AN EXPLORATORY STUDY OF PHYSICAL ACTIVITY AND BODY MASS INDEX IN A SAMPLE OF RURAL SASKATCHEWAN CHILDREN

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Abstract

In Canada, the prevalence of childhood overweight and obesity has increased dramatically since the 1980's. Few studies have examined factors associated with overweight and obesity in Canadian children. The purpose of this study was to: (1) explore the relationship between physical activity and BMI, (2) examine the prevalence of childhood overweight and obesity, and (3) explore the importance of age, gender, and residency (farm versus town) in relation to childhood overweight and obesity in a sample of rural Saskatchewan children.

This cross-sectional study included a self-report questionnaire survey and anthropometric assessment of a sample of children (Grades 4-6) from rural Saskatchewan. Of the 525 questionnaires distributed, 262 were completed with a signed consent form (response rate: 49.9%) and 251 of those students had their height, weight, and sitting height measured. The research questionnaire gathered demographic data about the child and the parents or guardian, data on the child's sedentary leisure activities, and a 7 day physical activity history using the Physical Activity Questionnaire for Older Children (PAQ-C). Each child's body mass index was estimated using the measured height and weight and these estimates were compared to international standards for BMI to estimate the prevalence of childhood overweight (25.5%) and obesity (7.1%) within the study population. There were no statistically significant gender differences in the proportion of children who were overweight or obese. The factors found to consistently have a significant association with the prevalence of overweight and obesity were Aboriginal descent and mother's and

father's BMI category. The mean PAQ-C score was similar for boys (3.3, SD = 0.64) and girls (3.2, SD = 0.57) and did not differ significantly by BMI category.

This descriptive study provided information on the prevalence of physical activity, overweight, and obesity in a sample of rural Saskatchewan children and the relationship between physical activity and BMI in the sample. Findings of this study can be used by nurses, other health professionals, and education leaders to develop health promotion programs to promote a healthier lifestyle for children and their families.

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CHAPTER 1

Introduction

Statement of the Problem

In 2003 the World Health Organization (WHO) declared that obesity has become a global epidemic. In particular, the rise in childhood obesity has become a major public health concern. In Canada, over the last twenty years, the prevalence of overweight and obesity among children has increased dramatically. From 1981 to 1996 the prevalence of overweight increased from 15% to 28.8% for boys and from 15% to 23.6% for girls and the prevalence of obesity increased from 5% to 13.5% for boys and from 5% to 11.8% for girls (Tremblay & Willms, 2000). The rise in overweight and obesity is also associated with an increased prevalence of chronic illnesses in childhood (i.e., type II diabetes mellitus, hypertension, hyperlipidemia, and heart and vascular disease), which were once only evident in the adult population (Fox, 2004; Janssen, Katzmarzyk, Boyce, King, & Picket, 2004; Laing, 2002; MacKenzie, 2000; O'Loughlin, Paradis, Renaud, Meshefedjian, & Gray-Donald, 1998; Tremblay & Willms, 2000; Sweet, Macdonald, Reeder, Chen, & Angel, 1997). Childhood obesity can have a negative impact on a child's psychological health (Janssen et al.; Laing). According to Laing, "poor self-esteem and psychological problems associated with the stigma of obesity can be seen even in very young children" (p. 15).

Prevalence of Childhood Overweight and Obesity

Studies conducted in the United States (Chai et al., 2003; Ogden, Flegal, Carroll, & Johnson, 2002; Wang, 2001; Wang, Monteiro, & Popkin, 2002), Australia (Booth, Macaskill, Lazarus, & Baur, 1999; Booth et al., 2001; Dollman, Norton, & Tucker, 2002), England (Chinn & Rona, 2001; Rudolph et al., 2004), Scotland (Chinn & Rona), Brazil (Wang et al., 2002), China (Luo & Hu, 2002; Wang et al., 2002), Mexico (Brewis, 2003; Hernandez et al., 2003; Sanchez-Castillo et al., 2001), South Africa (Monyeki, van Lenthe, & Steyn, 1999), Greece (Mamalakis, Kafatos, Manios, Anagnostopoulou, & Apostolaki, 2000), Jamaica (Chang, Hutchinson, Powell, & Walker, 1999), and Costa Rica (Nunez-Rivas, Monge-Rojas, Leon, & Rosello, 2003) have revealed a high prevalence of childhood overweight and obesity. In Canada, studies of childhood overweight and obesity have been conducted in Ontario (Evers & Hooper, 1995; Katzmarzyk & Malina, 1998; Plotnikoff, Bercovitz, & Loucaides, 2004), Quebec (O'Loughlin et al., 1998), Alberta (Ball, Marshall, Roberts, & McCargar, 2001; Plotnikoff et al.), Saskatchewan (Thompson, Baxter-Jones, Mirwald, & Bailey, 2002), and Newfoundland (Canning, Courage, & Frizzell, 2004). Secondary analyses of large national studies, including the Canada Fitness Survey (Tremblay, Katzmarzyk, & Willms, 2002; Tremblay & Willms, 2000; Willms, Tremblay, & Katzmarzyk, 2003), Campbell's Survey of the Well-being of Canadians (Tremblay & Willms, 2000), National Longitudinal Survey of Children and Youth (Tremblay et al., 2002; Tremblay & Willms, 2000, 2003; Willms et al., 2003), Canadian Community Health Survey (Mitura & Bollman, 2004), the National Population Health Survey (Tremblay et al., 2002), and the Health Behavior in School-aged Children Survey

(Janssen et al., 2004) have been conducted in Canada. The Canadian studies revealed variability in the prevalence of childhood overweight and obesity and three studies demonstrated a rise in the prevalence of overweight and obesity over time (Tremblay et al., 2002; Tremblay & Willms, 2000; Willms et al., 2003).

The prevalence of overweight and obesity is particularly high among children of Aboriginal descent from both Canada (Bernard, Lavallee, Gray-Donald, & Delisle, 1995; Hanley et al., 2000; Katzmarzyk & Malina, 1998) and the United States (Jackson, 1993). Canadian studies of Aboriginal children have been conducted in Ontario (Hanley et al.; Katzmarzyk & Malina) and Quebec (Bernard et al.).

In the large Canadian studies, data for height and weight were parent- or self-reported (Janssen et al., 2004; Mitura & Bollman, 2004; Tremblay et al., 2002; Tremblay & Willms, 2000, 2003; Willms et al., 2003). Use of parent- or self-reported values for height and weight is a limitation of these studies due to the tendency to underestimate weight and overestimate height (Brener, McManus, Galuska, Lowry, & Wechsler, 2003; Strauss, 1999). The inaccurate estimates of height and weight may have resulted in underestimation of body mass index [weight (kg)/height (m^2)], which was commonly used as an indicator of childhood overweight and obesity in these studies. Therefore, the true prevalence of childhood overweight and obesity in Canada may be higher than the published estimates, which were based on body mass index (BMI) using parent- or self-reported height and weight data.

Geographic Location

There are inconsistent results for the relationship between residency (urban versus rural) and the prevalence of childhood overweight and obesity. In Canada

(Mitura & Bollman, 2004; Plotnikoff et al., 2004), the United States (Davy, Harrell, Stewart, & King, 2004; McMurray, Harrell, Bangdiwala, & Deng, 1999), Mexico (Sanchez-Castillo et al., 2001), Spain (Moreno et al., 2001), and Sweden (Berg, Simonsson, Brantefors, & Ringqvist, 2001) a high prevalence of overweight and obesity was identified in rural populations. In Canada, boys aged 12 to 17 years living in small town regions were found to have a higher prevalence of being overweight or obese compared to boys living in large metropolitan regions (Mitura & Bollman; Plotnikoff et al.) and a higher proportion of girls aged 12 to 17 years living in rural settings were found to be obese compared to girls living in urban settings (Plotnikoff et al.). Outside Canada, a higher prevalence of overweight and obesity was found among urban children living in India (Mohan et al., 2004), China (Luo & Hu, 2002), and Costa Rica (Nunez-Rivas et al., 2003). A study of Australian children indicated that children's BMI levels did not differ significantly between children living in rural and urban locations (Booth et al., 1999). These geographical differences may be due to differences in the populations studied (age, ethnicity, and socioeconomic status) and the methodology used to study the sample.

A few suggestions have been identified in the literature as to why rural children may have a higher risk for overweight and obesity than urban children. One factor identified is the limited availability of recreational programs and facilities in rural areas (Plotnikoff et al., 2004), which results in children and their families having to travel longer distances for physical activity. In a study of rural Saskatchewan children, the participants traveled a mean distance of 42.2 (SD = 35.3) km (one way) in a week to participate in organized physical activities (Bilinski, Semchuk, & Chad,

2005). Another important factor identified in the literature is the potentially lower socioeconomic status of rural families compared to urban families (McMurray et al., 1999; Plotnikoff). Overweight and obesity of rural children was found to be related to a lower income and lower education level of the parents (McMurray et al.; Plotnikoff). The lower socioeconomic status of rural families may affect their ability to purchase recreational equipment and to access recreational programs.

Physical Activity

The rise in the prevalence of obesity has been attributed to changes in our society and culture (Ball, O'Connor et al., 2001; Laing, 2002). We have created a society that promotes a sedentary lifestyle through video and computer games. In addition to diet, an increased sedentary lifestyle of watching television (Arluk, Branch, Swain, & Dowling, 2003; Hancox, Milne, & Poulton, 2004; Janssen et al., 2004; Lowry, Wechsler, Galuska, Fulton, & Kann, 2002; Tremblay & Willms, 2003) and playing computer/video games (Arluk et al.; Tremblay & Willms, 2003) and a decrease in physical activity levels (Davy et al., 2004; Harrell et al., 2003; Janssen et al.; Lowry et al.; Seeley, 2005; Tremblay & Willms, 2003) have been related to the rise in childhood overweight and obesity. In addition, children have become less physically active in school due to a decline in physical education programs offered in schools (Active Healthy Kids Canada, 2005; Anderson, 2000; Datar & Sturm, 2004; Laing; MacKenzie). Due to the decline in physical education programs, most of a child's physical activity must occur outside of school; this has resulted in fewer children being physically active. Another factor related to decreased physical activity levels is unsafe neighborhoods; children of working parents are often instructed to

remain indoors due to safety concerns (Laing ; MacKenzie). This encourages more sedentary activities such as computer and video games.

In 2002, Health Canada released *Canada's Physical Activity Guide for Children*. According to this guide, children should be involved in at least 20 minutes of moderate physical activity and 10 minutes of vigorous physical activity every day. The Statistical Report on the Health of Canadians indicated that 30% of Canadian youth aged 12 to 14 years were physically inactive (Statistics Canada, 1999a). The Canadian Fitness and Lifestyle Research Institute (CFLRI, 2002) estimated that 49% of youth in Saskatchewan were not physically active enough for optimal growth and development. The low levels of physical activity were attributed to the availability of sedentary activities, such as television watching and video games, and the lack of supervised recreational programs (Laing, 2002; MacKenzie, 2000).

Throughout the research literature reviewed, results are inconsistent regarding the relationship between rural versus urban residency and childhood physical activity levels. In a study conducted in the United States there was no statistically significant difference in the physical activity levels of rural and urban children (McMurray et al., 1999). A study by the Center for Disease Control and Prevention found that children living in rural areas in the United States had higher levels of physical inactivity than children living in metropolitan areas (Felton et al., 2002). In an Australian study, rural youth were found to have higher levels of physical activity compared to urban youth (Dollman et al., 2002). In Canada, girls living in major metropolitan regions had a higher prevalence of inactivity compared to girls living in small metropolitan and rural areas and boys living in all regions of the country (Mitura & Bollman, 2004). In

a study conducted in Mexico, no differences were found in recreational physical activity levels between rural and urban children. Rural children, however, participated in more moderate to vigorous household chores (Reyes, Tan, & Malina, 2003). The results of these studies indicate that there are inconsistencies in the relationship between residency (rural versus urban) and physical activity. These differences may be due to differences in geographic location, differences in the populations studied (age, ethnicity, and socioeconomic status), and the methodology used to study the physical activity of the sample.

According to MacKenzie (2000), once a child is diagnosed with obesity, the condition becomes more difficult to treat. Often the obesity becomes a lifelong problem. Therefore, if the trend for childhood obesity continues, we are facing a future of obese adults who will place an enormous burden on our healthcare system. According to Laing (2002) it is "imperative that childhood obesity is tackled now to avert the impending healthcare crisis that threatens future generations" (p. 14). The most effective treatment for obesity, according to MacKenzie, is prevention.

Relevance and Significance

Prior to starting the study, a review of the published research indexed in CINAHL (1982-2005), MEDLINE® (1966-2005), and SPORT Discus (1830-2005) revealed wide geographic variation in the findings of studies of the prevalence of childhood overweight and obesity and of the relationship between childhood overweight and obesity and physical activity, and rural versus urban residence. Only 14 Canadian studies of the prevalence of childhood overweight and obesity were identified in the literature search. Overall, these studies revealed variability in the

prevalence of childhood overweight and obesity across Canada. A gap in the Canadian research is the lack of empirical information regarding the relationships among rural versus urban residency, physical activity, and childhood overweight and obesity. In addition, there is a distinct gap in Canadian research related to the use of measured height and weight data in the studies of childhood overweight and obesity. The previous large national studies were based on parent- or self-reported data for height and weight, which may have resulted in underestimation of the prevalence of childhood overweight and obesity in Canada.

Data obtained in the present study provides information on (1) the relationship between physical activity and BMI in a sample of rural Canadian children, (2) the prevalence of overweight and obesity in the rural sample, and (3) factors related to overweight and obesity in the sample of rural Saskatchewan children.

Purpose of the Study

The purpose of the proposed research was to (1) explore the relationship between physical activity and BMI in a sample of rural Saskatchewan children; (2) examine the prevalence of childhood overweight and obesity in the rural sample; and (3) explore the importance of age, gender, and residency (farm versus town) in relation to childhood overweight and obesity in the sample. This information can be utilized by nurses, teachers, and others to develop health promotion programs to enhance the health of children in Saskatchewan. The results of this study will be useful in planning and developing physical activity and health promotion programs that will lead to better health for Saskatchewan children. This information can be used

by the community, as well, to develop health promotion programs for children and their families.

Research Questions

1. What is the relationship between physical activity level and BMI in a sample of rural Saskatchewan children?
2. What is the prevalence of overweight and obesity in a sample of rural Saskatchewan children?
3. What factors are associated with being classified as overweight or obese in a sample of rural Saskatchewan children?

Research Hypothesis

The following hypothesis was tested for research question one:

There is an inverse relationship between physical activity level and BMI in a sample of rural Saskatchewan children.

Definitions of Terms

Throughout the research literature various definitions have been used for the terms physical activity, overweight, obesity, and rural area. In addition, a variety of methods have been used to measure the variables physical activity, overweight, and obesity. These definitions and methodologies will be examined further.

Overweight and Obesity

Overweight and obesity have been defined in the research literature using a variety of methods. A common method is to estimate the child's body mass index (BMI), which is defined as the relationship of the individual's weight to height calculated as weight in kilograms divided by height in meters squared (Statistics

Canada, 1999b)**,** and then compare these estimates to a standard definition. In some of the research articles reviewed, Centers for Disease Control and Prevention (CDC) growth charts were used to define overweight and obesity (Arluk et al., 2003; Ball, Marshall et al., 2001; Bolzan, Guimarey, & Frisanchos, 1999; Brewis, 2003; Chai, et al., 2003; Davis et al., 2003; Davy et al., 2004; Mamalakis et al., 2000; Monyeki et al., 1999; Moreno et al., 2001; Nunez-Rivas et al., 2003; Ogden et al., 2002; O'Loughlin et al., 1998; Plotnikoff et al., 2004; Skybo & Ryan-Wenger, 2003). According to these charts, at risk for overweight is defined as a BMI for age $\geq 85^{th}$ percentile and obesity is defined as a BMI for age $\geq 95^{th}$ percentile. These "BMI for Age" growth charts were based on data from five National Health and Nutrition Examination Survey (NHANES) studies conducted in the United States by the National Center for Health Statistics of the Centers for Disease Control and Prevention (Ogden et al.).

Cole, Bellizzi, Flegal, and Dietz (2000) developed international cut off points of BMI for childhood overweight and obesity, based on age and gender. These cut off points occur at six month intervals between the ages of 2 and 18 years. At age $\geq$18 years the cut off point for overweight is a BMI of 25 kg/m^2 and for obesity is a BMI of 30 kg/m^2. These standards were determined by averaging BMI data from Brazil, Great Britain, Hong Kong, the Netherlands, Singapore, and the United States. A variety of international studies (Berg et al., 2001; Booth et al., 2001; Chinn & Rona, 2001; Ekelund et al., 2004; Gordon et al., 2003; Hernandez et al., 2003; Luo & Hu, 2002; Sanchez-Castillo et al., 2001; Sekine et al., 2002; Wang, Ge, & Popkin, 2000; Wang et al., 2002; Wang et al., 2003) and Canadian studies (Canning et al., 2004;

Janssen et al., 2004; Mitura & Bollman, 2004; Tremblay et al., 2002; Tremblay & Willms, 2003; Willms et al., 2003) have used the international standards set by Cole et al. The use of the international standards set by Cole et al. are appropriate for the present study because they provide gender specific cut off points at six month intervals between the ages of 2 and 18 years. These age and gender specific cut off points have been identified using "dataset specific centiles linked to adult cut off points" (Cole et al., p. 1).

Other methods identified in the literature for estimating overweight and obesity include measurement of skin fold thickness (Booth et al., 1999; Dollman et al., 2002; Katzmarzyk & Malina, 1998; Monyeki et al., 1999; Moore et al., 2003; O'Loughlin et al., 1998; Skybo & Ryan-Wenger, 2003), use of dual energy x-ray absorptiometry (Francis, Bope, MaWhinney, Czajka-Narins, & Alford, 1999; Gordon et al., 2003), and waist-hip ratio (Chai et al., 2003; Dollman et al.).The reliability of BMI has been examined in comparison to these other methods of measurement including skin fold thickness, waist-hip ratio, and dual energy x-ray absorptiometry.

In comparison to skin fold thickness measurements BMI is a more reliable measure of fatness in a given population (Dietz & Robinson, 1998). Inaccurate placement of calipers to measure skin fold thickness can result in inaccurate results. Therefore, skin fold measurements should be avoided in children (Skybo & Ryan-Wenger, 2003). The use of dual energy x-ray absorptiometry has been identified as an accurate method for measuring body fatness in a research laboratory setting; however, dual energy x-ray absorptiometry is not practical for a field setting or clinic (Pietrobelli et al., 1998). According to a study by Pietrobelli et al., BMI has a strong

correlation with total body fat estimated by dual energy x-ray absorptiometry (R^2= 0.85 for boys and 0.89 for girls). In comparison to BMI, waist-hip ratio provides a more accurate estimation of the prevalence of overweight and obesity in individuals with central obesity. However, waist-hip ratio has only been identified as an accurate measurement of central obesity in adults and, therefore, may not be an accurate indication of central obesity in children and adolescents (Goran, 1998).

Advantages of BMI are that it is easily calculated from height and weight values, which are routinely measured in clinic and hospital settings, and it is safe and inexpensive to obtain (Dietz & Robinson, 1998; Pietrobelli et al., 1998). One disadvantage of using BMI is that muscle, bone, and fat influence BMI levels. A child with a large muscle mass in relation to height can have a BMI in the overweight status range and not be overweight (Skybo & Ryan-Wenger, 2003). Level of sexual maturation also has an effect on the percent of body fat at a given BMI. A "child who is more advanced in sexual maturation will have a lower percent body fat" (Daniels, Khoury, & Morrison, 1997, p. 807). This statement is true for boys, but not for girls.

For the purpose of the present research, overweight and obesity were defined using the international standards set by Cole et al. (2000). Measured height and weight values were used to estimate BMI in order to classify participants as normal weight, overweight, or obese.

Physical Activity

Physical activity is defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen, Powell, & Christenson, 1985, p.126). Physical activity has been described as achieving more than a state of physical

fitness. Physical activity "engages the whole person – the body, the mind, the spirit, the emotions, and the social aspects" (Swedburg & Izso, 1994, p. 33).

Throughout the research literature, physical activity levels among children have been operationalized using a variety of methods. These methods include accelerometers (Ekelund et al., 2004; Klasson-Heggebo & Anderssen, 2003; Patrick et al., 2004; Trost et al., 2002), self-report questionnaire (Dollman et al., 2002; Ball, Marshall et al., 2001; Francis et al., 1999; Harrell et al., 2003; Janssen et al., 2004; Lowry et al., 2002; McMurray et al., 1999; Mitura & Bollman, 2004; O'Loughlin et al., 1998; Pate et al., 1999; Paxton, Estabrooks, & Dzewaltowski, 2004; Plotnikoff et al., 2004; Reyes et al., 2003; Tremblay & Willms, 2003; Trost et al., 1997), total energy expenditure using doubly labeled water technique (Ball, O'Connor et al., 2001), heart rate monitor (Treuth, Butte, Adolph, & Puyau, 2004), and pedometers (Davy et al., 2004).

The most common method of measuring physical activity levels is the use of self-report questionnaire. Self-report questionnaires have the advantage of being very simple and are cost effective to administer (Cale, 1998). The disadvantage of the use of self-report questionnaires with children and adolescents is that they may report inaccurate estimates of their physical activity (Cale). Self-report methods also do not provide adequate estimates of the intensity and duration of physical activity (Klasson-Heggebo & Anderssen, 2003; Trost et al., 2002). Objective measurement methods, such as heart rate monitors and accelerometers (electronic motion sensors), significantly improve the ability to measure the frequency, duration, and intensity of a child's physical activity. However, the use of these methods can be very costly and

time consuming. Accelerometers and pedometers can be insensitive to many forms of physical activity such as stair climbing and biking (Trost, 2001).

The use of a self-report questionnaire is convenient and cost-effective and can provide a detailed physical activity history. Therefore, for the purpose of this research, physical activity levels were measured by self-report questionnaire.

Rural

The definition of 'rural' varies throughout the literature. According to Statistics Canada, rural areas are defined as "sparsely populated lands outside urban areas . . . small towns, villages, and other populated places with less than 1,000 population according to previous census" (1996, p. 226). In a previous study conducted in the United States, a rural population was defined as a population less than 2,500 (McMurray et al., 1999). A rural population was defined as less than 1,000 people in studies conducted in Spain (Moreno et al., 2001) and Sweden (Berg et al., 2001). In a study in Australia, a rural population was defined as less than 5,000 people (Dollman et al., 2002). A number of studies did not provide a definition for the rural population examined (Booth et al., 1999, 2001; Davis et al., 2003; Davy et al., 2004; Felton et al., 2002; Luo & Hu, 2002; Mohan et al., 2004; Nunez-Rivas et al., 2003; Potvin, Gauvin, & Nguyen, 1997; Reyes et al., 2003; Sanchez-Castillo et al., 2001; Tremblay et al., 2002; Wang, 2001; Welch, Gross, Bronner, Dewberry-Moore, & Paige, 2004). For the purpose of the present research "rural" was defined according to the definition by Statistics Canada.

Maturational Age

Variation in body mass index and physical activity of children may be a result of maturational age. According to Tanner (1990), girls mature two years before boys. As children age physical activity levels decrease. Therefore, the lower levels of physical activity identified in girls, when compared to boys of the same chronological age, may be due to early maturation (Thompson, Baxter-Jones, Mirwald, & Bailey, 2003). When studying childhood growth it is very important to identify the maturational age of each child (Mirwald, Baxter-Jones, Bailey, & Beunen, 2002).

Previous studies have identified maturational age using Tanner's pubertal stages (Ekelund et al., 2004; Treuth, Butte, & Sorkin, 2003). The limitation of this method is that the assessment of secondary sex characteristics does not reflect the timing of growth and can be perceived as very intrusive by adolescents (Mirwald et al., 2002). Another method of identifying maturational age is through the use of skeletal age assessment. Skeletal age assessment is the most accurate method; however, it is very costly and involves exposure to radiation. The most practical and noninvasive method of identifying maturational age is measurement of the age at peak height velocity (PHV), which "reflects the maximum growth in stature during adolescence" (Thompson et al., 2003, p. 1685). The relationship between leg length and sitting height may indicate maturational status. According to Tanner (1990), leg length reaches its peak prior to trunk length. Age at PHV is calculated using the variables gender, date of birth, date of measurement, height, sitting height, and weight. The ideal age for prediction of PHV is 9 to 13 years for females and 12 to 16 years for males (Mirwald et al., 2002;

http://athena.usask.ca/growthutility/phv_ui.cfm?type=1). Maturity age is calculated by subtracting age at PHV from chronological age at the time of measurement. At PHV maturity age equals 0. Prior to PHV maturity age is negative. Following PHV maturity age is positive (Thompson et al., 2002).

In a study of Saskatchewan children aged 8 to 16 years, age at PHV was estimated and cross-validated with two different samples of Saskatchewan children (Mirwald et al., 2002). The results of the study indicated a strong correlation between the age of maturity (age at PHV) and anthropometric measurement (R^2= 0.92 for boys and 0.91 for girls). For the purpose of the present research, maturational age was identified using age at PHV. The height, weight, and sitting height were measured for each participant.

CHAPTER 2

Literature Review

Prior to starting the present study, the author conducted a review of the published research indexed in CINAHL (1982-2005), MEDLINE® (1966-2005), and SPORT Discus (1830-2005). The following is a review of the published previous studies on childhood overweight and obesity, physical activity of children, and rural children.

Studies of Childhood Overweight and Obesity

Studies Conducted in Canada

In Canada, studies of childhood overweight and obesity have been conducted in Ontario (Evers & Hooper, 1995; Katzmarzyk & Malina, 1998; Plotnikoff et al., 2004), Quebec (O'Loughlin et al., 1998), Alberta (Ball, Marshall et al., 2001; Plotnikoff et al.), Saskatchewan (Thompson et al., 2002), and Newfoundland (Canning et al., 2004). The ages of the children included in these studies varied as follows: ages 3 – 4 years (Canning et al.), ages 6 – 10 years (Ball, Marshall et al.), ages 7 – 9 years (Evers & Hooper.), ages 8 – 16 years (Thompson et al.), ages 9-12 years (O'Loughlin et al., 1998), and Grades 9 – 12 (Plotnikoff et al.). In six of the seven studies (Ball, Marshall et al.; Canning et al.; Evers & Hooper; Katzmarzyk & Malina; O'Loughlin et al., 1998; Thompson et al.) the children's height and weight

were measured. The study by Plotnikoff et al. used the children's self-reported height and weight and estimates of BMI were compared to NHANES standards (Ball, Marshall et al.; Evers & Hooper; O'Loughlin et al., 1998; Plotnikoff et al.) and the international standards (Canning et al.) set by Cole et al. (2000). The results of all these studies indicated a high prevalence of overweight and obesity among Canadian children, with estimates varying from 7.7% to 35.2% for the prevalence of overweight and from 2.3% to 19.1% for the prevalence of obesity. The wide variation in the prevalence of overweight and obesity may be due to differences between studies in methodology, age of the children, ethnicity, or a real difference may exist.

In Canada, studies of childhood overweight and obesity among Aboriginal children have been conducted in Ontario (Hanley et al., 2000; Katzmarzyk & Malina, 1998) and Quebec (Bernard et al., 1995). In these studies the children's height and weight were measured and compared to NHANES standards. The results of these studies indicated a high prevalence of overweight (27.7% to 38%) among Aboriginal children.

Large national studies conducted in Canada. Secondary analyses of data from large national studies including the Canada Fitness Survey (Tremblay et al., 2002; Tremblay & Willms, 2000; Willms et al., 2003), Campbell's Survey on the Well-being of Canadians (Tremblay & Willms, 2000), the National Longitudinal Survey of Children and Youth (Tremblay et al., 2002; Tremblay & Willms, 2000, 2003; Willms et al.), the Canadian Community Health Survey (Mitura & Bollman, 2004), the National Population Health Survey (Tremblay et al., 2002), and the Health Behavior in School-aged Children Survey (Janssen et al., 2004) have been conducted in Canada.

The study populations for these large national studies included children and adolescents aged 7 – 13 years (Tremblay et al., 2002; Tremblay & Willms, 2000, 2003; Willms et al.) and adolescents aged 12 – 17 years (Janssen et al.; Mitura & Bollman) from across Canada. The data for height and weight for these studies were based on parent- or self-reported height and weight. The use of parent- or self-reported values for height and weight may have resulted in inaccurate estimates of the prevalence of childhood overweight and obesity, which may affect the internal and external validity of the study. Burns and Grove stated that "internal validity is the extent to which the effects detected in the study are a true reflection of reality rather than the result of extraneous variables" (2005, p. 215). The prevalence of overweight and obesity based on self-reported BMI may be inaccurate and, therefore, may not be a true reflection of reality. If the results of the study are not a true reflection of reality and the internal validity of the study is affected, then the external validity, which is "the extent to which study findings can be generalized beyond the sample used in the study" (Burns & Grove, pp. 218-219) may be affected as well.

In previous studies, estimates of BMI were compared to the international standards (Janssen et al., 2004; Mitura & Bollman, 2004; Tremblay et al., 2002; Tremblay & Willms, 2003; Willms et al., 2003) set by Cole et al. (2000) and the NHANES standards (Tremblay & Willms, 2000). The results of these studies all indicated a high prevalence of overweight and obesity among Canadian children with estimates varying from 7.7% to 35.2% for the prevalence of overweight and from 2.3% to 19.1% for the prevalence of obesity. However, the results of these studies do not take into account geographic variation. As Willms et al. noted, "further research is

required in Canada to better map the geographic variation in overweight and obesity in Canada" (2003, p. 672).

Few of the reviewed Canadian studies identified a difference in the prevalence of overweight and obesity between boys and girls. Four of the large secondary analyses identified a higher prevalence of overweight and obesity among boys (Janssen et al., 2004; Mitura & Bollman, 2004; Tremblay et al., 2002; Tremblay & Willms, 2000). The reliability of these results, however, may be questioned because parent- or self-reported height and weight were used in these studies to estimate BMI. One limitation of these studies is that girls were more likely than boys to underreport weight, which was used to calculate BMI. The tendency for girls to underreport weight (Brener et al., 2003; Strauss, 1999) may explain the finding that boys had a higher prevalence of overweight and obesity than girls (Janssen et al.; Tremblay & Willms).

In a study of 1,657 youth aged 12 to 16 years, measured and self-reported height and weight values were compared (Strauss, 1999). In the study, using self-reported weight values resulted in significant underestimation of weight for obese and overweight female youth. Strauss noted that "self-reported heights and weights results are not recommended for identifying an individual as 'overweight' since a fairly narrow height and weight range is required for accurate classification" (p. 907).

Studies Conducted Outside of Canada

Outside of Canada, studies of the prevalence of childhood overweight and obesity have been conducted in the United States (Chai et al., 2003; Ogden et al., 2002; Wang, 2001; Wang et al., 2002;), Australia (Booth et al, 1999, 2001; Dollman

et al., 2002), England (Chinn & Rona, 2001; Rudolph et al., 2002), Scotland (Chinn & Rona), Brazil (Wang et al., 2002), China (Luo & Hu, 2001; Wang et al., 2000), Mexico (Brewis, 2003; Hernandez et al., 2002; Sanchez-Castillo et al., 2001), South Africa (Monyeki et al., 1999), Greece (Mamalakis et al., 1999), Jamaica (Chang et al., 1999), and Costa Rica (Nunez-Rivas et al., 2003). Most of the previous studies utilized measured height and weight to estimate BMI. Estimates of BMI were compared to the NHANES standards (Arluk et al., 2003; Chai et al.; Chang et al.; Brewis; Mamalakis; Monyeki et al.; Ogden et al.) and the international standards (Chinn & Rona; Hernandez et al.; Rudolf et al.; Wang et al., 2000, 2002) set by Cole et al. (2000). In all of the previous studies, there was an increased prevalence of childhood overweight and obesity when BMI estimates were compared to NHANES standards or international standards. In a few of the studies there was a significant difference between girls and boys in the prevalence of overweight and obesity. In Mexico, 21.2% of girls aged 5 to 11 years had the highest estimated prevalence of overweight and obesity (Hernandez et al., 2003). Girls aged 4 to 11 years in England (13.5%) and in Scotland (15.8%) had the highest prevalence of overweight (Chinn & Rona, 2001). In South Africa, 15% of boys aged 3 to 4 years had the highest prevalence of overweight; however, as the children aged the prevalence of overweight and obesity decreased (Monyeki et al., 1999). In Jamaica, boys aged 6 to 7 years weighed significantly more than girls of that age, and girls aged 10 to 11 years were significantly heavier than boys of that age (Chang et al., 1999). In the remaining studies, gender differences were not identified.

Studies of Physical Activity of Children

Studies Conducted in Canada

In Canada, large national surveys of physical activity levels of children have been conducted. These surveys include the Canada Fitness Survey of children aged 7 to 19 years (Tremblay et al., 2002; Tremblay & Willms, 2000; Willms et al., 2003), the Campbell's Survey on the Well-being of Canadians (Tremblay & Willms, 2000) a longitudinal follow-up of the Canada Fitness Survey (Tremblay et al., 2002; Tremblay & Willms, 2000; Willms et al.), the National Longitudinal Survey of Children and Youth (Tremblay et al., 2002; Tremblay & Willms, 2000; Willms et al.) aged newborn to 13 years, the Health Behavior in School-Aged Children Survey (Janssen et al., 2004), and the Canada Fitness and Lifestyle Research Institute survey (2002). Results of a secondary analysis of the 1994 National Longitudinal Survey of Children and Youth indicated that increased physical activity is negatively associated with children being overweight or obese, and increased sedentary activity is a risk factor for being overweight or obese (Tremblay & Willms, 2003). According to the Canada Fitness Lifestyle Research Institute survey, 49% of Saskatchewan youth aged 12-19 are not physically active enough for optimal growth and development (2002).

Recently, the *Report Card on Physical Activity for Children and Youth* (Active Healthy Kids Canada, 2005) was published based on data from four large national studies (National Longitudinal Survey of Children and Youth, Canadian Community Health Survey, Health Behavior in School-Aged Children Survey, and Canada Fitness and Lifestyle Research Institute survey). Data presented in this report card indicate that children and youth in Canada were not meeting the recommended daily

requirements for physical activity as outlined in *Canada's Physical Activity Guide for Children and Youth* (Health Canada, 2002). In particular, girls reported lower levels of physical activity compared to boys. Physical education programs in the schools also received a low grade in the report card. Only 14% of elementary schools provided an average of 30 minutes of daily physical education and only 4% of secondary schools provided an average of 45 minutes of daily physical education.

In Quebec, physical activity levels of inner-city youth aged 9 to 13 years were measured using a self-report questionnaire (O'Loughlin, Paradis, Kishchuk, Barnett, & Renaud, 1999). Girls had the highest prevalence of inactivity compared to boys and levels of inactivity increased with age in both genders. A larger proportion of boys (40%) reported being part of a school sports team compared to girls (33.3%). In Alberta, physical activity levels of children aged 6 to 10 years were measured using a self-report questionnaire (Ball, Marshall et al., 2001). Results of the Alberta study revealed that the boys were more physically active than the girls. In a Saskatchewan study of boys and girls aged 6 to 9 living in two urban centers, Seeley (2005) found that children with low levels of physical activity in free time were more likely to be obese.

Studies Conducted Outside of Canada

A variety of published studies of physical activity levels of children have been conducted in the United States. Use of a self-report questionnaire was the most common method of physical activity assessment (Harrell et al., 2003; Lowry et al., 2002; McMurray et al., 1999; Paxton et al., 2004; Trost et al., 1997). Reported findings indicate a higher prevalence of physical activity among boys than girls

(Harrell et al., Trost et al., 1997). Lowry et al. identified sedentary behavior of more than 2 hours/day of television viewing as a risk factor for obesity. Harrell et al. found that girls reported a greater number of sedentary activities than boys. In a study of physical activity, assessed by accelerometer (Patrick et al., 2004; Trost et al., 2002), boys were found to be more physically active than girls (Trost et al., 2002) and both boys and girls in the normal weight group were significantly more active than those in the at risk for overweight group or in the overweight group (Patrick et al.). In an eight year longitudinal study of 3 to 5 year old children, using accelerometers, Moore et al. (2003) found a significant positive relationship between high levels of physical activity in childhood and less body fat in adolescence.

In Australia, a comparison of rural and urban children aged 10 to 11 years, using a self-report questionnaire identified higher levels of physical activity among rural children (Dollman et al., 2002). Ball, O'Connor, et al. (2001) measured total energy expenditure using the doubly labeled water method and found no significant difference in the physical activity levels of 6 to 9 year old Australian boys and girls. In Mexico, using a self-report questionnaire, Reyes et al. (2003) found no difference in the recreational physical activity levels of rural and urban children in grades 1 – 6; however, increased physical activity due to involvement with chores at home was found among rural children. In a cross-sectional study of children aged 9 to 10 years from four regions of Europe, physical activity was assessed using accelerometers (Ekelund et al., 2004). Results of the study indicated that the boys were significantly more active than the girls. In addition, normal weight children, based on BMI values compared to the international standards, were significantly more active than obese

children. In a study of 9 and 15 year old children in Norway, using accelerometers, Klasson-Heggebo and Anderssen (2003) found that physical activity levels were significantly higher among boys than girls in both age groups and children in the older group had significantly lower physical activity levels than children in the youngest group.

Studies of Rural Children

Studies Conducted in Canada

Few of the Canadian studies identified in the literature review had compared the physical activity levels and BMI of rural and urban children. Plotnikoff et al. (2004) compared the self-reported physical activity levels and prevalence of overweight and obesity (based on self-reported height and weight) of youth in grades 9 to 12 living in urban Ontario and in rural Alberta. The investigators found no significant difference in physical activity levels between the rural and urban youth when compared to the recommendations of *Canada's Physical Activity Guide to Healthy Active Living* (Health Canada, 2002). Comparing the estimated BMI values with the NHANES standards, a significantly higher percentage of boys in rural schools were overweight compared to boys in urban schools. Similarly, girls in rural schools were significantly more likely to be obese than girls from urban schools (Plotnikoff et al.).

In a large national study, Mitura and Bollman (2004) examined physical activity levels and BMI levels of youth aged 12 to 17 years from across Canada. Using self-reported data on height, weight, and physical activity levels, boys living in small town regions were found to have the highest prevalence of overweight and

obesity, when estimated BMI values were compared to international standards, compared to boys living in large metropolitan regions. The highest prevalence of inactivity was found among girls living in large metropolitan regions compared to girls in rural regions and boys living in all regions in Canada.

Studies Conducted Outside of Canada

There are several published reports of comparative studies of physical activity, overweight, and obesity, among rural and urban children living in countries other than Canada. The results of these studies, however, vary from country to country. In the United States, a comparison of rural and urban third and fourth grade students in South Carolina identified a significantly higher prevalence of overweight and obesity among the rural children, based on measured height and weight values (McMurray et al., 1999). Using a self-report physical activity questionnaire no significant differences were found in the physical activity levels of rural and urban children. In a comparison of the self-reported physical activity levels of Caucasian and African American girls living in rural and urban areas of South Carolina (Felton et al., 2002), African American girls living in rural areas were found to be more physically active than African American girls living in urban areas. In contrast, Caucasian girls living in urban areas were more physically active than Caucasian girls in rural areas.

In a study of children aged 6 to 18 years living in the United States, China, and Russia, Wang (2001) found that the prevalence of overweight and obesity varied by country. In Russia the prevalence of obesity (BMI $\geq 95^{th}$ percentile), based on measured height and weight, was higher in rural compared to urban areas. Conversely, in China the prevalence of obesity was higher in urban compared to rural areas. In

Australia, urban boys aged 7 to 16 years were found to have a higher prevalence of overweight and obesity than rural boys, based on measured height and weight values compared to international standards. The prevalence of overweight and obesity did not differ significantly between rural and urban girls (Booth et al., 2001). In Spain, rural children had higher BMIs than urban children, based on measured height and weight (Moreno et al., 2001). Urban children living in China (Luo & Hu, 2002), Mexico (Reyes et al., 2003), Costa Rica (Nunez-Rivas et al., 2003), and India (Mohan et al., 2004) had higher BMIs, based on measured height and weight, than rural children. In Sweden, rural children had higher BMIs than urban children; however, these findings are based on self-reported height and weight data (Berg et al., 2001).

Findings of Previous Studies

Consistencies

A common finding in the reviewed research literature is the high prevalence of overweight and obesity among children, youth, and adolescents living in several different countries (Ball, Marshall, et al., 2001; Booth et al., 1999, 2001; Brewis, 2003; Canning et al., 2004; Chai et al., 2003; Chang et al., 1999; Chinn & Rona, 2001; Davy et al., 2004; Dollman et al., 2002; Hernandez et al., 2002; Janssen et al., 2004; Luo & Hu, 2001; Mamalakis et al., 1999; Mitura & Bollman, 2004; Monyeki et al., 1999; Nunez-Rivas et al., 2003; Ogden et al., 2002; O'Loughlin et al., 1998; Plotnikoff et al., 2004; Rudolph et al., 2002; Sanchez-Castillo, 2001; Tremblay et al., 2002; Tremblay & Willms, 2000; Wang, 2001; Wang et al., 2002). Significant findings of these studies indicate that increased sedentary behavior, such as television watching and video game use, and decreased physical activity levels are strongly

related to overweight and obesity in children (Davy et al.; Ekelund et al., 2004; Hancox et al., 2004; Harrell et al., 2003; Janssen et al.; Lowry et al., 2002; Moore et al., 2003; Patrick et al., 2004; Tremblay & Willms, 2003). The results of the previous studies indicate there is a need for health promotion activities, especially physical activity programs, directed at improving the health of children, youth, and adolescents (Dollman et al.; Ekelund et al.; Harrell et al.; Janssen et al.; Klasson-Heggebo & Anderssen, 2003; Lowry et al.; Moore et al.; Tremblay & Willms, 2003).

Inconsistencies

There are inconsistent results for the relationship between BMI and rural versus urban residency and there is a wide variation in the prevalence of overweight and obesity between studies. A higher prevalence of overweight and obesity among rural children was identified in Canada (Mitura & Bollman, 2004; Plotnikoff et al., 2004) and the United States (McMurray et al., 1999). In particular, boys living in small town regions in Canada had the highest prevalence of being overweight (Mitura & Bollman). However, in a study of Australian children there was no statistically significant difference in BMI of children living in rural and urban locations (Booth et al., 2001). Because the study focused on children living in South Australia caution is advised when generalizing the results to Canadian children. A higher prevalence of overweight and obesity was found among urban children living in China (Luo & Hu, 2002), Mexico (Reyes et al., 2003), Costa Rica (Nunez-Rivas et al., 2003), and India (Mohan et al., 2004). These inconsistencies indicate a need for further comparative research on the prevalence of childhood overweight and obesity among rural and urban children.

There are also inconsistent results for the relationship between gender and the prevalence of overweight and obesity. Results of Canadian studies, based on self-reported height and weight, indicate a higher prevalence of overweight and obesity among boys compared to girls (Janssen et al., 2004; Mitura & Bollman, 2004; Tremblay et al., 2002; Tremblay & Willms, 2000). In studies conducted outside of Canada, based on measured height and weight, a higher prevalence of overweight and obesity was observed among girls compared to boys (Chang et al., 1999; Chinn & Rona, 2001; Hernandez et al., 2003). These inconsistencies indicate a need for further comparative research based on measured height and weight, on the prevalence of overweight and obesity among boys and girls.

Limitations

There are various limitations in the research literature reviewed. One major limitation is the use of self-reported height and weight to estimate BMI and, hence, the prevalence of overweight and obesity. Estimates of BMI based on measured height and weight provide a more accurate estimate of the prevalence of overweight and obesity among boys and girls compared to estimates of BMI based on self-reported height and weight.

A limitation of the Canadian research is that the majority of the studies were secondary analyses of data obtained from large national or international surveys. A limitation of the secondary analysis study design, according to Aaronson (1994), is the age of the data being analyzed (as cited in Burns & Grove, 2005). Some of the data studied were from 1981 (Tremblay et al., 2002; Tremblay & Willms, 2000; Willms et al., 2003) and 1994 (Tremblay & Willms, 2003). The prevalence estimates for

overweight and obesity, based on data from 1981 and 1994, may no longer be relevant indicators of the health of children today.

Another limitation of the reviewed research is the small number of studies that adjusted for maturational age. Differences in height, weight, and physical activity between boys and girls may be a result of maturational age. According to Thompson et al. (2003), an analysis of physical activity differences between boys and girls should consider maturational age to discern if gender differences are related to maturational age.

Gaps in the Research

From the literature reviewed, gaps in the research have been identified. One gap in the literature is that there are few published studies of the prevalence of childhood overweight and obesity among Canadian children. Of the few Canadian studies identified, most of the research was based on secondary analyses of existing data. Because the results of these studies are nationwide there is a lack of information on the prevalence of childhood overweight and obesity in the individual provinces, especially in the province of Saskatchewan. Another gap in the research is the limited number of Canadian studies where measured height and weight were used to estimate BMI. Use of parent- and self-reported height and weight data may result in the underestimation of the prevalence of childhood overweight and obesity.

The inconsistency of findings of previous studies of the prevalence of overweight and obesity among rural and urban children suggests another gap in the research. Willms et al. (2003) identified a need for further research in Canada to "better map the geographic variation in overweight and obesity in Canada" (p. 672).

On completion of the present study, an updated literature search was conducted to include the period from July 2005 through January 2007. Seven additional quantitative research studies of the prevalence of overweight and obesity, completed in Canada, were discovered. Two studies were of children aged 6 to 17 years from urban centers in Ontario, Canada (Haque, de la Rocha, Horbul, Desroches, & Orrell, 2006; He & Beynon, 2006). One study was of Grade 5 students from Nova Scotia, Canada (Veugelers & Fitzgerald, 2005). In all three studies, measured anthropometric data compared to the international standards set by Cole et al. (2000) were used to estimate the prevalence of overweight (16.6% to 32.9%) and obesity (6.7% to 11.8%) in the sample. One study of children aged 7 to 14 years was conducted in rural Ontario, Canada (Galloway, 2006). In this study measured anthropometric data, compared to the Centers for Disease Control standards, were used to estimate the prevalence of overweight (17.7%) and obesity (10.9%) in the sample. Two Canadian studies examined the BMI of the children, estimated using measured anthropometric data, and their self-reported physical activity levels (Gillis, Kennedy, & Bar-Or, 2006; Veugelers & Fitzgerald). In both studies, an inverse relationship was found between physical activity level and BMI. In a study of Grade 3, 7, and 11 students from Nova Scotia, Canada, Thompson et al. (2005) identified no significant association between the average amount of time involved in physical activity, estimated using accelerometers, and the BMI category of the children. The final study, by Tremblay, Barnes, Copeland, & Esliger (2005), compared urban and rural Saskatchewan children aged 8 to 13 years with Old Order Mennonite children, of the same age from Ontario, Canada. In this study, physical fitness (using measured

height, weight, and other physical fitness tests) and physical activity level (using accelerometers and the PAQ-C) of the three groups were compared. In this study no significant differences in self-reported physical activity or BMI was observed between the groups. Maturational age of the participants was estimated using age at PHV.

A recent report based on the 2004 Canadian Community Health Survey: Nutrition (Shields, 2005) was obtained from the Statistics Canada website. This report contains data on the measured height and weight of a large national sample of Canadian children aged 2 to 17 years. The BMI results for the participants, compared to the international standards set by Cole et al. (2000), indicate that in 2004 26% of Canadian children and youth were overweight and 8% were obese (Shields).

Results from these recently published studies further support the need for research on the prevalence of overweight and obesity in Canadian children, especially rural Saskatchewan children. Only one of the seven studies examined a sample of participants from rural Saskatchewan (Tremblay et al., 2005). Using measured anthropometric data compared to the international standards set by Cole et al. (2000) (Haque et al., 2006; He & Beynon, 2006; Shields, 2005; Tremblay et al., 2005; Veugelers & Fitzgerald, 2005) or the Centers for Disease Control standards (Galloway, 2006; Thompson et al., 2005) the studies indicated a wide variation in the prevalence of overweight (16.6% to 32.9%) and obesity (6.7% to 11.8%) in the sample. One limitation of these studies is that maturational age of the participants was only estimated in one study (Tremblay et al., 2005).

CHAPTER 3

Methodology

Setting for the Study

The study was conducted in a rural school division in southeastern Saskatchewan. The school division consisted of fourteen elementary schools located in fourteen towns. Twelve of the fourteen towns had a population less than 1,000 people. The other two towns had a population greater than 1,000 people (Statistics Canada, 2001). In total, principals of thirteen of the fourteen schools consented to participate in the study.

Target Population

The target population included all 525 students in grade four (n= 145), grade five (n= 186), and grade six (n= 194) attending the thirteen schools in the target school division (Table 3.1). The participants for the study lived in the towns and surrounding rural areas.

Ethical Considerations

Prior to the start of the study the research proposal including the questionnaire; information letter to the students, parents, and guardians; consent form, and letter to the principals, was submitted for ethical review and approval by the University of Saskatchewan Behavioural Research Ethics Board. Approval was received on

Table 3.1

Target Population by School and Grade

	Grade 4	Grade 5	Grade 6	Total
School A	12	12	11	35
School B	0	2	1	3
School C	4	6	8	18
School D	0	10	4	14
School E	19	20	22	61
School F	16	20	12	48
School G	14	11	22	47
School H	4	5	5	14
School I	27	35	38	100
School J	15	18	15	48
School K	12	10	15	37
School L	0	20	15	35
School M	22	17	26	65
Total	145	186	194	525

September 9, 2005. A copy of the approval letter from the University of Saskatchewan Behavioural Research Ethics Board is included in Appendix A.

The study was approved by the Assistant Director of Education for the target school division. Each principal of the fourteen schools in the division was contacted by letter regarding the study. Principals of thirteen of the fourteen schools approved the conduct of the study in their school.

A brief information session was held for the Grade 4 – 6 students in each participating school. The purpose of the information session was to explain the research study and the role of the students, if they chose to participate. A brief explanation of the questionnaire, the importance of participating in the study, and the steps to be taken to ensure confidentiality of the information obtained was provided. Each student received a research package, which included an information letter (see Appendix B) that outlined the purpose of the study, the time commitment, ethical considerations, the study participants' ability to withdraw from the study at any time, contact information for the researcher and supervisor, the risks and benefits of the study, the steps taken for the protection of confidentiality, and the use of the findings. Two copies of the consent form were included with the information letter (see Appendix C). The consent forms were signed by the child and a parent or guardian, because the children in the sample were under the age of 18 years. One copy of the consent form was kept by the participating student and parents (or guardian) for their records. To ensure confidentiality of the participants' information in the questionnaire survey all students were invited to return their questionnaire, whether completed or not, sealed in the envelope provided. All returned completed consent forms were

detached from the questionnaires before the information in the questionnaire was examined to maintain confidentiality of the data. An identification number was assigned to each study participant to protect the confidentiality of the data of the participant and his or her parent or guardian. After receiving the completed questionnaires, all students who had returned a signed consent form had their height, weight, and sitting height measured by the researcher. Each participant's height and weight measurements were conducted individually in a private space and the recorded measurements were safeguarded from the teachers, other students, and others to ensure confidentiality of the data. Prior to having their height, weight, and sitting height measured the students were informed about the procedures and reminded, in private, that they could withdraw from the study at that time if they wished. Each participant was monitored during the measurements for any expression of uneasiness, distress, or unhappiness with the research procedures. None of the students expressed unease, distress, or unhappiness with the procedures.

The names and locations of the school division and individual schools have not been and will not be identified in any reports, presentations, or publications resulting from the study. The consents were stored separate from the questionnaires and all data collected from the study will be kept in a locked cupboard at the University of Saskatchewan by the thesis supervisor (Dr. Karen M. Semchuk) for the five years following the study.

The Instrument

The process of data collection consisted of two phases: (1) completion of a self-report questionnaire and (2) anthropometric measurement. The first phase of the

data collection process involved the completion of the self-report questionnaire. Each student received a questionnaire, which was completed by the student and a parent or guardian. The research questionnaire consisted of three sections (see Appendix D for the questionnaire). Section one gathered demographic data about the child [date of birth, gender, grade, residency (farm versus town), Aboriginal versus non-Aboriginal descent] and the parents or guardian (perceived neighborhood safety, reported education level, height, and weight). Section two gathered data on the average number of hours per day the child was involved in sedentary leisure activities, such as television watching, video game and computer use, or talking on the phone. Section three gathered data on the child's 7 day physical activity history. The Physical Activity Questionnaire for Older Children (PAQ-C) developed by Crocker, Bailey, Faulkner, Kowalski, and McGrath (1997) at the College of Kinesiology, University of Saskatchewan was used. The PAQ-C was developed to assess the physical activity levels of children beyond Grade 3. The PAQ-C consists of nine items each scored on a 5 point scale. A final score is calculated as the mean of the nine items (see Appendix E for Scoring the PAQ-C). Permission was obtained to use this questionnaire (K. Kowalski, personal communication, April 5, 2005).

Two studies of elementary school students in Grades 4 to 8 in Saskatoon have been conducted to assess the reliability and validity of the PAQ-C. Test-retest reliability studies of the PAQ-C yielded statistically significant (alpha = .05) correlations of r = .75 for boys and r = .82 for girls (Kowalski, Crocker, & Faulkner, 1997). Construct validity was assessed by comparing the PAQ-C to other physical activity assessments, such as a 24 hour vigorous activity recall (r = .53), teacher's

rating of physical activity (r = .45), and a 7 day physical activity recall interview (r = .46) (Kowalski et al.). The results of these studies support the reliability and validity of the PAQ-C as an instrument to assess a child's physical activity levels.

A pilot test of the information letter and the entire questionnaire was conducted with a sample of four children aged 9 to 12 years who did not live in the study area. The purpose of the pilot test was to refine the information letter and questionnaire in terms of readability and comprehension and to determine the estimated time (30 minutes) to complete the survey.

The second phase of the data collection process consisted of anthropometric measurement of the study participants. Children with a signed consent form had their height, weight, and sitting height measured by the researcher. In order to maintain the confidentiality of the participants in the study, a random test-retest of the anthropometric measurements was not completed at a later date.

Procedure

The Assistant Director of Education for the target school division approved the study to be conducted within the school division. Once ethical approval was received from the University of Saskatchewan Behavioral Research Ethics Board (see Appendix A) each principal in the target school division was contacted by letter (see Appendix F). Once approval was received from the principals of the target schools, arrangements were made with each school to set up a time for an information session and data collection. Fifteen minute information sessions were held by the researcher with each grade four, five, and six classroom in the study area. Information sessions

and data collection were completed between September 29, 2005 and October 31, 2005.

The purpose of the brief information session was to explain the research study and the role of the students, if they chose to participate. A brief explanation of the questionnaire, the importance of participating in the study, and the steps to be taken to ensure confidentiality of the information obtained, was provided. Each participant received a research package, which contained an information letter (see Appendix B), two copies of the consent form (see Appendix C), and the questionnaire (see Appendix D).

Three days after distribution of the packages a reminder note was provided to the teachers to be sent home with each student, inviting completion of their questionnaire (see Appendix G). The completed consent forms and questionnaires were collected by the researcher one week following distribution. All returned completed consent forms were detached from the questionnaires before the information in the questionnaire was examined to maintain confidentiality of the data. An identification number was assigned to each study participant to protect the confidentiality of the data of the participant and his or her parent or guardian. A few days following collection of the completed questionnaires the researcher and the research assistant returned to the school to conduct the height and weight measurements. To ensure anonymity of the participants in the height and weight measurement phase each student in the participating classrooms was invited to come, individually, to the private space where the height and weight measurements were conducted. Students who did not return a signed consent form were thanked for their

interest in the study, reminded to enter the draw for an activity kit, provided with a copy of Canada's Physical Activity Guidelines for Children and an activity book (Health Canada, 2004), and were informed that they could return to their classroom. Students who had returned a completed consent form were informed about the measurement procedures and were reminded, in private, that they could withdraw from the study at that time if they wished. Height, sitting height, and weight were measured with the participant wearing light weight clothing (no heavy sweaters or jackets) and no shoes. Height and sitting height were measured to the nearest 0.1 cm using a stadiometer (measuring pole). Height was measured with the participant standing with their back to the stadiometer, arms resting at sides, and feet together. Sitting height was measured with the participant sitting on a level platform with hands resting on thighs. Sitting height is the maximum distance from the top of the head to the base of the sitting surface (http://athena.usask.ca/growthutility/ms.doc). Weight was measured to the nearest 0.5 pound using a digital scale. Each measurement was completed twice. When the height and sitting height measurements varied by more than 0.4 cm, a third measurement was completed. When the weight measurements varied by more than 1 pound, a third measurement was completed. When two measurements were recorded, the average value was used. When three measurements were recorded, the median value was used. In order to maintain the confidentiality of the participants in the study, a random test-retest of the anthropometric measurements was not completed at a later date.

Age at PHV was calculated using the variables gender, date of birth, date of measurement, height, sitting height, and weight (see Appendix H). Maturity age is

calculated by subtracting age at PHV from chronological age at the time of measurement (Mirwald et al., 2002; http://athena.usask.ca/growthutility/phv_ui.cfm?type=1).

Upon completion of the measurements, the students were invited to enter their names for the draw for an activity kit. Each student also received a copy of Canada's Physical Activity Guidelines for Children and an activity book (Health Canada, 2004).

After all anthropometric data were collected in each school, a teacher was selected to draw the name of a student for the activity kit. One student from each participating school received an activity kit, which consisted of a water bottle; a skipping rope; and a miniature foam basketball, football, or soccer ball. Prior to leaving each school, the researcher went to each participating classroom to thank the students and teachers for their time and interest in the study.

Data Analysis

Data from the questionnaires and measurements were coded, entered into computer compatible format, and analyzed using SPSS 14.0 software. Data regarding age, gender, grade, place of residence (farm, town, and reserve), Aboriginal versus non-Aboriginal descent, height, weight, sitting height, leg length, BMI, age at PHV, reported leisure activity on school days and weekend days, physical activity levels, who helped complete the questionnaire, and the parents' or guardians' perceptions of neighborhood safety, reported education levels, height, and weight were analyzed descriptively (frequency, range, mode, median, mean, and standard deviation). Differences between boys and girls for age, height, weight, sitting height, leg length, BMI, and physical activity level were compared using a t-test for independent

samples. The participants' mean ages at PHV were reported and compared to previously published research data (Baxter-Jones, Mirwald, McKay, and Bailey, 2003). The chi square test (with continuity correction) and Fisher's exact test were used to explore associations between gender and the categorical variables grade, place of residence (farm, town, and reserve), Aboriginal versus non-Aboriginal descent, BMI category, reported leisure activity on school days and weekend days, and the parents' or guardians' perceived neighborhood safety, reported education levels, and BMI category. Chi square tests were used to examine the relationships between the participant's BMI category and his or her mother's and father's BMI categories. Chi square tests were also used to explore associations between the participants' reported leisure activity on school days and weekend days and the categorical variables age, grade, gender, place of residence (farm, town, and reserve), Aboriginal versus non-Aboriginal descent, BMI category, and the parents' or guardians' perceptions of neighborhood safety, reported education levels, and BMI categories. Each participant's BMI was calculated using the measured height and weight values [weight (kg)/height (m^2)] and then compared to the international standards using the participant's age to the nearest six months (Cole et al., 2000). One-way analysis of variance was used to explore the distribution of the participants' mean PAQ-C score by age, gender, grade, place of residence (farm, town, and reserve), Aboriginal versus non-Aboriginal descent, BMI category, reported leisure activity on school days and weekend days, and the parents' or guardians' perceptions of neighborhood safety, reported education levels, and BMI categories. If ANOVA was significant a post-hoc analysis using Scheffe's test was done. The updated literature review revealed recent

population survey data on measured BMI for Saskatchewan and Canadian children (Shields, 2005) and population survey data on measured height, sitting height, weight, and BMI for a sample of urban and rural dwelling Saskatchewan children (Tremblay et al., 2005). Therefore, a post hoc analysis was conducted to compare the results of the present study with the results of the published survey data. The participants' mean height and weight measurements were compared to population survey data on measured height and weight for a sample of urban dwelling Saskatchewan children (Thompson, Baxter-Jones, Mirwald, & Bailey, 2003). Logistic regression analysis was used to identify factors and all first order interactions associated with being classified as overweight or obese in this sample of rural children. Students were asked to list any additional activities or chores they had participated in at home in the last 7 days and these responses were categorized using content analysis. For all statistical tests, statistical significance was indicated by an alpha of .05.

CHAPTER 4

Results

Response Rates

Thirteen of the 14 schools in the target school division agreed to participate in the study. A total of 525 questionnaires (boys: 263, girls: 262) were distributed to grade 4 (n= 145), grade 5 (n=186), and grade 6 (n= 194) students enrolled in the 13 schools. Of the 525 questionnaires distributed 346 (65.9%) were returned, either completed or not completed, and 179 (34.1%) were not returned. Of the 346 questionnaires returned, 262 were completed with a signed consent form. The overall response rate for completed questionnaires was 49.9% and was 42.2% for the boys and 57.6% for the girls (Table 4.1, Appendix I, and Appendix J). The response rates by school, grade, and gender are shown in Tables 4.1 and Appendix J. Of the 262 students who provided written consent, 251 (95.8%) had their height, weight, and sitting height measured. The remaining 11 students were absent from school during the measurements. The overall participation rate for the anthropometric measurements was 47.8%, and was 40.7% for the boys and 55.0% for the girls (Table 4.2, Appendix K, and Appendix L). The overall participation rate was higher for girls compared to boys.

Table 4.1

Response Rates for Completed Questionnaires by Grade and Gender

	Boys			Girls			All		
Grade	**N**	**No.**	**%**	**N**	**No.**	**%**	**N**	**No.**	**%**
Grade 4	74	31	41.9	71	40	56.3	145	71	49.0
Grade 5	85	37	43.5	101	61	60.4	186	98	52.7
Grade 6	104	43	41.3	90	50	55.6	194	93	47.9
Total	263	111	42.2	262	151	57.6	525	262	49.9

Table 4.2

Participation Rate for Anthropometric Measurements by Grade and Gender

	Boys			Girls			All		
Grade	**N**	**No.**	**%**	**N**	**No.**	**%**	**N**	**No.**	**%**
Grade 4	74	30	40.5	71	38	53.5	145	68	46.9
Grade 5	85	34	40.0	101	58	57.4	186	92	49.5
Grade 6	104	43	41.3	90	48	53.3	194	91	46.9
Total	263	107	40.7	262	144	55.0	525	251	47.8

Characteristics of the Sample

The demographic characteristics of the students in the sample are shown in Table 4.3. The sample of 262 students included 111 (42.4%) boys and 151 (57.6%) girls. The participants' ages ranged from 8 to 12 years (*M* = 10.7 years, *SD* = 0.88 year, *Mdn* = 10.6 years). The mean age was: 9.6 years (*SD* = 0.35) for participants in Grade 4, 10.5 years (*SD* = 0.40) for participants in Grade 5, and 11.6 years (*SD* = 0.51) for participants in Grade 6. The boys' ages ranged from 9 to 12 years (*M* = 10.7 years, *SD* = 0.91 year, *Mdn* = 10.7 years). The girls' ages ranged from 8 to 12 years (*M* = 10.6 years, *SD* = 0.87 year, *Mdn* = 10.5 years). The mean age of the participants did not differ significantly between boys and girls [t (248) = 0.93, p = .353].

The mean age at PHV for boys was 13.3 years (*SD* = 0.52). The mean age at PHV for girls was 11.8 years (*SD* = 0.55). In a seven year longitudinal study of 152 participants (85 boys and 67 girls), aged 8 to 15 years at baseline, the reported mean age at PHV was 13.4 years for boys and 11.8 years for girls (Baxter-Jones, Mirwald, McKay, and Bailey, 2003). Based on the mean age at PHV, the boys and girls in the present study, compared with the boys and girls in the study by Baxter-Jones et al., appear to be of similar maturational age.

The distribution of boys and girls did not differ significantly by grade [χ^2 (2, N = 262) = 1.47, p = .479]. The majority of the students were of non-Aboriginal descent (83.2%) versus Aboriginal descent (16.8%). The distribution of boys and girls did not differ significantly by Aboriginal versus non-Aboriginal descent [Fisher's exact (N = 256), p = .614]. The proportions of farm (47.5%) and town (46.4%) residents were similar. Only 6.1% of the participants reported that they lived on a reserve. The

Table 4.3

Demographic Characteristics of the Study Participants

Demographic Characteristic	Boys (n = 111)		Girls (n = 151)		All (n = 262)	
	No.	%	No.	%	No.	%
Age (years)[a]						
8	0	0.0	1	0.7	1	0.4
9	25	24.0	35	24.0	60	24.0
10	36	34.6	61	41.8	97	38.8
11	36	34.6	37	25.3	73	29.2
12	7	6.7	12	8.2	19	7.6
Total	104	99.9[b]	146	100.0	250	100.0
Grade						
4	31	27.9	40	26.5	71	27.1
5	37	33.3	61	40.4	98	37.4
6	43	38.7	50	33.1	93	35.5
Total	111	99.9[b]	151	100.0	262	100.0
Aboriginal Descent[c]						
Yes	20	18.3	23	15.6	43	16.8
No	89	81.7	124	84.4	213	83.2
Total	109	100.0	147	100.0	256	100.0
Place of Residence[d]						
Town	46	41.4	75	50.0	121	46.4
Farm	58	52.3	66	44.0	124	47.5
Reserve	7	6.3	9	6.0	16	6.1
Total	111	100.0	150	100.0	261	100.0

[a]Missing data on age for twelve students who did not provide their date of birth.

[b]Does not add up to 100% due to rounding.

[c]Missing data on Aboriginal descent for six students.

[d]Missing data on place of residence for one student.

distribution of boys and girls did not differ significantly by place of residence [χ^2 (2, N = 261) = 1.93, p = .381].

The participants were asked to complete a self-report questionnaire with the help of a parent or guardian (Table 4.4). For 81.3% of the participants, the participant's mother helped complete the questionnaire. The father assisted 10.1% of the participants. Both parents assisted 5.4% of the participants. A guardian assisted 3.1% of the participants. The majority of the parents and guardians surveyed considered their neighborhoods to be "quite safe" (41.5%) or "safe" (46.5%). The perceptions of neighborhood safety of parents and guardians did not differ significantly by the student's gender [χ^2 (4, N = 258) = 2.42, p = .658].

The parents or guardians who assisted with completion of the questionnaire were asked to report the participant's mother's and father's education levels. Table 4.4 shows that 69.9% of the participants' mothers had at least some post secondary education and 44.7% of the participants' fathers had at least some post secondary education. Mother's education level did not differ significantly by participant's gender [χ^2 (4, N = 259) = 1.91, p = .752]. Father's education level did not differ significantly by participant's gender [χ^2 (4, N = 257) = 5.86 p = .209].

Anthropometric measurements were completed for 251 students (Table 4.5). The mean height [t (249) = 0.070, p = .944], mean weight [t (249) = 0.691, p = .490], mean sitting height [t (249) = -0.420, p = .675], mean leg length [t (249) = 0.522, p = .602], and mean BMI [t (249) = 1.018, p = .310] of the participants did not differ significantly between boys and girls. Each participant's BMI was categorized based on the international cut points for body mass index for overweight and obesity by

Table 4.4

Characteristics of the Adults Who Helped Complete the Questionnaires

	Boys		Girls		All	
Characteristic	**No.**	**%**	**No.**	**%**	**No.**	**%**
Adult Who Helped with Questionnaire[a]						
Mother	85	77.3	124	84.4	209	81.3
Father	12	10.9	14	9.5	26	10.1
Mother and Father	9	8.2	5	3.4	14	5.4
Guardian	4	3.6	4	2.7	8	3.1
Total	110	100.0	147	100.0	257	99.9[b]
Perception of Neighbourhood Safety[c]						
Not at all safe	0	0.0	1	0.7	1	0.4
Somewhat safe	2	1.8	6	4.1	8	3.1
Moderately safe	8	7.2	14	9.5	22	8.5
Quite safe	48	43.2	59	40.1	107	41.5
Safe	53	47.8	67	45.6	120	46.5
Total	111	100.0	147	100.0	258	100.0
Education Level of Mother[d]						
Less than grade 12	9	8.2	17	11.4	26	10.0
High school diploma	21	19.1	31	20.8	52	20.1
Some post secondary	32	29.1	34	22.8	66	25.5
Technical training	36	32.7	48	32.2	84	32.4
University degree	12	10.9	19	12.8	31	12.0
Total	110	100.0	149	100.0	259	100.0
Education Level of Father[e]						
Less than grade 12	29	26.4	35	23.8	64	24.9
High school diploma	25	22.7	53	36.1	78	30.4
Some post secondary	12	10.9	13	8.8	25	9.7
Technical training	32	29.1	36	24.5	68	26.4
University degree	12	10.9	10	6.8	22	8.6
Total	110	100.0	147	100.0	257	100.0

[a]Missing data on who helped with questionnaire for five students.

[b]Does not add up to 100% due to rounding.

[c]Missing data on neighbourhood safety for four students.

[d]Missing data on Mother's Education Level for three students.

[e]Missing data on Father's Education Level for five students.

Table 4.5

Participants' Measured Anthropometric Data

Measurement	Boys (n = 107)		Girls (n = 144)		All (n= 251)	
Height[a]						
Mean ± SD	144.0 ± 8.19		144.0 ± 8.89		144.0 ± 8.58	
Range	126.1 – 165.7		123.0 – 168.6		123.0 – 168.6	
Weight[b]						
Mean ± SD	41.4 ± 11.39		40.4 ± 11.81		40.8 ± 11.62	
Range	22.1 – 89.3		22.3 – 91.4		22.1 – 91.4	
Sitting Height[c]						
Mean ± SD	75.0 ± 3.98		75.2 ± 4.77		75.1 ± 4.44	
Range	65.4 – 83.8		63.4 – 88.6		63.4 – 88.6	
Leg Length[d]						
Mean ± SD	69.1 ± 4.80		68.7 ± 4.70		68.9 ± 4.74	
Range	59.0 – 82.3		57.4 – 81.0		57.4 – 82.3	
BMI						
Mean ± SD	19.7 ± 3.98		19.2 ± 3.98		19.4 ± 3.98	
Range	13.9 – 37.9		13.0 – 37.9		13.0 – 37.9	
BMI Category[e,f]						
Normal Weight	68	68.0%	93	67.0%	161	67.4%
Overweight	23	23.0%	38	27.3%	61	25.5%
Obese	9	9.0%	8	5.8%	17	7.1%
Total	100	100.0%	139	100.1%[g]	239	100.0%

[a]Height measurements are in centimeters.

[b]Weight measurements are in kilograms.

[c]Sitting height measurements are in centimeters.

[d]Leg length measurements are in centimeters.

[e]BMI categories are based on the international cut points for body mass index for overweight and obesity by gender between 2 and 18 years, defined to pass

through BMI of 25 kg/m^2 (overweight) and 30 kg/m^2 (obesity) at age 18 years (Cole et al., 2000).

[f]Total number of participants does not equal 251 because 7 boys and 5 girls had not indicated their date of birth, which is required to calculate BMI.

[g]Does not add up to 100% due to rounding.

gender, for individuals between the ages of 2 and 18 years, defined to pass through a BMI of 25 kg/m^2 (overweight) or 30 kg/m^2 (obesity) at age 18 years (Cole et al., 2000). Based on these criteria, similar proportions of boys and girls were in the normal weight category. While the proportion overweight was larger for girls compared to boys and the proportion obese was larger for boys compared to girls, the distribution of participants' BMI category did not differ significantly between boys and girls [χ^2 (2, N = 239) = 1.30, p = .522]. Overall, the prevalence of overweight was 25.5% and the prevalence of obesity was 7.1% within the study population.

The adults who assisted the participants with the questionnaire were asked to report the participant's mother's and father's reported height and weight (Table 4.6). The mean reported height, mean reported weight, and mean estimated BMI were all higher for fathers than mothers. A large proportion of the participants' fathers were overweight or obese (87.6%) and over half of the mothers were overweight or obese (53.5%) (Table 4.7). Using the dichotomous variable "normal weight" versus "overweight or obese" the distribution of the parent's BMI category did not differ significantly by the participant's gender for mothers [$\chi^2_{[\text{continuity correction (c)}]}$ (1, N = 226) = 0.09, p = .766] or for fathers [$\chi^2_{(c)}$ (1, N = 225) = 3.66 p = .056].

Each participant's BMI category was compared to the participant's mother's and father's BMI category (Table 4.8). The proportion of overweight or obese participants whose mothers were also overweight or obese was larger than the proportion of overweight or obese participants whose mothers were of normal weight; however, this difference was not statistically significant [$\chi^2_{(c)}$ (1, N = 212) = 2.96,

Table 4.6

Self-Reported Anthropometric Measurements for the Participants' Parents

Measurement		Mother	Father
Height[a,b]			
	Mean ± SD	162.3 ± 6.70	174.4 ± 6.50
	Range	150.0 – 177.5	155.0 – 192.5
	n	249	242
Weight[c,d]			
	Mean ± SD	70.6 ± 14.91	88.9 ± 14.94
	Range	45.5 – 129.6	56.8 – 136.4
	n	227	225
BMI[e]			
	Mean ± SD	26.9 ± 5.42	29.2 ± 4.33
	Range	18.9 – 48.2	19.1 – 43.7
	n	226	225

[a]Height measurements are in centimeters.

[b]Height measurements are missing for mothers of 13 participants and for fathers of 20 participants.

[c]Weight measurements are in kilograms.

[d]Weight measurements are missing for mothers of 35 participants and for fathers of 37 participants.

[e]BMI measurements are missing for mothers of 36 participants and for fathers of 37 participants.

Table 4.7

Distribution of Parents' Body Mass Index Categories by Participants' Gender

	Boys		Girls		All	
BMI Category[a, b]	**No.**	**%**	**No.**	**%**	**No.**	**%**
BMI Category of Mother						
Normal Weight	43	44.8	62	47.7	105	46.5
Overweight	31	32.3	46	35.4	77	34.1
Obese	22	22.9	22	16.9	44	19.5
Total	96	100.0	130	100.0	226	100.1[c]
BMI Category of Mother (Dichotomous)						
Normal Weight	43	44.8	62	47.7	105	46.5
Overweight or Obese	53	55.2	68	52.3	121	53.5
Total	96	100.0	130	100.0	226	100.0
BMI Category of Father						
Normal Weight	7	7.1	21	16.5	28	12.4
Overweight	56	57.1	58	45.7	114	50.7
Obese	35	35.7	48	37.8	83	36.9
Total	98	99.9[c]	127	100.0	225	100.0
BMI Category of Father (Dichotomous)						
Normal Weight	7	7.1	21	16.5	28	12.4
Overweight or Obese	91	92.9	106	83.5	197	87.6
Total	98	100.0	127	100.0	225	100.0

[a]BMI categories are based on Statistics Canada (2006) definitions for BMI in which underweight is <18.5 kg/m^2, normal weight is 18.5 – 24.9 kg/m^2, overweight is 25.0 – 29.9 kg/m^2, and obese is >30.0 kg/m^2.

[b]None of the participants' mothers or fathers were in the underweight category.

[c]Does not add up to 100% due to rounding.

Table 4.8

Participants' BMI Category Compared to Parents' BMI Categories

Participant Overweight or Obese	Mother Overweight or Obese (n = 212)				Father Overweight or Obese (n = 211)				Either Mother or Father Overweight or Obese (n = 218)			
	No		Yes		No		Yes		No		Yes	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
All[a]												
No	77	36.3	70	33.0	25	11.8	118	55.9	19	8.7	130	59.6
Yes	25	11.8	40	18.9	3	1.4	65	30.8	2	0.9	67	30.7
Missing	50				51				44			
Boys												
No	34	38.2	29	32.6	6	6.7	57	63.3	5	5.4	60	64.5
Yes	7	7.9	19	21.3	1	1.1	26	28.9	1	1.1	27	29.0
Missing	22				21				18			
Girls												
No	43	35.0	41	33.3	19	15.7	61	50.4	14	11.2	70	56.0
Yes	18	14.6	21	17.1	2	1.7	39	32.2	1	0.8	40	32.0
Missing	28				30				26			

[a]Proportions do not add up to 100% due to rounding.

p= .085]. The proportion of overweight or obese participants whose fathers were also overweight or obese was significantly larger than the proportion of overweight or obese participants whose fathers were of normal weight [$\chi^2_{(c)}$ (1, N = 211) = 5.75, p = .016].

For boys, a statistically significant positive association was found between the participant's BMI category and his mother's BMI category [$\chi^2_{(c)}$ (1, N = 89) = 4.38, p = .036]. For girls, there was a statistically significant positive association between the participant's BMI category and her father's BMI category [$\chi^2_{(c)}$ (1, N = 121) = 5.48, p = .019]. For girls there was no statistically significant association between the participant's BMI category and the participant's mother's BMI category [$\chi^2_{(c)}$ (1, N = 123) = 0.11, p = .744]. For boys, the proportion of overweight or obese participants whose fathers were also overweight or obese was larger than the proportion of overweight or obese participants whose father was of normal weight. This difference, however, was not statistically significant [$\chi^2_{(c)}$ (1, N = 90) = 0.27, p = .606]. Overall, the proportion of overweight or obese participants with an overweight or obese parent [$\chi^2_{(c)}$ (1, N = 218) = 4.19, p = .041] was significantly larger than the proportion of overweight or obese participants whose parents were both of normal weight. While this relationship was not statistically significant for boys [$\chi^2_{(c)}$ (1, N = 93) = 0.08, p = .778], the proportion of overweight or obese girls with an overweight or obese parent was significantly larger than the proportion of overweight or obese girls whose parents were both of normal weight [$\chi^2_{(c)}$ (1, N = 125) = 4.02, p = .045].

The students were asked to report for the previous 7 days the average number

of hours per day they spent in leisure activity on school days (Table 4.9) and on the weekend (Table 4.10). The majority of boys (73.9%) and girls (66.9%) reported spending approximately 1-4 hours in leisure activity on school days. On the weekend, the majority of boys (69.1%) and girls (64.9%) reported spending approximately 1-4 hours per day in leisure activity. The average number of hours per day participants reported spending in leisure activity on school days [χ^2 (2, N = 259) = 1.51, p = .471] and on the weekend [χ^2 (2, N = 258) = 2.76, p = .252] did not differ significantly between boys and girls.

Potential associations were explored between the average number of hours per day participants reported spending in leisure activity on school days (Table 4.11) and on the weekend (Table 4.12) in the previous 7 days and the variables age, grade, Aboriginal descent, place of residence, parent's or guardian's perception of neighborhood safety, mother's education level, father's education level, participant's BMI category, mother's BMI category, and father's BMI category. Chi square tests of associations between the other variables of interest and the variable average number of hours spent in leisure activity on the weekend (Table 4.12) revealed a statistically significant association between the variables Aboriginal descent and average number of hours spent in leisure activity. A larger proportion of participants of Aboriginal descent (42.9%) reported spending, on average, more than 4 hours in leisure activity on the previous weekend compared to participants of non-Aboriginal descent (21.8%) [χ^2 (2, N = 253) = 9.28, p = .010]. No other statistically significant associations were observed between either of the leisure activity variables and any of the other variables examined.

Table 4.9

Participants' Reported Average Number of Hours Per Day Spent in Leisure Activity on School Days in the Previous 7 Days

	Boys (n = 111)		Girls[a] (n = 148)		All (n = 259)	
	No.	**%**	**No.**	**%**	**No.**	**%**
School Day Leisure Activity[b]						
< 1 hour/day	19	17.1	31	20.9	50	19.3
1-4 hours/day	82	73.9	99	66.9	181	69.9
> 4 hours/day	10	9.0	18	12.2	28	10.8
Total	111	100.0	148	100.0	259	100.0

[a]Missing data on school day leisure activity for three girls.

[b]In the questionnaire the categories for leisure activity on school days were not mutually exclusive, therefore the data were collapsed to create 3 new mutually exclusive categories: < 1 hour/day, 1-4 hours/day, and > 4 hours/day.

Table 4.10

Participants' Reported Average Number of Hours Per Day Spent in Leisure Activity on the Weekend in the Previous 7 Days

	Boys[a] (n = 110)		Girls[b] (n = 148)		All (n = 258)	
	No.	**%**	**No.**	**%**	**No.**	**%**
Weekend Leisure Activity[c]						
< 1 hour/day	5	4.5	15	10.1	20	7.8
1-4 hours/day	76	69.1	96	64.9	172	66.7
> 4 hours/day	29	26.4	37	25.0	66	25.6
Total	110	100.0	148	100.0	258	100.1[d]

[a]Missing data on weekend leisure activity for one boy.

[b]Missing data on weekend leisure activity for three girls.

[c]In the questionnaire the categories for leisure activity on the weekend were not mutually exclusive, therefore the data were collapsed to create 3 new mutually exclusive categories: < 1 hour/day, 1-4 hours/day, and > 4 hours/day.

[d]Does not add up to 100% due to rounding.

Table 4.11

Participants' Reported Average Number of Hours Spent Per Day in Leisure Activity on School Days in the Previous 7 Days by Age, Grade, Aboriginal versus Non-Aboriginal Descent, Place of Residence, and Other Selected Variables

	< 1 Hour/day		1-4 Hours/day		> 4 Hours/day		Total	
Variable	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Age (years)[a]								
8	1	100.0	0	0.0	0	0.0	1	100.0
9	8	13.6	45	76.3	6	10.2	59	100.1[b]
10	18	18.8	65	67.7	13	13.5	96	100.0
11	17	23.3	52	71.2	4	5.5	73	100.0
12	2	10.5	13	68.4	4	21.1	19	100.0
Grade[c]								
4	15	21.4	48	68.6	7	10.0	70	100.0
5	15	15.6	67	69.8	14	14.6	96	100.0
6	20	21.5	66	71.0	7	7.5	93	100.0
Aboriginal Descent[d]								
Yes	6	14.0	29	67.4	8	18.6	43	100.0
No	42	19.9	151	71.6	18	8.5	211	100.0
Place of Residence[e]								
Town	19	15.8	87	72.5	14	11.7	120	100.0
Farm	28	22.8	85	69.1	10	8.1	123	100.0
Reserve	3	18.8	9	56.3	4	25.0	16	100.1[b]
Parent's or Guardian's Perception of Neighborhood Safety[f]								
Not at all safe	0	0.0	1	100.0	0	0.0	1	100.0
Somewhat safe	1	12.5	7	87.5	0	0.0	8	100.0
Moderately safe	5	22.7	16	72.7	1	4.5	22	99.9[b]
Quite safe	13	12.3	76	71.7	17	16.0	106	100.0
Safe	30	25.2	79	66.4	10	8.4	119	100.0

	< 1 Hour/day		1-4 Hours/day		> 4 Hours/day		Total	
Variable	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Education Level of Mother[g]								
Less than grade 12	4	15.4	19	73.1	3	11.5	26	100.0
High school diploma	8	15.4	35	67.3	9	17.3	52	100.0
Some post secondary	18	27.3	41	62.1	7	10.6	66	100.0
Technical training	12	14.6	62	75.6	8	9.8	82	100.0
University degree	8	25.8	22	71.0	1	3.2	31	100.0
Education Level of Father[h]								
Less than grade 12	10	15.9	39	61.9	14	22.2	63	100.0
High school diploma	17	21.8	56	71.8	5	6.4	78	100.0
Some postsecondary	9	36.0	15	60.0	1	4.0	25	100.0
Technical training	9	13.4	54	80.6	4	6.0	67	100.0
University degree	5	22.7	14	63.6	3	13.6	22	99.9[b]
BMI Category of Participant[i]								
Normal weight	33	20.8	107	67.3	19	11.9	159	100.0
Overweight/Obese	11	14.1	60	76.9	7	9.0	78	100.0
BMI Category of Mother[j]								
Normal weight	20	19.4	69	67.0	14	13.6	103	100.0
Overweight/Obese	26	21.5	85	70.2	10	8.3	121	100.0
BMI Category of Father[k]								
Normal weight	3	11.1	20	74.1	4	14.8	27	100.0
Overweight/Obese	41	20.8	138	70.1	18	9.1	197	100.0

[a]Missing data on age for fourteen students (twelve for age, two for leisure activity).

[b]Does not add up to 100% due to rounding.

[c]Missing data on grade for three students (three for leisure activity).

[d]Missing data on Aboriginal descent for eight students (six for Aboriginal descent, two for leisure activity).

[e]Missing data on place of residence for three students (one for place of residence, two for leisure activity).

[f]Participant's parent's or guardian's perception of neighborhood safety. Missing data on neighborhood safety for six students (four for neighborhood safety, two for leisure activity).

[g]Missing data on mother's education level for five students (three for mother's education level, two for leisure activity).

[h]Missing data on father's education level for seven students (five for father's education level, two for leisure activity).

[i]Missing data on participant's BMI for fourteen students (twelve for participant's BMI category, 2 for leisure activity).

[j]Missing data on mother's BMI category for thirty-eight students (thirty-six for mother's BMI category, two for leisure activity).

[k]Missing data on father's BMI category for thirty-eight students (thirty-seven for father's BMI category, one for leisure activity).

Table 4.12

Participants' Reported Average Number of Hours Spent Per Day in Leisure Activity on the Weekend in the Previous 7 Days by Age, Grade, Aboriginal versus Non-Aboriginal Descent, Place of Residence, and Other Selected Variables

	< 1 Hour/day		1-4 Hours/day		> 4 Hours/day		Total	
Variable	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Age (years)[a]								
8	0	0.0	1	100.0	0	0.0	1	100.0
9	2	3.4	42	71.2	15	25.4	59	100.0
10	10	10.5	58	61.1	27	28.4	95	100.0
11	6	8.2	54	74.0	13	17.8	73	100.0
12	0	0.0	13	68.4	6	31.6	19	100.0
Grade[b]								
4	5	7.1	48	68.6	17	24.3	70	100.0
5	7	7.4	58	61.1	30	31.6	95	100.1[c]
6	8	8.6	66	71.0	19	20.4	93	100.0
Aboriginal Descent[d]								
Yes	4	9.5	20	47.6	18	42.9	42	100.0
No	15	7.1	150	71.1	46	21.8	211	100.0
Place of Residence[e]								
Town	7	5.8	85	70.8	28	23.3	120	99.9[c]
Farm	10	8.1	82	66.7	31	25.2	123	100.0
Reserve	3	20.0	5	33.3	7	46.7	15	100.0
Parent's or Guardian's Perception of Neighborhood Safety[f]								
Not at all safe	0	0.0	0	0.0	1	100.0	1	100.0
Somewhat safe	0	0.0	3	37.5	5	62.5	8	100.0
Moderately safe	1	4.5	16	72.7	5	22.7	22	99.9[c]
Quite safe	4	3.8	72	67.9	30	28.3	106	100.0
Safe	14	11.9	79	66.9	25	21.2	118	100.0

Variable	< 1 Hour/day		1-4 Hours/day		> 4 Hours/day		Total	
	No.	%	No.	%	No.	%	No.	%
Education Level of Mother[g]								
Less than grade 12	2	7.7	13	50.0	11	42.3	26	100.0
High school diploma	3	5.8	30	57.7	19	36.5	52	100.0
Some post secondary	6	9.2	46	70.8	13	20.0	65	100.0
Technical training	6	7.3	58	70.7	18	22.0	82	100.0
University degree	3	9.7	23	74.2	5	16.1	31	100.0
Education Level of Father[h]								
Less than grade 12	3	4.8	36	57.1	24	38.1	63	100.0
High school diploma	6	7.7	59	75.6	13	16.7	78	100.0
Some post secondary	4	16.0	17	68.0	4	16.0	25	100.0
Technical training	5	7.6	46	69.7	15	22.7	66	100.0
University degree	2	9.1	13	59.1	7	31.8	22	100.0
BMI Category of Participant[i]								
Normal weight	14	8.9	111	70.3	33	20.9	158	100.1[c]
Overweight/Obese	4	5.1	51	65.4	23	29.5	78	100.0
BMI Category of Mother[j]								
Normal weight	6	5.8	72	69.9	25	24.3	103	100.0
Overweight/Obese	11	9.2	82	68.3	27	22.5	120	100.0
BMI Category of Father[k]								
Normal weight	2	7.4	17	63.0	8	29.6	27	100.0
Overweight/Obese	15	7.7	139	70.9	42	21.4	196	100.0

[a]Missing data on age for fifteen students (twelve for age, three for leisure activity).

[b]Missing data on grade for four students (four for leisure activity).

[c]Does not add up to 100% due to rounding.

[d]Missing data on Aboriginal descent for nine students (six for Aboriginal descent, three for leisure activity).

[e]Missing data on place of residence for four students (one for place of residence, three for leisure activity).

[f]Participant's parent's or guardian's perception of neighborhood safety. Missing data on neighborhood safety for seven students (four for neighborhood safety, three for leisure activity).

[g]Missing data on mother's education level for six students (three for mother's education level, three for leisure activity).

[h]Missing data on father's education level for eight students (five for father's education level, three for leisure activity).

[i]Missing data on participant's BMI category for fifteen students (twelve for participant's BMI category, 3 for leisure activity).

[j]Missing data on mother's BMI category for thirty-nine students (thirty-six for mother's BMI category, three for leisure activity).

[k]Missing data on father's BMI category for thirty-nine students (thirty-seven for father's BMI category, two for leisure activity).

Participants were asked to complete the self-report Physical Activity Questionnaire for Older Children (PAQ-C) for the previous seven days. At the end of the PAQ-C, the students were asked whether they had been sick in the previous week or if anything had prevented them from participating in their normal physical activities. Overall, 36 (14.0%) of the 262 students, including 15 boys (13.6%) and 21 girls (14.2%) reported that they had been sick or injured during the previous week. Table 4.13 shows the distribution of the participants' mean (SD) PAQ-C scores by selected variables. One-way analysis of variance (ANOVA) revealed a statistically significant difference in the mean PAQ-C score by grade [$F(2, 257) = 3.77$, $p = .024$]. Grade 4 students in the sample had a significantly higher mean PAQ-C score than Grade 5 students. While ANOVA revealed a statistically significant difference in the distribution of mean PAQ-C score by place of residence [$F(2, 257) = 3.16$, $p = .044$], none of the differences between groups was statistically significant. The ANOVA revealed a statistically significant difference in the distribution of mean PAQ-C scores by reported average time spent in leisure activity on a school day [$F(2, 256) = 3.53$, $p = .031$]. Students who spent less than 1 hour/day in leisure activity on school days had a higher mean PAQ-C score compared to students who spent 1-4 hours/day in leisure activity. One-way analysis of variance did not reveal any statistically significant differences in the distribution of mean PAQ-C score by any of the other variables examined. Therefore, the data did not support the hypothesis of an inverse relationship between physical activity and BMI in the sample.

The distribution of the participants by BMI category was compared to recent

Table 4.13

Participants' Mean (SD) Physical Activity Questionnaire for Older Children (PAQ-C) Score by Selected Variables

		PAQ-C Score		
Variable		***n***	**Mean**	***SD***
Age (years)[a]				
	8 – 9	60	3.3	0.66
	10	97	3.1	0.62
	11	73	3.3	0.53
	12	19	3.1	0.48
Gender				
	Boys	111	3.3	0.64
	Girls	149	3.2	0.57
Grade				
	4	70	3.4[b]	0.67
	5	97	3.1	0.59
	6	93	3.2	0.55
Aboriginal Descent				
	Yes	43	3.1	0.67
	No	212	3.2	0.59
Place of Residence[c]				
	Town	121	3.3	0.60
	Farm	123	3.1	0.59
	Reserve	16	3.0	0.65
Parent's or Guardian's Perception of Neighborhood Safety[d,e]				
Unsafe – Moderately safe		31	3.3	0.72
	Quite safe	107	3.2	0.55
	Safe	119	3.2	0.60
Education Level of Mother				
	Less than grade 12	26	3.0	0.63
	High school diploma	52	3.2	0.59
	Some post secondary	66	3.3	0.54
	Technical training	83	3.2	0.63
	University degree	31	3.3	0.69

	PAQ-C Score		
Variable	***n***	**Mean**	***SD***
Education Level of Father			
Less than grade 12	64	3.1	0.64
High school diploma	78	3.3	0.59
Some post secondary	25	3.3	0.60
Technical training	67	3.1	0.58
University degree	22	3.2	0.60
BMI Category of Participant			
Normal weight	160	3.3	0.59
Overweight/Obese	78	3.1	0.61
BMI Category of Mother			
Normal weight	104	3.3	0.58
Overweight/Obese	121	3.2	0.61
BMI Category of Father			
Normal weight	27	3.4	0.57
Overweight/Obese	197	3.2	0.60
School Day Leisure Activity[f]			
< 1 hour/day	50	3.4[g]	0.63
1-4 hours/day	181	3.2	0.60
> 4 hours/day	28	3.2	0.58
Weekend Leisure Activity[f]			
< 1 hour/day	20	3.3	0.77
1-4 hours/day	172	3.2	0.59
> 4 hours/day	66	3.2	0.60

[a]One eight year old was included in the nine year old age category.

[b]Significantly different from 3.1; Scheffe's Procedure, p = .026.

[c]Significant difference in mean PAQ-C score across groups (ANOVA, F = 3.16; df = 2; p = .441). The p-values for all Scheffe's tests between groups were p > .05.

[d]Participant's parent's or guardian's perception of neighborhood safety.

[e]Because of the small number of participants in each category, three categories of neighborhood safety (not at all safe, somewhat safe, and moderately safe) were combined to create the new category unsafe – moderately safe.

[f]Leisure activity includes television watching, video game playing, computer games, internet use, and talking on the phone with friends.

[g]Significantly different from 3.2; Scheffe's Procedure, p = .031.

population survey data on BMI of children living in Saskatchewan and Canada. Table 4.14 summarizes the data used in this comparison. The Saskatchewan BMI data were based on measured height and weight of children aged 2 to 17 years, excluding pregnant females. The Canadian BMI data were based on measured height and weight for children aged 2 to 17 years, excluding pregnant females, and children aged 6 to 11 years. The Saskatchewan data and the Canadian data were obtained in the Canadian Community Health Survey: Nutrition (Shields, 2005). The BMI data obtained in the Canadian Community Health Survey: Nutrition were categorized using the international standards by Cole et al. (2000) used in the present study.

The participants' mean height and weight measurements were compared to population survey data on measured height and weight for a sample of urban dwelling Saskatchewan children from Saskatoon, Saskatchewan. Table 4.15 summarizes the data used in this comparison. The urban Saskatchewan data were collected in a seven year longitudinal study of 138 boys and girls (aged 8 to 15 years at baseline) living in middle-class neighborhoods in Saskatoon, Saskatchewan, Canada between 1991 and 1997 (Thompson et al., 2003).

The participants' mean height, mean sitting height, mean weight, and mean BMI were compared to published data on measured height, sitting height, and weight, and BMI for a population-based sample of urban and rural dwelling Saskatchewan children aged 8 to 13 years (see Table 4.16). The published data were collected in a cross-sectional study of 110 urban (52 boys and 58 girls) and 165 rural (75 boys and 90 girls) children aged 8 to 13 years living in Saskatchewan, Canada in 2002 (Tremblay et al., 2005).

Table 4.14

Comparison of Participants' BMI Category with Published Population Survey Data on BMI of Children Living in Saskatchewan and Canada

	Participants' Results (n = 239)			**Saskatchewan Survey Results**[b] (n = 197,406)		**Canadian Survey Results (2-17 years)**[b] (n = 6,184,425)		**Canadian Survey Results (6-11 years)**[c] (n =2,321,000)	
	No.	%	95% CI[a]	No.	%	No.	%	No.	%
Boys									
BMI Category[d]									
Normal Weight	68	68.0	58.9-77.1	70,156	66.9	2,320,807	73.0	—[f]	74.5
Overweight	23	23.0	14.8-31.2	22,314	21.3	567,963	17.9	—[f]	17.0
Obese	9	9.0	3.4-14.6	12,464	11.9	289,073	9.1	—[f]	8.5
All	100	100.0		104,934	100.1[e]	3,177,843	100.0	1,173,000	100.0
Girls									
BMI Category[d]									
Normal Weight	93	66.9	59.1-74.7	69,791	75.5	2,240,565	74.5	—[f]	73.7
Overweight	38	27.3	19.9-34.7	14,789	16.0	548,877	18.3	—[f]	18.8
Obese	8	5.8	1.9-9.7	7,891	8.5	217,139	7.2	—[f]	7.5
All	139	100.0		92,471	100.0	3,006,582	100.0	1,1486,000	100.0
All									
BMI Category[d]									
Normal Weight	161	67.4	61.5-73.3	139,947	70.9	4,561,372	73.8	—[f]	74.1
Overweight	61	25.5	20.0-31.0	37,103	18.8	1,116,840	18.1	—[f]	17.9
Obese	17	7.1	3.8-10.4	20,356	10.3	506,213	8.2	—[f]	8.0
All	239	100.0		197,406	100.0	6,184,425	100.0	2,321,000	100.0

[a]95% confidence interval (CI).

[b]Results based on measured height and weight, by gender, for individuals aged 2 to 17 years (excluding pregnant females) from Statistics Canada, Canadian Community Health Survey (CCHS): Nutrition, 2004 (Shields, 2005).

[c]Results based on measured height and weight, by gender, for individuals aged 6 to 11 years from Statistics Canada, Canadian Community Health Survey (CCHS): Nutrition, 2004 (Shields, 2005).

[d]BMI categories are based on the international cut points for body mass index for overweight and obesity by gender between 2 and 18 years, defined to pass through BMI of 25 kg/m^2 (overweight) and 30 kg/m^2 (obesity) at age 18 years (Cole et al., 2000).

[e]Does not add up to 100% due to rounding.

[f]The number of children in each BMI category was not reported.

Table 4.15

Comparison of Participants' Measured Height and Weight with Published Data on Measured Height and Weight for a Sample of Urban Saskatchewan Children

	Participants' Results				Saskatchewan Results[b]		
	n	Mean	SD	95% CI[a]	n	Mean	SD[c]
Boys							
Height[d]							
9	25	136.5	6.02	134.1-138.9	11	138.5	5.2
10	33	142.5	5.96	140.4-144.5	25	143.9	6.3
11	35	149.1	7.08	146.7-151.4	39	148.8	6.5
12	7	150.5	7.46	144.9-156.1	54	154.4	7.1
Weight[e]	25	34.0	7.05	31.3-36.7	11	32.0	4.9
9	33	40.4	10.47	36.8-44.0	25	35.8	5.5
10	35	46.7	12.28	42.6-50.8	39	40.1	6.7
11	7	46.9	13.15	37.2-56.6	54	45.1	8.0
12							
Girls							
Height[d]							
8	1	129.9[e]				—[f]	
9	33	138.2	5.73	136.3-140.1	23	138.4	9.8
10	58	141.6	7.17	139.7-143.4	41	143.3	8.8
11	37	150.9	7.78	148.4-153.4	53	148.9	8.8
12	10	149.4	9.08	143.8-155.0	64	155.3	8.6
Weight[e]							
8	1	29.1[f]				—[g]	
9	33	35.9	8.39	33.0-38.8	23	34.0	9.0
10	58	38.5	12.00	35.4-41.6	41	36.4	9.0
11	37	45.4	10.72	42.0-48.8	53	40.2	10.3
12	10	42.8	11.92	35.4-50.2	64	46.0	10.9

[a]95% confidence interval (CI).

[b]Results based on measured height and weight for children aged 8 to 15 years, at baseline, in a longitudinal study conducted in Saskatoon, Saskatchewan, Canada between 1991 and 1997 (Thompson, Baxter-Jones, Mirwald, & Bailey, 2003).

[c]SD were reported to one decimal place.

[d]Height measurements are in centimeters.

[e]Weight measurements are in kilograms.

[f]The measured height and weight were reported for this participant.

[g]The number and mean height and weight were not reported for 8 year old children in the survey.

Table 4.16
Comparison of Participants' Measured Height, Sitting Height, Weight, and BMI with Similar Published Data for a Sample of Urban and Rural Saskatchewan Children

	Participants' Results				Urban Saskatchewan Survey Results[b]			Rural Saskatchewan Survey Results[b]		
	n	Mean	SD	95% CI[a]	n	Mean	SD[c]	n	Mean	SD[c]
Boys										
Height[d]	107	144.0	8.19	142.49-145.59	52	146.9	10.8	75	145.3	9.6
Sitting Height[d]		75.0	3.98	74.24-75.74		74.8	4.7		76.7	4.5
Weight[e]		41.4	11.39	39.25-43.57		42.0	10.8		39.5	9.1
BMI		19.7	3.98	18.96-20.46		19.1	3.0		18.5	2.8
Girls										
Height[d]	144	144.0	8.89	142.51-145.41	58	146.5	9.9	90	147.3	10.3
Sitting Height[d]		75.2	4.77	74.45-76.01		75.3	5.0		79.1	7.0
Weight[e]		40.4	11.81	38.46-42.32		41.5	9.6		43.0	10.5
BMI		19.2	3.98	18.54-19.84		19.1	2.7		19.5	3.1

[a]95% confidence interval (CI).

[b]Results based on measured height, sitting height, and weight data collected in 2002 for a cross-sectional study of urban and rural children, aged 8 to 13 years in Saskatchewan, Canada (Tremblay, Barnes, Copeland, & Esliger, 2005).

[c]SD were reported to one decimal place.

[d]Height and sitting height measurements are in centimeters.

[e]Weight measurements are in kilograms.

With adjustment for gender, the participants' mean (SD) PAQ-C scores were compared to mean PAQ-C scores for 136 children, aged 6 to 10 years, from Edmonton, Alberta, Canada (Ball, Marshall, et al., 2001). A similar mean PAQ-C score was observed for boys (M = 3.3, SD = 0.64, 95% CI: 3.17 – 3.41) in the present study and boys (M = 3.3, SD = 0.79) in the Edmonton study. The mean PAQ-C score for girls in the present study appears somewhat higher (M = 3.2, SD = 0.57, 95% CI: 3.06 – 3.24) compared to the estimate for girls in the Edmonton study (M = 2.9, SD = 0.74).

With adjustment for gender, the participants' mean (SD) PAQ-C scores were compared to mean PAQ-C scores for 110 urban and 165 rural Saskatchewan children, aged 8 to 13 years (Tremblay et al., 2005). The mean PAQ-C score for boys (M = 3.3, SD = 0.64, 95% CI: 3.17 – 3.41) in the present study appears to be slightly higher than the estimates for urban dwelling boys (M = 3.1, SD = 0.60) and rural dwelling boys (M = 3.1, SD = 0.70) in the previous Saskatchewan study. The mean PAQ-C score observed for girls (M = 3.2, SD = 0.57, 95% CI: 3.06 – 3.24) in the present study appears to be slightly higher than the estimates for urban dwelling girls (M = 2.9, SD = 0.70) and rural dwelling girls (M = 2.9, SD = 0.70) in the previous Saskatchewan study.

Table 4.17 shows the univariate analysis and the distribution of the prevalence of overweight or obesity and the crude odds ratio for the association with overweight or obesity for each study variable for boys and girls considered together and for boys and girls considered separately. The factors found to have a significant association with the prevalence of overweight or obesity were Aboriginal descent, mother's

education level, mother's BMI category, father's BMI category, and weekend day leisure activity. When boys and girls were considered together there was a statistically significant association between the prevalence of overweight or obesity of participants and the variables Aboriginal descent and BMI category of the participant's father. The prevalence of overweight or obesity was significantly higher for participants of Aboriginal descent compared to those of non-Aboriginal descent and for participants whose fathers were overweight or obese compared to participants whose fathers were of normal weight. When boys were considered separately, the prevalence of overweight or obesity was significantly higher for boys of Aboriginal descent compared to boys of non-Aboriginal descent and for boys whose mothers were overweight or obese compared to boys whose mothers were of normal weight. In addition, the prevalence of overweight and obesity was lower for boys whose mothers had received technical training compared to boys whose mothers had a university degree. For girls, the prevalence of overweight or obesity was significantly higher for girls whose fathers were overweight or obese compared to girls whose fathers were of normal weight and for girls who spent more than 4 hours per day involved in leisure activity on the weekend compared to girls who spent $\leq$ 4 hours per day involved in leisure activity on the weekend. In the univariate analysis, no statistically significant associations were found between the prevalence of overweight or obesity and the variables gender, place of residence, parent's (or guardian's) perception of neighborhood safety, education level of father, school day leisure activity, or PAQ-C score.

Table 4.17

Prevalence (%), Crude Odds Ratio[a], and 95% Confidence Interval for Overweight or Obesity[b] in Participants by Study Variable of Interest

		All (n = 262)			Boys (n = 111)			Girls (n = 151)		
Variable		**No.**	**%**	**OR, 95% CI**	**No.**	**%**	**OR, 95% CI**	**No.**	**%**	**OR, 95% CI**
Gender										
	Girls	139	33.1	1.05, 0.61-1.82						
	Boys	100	32.0	1.00, Reference						
	Missing	23								
Aboriginal Descent										
	Yes	34	50.0	**2.35, 1.13-4.91**	16	62.5	**4.55, 1.48-13.99**	18	38.9	1.36, 0.49-3.77
	No	201	29.9	1.00, Reference	82	26.8	1.00, Reference	119	31.9	1.00, Reference
	Missing	27			13			14		
Place of Residence										
	Reserve	15	46.7	1.68, 0.57-5.00	7	57.1	2.77, 0.54-14.23	8	37.5	1.10, 0.24-5.01
	Farm	116	29.3	0.80, 0.45-1.40	53	28.3	0.82, 0.34-2.00	63	30.2	0.79, 0.38-1.65
	Town	108	34.3	1.00, Reference	40	32.5	1.00, Reference	68	35.3	1.00, Reference
	Missing	23			11			12		

	All (n = 262)			Boys (n =111)			Girls (n = 151)		
Variable	**No.**	**%**	**OR, 95% CI**	**No.**	**%**	**OR, 95% CI**	**No.**	**%**	**OR, 95% CI**
Parent's or Guardian's Perception of Neighborhood Safety									
Unsafe-Moderately Safe	28	25.0	0.66, 0.26-1.69	9	11.1	0.22, 0.03-1.92	19	31.6	0.99, 0.33-2.96
Quite Safe	96	32.3	0.94, 0.53-1.68	44	31.8	0.82, 0.35-1.97	52	32.7	1.04, 0.48-2.26
Safe	113	33.6	1.00, Reference	47	36.2	1.00, Reference	66	31.8	1.00, Reference
Missing	25			11			14		
Education Level of Mother									
High school or less	73	37.0	0.91, 0.37-2.22	29	37.9	0.41, 0.09-1.77	44	36.4	1.49, 0.45-4.94
Some post secondary	58	24.1	0.49, 0.19-1.29	28	25.0	0.22, 0.05-1.02	30	23.3	0.79, 0.21-3.00
Technical training	78	32.1	0.73, 0.30-1.78	32	21.9	**0.19, 0.04-0.85**	46	39.1	1.67, 0.51-5.49
University degree	28	39.3	1.00, Reference	10	60.0	1.00, Reference	18	27.8	1.00, Reference
Missing	25			12			13		
Education Level of Father									
High school or less	130	34.6	1.85, 0.58-5.96	49	40.8	2.41, 0.45-12.84	81	30.9	1.56, 0.30-8.06
Some post secondary	24	20.8	0.92, 0.21-4.07	12	25.0	1.17, 0.15-9.01	12	16.7	0.70, 0.08-6.22
Technical training	63	36.5	2.01, 0.59-6.84	29	24.1	1.11, 0.19-6.65	34	47.1	3.11, 0.56-17.20
University degree	18	22.2	1.00, Reference	9	22.2	1.00, Reference	9	22.2	1.00, Reference
Missing	27			12			15		

	All (n = 262)			Boys (n = 111)			Girls (n = 151)		
Variable	**No.**	**%**	**OR, 95% CI**	**No.**	**%**	**OR 95% CI**	**No.**	**%**	**OR, 95% CI**
BMI Category of Mother									
Overweight/Obese	110	36.4	1.76, 0.97-3.19	48	39.6	**3.18, 1.17-8.64**	62	33.9	1.22, 0.57-2.62
Normal weight	102	24.5	1.00, Reference	41	17.1	1.00, Reference	61	29.5	1.00, Reference
Missing	50			22			28		
BMI Category of Father									
Overweight/Obese	183	35.5	**4.59, 1.34-15.79**	83	31.3	2.74, 0.31-23.90	100	39.0	**6.07, 1.34-27.53**
Normal weight	28	10.7	1.00, Reference	7	14.3	1.00, Reference	21	9.5	1.00, Reference
Missing	51			21			30		
School Day Leisure Activity[c]									
> 4 hours/day	26	26.9	0.73, 0.29-1.81	10	20.0	0.50, 0.10-2.50	16	31.3	0.89, 0.29-2.72
≤ 4 hours/day	211	33.6	1.00, Reference	90	33.3	1.00, Reference	121	33.9	1.00, Reference
Missing	25			11			14		
Weekend Day Leisure Activity[c]									
> 4 hours/day	56	41.1	1.58, 0.85-2.94	25	28.0	0.76, 0.28-2.07	**31**	**51.6**	**2.70, 1.19-6.14**
≤ 4 hours/day	180	30.6	1.00, Reference	74	33.8	1.00, Reference	106	28.3	1.00, Reference
Missing	26			12			14		

Variable		All (n = 262) No.	%	OR, 95% CI	Boys (n = 111) No.	%	OR, 95% CI	Girls (n = 151) No.	%	OR, 95% CI
PAQ-C Score										
	Missing	238	N/A	0.67, 0.42-1.05	100	N/A	0.85, 0.43-1.68	138	N/A	0.55, 0.29-1.03
		24			11			13		

[a]Results of logistic regression analysis. Crude odds ratios were not estimated for the variables age and grade because the BMI estimates on which the classification of normal weight versus overweight or obesity already take into consideration the child's age.

[b]BMI categories are based on the international cut points for body mass index for overweight and obesity by gender between 2 and 18 years, defined to pass through BMI of 25 kg/m^2 (overweight) and 30 kg/m^2 (obesity) at age 18 years (Cole et al., 2000).

[c]Because of the small number of participants in the < 1 hour/day category, two categories of leisure activity (< 1 hour/day and 1-4 hours/day) were combined to create the new category $\leq$ 4 hours/day.

Table 4.18 shows the adjusted odds ratio for overweight or obesity for each study variable of interest with adjustment for the effects of all the other study variables included in the logistic regression model. When boys and girls were considered together, with adjustment for all the other variables in the model, statistically significant positive associations were observed between the prevalence of overweight or obesity of participants and the variables gender, Aboriginal descent, and BMI category of the participant's father (Table 4.18, Model 1). A statistically significant inverse association was observed for the variable parent's or guardian's perception of neighborhood safety and a significant first order interaction was found between the variables gender and BMI category of the participant's mother. None of the other variables in the model were statistically significant. When boys were considered separately, with adjustment for all the other variables in the model, the prevalence of overweight or obesity was significantly higher for boys of Aboriginal descent compared to boys of non-Aboriginal descent and for boys whose mothers were overweight or obese compared to boys whose mothers were of normal weight and none of the other variables were statistically significant (Table 4.18, Model 2). For girls, the prevalence of overweight or obesity was significantly higher for girls whose fathers were overweight or obese compared to girls whose fathers were of normal weight and none of the other variables were statistically significant (Table 4.18, Model 3). In the multiple variable analysis, no statistically significant associations were found between the prevalence of overweight or obesity and the variables place of residence, education level of the participant's mother, education level of the participant's father, weekend day leisure activity, or PAQ-C score.

Table 4.18

Adjusted Odds Ratio[a] and 95% Confidence Interval for Overweight or Obesity[b] in Participants by Logistic Regression Model and Study Variables of Interest

	Model 1 All (n = 194)		**Model 2 Boys (n = 83)**		**Model 3 Girls (n = 111)**	
Variable	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Gender						
Girls	**4.11**	**1.31-12.88**				
Boys	1.00	Reference				
Aboriginal Descent						
Yes	**4.38**	**1.58-12.15**	**13.50**	**2.59-70.43**	2.41	0.52-11.03
No	1.00	Reference	1.00	Reference	1.00	Reference
Place of Residence						
Farm or Reserve	0.81	0.41-1.60	2.27	0.62-8.27	0.44	0.17-1.13
Town	1.00	Reference	1.00	Reference	1.00	Reference
Parent's or Guardian's Perception of Neighborhood Safety						
Unsafe-Moderately Safe	**0.26**	**0.07-0.94**	0.07	0.00-1.71	0.28	0.06-1.42
Quite Safe	1.08	0.52-2.23	1.14	0.29-4.45	1.29	0.47-3.57
Safe	1.00	Reference	1.00	Reference	1.00	Reference
Education Level of Mother						
High school or less	0.93	0.28-3.12	0.18	0.02-1.82	2.27	0.39-13.10
Some post secondary	0.52	0.15-1.79	0.11	0.01-1.02	1.47	0.23-9.45
Technical training	0.98	0.32-3.03	0.11	0.01-1.09	2.56	0.52-12.70
University degree	1.00	Reference	1.00	Reference	1.00	Reference
Education Level of Father						
High school or less	1.30	0.35-4.89	2.75	0.23-33.13	1.91	0.27-13.40
Some post secondary	0.35	0.05-2.42	0.95	0.04-21.01	0.74	0.04-14.16
Technical training	1.44	0.36-5.81	1.94	0.13-29.09	3.47	0.45-26.77
University degree	1.00	Reference	1.00	Reference	1.00	Reference

	Model 1 All (n = 194)		Model 2 Boys (n = 83)		Model 3 Girls (n = 111)	
Variable	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
BMI Category of Mother						
Overweight/Obese	**5.10**	**1.56-16.73**	**7.21**	**1.60-32.51**	0.75	0.28-1.97
Normal weight	1.00	Reference	1.00	Reference	1.00	Reference
BMI Category of Father						
Overweight/Obese	**4.53**	**1.17-17.54**	2.08	0.13-34.31	**5.41**	**1.04-28.07**
Normal weight	1.00	Reference	1.00	Reference	1.00	Reference
Weekend Day Leisure Activity						
> 4 hours/day	1.55	0.69-3.48	1.34	0.29-6.08	1.93	0.65-5.71
≤ 4 hours/day	1.00	Reference	1.00	Reference	1.00	Reference
PAQ-C Score	0.75	0.40-1.38	1.80	0.52-6.26	0.45	0.18-1.15
Gender*BMI Category of Mother[c]						

[a]Results of multiple logistic regression analysis. Adjusted crude odds ratios were not estimated for the variables age and grade because the BMI estimates on which the classification of normal weight versus overweight or obesity already take into consideration the child's age.

[b]BMI categories are based on the international cut points for body mass index for overweight and obesity by gender between 2 and 18 years, defined to pass through BMI of 25 kg/m^2 (overweight) and 30 kg/m^2 (obesity) at age 18 years (Cole et al., 2000).

[c]Statistically significant interaction between the variables gender and BMI category of the participant's mother (p = .015). With adjustment for the other variables in the model, the odds ratio estimates were:

(1) Odds ratio = 4.11 (95% CI = 1.31 – 12.90) for boys whose mothers were overweight or obese compared to boys whose mothers were not overweight or obese.

(2) Odds ratio = 0.68 (95% CI = 0.27 – 1.71) for girls whose mothers were overweight or obese compared to girls whose mothers were not overweight or obese.

(3) Odds ratio = 5.10 (95% CI = 1.56 – 16.74) for girls whose mothers were not overweight or obese compared to boys whose mothers were not overweight or obese.

(4) Odds ratio = 0.84 (95% CI = 0.34 – 2.05) for girls whose mothers were overweight or obese compared to boys whose mothers were overweight or obese.

First order interactions were assessed between all of the study variables that were statistically significant in the logistic regression analysis and between each of these variables and the variable gender. The multiple variable analysis revealed a significant interaction between the variables gender and BMI category of the participant's mother (Table 4.18, Model 1). Assessment of the interaction between gender and the BMI category of the participant's mother (see Appendix M) revealed that a significantly larger proportion of boys whose mothers were overweight or obese were also overweight or obese compared to boys whose mothers were of normal weight (OR = 4.11, 95% CI = 1.31-12.90) (Table 4.19). In addition, for participants whose mothers were not overweight or obese, a significantly larger proportion of girls were overweight or obese compared to boys (OR = 5.10, 95% CI = 1.56-16.74).

At the end of the PAQ-C, the students were asked to list any additional activities or chores they had participated in at home in the last 7 days. Using content analysis, the responses were categorized into themes and the frequency of responses for each theme was recorded (Table 4.20). Overall, the majority of the students reported participating in household chores (34.7%), such as vacuuming, dusting, and washing the dishes, and sports and physical activities (22.9%), such as soccer, volleyball, and dance. In order of frequency, the other types of activities included yard and garden work (e.g., raking leaves), farm maintenance (e.g, hauling bales), games (e.g, hide and go seek), farm animal care (e.g., feeding the cows), pet care (e.g., feeding the cats), sedentary activity (e.g., reading a book), part-time job (e.g., feeding the cats), delivering the newspaper), and errands (e.g., delivering mail to Grandma).

Table 4.19

Participants' BMI Category Compared to Mothers' BMI Category

	Mother Overweight or Obese			
	No		Yes	
	No.	%	No.	%
Boys				
Overweight or Obese				
No	34	38.2	29	32.6
Yes	7	7.9	19	21.3
Girls				
Overweight or Obese				
No	43	35.0	41	33.3
Yes	18	14.6	21	17.1

Table 4.20

Participants' Responses to the Question "What additional activities or chores have you participated in at home in the last 7 days?"

	Responses (n =203)	
Categories	**Frequency**	**%**
Household Chores	207	34.7
Sports and Physical Activities	137	22.9
Yard and Garden Work	75	12.6
Farm Maintenance	45	7.5
Games	43	7.2
Farm Animal Care	35	5.9
Pet Care	31	5.2
Sedentary Activity	16	2.7
Part-time Job	4	0.7
Errands	4	0.7
Total	597	100.1[a]

[a] Does not add up to 100% due to rounding.

CHAPTER 5

Discussion

The purpose of this exploratory study was threefold: (1) to explore the relationship between physical activity and BMI in a sample of rural Saskatchewan children, (2) to examine the prevalence of childhood overweight and obesity in the rural sample, and (3) to explore the importance of age, gender, and residency (farm versus town) in relation to childhood overweight and obesity in the sample. The results will be discussed in relation to the three research questions for the study.

Research Question 1

What is the relationship between physical activity level and BMI in a sample of rural Saskatchewan children?

The hypothesized relationship between physical activity level and BMI was tested. ANOVA revealed no statistically significant difference in mean PAQ-C score between BMI categories. Therefore, the hypothesized inverse relationship between physical activity level and BMI was not supported. Participants in the normal weight category had a mean PAQ-C score of 3.3 (SD = 0.59) and participants in the overweight or obese category had a mean PAQ-C score of 3.1 (SD = 0.61). In previous studies, normal weight children have been found to be more physically active than overweight or obese children (Ball, Marshall, & McCargar, 2005; Ekelund et al.,

2004; Patrick et al., 2004). In a recent study of 6 to 10 year old elementary students from Edmonton, Alberta, using the PAQ-C, Ball et al. (2005) identified significantly higher levels of self-reported physical activity in the normal weight group (3.2 $\pm$ 0.80) compared to the overweight group (2.8 $\pm$ 0.80). The differences in findings between the present study and the previous studies may be due to differences in the ages of the children studied, differences in geographic location, or low statistical power of the present study. The study by Ball et al. (2005) included urban dwelling 6 to 10 year old children, while the ages of the children in the present study varied from 8 to 12 years. In a recent study of Grade 3, 7, and 11 students from Nova Scotia, Thompson et al. (2005) found no significant association between the average amount of time involved in physical activity and the BMI category of the children, which is similar to the findings of the present study.

A statistically significant difference in the distribution of mean PAQ-C scores by time spent in leisure activity on a school day was identified in the present study. Students who spent less than 1 hour/day in leisure activity on school days had a higher mean PAQ-C score compared to students who spent 1-4 hours/day in leisure activity. Very little literature is available to support these findings. Jago, Baranowski, Thompson, Baranowski, and Greaves (2005) estimated that the "relationship between television viewing, the most studied form of sedentary behavior, and the physical activity of young children is unclear" (p. 364). In a 3 year longitudinal study of 3 to 4 year old children living in Texas, Jago et al. found a significant negative correlation between the number of minutes spent watching television and physical activity level ($r = -.20$) in the first year of the study, but not in the subsequent two years. In a study of

9 to 18 year old youth from Quebec City; Katzmarzyk, Malina, Song, and Bouchard (1998) found no significant association between the self-reported duration of television viewing and physical activity level assessed using a 3 day activity record.

In the present study, no statistically significant difference was observed between the mean PAQ-C score for the boys (3.3 $\pm$ 0.64) and the mean PAQ-C score for the girls (3.2 $\pm$ 0.57). This finding is consistent with some previous studies (Ball, O'Connor, et al., 2001; Ball et al., 2005; Bilinski, Semchuk, & Chad, 2005; Thompson et al., 2005; Tremblay et al., 2005). In a recent study of 8 to 13 year old children from both rural and urban parts of Saskatchewan, Tremblay et al. (2005) found no significant difference in the mean PAQ-C score between rural boys (3.1 $\pm$ 0.70) and girls (2.9 $\pm$ 0.70) or between urban boys (3.1 $\pm$ 0.60) and girls (2.9 $\pm$ 0.70). In the study of 6 to 10 year old elementary students from Edmonton, Alberta, Ball et al. (2005) found no significant difference in the mean PAQ-C score between boys (3.4 $\pm$ 0.80) and girls (2.9 $\pm$ 0.70). In a study of rural dwelling Saskatchewan children aged 8 to 13 years Bilinski et al. found no significant differences in the reported physical activity patterns of boys and girls.

In other previous studies, however, boys were found to have significantly higher mean physical activity levels than girls (Ekelund et al., 2004; Gillis et al., 2006; Harrell et al., 2003; Klasson-Heggebo & Anderssen, 2003; Patrick et al., 2004; Trost et al., 1997; Trost et al., 2002). In some of the previous studies accelerometers were used to measure physical activity levels (Ekelund et al.; Klasson-Heggebo & Anderssen; Patrick et al.; Thompson et al., 2005; Trost et al., 2002) instead of a self-report questionnaire (Ball et al., 2005; Bilinski et al.; Gillis et al.; Harrell et al.; Trost

et al., 1997; Tremblay et al., 2005) like the one used in the present study. Thus, differences in findings between the present study and previous studies may be due to the differences in instrumentation. The PAQ-C, a self-report questionnaire, may not be as sensitive as other methods, such as accelerometers, for identifying differences in physical activity levels.

Research Question 2

What is the prevalence of overweight and obesity in a sample of rural Saskatchewan children?

Participants in the present study had their height and weight measured and these measured values were used to calculate BMI. Each participant's BMI was categorized based on the international standards set by Cole et al. (2000). In the present study, for boys and girls combined, the overall prevalence of overweight was 25.5% and the overall prevalence of obesity was 7.1%. Previous studies of Canadian children aged 2 to 17 years have yielded estimates varying from 7.7% to 35.2% for the overall prevalence of overweight and from 2.3% to 19.1% for the overall prevalence of obesity (Galloway, 2006; Haque et al., 2006; He & Beynon, 2006; Janssen et al., 2004; Mitura & Bollman, 2004; Shields, 2005*;* Tremblay et al., 2002; Tremblay & Willms, 2003; Veugelers & Fitzgerald, 2005; Willms et al., 2003). A recent study of 6 to 17 year old students from Timmins, Ontario, using measured height and weight compared to the international standards set by Cole et al., reported similar findings for the prevalence of obesity (6.7%); however, a smaller proportion were found to be overweight (17.9%) compared to participants in the present study (Haque et al.). As shown in Chapter 4, compared to published data on boys and girls aged 2 to 17 years

from Saskatchewan and Canada in the Canadian Community Health Survey: Nutrition (Shields), a larger proportion of the children aged 8 to 12 years in the present study was overweight. In the present study, the prevalence of overweight was significantly higher for girls (27.3%) compared to boys (23.0%). This difference is consistent with the results of the previous study by Haque et al. The observed differences in findings between the present study and the previous studies may be due to differences in sample size, geographic location, or age of the participants. While the present study included rural dwelling children aged 8 to 12 years, participants in the study by Haque et al. were from an urban center in Ontario and the ages varied from 6 to 17 years. Participants in the Canadian Community Health Survey: Nutrition (Shields) were from both urban and rural centers in Saskatchewan and from across Canada. The ages of participants from Saskatchewan ranged from 2 to 17 years, excluding pregnant females, and the ages of participants from Canada ranged from 2 to 17 years, excluding pregnant females, and from 6 to 11 years.

In the present study, based on a comparison of BMI categories, similar proportions of boys (68.0%) and girls (67.0%) were in the normal weight category. While the proportion overweight was larger for girls (27.3%) compared to boys (23.0%) and the proportion obese was larger for boys (9.0%), compared to girls (5.8%); however, these results were not statistically significant. The lack of statistical significance of these findings may be due to small sample size and low statistical power of the tests or measured differences may be due to chance. Findings of this study are consistent with results of previous studies conducted in Canada (Haque et al., 2006; Veugelers & Fitzgerald, 2005) and the United States (Davy et al., 2004;

Ogden et al., 2002) where no significant difference was observed in the prevalence of overweight and obesity by gender. Although Tremblay and Willms (2000) and Tremblay et al. (2002) observed higher proportions of overweight and obesity for Canadian boys than girls, these differences were not statistically significant. In other studies conducted in Canada (Janssen et al., 2004; Mitura & Bollman, 2004), the United States (Lewis et al., 2006; Thorpe et al., 2004), and South Africa (Monyeki et al., 1999) a higher prevalence of overweight and obesity was observed for boys compared to girls. In studies conducted in Jamaica (Chang et al., 1999), Mexico (Hernandez et al., 2003), and Scotland (Chinn & Rona, 2001), however, a higher prevalence of overweight and obesity was observed for girls, compared to boys.

The use of BMI to measure the prevalence of overweight and obesity has resulted in inconsistent results between the present study and the previous studies. Some of these differences may be real differences due to geographic location, age, and ethnicity of the participants. However, there may also be limitations to the use of BMI. Level of sexual maturation, muscle, bone, and fat can influence BMI results.

Research Question 3

What factors are associated with being classified as overweight or obese in a sample of rural Saskatchewan children?

In this study, potential associations were explored between the prevalence of childhood overweight and obesity and a variety of factors: gender, place of residence, Aboriginal descent, parent's or guardian's perception of neighborhood safety, mother's education level, father's education level, mother's BMI category, father's BMI category, hours spent in leisure activity on school days and on the weekend, and

the participant's physical activity level. In the univariate logistic regression analysis, the factors found to have a significant association with the prevalence of overweight and obesity were: Aboriginal descent, mother's education level, mother's BMI category, father's BMI category, and hours spent in leisure activity on the weekend. However, when all variables were considered together in the multiple logistic regression analysis, with adjustment for all the other variables in the model, the factors found to have a significant association with the prevalence of overweight and obesity were: gender, Aboriginal descent, parent's or guardian's perception of neighborhood safety, mother's BMI category, and father's BMI category. No statistically significant associations were found between the prevalence of childhood overweight and obesity and the variables place of residence, mother's education level, father's education level, hours spent in leisure activity on the weekend, and the participant's physical activity level. Assessment of potential first order interactions revealed a statistically significant interaction between the variables gender and the participant's mother's BMI category. In particular, a significantly larger proportion of boys whose mothers were overweight or obese were also overweight or obese compared to boys whose mothers were of normal weight. In addition, for participants whose mothers were not overweight or obese, a significantly larger proportion of girls were overweight or obese compared to boys.

In the present study, the prevalence of overweight or obesity was significantly higher for participants of Aboriginal descent compared to participants of non-Aboriginal descent. The prevalence of overweight and obesity in Aboriginal populations has been examined in previous studies in Canada (Bernard, Lavallee,

Gray-Donald, & Delisle, 1995; Hanley et al., 2000; Katzmarzyk & Malina, 1998; Shields, 2005) and the United States (Jackson, 1993). A high prevalence of overweight and obesity was found among Aboriginal youth when BMI data were compared with NHANES reference data (Bernard et al.; Hanley et al.; Jackson; Katzmarzyk & Malina). In a study of Aboriginal youth aged 2 to 19 years from the Sandy Lake First Nation in Ontario, the overall prevalence of overweight among participants was significantly higher compared to NHANES reference data for overweight (Hanley et al.). The overall mean BMI for Aboriginal boys and girls combined (21.4 $\pm$ 4.70) in the present study is similar to the reported mean BMI for Aboriginal boys (19.9 $\pm$ 4.39) and Aboriginal girls (21.8 $\pm$ 5.89) in the study by Hanley et al.

In the present study, when boys were considered separately, the prevalence of overweight or obesity was significantly higher for boys of Aboriginal descent compared to boys of non-Aboriginal descent. A review of the literature did not reveal any observed significant differences in the prevalence of overweight and obesity between children of Aboriginal and non-Aboriginal descent in previous studies (Bernard et al., 1995; Hanley et al., 2000; Jackson, 1993; Katzmarzyk & Malina, 1998; Shields, 2005).

In the present study, the proportion of overweight or obese participants (30.7%) with an overweight or obese parent was significantly larger than the proportion of overweight or obese participants (0.9%) whose parents were both in the normal weight category. In previous studies conducted in Canada (Carriere, 2003; O'Loughlin et al., 1998), the United States (Arluk et al., 2003; Cutting, Fisher,

Grimm-Thomas, & Birch, 1999; Treuth et al., 2003), Australia (Burke, Beilin, & Dunbar, 2001), Finland (Fogelholm, Nuutinen, Pasanen, Myohanen, & Saatela, 1999), Germany (Danielzik, Langnase, Mast, Spethmann, & Muller, 2002), Italy (Maffeis, Talamini, & Tato, 1998), Japan (Sekine et al., 2002), Korea (Park, Sook, & Cho, 2004), and the Netherlands (Vogels et al., 2006) researchers have consistently identified a positive relationship between parental overweight and obesity and childhood overweight and obesity. In particular, in the present study, the proportion of overweight or obese participants (30.8%) whose fathers were also overweight or obese was significantly larger than the proportion of overweight or obese participants (1.4%) whose fathers were of normal weight. Although the proportion of overweight or obese participants (18.9%) whose mothers were also overweight or obese was larger than the proportion of overweight or obese participants (11.8%) whose mothers were of normal weight, this difference was not statistically significant. These findings are consistent with findings of some previous studies (Arluk et al; Danielzik et al.; Park et al.; Vogels et al.). For example, in a longitudinal study of Dutch children, whose ages varied from birth to 12 years, a positive association was identified between the BMI of the child and the BMI of the child's father (Vogels et al.). In other studies, conducted in the United States (Arluk et al.), Germany (Danielzik et al.), and Korea (Park et al.) researchers found positive associations between the BMI of the child and the BMI of the child's mother. The differences in findings between the previous studies may be due to differences in the geographic locations of the studies, ages of the participants, or the methods used for the height and weight measurements.

Another significant finding in the present study is the large proportion of overweight or obese girls with an overweight or obese parent. This finding is consistent with the results of a previous study of 9 to 12 year old inner city children from Montreal (O'Loughlin et al., 1998). In the previous study, a significant positive association was identified between obesity in girls and obesity in the girls' mothers and fathers when the children's measured height and weight were compared with NHANES reference data.

Further findings of the present study include a statistically significant positive association for boys between the participant's BMI category and his mother's BMI category and for girls between the participant's BMI category and her father's BMI category. Compared to boys of normal weight, boys who were overweight or obese were more likely to have an overweight or obese mother. Similarly, compared to girls of normal weight, girls who were overweight or obese were more likely to have an overweight or obese father. Findings of the present study are consistent with results of previous studies. In a longitudinal study of Australian youth aged 9 to 18 years, Burke et al. (2001) observed statistically significant associations between the prevalence of overweight or obesity in fathers and daughters, fathers and sons, mothers and sons, and mothers and daughters. In a study of preschool children from Pennsylvania, Cutting et al. (1999) observed a positive correlation between the daughters' and mothers' BMIs ($r = .43$, $p < 0.05$).

Post Hoc Analysis

In a post-hoc analysis, the distribution of the participants' BMI category in the present study was compared to recent population survey data on BMI of children

living in Saskatchewan and Canada (Shields, 2005). The results of the comparisons indicate that the proportions of boys aged 9 to 12 years in the present study who were of normal weight, overweight, or obese are similar to the published population estimates for boys aged 2 to 17 years living in Saskatchewan and for boys of the same age living in Canada. A smaller proportion of girls aged 8 to 12 years in the present study was of normal weight compared to the previous estimate for girls aged 2 to 17 years living in Saskatchewan. A larger proportion of girls in the present study were overweight compared to girls aged 2 to 17 years living in Saskatchewan and girls of the same age living in Canada. The results for boys and girls, combined, indicate that in the present study a smaller proportion of the sample was of normal weight compared to previous survey results for boys and girls living in Canada. A larger proportion of boys and girls, in the present study, was overweight compared to the previous survey results for boys and girls living in Saskatchewan and for boys and girls living in Canada (Shields).

The participants' mean height and weight measurements in the present study were compared to data on measured height and weight for a sample of urban dwelling children from Saskatoon, Saskatchewan (Thompson et al., 2003). The results of the comparison indicate that the boys (aged 9 to 12 years) in the present study were of similar height compared to the published estimates for boys of the same age living in Saskatoon. The data suggest, however, that the age adjusted mean weight of boys aged 10 years and 11 years was higher in the present study. For girls aged 12 years the age adjusted mean height was lower for girls in the present study compared to girls of the same age in the urban study and was similar for girls aged 9 years, 10 years, and

11 years. For girls aged 9 to 11 years the age adjusted mean weight was higher for girls aged 11 years in the present study compared to the previous estimates for urban dwelling girls and was similar for girls aged 9 years, 10 years, and 12 years.

The mean height, sitting height, weight, and BMI of the participants in the present study were compared to population survey data on measured height, sitting height, weight, and BMI of a sample of urban and rural dwelling Saskatchewan children (Tremblay et al., 2005). The results of the comparison suggest that the mean height of the urban boys in the previous study was greater than the mean height for boys in the present study. The mean sitting height for rural boys in the previous study appears to be greater than the mean sitting height for boys in the present study. The estimated mean weight of boys in the present study was similar to the estimates for urban and rural residents in the previous study. The mean BMI for rural boys in the previous study appears to be less than the mean BMI for boys in the present study. For girls, the mean height appears to be higher for urban and rural girls in the previous study compared to the mean height for the girls in the present study. The mean sitting height and mean weight for rural girls in the previous study appear to be higher compared to the estimates for girls in the present study. The estimated mean BMI for girls in the present study was similar to the previous estimates for urban and rural-dwelling girls.

Strengths and Limitations

In a study, internal validity and external validity are two important criteria to evaluate the credibility and reliability of the results (Burns & Grove, 2005; LoBiondo-Wood & Haber, 1998). Internal validity is the "extent to which the effects detected in

the study are a true reflection of reality rather than the result of extraneous variables" (Burns & Grove, p. 215). External validity "is concerned with the extent to which study findings can be generalized beyond the sample used in the study" (Burns & Grove, p. 218-219).

Internal Validity

Threats to internal validity can include instrumentation and selection bias (Burns & Grove, 2005; LoBiondo-Wood & Haber, 1998).

Instrumentation. Instrumentation threats involve changes in the measurement instruments or techniques that result in changes in measurement outcomes (LoBiondo-Wood & Haber, 1998). The reliability (consistency of measurements obtained) and the validity (the extent to which the instrument actually measures the variable being examined) of an instrument have an effect on the internal validity of a study (Burns & Grove, 2005). In the present study, the reliability of the PAQ-C was established by Kowalski et al. (1997). Test-retest reliability studies of the PAQ-C yielded statistically significant (alpha = .05) correlations of r = .75 for boys and r = .82 for girls, indicating an acceptable level of test-retest reliability. Construct validity, which "examines the fit between the conceptual definitions and operational definitions of variables" (Burns & Grove, p. 217), was assessed by comparing the PAQ-C to other physical activity assessments, such as a 24 hour recall of vigorous activity (r = .53), teacher's rating of physical activity (r = .45), and a 7 day physical activity recall interview (r = .46) (Kowalski et al.), indicating a moderate level of construct validity. The results of these studies support the reliability and validity of the PAQ-C as an instrument to assess children's physical activity levels. A pilot test of the information letter and the entire

questionnaire was conducted with a sample of four children aged 9 to 12 years who did not live in the study area. The purpose of the pilot test was to refine the information letter and questionnaire in terms of readability and comprehension and to determine the estimated time (30 minutes) to complete the survey. No changes were made to the information letter or questionnaire as a result of the pilot test. On completion of the study, however, it was discovered that in section two of the questionnaire the categories for questions regarding leisure activity on weekdays and leisure activity on the weekend were not mutually exclusive (see Appendix D, page 139). In order to create mutually exclusive categories the results were recategorized to create 3 new mutually exclusive categories: less than one hour/day, 1-4 hours/day, and more than 4 hours/day.

In the present study, measurement of the participants' height and sitting height were measured to the nearest 0.1 cm using a stadiometer (measuring pole). Weight was measured to the nearest 0.5 pound using a digital scale. In order to maintain the confidentiality of the participants in the study, a random test-retest of the anthropometric measurements was not completed at a later date. Instead, each measurement was completed twice, if the height and sitting height measurements varied by more than 0.4 cm a third measurement was completed. If the weight measurements varied by more than 1 pound a third measurement was completed. If two measurements were recorded the average value was used. If three measurements were recorded the median value was used. To maintain consistency and accuracy of the anthropometric data, the researcher completed all measurements and recording herself. The same stadiometer and digital scale were used for all measurements. A

research assistant was available to assist with the organization of the participants, but was not responsible for the measuring or recording of the data.

Selection bias. Selection bias may occur in studies where randomization of participants is not possible (Burns & Grove, 2005). In particular self-selection, where the individual chooses to be part of the study, can be a source of bias in the study. Participants who are interested in the topic may be more motivated to participate in the study (LoBiondo-Wood & Haber, 1998). In the present study, 525 students in grades 4 through 6 in the target school division were invited to participate in the study. Of those 525 students, 262 (49.9%) provided consent and completed the questionnaire. The response rate for the participants may reflect a self-selection bias in that students and parents or guardians interested in physical activity and BMI may have been more likely to decide to participate in the study compared to those not interested in the topic. This may have resulted in an overestimation of physical activity levels and an underestimation of BMI in the target population.

External Validity

Threats to external validity affect the generalizability of the study findings to other populations and environments. Factors affecting external validity are selection and reactivity effects (LoBiondo-Wood & Haber, 1998).

Effect of selection. Effect of selection occurs when an ideal sample population is not obtained. In some situations the number of available participants may be low, resulting in the use of non-probability sampling instead of probability sampling (LoBiondo-Wood & Haber, 1998). In the present study, a convenience sample (non-probability) was used. To increase the response rate of the sample, several strategies

were implemented. Each school in the target school division was personally visited by the researcher and an information session was provided to encourage participation in the study and to assure confidentiality of the information obtained. A reminder note about the study was left with the teachers to hand out to the students 3 days following the information session. The overall response rate for the study was 49.9%. This is similar to the anticipated response rate which is approximately 50% (Burns & Grove, 2005). Caution should be taken when generalizing the findings of this study beyond the sample because a response rate of 49.9% indicates that the sample may not be representative of the population.

Reactive effects. "Reactivity is defined as the subjects' responses to being studied" (LoBiondo-Wood & Haber, 1998, p. 168). Participants in a study may change their behavior or provide inaccurate responses because of the fact that they are being studied (LoBiondo-Wood & Haber). In the present study, a self-report questionnaire was used to report sedentary activities and physical activity levels. According to Cale (1998), the use of self-report questionnaires with children and adolescents may result in inaccurate reporting. Self-report relies on memory and children may not be able to accurately recall their daily activities over the past seven days. Children may also report their favorite activities instead of their actual activity, or feel pressure to report more socially desirable activities (Harrell et al., 2003). Although the participants in the study were encouraged to be honest with their answers and were informed that there was no right or wrong answer, the results of the self-reported information for sedentary activity may be underestimated and the results may be overestimated for physical activity. This may be due to the participants

wanting to provide answers that fit the social norm for sedentary activities and physical activities. Therefore, caution should be taken in generalizing the results beyond the sample. Direct measurements, instead of using self-reported data on the participants' weight, height, and sitting height were used to increase the validity of the results for BMI; this is a strength of the study.

Study Power

Power is the "probability that a statistical test will detect a significant difference that exists" (Burns & Grove, 2005, p. 451). Of the 525 students invited to participate in the study, 262, including 111 boys (42.4%) and 151 girls (57.6%), provided written consent and, so, were included in the study. Stratification of the sample by gender, grade, place of residence, and by other variables in the study, resulted in small cell sizes for some of the statistical tests. Small cell sizes decrease the overall power of the study to detect statistically significant results (Burns & Grove) and the risk of making a type II error, concluding that there is no difference between two groups when in fact one exists, is increased.

Based on a post hoc analysis (Fleiss, 1981), the present study had low statistical power to detect a significant difference in proportions between overweight or obese boys and girls. For the approximate proportions for overweight or obese participants (30% for boys and 35% for girls) in the study, a sample size of 1,416 children in each comparison group would have been required, assuming a statistical power of .8 and a two-tailed test of significance with alpha = .05, to detect a significant difference in the proportion of overweight or obese children between boys and girls. The present study had low statistical power to detect a significant difference

in mean PAQ-C score between the boys and girls. An effect size of 0.25 was calculated for the mean PAQ-C scores of boys (M = 3.3, SD = 0.64) and girls (M = 3.2, SD = 0.57) in the present study. Assuming a power of .80 and a two-tailed test of significance with alpha = .05, to detect a significant difference between groups, a sample size of 251 children in each comparison group would be required (Polit & Beck, 2004).

In summary, the present study has both limitations and strengths based on the research design and study methods used. One limitation of the present study is the use of a cross-sectional design instead of a longitudinal design. Another limitation of the present study is the sample size and type of sample used. The convenience sample of 262 participants (49.9% response rate) might not be representative of the entire target population, which may limit the generalizability of the findings. The use of a self-report questionnaire to collect information regarding sedentary activities and physical activity is another limitation of the present study. Self-report relies on memory and children may not be able to accurately recall their daily activities. Children may also report their favorite activities instead of their actual activity, or feel pressure to report more socially desirable activities. However, the findings of this study are very similar to the results of a previous study of children of the same age from Saskatchewan using measured height and weight (Tremblay et al., 2005). Due to missing data on age, 12 children were excluded from the estimation of the prevalence of overweight and obesity in the sample. The research questionnaire could have asked for the participant's exact age as well as their date of birth, which might have resulted in

inclusion of those children who were not included in the estimation of the prevalence of BMI when age was calculated using the reported date of birth.

This study has a number of strengths. One strength of the present study is that measured instead of self-reported data for weight, height, and sitting height were used to estimate BMI. The consistency of the method by which the anthropometric data were obtained is another strength of the present study. The researcher completed all measurements herself using the same stadiometer and scale for each participant. Another strength is that this study contributes to the body of knowledge on the prevalence of overweight and obesity in children. In particular, this study adds to the Canadian literature regarding differences in the prevalence of overweight and obesity in Aboriginal and non-Aboriginal children.

Implications for Nursing Practice

This exploratory descriptive study provided a cross-sectional view of the prevalence of physical activity, overweight, and obesity in a sample of rural Saskatchewan children aged 8 to 12 years and the relationship between physical activity level and BMI in the sample. Findings of this study can be used by nurses, other health professionals, and education leaders to develop health promotion programs to promote a healthier lifestyle for children and their families. Overweight and obesity have become a major health concern among Canadian children (Carriere, 2003; Haque et al., 2006; He & Beynon, 2006; Veugelers & Fitzgerald, 2005). The long-term effects of childhood overweight and obesity are both physical (hypertension, hyperlipidemia, and type II diabetes) and psychological (depression and poor self-esteem) (Carriere; He & Beynon; Tremblay & Willms, 2000; Veugelers

& Fitzgerald). Change must occur, now, to prevent long-term health and social consequences of obesity (Golan, Weizman, Apter, & Fainaru, 1998; Must & Strauss, 1999). Findings of longitudinal studies indicate that childhood obesity is predictive of obesity in adulthood (Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001; Magarey, Daniels, Boulton, & Cockington, 2003).

In the present study, a positive relationship was found between parental overweight and obesity and childhood overweight and obesity. This finding is consistent with results of previous studies of childhood overweight and obesity (Arluk et al., 2003; Burke et al., 2001; Carriere, 2003; Cutting et al., 1999; Danielzik et al., 2002; Fogelholm et al., 1999; Maffeis et al., 1998; O'Loughlin et al., 1998; Park et al., 2004; Sekine et al., 2002; Treuth et al., 2003 Vogels et al., 2006). Carriere suggested that "parental overweight or obesity may be an early indicator of children at risk" (p. 37). Therefore, prevention of childhood overweight and obesity should be targeted at families. Health promotion programs directed at the entire family may be the key to preventing future complications related to overweight and obesity. Golan et al. (1998) suggested a family-based approach that focuses on diet and physical activity. Community health programs that encourage family participation could be provided through schools and health centers.

School based health promotion programs that target overweight and obesity may also help to address this concern. School plays a major role in the lives of children and can provide opportunities to educate children about the importance of a healthy lifestyle, which could be encouraged through physical activities during and after school. In the present study, compared to participants who spent a lot of time

involved in leisure activities during school days, participants who spent little time involved in leisure activity during school days were more likely to be involved in physical activity. This finding suggests that if children are provided with opportunities for physical activity they may be less likely to be involved in leisure activities, such as television watching or computer games.

In order to address the rising prevalence of childhood obesity, communities should work together to provide fun opportunities for children to be active and develop a healthy lifestyle. Health promotion and education programs should involve collaboration of health professionals, schools, individuals, and families in order to provide holistic programs tailored to the needs of individuals and their families.

Recommendations for Future Research

The present study provides a cross-sectional view of the prevalence of overweight and obesity among children, in grades 4-6, living in rural communities in Saskatchewan. This study was conducted to explore the relationship between physical activity and BMI, using measured height and weight data, in a sample of rural-dwelling children living in Saskatchewan. Prior to this study, in June of 2005, a review of all the published literature indexed in CINAHL (1982-2005), MEDLINE® (1966-2005), and SPORT Discus (1800-2005) revealed no published studies of the relationship between physical activity and BMI in rural-dwelling children in Saskatchewan or Canada. On completion of the present study, an updated literature search revealed one published similar study of school aged children living in rural communities in Saskatchewan. This published study used measured height and weight to compare the BMI's of rural and urban children aged 8 to 13 years living in

Saskatchewan with Old Order Mennonite children of the same age living in Ontario, Canada (Tremblay et al., 2005). The results of the study by Tremblay et al. (2005) and the present study are consistent and provide baseline information for future studies. In future research, a larger random sample should be used, including children from all age groups, to ensure that the sample is representative of the population of children living in rural areas in Saskatchewan. This would result in information that could be generalized to all rural-dwelling children in the province.

Although in previous studies researchers have identified a significant inverse relationship between physical activity and BMI, this finding was not observed in the present study. A limitation of the present study is the use of a self-report questionnaire to assess the physical activity of children. The use of other methods, such as accelerometers, to measure physical activity, may provide a more accurate view of the physical activity levels of rural children.

In the present study the mean maturational age of the participants was reported and compared to recently published research data. In future research on the relationship between physical activity and BMI, adjustment could be made for the maturational age of the participants in order to facilitate comparison with findings of other studies.

In the present study a significant relationship was found between parental overweight and obesity and childhood overweight and obesity. Further study is needed to identify risk factors for parental overweight and obesity in rural populations. In particular, lifestyle habits, including diet, physical activity, and sedentary activity of both the parents and children should be explored. Findings of this

research would be beneficial in developing health promotion programs in rural communities to promote the overall health of families.

Further studies that compare physical activity and BMI of rural and urban children are needed. This research would help to identify health needs specific to rural and urban children and to assist in the development of health promotion programs tailored to those needs.

Finally, considering the long-term health consequences of childhood overweight and obesity, a longitudinal study of rural-dwelling children in Saskatchewan is needed in order to identify future health risks of overweight and obesity in rural Saskatchewan children.

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Appendix A

UNIVERSITY OF SASKATCHEWAN
Behavioural Research Ethics Board (Beh-REB)

NAME: Karen Semchuk, Nursing **Beh 05-201**
Jeniffer Dupuis

DATE: 09-Sep-2005

The Behavioural Research Ethics Board (Beh-REB) has reviewed the Application for Ethics Approval for your study "An Exploratory Study of Physical Activity and Body Mass Index in a Sample of Rural Saskatchewan Children" (Beh 05-201).

1. Your study has been APPROVED.
2. Any significant changes to your proposed method, or your consent and recruitment procedures should be reported to the Chair for Committee consideration in advance of its implementation.
3. The term of this approval is for 5 years.
4. This approval is valid for one year. A status report form must be submitted annually to the Chair of the Committee in order to extend approval. This certificate will automatically be invalidated if a status report form is not received within one month of the anniversary date. Please refer to the website for further instructions http://www.usask.ca/research/behavrsc.shtml

I wish you a successful and informative study.

Dr. Valerie Thompson, Chair
Behavioural Research Ethics Board (Beh-REB)

Office of Research Services, University of Saskatchewan
Room 1607, 110 Gymnasium Place, Box 5000 RPO University, Saskatoon SK S7N 4J8 CANADA
Telephone: (306) 966-8576 Facsimile: (306) 966-8597
http://www.usask.ca/research

Appendix B

Information Letter

Dear Student and Parent or Guardian,

You are invited to participate in a study entitled – An Exploratory Study of Physical Activity and Body Mass Index in a Sample of Rural Saskatchewan Children.

My name is Jeniffer Dupuis. I am a Registered Nurse completing my Master of Nursing Degree at the College of Nursing, University of Saskatchewan. I am interested in the health of children living in rural Saskatchewan. Childhood overweight and obesity is a health problem affecting many children in Canada. Very little is known about the physical activity levels of children living in Saskatchewan and the relationship with standard indicators of overweight and obesity such as body mass index based on a child's weight and height. The purpose of this study is to gather information about physical activity levels and weight and height patterns of a sample of children living in rural Saskatchewan. The overall results of this study will be provided to your school to help in planning and developing physical activity programs that will lead to better health for Saskatchewan children. A copy of the results will be sent home with each student in the participating classrooms. The results of this study will be used for my master's thesis. I will also use the information from this study to publish articles in journals and for presentations at conferences.

Participation in this study is not part of the student's regular classroom work; it is an optional activity in which the student can choose to participate. This study involves two parts of information collection. The first part is completion of a questionnaire. The questionnaire asks questions about physical activities in which the student is involved and for some additional information about the student and parents or guardian. The questionnaire is to be completed by the student and a parent or guardian. It will take approximately 20 to 30 minutes of your time to complete the questionnaire. The questionnaire is enclosed in this package. The second part of the study involves the student having his or her height, weight, and sitting height measured by me, the researcher. This part of the study will take place at your school. Each student will have his or her height, weight, and sitting height measured individually. The weight and height measurements will take approximately 5 minutes. A random number of students will have these measurements repeated once to ensure accuracy. The measurements will not be shared with your classmates or teacher. All information collected in this study will be kept confidential.

This study was reviewed and approved by the University of Saskatchewan Behavioural Research Ethics Board on September 9, 2005. This study was also approved by the school division on September 16, 2005. There are no foreseen risks of participating in this study. All of the information collected in this study will be kept in a locked cupboard at the University of Saskatchewan by the research supervisor, Dr. Karen M. Semchuk, for a minimum of 5 years.

Your participation in this study is very important, but it is entirely your choice. If the student, parents, or guardian choose to refuse to participate in any part of the study or withdraw from the study at any time, for any reason, this will not cause anyone to be upset or angry, and this will not result in any type of penalty.

If you have any questions regarding this study, please feel free to call me at (306) 242-2065 or the research supervisor Dr. Karen M. Semchuk at (306) 966-8279. If you have any questions regarding your rights or your child's rights as participants in this study you can call the University of Saskatchewan Research Ethics Office collect at (306) 966-2084.

Thank you, in advance, for considering participation in this study. Should you and your child choose to participate, please read and sign the attached consent form. Keep one consent form for your records and return the other copy with your completed questionnaire. To ensure confidentiality, the consent form will be detached from your questionnaire and will be locked up apart from the questionnaire before the information in the questionnaire is examined. Students who have returned a completed and signed consent form will have their height and weight measured at their school. Please return the questionnaire (whether completed or not) sealed in the envelope provided to your child's teacher within one week. All students who have returned their questionnaires, whether completed or not, will be invited to enter a draw for an Activity Kit. One Activity Kit will be drawn for each participating school.

Sincerely,

Jeniffer Dupuis, R.N., B.S.N.

Graduate Student
College of Nursing
University of Saskatchewan

Karen M. Semchuk, Ph.D.

Professor
College of Nursing
University of Saskatchewan

Appendix C

Consent Form

RETURN WITH QUESTIONNAIRE

An Exploratory Study of Physical Activity and Body Mass Index in a Sample of Rural Saskatchewan Children

I, _____, father/mother/guardian of _____ agree to permit my child to provide the information requested in the questionnaire and to have his/her height, weight, and sitting height measured, by the researcher at my child's school. I understand that the results of this study of "An Exploratory Study of Physical Activity and Body Mass Index in a Sample of Rural Saskatchewan Children" will be used in the researcher's thesis and for publication in journals and presentation at conferences. I am aware that if I have any questions or concerns about the study I can contact the researcher at (306) 242-2065 or the research supervisor Dr. Karen M. Semchuk at (306) 966-8279. Any questions or concerns regarding my rights or my child's rights as a participant in this study can be addressed to the Office of Research Services at (306) 966-2084. I understand that there will be no discomfort or foreseeable risks to participating in this study. I understand that all information my child and I provide will remain strictly confidential. I have read and understand the information provided above and in the information letter. I have been provided with the opportunity to ask questions and my questions have been answered satisfactorily. I consent to have my child participate in the study described above, understanding that we may refuse to participate in any part of the study and can withdraw from the study at any time. I have kept one copy of this consent form for my records and will return the second copy with the completed questionnaire. The returned consent form will be detached from the questionnaire and will be kept locked up apart from the questionnaire before the information in the questionnaire is examined.

Child's Age: _____
Grade: _____
Teacher: _____
School: _____

Name of Child: _____
Name of Parent/Guardian: _____
Relationship to Child: _____

_____ _____
(Signature of Child) (Signature of Parent/Guardian)

_____
(Date)

Appendix D

Questionnaire

An Exploratory Study of Physical Activity and Body Mass Index in a Sample of Rural Saskatchewan Children

THE FOLLOWING SECTIONS ARE FOR YOU TO COMPLETE WITH THE HELP OF A PARENT OR GUARDIAN.

Section 1

Who is helping you complete the questionnaire? (Please check all that apply)

☐ Mother

☐ Father

☐ Guardian

INFORMATION ABOUT YOU:

Date of Birth: _____
Grade: _____

I am a ☐ Boy ☐ Girl (Please check one)

Where do you live most of the year? (Please check one)

☐ In town ☐ On a farm ☐ Other specify:

_____

Do you consider yourself to be of Aboriginal descent? (Please check one)

☐ Yes ☐ No

INFORMATION FROM YOUR PARENTS OR GUARDIAN:

How safe do you consider your neighborhood to be?

☐ Not at all safe

☐ Somewhat safe

☐ Moderately safe

☐ Quite safe

☐ Safe

What is your mother's (or guardian's) education level? (Please check one)

☐ Less than Grade 12

☐ High school diploma or equivalent (GED)

☐ Some post secondary education

☐ Completed technical training program

☐ Completed university degree

What is your father's (or guardian's) education level? (Please check one)

☐ Less than Grade 12

☐ High school diploma or equivalent (GED)

☐ Some post secondary education

☐ Completed technical training program

☐ Completed university degree

What is your mother's weight? _____

What is your mother's height?_____

What is your father's weight? _____

What is your father's height?_____

Section 2

In this section we would like to collect information about the average amount of time you spent in the last 7 days involved in leisure activities such as television watching, video game playing, computer games, internet use, and talking on the phone with friends.

On average how many hours a day do you spend involved in leisure activity?

On weekdays:
(please check one)

- ☐ None
- ☐ Less than 1 hour
- ☐ 1-2 hours
- ☐ 2-3 hours
- ☐ 3-4 hours
- ☐ More than 4 hours

On weekends:
(please check one)

- ☐ None
- ☐ Less than 1 hour
- ☐ 1-2 hours
- ☐ 2-3 hours
- ☐ 3-4 hours
- ☐ More than 4 hours

Section 3

Physical Activity Questionnaire (Elementary School)

In this section we would like to collect information about your level of physical activity in the last 7 days.

Remember:

1. There are no right and wrong answers — this is not a test.
2. Please answer all the questions as honestly and accurately as you can — this is very important.

---

1. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, how many times? (Mark only one circle per row.)

	No	1-2	3-4	5-6	7 times or more
Skipping	❍	❍	❍	❍	❍
Rowing/canoeing	❍	❍	❍	❍	❍
In-line skating	❍	❍	❍	❍	❍
Tag	❍	❍	❍	❍	❍
Walking for exercise	❍	❍	❍	❍	❍
Bicycling	❍	❍	❍	❍	❍
Jogging or running	❍	❍	❍	❍	❍
Aerobics	❍	❍	❍	❍	❍
Swimming	❍	❍	❍	❍	❍
Baseball, softball	❍	❍	❍	❍	❍
Dance	❍	❍	❍	❍	❍
Football	❍	❍	❍	❍	❍
Badminton	❍	❍	❍	❍	❍
Skateboarding	❍	❍	❍	❍	❍
Soccer	❍	❍	❍	❍	❍
Street hockey	❍	❍	❍	❍	❍
Volleyball	❍	❍	❍	❍	❍
Floor hockey	❍	❍	❍	❍	❍
Basketball	❍	❍	❍	❍	❍
Ice skating	❍	❍	❍	❍	❍
Cross-country skiing	❍	❍	❍	❍	❍
Ice hockey/ringette	❍	❍	❍	❍	❍
Other:					
_____....	❍	❍	❍	❍	❍
_____....	❍	❍	❍	❍	❍

2. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? (Check one only.)

I don't do PE ..... ❍
Hardly ever ..... ❍
Sometimes ..... ❍
Quite often ..... ❍
Always ..... ❍

3. In the last 7 days, what did you do most of the time *at recess*? (Check one only.)

Sat down (talking, reading, doing schoolwork)… ❍
Stood around or walked around ..... ❍
Ran or played a little bit ..... ❍
Ran around and played quite a bit ..... ❍
Ran and played hard most of the time ..... ❍

4. In the last 7 days, what did you normally do *at lunch* (besides eating lunch)? (Check one only.)

Sat down (talking, reading, doing schoolwork).… ❍
Stood around or walked around ..... ❍
Ran or played a little bit ..... ❍
Ran around and played quite a bit ..... ❍
Ran and played hard most of the time ..... ❍

5. In the last 7 days, on how many days *right after school*, did you do sports, dance, or play games in which you were very active? (Check one only.)

None .....… ❍
1 time last week ..... ❍
2 or 3 times last week ..... ❍
4 times last week ..... ❍
5 times last week ..... ❍

6. In the last 7 days, on how many *evenings* did you do sports, dance, or play games in which you were very active? (Check one only.)

None ..... ❍
1 time last week ..... ❍
2 or 3 times last week ..... ❍
4 or 5 times last week ..... ❍
6 or 7 times last week ..... ❍

7. *On the last weekend*, how many times did you do sports, dance, or play games in which you were very active? (Check one only.)

None ..... ❍
1 time ..... ❍
2 — 3 times ..... ❍
4 — 5 times ..... ❍
6 or more times ..... ❍

8. Which *one* of the following describes you best for the last 7 days? Read *all five* statements before deciding on the *one* answer that describes you.

A. All or most of my free time was spent doing things that involve little physical effort ..... ❍

B. I sometimes (1 — 2 times last week) did physical things in my free time (e.g. played sports, went running, swimming, bike riding, did aerobics) ..... ❍

C. I often (3 — 4 times last week) did physical things in my free time ..... ❍

D. I quite often (5 — 6 times last week) did physical things in my free time … ❍

E. I very often (7 or more times last week) did physical things in my free time .❍

9. Mark how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week.

	None	Little bit	Medium	Often	Very often
Monday	❍	❍	❍	❍	❍
Tuesday	❍	❍	❍	❍	❍
Wednesday	❍	❍	❍	❍	❍
Thursday	❍	❍	❍	❍	❍
Friday	❍	❍	❍	❍	❍
Saturday	❍	❍	❍	❍	❍
Sunday	❍	❍	❍	❍	❍

10. Were you sick last week, or did anything prevent you from doing your normal physical activities? (Check one.)

Yes ..... ❍
No ..... ❍
If Yes, what prevented you? _____

11. What additional activities or chores have you participated in at home in the last 7 days? (Please use back of page if you need additional space.)

Appendix E

Scoring the PAQ-C

The PAQ-C activity summary for elementary school students consists of 9 items ranging from 1 to 5 (with sub-items on items 1 and 9 also ranging from 1 to 5; item 10 ("Were you sick last week, or did anything prevent you from doing your normal activity") is NOT used in the calculation of the activity summary.

Item 1 Take the mean of all activities (1 being "no" activity, 5 being "7 times or more") on the activity checklist to form a composite for item 1.

Item 2 to 8 Simply use the reported values that are checked off (1 being low activity and 5 being high activity).

Item 9 Take the mean of all days of the week (1 being "none", 5 being "very often") to form a composite for item 10.

Item 10 Can be used to identify students who had unusual activity during the previous week, but is NOT used as part of the summary activity score.

Once you have a value from 1 to 5 for each of the 9 items (items 1 to 9) used in the physical activity composite score, you simply take the mean of these 9 items which results in the final PAQ-C activity summary score.

Crocker, P.R.E., Bailey, D.A., Faulkner, R.A., Kowalski, K.C., & McGrath, R. (1997). Measuring general levels of physical activity: Preliminary evidence for the Physical Activity Questionnaire for Older Children. *Medicine and Science in Sports and Exercise*, *29*, 1344-1349.

Kowalski, K.C., Crocker, P.R.E., & Faulkner, R.A. (1997). Validation of the physical activity questionnaire for older children [Electronic version]. *Pediatric Exercise Science, 9*, 174-186.

Appendix F

Letter to Principals

September 16, 2005

Dear Principal,

Your school is invited to participate in a research project entitled – An Exploratory Study of Physical Activity and Body Mass Index in a Sample of Rural Saskatchewan Children. Please read the following information and feel free to ask questions you might have.

My name is Jeniffer Dupuis. I am a Registered Nurse completing my Master of Nursing Degree at the College of Nursing, University of Saskatchewan. My background is in pediatric nursing and I am very interested in the health of children living in rural Saskatchewan.

Childhood overweight and obesity is a major health concern affecting many children in Canada. An increased sedentary lifestyle of watching television and playing video games and a decrease in physical activity levels have been related to the rise in childhood overweight and obesity. The rise in overweight and obesity has resulted in an increased prevalence of chronic illnesses in childhood, which were once only evident in the adult population. These illnesses include type II diabetes mellitus, high blood pressure, high cholesterol, and heart disease. Very little is known about the physical activity levels of children living in rural Saskatchewan and relationship with standard indicators of overweight and obesity such as body mass index [i.e., child's weight(kg)/height(m^2)]. The results of this research study will be used for my master's thesis. I will also use the information from this study to publish articles in journals and for presentations at professional conferences.

The purpose of this study is to: (1) explore the relationship between physical activity and body mass index in a sample of rural Saskatchewan children; (2) examine the prevalence of childhood overweight and obesity in the sample; and (3) explore the importance of age, gender, and residency (farm versus town) in relation to childhood overweight and obesity in the sample. The overall results of this study will be provided to your school to help in planning and developing physical activity and health promotion programs that will lead to better health for Saskatchewan children. In addition, a copy of the results will be sent home with each student in the participating classrooms.

If you are interested in your school being involved in the study I would invite grade 4-6 students within the school to participate. The data collection for the study will involve two parts. First, the students will be invited to complete a self-report questionnaire, which will ask for some demographic information, a seven day history of physical activity, including physical activity that occurs during physical education class, recess, lunch, after school, evenings, and weekends, and a seven day history of

sedentary activity. The questionnaire will be taken home and completed by the student with the help of a parent or guardian.

For the second part of the study, each student who has returned a signed consent form and a completed questionnaire will be invited to have his or her height, weight, and sitting height measured. I will come to the school to measure each participating student's height, weight, and sitting height. This part of the research study will take place at school during a time that is convenient for the teachers and students involved in the study. A random sample of children will have these measurements repeated once to ensure accuracy.

All information collected during this research, including the names of towns and schools, will be kept confidential. Participation in this research will take approximately 20 to 30 minutes of the student's and parent's or guardian's time to complete the questionnaire. Weight and height measurements at school will take approximately 5 minutes for each student. There are no foreseen risks for the participants in this study. Participation in this study is very important; however, students are free to withdraw from the study at any time, for any reason, if they so choose. All students who have returned their questionnaires, whether completed or not, will be invited to enter a draw for an Activity Kit. One Activity Kit will be drawn for each participating school.

This study was reviewed and approved by the University of Saskatchewan Behavioural Research Ethics Board on September 9, 2005. This study was also approved by the school division on September 16, 2005. All of the data collected in this study will be kept in a locked cupboard at the University of Saskatchewan by the research supervisor Dr. Karen M. Semchuk for a minimum of 5 years.

Thank you, in advance, for your consideration of this study. Data gathered from the study will provide valuable information regarding the health status of children in your school. This information can be used by the school and community to develop health promotion programs for children and their families. If you have any questions regarding the proposed study, please call me at (306) 242-2065 or my master's thesis research supervisor Dr. Karen M. Semchuk at (306) 966-8279. Questions regarding this study can be addressed to the University of Saskatchewan Research Ethics Office at (306) 966-2084.

Sincerely,

Jeniffer Dupuis, R.N., B.S.N.

Graduate Student
College of Nursing
University of Saskatchewan

Karen M. Semchuk, Ph.D.

Professor
College of Nursing
University of Saskatchewan

Appendix G

Reminder Note

Dear Student and Parent or Guardian,

This note is just a reminder of the questionnaire that was sent home regarding a study entitled – An Exploratory Study of Physical Activity and Body Mass Index in a Sample of Rural Saskatchewan Children. If you are interested in participating in the study and you have not already completed the questionnaire and signed the consent form, please do so right away. Please return the questionnaire and signed consent form, sealed in the envelope provided, to your child's teacher by _____. If you have not received a questionnaire and you are interested in participating in the study please contact your school and they will be able to provide you with a package including an information letter regarding the study, a consent form, and a questionnaire**.** If you do not wish to participate in this study please return the uncompleted questionnaire and consent form sealed in the envelope provided. Regardless of whether you participate in the study or not, all students in your classroom are eligible for the draw for the activity kit. Thank you for considering participation in this study.

Sincerely,

Jeniffer Dupuis, R.N., B.S.N.

Graduate Student
College of Nursing
University of Saskatchewan

Karen M. Semchuk, Ph.D.

Professor
College of Nursing
University of Saskatchewan

Appendix H

Formula for Calculating Age at PHV

Males

Maturity Offset = -9.236 + [0.0002708 x (Leg Length x Sitting Height)] + [-0.001663 x (Age x Leg Length)] + [0.007216 x (Age x Sitting Height)] + [0.02292 x (Weight by Height Ratio)]

Females

Maturity Offset = -9.376 + [0.0001882 x (Leg Length x Sitting Height)] + [0.0022 x (Age x Leg Length)] + [0.005841 x (Age x Sitting Height)] + [- 0.002658 x (age x weight)] + [0.07693 x (Weight by Height Ratio)]

Mirwald, R.L., Baxter-Jones, A.D.G., Bailey, D.A., & Beunen, G.P. (2002). An assessment of maturity from anthropometric measurements [Electronic version]. *Medicine and Science in Sports and Exercise, 34*(4), 689-694.

Appendix I

Response Rates for Questionnaire Survey by School and Gender

School/ Gender	Questionnaires Provided	Questionnaires Returned[a]		Questionnaires Not Returned		Questionnaires Completed	
		No.	%	No.	%	No.	%
School A							
Boys	18					9	50.0
Girls	17					14	82.3
All	35	32	91.4	3	8.6	23	65.7
School B							
Boys	0						
Girls	3					1	33.3
All	3	1	33.3	2	66.7	1	33.3
School C							
Boys	12					5	41.7
Girls	6					4	66.7
All	18	15	83.3	3	16.7	9	50.0
School D							
Boys	5					3	60.0
Girls	9					5	55.5
All	14	11	78.6	3	21.4	8	57.1
School E							
Boys	30					13	43.3
Girls	31					21	67.7
All	61	42	68.9	19	31.1	34	55.7
School F							
Boys	21					9	42.9
Girls	27					16	59.3
All	48	36	75.0	12	25.0	25	52.1
School G							
Boys	26					12	46.1
Girls	21					15	71.4
All	47	40	85.1	7	14.9	27	57.4

School/ Gender	Questionnaires Provided	Questionnaires Returned[a]		Questionnaires Not Returned		Questionnaires Completed	
		No.	%	No.	%	No.	%
School H							
Boys	8					6	75.0
Girls	6					2	33.3
All	14	11	78.6	3	21.4	8	57.1
School I							
Boys	52					13	25.0
Girls	48					22	45.8
All	100	40	40.0	60	60.0	35	35.0
School J							
Boys	27					13	48.1
Girls	21					16	76.2
All	48	40	83.3	8	16.7	29	60.4
School K							
Boys	17					6	35.3
Girls	20					11	55.0
All	37	20	54.1	17	45.9	17	45.9
School L							
Boys	13					10	76.9
Girls	22					13	59.1
All	35	29	82.9	6	17.1	23	65.7
School M							
Boys	34					12	35.3
Girls	31					11	35.5
All	65	29	44.6	36	55.4	23	35.4
Total							
Boys	263					111	42.2
Girls	262					151	57.6
All	525	29	44.6	36	55.4	262	49.9
Total	525	346[a]	65.9	179	34.1	262	49.9

[a]Includes completed and not completed questionnaires. The number of questionnaires returned by gender is not known because gender was not indicated on some of the returned questionnaires.

Appendix J

Response Rates for Questionnaire Survey by School and Grade

School/ Grade	Questionnaires Provided	Questionnaires Returned[a]		Questionnaires Not Returned		Questionnaires Completed	
		No.	%	No.	%	No.	%
School A							
Grade 4	12					8	66.7
Grade 5	12					8	66.7
Grade 6	11					7	63.6
All	35	32	91.4	3	8.6	23	65.7
School B							
Grade 4	0						
Grade 5	2					1	50.0
Grade 6	1						
All	3	1	33.3	2	66.7	1	
School C							
Grade 4	4					3	75.0
Grade 5	6					5	83.3
Grade 6	8					1	12.5
All	18	15	83.3	3	16.7	9	50.0
School D							
Grade 4	0						
Grade 5	10					4	40.0
Grade 6	4					4	100.0
All	14	11	78.6	3	21.4	8	57.1
School E							
Grade 4	19					11	57.9
Grade 5	20					13	65.0
Grade 6	22					10	45.4
All	61	42	68.9	19	31.1	34	55.7
School F							
Grade 4	16					8	50.0
Grade 5	20					11	55.0
Grade 6	12					6	50.0
All	48	36	75.0	12	25.0	25	52.1

School/ Grade	Questionnaires Provided	Questionnaires Returned[a]		Questionnaires Not Returned		Questionnaires Completed	
		No.	%	No.	%	No.	%
School G							
Grade 4	14					10	71.4
Grade 5	11					5	45.4
Grade 6	22					12	54.5
All	47	40	85.1	7	14.9	27	57.4
School H							
Grade 4	4					1	25.0
Grade 5	5					3	60.0
Grade 6	5					4	60.0
All	14	11	78.6	3	21.4	8	57.1
School I							
Grade 4	27					10	37.0
Grade 5	35					13	37.1
Grade 6	38					12	31.6
All	100	40	40.0	60	60.0	35	35.0
School J							
Grade 4	15					9	60.0
Grade 5	18					11	61.1
Grade 6	15					9	60.0
All	48	40	83.3	8	16.7	29	60.4
School K							
Grade 4	12					3	25.0
Grade 5	10					5	50.0
Grade 6	15					9	60.0
All	37	20	54.1	17	45.9	17	45.9
School L							
Grade 4	0						
Grade 5	20					14	70.0
Grade 6	15					9	60.0
All	35	29	82.9	6	17.1	23	65.7

School/ Grade	Questionnaires Provided	Questionnaires Returned[a]		Questionnaires Not Returned		Questionnaires Completed	
		No.	%	No.	%	No.	%
School M							
Grade 4	22					8	36.4
Grade 5	17					5	29.4
Grade 6	26					10	38.5
All	65	29	44.6	36	55.4	23	35.4
Total							
Grade 4	145					71	49.0
Grade 5	186					98	52.7
Grade 6	194					93	47.9
All	525	346	65.9	179	34.1	262	49.9
Total	525	346[a]	65.9	179	34.1	262	49.9

[a]The number of questionnaires returned by grade is not known because gender was not indicated on some of the returned questionnaires.

Appendix K

Participation Rate for Anthropometric Measurements by School and Gender

School/ Gender	Eligible Students	Students Measured	
		No.	%
School A			
Boys	18	9	50.0
Girls	17	14	82.4
All	35	23	65.7
School B			
Boys	0		
Girls	3	1	33.3
All	3	1	33.3
School C			
Boys	12	5	41.7
Girls	6	4	66.7
All	18	9	50.0
School D			
Boys	5	3	60.0
Girls	9	4	44.4
All	14	7	50.0
School E			
Boys	30	13	43.3
Girls	31	18	58.1
All	61	31	50.8
School F			
Boys	21	8	38.1
Girls	27	15	55.5
All	48	23	47.9
School G			
Boys	26	11	42.3
Girls	21	14	66.6
All	47	25	53.2

School/ Gender	Eligible Students	Students Measured	
		No.	%
School H			
Boys	8	6	75.0
Girls	6	2	33.3
All	14	8	57.1
School I			
Boys	52	13	25.0
Girls	48	22	45.8
All	100	35	35.0
School J			
Boys	27	13	48.1
Girls	21	16	76.2
All	48	29	60.4
School K			
Boys	17	6	35.3
Girls	20	10	50.0
All	37	16	43.2
School L			
Boys	13	8	61.5
Girls	22	13	59.1
All	35	21	60.0
School M			
Boys	34	12	35.3
Girls	31	11	35.5
All	65	23	35.4
Total			
Boys	263	107	40.7
Girls	262	144	55.0
All	525	251	47.8
Total	525	251	47.8

Appendix L

Participation Rate for Anthropometric Measurements by School and Grade

School/ Grade	Eligible Students	Students Measured	
		No.	%
School A			
Grade 4	12	8	66.7
Grade 5	12	8	66.7
Grade 6	11	7	63.6
All	35	23	65.7
School B			
Grade 4	0		
Grade 5	2	1	50.0
Grade 6	1		
All	3	1	33.3
School C			
Grade 4	4	3	75.0
Grade 5	6	5	83.3
Grade 6	8	1	12.5
All	18	9	50.0
School D			
Grade 4	0		
Grade 5	10	4	40.0
Grade 6	4	3	75.0
All	14	7	50.0
School E			
Grade 4	19	10	52.6
Grade 5	20	11	55.0
Grade 6	22	10	45.4
All	61	31	50.8
School F			
Grade 4	16	7	43.8
Grade 5	20	10	50.0
Grade 6	12	6	50.0
All	48	23	47.9

School/ Grade	Eligible Students	Students Measured	
		No.	%
School G			
Grade 4	14	9	64.3
Grade 5	11	4	36.4
Grade 6	22	12	54.5
All	47	25	53.2
School H			
Grade 4	4	1	25.0
Grade 5	5	3	60.0
Grade 6	5	4	60.0
All	14	8	57.1
School I			
Grade 4	27	10	37.0
Grade 5	35	13	37.1
Grade 6	38	12	31.6
All	100	35	35.0
School J			
Grade 4	15	9	60.0
Grade 5	18	11	61.1
Grade 6	15	9	60.0
All	48	29	60.4
School K			
Grade 4	12	3	25.0
Grade 5	10	5	50.0
Grade 6	15	8	53.3
All	37	16	43.2
School L			
Grade 4	0		
Grade 5	20	12	60.0
Grade 6	15	9	60.0
All	35	21	60.0
School M			
Grade 4	22	8	36.4
Grade 5	17	5	29.4
Grade 6	26	10	38.5
All	65	23	35.4

School/ Grade	Eligible Students	Students Measured	
		No.	%
Total			
Grade 4	145	68	46.9
Grade 5	186	92	49.5
Grade 6	194	91	46.9
All	525	251	47.8
Total	525	251	47.8

Appendix M

Hand Calculations for Interaction Assessment

Interaction Term: MomBMI x Gender

β_1 MomBMI

β_2 Gender

β_3 MomBMI x Gender

$\beta_{\underline{z}}$ other variables

$$\ell(h, e, \underline{z}) = \beta_0 + \beta_1 h_1 + \beta_2 e_1 + \beta_3 h_1 e_1 + \beta_{\underline{z}}$$

Gender (h) \ MomBMI (e)	e_0	e_1	
h_0	β_0	$\beta_{01} + \beta_3 e_1$	$\hat{d}_1 = \beta_0$
h_1	$\beta_0 + \beta_1 h_1$	$\beta_{01} + \beta_1 h_1 + \beta_2 e_1 + \beta_3 h_1 e_1$	$\hat{d}_2 = \beta_2 + \beta_3$
	$\hat{d}_3 = \beta_1$	$\hat{d}_4 = \beta_1 + \beta_3$	

$\hat{d}_1 = \beta_0$

$= 1.414$

$\text{Exp}(\beta) = \text{OR} = 4.11$

$v(\hat{d}_1) = v(\beta_0)$

$= (.583)^2 = 0.340$

95% CI $= \exp[1.414 \pm 1.96(.583)]$

$= e^{0.271}, e^{2.557}$

$= 1.31 - 12.90$

$\hat{d}_2 = \beta_2 + \beta_3$

$= 1.414 + (-1.803)$

$= -.389$

$\text{Exp}(\beta) = \text{OR} = 0.68$

$$\text{corr } B_2, B_3 = \frac{\text{cov } B_2, B_3}{SE\,B_2 \times SE\,B_3}$$

$$\text{cov } B_2, B_3 = \text{corr } B_2, B_3 \,(SE\,B_2 \times SE\,B_3)$$

$$\text{cov } B_2, B_3 = -.773\,(.583 \times .740)$$

$$\text{cov } B_2, B_3 = -.333$$

$$V(\hat{d}_2) = V(B_2) + V(B_3) + 2\,\text{cov}(B_2, B_3)$$

$$= (.583)^2 + (.740)^2 + 2(-.333)$$

$$= .340 + .548 + (-.666)$$

$$= .222$$

$$SE = \sqrt{.222} = .471$$

$$95\%\ CI = \exp[-.389 \pm 1.96(.471)]$$

$$= e^{-1.312},\ e^{0.534}$$

$$= 0.27 - 1.71$$

$$\hat{d}_3 = B_1 = 1.630$$

$$\text{Exp}(B) = OR = 5.10$$

$$V(\hat{d}_3) = V(B_1) = (.606)^2 = .367$$

$$95\%\ CI = \exp[1.630 \pm 1.96(.606)]$$

$$= e^{0.442},\ e^{2.818}$$

$$= 1.56 - 16.74$$

$$\hat{d}_4 = B_1 + B_3$$

$$= 1.630 + (-1.803)$$

$$= -.173$$

$$\text{Exp}(B) = OR = 0.84$$

$$\text{corr } B_1, B_3 = \frac{\text{cov } B_1, B_3}{SE\,B_1 \times SE\,B_3}$$

$$\text{cov } B_1, B_3 = \text{corr } B_1, B_3 \,(SE\,B_1 \times SE\,B_3)$$

$$\text{cov } B_1, B_3 = -.789\,(.606 \times .740)$$

$$\text{cov } B_1, B_3 = -.354$$

$$V(\hat{d}_4) = V(B_1) + V(B_3) + 2\,\text{cov}(B_1, B_3)$$

$$= (.606)^2 + (.740)^2 + 2(-.354)$$

$$= .367 + .548 + (-.708)$$

$$= .207$$

$$SE = \sqrt{.207} = .455$$

$$95\%\ CI = \exp[-.173 \pm 1.96(.455)]$$

$$= e^{-1.065}, e^{0.719}$$

$$= 0.34 - 2.05$$