.

The independent variables that are included in the study as potential correlates of physical activity represent a range of individual, social, environmental and school-level factors that previous research has shown to be associated with physical activity levels in similar populations and are listed in Table 1.

Individual variables include: *grade, sex, active transportation to school, sedentary behaviour, healthy eating, smoking status, body mass index (BMI), self-perception of body image and feelings of hopelessness*. The social variable included in this study is *school connectedness*. Environmental variables include: *feeling safe at school and whether or not the school curriculum included content on physical activity*. The final set of variables are school-level variables and include a *measure of the socio-economic status of the school area and the school average score for the importance of physical activity*.

The first school-level variable, the socio-economic status of the school neighbourhood, was measured using the Socio-Economic Factor Index (SEFI). SEFI is an index created by the Manitoba Centre for Health Policy (MCHP) to examine the relationship of a population's socioeconomic characteristics to its health status and use of health care services (Manitoba Centre for Health Policy,n.d.). SEFI has been used in numerous studies of health behaviours and health status (Chateau, Metge, Prior, & Soodeen, 2012; Roos, Magoon, Gupta, Chateau, & Veuglers, 2004). The second school-level variable, the school-level importance of physical activity variable, is derived based on the overall school average for student responses to the question "the subjects taught at school teach about why it is important to be physically active". This school average was then applied to each student as one of the school-level variables. Results of each school environment indicator were placed into quartiles that were then used to create measures

of the school environment. In the school-level importance of physical activity, quartile 1 is the least desirable score and 4 is the most desirable score. In the SEFI score, 1 is the most desirable score and 4 is the least desirable score due to the fact that having a lower SEFI score indicates a higher socio-economic status. These quartile scores were applied to each student as the school-level variables.

Some of the study variables are derived and others are calculated frequencies from the survey results. A complete listing of study variables can be found in Appendix 4 and 5. Appendix 4 indicates the source of the survey question, with references and scores for reliability and validity testing. Appendix 5 indicates the type of variable, its range of values and the calculation method, if it is a derived variable.

3.4 Calculation of Derived Variables

Some of the variables included in the study are derived variables (i.e. calculated using responses to specific survey questions). A summary of the derived variables, including references supporting calculations and cut-off points follows.

a. Physical activity level – Physical activity level was estimated using kilocalories per kilogram of body weight per day (KKD). KKDs are calculated by multiplying the number of hours of each type of physical activity, moderate or vigorous, by the average number of metabolic equivalents (METs) expended in each type of activity. Metabolic equivalents (METs) are commonly used to express the intensity of physical activity (i.e. moderate or vigorous) by estimating the amount of oxygen used by the body during physical activity (World Health Organization, 2004b). The MET is the ratio of an adult person's working metabolic rate relative

to their resting metabolic rate. One MET is defined as the energy cost of sitting quietly at rest and is equivalent to a caloric consumption of 1 kcal/kg/hour. It is estimated that compared with sitting quietly, a person's caloric consumption is three to six times higher when being moderately active (3 – 6 METs) and more than six times higher when being vigorously active (>6 METs) (Centres for Disease Control and Prevention, b; World Health Organization, 2004b). Greater detail can be found in Section 2.3 - Measurement of Physical Activity. Using previously validated survey questions (Wong et al., 2006) students were asked to record their daily amount of moderate (MPA) and vigorous (VPA) physical activity in 15-minute intervals. The average daily KKD will be calculated as:

KKD = [(Hours of moderate PA * 3 MET) + (Hours of vigorous PA * 6 MET)] / 7 days.

According to this formula, 3 KKD would be roughly equivalent to 1 hour of moderate activity or 30 minutes of vigorous activity daily, while 6 KKD would be equivalent to 2 hours of moderate activity or 1 hour of vigorous activity daily (Leggett, Irwin, Griffith, Xue, & Fradette, 2011). As such, 6 KKD would classify a student as active according to the Canadian Physical Activity Guidelines (2011). However, based on the knowledge that youth consistently over-report physical activity (Robertson-Wilson, Leatherdale, & Wong, 2008), participants were classified as moderately active/inactive if they expended <= 8 KKD or active if they expended > 8 KKD (Leggett et al., 2011). Therefore the physical activity

variable will be expressed as a categorical variable with two values (moderately active/inactive and active).

b. Body Mass Index (BMI) – The students 'self-reported height and weight was used to calculate each students' BMI score using the standard BMI formula:

BMI = weight (kg)/[height (m)]^2

BMI scores were categorized as underweight (< 5th percentile), normal weight (5th to < 85th percentile), overweight and obese (equal to or > 85th percentile) based on the age and sex specific CDC guidelines (Centres for Disease Control and Prevention, 2004).

c. Smoking status – Smoking status is determined by student responses to the smoking questions and is categorized as follows

Daily smoker: has smoked every day or almost every day in last 30 days
Occasional smoker: has smoked some days or 1 or 2 days in last 30 days
Non-smoker: has not smoked in last 30 days
(University of Waterloo, 2010).

d. Healthy eating – The responses to the healthy eating questions were totalled and divided by 7 to obtain the average daily consumption of fruits and vegetables, expressed as "times per day".

e. Sedentary time – Weekly sedentary time is calculated by adding together the daily reported sedentary time for questions on watching TV, computer time, playing video games, etc.

3.5 Overview of Analysis Methods

All analysis was conducted using SAS version 9.2. A descriptive analysis was conducted first, including chi-squared analyses, in order to understand the distribution of each variable in the study and to determine if there was any difference between males and females in the study group. Risk ratios were then calculated for 2005 and 2009 and compared to determine if there was any change over time in physical activity level. Univarite analysis (logistic regression) was conducted as the first level in the investigation of the relationship between each independent variable and the dependent variable, physical activity. This facilitated the understanding of the unadjusted relationships between each independent variable and physical activity.

The dependent variable in this study, physical activity, is binary therefore multi-level logistic regression was conducted to investigate individual- and group-level variables simultaneously. Given that there are two cycles of the YHS included in this study there is a very strong likelihood that responses are correlated over the two time periods. The usual assumption of regression models, that observations are independent, is violated as

some students are in both time periods. A generalized estimating equation (GEE), including both individual- and group-level effects, was used to adjust for these correlated measures and the clustering of students at the school level to answer the research questions.

GEE methods (an example of a marginal model) are used to analyze longitudinal and other correlated response data, particularly if the response is binary. This method assumes that measurements are independent across the clusters (i.e. between the schools) but are correlated within the clusters (i.e. within the schools). GEE values are adjusted for these correlations essentially by widening the standard errors found in the analysis. The focus of GEEs is the estimation of the average responses over the population to obtain population-averaged effects (Hanley, Negassa, deB. Edwardes, & Forrester, 2003). Population-averaged effects are appropriate for this study as we are attempting to make inferences about the youth population of the Interlake as a whole and not about individual students within the Interlake.

Chapter 4 - Results

4.1 Descriptive Statistics

Descriptive statistics (by sex) of all variables included in the study are presented in Tables 2 to 5. The total sample size was 10,774 with 5,499 surveys completed in 2005 and 5,275 surveys completed in 2009. Slightly less than half of the students who participated in the survey over the two cycles (2005 & 2009) were female (48.5%) whereas 50.5% were male. One percent of students did not state their sex.

Table 2: Descriptive Statistics of Interlake Students by Sex - Individual Level Variables

		TOTAL		FEMALE		MALE		X^2
		N	% of total sample	N	% of row total	N	% of row total	
Year (n=10665)*								
	2005	5441	51%	2663	48.9%	2778	51.1%	X^2=0.004, df=1, p=0.9495
	2009	5224	49%	2560	49%	2664	51%	
Grade (n=10654)								
	6	1503	14.1%	765	50.9%	738	49.1%	X^2=8.8943, df=6, p=0.1796
	7	1612	15.1%	770	47.8%	842	52.2%	
	8	1720	16.1%	858	49.9%	862	50.1%	
	9	1706	16%	818	48%	888	52%	
	10	1509	14.2%	753	50%	756	50%	
	11	1349	12.7%	671	50%	678	50%	
	12	1255	11.8%	581	46.3%	674	53.7%	
Physical Activity (n=10408)								
	Moderately Active/Inactive	4821	46.3%	2671	55.4%	2149	44.6%	X^2=138.051, df=2, p<.0001
	Active	5587	53.7%	2452	43.9%	3135	56.1%	

		TOTAL		FEMALE		MALE		X^2
		N	% of total sample	N	% of row total	N	% of row total	
Active Transport (n=10408)								
	Inactive	6197	59.5%	2970	47.9%	3227	52.1%	X^2=29.5616, df=2, p<.0001
	Mixed	1901	18.3%	1043	54.9%	858	45.1%	
	Active	2310	22.2%	1111	48.1%	1199	51.9%	
Sedentary Behaviour (n=10408)								
	< 1 hour	202	1.9%	76	37.6%	126	62.4%	X^2=11.6609, df=2, p=0.0029
	1 – 2 hours	358	3.4%	184	51.4%	174	48.6%	
	3 + hours	9848	94.7%	4864	49.4%	4984	50.6%	
Healthy Eating (n=10408)								
	<= 2 servings	4538	43.6%	2198	48.4%	2340	51.6%	X^2=13.9784, df=2, p=0.0009
	3 – 6 servings	4222	40.6%	2164	51.3%	2058	48.7%	
	7+ servings	1648	15.8%	762	46.2%	886	53.8%	
Smoking Status (n=10408)								
	Non smoker	8664	83.2%	4174	48.2%	4490	51.8%	X^2=23.1223, df=2, p<.0001
	Occasional Smoker	1024	9.8%	561	55.8%	463	45.2%	
	Daily Smoker	720	6.9%	389	54%	331	46%	
Alcohol Use (n=10341)								
	None	6209	60%	3115	50.2%	3094	49.8%	X^2=22.9903, df=2, p<.0001
	1 – 2 days	2022	19.6%	1051	52%	971	48%	
	3 + days	2110	20.4%	950	45%	1150	55%	
Illegal Drug Use (n=9876)								
	None	7974	80.7%	4036	50.6%	3938	49.4%	X^2=31.25, df=2, p<.0001
	1 – 2 times	712	7.2%	381	53.5%	331	46.5%	
	3 + times	1190	12.1%	506	42.5%	684	57.5%	

		TOTAL		FEMALE		MALE		X^2
		N	% of total sample	N	% of row total	N	% of row total	
Body Image (n=10144)								
	Underweight	1011	10%	367	36.3%	644	63.7%	X^2=169.6418, df=2, p<.0001
	Healthy Weight	6647	65.5%	3177	47.8%	3470	52.2%	
	Overweight/Obese	2486	24.5%	1469	59.1%	1017	40.9%	
BMI (n=7621)								
	Underweight	270	3.5%	137	50.7%	133	49.3%	X^2=131.8997, df=3, p<.0001
	Healthy Weight	5414	71%	2699	49.9%	2715	50.1%	
	Overweight	1154	15.1%	472	40.9%	682	59.1%	
	Obese	783	10.3%	231	29.5%	552	70.5%	
Feeling Hopeless (n=10210)								
	Yes	3818	37.4%	2284	59.8%	1534	40.2%	X^2=259.4058, df=1, p<.0001
	No	6392	62.6%	2771	43.4%	3621	56.6%	

* Numbers may not equal total sample size because of missing values

Table 2 describes the individual level variables of the students in the study. The grade distribution of students decreased from 14.1% in grade 6 to 11.8% in grade 12. Students in grades 6 to 8 accounted for 45.3% of all students and 54.4% were in grades 9 to 12, which suggests a slightly younger student population in the study.

More than half of all students were active (53.7%) and 46.3% were moderately active/inactive. Males comprised 56.1% of the active students. Two other indicators related to physical activity were also measured, active transportation to school and sedentary behaviour. Forty percent of students got to school using active transportation or a mix of active and inactive modes. Six percent of students reported less than 3 hours

of daily sedentary time. Of the students who reported less than 3 hours of daily sedentary time, 46% were female and 54% were male.

With respect to healthy personal behaviours, 15.8% of students met the requirements of Canada's Food Guide by consuming 7 or more servings of fruits and vegetables on a daily basis. When reporting drug and alcohol use, a majority of all students stated that they had not used either substance. Females reported slightly higher smoking rates, accounting for 54% of all daily smokers.

Students were also asked to report their height and weight in order to calculate their body mass index (BMI). The BMI calculations were made according to the CDC guidelines (Centres for Disease Control and Prevention, a) which are an age and sex specific calculation. They were also asked to report their own perceptions of their body weight. More females perceive themselves as being overweight or obese than males but significantly fewer females had an estimated BMI that places them in the overweight or obese categories. The results for males are reversed with 19.8% of males perceiving themselves as being overweight or obese but their calculated BMI's place 30.3% in the overweight or obese categories.

On an overall measure of mental health, feeling hopeless, 37% of students reported that they had felt sad or hopeless in the past year. Sixty percent of this group were female and 40% were male.

Table 3: Descriptive Statistics of Interlake Students by Gender - Social Level Variables

		TOTAL		FEMALE		MALE		X^2
		N	% of total sample	N	% of row total	N	% of row total	
School Connectedness (n=10057)								
	Agree	8022	79.8%	4002	49.9%	4020	50.1%	X^2=0.5790, df=1, p=0.4467
	Disagree	5224	20.2%	996	48.9%	1039	51.1%	

* Numbers may not equal total sample size because of missing values

One social level variable is included in this study, feelings of connectedness to school. Eighty percent of students feel connected to their school.

Table 4: Descriptive Statistics of Interlake Students by Gender - Environmental Level Variables

		TOTAL		FEMALE		MALE		X^2
		N	% of total sample	N	% of row total	N	% of row total	
Feel safe at school (n=10032)								
	Agree	8374	83.5%	4206	50.2%	4168	49.7%	X^2=8.1879 df=1, p=0.0042
	Disagree	1658	16.5%	769	46.4%	889	53.6%	
Importance of PA (n=10231)								
	Yes	7604	74.3%	3824	50.3%	3780	49.7%	X^2=19.9481 df=2, p<.0001
	No	1013	9.9%	434	42.8%	579	57.2%	
	I don't know	1614	15.8%	790	49%	824	51%	
Results of Not Being PA (n=10219)								
	Yes	5837	57.1%	2917	50%	2920	50%	X^2=10.1048 df=2, p=0.0064
	No	2073	20.3%	958	46.2%	1115	53.8%	
	I don't know	2309	22.6%	1164	50.4%	1145	49.6%	

		TOTAL		FEMALE		MALE		X^2
		N	% of total sample	N	% of row total	N	% of row total	
Friends Influence on PA								
	Yes	4401	43%	2049	46.6%	2352	53.4%	X^2=25.2185 df=2, p<.0001
	No	3023	29.5%	1542	51%	1481	49%	
	I don't know	2815	27.5%	1465	52%	1350	48%	
TV Influence on PA (n=10186)								
	Yes	3802	37.3%	1782	46.9%	2020	53.1%	X^2=19.4971 df=2, p<.0001
	No	3535	34.7%	1759	49.8%	1776	50.2%	
	I don't know	2849	28%	1490	52.3%	1359	47.7%	

* Numbers may not equal total sample size because of missing values

Table 4 describes the environmental level variables included in the study. When commenting on how safe they felt in school, 83.5% of students reported feeling safe when in school. Students were also asked whether or not their classes taught them about influences on their physical activity levels: 74.3% report being taught about the importance of being physically active; 57.1% report that they are taught about the results of not being physically active; 43% are taught how much your friends can influence your physical activity levels; and, 37.3% are taught how much TV can influence your physical activity levels.

Table 5: Descriptive Statistics of Interlake Students by Gender - School Level Variables

		TOTAL		FEMALE		MALE		X^2
		N	% of total sample	N	% of row total	N	% of row total	
School level importance of PA (n=10665)								
	1 (low)	3032	28.4%	1514	50%	1517	50%	X^2=4.0912, df=3, p=0.2518
	2	2233	20.9%	1115	49.9%	1118	50.1%	
	3	3065	28.7	1466	47.8%	1599	52.2	
	4 (high)	2335	21.9%	1127	48.3%	1208	51.7%	
SEFI (n=10665)								
	1 (high)	3557	33.4%	1760	49.5%	1797	50.5%	X^2=0.5497, df=3, p=0.9078
	2	2050	19.2%	998	48.7%	1052	51.3%	
	3	2760	25.9%	1345	48.7%	1415	51.3%	
	4 (low)	2298	21.6%	1120	48.7%	1178	51.3%	

* Numbers may not equal total sample size because of missing values

Table 5 describes the school-level variables included in the study. Thirty-three percent of students attended a school in the highest SEFI category. Twenty-two percent of students attended a school having the greatest percentage of students report being taught about the benefits of physical activity in their classes.

A majority of the variables included in these descriptive statistics (Tables 2 to 5) showed a significant association between sex and the variables with the significance set at $p < 0.05$. Non-significant associations were found in the year of the survey, the students' grade, school connectedness, SEFI score and school level importance of PA.

4.2 Changes Over Time

The calculated relative risk of being physically active versus being moderately active/inactive between the years of 2009 and 2005 was used to measure change over time in the physical activity levels of the students. Relative risk is used because it is important to determine the nature of the association and the strength of the relationship through the examination of proportions. Relative risk also measures events in a way that is interpretable and consistent with the way people think (Simon, 2001) . Results from this analysis are presented in Tables 6 and 7 and key elements have been graphed in Figures 6 to 8.

Table 6: Relative Risk of being active versus moderately active/inactive between 2009 and 2005 for various grades and grade groupings

	2009 vs 2005			
	N = 10,774*	**% active 2009 / 2005**	**RR****	**95% CI**
All grades, all students	10,774	54.22/52.65	1.03	0.99,1.07
All grades, Female	5,223	48.95/46.53	1.05	0.99,1.11
All grades, Male	5,442	59.23/58.42	1.01	0.97,1.06
Grade 6, all students	1,521	54.39/54.10	1.01	0.92,1.10
Grade 6, Female	765	52.30/51.74	1.01	0.88,1.16
Grade 6, Male	738	56.92/56.67	1.00	0.88,1.14
Grade 7, all students	1,629	57.38/57.77	0.99	0.91,1.08
Grade 7, Female	770	57.10/53.96	1.06	0.93,1.20
Grade 7, Male	842	57.28/61.40	0.93	0.83,1.04
Grade 8, all students	1,739	58.17/55.16	1.05	0.97,1.15
Grade 8, Female	858	52.22/48.77	1.07	0.94,1.22
Grade 8, Male	862	64.87/61.38	1.06	0.95,1.17

	2009 vs 2005			
	N = 10,774*	**% active 2009 / 2005**	**RR****	**95% CI**
Grade 9, all students	1,718	59.26/55.26	1.07	0.99,1.16
Grade 9, Female	818	54.24/49.18	1.10	0.97,1.26
Grade 9, Male	888	64.05/60.47	1.06	0.96,1.17
Grade 10, all students	1,523	53.19/52.92	1.01	0.91,1.10
Grade 10, Female	753	44.20/44.76	0.99	0.84,1.16
Grade 10, Male	756	61.52/61.50	1.00	0.89,1.12
Grade 11, all students	1,362	49.48/45.84	1.08	0.97,1.21
Grade 11, Female	671	42.49/38.83	1.09	0.99,1.31
Grade 11, Male	678	55.49/53.56	1.04	0.90,1.19
Grade 12, all students	1,271	44.59/44.17	1.01	0.89,1.14
Grade 12, Female	581	34.91/34.97	1.00	0.80,1.25
Grade 12, Male	674	52.08/51.48	1.01	0.87,1.17

*Numbers may not add to total because of missing values
**Greater than 1 = more active in 2009, less than 1 = less active in 2009

When comparing all students taken together (all grades, male and female) from Table 6, we see that students are not statistically more active in 2009 (RR = 1.03, 0.99-1.07, NS) even though a slight trend appears in the more active direction. Figure 6 graphically presents these rates for each grade. When separating the students by grade we see the same trend as evidenced when all students are taken together.

Figure 6: Percentage of Active Students by Grade for 2005 and 2009

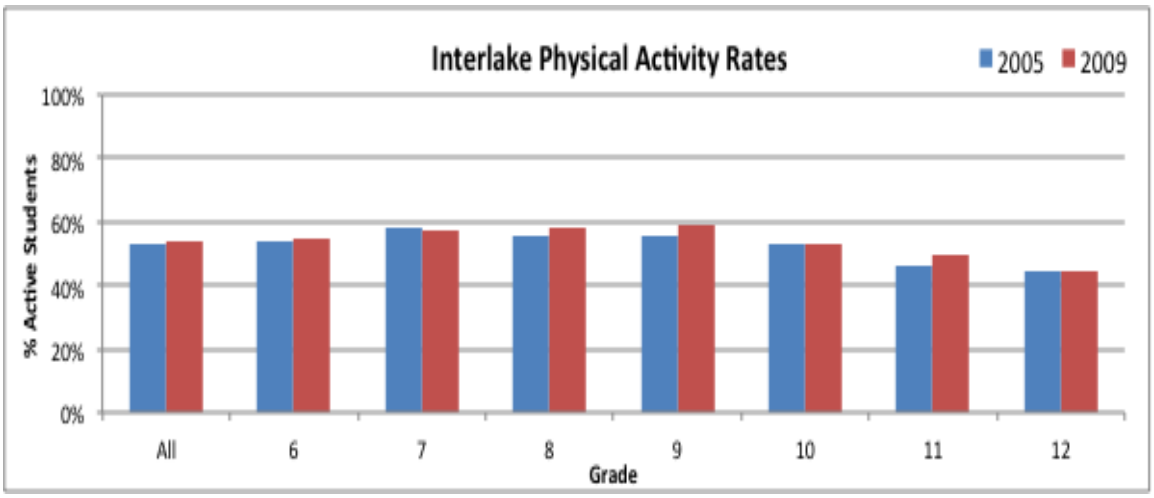


Table 7: Relative Risk of being active versus moderately active/inactive between 2009 and 2005 to illustrate changes over time in groupings of students

	2009 vs 2005			
	N = 10,774*	**% active 2009/2005**	**RR****	**95% CI**
Grades 6 to 8 (2005) to Grades 10 to 12 (2009), all students	4,564	49.39/55.70	0.89	**0.84,0.94**
Grades 6 to 8 (2005) to Grades 10 to 12 (2009), Females	2144	40.98/51.48	0.80	**0.72,0.87**
Grades 6 to 8 (2005) to Grades 10 to 12 (2009), Males	2371	56.63/59.84	0.95	0.88,1.01
Grade 6 (2005) to Grade 10 (2009), all students	1,573	53.19/54.10	0.98	0.90,1.08
Grade 6 (2005) to Grade 10 (2009), Female	744	44.20/51.74	0.85	**0.73,0.99**
Grade 6 (2005) to Grade 10 (2009), Male	815	61.52/56.67	1.09	0.97,1.22

	2009 vs 2005			
	N = 10,774*	**% active 2009/2005**	**RR****	**95% CI**
Grade 7 (2005) to Grade 11 (2009), all students	1,520	49.48/57.77	0.86	**0.78,0.94**
Grade 7 (2005) to Grade 11 (2009), Female	717	42.49/53.96	0.79	**0.67,0.92**
Grade 7(2005) to Grade 11 (2009), Male	785	55.49/61.40	0.90	0.80,1.02
Grade 8 (2005) to Grade 12 (2009), all students	1,471	44.59/55.16	0.81	**0.73,0.90**
Grade 8 (2005) to Grade 12 (2009), Female	683	34.91/48.77	0.72	**0.59,0.87**
Grade 8 (2005) to Grade 12 (2009), Male	771	52.08/61.38	0.85	**0.75,0.96**

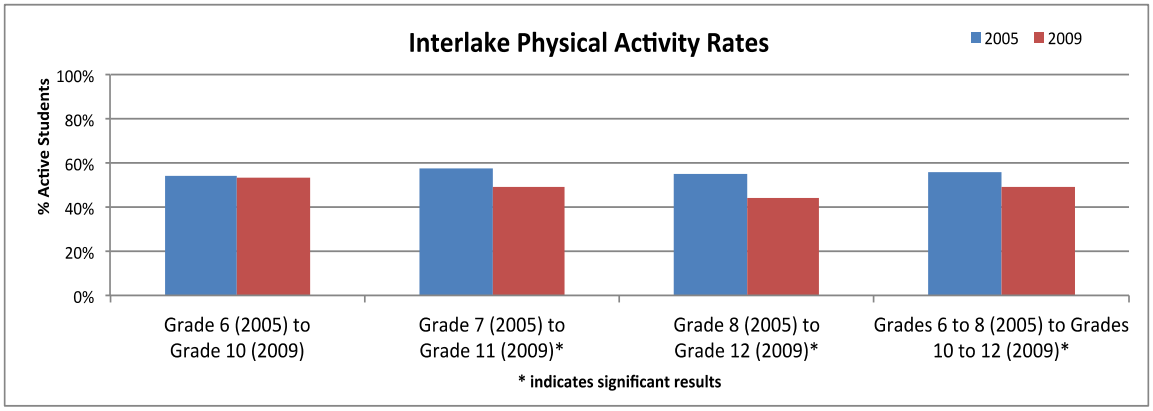
*Numbers may not add to total because of missing values
**Greater than 1 = more active in 2009, Less than 1 = more active in 2005
Bold indicates significant result

As evidenced in the literature, it is important to determine when students' physical activity levels change during their school years. The complete dataset contains two cycles of survey data and some of the students would be in both cycles (i.e. grade 6 students in 2005 will be in grade 10 in 2009, grade 7 students in 2005 will be in grade 11 in 2009 and grade 8 students in 2005 will be in grade 12 in 2009). Table 7 compares students by grade in 2005 with the grade they would be in in 2009 in an attempt to capture the effect of time on the same or similar groups of students. In order to identify such changes over time we compare the results for students in grades 6 to 8 in 2005 with students in grades 10 to 12 in 2009.

We observe that females moving from grade 6 in 2005 to grade 10 in 2009 are less active (RR=0.85 (0.73, 0.99)); all students moving from grade 7 in 2005 to grade 11 in 2009 are less active (RR=0.86 (0.78, 0.94)) as well as females alone in this time period (RR=0.79 (0.67, 0.92)); and, all students moving from grade 8 in 2005 to grade 12 in 2009 are less active (RR=0.81 (0.73, 0.90)).

When we compare the aggregate of grades 6 to 8 students in 2005 with grades 10 to 12 students in 2009 we observe that all students (RR=0.89 (0.84, 0.94)) and females alone (RR=0.80 (0.7247, 0.87)) are less active. These comparisons are also illustrated in Figure 7.

Figure 7: Changes over time in the percentage of active students (2005 compared to 2009) for grade groupings



The above analysis considers the "active" group alone and we see student physical activity decreasing as they age and move through high school, especially the female students. This finding is consistent with findings of other research studies (Craggs et al. 2011 and Broderson et al. 2007).

An additional analysis was conducted at this point to determine if differing results would be obtained by combining results from the "active" and "moderately active"

students and comparing these over time. By combining active and moderately active students we begin to observe slight increases in physical activity rates (See Table 8 and Figure 8). This indicates that gains are being made in increasing the percentage of students that fall into the moderately active category.

Table 8: Relative Risk of being active/moderately active versus inactive between 2009 and 2005 to illustrate changes over time in groupings of students

	2009 vs 2005			
	N = 10,774*	**% active 2009/2005**	**RR****	**95% CI**
Grades 6 to 8 (2005) to Grades 10 to 12 (2009), all students	4,564	82.95/85.35	0.97	**0.94,0.99**
Grades 6 to 8 (2005) to Grades 10 to 12 (2009), Females	2144	79.87/84.73	0.94	**0.90,0.98**
Grades 6 to 8 (2005) to Grades 10 to 12 (2009), Males	2371	.85.54/86.15	0.99	0.96,1.02
Grade 6 (2005) to Grade 10 (2009), all students	1,573	85.83/83.96	1.02	0.98,1.06
Grade 6 (2005) to Grade 10 (2009), Female	744	83.83/85.25	0.98	0.92,1.04
Grade 6 (2005) to Grade 10 (2009), Male	815	87.59/83.33	1.05	0.99,1.11
Grade 7 (2005) to Grade 11 (2009), all students	1,520	81.98/87.07	0.94	**0.90,0.98**
Grade 7 (2005) to Grade 11 (2009), Female	717	79.23/86.88	0.91	**0.85,0.97**
Grade 7(2005) to Grade 11 (2009), Male	785	84.23/87.44	0.96	0.90,1.02
Grade 8 (2005) to Grade 12 (2009), all students	1,471	80.45/84.98	0.95	**0.90,0.99**

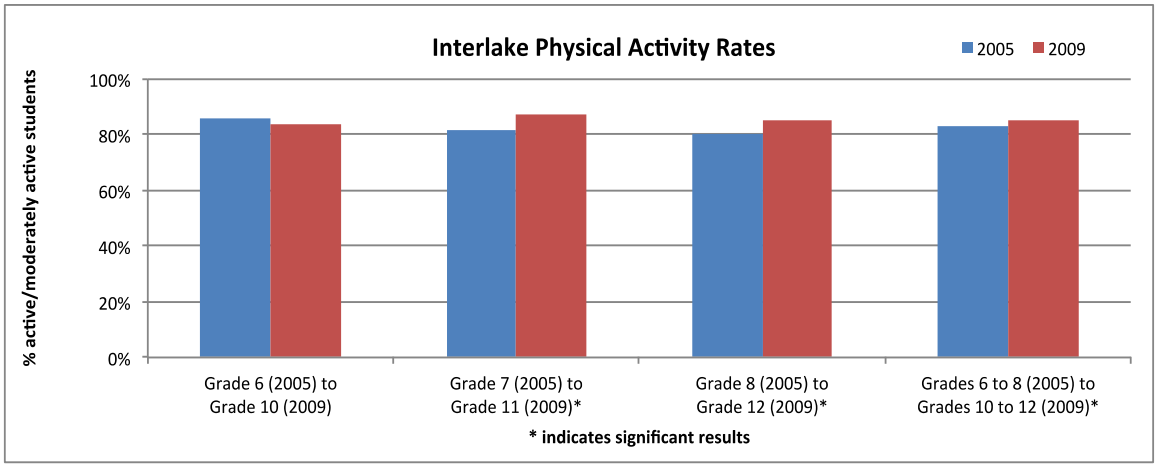
	2009 vs 2005			
	N = 10,774*	**% active 2009/2005**	**RR****	**95% CI**
Grade 8 (2005) to Grade 12 (2009), Female	683	75.27/82.11	0.92	**0.84,0.99**
Grade 8 (2005) to Grade 12 (2009), Male	771	84.52/87.59	0.97	0.91,1.02

*Numbers may not add to total because of missing values

**Greater than 1 = more active in 2009, Less than 1 = more active in 2005

Bold indicates significant result

Figure 8: Change over time in the percentage of active/moderately active students (2005 compared to 2009) for each grade grouping



In summary, as students age they are not statistically more active but we are starting to see a slight increase in physical activity, especially in females.

4.3 Reduction in Number of Independent Variables

At this point in the analysis some independent variables were removed from the models. Age and grade are highly correlated so age was dropped. Research has shown comorbid use of alcohol, drugs and tobacco (Leatherdale & Burkhalter, 2012). In order

to verify this association with the Interlake students, regression and correlation analyses were conducted on alcohol, drugs and tobacco controlling for grade and sex. After controlling for sex and grade, drugs and alcohol use was strongly associated with smoking. Therefore smoking status was used as a proxy for alcohol and drug use in this study. In the survey there are four questions that ask students about the subjects that are taught at school and the results of these are highly correlated. The question asking about the "importance of being physically active" is the most generalizable of the four questions about subjects taught at school and therefore it will be the only one that is carried forward in the study. The remainder of the analysis will use a dataset comprised of the independent variables listed in Table 9.

Table 9: Final List of Independent Variables

Individual	Social	Environmental
• Grade • Sex • Active transport to school • Sedentary behaviour • Healthy eating • Smoking status • BMI • Body Image • Feelings of hopelessness	• School connectedness	• Feel safe at school • Subjects taught at school teach about the benefits of PA
		School Level
		• SEFI quartiles • School level importance of PA quartiles

4.4 Univariate Regression

A univariate logistic regression was conducted to compare each independent variable with physical activity. The results of this univariate regression presented in Table 10 represent the association between each independent variable and the outcome variable of physical activity level for all students in the study.

Table 10: Univariate associations between study variables and physical activity for all students

n = 10774	**Crude Odds Ratio Active vs ModAct/Inactive**	
Independent Variables	**OR (95% CI)**	***p***
Male	1.00	
Female	0.66 (0.60, 0.70)	<.0001
Grade 6	1.00	
Grade 7	1.05 (0.91, 1.21)	0.4894
Grade 8	1.01 (0.88, 1.16)	0.8532
Grade 9	1.03 (0.90, 1.18)	0.6768
Grade 10	0.87 (0.76, 1.01)	0.0567
Grade 11	0.70 (0.61, 0.81)	<0.0001
Grade 12	0.61 (0.53, 0.71)	<0.0001
Get to school inactively	1.00	
Get to school actively	1.26 (1.17, 1.37)	<0.0001
Subjects teach importance of PA - no	1.00	
Subjects teach importance of PA - yes	1.14 (1.00, 1.29)	0.0546
Sedentary time - < 1 hour	1.00	
1-2 hours	1.94 (1.43, 2.62)	<0.0001
3+ hours	2.10 (1.68, 2.63)	<0.0001
Healthy eating - <= 2 servings	1.00	
3-6 servings	1.73 (1.59, 1.88)	<.0001
7+ servings	2.57 (2.29, 2.89)	<.0001
Smoking status - non-smoker	1.00	
Daily smoker	0.81 (0.73, 0.90)	<0.0001

n = 10774	**Crude Odds Ratio** **Active vs ModAct/Inactive**	
Independent Variables	**OR (95% CI)**	***p***
Body image - healthy weight	1.00	
overweight/obese	0.68 (0.62, 0.74)	<0.0001
underweight	0.97 (0.85, 1.11)	0.6434
Feelings of hopelessness - no	1.00	
Feelings of hopelessness - yes	0.79 (0.73, 0.85)	<0.0001
Feel close to people at school - disagree	1.00	
Feel close to people at school - agree	1.43 (1.30, 1.57)	<0.0001
Feel safe at school - disagree	1.00	
Feel safe at school - agree	1.09 (0.98, 1.21)	0.0990
BMI - healthy weight	1.00	
underweight	0.94 (0.73, 1.20)	0.5923
overweight	0.98 (0.87, 1.16)	0.7803
obese	0.78 (0.67, 0.90)	0.0009
Year - 2005	1.00	
2009	1.07 (0.99, 1.15)	0.1021
SEFI - level 4	1.00	
level 3	1.01 (0.90, 1.12)	0.9157
level 2	1.15 (1.02, 1.30)	0.0209
level 1	0.85 (0.77, 0.95)	0.003
school level importance of PA - level 1	1.00	
level 2	0.87 (0.78, 0.97)	0.0137
level 3	1.08 (0.98, 1.20)	0.1151
level 4	0.89 (0.80, 0.99)	0.0382

In order to be more inclusive when choosing the independent variables that would be fitted into the full model, $p<0.10$ was chosen as the cut-off point.

4.5 Multiple Imputation of Body Mass Index

The body mass index variable has a large number of missing values (2005 = 21% and 2009 = 34%) and all other IVs have small percentages of missing values (<= 5%). There have been many procedures developed for dealing with missing values but multiple imputation is now routinely seen as the most useful strategy for dealing with missing data due to the fact that most statistical software now has a relatively straight forward method of handling missingness (Sterne et al., 2009; Yuan, 2000). In order to utilize the full dataset (as opposed to a complete-case analysis methodology), a multiple imputation process was used to impute the missing values of BMI. A dataset for use in the multiple imputation process was created with the independent variables listed in Table 8 plus physical activity, year and school name. Missing BMI values were imputed five times to create five imputed datasets. These five datasets were combined into one large dataset and then used in final model building (UCLA Statistical Consulting Group; Wayman, 2003) . Records with missing values for other variables were deleted from future analysis and the final dataset containing the imputed BMI values had 47,990 records.

4.6 Multinomial Logistic Regression

Model building occurred in a block wise manner, starting with the non-modifiable demographic variables of year, grade & sex. The order of addition of the variables to the

models was based on the social ecological model of health behaviour. The remainder of the individual level variables (active transportation, sedentary time, healthy eating, smoking, BMI, body image and feelings of hopelessness) were added in Model 1. To develop Model 2, the social level variable (felt close to people at school) was included. Physical environment variables (felt safe at school and taught the importance of PA) were included in Model 3. Model 4 was the final model with the addition of the school level variables (school SES (SEFI) and school level importance of PA). None of the variables were dropped during the model building process because they had all proven to be significantly associated with physical activity in the univariate analysis.

During the model building process, BMI and body image were added into the models separately and then together. Both were significant when they were in the model alone, but only body image was significant when they were both in the model, regardless of the other variables in the model. In order to test the association between BMI and body image a logistic regression to predict BMI using year, sex, grade and body image was created. After controlling for year, sex and grade, body image showed strong evidence of having a positive effect on the BMI of students. Given the subjects in this study and the other variables included in this investigation, body image can be used on its own to predict physical activity levels.

The final model (Model 4) in Table 11 shows that sex, year, active transportation to school, healthy eating, body image and feeling close to people at school are all highly associated with physical activity levels of the Interlake students included in this study. Sedentary time, feelings of hopelessness, feeling safe at school and learning about the benefits of physical activity are moderately associated with physical activity levels.

Grade, smoking status, BMI, school SES and school level importance of PA are not associated with the resulting levels of physical activity.

To test the predictive nature of this model, two fictitious students were created. The first student was male and in the lower grade range (grades 6 to 8). He had positive characteristics in the variables that were shown to be associated with physical activity in the model, such as being a non-smoker, having a healthy body image, consuming fruits and vegetables frequently, not feeling hopeless, feeling close to people at school, feeling safe at school, using active transportation to get to school, and not spending too much time watching television. He also attended a school that was in the highest quartile for teaching the importance of physical activity. The model outcome was that this student had a probability of 0.85 of being physically active.

The second student was female and in the higher grade range (grades 9 to 12) and exhibited negative characteristics in the variables that were shown to be associated with physical activity in the model, such as being a smoker, perceiving herself as overweight, not consuming fruits and vegetables frequently, feeling hopeless, not feeling close to people at school, not feeling safe at school, not using active transportation to get to school, and spending too much time watching television. She also attended a school that was in the lowest quartile for teaching the importance of physical activity. The model outcome was that this student had a probability of 0.56 of being physically active. These results demonstrate that the model is a good representation of the correlates of physical activity of the Interlake students that completed the YHS in 2005 and 2009.

Table 11: Fully adjusted odds ratios for active versus moderately active/inactive for all independent variables - Final Model

Active vs Inactive/Moderately Active								
N = 47,900	**Individual Model 1**		**Social Model 2**		**Environment Model 3**		**Final Model 4**	
	OR (95% CI)*	***p***	**OR (95% CI)***	***p***	**OR (95% CI)***	***p***	**OR (95% CI)***	***p***
Sex								
Male	1.00		1.00		1.00		1.00	
Female	0.64 (0.55,0.74)	<.0001	0.63 (0.55,0.73)	<.0001	0.63 (0.55,0.73)	<.0001	0.63 (0.55,0.73)	<.0001
Grade								
Grade 6 - 8	1.00		1.00		1.00		1.00	
Grade 9 - 12	0.95 (0.82,1.09)	0.4397	0.95 (0.82,1.10)	0.4761	0.96 (0.83,1.11)	0.5562	0.96 (0.83,1.11)	0.5562
Year								
2005	1.00		1.00		1.00		1.00	
2009	0.81 (0.71,0.91)	0.0006	0.80 (0.71,0.90)	0.0004	0.80 (0.71,0.90)	0.0002	0.80 (0.71 0.90)	0.0002

	Individual Model 1		**Social Model 2**		**Environment Model 3**		**Final Model 4**	
	OR (95% CI)*	***p***	**OR (95% CI)***	***p***	**OR (95% CI)***	***p***	**OR (95% CI)***	***p***
Active Transportation								
Inactively	1.00		1.00		1.00		1.00	
Actively	1.23 (1.12,1.36)	<.0001	1.23 (1.12,1.35)	<.0001	1.24 (1.12,1.35)	<.0001	1.24 (1.12,1.35)	<.0001
Sedentary Time								
1 - 2 hours	1.00		1.00		1.00		1.00	
3+ hours	1.36 (1.11,1.67)	0.0030	1.35 (1.10,1.67)	0.0048	1.35 (1.10,1.66)	0.0046	1.35 (1.10,1.66)	0.0046
Healthy Eating								
<= 2 servings	1.00		1.00		1.00		1.00	
3 - 6 servings	1.80 (1.59,2.03)	<.0001	1.79 (1.58,2.02)	<.0001	1.79 (1.58,2.01)	<.0001	1.79 (1.58,2.01)	<.0001
7+ servings	2.84 (2.50,3.22)	<.0001	2.83 (2.50,3.20)	<.0001	2.82 (2.49,3.20)		2.82 (2.49,3.20)	

	Individual Model 1		**Social Model 2**		**Environment Model 3**		**Final Model 4**	
	OR (95% CI)*	***p***	**OR (95% CI)***	***p***	**OR (95% CI)***	***p***	**OR (95% CI)***	***p***
Smoking								
Daily smoker	1.00		1.00		1.00		1.00	
Non-smoker	0.99 (0.88,1.12)	0.9146	0.98 (0.87,1.11)	0.7599	0.98 (0.87,1.11)	0.7681	0.98 (0.87,1.11)	0.7681
BMI								
Overweight/obese	1.00		1.00		1.00		1.00	
Healthy weight	1.06 (0.90,1.26)	0.4619	1.07 (0.90,1.26)	0.4540	1.07 (0.90,1.27)	0.4387	1.07 (0.90,1.27)	0.4387
Body Image								
Overweight/obese	1.00		1.00		1.00		1.00	
Healthy weight	1.26 (1.16,1.37)	<.0001	1.24 (1.14,1.35)	<.0001	1.25 (1.14,1.36)	<.0001	1.25 (1.14,1.36)	<.0001
Feelings of Hopelessness								
No	1.00		1.00		1.00		1.00	
Yes	0.88 (0.81,0.95)	0.0022	0.90 (0.82,0.98)	0.0139	0.89 (0.82,0.97)	0.0087	0.89 (0.82,0.97)	0.0087

	Individual Model 1		**Social Model 2**		**Environment Model 3**		**Final Model 4**	
	OR (95% CI)*	***p***	**OR (95% CI)***	***p***	**OR (95% CI)***	***p***	**OR (95% CI)***	***p***
Close to people at school								
Disagree/definitely disagree			1.00		1.00		1.00	
Agree/definitely agree			1.28 (1.18,1.38)	<.0001	1.30 (1.19,1.43)	<.0001	1.30 (1.19,1.43)	<.0001
Feeling safe at school								
Disagree/definitely disagree					1.00		1.00	
Agree/definitely agree					0.88 (0.77,1.00)	0.0421	0.88 (0.77,1.00)	0.0421
Taught the importance of PA								
No					1.00		1.00	
Yes					1.17 (1.01,1.34)	0.031	1.17 (1.01,1.34)	0.031
School SEFI								
Low							1	
High							0.98 (0.80,1.21)	0.8734

	Individual Model 1		**Social Model 2**		**Environment Model 3**		**Final Model 4**	
	OR (95% CI)*	***p***	**OR (95% CI)***	***p***	**OR (95% CI)***	***p***	**OR (95% CI)***	***p***
School level importance of PA								
Low							1	
High							1.04 (0.83,1.30)	0.7439

Chapter 5 - Discussion and Conclusion

5.1 Physical Activity Levels of Interlake Youth

The first research question developed for this study centered on the determination of physical activity levels of Interlake youth in 2005 and 2009 by grade and by sex. It was hypothesized that students in the earlier grades (i.e. grades 6 to 8) would be more physically active than those in the later grades (i.e. grades 9 to 12) and that males would be more active than females.

Study findings showed that overall, slightly more than half of the students reported being physically active (54%) and a greater proportion of male students were physically active (59%) compared to female students (48%). Physical activity rates were just over 50% in grade 7 and increased to nearly 60% by grade 9 but then fell off to 45% by grade 12. This pattern of change was consistent for both sexes but the rate of decline for females was more pronounced. By grade 12 only 35% of females were considered to be physically active whereas over 50% of male students were active.

The findings from this study are very consistent with findings in the published literature. Boys were found to be more active than girls by Brodersen et al. (2007) , Hobin et al. (2010) , Hobin et al. (2012), Jekauc et al. (2012), Koezuka et al. (2006) and Leatherdale et al. (2010). In a study based on a similar population of Manitoba youth and using accelerometers to measure physical activity levels, McGavock (2013) also found that boys are more active than girls. On-line results from the Canadian Community Health Survey between 2008 and 2012 show a slight increase in physical

activity rates of youth between the ages of 12 and 18 in both Manitoba and Canada as a whole (Statistics Canada, 2013).

5.2 Relationship of Physical Activity Level to Student Sex and Time

The second research question developed in this study focussed on the changes in physical activity levels over time. It was hypothesized that physically activity levels would remain relatively constant between 2005 and 2009.

When a comparison was made between the time periods, 2005 and 2009, we saw that students were not statistically more active in 2009. When testing changes in physical activity levels of the same groups of students as they moved through high school (i.e. students in grades 6 to 8 in 2005 were in grades 10 to 12 in 2009) it was found that students, especially female students, are less active over time as they moved through high school. This finding was found when students were analyzed as a group (grades 6 to 8 in 2005 compared to grades 10 to 12 in 2009) as well as when individual grades were compared (i.e. grade 6 in 2005 compared to grade 10 in 2009 and so on).

When comparisons were made combining the active and moderately active categories of physical activity we began to observe slight increases in the moderate physical activity category. This may indicate that increases are being seen in the percentage of students that fall into the moderately active category and may warrant further research. In summary, as students age they are less likely to be physically active. This study demonstrates similar findings although a trend of increased physical activity over time appears to be developing. Future studies such as this may benefit from analyzing physical

activity in three levels (inactive, moderately active and active) to determine if this phenomenon is true.

The topic of physical activity decline in children as they move into adolescence and adulthood has been the subject of much research. Published studies have found similar results as found in this study. Sallis et al. (2000) has found the steepest decline between the ages of 13 and 18 and Dumith et al. (2012) has quantified this decline to be as much as 5% per year. Nelson et al. (2006), Broderson et al. (2007) and Gadella et al. (2012) have also found this decline to be true and Jekauc et al. (2012) found that the steepest decline occurred during the transition from primary school to secondary school (roughly equivalent to grades 8 to 9 in the Manitoba school system). Dumith et al. (2011) and Broderson et al. (2007) reviewed this decline by sex and also found that the decline was greater for girls than it was for boys.

5.3 Individual, Social and Environmental Variables Associated with Physical Activity Levels

The final research question looked at the individual, social and environmental factors that are uniquely associated with the physical activity levels of Interlake youth. It was hypothesized that at the individual level males are more physically active than females, active transportation to school and positive health behaviours (i.e. healthy eating) will be positively associated with physical activity whereas poor mental health status (i.e. feelings of hopelessness), increased BMI and perceived BMI, increased sedentary behaviour, grade and tobacco use will be negatively associated with physical activity. At the social level, school connectedness will be positively associated with physical activity.

At the environmental level, feeling safe at school and learning about the importance of physical activity will also be positively associated with physical activity levels. Additionally, it was hypothesized that at the school level, schools in areas with a higher social economic status and those that have a higher average score for teaching about the importance of physical activity will be positively associated with individual physical activity levels.

In the multinomial logistic regression the male sex, the first year of survey (2005), active transportation to school, healthy eating, having a healthy body image and feeling close to people at school were highly positively associated with physical activity levels. Increased sedentary behaviour and being taught the importance of physical activity were moderately positively associated with physical activity. Whereas having feelings of hopelessness was highly negatively associated and feeling safe at school was moderately negatively associated with physical activity levels of the Interlake students included in this study. Grade, smoking status, BMI, school social economic status and school level importance of physical activity were not associated with the resulting levels of physical activity in this study.

Most surprising amongst these results was the positive association between sedentary behaviour and physical activity and the fact that grade, smoking, BMI and school level variables did not show a significant relationship with physical activity in this study population. Sedentary behaviour may have shown a positive relationship with physical activity, as opposed to the expected negative association, simply because the internet, computer games and videos are such a pervasive part of todays youth culture that they are high for all students or due to the self-reported nature of the survey. Grade, smoking and

BMI may not have shown any association to physical activity level because of other variables in the model or the combination of variables in the model. School level variables may not have shown any association to physical activity level because of the nature of the variables, the fact that they were derived as opposed to collected independently at the time of the survey. There are numerous examples of school level variables in published research that at the time of this study were not available to the researcher for this study population.

Several studies have incorporated a social ecological model into the investigation of correlated factors of physical activity. Most notable among these is Sallis and colleagues (1996, 1999, 2000, 2006, 2008), Schneider & Stokols (2009) and Grzywacz & Fuqua (2000). Their findings have shown that factors at multiple levels of the social ecological model are associated with physical activity levels. Although other research does not always find a relationship between the specific factors that proved significant in the Interlake population, the fact remains that similar correlates are found at all levels of the social ecological model.

The association of the sex of the student and the level of physical activity is the most common finding in correlational studies. Hilland et al. (2011), Sallis et al. (2000), Van der Horst et al. (2007), Kohl & Hobbs (1998), Leatherdale et al. (2010, 2011), Gadalla (2012) and Craggs et al. (2011) have all found that boys are more active than girls. Another common finding is that other personal health behaviours are associated with physical activity. These are positive associations, that is, positive health behaviours are associated with increased physical activity levels. Sallis et al. (2000) found an association between increased healthy eating and decreased sedentary time and increased physical

activity. Leatherdale et al. (2008, 2010, 2011), Perez (2003) and Koezuka et al. (2006) also found a positive association between reduced sedentary time and increased physical activity. Hobin et al. (2012) found an association between active transportation to school and physical activity levels.

If students are taught about the benefits of being physically active there was a positive effect on physical activity. This finding has also been reported in studies by Barr-Anderson et al. (2008), Hallal et al. (2006), Hilland et al. (2011), Kohl & Hobbs (1998), Van der Horst et al. (2007) and Lowry, Lee, Fulton, Demissie, & Kann (2013) . A positive school climate, which can be defined in many different ways, has been shown to be positively associated with physical activity by Barr-Anderson et al (2008) and Hobin et al. (2010). Mental health issues such as depression and feelings of hopelessness have been shown to have a negative association with physical activity by Sallis et al. (2000) and Alamian & Paradis (2012) .

These results demonstrate that when studying the physical activity level of adolescents it is important to consider the age and sex of the study participants as well as all factors that may influence physical activity levels (i.e. individual, inter/intra-personal, organizational, community, environmental and policy). It is also important to examine changes over time. This information is useful when planning interventions and programs aimed at increasing physical activity levels at the community level for youth of various ages.

The significant associations noted above can also be very important at a program level with respect to the sex of the students. This means that the effects of any treatments or programs may produce statistically different effects or results depending on the sex of

the participants. This type of program importance (or significance) is based on literature around successful programming for youth health behaviours (Barr-Anderson et al., 2008; Hobin et al., 2012; Taber et al., 2011). It will be important for those who act on the results of studies such as this to take into consideration the sex of the participants in any programs that will be developed. The following table (Table 12) summarizes the statistically significant findings of this study and identifies which of these findings may have significance with respect to the sex of the participant when developing a program as well.

Table 12: Independent Variables that attained statistical significance and identification of variables that also have program significances

Statistically Significant ($p<0.05$)	**Program Significance**
• body image	• body image
• healthy eating	• healthy eating
• active transport to school	
• sedentary behaviour	• sedentary behaviour
• feelings of hopelessness	• feelings of hopelessness
• importance of being PA	
• feeling safe at school	• feeling safe at school
• close to people at school	• close to people at school

In conclusion, this study found that overall 54% of all students were physically active. Males were more active than females (59% compared to 48%) and younger students were more active than older students (grade 7 – 60% compared to grade 12 – 45%). The rate of decline in the physically activity levels of students was steeper for females than it was for males. By grade 12 only 35% of female students were physically active whereas 50% of male students were physically active. A strong positive association was found between sex (male), year (2005), active transportation to school,

healthy eating, healthy body image, feeling close to people at school and physical activity. A strong negative association was found between feelings of hopelessness and physical activity.

5.4 Strengths and Limitations

The main strength of this study is the large sample size, which allows for the examination of the relationships between the outcome variable (physical activity) and a large numbers of potential correlates. A second strength was the fact the survey participants were from all areas of a very geographically diverse region and this allows for the generalizability of findings to the whole region and potentially many other rural Manitoba regions as well. A third strength was the broad variety of topics included in the YHS which allowed us to examine all levels of a social ecological framework as it relates to physical activity. And finally, the results found in this study are largely consistent with findings of published research, especially similar research in Manitoba. To our knowledge it is the first study of its kind in Manitoba and the results will have implications for all rural regions of the province

Despite the promising and insightful findings of this study it is not without limitations that should be considered. First, the cross-sectional design of the study and the inability to link students between the time periods does not allow for the determination of causality. Second, a selection bias was introduced into the study due to the fact that only students who were registered to be in school and attended school on the day the survey was administered were included in the sample. Third, the data came from a self-administered paper based survey which relies on the self-reporting of all health

behaviours, including the outcome measure physical activity level, and this may lead to questions surrounding the validity of responses. Physical activity levels were estimated using a measure of activity, KKD, which used METs developed for adults. Another limitation introduced by the self-reported survey used was the calculation method of BMI. BMI was calculated based on self-reported height and weight and these results were not adjusted according the method developed by researchers at Statistics Canada to allow for a correction factor due to usual the over-reporting of height and underreporting of weight (Gorber, Shields, Tremblay, & McDowell, 2008) . Fourth, the data was collected over two cycles of the YHS and there may have been environmental changes, including policy and program changes, during this time period that were not captured. Finally, social ecological model theory states that variables interact with each other to affect behaviour but the model developed in this study did not include any interaction effects.

5.5 Implications and Policy Recommendations

An in-depth understanding of the factors that affect the physical activity of youth is an important aspect of improving the overall health of the population. Further, factors in all areas of the social ecological model of health behaviour need to be considered when developing health promotion programs.

The results of this study illustrate that key variables at the individual level, the social level and the environmental level have significant impacts on the physical activity level of youth. Key among these is the sex of the youth. Males have shown to be more physically active throughout their youth and also to have a lower rate of decrease in

physical activity as they age. The results of this study with respect to the sex of the student have mirrored previous research.

Other factors identified as having a significant association with physical activity in this study population have also been reported in other studies. The most consistent among these are active transportation, healthy eating, mental health and school connectedness.

The understanding of factors affecting physical activity levels provides an opportunity for organizations involved in the creation and implementation of health promotion programs to obtain maximum benefit from their efforts by taking all behaviours of the participant and the participants' environment into account. By having programs targeted to the needs of the participant, the investments made in improving the health behaviours of youth will be enhanced. Segments of the population that can benefit the most from programs will obtain these benefits as a result of targeted programming.

Schools are well positioned and poised to play active and important roles in the health of adolescents. From efforts to support active transportation to school to curricula focussed on the benefits of physical activity to improving the mental health of their students, schools are an integral partner in health promotion planning and delivery.

Three similar studies have recently been performed on subpopulations of Manitoba youth and all have obtained results similar to those found in this study. Leggett and colleagues (2011) examined grades 9 to 12 students from across Manitoba who completed the 2009 YHS. Their analysis included some of the variables included in this study and they found grade, active transportation, smoking and school connectedness to be associated with physical activity. Hobin and colleagues (2014) used a direct method

of data collection (the use of accelerometers) to collect information on physical activity levels of a sample of Manitoba youth and they found a grade related decline in physical activity levels. McGavock and colleagues (2013) used a direct method of data collection (the use of accelerometers) to evaluate the provincial physical education policy and one of their findings was that male students were more active then female students.

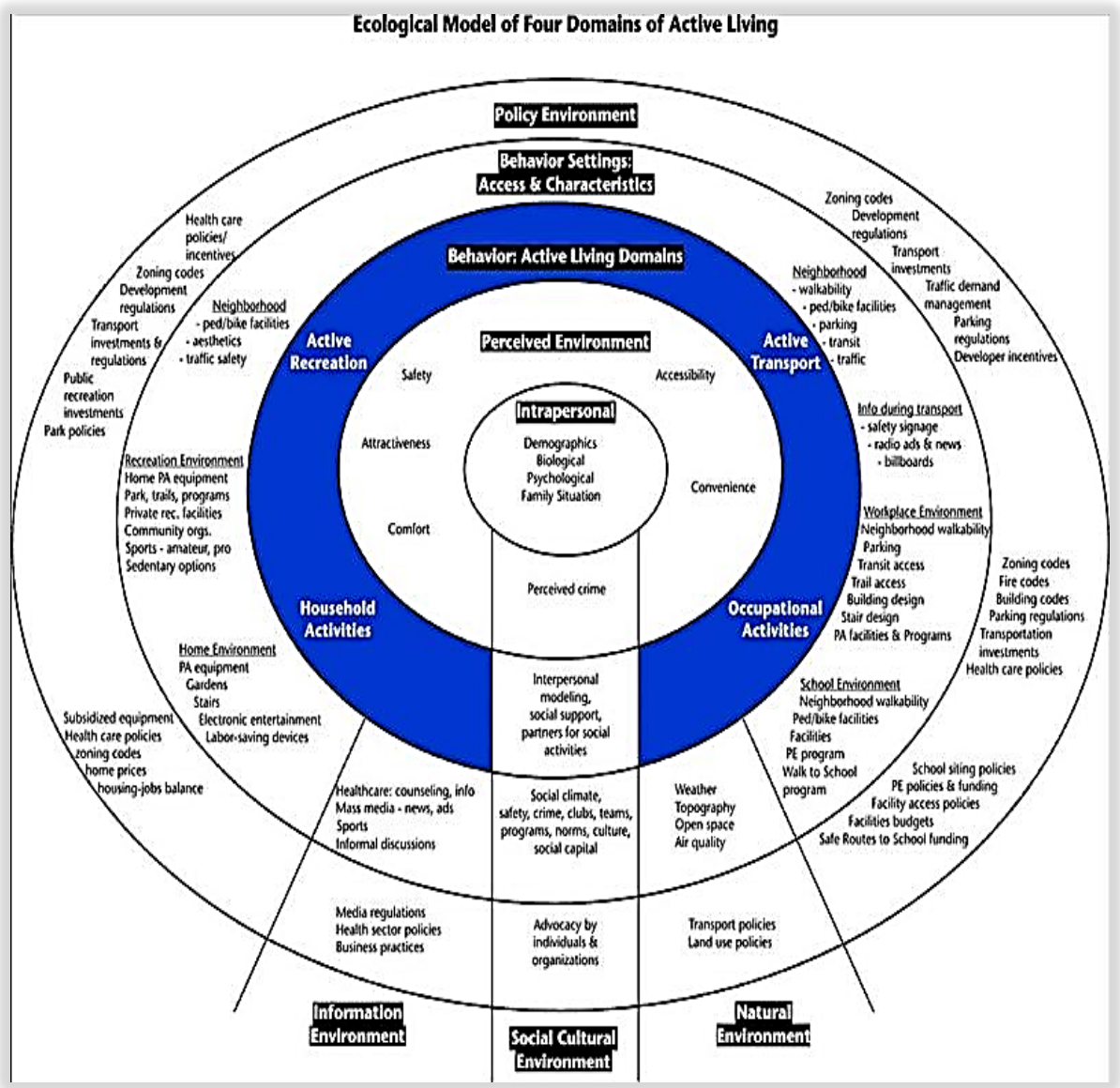
With respect to the theoretical framework adopted for this study, the social ecological model of health behaviours, the findings from this study are consistent with the findings of other researchers in this field in that key variables at the individual, social level and environmental level have significant association with the physical activity level of youth. This study did not find a significant association between the school level variables and physical activity and this may be due to the fact that the YHS was developed with the primary purpose of quantifying individual health behaviours. Additional environmental and school level variables should be included in future iterations of the YHS to allow for a broader understanding of the full range of effects on physical activity.

Future development of policies, programs and interventions aimed at improving the health behaviours of our youth should involve partners in RHAs, schools and communities and should use a social ecological model of health behaviour as their underpinning to ensure that every aspect of an adolescent's life is taken into consideration.

Although the results presented in this study are representative of the Interlake region of Manitoba, and to some extent to other rural regions in the province, they are not nationally generalizable. The data used in this study was collected just prior to the implementation of a provincial physical education/health education policy change in

Manitoba that required physical activity to be included in the curriculum of all grades 11 and 12 students. Future research needs to be done with a greater range of individual, social, environmental and school level variables to more fully understand the effects of various factors on physical activity, to understand the effect of the provincial policy change and to further aid in the development of successful health promotion programs.

Appendix 1 – Ecological Model of Four Domains of Active Living



Source: Sallis, J. F., Cervero, R. B., Ascher, W., Henderson, K. A., Kraft, M. K., & Kerr, J. (2006). An ecological approach to creating active living communities. *Annual Review of Public Health*, *27*, 297-322.

Appendix 2 – 2005 Youth Health Survey

INTERLAKE REGIONAL HEALTH AUTHORITY

YOUTH HEALTH SURVEY

Your answers are anonymous & confidential

1. The name of my school is:

_____

2. What grade are you in?
   - ☐ 6
   - ☐ 7
   - ☐ 8
   - ☐ 9 (Senior 1)
   - ☐ 10 (Senior 2)
   - ☐ 11 (Senior 3)
   - ☐ 12 (Senior 4)

3. How old are you?
   - ☐ 11 or younger
   - ☐ 12
   - ☐ 13
   - ☐ 14
   - ☐ 15
   - ☐ 16
   - ☐ 17
   - ☐ 18 or older

4. Are you male or female?
   - ☐ Male
   - ☐ Female

The following 18 questions deal with physical activity.

5. How physically active are you at the following times?

	Active	Somewhat active	Inactive	Does not apply
Before school	☐	☐	☐	☐
After school	☐	☐	☐	☐
Recess	☐	☐	☐	☐
Lunch	☐	☐	☐	☐

6. What do you think of the number of sports offered at your school?
   - ☐ Does not matter to me
   - ☐ Too few
   - ☐ Just right
   - ☐ Too many

7. How much do your parent(s) or guardian(s) encourage you to be physically active?
   - ☐ Strongly encourage
   - ☐ Encourage
   - ☐ Do not encourage or discourage
   - ☐ Discourage

8. How much do your parent(s) or guardian(s) support you in being physically active (such as driving you to team games or buying your sporting equipment)?
   - ☐ Very supportive
   - ☐ Supportive
   - ☐ Unsupportive
   - ☐ Very unsupportive

9. Your closest friends are the friends you like to spend the most time with. How many of your 5 closest friends are physically active?
   - ☐ None
   - ☐ 1
   - ☐ 2
   - ☐ 3
   - ☐ 4
   - ☐ 5

10. On how many days in the last week did you do exercises to **strengthen or tone your muscles**, such as push-ups, sit-ups, or weight lifting?
    - ☐ 0 days
    - ☐ 1 day
    - ☐ 2 days
    - ☐ 3 days
    - ☐ 4 days
    - ☐ 5 days
    - ☐ 6 days
    - ☐ 7 days

11. In the last week, how did you **usually** get to and from school?
    - ☐ Actively (e.g., walk, bike, skateboard)
    - ☐ Inactively (e.g., car, bus, public transit)
    - ☐ Mixed (actively and inactively)

***Hard** physical activities increase your heart rate and make you breathe hard and sweat. They include jogging, team sports, fast dancing, jump-rope.*

12. Mark how many minutes of **hard** physical activity you did for each day last week. Include activities that lasted for at least 15 minutes at one time during physical education class, lunch, recess, after school, evenings, and spare time.

For example: If you did 1 hour and 15 minutes of hard activity on Monday you would shade:

	Hours	Minutes
Monday	0 (1) 2 3 4	0 (15) 30 45

	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)

13. Was this a typical week for the amount of **hard** physical activity that you **usually** do?
    - ☐ Yes
    - ☐ No

14. In the last week, when did you **usually** do **hard** physical activities? (choose all that apply)
   - ☐ I do not do any hard physical activities
   - ☐ Before school
   - ☐ During school
   - ☐ After school
   - ☐ In the evening
   - ☐ On weekends

Moderate *physical activities are easier activities such as walking, biking and recreational swimming.*

15. Mark how many minutes of **moderate** physical activity you did for each day last week. Include activities that lasted for at least 15 minutes at one time during physical education class, lunch, recess, after school, evenings, and spare time.

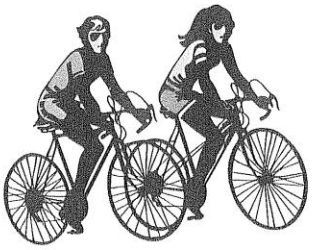
For example: If you did 1 hour and 15 minutes of moderate activity on Monday you would shade:

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

	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

16. Was this a typical week in terms of the amount of **moderate** physical activity that you **usually** do?
   - ☐ Yes
   - ☐ No

17. In the last week, when did you **usually** do **moderate** physical activities? (Choose all that apply)
   - ☐ I do not do any moderate physical activities
   - ☐ Before school
   - ☐ During school
   - ☐ After school
   - ☐ In the evening
   - ☐ On weekends



18. Mark how much time you spent watching TV, movies, playing video/computer games, surfing the internet, or talking on the phone for each day last week.

	None	Less than 1 hour	1-2 hours	3-5 hours	6 or more hours
Monday	☐	☐	☐	☐	☐
Tuesday	☐	☐	☐	☐	☐
Wednesday	☐	☐	☐	☐	☐
Thursday	☐	☐	☐	☐	☐
Friday	☐	☐	☐	☐	☐
Saturday	☐	☐	☐	☐	☐
Sunday	☐	☐	☐	☐	☐

19. In the last week, how much total time did you spend reading, not counting at work or at school or homework. (Include books, magazines and newspapers)?
   - ☐ None
   - ☐ Less than 1 hour
   - ☐ From 1 to 6 hours
   - ☐ From 7 to 13 hours
   - ☐ 14 or more hours

20. In the last week, how much total time did you spend doing homework?
   - ☐ None
   - ☐ Less than 1 hour
   - ☐ From 1 to 6 hours
   - ☐ From 7 to 13 hours
   - ☐ 14 or more hours

21. Do the subjects offered in your school teach about:

	Yes	No	I don't know
a. Why it's important to be physically active?	☐	☐	☐
b. How you can get sick if you are not physically active?	☐	☐	☐
c. How TV can influence you about physical activity?	☐	☐	☐
d. How your friends can influence you about physical activity?	☐	☐	☐

22. List up to 3 recreation activities that you would like to do that are currently not available in your community?

_____

_____

_____

☐ I am not interested in any recreation activities

23. For the above activities, when would you like to participate in them?
    - ☐ Weekends
    - ☐ Weekdays (check time)
        - ☐ 6 am to 9 am
        - ☐ 9 am to 5 pm
        - ☐ after 5 pm

The following 6 questions deal with what you eat.

24. In the past week, how many times did you drink 100% fruit juice?
    (For example: 3 times a week)
    ____ times

25. In the past week, how often did you eat fruit (not counting fruit juice)?
    ____ times

26. In the past week, how often did you eat green salad?
    ____ times

27. In the past week, how often did you eat potatoes? (Do not count french fries, fried potatoes, or potato chips.)
    ____ times

28. In the past week, how often did you eat carrots?
    ____ times

29. In the past week, how often did you eat other vegetables (not counting carrots, potatoes, or salad)?
    ____ times

The following 2 questions deal with weight and height.

30. How much do you weigh **without** your shoes on?
    My weight is_____ pounds **or**_____ kilograms

31. How tall are you without your shoes on?
    My height is ____feet___inches **or** ____centimeters

The following 12 questions deal with smoking.

32. Have you ever smoked a cigarette, even just a few puffs?
    - ☐ Yes
    - ☐ No (If no, go to question #41)

33. Have you ever smoked a whole cigarette?
    - ☐ Yes
    - ☐ No

34. Have you smoked 100 or more whole cigarettes in your life?
    - ☐ Yes
    - ☐ No

35. Think about the last 30 days. Did you smoke a cigarette, even just a few puffs?
    - ☐ Yes - ☐ Every day
        - ☐ Almost every day
        - ☐ Some days
        - ☐ 1 or 2 days
    - ☐ No

36. Do you plan to quit smoking cigarettes?
    - ☐ I have already quit
    - ☐ Yes, within one week
    - ☐ Yes, within 30 days
    - ☐ Yes, within six months
    - ☐ Yes, within one year
    - ☐ Yes, but I'm not sure when
    - ☐ No, I do not plan to quit smoking

37. How do you usually get your cigarettes?
    - ☐ I buy them
    - ☐ Someone buys them for me
    - ☐ I get them from my friends
    - ☐ I get them from home
    - ☐ Other:_____

38. If you buy your own cigarettes, where do you buy them? **Please fill in all that apply.**
    - ☐ Convenience store (e.g. 7-11, Macs, corner store)
    - ☐ Gas station
    - ☐ Grocery store/supermarket
    - ☐ Restaurant/diner/cafeteria
    - ☐ Bar
    - ☐ Friend or other person
    - ☐ Other:_____
    - ☐ I do not buy cigarettes

39. In the past month, when you tried to buy cigarettes, how often were you asked your age?
    - ☐ Never
    - ☐ Less than half of the time
    - ☐ About half of the time
    - ☐ More than half of the time
    - ☐ Always or almost always
    - ☐ I did not buy cigarettes in the past month

40. Your closest friends are the friends you like to spend the most time with. How many of your 5 closest friends smoke cigarettes?
    - ☐ None
    - ☐ 1
    - ☐ 2
    - ☐ 3
    - ☐ 4
    - ☐ 5

41. Not counting yourself, how many people smoke inside your home every day or almost every day?
- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 or more

42. Do you think all public places (e.g., restaurants, malls, arcades, etc.) should be smoke-free?
- ☐ Definitely yes
- ☐ Probably yes
- ☐ Probably not
- ☐ Definitely not

43. Does your school have a clear set of rules about smoking for students to follow?
- ☐ Yes
- ☐ No
- ☐ I don't know

The following 2 questions deal with alcohol.

44. During the past 30 days, on how many days did you have at least one drink of alcohol?
- ☐ 0 days
- ☐ 1 or 2 days
- ☐ 3 to 5 days
- ☐ 6 to 9 days
- ☐ 10 to19 days
- ☐ 20 to 29 days
- ☐ All 30 days

45. During the past 30 days, on how many days did you have 5 or more drinks of alcohol within a couple of hours?
- ☐ 0 days
- ☐ 1 or 2 days
- ☐ 3 to 5 days
- ☐ 6 to 9 days
- ☐ 10 to 19 days
- ☐ 20 to 29 days
- ☐ All 30 days

The following question deals with street drugs.

46. During the past 30 days, how many times did you use illegal drugs, (e.g., marijuana, cocaine, heroine, methamphetamines, ecstasy, steroid pills/shots, sniffed glue)?
- ☐ 0 times
- ☐ 1 or 2 times
- ☐ 3 to 9 times
- ☐ 10 to19 times
- ☐ 20 to 39 times
- ☐ 40 or more times

The following 5 questions deal with feelings.

47. How strongly do you agree with each of the following statements?

	Strongly Agree	Agree	Disagree	Strongly Disagree
a. I feel close to people at this school	☐	☐	☐	☐
b. I feel I am part of this school	☐	☐	☐	☐
c. I am happy to be at this school	☐	☐	☐	☐
d. I feel safe in my school	☐	☐	☐	☐

48. In general, compared to other students your age, how would you rate your athletic ability?
- ☐ Excellent
- ☐ Good
- ☐ Fair
- ☐ Poor

49. In general, compared to other students your age, how well are you doing in your school work?
- ☐ Above average
- ☐ Average
- ☐ Below average

50. Do you consider yourself:
- ☐ Very overweight?
- ☐ Slightly overweight?
- ☐ About the right weight?
- ☐ Slightly underweight?
- ☐ Very underweight?

51. During the past 12 months, did you ever feel so sad or hopeless that you stopped doing some usual activities for a while?
- ☐ Yes
- ☐ No

Thank You for participating in this Youth Health Survey

For more information, contact
Tannis Erickson at 642-4522
www.irha.mb.ca
Toll Free 1-888-488-2299

Appendix 3 – 2009 Youth Health Survey

INTERLAKE REGIONAL HEALTH AUTHORITY

YOUTH HEALTH SURVEY

Your answers are anonymous & confidential

The following questions are about you

1. The name of my home community is:

   _____

2. The name of my school is:

   _____

3. What grade are you in?
   - ☐ 6
   - ☐ 7
   - ☐ 8
   - ☐ 9
   - ☐ 10
   - ☐ 11
   - ☐ 12

4. How old are you?
   - ☐ 11 or younger
   - ☐ 12
   - ☐ 13
   - ☐ 14
   - ☐ 15
   - ☐ 16
   - ☐ 17
   - ☐ 18 or older

5. Are you male or female?
   ☐ Male ☐ Female

6. How much do you weigh without your shoes on? (Please write your weight on the line and then fill in the appropriate numbers for your weight in pounds OR kilograms.)
   - ☐ **"My weight is _____"**
   - ☐ I do not know my weight

Example: **127 lbs**

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

7. How tall are you without your shoes on? (Please write your height on the line and then fill in the appropriate numbers for your height in feet and inches OR centimetres.)
   - ☐ **"My height is _____"**
   - ☐ I do not know my height

Example: **5' 7"**

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

8. In general, how do you describe your health?
   - ☐ Excellent
   - ☐ Very Good
   - ☐ Good
   - ☐ Fair
   - ☐ Poor

9. What do you think are the major causes of poor health and chronic diseases? Choose all that apply.
   - ☐ Poor diet (ie too much fat, too much salt)
   - ☐ Being overweight
   - ☐ Lack of exercise
   - ☐ Smoking
   - ☐ Worry, stress or tension
   - ☐ Drinking too much alcohol
   - ☐ Using drugs
   - ☐ Being underweight
   - ☐ Low income, low education
   - ☐ Not sure

The following questions deal with feelings

10. Do you agree with each of the following statements?

	Agree	Disagree
a. I feel close to people at this school	☐	☐
b. I feel I am a part of this school	☐	☐
c. I am happy to be at this school	☐	☐
d. I feel safe at my school	☐	☐
e. I feel safe in my community	☐	☐
f. I feel safe in my home	☐	☐
g. I have at least 1 close friend that I can share things with	☐	☐
h. I feel my family supports me	☐	☐
i. I feel involved in my community	☐	☐

11. Do you consider yourself:
    - ☐ Overweight?
    - ☐ About the right weight?
    - ☐ Underweight?

Page 1

12. During the past 12 months, did you ever feel so sad, hopeless, irritable or angry, for several days in a row, that you stopped doing some usual activities?
    - ☐ Yes ☐ No

13. During the past 12 months, how often have you felt you were under more strain, stress or pressure than you could handle?
    - ☐ Not at all ☐ At least once per week
    - ☐ At least once per month ☐ Daily

14. During the past 12 months, have you felt so sad, discouraged, hopeless or had so many problems for several days in a row, that you wondered if anything was worthwhile?
    - ☐ Not at all
    - ☐ Some, enough to bother me
    - ☐ Quite a bit
    - ☐ Extremely so, to the point I couldn't do my work or deal with things

15. How much do you agree with the following statements?

    I usually feel good about myself.
    - ☐ Never ☐ Sometimes ☐ Always

    I am able to do things as well as most other people.
    - ☐ Never ☐ Sometimes ☐ Always

    On the whole, I'm satisfied with myself.
    - ☐ Never ☐ Sometimes ☐ Always

    I feel I do not have much to be proud of.
    - ☐ Never ☐ Sometimes ☐ Always

    Sometimes I think that I am no good.
    - ☐ Disagree ☐ Agree

    I feel that I can't do anything right.
    - ☐ Never ☐ Sometimes ☐ Always

16. If you were having a serious problem, is there an adult in your life that you would feel okay talking to?
    - ☐ Yes, family member ☐ No
    - ☐ Yes, not a family member

17. If you were having a serious problem, is there a resource or number you would call to talk to someone?
    - ☐ Yes ☐ No

18. How do you currently get the mental health information you need (ie/ for stress, anxiety, depression, etc)?
    - ☐ In a group setting from a mental health worker, teacher or school counsellor
    - ☐ In a private setting from a mental health worker, teacher or school counsellor
    - ☐ From my doctor/nurse/health care professional
    - ☐ From friends & peers
    - ☐ From written material such as pamphlets, self-help books
    - ☐ From the internet
    - ☐ Don't need any information

19. How would you be most comfortable receiving the mental health information you need?
    - ☐ In a group setting from a mental health worker, teacher or school counsellor
    - ☐ In a private setting from a mental health worker, teacher or school counsellor
    - ☐ From my doctor
    - ☐ From friends & peers
    - ☐ From written material such as pamphlets, self-help books
    - ☐ From the internet
    - ☐ Don't need any information

The following questions deal with physical activity.

Hard physical activities increase your heart rate and make you breathe hard and sweat. They can include jogging, team sports, fast dancing, jump rope, etc.

20. Mark how many minutes of hard physical activity you did for each day last week. Include activities that lasted for at least 15 minutes at one time during physical education class, lunch, recess, after school, evening, and spare time.

    For example: If you did 1 hour and 15 minutes of hard activity on Monday you would shade:

	Hours	Minutes
Monday	0 ● 2 3 4	0 ● 30 45

	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

21. Was this a typical week for the amount of **hard** physical activity that you **usually** do?
    - ☐ Yes
    - ☐ No, I was more active than usual in the last seven days.
    - ☐ No, I was less active than usual in the last seven days.

22. In the last week, when did you **usually** do **hard** physical activities? (choose all that apply)
    - ☐ I did not do any hard physical activities
    - ☐ Before school
    - ☐ During phys. ed. class
    - ☐ During lunch break
    - ☐ After school
    - ☐ In the evening
    - ☐ On weekends

Moderate physical activities are easier activities such as walking, biking and recreational swimming, etc.

23. Mark how many minutes of **moderate** physical activity you did for each day last week. Include activities that lasted for at least 15 minutes at one time during physical education class, lunch, recess, after school, evenings, and spare time.

For example: If you did 1 hour and 15 min of moderate activity on Monday you would shade:

	Hours	Minutes
Monday	0 (●) 2 3 4	0 (●) 30 45

	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)

24. Was this a typical week in terms of the amount of **moderate** physical activity that you **usually** do?
    - ☐ Yes
    - ☐ No, I was more active than usual in the last seven days.
    - ☐ No, I was less active than usual in the last seven days.

25. In the last week, when did you **usually** do **moderate** physical activities? (Choose all that apply)
    - ☐ I did not do any moderate physical activities
    - ☐ Before school
    - ☐ After School
    - ☐ During phys. ed. class
    - ☐ In the evening
    - ☐ During lunch break
    - ☐ On weekends

26. In a typical week, how much time do you usually spend on a computer, including playing computer games and using the Internet?
    - ☐ None
    - ☐ From 6-10 hours
    - ☐ Less than 1 hour
    - ☐ From 11-14 hours
    - ☐ From 1-2 hours
    - ☐ From 15-20 hours
    - ☐ From 3-5 hours
    - ☐ More than 20 hours

27. In a typical week, how much time do you usually spend playing video games, such as Xbox, Nintendo or Playstation (Not including active Wii games, Dance Dance Revolution, etc.)
    - ☐ None
    - ☐ From 6-10 hours
    - ☐ Less than 1 hour
    - ☐ From 11-14 hours
    - ☐ From 1-2 hours
    - ☐ From 15-20 hours
    - ☐ From 3-5 hours
    - ☐ More than 20 hours

28. In a typical week how much time did you usually spend watching television or movies?
    - ☐ None
    - ☐ From 6-10 hours
    - ☐ Less than 1 hour
    - ☐ From 11-14 hours
    - ☐ From 1-2 hours
    - ☐ From 15-20 hours
    - ☐ From 3-5 hours
    - ☐ More than 20 hours

29. Do the subjects offered in your school teach about:

	Yes	No	I don't know
a) Why it's important to be physically active	☐	☐	☐
b) What the risk factors are of being physically inactive	☐	☐	☐
c) How TV can influence your physical activity	☐	☐	☐
d) How your friends can influence your physical activity	☐	☐	☐

30. Of the extra-curricular sports offered in your school, how many do you participate in?
    - ☐ None
    - ☐ 3 or 4
    - ☐ 1 or 2
    - ☐ 5 or more

31. Of the activities offered outside of your school (ie/ hockey, soccer, figure skating, dance), how many do you participate in?
    - ☐ None
    - ☐ 3 or 4
    - ☐ 1 or 2
    - ☐ 5 or more

32 How often do you participate in intra-mural sports?
    - ☐ Never or seldom
    - ☐ Once a week
    - ☐ 2 to 3 times per week
    - ☐ 4 or more times per week
    - ☐ We do not have intra-mural sports

33. In the last week, how did you usually get to and from school?
    - ☐ Actively (ie/walk, bike, skateboard)
    - ☐ Inactively (ie/car, bus, public transit)
    - ☐ Mixed (actively and inactively)

34. Do you think you get enough physical activity?
    - ☐ Yes
    - ☐ No

35. What helps you get enough physical activity? (Check all that apply)
    - ☐ I am not physically active
    - ☐ Family support
    - ☐ Peer support
    - ☐ School programs
    - ☐ Community Programs
    - ☐ Sport Manitoba Funding
    - ☐ Desire to be fit and healthy
    - ☐ Desire to look a certain way

36. Why haven't you been active? (Check all that apply)
    - ☐ I have been physically active
    - ☐ Travel (Can't get to the activity/games/practices that interest me)
    - ☐ No family support
    - ☐ No money for activities
    - ☐ Medical Reasons
    - ☐ Peer pressure
    - ☐ Time (not enough time in the day, not available at the time I am able to participate)
    - ☐ I don't want to be physically active

37. Of the following list, choose 3 sport/active recreation activities that you would like to do that are currently not available in your community:
- ☐ Swimming ☐ Lap ☐ Synchronized ☐ Swim Lessons ☐ Water Polo ☐ Underwater Hockey
- ☐ Dance classes ☐ Ballet ☐ Jazz ☐ Hip Hop
- ☐ Martial arts ☐ Judo ☐ Karate ☐ Tae Kwon Do
- ☐ Indoor soccer
- ☐ Football ☐ Flag/tackle ☐ 9 Man ☐ Touch Football
- ☐ Golf
- ☐ Lacrosse
- ☐ Archery
- ☐ Cross Country Ski
- ☐ Cycling ☐ Road/Mountain Biking ☐ BMX
- ☐ Triathlon
- ☐ Table Tennis
- ☐ Rugby

38. Of the following list, choose 3 arts (non-sport) recreation activities that you would like to do that are currently not available in your community:
- ☐ Drama classes
- ☐ Art classes ☐ Painting ☐ Pottery
- ☐ Youth drop in activities
- ☐ Instrument lessons ☐ Guitar ☐ Piano (organ) ☐ Brass Band Instruments
- ☐ Voice lessons
- ☐ Join a Club ☐ 4H ☐ Cooking ☐ Reading ☐ Computer

The following questions deal with what you eat.

39. Yesterday, how many times did you eat or drink the following:

	None	1-2 Times	3-4 Times	5-6 Times	7+ Times
100% Fruit Juice	☐	☐	☐	☐	☐
Fruits	☐	☐	☐	☐	☐
Green Salad or Vegetables	☐	☐	☐	☐	☐
Potatoes (not french fries or potato chips)	☐	☐	☐	☐	☐
Water	☐	☐	☐	☐	☐
Pop/soda (non diet), slurpees/Slushies	☐	☐	☐	☐	☐
Energy Drinks (Red Bull, etc.)	☐	☐	☐	☐	☐
Cookies, cake, donuts, chocolate bars	☐	☐	☐	☐	☐
Hot dogs, hamburgers, french fries, potato chips	☐	☐	☐	☐	☐
Coffee/lattes/iced coffee	☐	☐	☐	☐	☐
Sports drinks (gatorade)	☐	☐	☐	☐	☐
Milk (white, chocolate or soy)	☐	☐	☐	☐	☐
Cheese/yogurt	☐	☐	☐	☐	☐
Meal replacement bars (Vector/Powerbars)	☐	☐	☐	☐	☐
Protein Shakes/Creatine/ other supplements	☐	☐	☐	☐	☐
Meat or fish (not fried) eggs/nuts	☐	☐	☐	☐	☐
White Bread	☐	☐	☐	☐	☐
Brown Bread	☐	☐	☐	☐	☐
Pasta/Rice/Cereal	☐	☐	☐	☐	☐

40. Last weekend, how many times did you eat or drink the following:

	None	1-2 Times	3-4 Times	5-6 Times	7+ Times
100% Fruit Juice	☐	☐	☐	☐	☐
Fruits	☐	☐	☐	☐	☐
Green Salad or Vegetables	☐	☐	☐	☐	☐
Potatoes (not french fries or potato chips)	☐	☐	☐	☐	☐
Water	☐	☐	☐	☐	☐
Pop/soda (non diet), slurpees/Slushies	☐	☐	☐	☐	☐
Energy Drinks (Red Bull, etc.)	☐	☐	☐	☐	☐
Cookies, cake, donuts, chocolate bars	☐	☐	☐	☐	☐
Hot dogs, hamburgers, french fries, potato chips	☐	☐	☐	☐	☐
Coffee/lattes/iced coffee	☐	☐	☐	☐	☐
Sports drinks (gatorade)	☐	☐	☐	☐	☐
Milk (white, chocolate or soy)	☐	☐	☐	☐	☐
Cheese/yogurt	☐	☐	☐	☐	☐
Meal replacement bars (Vector/Powerbars)	☐	☐	☐	☐	☐
Protein Shakes/Creatine/ other supplements	☐	☐	☐	☐	☐
Meat or fish (not fried) eggs/nuts	☐	☐	☐	☐	☐
White Bread	☐	☐	☐	☐	☐
Brown Bread	☐	☐	☐	☐	☐
Pasta/Rice/Cereal	☐	☐	☐	☐	☐

41. Where do you usually eat breakfast?
- ☐ At home ☐ At School
- ☐ I do not usually eat breakfast

42. During school do you usually:
- ☐ Bring lunch from home
- ☐ Eat lunch at home
- ☐ Buy lunch at school cafeteria/canteen
- ☐ Eat fast food at a restaurant or store
- ☐ Don't eat lunch

The following questions deal with smoking

43. Have you ever smoked a cigarette, even just a few puffs?
☐ Yes ☐ No

44. Have you ever smoked a whole cigarette?
☐ Yes ☐ No

45. Have you smoked 100 or more whole cigarettes in your life?
☐ Yes ☐ No

46. During the past 30 days, on how many days did you smoke cigarettes?
- ☐ 0 days
- ☐ 1 or 2 days
- ☐ 3 to 5 days
- ☐ 6 to 9 days
- ☐ 10 to 19 days
- ☐ 20 to 29 days
- ☐ All 30 days

47. Are you a smoker?
☐ Yes ☐ No

48. If one of your best friends was to offer you a cigarette, would you smoke it?
☐ Definitely yes ☐ Probably not
☐ Probably yes ☐ Definitely not

49. At any time during the next year do you think that you will smoke a cigarette?
☐ Definitely yes ☐ Probably not
☐ Probably yes ☐ Definitely not

50. During the past 30 days, on how many days did you use chewing tobacco, snuff, or dip, such as Skoal or Copenhagen?
☐ 0 days ☐ 10 to 19 days
☐ 1 or 2 days ☐ 20 to 29 days
☐ 3 to 5 days ☐ All 30 days
☐ 6 to 9 days

51. During the past 30 days, on how many days did you smoke cigars, cigarillos, flavoured cigarillos (Captain Black Sweet), or little cigars?
☐ 0 days ☐ 10 to 19 days
☐ 1 or 2 days ☐ 20 to 29 days
☐ 3 to 5 days ☐ All 30 days
☐ 6 to 9 days

52. Where do you usually get your cigarettes?
☐ I do not smoke
☐ I buy them myself at a store/gas station/vending machine
☐ I buy them from a friend or someone else
☐ I ask someone to buy them for me
☐ I get them from a family member
☐ A friend or someone else gives them to me

53. In the past month, when you tried to buy cigarettes, how often were you asked your age, or to show identification?
☐ I do not smoke
☐ Never
☐ Less than half of the time
☐ About half of the time
☐ More than half of the time
☐ Always or almost always
☐ I did not buy cigarettes in the past month

54. Your closest friends are the friends you like to spend the most time with. How many of your 5 closest friends smoke cigarettes/cigars/cigarillos or use chewing tobacco?
☐ None ☐ 3
☐ 1 ☐ 4
☐ 2 ☐ 5

55. Not counting yourself, how many people smoke inside your home every day or almost every day?
☐ 0 ☐ 3
☐ 1 ☐ 4
☐ 2 ☐ 5 or more

56. During the past 7 days, on how many days did you ride in a car with someone who was smoking cigarettes?
☐ 0 days ☐ 4 to 6 days
☐ 1 to 3 days ☐ All 7 days

57. Does your school have a clear set of rules about smoking for students to follow?
☐ Yes ☐ No
☐ I don't know

58. Is there help available at your school for students who want to quit smoking?
☐ Yes ☐ No
☐ I don't know

59. Have you **ever** tried to quit smoking?
☐ 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 more times

60. Do you think you would be able to quit smoking cigarettes if you wanted to?
☐ I do not smoke ☐ Probably not
☐ Definitely yes ☐ Definitely not
☐ Probably yes

61. If you were thinking about quitting smoking, rate whether you might use each of the following:

	I don't Smoke	Definitely	Maybe	Never
a. A self-help booklet	☐	☐	☐	☐
b. Quit smoking program at school	☐	☐	☐	☐
c. My doctor	☐	☐	☐	☐
d. Chat room on the internet	☐	☐	☐	☐
e. Information site on the internet	☐	☐	☐	☐
f. Teacher, guidance counsellor or school nurse	☐	☐	☐	☐
g. Free telephone quit line (ie/Smoker's Helpline)	☐	☐	☐	☐
h. Friend's advice	☐	☐	☐	☐
i. Quit on my own	☐	☐	☐	☐
j. Nicotine gum or nicotine patch	☐	☐	☐	☐
k. Prescription medication	☐	☐	☐	☐
l. Other:	☐	☐	☐	☐

62. What has prevented you from quitting smoking? (check all that apply)
☐ I don't smoke ☐ My friends smoke
☐ I'm addicted ☐ I don't want to quit
☐ I don't know where to get help

The following questions deal with alcohol

63. During the past 30 days, on how many days did you have at least one drink of alcohol? (One drink of alcohol is defined as one bottle of beer, a 5 oz glass of wine, a cooler or one ounce (a shot) of liquor)
☐ 0 days ☐ 3 to 14 days
☐ 1 or 2 days ☐ 15 or more

64. During the past 30 days, on how many days did you have 5 or more drinks of alcohol within a couple of hours? (One drink of alcohol is defined as one bottle of beer, a 5 oz glass of wine, a cooler or one ounce (a shot) of liquor)
- ☐ 0 days
- ☐ 1 or 2 days
- ☐ 3 to 14 days
- ☐ 15 or more

65. During the past 30 days, how did you usually get the alcohol you drank?
- ☐ I did not drink alcohol during the past 30 days
- ☐ I bought it in a store such as a liquor store or vendor
- ☐ I bought it at a restaurant, bar or club
- ☐ I bought it at a public event such as a concert or sporting event
- ☐ I gave someone else money to buy it for me
- ☐ I got it from a family member
- ☐ A friend gave it to me

The following question deals with street drugs

66. In the past 30 days, how many times have you used any of the following drugs to get high, feel better or change your mood?

	Never	1-2 times	3-14 times	15 or more
Marijuana	☐	☐	☐	☐
Hashish ("hash", oil)	☐	☐	☐	☐
Cocaine (powder)	☐	☐	☐	☐
Crack	☐	☐	☐	☐
Heroin	☐	☐	☐	☐
Magic Mushrooms	☐	☐	☐	☐
Crystal Meth	☐	☐	☐	☐
Inhalants & Solvents (sniffed glue)	☐	☐	☐	☐
Steroids	☐	☐	☐	☐
Prescription medication (to get high)	☐	☐	☐	☐

The following questions deal with safety

67. During the past 12 months how often did you wear a helmet when you rode a bicycle?
- ☐ I did not ride a bicycle
- ☐ Never
- ☐ Sometimes
- ☐ Most of the time
- ☐ Always

68. During the past 12 months how often did you wear a helmet when riding other vehicles (ie/snowmobile, ATV, dirt bike)?
- ☐ I did not ride other vehicles
- ☐ Never
- ☐ Sometimes
- ☐ Most of the time
- ☐ Always

69. During the past 12 months how often did you wear a seat belt when driving or riding in a car or truck?
- ☐ Never
- ☐ Sometimes
- ☐ Most of the time
- ☐ Always

70. During the past 30 days, how many times did you **ride** in a car or other vehicle (ie/snowmobile, ATV, dirt bike) driven by someone who had been drinking alcohol, using marijuana or other illegal drugs?
- ☐ Never
- ☐ 1-3 times
- ☐ 4 or more times

71. During the past 30 days, how many times did you drive a car or other vehicle (ie/snowmobile, ATV, dirt bike) when you had been drinking alcohol, using marijuana or other illegal drugs?
- ☐ Never
- ☐ 1-3 times
- ☐ 4 or more times

72. How many times in the past year (12 months) has anyone done any of the following TO YOU:

	Never	1-5 Time	6 or More
a) Physically threatened or injured you	☐	☐	☐
b) Threatened or injured you with a weapon such as a gun, knife or club	☐	☐	☐
c) Bullied, taunted or ridiculed you	☐	☐	☐
d) Said something bad about your race or culture	☐	☐	☐
e) Sexually abused or assaulted you	☐	☐	☐
f) Asked for personal information over the internet (ie/address, phone number, last name)	☐	☐	☐
g) Made you feel unsafe when you were in contact with them over the internet	☐	☐	☐
h) Bullied or picked on you through the internet	☐	☐	☐

73. Have you reported any of the above to/sought help for any of the above from:

	Yes	No
Parents/family member	☐	☐
School staff	☐	☐
Friends/peers	☐	☐
Doctor/nurse/health care professional	☐	☐
Counsellor	☐	☐

74. How do you currently get the health information you need?
- ☐ In a group setting from a health worker, teacher or school counsellor
- ☐ In a private setting from a health worker, teacher or school counsellor
- ☐ From my doctor/nurse/health care professional
- ☐ From friends & peers
- ☐ From written material such as pamphlets, self-help books
- ☐ From the internet
- ☐ Don't need any information

Thank You for participating in this Youth Health Survey

For more information, contact
Tannis Erickson at 642-4522
www.irha.mb.ca
Toll Free 1-888-488-2299

Appendix 4 – Youth Health Survey Question Sources, Reliability and Validity Reference and Scores

Study Variable	**2005 Q#**	**2009 Q#**	**Question Source/ Reliability & Validity Reference**	**Kappa scores (reliability) Spearman correlations (validity)**
Dependent Variable:				
Physical activity level	12 & 15	20 & 23	SHAPES – PA (Wong et al., 2006)	Kappa = 0.60 (0.50, 0.70) r = 0.44
Independent Variables:				
Time	------	-----	IRHA developed	
School	1	2	IRHA developed	
Grade	2	3	SHAPES – PA (Wong et al., 2006)	Kappa = 0.98 (0.97, 0.99)
Individual:				
Gender	4	5	SHAPES – PA (Wong et al., 2006)	Kappa = 0.55 (0.54, 0.56)
Age	3	4	SHAPES – PA (Wong et al., 2006)	Kappa = 0.55 (0.54, 0.56)
Transport to school	11	33	SHAPES - PA	
Sedentary time	18	26, 27, 28	2005 – SHAPES – PA (Statistics Canada, ; Wong et al., 2006) CCHS (Statistics Canada)	Kappa = 0.55 (0.54, 0.56)
Alcohol Use	44	63	YRBS (modified) (Brener et al., 2002)	Kappa = 0.634 (0.588,0.680)
Healthy eating	24 to 29	39	CCHS (modified)	

Drug Use	46	66	YRBS (modified) (Brener et al., 2002)	Kappa = 0.634 (0.588,0.680)
Smoking status	34 & 35	45 & 46	SHAPES – PA (Wong et al., 2006)	Kappa = 0.80 (0.74, 0.86)
Weight perception	50	11	SHAPES – PA (modified)	
BMI	30 & 31	6 & 7	SHAPES – PA (modified) (Wong et al., 2006)	r = 0.90
Feeling hopeless	51	12	YRBS (modified)	
Social:				
Parental support	8	35	SHAPES – PA (modified)	
Peer support	9	35	SHAPES - PA	
Feelings: School connectedness	47 A	10 A	SHAPES – PA (modified) (Wong et al., 2006)	Kappa = 0.50 (0.47, 0.53)
Physical:				
Feelings: Feel safe at school	47 D	10 D	SHAPES – PA (modified) (Wong et al., 2006)	Kappa = 0.50 (0.47, 0.53)
Subjects at school	21 a	29 a	IRHA developed	

Appendix 5 – Study Variables (including type and range of values)

Variable Name	2005 Q #	2009 Q #	Type of Variable	Range of Values
Dependent Variable:				
Physical activity level	12 & 15	20 & 23	Categorical - Ordinal Calculate daily KKD from minutes of hard & moderate PA [KKD = (hrs of weekly PA*MET)/7]	Inactive Moderately active Active
Independent Variables:				
Time			Categorical – Binary	2005 or 2009
School	1	2	Categorical - Nominal	text
Grade	2	3	Numerical – Discrete	6 to 12
Individual:				
Gender	4	5	Categorical – Binary	Male Female
Age	3	4	Numerical – Discrete	<= 12 to 18+
Transport to school	11	33	Categorical - Nominal	Actively Inactively Mixed
Sedentary time	18	26, 27, 28	Categorical – Ordinal Calculate daily sedentary time in hours by taking the midpoint of each response range (for 2005 data calculate each day of the week & take an average & for 2009 data divide the response by 7)	<1 1 to 2 3+
Alcohol Use	44	63	Categorical – Binary	1 to 5 6 to 30

Healthy eating	24 to 29	39	Categorical – Ordinal Calculate daily fruit & veg servings by totaling question responses (2005 – add responses to Q 24 to 29 & divide by 7 & place into categories that match 2009 responses)	<= 2 3 to 6 7 to 8 >8
Drug Use	46	66	Categorical – Binary 2009 – add individual results to obtain overall drug use	1 to 9 10+
Smoking status	34 & 35	45 & 46	Categorical – Ordinal Calculate smoking status per formula	Non-smoker Occasional smoker Daily smoker
Weight perception	50	11	Categorical – Ordinal	Underweight About right Overweight
BMI	30 & 31	6 & 7	Categorical – Ordinal Calculate BMI & categorize	Underweight Normal weight Overweight/obese
Feeling hopeless	51	12	Categorical – Binary	Yes No
Social:				
Parental support	8	35	Categorical - Ordinal	Not supportive Supportive Very supportive
Peer support	9	35	Numerical – Discrete	0 to 5
Feelings: School connectedness	47 A	10 A	Categorical – Binary	Agree Disagree
Physical:				
Feelings: Feel safe at school	47 D	10 D	Categorical – Binary	Agree Disagree

Subjects at school	21 a	29 a	Categorical - Nominal	Yes No Do Not Know

References

Active Canada 20/20.Social-ecological model. Retrieved from http://www.activecanada2020.ca/sections-of-ac-20-20/appendix-a/appendix-b/appendix-c-1/appendix-d

Active Healthy Kids Canada. (2013). *Active healthy kids canada report card on physical activity for children and youth 2013*.

Alamian, A., & Paradis, G. (2012). Individual and social determiants of multiple chronis disease behavioral risk factors among youth. *BMC Public Health, 12*, 224.

Allender, S., Cowburn, G., & Foster, C. (2006). Understanding participation in sport and physical activity among children and adults: A review of qualitative studies. *Health Education Research, 21*(6), 826-835. doi:10.1093/her/cyl063

Barr-Anderson, D. J., Neumark-Sztainer, D., Schmitz, K. H., Ward, D. S., Conway, T. L., Pratt, C., . . . Pate, R. R. (2008). But I like PE: Factors associated with enjoyment of physical education class in middle school girls. *Research Quarterly for Exercise and Sport, 79*(1), 18-27.

Bates, H. (2006). *Daily physical activity for children and youth: A review and synthesis of the literature.* (No. ISBN 0-7785-4751-5). Alberta: Alberta Education.

Beets, M. W., Cardinal, B. J., & Alderman, B. L. (2010). Parental social support and the physical activity-related behaviors of youth: A review. *Health Education and Behavior, 37*(5), 621-644.

Brener, N. D., Kann, L., McManus, T., Kinchen, S. A., Sundberg, E. C., & Ross, J. G. (2002). Reliability of the 1999 youth risk behavior survey questionnaire. *Journal of Adolescent Health, 31*, 336-342.

Brodersen, N. H., Steptoe, A., Boniface, D. R., & Wardle, J. (2007). Trends in physical activity and sedentary behaviour in adolescence: Ethnic and socioeconomic differences. *British Journal of Sports Medicine, 41*(3), 140-144. doi:10.1136/bjsm.2006.031138

Canadian Society for Exercise Physiology. (2011). *Canadian physical activity guidelines background information.*

Castelli, D. M., & Erwin, H. E. (2007). Chapter 4: A comparison of personal attributes and experiences among physically active and inactive children. *Joural of Teaching in Physical Education, 26*, 375-389.

Centres for Disease Control. (2011). Social ecological model. Retrieved 06/28, 2011, from www.cdc.gov/cancer/crccp/sem.html

Centres for Disease Control and Prevention. (a). About BMI for children and teens. Retrieved 11/22, 2013, from www.cdc.gov/healthyweight/assessng/bmi/childrens_bmi/about_childrens_bmi.html

Centres for Disease Control and Prevention. (b). Physical activity for everyone: Glossary of terms. Retrieved 10/02, 2011, from www.cdc.gov/physicalactivity/everyone/glossary/index.html

Centres for Disease Control and Prevention. (1997). *Guidelines for school and community programs to promote lifelong physical activity among young people.* (No. MMWR 46 (RR-6)).

Centres for Disease Control and Prevention. (2004). *Methodology for the youth risk behavior surveillance system.* (No. MMWR 2004;53(RR-12)).

Chateau, D. (2011). *Personal correspondence*

Chateau, D., Metge, C., Prior, H., & Soodeen, R. (2012). Learning from the census: The socio-economic factor index (SEFI) and health outcomes in manitoba. *Canadian Journal of Public Health, 103 (Suppl. 2)*, S23.

Choi, B. C. K., & Pak, A. W. P. (2005). A catalog of biases in questionnaires. *Preventing Chronic Disease, 2*(1)

Colley, R. C., Garriguet, D., Janssen, I., Craig, C. L., Clarke, J., & Tremblay, M. S. (2011). *Physical activity of canadian children and youth: Accelerometer results from the 2007 to 2009 canadian health measures survey.* (). Ottawa: Statistics Canada.

Corder, K., Ekelund, U., Steele, R. M., Wareham, N. J., & Brage, S. (2008). Assessment of physical activity in youth. *Journal of Applied Physiology (Bethesda, Md.: 1985), 105*(3), 977-987. doi:10.1152/japplphysiol.00094.2008

Craggs, C., Corder, K., vanSluijs, E. M. F., & Griggin, S. J. (2011). Determinants of change in physical activity in children and adolescents. *American Journal of Preventive Medicine, 40*(6), 645.

De Cocker, K., Ottevaere, C., Sjostrom, M., Moreno, L. A., Warnberg, J., Valtuena, J., . . . HELENA Study Group. (2011). Self-reported physical activity in european adolescents: Results from the HELENA (healthy lifestyle in europe by nutrition in adolescence) study. *Public Health Nutrition, 14*(2), 246-254. doi:10.1017/S1368980010000558

Dumith, S. C., Gigante, D. P., Domingues, M. R., Hallal, P. C., Menezes, A. M. B., & Kohl, H. W. (2012). Predictors of physical activity change during adolescence: A 3-5 year follow-up. *Public Health Nutrition, 15*(12), 2237-2245.

Eder, W., Ege, M. J., & Von Mutius, E. (2006). The asthma epidemic. *New England Journal of Medicine, 355*(21), 2226-2235. doi:10.1056/NEJMra054308

Ekelund, U., Tomkinson, G. R., & Armstrong, N. (2011). What proportion of youth are physically active? measurement issues, levels and recent time trends. *British Journal of Sports Medicine, 55*, 859-865.

Elder, J. P., Lytle, L., Sallis, J. F., Young, D. R., Steckler, A., Simons-Morton, D., . . . Ribisl, K. (2007). A description of the social-ecological framework used in the trial of activity for adolescent girls (TAAG). *Health Education Research, 22*(2), 155-165. doi:10.1093/her/cyl059

Ferreira, I., Van Der Horst, K., Wendel-Vos, W., Kremers, S., van Lenthe, F. J., & Brug, J. (2006). Environmental correlates of physical activity in youth - a review and update. *Obesity Reviews, 8*, 129-154.

Gadalla, T. M. (2012). Unhealthy behaviors among canadian adolescents: Prevalence, trends and correlates. *Chronic Diseases and Injuries in Canada, 32*(3), 156.

Gorber, S. C., Shields, M., Tremblay, M. S., & McDowell, I. (2008). The feasibility of establishing correction factors to adjust self-reported estimates of obesity. *Health Reports, September*

Gorely, T., Marshall, S. J., Biddle, S. J., & Cameron, N. (2007). The prevalence of leisure time sedentary behaviour and physical activity in adolescent girls: An ecological momentary assessment approach. *International Journal of Pediatric Obesity : IJPO : An Official Journal of the International Association for the Study of Obesity, 2*(4), 227-234. doi:10.1080/17477160701408833

Grzywacz, J. G., & Fuqua, J. (2000). The social ecology of health: Leverage points and linkages. *Behavioral Medicine, 26*, 101-115.

Hallal, P. C., Victoria, C. G., Azevedo, M. R., & Wells, J. C. K. (2006). Adolescent physical activity and health: A systematic review. *Sports Medicine, 36*(12), 1019-1030.

Hanley, J. A., Negassa, A., deB.Edwardes, M., & Forrester, J. E. (2003). Statistical analysis of correlated data using generalized estimating equations: An orientation. *American Journal of Epidemiology, 157*, 364-375.

Harrell, J. S., McMurray, R. G., Baggett, C. D., Pennel, M. L., Pearce, P. F., & Bangdiwala, S. I. (2005). Energy costs of physical activities in children and adolescents. *Medicine and Science in Sports and Exercise, 37*(2), 329-336.

Heart and Stroke Foundation of Canada. (2011). *Position statement: Physical activity, heart disease and stroke.*

Hilland, T. A., Ridgers, N. D., Stratton, G., & Fairclough, S. J. (2011). Associations between selected demographic, biological, school environmental and physical education based correlates, and adolescent physical activity. *Pediatric Exercise Science, 23*, 61-71.

Hills, A. P., King, N. A., & Armstrong, T. P. (2007). The contribution of physical activity and sedentary behaviours to the growth and development of children and adolescents: Implications for overweight and obesity. *Sports Medicine (Auckland, N.Z.), 37*(6), 533-545.

Hobin, E. P., Leatherdale, S. T., Manske, S., Dubin, J. A., Elliot, S., & Veugelers, P. J. (2012). A multilevel examination of gender differences in the association between features of the school environment and physical activity among a sample of grades 9 to 12 students in ontario, canada. *BMC Public Health, 12*, 74.

Hobin, E. P., Leatherdale, S. T., Manske, S. R., & Robertson-Wilson, J. (2010). A multilevel examination of school and student characteristics associated with moderate and high levels of physical activity among elementary school students (ontario, canada). *Canadian Journal of Public Health, 101*(6), 495-499.

Interlake Regional Health Authority. (2009). *Youth health survey report: Interlake region.* Stonewall, Manitoba: Interlake Regional Health Authority.

Interlake Regional Health Authority. (2011). *Cost of chronic disease in the interlake.*

Janssen, I., & LeBlanc, A. (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *International Journal of Behavioral Nutrition and Physical Activity, 7*(40)

Jekauc, D., Reimers, A. K., Wagner, M. O., & Woll, A. (2012). Prevalence and socio-demographc correlates of the compliance with the physical activity guidelines in children and adolescents in germany. *BMC Public Health, 12*, 714.

Jimenez-Pavon, D., Kelly, J., & Reilly, J. J. (2010). Associations between objectively measured habitual physical activity and adiposity in children and adolescents: Systematic review. *International Journal of Pediatric Obesity : IJPO : An Official Journal of the International Association for the Study of Obesity, 5*(1), 3-18. doi:10.3109/17477160903067601

Jose, K. A., Blizzard, L., Dwyer, T., McKercher, C., & Venn, A. J. (2011). Childhood and adolescent predictors of leisure time physical activity during the transition from adolescnece to adulthood: A population based cohort study. *International Journal of Behavioral Nutrition and Physical Activity, 8*, 54.

Kirby, J., Levin, K. A., & Inchley, J. (2012). Associations between the school environment and adolescent girls' physical activity. *Health Education Research, epub prior to publication*

Koezuka, N., Koo, N., Allison, K. R., Adlaf, E. M., Dwyer, J. J. M., Faulkner, G., & Goodman, J. (2006). The relationship between sedentary activities and physical inactivity among adolescents; results from the canadian community health survey. *Journal of Adolescent Health, 39*, 515.

Kohl, H. W., & Hobbs, K. E. (1998). Development of physical activity benaviors among children and adolescents. *Pediatrics, 101*, 549-554.

Kreuger, H. (2010). *Making the case for primary prevention: An economic analysis of risk factors in manitoba.* Winnipeg, Manitoba:

Kwan, M. Y., Cairney, J., Faulkner, G. E., & Pullenayegum, E. E. (2012). Physical activity and other health-risk behaviors during the transition into early adulthood: A longitudinal cohort study. *American Journal of Preventive Medicine, 42*(1), 14-20.

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33*(1), 159-174.

Leatherdale, S., & Wong, S. (2008). Modifiable characteristics associated with sedentary behaviours among youth. *International Journal of Pediatric Obesity,* , 1-9.

Leatherdale, S. T., & Burkhalter, R. (2012). The substance use profile of canadian youth: Exploring the prevalence of alcohol, drug and tobacco use by gender and grade. *Addictive Behaviour, 37*, 318-322.

Leatherdale, S. T., Manske, S. R., Faulkner, G., Arbour, K., & Bredin, C. (2010). A multi-level examination of school programs, policies and resources associated with physical activity among elementary school youth in the PLAY-on study. *International Journal of Behavioral Nutrition and Physical Activity, 7*(6), 1-13.

Leatherdale, S. T., & Papadakis, S. (2011). A multi-level examination of the associaion between older social models in the school environment and overweight and obesity among younger students. *Journal of Youth and Adolescence, 40*, 361-372.

Leggett, C., Irwin, M., Griffith, J., Xue, L., & Fradette, K. (2011). Factors associated with physical activity among canadian high school students. *International Journal of Public Health,*

Lemstra, M., Neilson, G., Rogers, M., Thompson, A., & Morasos, J. (2012). Physical activity in youth. *Canadian Family Physicia, 58*, e54-e61.

Loprinzi, P. D., Cardinal, B. J., Loprinza, K. L., & Lee, H. (2012). Benefits and environmental determinants of physical activity in children and adolescents. *Obesity Facts, 5*, 597-610.

Lowry, R., Lee, S. M., Fulton, J. E., Demissie, Z., & Kann, L. (2013). Obesity and other correlates of physical activity and sedentary behaviors among US high school students. *Journal of Obesity, 2013*

Lowry, R., Kann, L., Collins, J., & Kolbe, L. J. (1996). The effect of socioeconomic status on chronic disease risk behaviors among US adolescents. *Journal of American Medical Association, 276*(10), 792-797.

Lytle, L. A., Murray, D. M., Evenson, K. R., Moody, J., Pratt, C. A., Metcalfe, L., & Parra-Medina, D. (2009). Mediators affecting girls' levels of physical activity outside of school: Findings from the trial of activity in adolescent girls. *Annals of Behavioral Medicine : A Publication of the Society of Behavioral Medicine, 38*(2), 124-136. doi:10.1007/s12160-009-9127-2

Manitoba Centre for Health Policy.Concept: Socioeconomic factor index (SEFI). Retrieved 11/22, 2013, from umanitoba.ca/faculties/mediciner/units/mchp/resources/concept_dictionary.html

Marcus, B. H., Williams, D. M., Dubbert, P. M., Sallis, J. F., King, A. C., Yancey, A. K., . . . Interdisciplinary Working Group on Quality of Care and Outcomes Research. (2006). Physical activity intervention studies: What we know and what we need to know: A scientific statement from the american heart association council on nutrition, physical activity, and metabolism (subcommittee on physical activity); council on cardiovascular disease in the young; and the interdisciplinary working group on quality of care and outcomes research. *Circulation, 114*(24), 2739-2752. doi:10.1161/CIRCULATIONAHA.106.179683

McGavock, J. (2013). Is the provision of physical activity education to senior years students associated with greater physical activity levels? insight into a province-wide policy. *Journal of Physical Activity and Health,*

McLaren, L., & Hawe, P. (2005). Ecological perspectives in health research. *Journal of Epidemiology and Community Health, 59*, 6-14.

McNeill, L. H., Wyrwich, K. W., Brownson, R. C., Clark, E. M., & Kreuter, M. W. (2006). Individual, social environmental, and physical environmental influences on physical activity among black and white adults: A structural equation analysis. *Annals of Behavioral Medicine, 31*(1), 36-44. doi:10.1207/s15324796abm3101_7

Motl, R. W. (2007). Chapter 2: Theoretical models for understanding physical activity behavior among children and adolescents - social cognitive theory and self-determination theory. *Journal of Teaching in Physical Education, 26*(4), 350-357.

Norman, G. J., Schmid, B. A., Sallis, J. F., Calfas, K. J., & Patrick, K. (2005). Psychosocial and environmental correlates of adolescent sedentary behaviors. *Pediatrics, 116*(4)

Partners in Planning for Healthy Living. (2010). *Youth health survey report 2009.*

Perez, C. E. (2003). *Children who become active.* Ottawa: Statistics Canada.

Physical Activity Guidelines Advisory Committee. (2008). *Physical activity guidelines advisory committee report, 2008.* (). Washington, DC: U.S. Department of Health and Human Services.

Porta, M. (2008). *A dictionary of epidemiology* (Fifth Edition ed.) Oxford University Press.

Public Health Agency of Canada. (2010). *Chronic disease risk factor atlas.*

Public Health Agency of Canada. (2011). Backgrounder - united nations NCD summit 2011. Retrieved from http://www.phac-aspc.gc.ca/media/nr-rp/2011/2011_0919-bg-di-eng.php

Rangul, V., Holmen, T. L., Bauman, A., Bratberg, G. H., Kurtze, N., & Midthjell, K. (2011). Factors predicting changes in physical activity through adolescence: The young-HUNT study, norway. *Journal of Adolescent Health, 48*, 616-624.

Ridley, K., & Olds, T. M. (2008). Assigning energy costs to activities in children: A review and synthesis. *Medicine and Science in Sports and Exercise, 40*(8), 1439-1446.

Robertson-Wilson, J. E., Leatherdale, S., & Wong, S. (2008). Social-ecological correlates of active commuting to school among high school students. *Journal of Adolescent Health, 42*(486), 495.

Rodrigues, A. M. M., Mota, J., Cumming, S. P., Sherar, L. B., Neville, H., & Malina, R. M. (2010). Confounding effect of biological maturation on sex differences in physical activity and sedentary bebavior in adolescents. *Pediatric Exercise Science, 22*, 442-453.

Roos, L., Magoon, J., Gupta, S., Chateau, D., & Veuglers, P. J. (2004). Socioeconomic determinants of mortality in two canadian provinces: Multilevel modelling and neighborhood context. *Social Science and Medicine, 59*, 1435.

Sallis, J. F., Cervero, R. B., Ascher, W., Henderson, K. A., Kraft, M. K., & Kerr, J. (2006). An ecological approach to creating active living communities. *Annual Review of Public Health, 27*, 297-322.

Sallis, J. F., Owen, N., & Fisher, E. B. (2008). Ecological models of health behavior. In K. Glanz, B. K. Rimer & K. Viswanath (Eds.), *Health behavior and health education: Theory, research and practice* (4th ed., pp. 465-485) Jossey-Bass.

Sallis, J. F., Prochaska, J. J., & Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine and Science in Sports and Exercise, 32*(5), 963-975.

Sallis, J. F., Prochaska, J. J., Taylor, W. C., Hill, J. O., & Geraci, J. C. (1999). Correlates of physical activity in a national sample of girls and boys in grades 4 through 12. *Health Psychology, 18*(4), 410-415.

Schneider, M., & Stokols, D. (2009). Multilevel theories of behavior change: A social ecological framework. In S. A. Shumaker, J. K. Ockene & K. A. Riekert (Eds.), *The handbook of health behavior* (3rd ed., pp. 85-105) Springer Publishing Company.

Simon, S. D. (2001). Understanding the odds ratio and the relative risk. *Journal of Andrology, 22*(4), 533.

Spadano, J. L., Must, A., Bandini, L. G., Dallal, G. E., & Dietz, W. H. (2003). Energy cost of physical activities in 12-y-old girls: MET values and the influence of body weight. *International Journal of Obesity, 27*, 1528-1533.

Statistics Canada.Canadian community health survey data sources and methodology. Retrieved 09/28, 2011, from www.stat.can.gc.ca

Statistics Canada. (2013). CANSIM table 105-0501: Health indicator profile - leisure time physical activity. Retrieved 11/26, 2013, from www5.statcan.gc.ca/cansim/a05

Sterne, J. A. C., White, I. R., Carlin, J. B., Spratt, M., Royston, P., Kenward, M. G., . . . Carpenter, J. R. (2009). Multiple imputation for missing data in epidemiological and clinical research: Potentials and pitfalls. *British Medical Journal, 339*, 157.

Stokols, D. (1996). Translating social ecological theory into guidelines for community health promotion. *American Journal of Health Promotion, 10*(4), 282-298.

Suhrcke, M., & dePazNieves, C. (2011). *The impact of health and health beaviours on educational outcomes in high-income countries: A reivew of the evidence.* (). Copenhagen: WHO Regional Office for Europe.

Taber, D. R., Stevens, J., Lytle, L. A., Foreman, R. D., Moody, J., Parra-Medina, D., & Pratt, C. A. (2011). Association between school- and nonschool-based activity

programs and physical activity in adolescent girls. *Journal of Physical Activity and Health, 8*(7), 971.

Tremblay, M. S., & Willms, J. D. (2003). Is the canadian childhood obesity epidemic related to physical inactivity? *International Journal of Obesity, 27*, 1100-1105.

UCLA Statistical Consulting Group.Statistical computing seminars - multiple imputation in SAS. Retrieved 04/29, 2013, from www.ats.ucla.edu/stat/sas/notes2

University of Waterloo. (2010). *Youth smoking survey 2008-2009: Microdata user guide.*

Van Der Horst, K., Paw, M. J., Twisk, J. W., & Van Mechelen, W. (2007). A brief review of correlates of physical activity and sedentariness in youth. *Medicine and Science in Sports and Exercise, 39*(8), 1241-1250. doi:10.1249/mss.0b013e318059bf35

Wayman, J. C. (2003). *Multiple imputation for missing data: What is it and how can I use it?*. Annual Meeting of the American Educational Research Association:

Wilcox, S., & Ainsworth, B. E. (2009). The measurement of physical activity. In S. A. Shumaker, J. K. Ockene & K. A. Riekert (Eds.), *The handbook of behavior change* (3rd ed., pp. 327-346) Springer Publishing Company.

Wong, S., Leatherdale, S., & Manske, S. (2006). Reliability and validity of a school-based physical activity questionnaire. *Medicine and Science in Sports and Exercise, 38*(9), 1593-1600.

Woods, C. B., Nelson, N. M., O'Gorman, D. J., Foley, E., & Moyna, N. M. (2009). The take PART study (physical activity research for teenagers): Rationale and methods. *Journal of Physical Activity and Health, 6*(2), 170-177.

World Health Organization.(2005) Facing the facts: The impact of chronic disease in canada. Retrieved from www.who.int/chp/chronic_disease_report/en/

World Health Organization. (1986). *Ottawa charter for health promotion.*

World Health Organization. (2003). *WHO framework convention on tobacco control.* World Health Organization.

World Health Organization. (2004a). Global strategy on diet, physical activity and health. Retrieved 09/29, 2011, from www.who.int/dietphysicalactivity/physical_activity_intensity/en/index.html

World Health Organization. (2004b). *What is moderate-intensity and vigorous-intensity physical activity?*.

World Health Organization. (2011). *Global status report on noncommunicable diseases 2010.*

Yuan, Y. C. (2000). *Multiple imputation for missing data: Concepts and new development (version 9.0)* SAS Institute Inc.