THE CHARACTERISTICS OF OBESITY AND BEING OVERWEIGHT IN CHILDREN LIVING IN TWO SASKATCHEWAN COMMUNITIES

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By

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Abstract

There is limited study of the prevalence of childhood obesity and being overweight in 6 to 9 year old children living in Saskatchewan and Canada using the international standards and measured data. Limited data exists of the prevalence of obesity in rural and small urban communities.

In 2000, a cross-sectional survey of children was conducted that primarily assessed the respiratory health of children in two southern Saskatchewan communities. Anthropometric measurements (height and weight) as well as child and familial data were available for 1241 children ages 6 to 9 years. Using data from this study and applying international standards for obesity and overweight developed by Cole and colleagues (2000) an analysis was undertaken to describe and compare the prevalence of overweight and obesity between communities and identify associated risk factors.

Although the mean body mass index (BMI) differed statistically between communities, no differences in overweight and obesity were identified once the international standards were applied. The overall prevalence was 19.2% for being overweight and 5.2% for obesity. More girls than boys were overweight and obese at age 9. After adjusting for age, sex and community, maternal smoking during pregnancy and current gastrointestinal symptoms of nausea and/or diarrhea were associated with overweight and obesity. Lower physical activity in free time was associated with being overweight as a child. Children who were not consistently participating in physical education and sports in school were more likely to be overweight and obese.

This research provides important new information regarding the prevalence and associated risk factors for overweight and obesity in school aged children in Saskatchewan. Although results concur with international prevalence rates of childhood obesity, children in this study were not as overweight or obese as previously reported data has shown for similar Canadian populations. Less physical activity, both in school and at home, may be important for the development and continuation of childhood obesity. Further research is necessary to explore reasons why obese and overweight children are experiencing significant digestive related health concerns.

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Dedication

I would like to dedicate this thesis to my husband and children. Throughout this experience they have provided me with constant support and motivation.

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List of Abbreviations

The following is a list of commonly used abbreviations:

BMI	Body Mass Index
OR	Odds Ratio
CI	Confidence Interval
df	degrees of freedom
χ^2	Chi Square
sd	Standard deviation
x	Mean

Chapter 1: Introduction

1.1 Background

The data for this thesis is derived from the research study entitled "A study of asthma prevalence in school age children in Estevan and Swift Current" conducted by Dr. D. Rennie and associates at the University of Saskatchewan. Estevan citizens had expressed concern about asthma in their community and a study was undertaken to explore this concern. Swift Current was used as the control community. Funding was sought from and granted by the Saskatchewan Lung Association in 1999. Ethical approval for the study was received in late 1999 and the study was conducted between January and April 2000. All students attending Grades 1 to 6 in the elementary schools in both communities were eligible for the study. Anthropometric measurements and spirometry were collected from students in Grades 1 to 4 with valid consents from both the subject and a parent.

1.2 Statement of the Problem

Over the past decade, the rising prevalence of children who are overweight and obese has become a dominant public health concern in developed regions such as Europe (Chinn & Rona, 2001; Lalie, Lenz & von Kries, 2002; Rolland-Cachera, et al., 2002), the United States (Gortmaker, Dietz, Sobol & Wehler, 1987; Ogden, Flegal, Carroll & Johnson, 2002; Straus & Pollack, 2001), Canada (Chen, Rennie & Reeder, 1995; Evers & Hooper, 1995; Marshall, Hazlett, Spady, Conger & Quinney, 1991; Tremblay & Willms,

2000; Young, Dean, Fleet, & Wood Steinman, 2000), Australia (Ball, et al., 2001; Lazarus, Wake, Hesketh & Waters, 2000), and China (Hu, et al., 2000; Wang, Ge & Popkin, 2000). International standards based on body mass index (BMI), age and gender to categorize overweight and obesity in children were made available by Cole and colleagues in 2000. However, until that time, the international and national prevalence of childhood obesity and overweight had been difficult to assess due in part to the lack of a universal definition of obesity and the numerous indicators chosen to measure obesity.

Within studies of obesity related factors, childhood obesity has potential detrimental health effects that can be a result of excess weight, lack of physical activity, and poor diet (Muennich Cowell, Warren, & Mongomery, 1999). These health related effects can include asthma (Gortmaker, Must, Perrin, Sobol & Dietz, 1993), diabetes (American Diabetes Association, 2000; Smith, Gowanlock, & Babcock, 2001; Wang & Dietz, 2002; Wei, et al., 2003; Young, et al., 2000), hypertension (Freedman, Dietz, Srinivasan & Berenson, 1999; Government of Canada, 1999; Menard, Park & Scholfield, 1999; Prinease, Gillum, Horbide, & Hannan, 1980; Vessey, et al., 2001; Voors, Webber, Frerichs & Berenson, 1977), gallbladder disease (Wang & Dietz), sleep apnea (Wang & Dietz), and psychosocial issues such as low self-esteem (French, Storey & Perry, 1995; Gortmaker, et al., 1993; Thompson & Chad, 2003). Long term health risks of child and adolescent obesity is adult adiposity. In a literature review, it was reported that adult obesity is moderately well predicted from childhood and adolescence (Power, Lake and Cole, 1997).

Previous research on obesity has addressed three main areas including the prevalence and trends of childhood obesity (Kautiainen, Rimpela, Vikat & Virtanen, 2002; O'Loughlin, Paradis, Meshefedjan & Gray-Donald, 2000; Savva, et al., 2002; Stettler, et

al., 2002), the natural history of obesity from childhood to adulthood (Guo & Chumlea, 1999; Hill & Trowbridge, 1998) and the possible relationship between obesity and associated factors (Muennich Cowell, Warren & Montgomery, 1999; Must & Strauss, 1999; Power, Lake & Cole, 1997). These issues have been examined extensively in the literature and while there is consensus concerning an increased prevalence of obesity, there is no consensus concerning the long-term effects of childhood obesity or associated risk factors.

1.3 Need for the Study

A review of the literature of studies on childhood obesity revealed diversity in the definition of obesity, indicators to measure obesity, prevalence of obesity and contributing epidemiological factors. Studies of childhood obesity from across Canada (Canning, Courage & Frizzell, 2004; Evers & Hooper, 1995; Marshall, et al., 1991; O'Loughlin, Paradis, Kishchuk, Barnett & Renaud, 1999; Willms, Tremblay and Katzmarzyk, 2003) and Westernized countries (Lobstein, James & Cole, 2003; Ogden, Flegal, Carroll & Johnson, 2002; Straus & Pollack, 2001) show that the prevalence of obese children is increasing. Within these reports, there is wide geographical variation of prevalence rates reported. Most of these studies were conducted within large urban centers. Not much is known about prevalence rates and associated factors of childhood obesity in Saskatchewan small urban and rural communities. In the few large research studies completed in Canada on 6 to 9 year old children, self-reported height and weight has been the primary source of data for assessing obesity (Tremblay, Katzmarzyk & Willms, 2002; Willms, Tremblay and Katzmarzyk). Thus, identification of the prevalence of overweight and obese children through measured data and using the international standards would add to current knowledge of obesity in Canadian and Saskatchewan school aged prepubescent children.

The long term physical, emotional and social consequences for children with obesity include the development of chronic disease, such as Type II diabetes, respiratory conditions, and low self-esteem. Previous research has identified associations between being overweight or obese and a variety of host and environmental characteristics. There is limited knowledge of associated factors such as physical activity, familial and child history with 6 to 9 year old Canadian children.

1.4 Purpose of the Study

The purposes of the study were to describe and compare the prevalence of overweight and obesity in a Saskatchewan population of children ages 6 to 9 living in two small urban communities and to identify selected characteristics associated with being overweight and obese.

Chapter 2: Literature Review

2.1 Definition of Obesity

The terms overweight and obesity have erroneously been used interchangeably, despite the fact they are not identical (Kain, Uauy, Vio & Albala, 2002). The different methods used to measure childhood adiposity and to define obesity and overweight in children adds to the variation of findings from international studies. It is difficult to compare survey results unless standard procedures and definitions are used consistently between surveys.

Historically, there have been two types of standards used to define obesity: criterion referenced standards and normative referenced standards. Criterion referenced standards are used to compare a subject against a preset standard or criterion (Talbot, 1995). A criterion standard could be skinfold measurements where the percentage of body fat >25% would indicate obesity. Norm-referenced standards compare a subject's performance relative to a defined group (Talbot). Standardized growth reference charts specific to age and gender are one normative based method of determining BMI, where weight (kilograms) is divided by height (meters) squared (BMI = weight/height^2) and where adult obesity indicates BMI greater than 30 kilograms (kg)/meters(m)^2 (Cole, Bellinzi, Flegal & Dietz, 2000).

For over three decades researchers have been interested in examining the application of weight-height ratios and other body indices (e.g. skinfold measures, waist

circumference) for the definition of obesity in children (Killeen, Vanderburg & Harlan, 1978). Prior to the year 2000, knowledge of the prevalence of childhood obesity worldwide was unclear due in part to the lack of an internationally agreed upon definition of obesity and the variation in methodologies used to calculate and define obesity (Hodges, 2003; Keller & Stevens, 1996; Power, Lake & Cole, 1997).

2.2 Indicators Used to Measure Obesity

Obesity refers to a measure of the amount of body fat, which is generally expressed in terms of either total body fat in kilograms (kg) or as the percent (%) of total body mass (Hodges, 2003; Power, Lake & Cole, 1997). The construct of obesity can be measured in a variety of ways such as by skinfold thickness, waist circumference, waist hip ratio, or by more technical methods such as densitometry. However, the most frequent method of measuring obesity in populations has been BMI.

The technical methods used to measure children's body fat include dual energy X-Ray absorptiometry (DXA) [Salbe, et al., 2002(a)(b)], bioelectrical impedance or underwater weighing (densitometry) (Bray, DeLany, Harsha, Volaufova, & Champagne, 2001). These methods require complex instrumentation, tend to be more difficult to use, and are time consuming and expensive to operate (Sarria, et al.., 2001). The gold standard for measuring obesity in adults has been densitometry (Sarria, et al.). Densitometry is complicated to assess and there is also a worldwide shortage of doubly labelled water required for this procedure [Salbe, et al. (a)(b)]. Thus, there are limitations with the densitometry or similar methods in the pediatric population (Sarria, et al.). A gold standard for children has not been established.

2.2.1. Skinfold and waist circumference.

Skinfold thickness is a measure of subcutaneous fat at various sites on the body, usually the triceps and subscapular (Power, Lake & Cole, 1997). In some research studies, skinfold thickness measurements are used in addition to BMI to measure obesity (Bray, et al., 2001; Guilliford, Mahabir, Rocke, Chinn & Rona, 2001). Skinfold measurement are economical and simple to measure; however, correlations to body fat and reproducibility can depend on the site used, gender and ethnic differences of the subject and the training of technicians (Higgins, Gower, Hunter, & Goran, 2001; Keller & Stevens, 1996; Power, Lake & Cole).

More recently, a measure of central fatness/waist circumference has been used with children (Higgins, et al., 2001; Maffeis, Grezzani, Pietrobelli, Provera, & Tato, 2001; Power, Lake & Cole, 1997). Waist circumference is simple, economical to use and with use of recommended standards, is reproducible (Power, Lake & Cole). Past research has demonstrated correlations of waist circumference with BMI (Higgins, et al.; Maffeis, et al.; Power, Lake & Cole).

2.2.2 Body mass index.

Body mass index (BMI) is a well-recognized, international tool which compares well with the World Health Organization (WHO) standard for measurement of obesity (Wang & Wang, 2001) and is frequently used to determine obesity in population based research studies. The use of BMI as an index of childhood obesity provides consistency with measurement practice for adult BMI cut offs where 25 kg/m^2 for overweight and 30 kg/m^2 for obesity are used for determining adiposity (Reilly, et al., 2000).

Height and weight measurements, components for calculation of BMI, are easy to obtain, non-obtrusive and less invasive than other methods (Power, Lake & Cole, 1997;

Reilly, et al., 2000). It is recognized that BMI is not a measure of degree of adiposity, and that BMI is not a perfect measure in children as it will vary with height, muscle mass, and stage of maturation (Cole, Bellizzi, Flegal & Dietz, 2000; Power, Lake & Cole; Widhalm, Schonegger, Huemer & Auterith, 2001). A further limitation of BMI is that it is a function of weight and height only, and when height and weight increase in a population over time, it is difficult to identify changes that are due to increases in body fat or increases in lean body mass (Reilly, et al.). However, a majority of researchers agree that measurement of BMI is at present the best option for screening of overweight and obesity (Reilly et al.; Wells, Coward, Cole and Davies, 2002). In summary, BMI is a simplified measure of overweight which is reproducible, easy to measure, inexpensive and useful for the international comparison with epidemiological studies for prepubescent children.

2.2.3 International standards for overweight and obesity.

Cole and colleagues (2000) developed a generally accepted international definition of child overweight and obesity, specifying the measurement as BMI, the reference population as Western countries, with age and gender specific cut off points which would allow for consistency when comparing prevalence rates internationally (Appendix A). Childhood obesity standards proposed by Cole and colleagues in 2000 are commonly referred to as the international standards.

Cole and colleagues (2000) identified in a review of the literature that children have periods of rapid growth in which the body is in a continual state of flux and that genetics, ethnicity, and environmental factors can affect growth and sexual maturity. With a goal to establish a standard definition for childhood overweight and obesity worldwide, Cole and fellow authors addressed deficits with previous definitions of obesity such as the use of different referent populations and the use of different percentile cut off points which

may or may not have been age and gender specific. The result was an international report, which compiled national cross-sectional growth studies from six developed countries (Brazil, Great Britain, Hong Kong, the Netherlands, Singapore and the United States) where BMI was the main outcome measure. Four of the data sets were based on single samples. Pooled data was available for British and American children. Six other datasets were considered but excluded because they were too small or nationally unrepresentative including: Canada, France, Japan, Russia, Sweden and Venezuela.

All six datasets went through a process where the curves were superimposed leading to a cluster of centile curves that would all pass through the adult cut off point for obesity and overweight seen at age 18 years. This was followed by an averaging of the curves to provide a single smooth curve which would pass through the adult BMI cut off point of greater than 30 kg/m^2 for obesity and 25 kg/m^2 for overweight at age 18 years. The process was conducted separately for males and females. The resulting cuts off points based on a compilation of measurements from six westernized countries and for each six month time point in childhood from ages 2 to 18 years for boys and girls provided a more internationally based precise measurement (Cole et al., 2000; Jebb & Prentice, 2001).

Rigor of the international standards has been examined in relation to sensitivity and specificity. Two studies using prepubescent children found high specificity and lower sensitivity for obesity with the use of BMI and the international standards where densitometry was chosen as the gold standard. Reilly and colleagues (2000) in a UK population of 4175 children who were 5 to 7 years of age found that the definition of pediatric obesity using the international standards had a high specificity for obesity with both sexes (99%) and a lower sensitivity for obesity in boys (46%) than in girls (72%). As well, the cut offs for overweight had high sensitivity (90% for boys and 97% for girls)

with lower specificity (46% for boys and 72% for girls) if the appropriate age and gender cut-off was chosen and if the study group had not reached puberty. Fu and colleagues (2003) in a study of 623 children, who were 6 to 11 years of age, reported similar findings to Reilly's et al. of high specificity (96%) and lower sensitivity (75%) for obesity with a significant gender difference ($p < 0.05$).

Two studies with adolescents, using international standards for obesity, also identified high specificity and lower sensitivity with a gender difference for sensitivity (Malina & Katzmarzyk, 1999: Neovius, Linne, Barkeling, & Rossner, 2004) when compared with densitometry. In 2004, Rudolf and colleagues from Leeds, UK, studied a cohort of school children for six years and reported the international standards were found to be a more stringent measurement than waist and skinfold measurements with this cohort.

Similar results have been reported for non-westernized countries. Gaskin and Walker (2003) assessed 306 Jamaican children ages 7 to 8 years and then again four years later, using four different anthropometric methods. They found a low sensitivity and specificity with the international cut off points and suggested the international standard for overweight and obesity may underestimate the local prevalence of childhood obesity. Fu and colleagues (2003) recruited 623 Singapore children, ages 6 to 11 years, to study the applicability of the international definition of obesity. The authors concluded that the international standards for overweight and obesity had low sensitivity and underestimated the local prevalence of childhood obesity. They recommend future efforts be directed towards defining cut off values for non-westernized populations which reflect population and ethnic variations.

The findings of sensitivity and specificity suggest caution when using the international standards on overweight and obesity in non-westernized countries and with assessing obesity in westernized countries. Current international standards can underestimate the prevalence of obesity and might overestimate the prevalence of overweight. However, it is important to have standardized reference points available in order to monitor and compare prevalence rates for overweight and obese children nationally and internationally. As more data is developed and large studies are completed, the international standards can be modified to reflect the new data.

2.3 Prevalence of Childhood Obesity and Overweight

The past differences seen in the international prevalence of obesity in Westernized countries could be in part due to the diversity of definitions of obesity and the mixed methodologies used to measure and calculate child obesity. Recently, as a result of the use of international standards in studies, childhood obesity prevalence is more comparable internationally. In Jamaican children the prevalence of obesity was found to be 9.5% (Gaskin & Walker, 2003), in Canadian children 9% to 19% (Tremblay, Katzmarzyk & Willms, 2002), in Australian children 3.7% to 4.1% (Booth, et al., 2003) and 5.7% (Wake, et al., 2002), in Cyprus children 5.7% to 6.9% (Savva, et al., 2002), in German children 2.9% to 3.1% (Kailes, et al., 2002) and 2.7% to 3.5% (Gei , Parhofer, & Schwandt, 2001), in Switzerland children 2% to 3% (Schultz and Woringer, 2002), in Scottish and English children 1.7% to 3.2% (Chinn & Rona, 2001), and in French children 3.8% (Rolland-Cachera, et al., 2002).

Overweight prevalence as defined by international standards has been reported as 28.9% to 34.5% in Spanish children (Rodriguez-Artalego, et al., 2002), 18.5% in children from northwest Germany (Langnase, Mast & Muller, 2002), 17% to 20.3% in Mexican

children (Sanchez-Castillo, et al., 2001), 17% to 23.6% in children in England (Lobstein, James & Cole, 2003), and 10 to 15% in American children (Ogden, et al., 2002; Strauss & Pollack, 2001).

Results of international studies show child obesity is a greater problem in urban populations when compared to their rural counterparts. In Thailand 22.7% of urban children were obese as compared with 7.4% of rural children (Sakamoto, Wansorn, Tontisirin & Marui, 2001). Researchers in China, (Luo & Hu, 2002) determined BMI in China urban centers increased yearly by 0.2kg/m^2 compared to only a 0 .1kg/m^2 increase in rural areas.

There were three Canadian studies that were conducted in school age children prior to the use of international standards. The prevalence of obesity in Canadian studies has varied widely: 14% for children 7 to 14 years living in Edmonton (Marshall, et al., 1991); 23.2% for children 7 to 9 years living in Ontario (Evers & Hooper, 1995); and 35% for children 9 to 12 years living in Montreal (O'Loughlin, et al., 1999). All studies evaluated the prevalence of childhood obesity in large urban centers. Although BMI was used in each as an outcome measure, each study used a different method to define obesity, which makes comparisons between these studies difficult.

In 2003, Willms, Tremblay and Katzmarzyk published a cross-sectional study which examined the geographic and demographic variation of childhood obesity and overweight using BMI data from the 1981 and 1996 national surveys on children ages 7 to 13 years. Through a random selection of Canadian children from birth to age 13, the person most knowledgeable about the child was interviewed and either provided a self-report of the child's height and weight or height and weight were assessed directly (proportion unknown). Using BMI and the international standards, the national prevalence

of overweight children in 1996 ranged from 36% to 44% for boys and from 26% to 37% for girls ages 7 to 9 years. Obesity rates in 1996 ranged from 10% to 21% and 12% to 16% for Canadian boys and girls, respectively. The authors identified a trend for increasing overweight from western to eastern Canada. The Saskatchewan prevalence of overweight increased from 11.9% to 25.7% over the fifteen years. Obesity had increased in the Prairie Provinces from 12.6% to 24.4%.

Only one Canadian study explored obesity with a remote population. Using BMI and the National Health and Nutrition Examinations Survey (1971 to 1974) as the reference population, the authors determined that children 4 to 19 years living in an Aboriginal Manitoba community had a much higher level of obesity than the national average (Young, et al., 2001). The authors reported 40% boys and 34% girls as being obese. The prevalence of overweight and obesity internationally and in Canada varies and the majority of research is based on large urban centers with little rural data.

2.4 Contributing Epidemiological Factors

Childhood is a period of rapid growth when choices related to nutrition, physical activity and lifestyle patterns are initiated. These choices have implications for development of coronary artery disease, respiratory and orthopaedic conditions during childhood and later during adulthood (Gortmaker et al., 1993). Figure 2.1 presents a framework that identifies several epidemiological factors that influence of childhood obesity and overweight. Several outcomes are associated with childhood obesity and overweight including weight loss behaviours, psychosocial and physiological outcomes. Important influences (host and environmental characteristics) for overweight and obesity

include age, gender, ethnicity, socioeconomic status, physical activity levels, genetic, prenatal, nutritional, and parental obesity characteristics.

Numerous retrospective and prospective studies have attempted to identify reasons for childhood obesity. Parental factors such as increased parental BMI, smoking, and physical inactivity have been shown to be associated with being overweight and obese as a child (Safer, Agras, Bryson & Hammer, 2001). However, environmental risk factors such as dietary factors, physical activity and socioeconomic status are numerous and complex (American Academy of Pediatrics, 2003), and findings for these risk factors tend to be inconclusive (Hui, Nelson, Yu, Li & Fok, 2003; Wang, 2001).

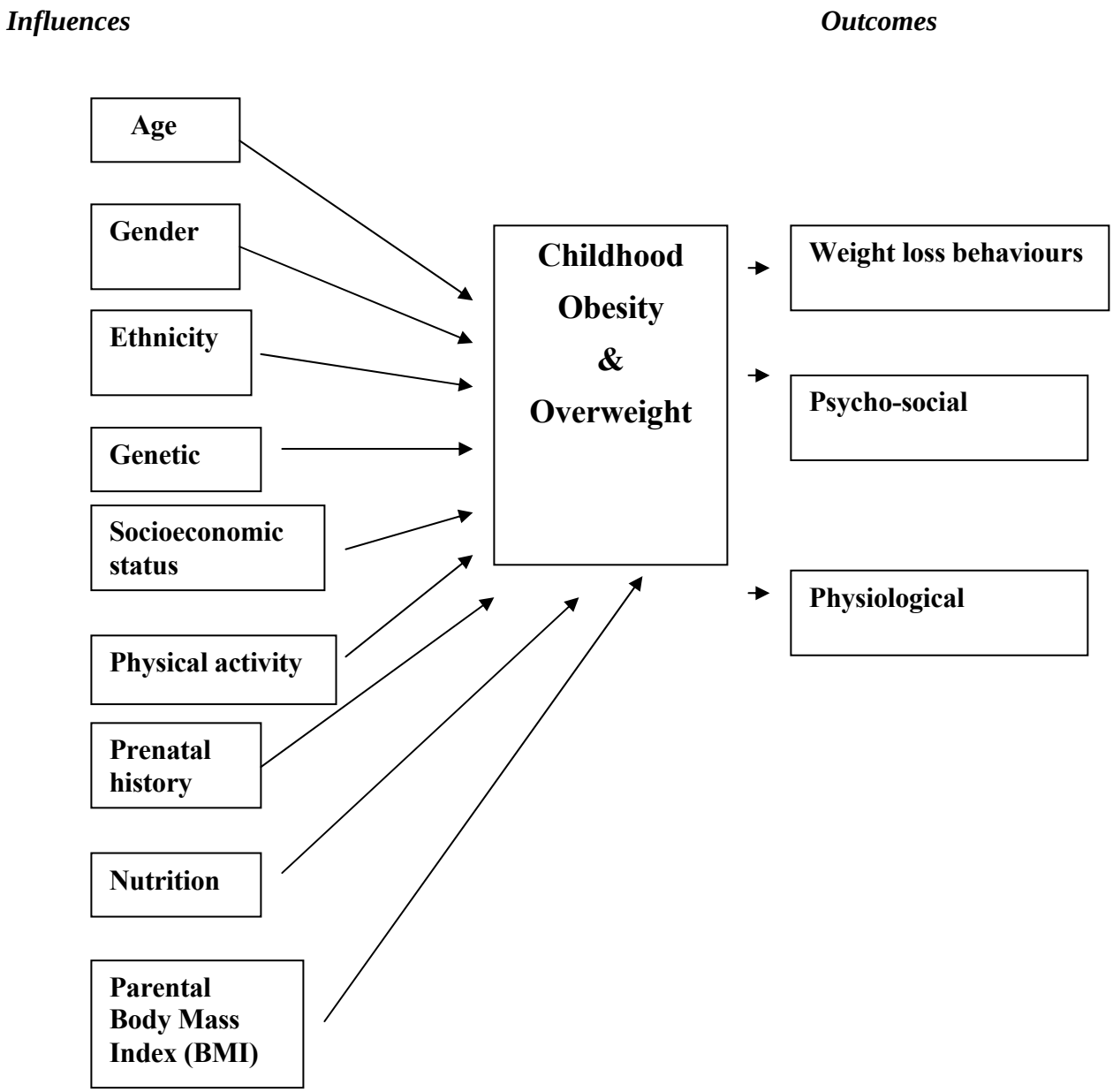


Figure 2.1. Conceptual model of environmental and host influences and outcomes associated with being overweight and obese as a child.

2.4.1 Genetic.

Debate exists as to the role of genetics in childhood obesity. Rarely is obesity an endocrine problem (Berrall, 2003; Keller & Stevens, 1996). At present, results of studies to identify genes responsible for obesity in children are inconclusive.

2.4.2 Prenatal.

Recently, the Canadian Institute of Child Health (CICH) in 2000 stressed the importance of prenatal environment and the relationship to childhood obesity. Debate exists to the role of prenatal factors with childhood obesity, in particular, the effect of birth weight on childhood obesity. Most of the research concludes that low birth weight has a protective factor for overweight and obesity. Two German research teams, Frye and Heinrich (2003) and von Kries and colleagues (1999) found in large cross-sectional studies on school aged children that low birth weight and higher parental education were protective factors for overweight and obesity. Furthermore, a Finnish birth cohort study concluded that the incidence of obesity rose with increasing birth size (Eriksson, Forsen, Osmond & Barker, 2003). Belgium researchers in 2001 completed a prospective study of randomly selected twins. Their findings support a positive association between birth weight and adult fat composition (Loos, et al., 2001).

Two research studies have found opposite results. Fuentes and colleagues (2003) did not find birth weight was a good predictor of BMI in Finnish children. Spanish researchers concluded that intrauterine development was not responsible for children being overweight or obese (Rodriguez-Artalejo, et al., 2002).

Maternal smoking during pregnancy could have a potential association with overweight and obesity in children. In a longitudinal birth cohort study, Bergmann and colleagues (2003) identified that maternal smoking during pregnancy was an important

risk factor to developing overweight and obesity in children at six years of age. Toschke and colleagues (2003) assessed the impact of maternal smoking during the first trimester on 4,974 German children ages five to six years. However, there was no statistically significant difference in childhood obesity risk for maternal smoking during the first trimester when compared with smoking throughout the pregnancy. The positive association relating maternal smoking to overweight and obesity in children have been supported by others (Montgomery & Ekbom, 2002; Ong, et al., 2000; Parsons, Powers & Manor, 2001; von Kries, et al., 1999; von Kries, Toschke, Wurmser, Sauerwald & Koletzko, 2002). The role of prenatal factors with childhood obesity is complex and inconclusive.

2.4.3 Parental obesity.

Within cross-sectional studies, parental obesity and in particular maternal obesity are strong predictors of being overweight or obese as a child (Davison & Birch, 2001; Hediger, Overpeck, Kuczmarkski & Ruan, 2001; Hui, et al., 2003; Williams, 2001). This concurs with Safer and colleagues (2001) who found a significant correlation between parental and offspring BMI in a United States cohort study of 114 children (p value< 0.001). In the Safer study, children with two overweight parents consistently had an elevated BMI. In a 15 year prospective population based study of 138 Finnish children using a survey format and measured data (Fuentes, Notkola, Shemeikka, Tuomilehto & Nissinen, 2003) found that a family history of obesity was not a good predictor of BMI during childhood. A possible reason for the differences in findings between studies could be that the latter study had a small sample size and did not use the international standards to define obesity.

2.4.4 Socioeconomic status.

International researchers have reported in cross-sectional studies of obesity that higher socio-economic status and better educational attainment were associated with a lower prevalence of childhood obesity (Eriksson, et al., 2003; Frye & Heinrich, 2003; Luo & Hu, 2002; Sakamoto, et al., 2001). Mustillo and colleagues (2003) conducted an eight-year longitudinal study on childhood obesity of American rural youth ages, 9 to 16 years. Of the 991 children participating, 20% were obese and chronic obesity was found to be more common if children had poor, uneducated parents. Power, Manor and Matthews (2003) published a British birth cohort study that followed 11,405 men and women from birth to 33 years of age. They concluded that socioeconomic conditions around birth to 7 years of age did influence the risk of adult obesity. Lower socioeconomic status and lower parental education could be associated with being overweight or obese as a child.

2.4.5 Ethnicity.

International cross-sectional studies have strongly suggested that the relationship between BMI is different among children of different ethnic backgrounds (Guilliford, 2et al., 2001; Malina & Katzmarzyk, 1999; Martorell, Medoza & Castillo, 1989; Menard, Park & Scholfield, 1999; von Deuerenberg, et al., 2003). This is most obvious when comparisons are made between Western and Asian children. In Japan, the prevalence of adult obesity (BMI >30 kg/m^2) is quite low compared to western counties (Matsushita, Yoshiike, Kaned, Yoshia & Takimoto, 2004; Yoshinaga, et al., 2002). Gordon and colleagues (2003) also recognized ethnic differences in a New Zealand study of 3 to 7 year old Pacific Island children. A high level of obesity existed in this population (34% to 49%) and was dependent on the methodology used to define obesity. The authors believed that

the use of international standards for overweight and obesity did not appear to be valid for this population of Pacific Island children.

Cole and colleagues (2000) in the development of international standards for obesity and overweight in children included data from six westernized countries and acknowledged the lack of data from Africa and Asia. They identified the need for additional data from these populations once sufficiently large sample sizes had been completed.

2.4.6. Physical activity.

Technological advances which promote sedentary activity have led to children spending greater amounts of time watching television, playing video games, and using computers. This can lead to an imbalance between physical activity and nutritional intake and consequently, overweight and obesity can occur (CICH, 2000; Faith, et al., 2001; Keller & Stevens, 1996). Researchers followed American children ages 10 to 15 years for seven years and discovered when physical activity increased, BMI decreased (Berkey, Rockett, Gillman, & Colditz, 2003). Other American researchers' revealed time spent watching television was an independent predictor of changes in children's BMI (Anderson, Crespo, Bartlett, Cheskin & Pratt, 1998; Proctor, et al., 2003). These findings are supported by other international studies (Hernadez, et al., 1999).

Lifestyle choices such as inactivity can be inversely correlated to a child's BMI (Anderson, et al., 1998; Hernandez, et al., 1999; Keller & Stevens, 1996; Proctor, et al., 2003; Tremblay & Willms, 2003). Hence, physical activity choices parents and their children make, whether in school or during free time, influence children's health and risk for overweight and obesity (Berkey, et al., 2003; Davison & Birch, 2001; O'Loughlin, et al., 1999; Thompson, Baranowski, et al., 2003; Tremblay & Willms).

2.4.7 Nutrition.

The association between infant breast feeding and being overweight in children is controversial. There were inconsistent associations reported for breast feeding, its duration and the risk of being overweight as a child. The majority of researchers have found a strong, inverse association with breast feeding and being overweight and that the longer the child is breastfed the less likely the occurrence of obesity (Bergmann, et al., 2003; Frye & Heinrich, 2003; Gillman, et al., 2001; Leis, et al., 2001; von Kries, et al., 1999). However, some researchers have found no evidence that breast feeding influences childhood obesity (Eriksson, et al., 2003; Hediger, et al., 2001; Victoria, Barros, Lima, Horta & Wells, 2003). Differences among findings could exist for many reasons such as differences in sampling methods used, small sample sizes, and the definition of the type of breast feeding being used, whether exclusive or non-exclusive.

A nutritious diet is important to the healthy development of children (CICH, 2000). Easy accessibility to high fat foods with little nutritional value can contribute to medical conditions such as obesity and Type II Diabetes (CICH). Canadian researchers explored the role of nutrition, BMI and low social economic status in an Ontario inner city population. They discovered that most of the diets of 7 to 9 year olds were deficient in calcium and vitamin A and no association was found between caloric intake and BMI (Evers & Hooper, 1995). Limitations of this study included a short recall of their diet by children which could lead to an information bias with the findings.

International researchers have identified the higher intake of cholesterol and saturated fats can be associated with higher BMI in children (McGloin, et al., 2002; Rodriguez-Artalejo, et al., 2002). Large international cross-sectional surveys in Taiwan (Chu, 2001) and in North America (Freedman, et al., 1999; Sanchez-Carracedo, Saldana &

Domenech, 1996) found that schoolchildren who were overweight had higher levels of cholesterol, triglycerides and fasting insulin when compared to children with normal weights.

The significance of easily available high fat, quick service foods is an important variable to consider with North American residents (Thompson, Baranowski, et al., 2003). In particular, American researchers discovered adolescent females were more likely to increase their BMI, with eating out more than two times per week (Thompson, et al.). This dietary pattern has been studied internationally. Spanish researchers (Rogriguez-Artalejo, et al., 2002) discovered 1112 urban children showed a high prevalence of overweight (28.9% to 34.5%) and obesity (8.5% to 5.7%). Diets were high in calories with an excessive intake of saturated fats, proteins, sugars, cholesterol (commonly found in fast foods), and low in complex carbohydrates and fibre.

2.4.8 Weight loss behaviours.

Dietary choices children make have health consequences. Weight loss behaviours such as focusing on healthy food choices combined with increased physical activity can be healthy (CICH, 2000). In addition, dietary choices parents make may influence their children's potential to be overweight or obese. American researchers have explored the relationship between mothers and child feeding practices and child's adiposity (Spruijt-Metz, Lindquist, Birch, Fisher & Goran, 2002). These authors conclude child-feeding practices were an important behavioural variable related to total fat mass.

According to the CIHI (2000), girls were far more likely than boys to be preoccupied with losing weight and both were concerned about body image. Being overweight and obese as a child and adolescent can have damaging effects on their

subsequent physical and emotional health such as self-esteem, social and economic characteristics (Gortmaker, 1993).

2.4.9 Physiological .

Increased systolic and diastolic blood pressure has been correlated with height, weight and BMI and is a risk factor of cardiovascular disease in children (Voor, Webber, Frerichs & Berenson, 1977; Menard, Park & Scholfield, 1999). Chen, Rennie and Reeder (1995) conducted a study of children in Humboldt, Saskatchewan and found that children with higher BMI had higher blood pressure. This finding has been supported in other studies (Chu, 2001; Freedman, et al., 1999; Gei, Parhofer, & Schwandt, 2001; Maffeis, et al., 2001).

Other physiological sequelae associated with childhood obesity include diabetes (American Academy of Pediatrics, 2000), sleep apnea (Schwimmer, Burwinkle & Varni, 2003), cardiovascular disease (Gei, Parhofer & Schwandt, 2001; Menard, Park & Scholfield, 1999; Voors, Webber, Frerichs & Berenson, 1977), and orthopaedic problems such as slipped capital femoral epiphyses (Berall, 2003).

2.4.10 Psychosocial.

Marsh (1999) indicated the need for recognizing and measuring adolescent eating disorders. In this study Marsh estimated that 20% of the total female population between the ages of 12 and 30 suffered from an eating disorder. Saskatchewan researchers Thompson (1994) and Thompson and Chad (2003) investigated the relationship of age, body image and social physique anxiety to developing an eating disorder. Thompson studied 77 female recreational dancers 7 to 16 years of age. As age and social physique anxiety increased, there was an accompanying increase in the risk for developing an eating disorder. Thompson and Chad conducted a study of the relationship of pubertal status to

body image, social physique anxiety, preoccupation with weight and nutritional status in young females. They reported 34% of prepubescent girls were dissatisfied with their body shape and all groups showed social physique anxiety and preoccupation with weight.

2.5 Summary

In summary, there are a variety of assessment methods for overweight and obesity including BMI, skinfold thickness and waist circumference. More technical methods are also available such as DXA or densitometry but there are limitations with these methods for children. A measure more suitable for use with children is BMI, which is a well-recognized international tool in epidemiological studies of children.

The international prevalence of overweight has been reported as low as 9% in 5 to 6 year old German children (Kalies, Lenz & von Kries, 2002) and as high as 49% in a New Zealand Pacific Island preschool population (Gordon et al., 2003). Obesity rates were approximately 5% to 20% in young school age children. Wide variation may be the result of different standards and definitions used to categorize obesity, different groups studied (prepubescent versus adolescent), or differences in maturation and genetics between cultures. However, the international guidelines for categorizing overweight and obesity presented by researchers Cole and colleagues (2000) should enable better comparisons internationally, excluding children from non-westernized countries. These standards appear to be useful for measuring overweight in western populations but may underestimate obesity. The literature shows an increase in the rates of childhood obesity and overweight in the past decade regardless of geographical location, ethnicity, gender, age, and socioeconomic status.

A review of the literature showed that the majority of research on obesity is conducted outside of Canada and is composed primarily of urban populations. Few studies

have been conducted with rural or small urban populations. Studies of children in Canada and other developed countries have yielded conflicting results for obesity prevalence. Since the development of the new international standards for overweight and obesity, results appear to be more consistent. Although previous Canadian studies have examined childhood obesity, none of these studies had focused specifically on the prevalence of childhood obesity in school aged children using only measured data for determining BMI and the use of international standards for classification of obesity and overweight.

Several cross-sectional but fewer longitudinal studies have revealed factors associated with childhood overweight and obesity such as limited or no breast feeding, diets high in fat, low physical activity, prenatal (maternal smoking), parental obesity, low socioeconomic status, and ethnicity. Debate exists within the literature concerning genetic, prenatal, and early childhood effects. Children of low birth weight or prematurity have been shown to have less obesity in later life. The rapid global increase of child obesity suggests the importance of examining the child's environment and choices related to physical activity and nutrition.

2.6 Research Questions

Based on a review of the literature and information available from the original survey, the following research questions were addressed in this study:

1. What is the prevalence of overweight and obese children living in two southern Saskatchewan communities?

There is a limited study of prevalence of childhood obesity and overweight in prepubescent school age children living in Canadian and Saskatchewan rural and small urban communities using the international standards and measured data. Most of the information collected on children has been in large urban centers. Assessment of obesity

prevalence and identifying trends in Saskatchewan is important for implementing health promotion strategies.

2. Is there a difference between communities in the prevalence of overweight and obesity in children ages 6 to 9 years?

Information on children is available for two communities in southern Saskatchewan that have similar populations size. Geographical variation for overweight and obesity has reported in previous studies.

3. What selected environmental factors are associated with being overweight or obese as children living in southern Saskatchewan?

Obesity in children is a complex multi-factoral problem. At present there is limited information available on physical activity at school and physical activity in free time, current health status and familial history as associated with obesity in prepubescent school aged children in Saskatchewan and Canada.

Chapter 3: Methodology

3.1 Setting

The data for answering the research questions for this study was obtained from a cross-sectional study that assessed the respiratory and general health of children in Swift Current and Estevan in southern Saskatchewan (Rennie, Lawson, Cockcroft, Senthilselvan, & McDuffie, 2004). Estevan is a town in southeast Saskatchewan located close to the Saskatchewan, Manitoba and United States borders. The population of Estevan in 1996 was 10,752 of which 923 were ages 5 to 9 years old (Saskatchewan Tourism, 2003). Swift Current is located in the south western area of Saskatchewan. The population of Swift Current in 1996 was 14,890 of which 1,008 were ages 5 to 9 years (Saskatchewan Tourism). Although towns had many similar industries there were differences with Estevan having coal fired power plants. Both towns would be considered small urban centers in Saskatchewan.

3.2 Collected data

3.2.1 Design.

Following ethics approval from the University of Saskatchewan Advisory Committee on Ethics in Human Experimentation in 1999 (Appendix B), the study was approved by local school boards (separate and public) and by principals in each school (Appendix C). Specific details and deadlines were articulated in a letter to teachers regarding distribution of questionnaires.

In January 2000, the survey (Appendix D) was distributed through the schools to students in Grades 1 to 6. A consent form for anthropometric data and spirometry was included. Both the parent and the child were to complete the consent form. The survey questionnaire was accompanied with a letter which described the purpose of the study and how to complete the questionnaire (Appendix E). Questionnaires were to be filled in by the person most knowledgeable about the child and were to be returned to the school. Parents were encouraged to return the questionnaires in a sealed envelope even if they chose not to participate in the study. The questionnaires and consent (Appendix F) were returned to the participating school for collection by the research team. A reminder letter was sent home to all parents who had not returned a questionnaire one week after the questionnaires were distributed in order to achieve a better response rate (Lawson, 2002).

The procedure for distributing and retrieving questionnaires through the school and for conducting the objective measurements in schools has been used effectively elsewhere by the principal investigator (Chen, Rennie & Reeder, 1995; Rennie, et al., 2004). Only those students with valid consents from both the child and a parent had the objective measurements completed. Prior to measurement, each child was given the opportunity to change his/her mind about participation. Subjects were provided with a copy of the objective measurements (Lawson, 2002).

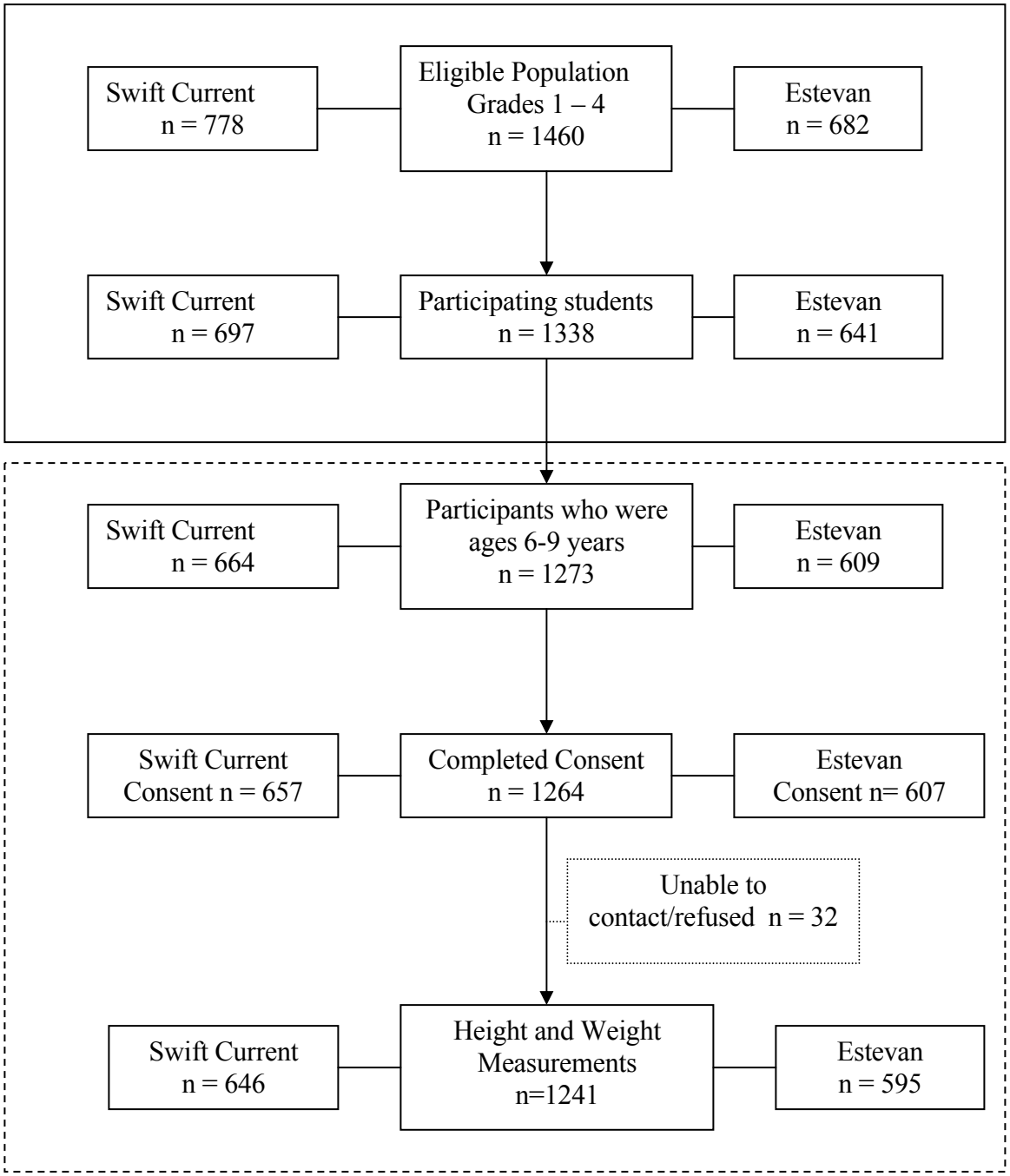
3.2.2 Response rates for this analysis.

Figure 3.1 describes the study design for the captured population for ages 6 to 9 years. A total of 1460 questionnaires and consents for objective measurements were distributed to Estevan and Swift Current children in Grades 1 to 4 in the original study. Of these, there were 122 children who did not return questionnaires for a participation rate of

91.6%. From the original survey there were 1273 children who were 6 to 9 years of age. Consents were available for most of these children (n = 1264). Thirty two children did not provide consent for anthropometric testing or had a signed consent but the testers were unable to contact them on the dates of data collection. The final number of subjects with height and weight measurements was 1241 or 97.5% of those children with a valid consent.

3.2.3 Questionnaire.

The questionnaire (See Appendix D**)** was composed of four parts – Part One was consent for the anthropometric measurements, blood pressure and breathing test. Part Two included general questions about the child's past and present health. Part Three integrated specific details about the child's environment. Part Four had questions about the child's personal and family history. The person most familiar with the child's health was asked to complete the questionnaire. The questions were derived from the American Thoracic Society's Children's Respiratory Disease Questionnaire, self administered questionnaires used in the Study Lunch Health Study and the asthma prevalence questionnaire used in the 1993 Humboldt Study (Lawson, 2002). Although this survey was primarily a respiratory survey, information on demographics and the health of the children were available such as past illness (respiratory, diabetes, heart disease), information regarding diet, weight loss, lifestyle factors, and family history of disease.



—— Survey population with objective measurements from original study on asthma
----- Captured population in the current research study

Figure 3.1. Description of study design for captured population (ages 6 to 9) of participants and non-participants who attended Grades 1 to 4 in Estevan and Swift Current.

3.2.4 Operational Definitions.

The following operational definitions were used in this study.

Body mass index (BMI): Weight in kilograms over height in meters squared ($BMI = wt / ht^2$).

Breast feeding: Less than six months, greater than six months or no breast feeding.

Gastrointestinal symptoms (Yes/No): Gastrointestinal symptoms of nausea or diarrhea experienced at least three times in the past three months.

Maternal smoking during pregnancy (Yes/No): Based on the questionnaire whether the mother had smoked during pregnancy.

Obesity (Yes/No): Obesity was defined for the study based on the child's age and sex specific BMI cut off for obesity according to Cole et al., 2000 (see Appendix A).

Overweight (Yes/No): Includes children with defined obesity. Overweight was defined for the study based on the child's age and sex specific BMI cut off for overweight according to Cole et al., 2000 (see Appendix A).

Parental education: Educational status was assigned to each student based on the highest level of education of either parent using two levels: ≤ Grade 12 (public school or Grade 12) and > Grade 12 (technical school or university degree).

Parental history of heart disease or diabetes (Yes/No): Based on a questionnaire response to any of: history of high blood pressure, cardiovascular disease or diabetes in either natural parent.

Physical activity in free time: Outcomes assigned to physical activity in free time were: active and never or sometimes active.

Physical activity at school: Outcomes assigned to physical activity at school were: active and never or sometimes active.

Prematurity ≥ 4 weeks (Yes/No): Based on the survey question of whether the child was born prematurely and if so, a report of being four or more weeks premature.

Single parent status (Yes/No): Based on the survey question whether living in a two parent home (no to single parent status) or not (yes to single parent status).

3.2.5 Anthropometric measures.

The same research technician, a registered nurse, in each center collected height and weight measurements. Height was measured to the nearest 0.1 cm against a wall using a fixed tape measure with subjects standing shoeless on a hard floor. Weight was measured to the nearest 0.1 kg using a calibrated spring scale with subjects dressed in normal indoor clothing without shoes. These measurement techniques were similar in other research studies examining prevalence of obesity in children (Burke, Beilin & Dunbar, 2001; Chen, Rennie & Reeder, 1995; Maffeis, Talamini & Tato, 1998; Young et al., 2000). Body mass index was calculated on each child using the measured data, and then the children were categorized as overweight or obese as per the international standards (Cole et al., 2000).

3.2.6 Ethical considerations.

Ethics approval for this data analysis was obtained from the University of Saskatchewan Behavioural Research Ethics Board in October 2004 (Appendix G). All information was to be kept confidential and used only for research purposes. All personal identifiers, kept under lock and key of the principal investigator, were not available to the author. Data will be kept by the principal investigator for five years subsequent to this analysis.

3.3 Data Analysis

3.3.1 Sample.

As mentioned previously, all children attending Grades 1 to 4 in elementary school in Estevan and Swift Current were eligible to participate in height and weight assessment. In total there were 14 schools between the two communities. This analysis was limited to those children ages 6 to 9 years with weight and height measurements for a total of 1241 children.

The following equation was used to determine sample size based on suspected prevalence within the study population (Lwanga & Lemeshow, 1991):

$$n = \frac{z_{\alpha}^{2} P(1-P)}{d^{2}} \qquad (3.1)$$

Where: P = anticipated population proportion of overweight.

z_{α} = two-sided point for standard normal distribution based on confidence level determined for analyses in the study. For a 95% confidence level, $z_{\alpha} = 1.96$.

d = absolute percent precision required on either side of the proportion set at 4%.

Based on Tremblay and colleague's (2002) research which indicated the proportion for overweight children ages 7 to 13 years in 1996 was 33% for boys and 27 % for girls, sample size estimates for this study population were as follows in Table 3.1:

Table 3.1: Sample size estimates for study population based on gender.

	Estimated proportion ± Confidence Interval *	Sample size
Boys (33%)	0.33 ± 0.04	530
Girls (27%)	0.27 ± 0.04	473
Total sample required		1103

*estimated proportion of overweight study population

The 1241 children with available objective height and weight measurements exceed the required number of 1103 projected in sample size calculation.

3.3.2 Data entry.

Data for the respiratory study were collected between January and April 2000. Data entry was completed and double-entered by a research assistant through May to September 2000. Data cleaning was conducted in 2000 to 2001.

3.3.3 Methods of analysis.

This research incorporated descriptive and correlational analysis at the univariate level examining associations for overweight and obesity by age, gender and town. BMI was calculated for each subject. BMI was then standardized for age and sex according to the international standards developed in 2000 (Cole, et al., 2000). Cole and colleagues state in their paper that for epidemiological use, with age groups of one year width, the cut off point at the mid year value (for example 6.5 for the 6 to 7 year age group) will give an unbiased estimate of the prevalence for age. See Appendix A for cut off points for age and gender.

Variables were analyzed overall, descriptively and then by town using frequency distributions, percentages, measures of central tendency (median, mean), and measures of variability (range). Differences in BMI between towns and gender were assessed using t-test for independent means. Differences in BMI by age were assessed by linear regression. To test for differences in the proportion of being overweight or obese in the children between communities by age and sex, chi square tests for association and overall trend were used.

Analyses using logistic regression reporting odds ratio (OR), 95% confidence intervals (CI) and p values were used to assess associations between overweight and non-

overweight children for environmental and host characteristics including gender, age, town, current gastrointestinal symptoms, prenatal history (maternal smoking and prematurity ≥ 4 weeks), single parent status, parental education level, breast feeding status, family history of heart disease or diabetes, physical activity in school and physical activity in free time. Similar analyses were conducted for obesity. Variables significant at the univariate level ($p < 0.25$) and clinically relevant variables were examined in a multivariate enter method logistic regression for overweight and obesity separately. All analyses were carried out using the Statistical Package for the Social Sciences (SPSS) 11.5. The level of significance (alpha) was set at ≤ 0.05.

Chapter 4: Results

4.1 Response to Questionnaire

4.1.1 Inclusion/Exclusion .

Table 4.1 presents a comparison of the study participants and the 32 participants who did not provide consent or were absent for testing. There were no statistical differences between the two groups on selected characteristics.

4.2 Characteristics of the Study Population

Table 4.2 presents general environmental and host characteristics of children with viable height and weight measurements living in the two communities. Distributions by age, gender and race were similar between towns. The mean age of the study population was 7.6 ± 1.10 years with mean ages similar between communities.

As highlighted in the Table 4.2, the communities varied on some general characteristics of the study population. There were more parents in Estevan with less than a Grade 12 education compared to Swift Current ($\chi^2 = 5.80$, df = 1, p = 0.02). There were more single parent households in Swift Current ($\chi^2 = 6.88$, df = 1, p = 0.01). There were more children who were breast fed in Swift Current compared to Estevan ($\chi^2 = 7.22$, df = 2, p = 0.03). More children in Estevan reported gastrointestinal symptoms of nausea or diarrhea in the past three months ($\chi^2 = 14.18$, df = 1, $p<0.001$).

Table 4.1. Comparison of selected characteristics of study subjects (n=1241) versus excluded subjects (n=32).

Characteristics	Exclusion Group n=32 mean ± s.d.*	Study Group n=1241 mean ± s.d.*
Age (years)	7.3 ± 1.13	7.6 ± 1.10
Birth weight (lbs)	7.0 ± 1.36	7.1 ± 1.24
	n (%)	n (%)
Gender		
Boy	19 (59.4)	630 (50.8)
Girl	13 (40.6)	611 (49.2)
Town		
Swift Current	18 (56.3)	646 (52.1)
Estevan	14 (43.8)	595 (47.9)
House type		
single family	31 (96.9)	1084 (87.3)
Other	1 (3.1)	157 (12.7)
Parental education		
≤ Grade 12	11 (34.4)	376 (30.3)
> Grade 12	21 (65.6)	865 (69.7)
Absent from school		
No	29 (90.6)	1172 (94.4)
Yes	3 (9.4)	69 (5.6)
Gastrointestinal symptoms		
No	25 (78.1)	1172 (94.4)
Yes	7 (21.9)	155 (12.5)
Doctor visit past year		
No	27 (84.4)	1086 (87.5)
Yes	5 (15.6)	155 (12.5)
Maternal smoking in pregnancy		
No	23 (71.9)	899 (72.4)
Yes	9 (28.1)	342 (27.6)
Physical activity in free time		
never/sometimes	23 (71.9)	755 (60.8)
Active	9 (28.1)	486 (39.2)
Physical activity at school		
never/sometimes	23 (71.9)	1025 (94.8)
Active	9 (28.1)	216 (17.4)
Prematurity ≥ 4 weeks		
No	31 (96.9)	1177 (94.8)
Yes	1 (3.1)	64 (5.2)
Answered questionnaire		
Mother	28 (87.5)	1099 (88.5)
Other	4 (12.5)	142 (11.5)

*sd=standard deviation

Table 4.2. General characteristics of the study population in Estevan and Swift Current with viable height and weight measurements (n=1241).

Characteristics	Estevan (n=595) n (%)	Swift Current (n=646) n (%)	Total (n=1241) n (%)
Age (years)			
6	133 (22.4)	135 (20.9)	268 (21.6)
7	157 (26.4)	180 (27.9)	337 (27.2)
8	144 (24.2)	158 (24.5)	302 (24.3)
9	161 (27.1)	173 (26.8)	302 (26.9)
Gender			
Boy	298 (50.1)	331 (51.2)	629 (50.7)
Girl	297 (49.9)	315 (48.8)	612 (49.3)
House type			
Single family	513 (86.2)	571 (88.4)	1084 (87.3)
Other	75 (13.8)	82 (11.6)	157 (12.7)
Parental education			
≤ Grade 12	242 (40.7)[1]	220 (34.1)	462 (37.2)
> Grade 12	35 (59.3)	426 (65.9)	779 (62.8)
Single parent			
No	532 (89.4)	545 (84.4)	1077 (86.8)
Yes	36 (10.6)[2]	101 (15.6)	164 (13.2)
Gastrointestinal symptoms			
No	447 (75.1)	541 (83.7)	998 (79.6)
Yes	148 (24.9)[3]	105 (16.3)	253 (20.4)
Maternal smoking in pregnancy			
No	438 (73.6)	461 (71.4)	899 (72.4)
Yes	157 (26.4)	185 (28.6)	342 (27.6)
Physical activity in free time			
Never/sometimes	357 (60.0)	398 (61.6)	755 (60.8)
Active	238 (40.0)	248 (38.5)	486 (39.2)
Physical activity at school			
Never/sometimes	100 (16.8)	116 (18.0)	216 (17.4)
Active	495 (83.2)	530 (82.0)	1025 (82.6)
Breast fed			
No	169 (28.4)[1]	145 (22.5)	314 (25.3)
< 6 months	225 (37.8)	245 (37.9)	470 (37.9)
≥6 months	201 (33.8)	256 (39.6)	457 (36.8)
Parental history of heart disease or diabetes			
No	24 (4.0)	3 (5.6)	60 (4.8)
Yes	571 (96.0)	610 (94.4)	1181 (95.2)

[1]$p<0.05$. [2]$p<0.01$. [3]$p<0.001$.

4.3 Body Mass Index

Table 4.3 presents the mean BMI, height and weight measurements of the study population. The overall BMI was 16.9 ± 2.82 kg/m^2 with a mean BMI of 16.5 ± 2.75 kg/m^2 in Swift Current and 17.3 ± 2.84 kg/m^2 in Estevan. The BMI differed significantly between towns ($t = 1.365$, $df = 255$, $p < 0.001$). Values for means and medians were similar for BMI, height and weight in the sample population.

Table 4.3. Mean body mass index (BMI), height, and weight of the study population in Estevan and Swift Current (n=1241).

	Estevan (n=595)	Swift Current (n=646)	Overall (n=1241)
Characteristics	Mean ± sd*	Mean ± sd	Mean ± sd
BMI**	17.3 ± 2.84 [1]	16.5 ± 2.75	16.9 ± 2.82
Height (cm)	128.6 ± 80	130.4 ± 8.59	129.5 ± 8.73
Weight (kg)	28.9 ± 7.78	28.5 ± 7.30	28.7 ± 7.54

*sd=standard deviation. **BMI in kg/m^2. [1] $p<0.01$.

4.4 Research Question 1

What is the prevalence of overweight and obese children living in two southern Saskatchewan communities?

4.4.1 Overall prevalence of overweight and obesity .

Following BMI calculations for all children with height and weight measurements, the study participants were categorized as overweight or obese using the international standards. There were 238 children who were found to be overweight (19.2%) and within the overweight group, 69 children were categorized as obese (5.6%).

4.4.2 Proportion of overweight and obesity by age and gender.

Figure 4.1 presents the overall proportion of overweight and obese children by age. Although the prevalence of being overweight or obese did not differ by age, there appeared to be a trend for the proportion of overweight subjects to increase with increasing age (χ^2_{trend} = 3.2, df = 1, p = 0.07). No such trend with increasing age was observed with the prevalence of obesity.

Figure 4.2 presents the proportion of overweight and obese children by gender. There were 107 (17%) boys and 131 (21.1%) girls categorized as overweight. There were significantly more girls (n = 131; 21.4%) than boys (n = 101; 17.0%) who were overweight (χ^2 = 3.86, df = 1, p = 0.05). Of the overweight children, there were 30 (4.8%) boys and 39 (6.4%) girls categorized as obese. Gender differences were not found in the obese category.

When the prevalence of overweight and obesity were examined by age and gender, there was a trend for more girls than boys to be overweight with increasing age (χ^2_{trend} = 5.77, df = 1, p = 0.02; see Figure 4.3). Nine year old girls (26.3%) were significantly more overweight than 9 year old boys (17.4%; χ^2 = 3.94, df = 1, p = 0.05). Similarly for obesity, as seen in Figure 4.4, 9 year old girls (8.4%) were more obese than 9 year old boys (3.0%; χ^2 = 4.52, df = 1, p = 0.03). Numbers for obese children by age were small.

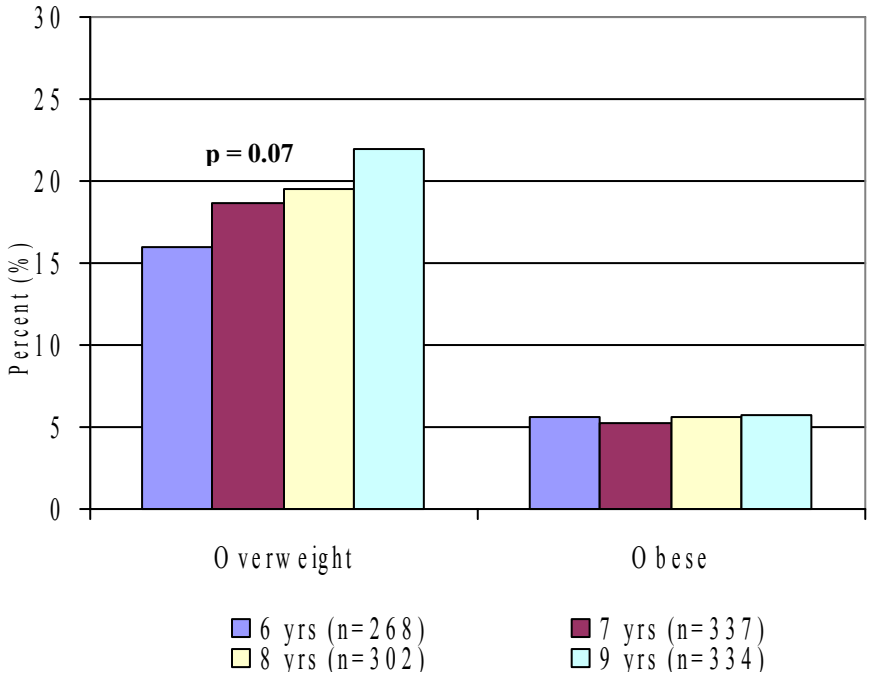


Figure 4.1. Proportion (%) of overweight and obese children by age.

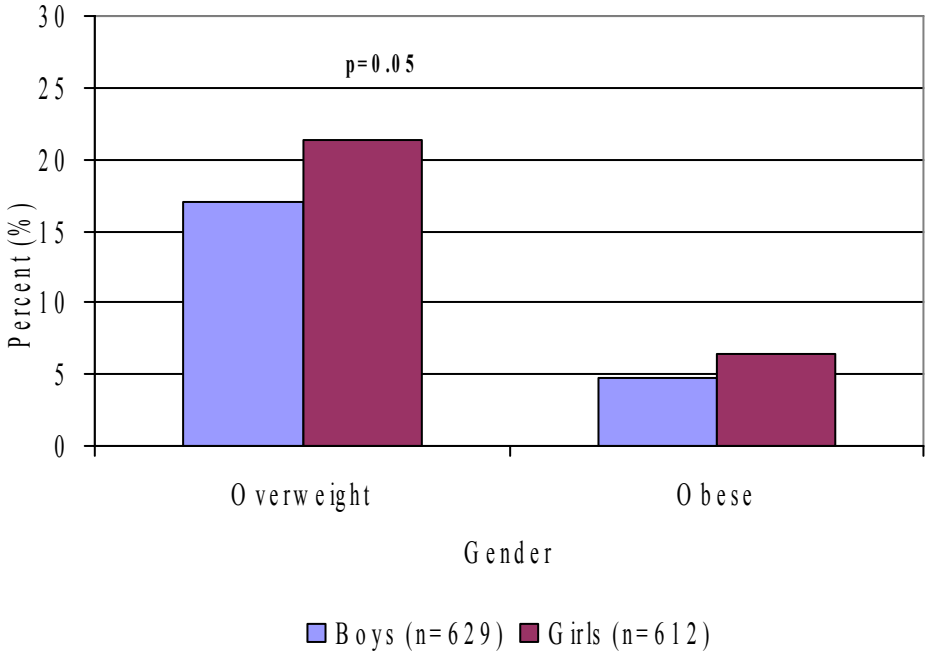


Figure 4.2. Proportion (%) of overweight and obese children ages 6 to 9 years by gender.

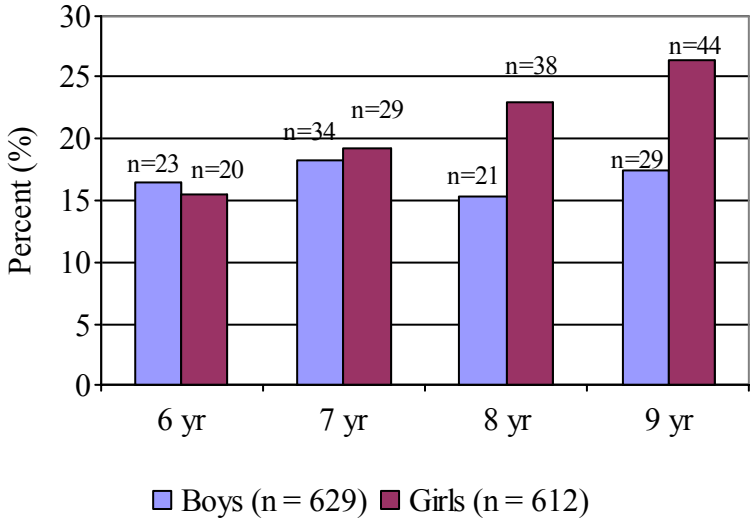


Figure 4.3. Proportion (%) of study population that were overweight by gender and age.

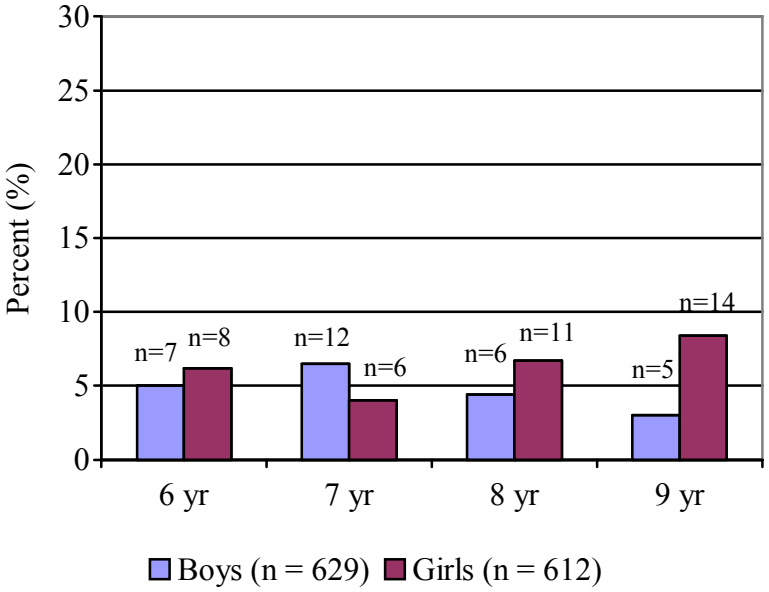


Figure 4.4. Proportion (%) of the study population that were obese by gender and age.

4.5 Research Question 2

Is there a difference between the communities in the prevalence of overweight and obesity in children ages 6 to 9 years?

4.5.1 Overall prevalence of overweight and obesity by community.

Research Question 2 compares differences between the two communities for the prevalence of overweight and obese children. Differences between towns were addressed by age and gender. The prevalence of being overweight was 18.0% (n = 116) in Swift Current and 20.5% (n = 122) in Estevan. The prevalence of obesity was 5.0% (n = 32) in Swift Current and 6.2% (n=37) in Estevan. Overall prevalence rates did not differ significantly between communities for overweight or obesity.

4.5.2 Comparison of overweight and obesity by age and gender between communities.

The prevalence of overweight children by age ranged from 11.9% for Swift Current 6 year old children to 22.4% for Estevan 9 year olds. See Figure 4.5. In Swift Current there was a trend for children to be more overweight with increasing age (p=0.07). There was also a trend for 6 year old children living in Estevan to be overweight when compared to their Swift Current counterparts ($\chi^2 = 3.55$, df = 1, p = 0.06).

When obesity was examined by age groups, the prevalence of obesity was very similar in each community (data not presented). The prevalence of obesity ranged from 4.6% for Swift Current 9 year old children to 6.8% in Estevan 9 year olds. There were no differences in prevalence of obesity between communities by age.

Figures 4.6 and 4.7 present the prevalence of overweight and obesity for girls and boys by town. There were no differences between communities for the prevalence of overweight or obesity by gender. The overall prevalence of overweight children in

Estevan was 21.9% for girls and 19.1% for boys. In Swift Current the prevalence was 21.0% for girls and 15.1% for boys which was significant ($\chi^2 = 3.75$, df = 1, $p \leq 0.05$). In Estevan 6.7% of girls and 5.7% of boys were obese compared to 6.0% of girls and 3.9% of boys who were obese in Swift Current.

With the exception of six year old boys there were no differences in obesity and overweight by age and gender between towns. Significantly more six year old boys from Estevan were overweight than 6 year old boys from Swift Current ($\chi^2 = 7.39$, df = 1, $p \leq 0.05$).

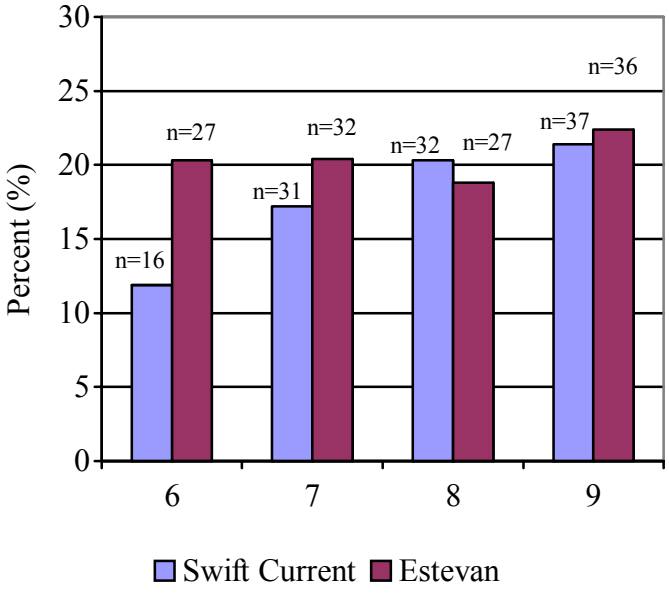


Figure 4.5. Proportion (%) of overweight children by age for Swift Current and Estevan.

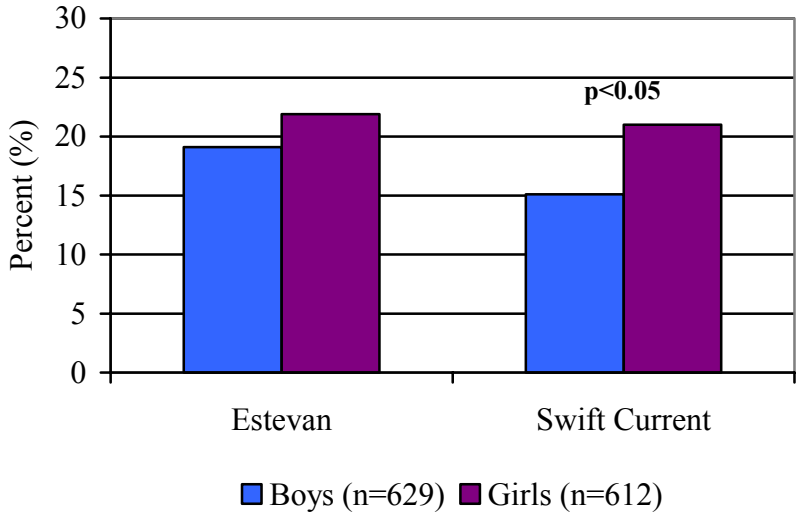


Figure 4.6. Proportion (%) of overweight children by gender for Swift Current (n = 646) and Estevan (n = 595).

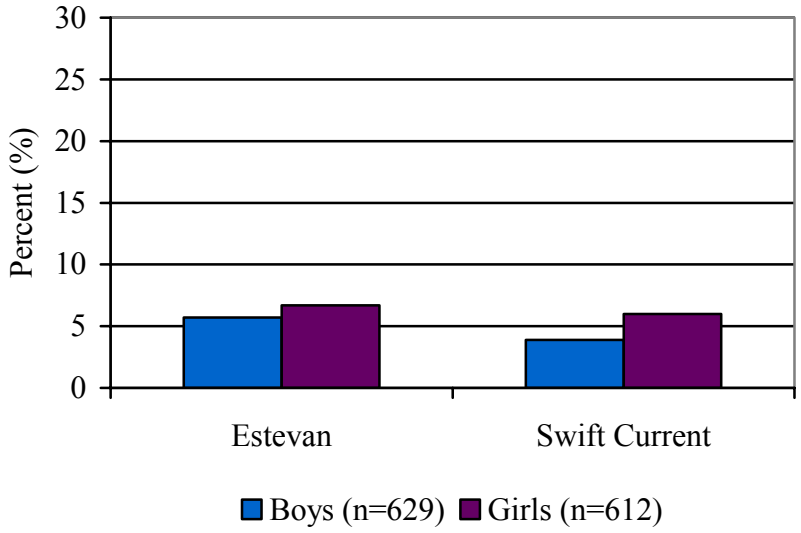


Figure 4.7. Proportion (%) of obese children by gender for Swift Current (n = 646) and Estevan (n = 595).

4.6 Research Question 3

What selected environmental factors are associated with being overweight or obese as children living in two southern Saskatchewan communities?

Research question 3 examined the associations between risk factors reported in the cross-sectional survey questionnaire and being overweight or obese. Environmental and demographic variables were selected based upon the factors identified in the conceptual framework and availability of information from the questionnaires. Univariate associations between independent variables and the outcome of being overweight and obese were addressed. Final multivariate logistic regressions were used to determine what factors were significant for obesity and for overweight at $p \leq 0.05$.

4.6.1 Characteristics of overweight children compared to non-overweight children.

Table 4.4 presents information comparing overweight children to the non-overweight children in the sample. Overweight children were more likely to have experienced gastrointestinal symptoms at least three times in the past three months (χ^2 = 7.68, df = 1, p<0.01). Mothers of overweight children were more likely to have smoked during pregnancy (χ^2 = 8.83, df = 1, p<0.01). Lower physical activity in free time was associated with being overweight as a child (χ^2 = 9.81, df = 1, p<0.01). Children who were not participating in physical education and sport in school all of the time were more likely to be overweight (χ^2 = 7.68, df = 1, p=0.01). Girls were more likely to be overweight than boys (χ^2 = 3.86, df = 1, p<0.05). In addition, more parents of overweight children reported a past history of diabetes or heart disease (χ^2 = 4.76, df = 1, p<0.05). There was a trend for the overweight children to have been more than four weeks premature (χ^2 = 2.96, df = 1, p<0.10).

Table 4.4. Distribution of host characteristics for overweight children compared with non-overweight children in the study population (n=1241).

Characteristics	Overweight n=238 n (%)	Non-overweight n=1003 n (%)
Age (years)		
6	43 (18.1)	225 (22.4)
7	63 (26.5)	274 (27.3)
8	59 (24.8)	243 (24.2)
9	73 (30.7)	261 (26.0)
Gender		
Boy	107 (45.0)[2]	522 (52.0)
Girl	131 (55.0)	481 (48.0)
House type		
Single family	207 (87.0)	877 (87.4)
Other	31 (13.0)	126 (12.6)
Parental education		
≤ Grade 12	97 (40.8)	365 (36.4)
> Grade 12	141 (59.2)	638 (63.6)
Single parent		
No	204 (85.7)	873 (87.0)
Yes	34 (14.3)	130 (13.0)
Gastrointestinal symptoms		
No	174 (73.1) [1]	814 (81.2)
Yes	64 (26.9)	189 (18.8)
Maternal smoking in pregnancy		
No	154 (64.7) [1]	745 (74.3)
Yes	84 (35.3)	258 (25.7)
Physical activity in free time		
Never/sometimes	166 (69.7) [1]	589 (58.7)
Active	72 (30.3)	414 (41.3)
Physical activity at school		
Never/sometimes	56 (23.5)[1]	160 (16.0)
Active	182 (76.5)	843 (84.0)
Breast fed		
No	58 (24.4)	256 (25.5)
< 6 months	100 (42.0)	370 (36.9)
≥6 months	80 (33.6)	377 (37.6)

Table 4.4 (continued). Distribution of host characteristics for overweight children compared with non-overweight children in the study population (n=1241).

Characteristics	Overweight n=238 n (%)	Non-overweight n=1003 n (%)
Parental history of heart disease or diabetes		
No	220 (92.4)[2]	961 (95.8)
Yes	18 (7.6)	42 (4.2)
Prematurity ≥ 4 weeks		
No	231 (97.1)	946 (94.3)
Yes	7 (2.9)	57 (5.7)

[1] $p<0.01$. [2] $p<0.05$.

4.6.2 Characteristics of obese children compared to non-obese children.

Table 4.5 presents findings for obese children compared to their non-obese counterparts. Obese children were more likely to have a mother who smoked during pregnancy ($\chi^2 = 15.03$, df = 1, $p<0.001$). Children who were not participating in physical education and sports in school all of the time were more likely to be obese ($\chi^2 = 12.89$, df = 1, $p=0.001$). Lower physical activity in free time was associated with being obese as a child ($\chi^2 = 5.24$, df = 1, $p<0.05$). Obese children were more likely to have experienced gastrointestinal symptoms at least three times in the past three months ($\chi^2 = 4.55$, df = 1, $p<0.05$).

Table 4.5. Distribution of host characteristics for obese children compared with non-obese children in the study population (n=1241).

Characteristics	Obese n=69 N (%)	Non-obese n=1172 n (%)
Gender		
Boy	30 (43.5)	599 (51.1)
Girl	39 (56.5)	573 (48.9)
House type		
Single family	58 (84.1)	1026 (87.5)
Other	11 (15.9)	146 (12.5)
Parental education		
≤ Grade 12	31 (44.9)	431 (36.8)
> Grade 12	38 (55.1)	741 (63.2)
Single parent		
No	60 (87.0)	1017 (86.8)
Yes	9 (13.0)	155 (13.2)
Gastrointestinal symptoms		
No	48 (69.6) [1]	940 (80.2)
Yes	21 (30.4)	232 (19.8)
Maternal smoking in pregnancy		
No	36 (52.2) [2]	863 (73.6)
Yes	33 (47.8)	309 (26.4)
Physical activity in free time		
Never/sometimes	51 (73.9)[2]	704 (60.1)
Active	18 (26.1)	468 (39.9)
Physical activity at school		
Never/sometimes	23 (33.3) [2]	193 (16.5)
Active	46 (66.7)	979 (83.5)
Breast fed		
No	21 (30.4)	293 (25.0)
< 6 months	31 (44.9)	439 (37.5)
≥6 months	17 (24.6)	440 (37.5)
Parental history of heart disease or diabetes		
No	65 (94.2)	1116 (95.2)
Yes	4 (5.8)	56 (4.8)
Prematurity ≥ 4 weeks		
No	67 (97.1)	1110 (94.7)
Yes	2 (2.9)	62 (5.3)

[1] $p<0.001$. [2] $p<0.05$.

4.6.3 Univariate logistic regression .

The univariate logistic regression of host and environmental factors for overweight and obese children 6 to 9 years of age is presented in Table 4.6. These findings summarize what is reported in the descriptive analysis and are presented here as general information prior to the multivariate logistic regression.

4.6.4 Multivariate logistic regression model .

Multivariate logistic regression analyses (see Appendix H) were used to determine what characteristics overall were important for overweight and obese in this study population. Variables that were significant at $p < 0.25$ in the univariate analysis and those variables which were deemed clinically important were included in the multivariate analyses for overweight and for obese. The variables chosen for each full model were age, gender, town, single parent status, parental educational status, current gastrointestinal symptoms, a family's history of heart disease or diabetes, breast feeding, prematurity of four weeks or greater, physical activity at school and physical activity in free time, and maternal smoking during pregnancy.

The final multivariate analysis for overweight is presented in Table 4.7. When all the variables were entered into the analysis, the following were associated with being overweight at $p \leq 0.05$: age, gastrointestinal symptoms in the past three months, and maternal smoking during pregnancy. A significant negative association was found between being overweight and being physically active at school and being physically active in free time.

Table 4.6. Results of univariate logistic regression for host and environmental factors for overweight (n=238) and obese (n=69) children ages 6 to 9.

	Overweight		Obese	
Variables	OR (95% CI)	p-value	OR (95% CI)	p-value
Gender				
Boy	1.00		1.00	
Girl	1.33 (1.00, 1.77)	**0.05**	1.36 (0.83, 2.22)	0.22
Town				
Swift Current	1.00		1.00	
Estevan	1.18 (0.89, 1.56)	0.26	1.27 (0.78, 2.07)	0.33
Parental education				
≤ Grade 12	1.00		1.00	
> Grade 12	0.83 (0.62, 1.11)	0.21	0.71 (0.44, 1.16)	0.17
Single parent				
No	1.00		1.00	
Yes	0.89 (0.60, 1.34)	0.59	1.02 (0.19, 2.09)	0.97
Gastrointestinal symptoms				
No	1.00		1.00	
Yes	1.58 (1.11, 2.20)	**0.01**	1.77 (1.04, 3.02)	**0.03**
Maternal smoking in pregnancy				
No	1.00		1.00	
Yes	1.58 (1.17, 2.13)	**<0.001**	2.56 (1.57, 4.18)	**<0.001**
Physical activity in free time				
Never/sometimes	1.00		1.00	
Active	0.65 (0.47, 0.91)	**0.03**	0.54 (0.30, 0.97)	**0.04**
Physical activity at school				
Never/sometimes	1.00		1.00	
Active	0.62 (0.44, 0.87)	**0.01**	0.39 (0.23, 0.67)	**<0.001**
Breast fed				
No	1.00	0.32	1.00	0.10
< 6 months	1.19 (0.83, 1.71)	0.34	0.99 (0.56, 1.75)	0.96
≥6 months	0.94 (0.65. 1.36)	0.73	0.54 (0.28, 1.04)	0.07
Parental history of heart disease or diabetes				
No	1.00		1.00	
Yes	1.87 (1.06, 3.32)	**0.03**	1.23 (0.43, 3.49)	0.70
Prematurity ≥4 weeks				
No	1.00		1.00	
Yes	0.50 (0.23, 1.12)	0.09	0.53 (0.13, 2.23)	0.38
Low birth weight				
No	1.00		1.00	
Yes	0.75 (0.39, 1.45)	0.39	1.60 (0.67, 3.82)	0.29

Table 4.7. Full model logistic regression comparing the overweight group (n=238) to the non-overweight group (n=1002).

Variable (referent)	B	SE	OR (95% CI)	p-value
Age	**0.131**	**0.067**	**1.14 (1.00, 1.30)**	**0.05**
Gender (boy)	0.233	0.148	1.26 (0.94, 1.69)	0.12
Town (Swift Current)	-0.160	0.150	1.17 (0.88, 1.56)	0.28
Gastrointestinal symptoms (no)	**0.444**	**0.172**	**1.56 (1.11, 2.19)**	**0.01**
Maternal smoking during pregnancy (no)	**0.419**	**0.162**	**1.52 (1.11, 2.19)**	**0.01**
Single parent status (no)	-0.048	0.217	0.95 (0.62, 1.46)	0.83
Parental education (≤Grade 12)	-0.120	0.156	0.89 (0.65, 1.20)	0.44
Breast feeding (no)				0.55
< 6 months	0.205	0.191	1.23 (0.84, 1.78)	0.28
≥ 6 months	0.105	0.204	1.11 (0.75, 1.66)	0.61
Prematurity ≥ 4 weeks (no)	-0.681	0.412	0.51 (0.23, 1.14)	0.10
Physical activity in free time (never/sometimes)	**-0.423**	**0.159**	**0.66 (0.48, 0.90)**	**0.01**
Physical activity at school (never/sometimes)	**-0.472**	**0.182**	**0.62 (0.44, 0.89)**	**0.01**
Family history of disease (no)	0.564	0.300	1.76 (0.98, 3.17)	0.06

The final model examining factors associated with obesity is presented in Table 4.8. Positive associations ($p \leq 0.05$) with obesity were found for maternal smoking during pregnancy and current gastrointestinal symptoms of nausea and/or diarrhea. A strong negative association was identified between obesity and being physically active at school ($p < 0.001$).

Table 4.8. Full model logistic regression comparing the obese group (n=69) to the non-obese group (n=1172).

Variable (referent)	B	SE	OR (95% CI)	p-value
Age	0.020	0.115	1.02 (0.81, 1.28)	0.86
Gender (boy)	0.272	0.256	1.31 (0.80, 2.17)	0.29
Town (Swift Current)	0.185	0.258	1.20 (0.73, 2.00)	0.47
Gastrointestinal symptoms (no)	**0.553**	**0.281**	**1.74 (1.00, 3.02)**	**0.05**
Maternal smoking during pregnancy (no)	**0.901**	**0.263**	**2.46 (1.47, 4.12)**	**0.001**
Single parent status (no)	0.260	0.385	1.30 (0.61, 2.76)	0.50
Parental education (≤Grade 12)	-0.151	0.264	0.86 (0.51, 1.44)	0.57
Breast feeding (no)				0.51
< 6 months	0.076	0.305	1.08 (0.59, 1.96)	0.80
≥ 6 months	-0.295	0.357	0.74 (0.37, 1.50)	0.41
Prematurity ≥ 4 weeks (no)	-0.699	0.741	0.50 (0.12, 2.12)	0.35
Physical activity in free time (never/sometimes)	-0.512	0.287	0.60 (0.34, 1.05)	0.07
Physical activity at school (never/sometimes)	**-0.920**	**0.276**	**0.40 (0.23, 0.69)**	**0.001**
Family history of disease (no)	0.089	0.549	1.09 (0.37, 3.21)	0.87

4.7 Summary

In summary, the results of these analyses provide important information regarding the prevalence of overweight and obesity in elementary school age children in Swift Current and Estevan. The mean BMI was higher with Estevan children than Swift Current children ($p<0.001$). There were no differences between mean ages, height, and weight for children between towns. The overall prevalence of overweight and obese children was 19.2% and 5.6%, respectively. There were no statistical differences in the overall prevalence of overweight and obesity between the two communities. When the prevalence of obesity and overweight were examined by age and gender, the following results were found:

1. Proportionately more girls than boys were overweight. No gender differences were noted for obesity.
2. There was a trend for more children to be overweight with increasing age. No such trend was noted for obesity.
3. Nine year old girls were more likely to be overweight or obese when compared with nine year old boys.
4. There were no differences for age and gender for the prevalence of obesity or overweight between towns.
5. Within communities Swift Current had significantly more girls than boys who were overweight. No such differences were noted for Estevan.

In the multivariate analysis the following observations were made:

1. Lower physical activity in free time was associated with being overweight as a child.
2. Children who were not participating in physical education and sports in school all of the time were more likely to be overweight or obese.

3. Both overweight and obese children reported more gastrointestinal symptoms of nausea or diarrhea in the past three months.
4. Maternal smoking during pregnancy was associated with being overweight and obese in children.
5. There was a trend for children who were older to be more overweight.

Chapter 5: Discussion

The purpose of this analysis was to determine the characteristics of childhood obesity in two Saskatchewan communities and to identify factors associated with childhood obesity. The cross-sectional design was appropriate to explore prevalence and associated risk factors with being overweight or obese. The response rate was excellent at over 90%. The use of measured data and the use of international standards for BMI based on age and sex provided useful information about the prevalence of childhood obesity and overweight in a large Canadian population. The following discussion will examine results for each research question. The strengths and limitations of the study will be discussed. The value of the findings for nursing practice will be explored.

5.1 Research Questions 1 and 2

What is the prevalence of overweight and obese children living in two southern Saskatchewan communities?

Is there a difference between communities in the prevalence of overweight and obesity in children ages 6 to 9 years?

5.1.1 Prevalence of overweight and obesity.

The overall prevalence of overweight and obesity was 19.2% and 5.6%, respectively. When examined by town, the estimated prevalence of overweight in elementary school age children was 20.5% in Estevan and 18.0% in Swift Current. The prevalence of obesity for 6 to 9 year olds was 5.0% in Swift Current and 6.2% in Estevan.

There were only two other Canadian studies that could be located which used the international standards to assess overweight and obesity in children. Willms et al. (2003) used the international standards with mostly self-reported data (proportion not stated) and included children ages 7 to 13 years. The prevalence of overweight and obese children was 29.3% and approximately 10%, respectively. The prevalence of overweight children in Saskatchewan was 25.7%, and 35.5% in Atlantic Canada. In the Willm's et al. study, the prevalence of overweight tended to be higher among younger children, which was opposite to the present study.

A study of 4161 Newfoundland and Labrador preschool children (Canning, Courage & Frizzell, 2004) used the international standards with measured data and reported the prevalence of overweight to widely vary from 9.8% to 19.4%. Obesity rates ranged from 7.2% to 9.8%. The current findings for the prevalence of overweight are lower than those reported by Willms et al.(2003) and similar to the higher prevalence reported by Canning et al..

Differences found between the current study and the two other Canadian studies that used international standards could be due to differences in geographical location of studies, the use of self-reported versus measured data, and the difference of the ages in each study population. In the study by Willms et al. (2003), the prevalence of overweight in Saskatchewan (25.7%) was much lower than the Canadian average. The prevalence rate for Saskatchewan is still higher than what was found in the current study (19.2%). Although the current study and the study by Willms et al., used international standards some of the data from the Willms et al. study was self-reported and therefore, may not be as reliable as measured data. In the study by Canning et al. (2004), children were preschoolers, younger than the current study population and at an age where rapid growth

patterns can occur. This difference in age of the study population could explain the wide variation in reported prevalence for overweight compared to the present study. There is a need to examine the reasons for the wide variation in the prevalence of obesity and overweight in Canadian children between the current study and the Willms study.

No studies on young children were found exploring the validity of self-reported data for overweight and obesity. Studies conducted with adult and adolescent populations have shown that self-reported data underestimates the BMI used to categorize overweight and obesity (Goodman, Hinden, & Khandelwal, 2000). Due to the limited research studies addressing the validity of parental self-report of a child's height and weight, measured data should provide a better predictor of obesity and overweight than parental or self-report.

5.1.2 International prevalence rates for overweight and obesity.

The prevalence of overweight and obesity in the current study was consistent with the majority of other international studies that used the international standards from Cyprus, Mexico, Chile, England and Australia. Researchers described children ages 6 to 7 years old in Cyprus as having a prevalence rate of overweight at 18.8% for boys' and 17% for girls' (Savva, et al., 2002). Mexican researchers found a prevalence rate of 18.8% for boys' and 22.3% for girls' ages 10 to 17 years (Del-Rio-Navarro, et al., 2004). Chilean researchers reported a prevalence rate for overweight of 18.8% for boys and 18.0% for girls' age 6 years (Kain, Uauy, Vio & Albala, 2002) and London, UK researchers published a rate of 20% for all children (Lobstein, James & Cole, 2003). Australian researchers reported an overweight prevalence of 17% for 5 to 13 year olds (Wake, et al., 2002), of 13.0% to 16.7% for 7 to 9 year olds (Booth, et al., 2003) and 15.0% to 15.8% for 7 to 15 year olds (Magarey, Daniels & Bouton, 2001).

There were two studies in which the prevalence of overweight was higher than what has been reported in this study. In Spain the prevalence was reported from 28.9% to 34.5% (Rodriguez-Artalego, et al., 2002) and in New Zealand Pacific Island preschoolers 42% (Gordon, et al., 2003). In Europe the prevalence of being overweight was usually much lower than the current findings with a prevalence of 9.4% to 12.4% in 5 to 6 year olds (Kalies, et al., 2002) and 8.6% to 10.4% in 4 to 9 year olds (Gei, Parhofer, & Schwandt, 2001). Similar prevalence rates were found in a study conducted from 1974 to 1994 with 4 to 11 year old British and Scottish children. The published rate for overweight was 9% to 13.5% for English children and 10% to 15.8% for Scottish children (Chinn & Rona, 2001). Children 5 to 16 years from Switzerland had a slightly higher prevalence rate of being overweight at 13% to 18% (Schultz and Woringer, 2002).

Internationally, similarities exist for obesity between this study population and children from the Cyprus study (Savva, et al., 2002) and Australian studies (Booth, et al., 2003; Wake, et al., 2002). The prevalence of obesity appears to be much lower for European children than what was found in the current study. German researchers reported 2.7% to 3.5% (Gei, Parhofer & Schwandt., 2001; Kalies, et al., 2002), Switzerland 2% to 3% (Schultz & Woringer, 2002), Scottish and English children 1.7% to 3.2% (Chinn & Rona, 2001), and French children 3.8% (Rolland-Cachera, et al., 2002). However, there are two other international studies where the prevalence of obesity is greater than the current findings. A higher rate of obesity was found for Spanish children (8.5% to 15.7%; Rodriguez-Artalejou, et al., 2002) and for Italian children (10% to 17%; Cacciari, et al., 2002).

Possible explanations for the variation in prevalence rates reported internationally could be due to geographical differences that have been identified in Canadian (Willms, et

al., 2003) and European (Cacciari, et al., 2002) children. Although there were no differences found between the two Saskatchewan communities for the prevalence of overweight or obesity, Canada is a vast country. Regional differences could exist for the prevalence of overweight and obesity in children.

As noted with Canadian studies, differences in prevalence rates could be due to the use of self-reported data versus measured data. The use of objectively measured data, as occurred in the current analysis, should provide a more reliable estimate of BMI and subsequently, an improved estimation of overweight and obesity. In summary, differences in the international reports of overweight and obesity highlights the benefits of standardizing the process nationally and internationally in order to increase reliability of the international standards. Larger studies need to be done and in the future possibly modifying the international standards based on current relevant data. It is imperative that prevalence rates are monitored and the trends identified for comparison internationally in order to monitor this public health concern.

5.1.3 Age and gender differences in the prevalence of overweight and obesity.

In studies to date the findings for associations between childhood overweight and obesity with age and gender are inconclusive. The current research identified an increased trend in the prevalence of being overweight as a child with increasing age. Only a few studies reported age related changes that have used the international standards. Booth and colleagues (2003) in an Australian study of 7 and 9 year old children reported that as age increased so did the prevalence of overweight, with no identified changes with obesity. Yoshinaga et al. (2002) in a longitudinal study followed Japanese children from Grade 1 to Grade 7 and reported a rising trend of overweight, especially with 12 year old girls versus the 6 year old girls. Rolland-Cachera et al. (2002) in a large (n = 1582) study of 7

to 9 year old European children found that whatever the reference used (National Health Association Examinations, Centers for Disease Control, or the international standards) the highest values were reported for the 9 year old child. These three studies have similar findings to the current study. However, two research studies identified a decreased trend with age for obesity (Savva et al., 2002) and overweight (Willms et al., 2003). This finding is interesting as the international standards have been standardized for age and gender.

In this analysis girls were more likely to be obese and overweight than boys and with significant differences at age 9. Gender differences in the current study are supported in some international studies (Chinn & Rona, 2001; Gaskin & Walker, 2003; Kain, et al., 2004; Kalies, et al., 2002; Rudolf, et al., 2004; Sanchez-Casttillo, et al., 2001; Savva, et al, 2002; Young, et al., 2000) but are not consistent with previously reported distribution by gender in other international studies (Cacciari, et al., 2002; Chu, 2001; Leise, et al., 2001) and in Canada (Willms, Tremblay, & Katzmarzyk, 2003). In addition, no gender differences have been found in a few studies (Hui, et al., 2003; Lin, Huang, & French, 2004; Magarey, Daniels & Bouton., 2001; Rolland-Cachera, et al., 2002; Yoshinga, et al., 2002).

A possible difference in findings between studies in the prevalence of obesity and overweight related to gender could be in part due to the use of self-reported versus measured data. No studies were available on the validity of parental report of height and weight with prepubescent children; however, parental and teen self-reports of height and weight along with self-reported data reported a tendency for parents and teens to over report height and under report weight (Goodman, Hinden & Khandelwal, 2000; Strauss & Pollack, 2001). In particular girls can be more preoccupied with their health and give more

attention to their weight and appearance (Tremblay, Dahinten & Kohen, 2003) thus under-reporting of actual weight and over-reporting of actual height could occur more frequently in girls. Jeffery and colleagues (2005) studied parent's awareness of overweight in themselves and their children in a cross-sectional study within a cohort. Parents were poor at identifying overweight in themselves and their children and were less likely to identify overweight in their sons. Baughcum and colleagues (2000) reported factors which were associated with mothers' failure to perceive when their preschool children were overweight in a cross-sectional survey. The majority of mothers did not view their overweight children as overweight in this study; however 95% of overweight mothers believed they were obese. Reasons for poor awareness of childhood obesity might include denial, reluctance to admit a weight problem or desensitization to excess weight as it has become a norm with our populations (Baughcum, et al.).

Physiological concerns exist when monitoring the prevalence rates of overweight and obesity in children due to the rapid growth experienced in childhood. Extensive literature on growth and development changes in BMI and body fat during childhood relates in large part to normal physiological development. Therefore possible reasons for differences in prevalence rates with age and gender could be related to the fact that BMI in childhood changes substantially with age (Cole et al., 2000). This is part of the rationale behind the development of the international standards, to define child obesity with clear cut off points related to age. As the children in the current study were ages 6 to 9 years, it is believed that the majority of the study population has probably passed the age of adiposity rebound which occurs from ages 4 to 6 years (Dietz, 2004; Skinner, Bounds, Carruth, Morris, & Ziegler, 2004; Williams, Davie & Lano, 1999). The use of the

international standards strengthens the study due to the cut off points established for age and gender.

Another concern in relation to prepubescent children is the possible introduction of confounding factors (pubertal stage, dieting, eating disorders, and physical activity) experienced with puberty. Fat deposition can occur during adolescence, when females in particular deposit fat centrally and lose fat peripherally as they mature (Dietz, 1994). The female growth spurt can occur early in puberty (mean age 11 – 12 years) compared with later in boys (mean age 14 years) (Christie & Viner, 2005). However, the defining event of puberty in girls is menarche, with the mean age in Caucasian girls at around 13 years (Christie & Viner) with varying reports that range from 12.4 to 12. 8 years (Styne, 2004) to delayed menarche in athletes from 13.3 to 14.3 years (Baxter-Jones, Helms, Baines-Preece, & Preece, 1994). The published average age for menarche internationally ranges from 12.5 to 13.7 years (Andersen, Dallal, & Must, 2003; del Rio-Navarro et al., 2004; Must, Phillips, Stunkard & Naumova, 2002; Wang and Adair, 2001). Ethnic differences exist with the age of maturation; with African-American girls maturing earlier than Caucasian girls, who can begin maturation by age 6.7 years (Styne). In addition age at menarche has been inversely correlated with BMI in a large population study of 11,293 young Israeli women (Mandel, Zimlichman, Mimouni, Grotto & Kreiss, 2004).

The rapid growth associated with maturation in girls may have influenced the findings in this study for those girls at the upper age limit of the study population. However, the trend found for increasing overweight with increasing age for girls is still noted for earlier age groups. Maturation will make a difference with the cut off points only in those countries reporting delayed or early puberty. Data for Canadian populations could not be located.

Information on maturation was not collected in the original study of asthma in children. Possible age and gender differences seen in the international studies compared to this study could be due to the use of self-reported versus measured data, differences experienced in rapid growth as a child, and age of onset of puberty between children and countries.

5.2 Research Question 3

What selected environmental factors are associated with being overweight or obese as children living in two southern Saskatchewan communities?

The findings from this study indicated that there were environmental factors that were associated with being overweight or obese as children living in two southern small urban Saskatchewan communities. These factors included physical inactivity in school and maternal smoking during pregnancy. In addition, both overweight and obese children reported increased frequency of gastrointestinal symptoms in the past three months. Children who were overweight were also more likely to have low physical activity during their free time

5.2.1 Physical activity.

The current study provides some understanding of overweight and obese children as it relates to physical activity choices in free time and in school. Children who were physically inactive at school were more likely to be overweight or obese. In addition, inactivity in leisure time was associated with being overweight as a child.

Canadian researchers note behaviours such as television watching and video game use (sedentary activities) are risk factors for being overweight and obese (Carriere, 2003; O'Loughlin, et al., 1999; Tremblay & Willms, 2003). This was supported by national and international evidence of the link between physical inactivity in children and increasing

obesity (Davison & Birch, 2001; Salbe, et al., 2002(b); Tremblay & Willms). Inactivity has been found to be positively correlated with increased BMI in children (Anderson, et al., 1998; Hernandez, et al., 1999; Keller & Stevens, 1996; Proctor, et al., 2003; Tremblay & Willms). However, one cross-sectional study reported no significant correlation between child's BMI and television viewing (Lin, Huang & French, 2004).

The level of physical activity may also be important. In a cross-sectional survey of Saskatchewan children Biliniski (2002) examined a parental report of children's physical activity. Approximately 86.0% of the rural children studied met the Health Canada guidelines (not specific for children) for physical activity (30 minutes of moderate physical activity on > 5 days/week). However, only 53.7% of children met more rigorous criteria according to the Canadian Fitness and Lifestyle Research Institute which recommends children participate in physical activity at a moderate to vigorous intensity level for 60 minutes/day for 7 days/week. Although the response rate was low to this survey it provides evidence that the intensity of the activity may be an important factor.

In the current study the parents of study subjects were provided with examples of low and high activity in free time. The intensity and frequency of either type of activity was not determined in the current study, which may also be important in the relationship of physical activity in free time to overweight and obesity. As well, the level and characteristics of physical activity in schools was not explored in depth and could be important for the accuracy of quantifying physical activity involvement in schools. Physical education programs could vary by town and by local school board policies. In this study, the proportion that participated in physical activity at school or at home in their free time was very similar between communities. Therefore, these communities could be considered as having similar physical educational programs.

The American researcher, Perez (2003) used longitudinal data from the National Longitudinal Survey of Children and Youth, cycles one through three. Perez focused the analysis on two groups of inactive children ages 4 to 11 years in 1994/1995: those who were overweight or obese and those who were of acceptable weight. Perez reported that 38% of children with acceptable weight and 34% of overweight/obese children were physically active. The results from the current research study are similar to the findings of Perez with 39.2% of children found to be physically active in their free time.

Exercise frequency is an important health indicator. Research has shown that gender differences exist in children and their level of physical activity. CIHI (2000) reported that gender, more than age, appeared to be an important factor influencing young people's exercise habits in grades 6 to 8. Girls reported exercising less than boys and furthermore female students in 1998 exercised less often than their female peers in 1990 (CIHI). Thompson and colleagues concluded in a longitudinal study of 138 Canadian children that physical activity decreased with increasing chronological age in both boys and girls (Thompson, Baxter-Jones, et al., 2003). In the current study the classification of overweight and obesity was adjusted by gender through the use of international standards. Following this, gender differences were found for overweight and obesity at age nine and a trend for more girls than boys to be overweight at all ages. The intensity of physical activity could explain gender differences and should be explored further.

The current research findings which indirectly address the relationship between physical activity and BMI were consistent with international and national research. In longitudinal studies of prepubescent children in Westernized countries [Burke, et al., 2001; Maffeis, Talamini & Tato, 1998; Salbe, et al, 2002 (a) (b)] physical inactivity was a strong predictor of increased BMI ($p < 0.05$). Cross-sectional studies using questionnaires

have identified childhood obesity was negatively associated with physical activity ($p<0.05$) in prepubescent children (Dowda, Ainsworth, Addy, Saunders & Riner, 2001; Hernandez, et al, 1999).

Few studies use measured data for physical activity. In a cross-sectional study of preadolescent youth, Trost and colleagues used accelerometers and identified that there were gender differences with the amount of moderate and vigorous physical activity (1999). In the current study after considering gender, physical activity was still associated with being overweight. In addition Trost and colleagues (2001) reported obese children exhibited lower levels of physical activity ($p<0.002$), were involved in fewer community organization activities promoting physical activity ($p<0.005$) and the fathers were less likely to physically active ($p<0.04$) (2001). The current study did not examine parental physical activity which could be important for children's physical activity levels.

In conclusion, research studies generally support the current findings in which lower physical activity both in school and physical activity in free time was associated with being overweight or obese as a child. This study on childhood obesity was consistent with provincial, national and international research reporting a significant negative correlation of physical activity in free time and of physical activity at school with overweight and obesity. The frequency and/or intensity of physical activity are an area for further investigation. Exploration of family patterns in physical activity may be useful in predicting childhood obesity and should be explored. This research provides further support for mandatory physical activity in all elementary schools.

5.2.2 Maternal smoking during pregnancy.

The strong positive association of maternal smoking in pregnancy with childhood obesity in the current study supports findings from other cross-sectional studies

(Bergmann, et al., 2003; Ong, et al., 2000; Toschke, et al., 2003; von Kries, et al., 1999; von Kries, et al., 2002) and a longitudinal cohort study (Montgomery & Ekbom, 2002). In the current research study, there was no association identified with either being obese or overweight and current paternal or maternal smoking, low birth weight, prematurity of four weeks or greater or single parent status.

Within this research study approximately 25% of mothers smoked during pregnancy. According to results reported from the National Population Health Survey (NPHS, 1996 to 1997) 28% of Canadians ages 12 and older smoked. Of new mother's between the ages of 18 to 24 years who reported a smoking history, 42% to 46% smoked during their last pregnancy (Government of Canada, 1999). These findings from the NPHS are higher than rates in the current research study of rates of mothers who smoked during pregnancy.

Fetal exposure to nicotine has several adverse effects that have been well established in the research such as low birth weight and increased fetal and infant mortality (Government of Canada, 2005; Tortora & Gabowski, 1996). Nicotine has a vasoconstrictive property that results in less blood supply to the fetus during pregnancy (Grohe, 2005). Carbon monoxide, also a by-product of cigarette smoke, results in a decreased delivery of oxygen to fetal tissues and potentially fetal hypoxia (Grohe). The ensuing result is low birth weight and increased risk of intrauterine growth retardation. However, no studies examining the association between maternal smoking in pregnancy and metabolic changes that could affect later obesity in children could be located.

The relationship between maternal smoking and childhood obesity has been suggested in the literature to be the result of catch up growth as a result of low birth weight, low socioeconomic status, or maternal weight control in pregnancy. Catch up

growth is a variable weight pattern which can compensate for intrauterine restraint (Ong, et al., 2000). This growth pattern usually occurs in the first two years of life and is suggested to occur with low birth weight babies related to prenatal smoking or the poor eating habits of smoking mothers (Hui, et al, 2003; Ong et al., 2000); however, this has not been confirmed in the literature.

Socioeconomic status and the possible association with maternal smoking and childhood obesity has been explored in the literature. Conter and colleagues (1995) in a longitudinal study of 12, 987 babies reported the deficits of birth weight in children born to mothers who smoked during pregnancy are overcome by six months of age. Furthermore, Conter suggests that the deficits are probably associated with other variables such as low socioeconomic status. The effect of intrauterine tobacco exposure on childhood obesity in the study by Toschke and colleagues (2003) of 4,974 German children was confounded by socioeconomic status. Children of pregnant women who smoked and of low economic status were more likely to be obese. Toschke reported that there was no significant difference in obesity risk between smoking in the first trimester compared with throughout pregnancy.

Further possible hypotheses for the role of maternal smoking with childhood overweight and obesity could be related to high maternal BMI and possible weight loss behaviours. There is consensus in the literature of the effects of high maternal BMI and the risk of childhood obesity (Hui, et al, 2003; von Kries, et al., 2002). It is possible that the mother could smoke in order to reduce weight gain while pregnant; however studies examining maternal smoking and the association with weight loss attempts could not be located.

It can not be ascertained if these mothers who were smokers were overweight during pregnancy, use tobacco as a method of weight control or were currently overweight and dieting. In order to confirm if mother's with higher maternal weight was associated with children's weight, this study would have needed information on mother's current weight and pre-pregnancy weight, which was not obtained in the original study on asthma in children. The strong positive association with maternal smoking in pregnancy and childhood obesity found in the current study adds to the literature of associated risk factors and childhood obesity.

5.2.3 Breast feeding.

Breast feeding as the optimal food for infants is well established in the literature (Canadian Paediatric Society, 2005; World Health Organization, 2005). The role of breast feeding in the prevention of obesity is controversial. Escarda (2005) suggests the connection between breast feeding and obesity could be related to nutrients in breast milk (breast milk has significantly different fats and proteins that are easier to metabolize versus artificial infant milk), or the different regulation of amount and type of milk the baby receives with breast feeding and the stimulation of appetite centers in the brain (versus a constant flow of formula by bottle feeding), or parental behavioural consequences such as breast feeding on demand (versus controlled feeding schedules).

In the current study breast feeding was not statistically associated with either being overweight or obese. This finding is consistent with other international findings (Eriksson, et al, 2003; Li, Parsons & Power, 2003; Hediger, et al., 2001; Victoria, et al., 2003). However, a majority of researchers (Bergmann, et al., 2003; Frye & Heinrich, 2003; Gillman, et al., 2001; Leise, et al., 2001; von Kries, et al., 1999) have found breast feeding to be a protective factor for childhood obesity. Differences between the current

study and those studies could be due to differences in study designs, variation in the definitions of breast feeding, and the age at which obesity was measured.

Primarily, two different study designs were used to assess the association between breast feeding and childhood obesity – cross-sectional (Leise, et al., 2001; Gillman, et al., 2001; Hediger, et al., 2001; von Kries, et al., 1999) and birth cohort studies that ranged from 1934 and 1994 (Erikkson, et al., 2001), to 1958 (Li, et al., 2003), to 1982 (Victoria, et al., 2003) and in the 1990's (Frye & Heinrich, 2003; Bergmann, et al., 2003). There was a wide variety of definitions for breast feeding and different categorization of length of breast feeding. One cross sectional survey by Leise and colleagues categorized breast feeding similar to the current study (never, less than 6 months, equal to or greater than 6 months). Categories included ever breastfed versus never breastfed (Hediger, et al.), or ever breastfed broken down into sub-categories of less than 6 months, 6 to 12 months, and greater than a year (Leise et al) or sub-categories of less than 4 weeks, between 4 and 12 weeks and greater than 12 weeks (Frye & Heinrich). Others studies have compared bottle feeding to breast feeding (Bergmann, et al.; Gillman, et al.) however these two studies categorized bottle feeding differently. Variation in the age at which obesity was measured was varied throughout the studies from 3 to 5 years of age (Hediger, et al.; Victoria, et al.), to 5 and 6 years of age (von Kries, et al.), and 9 through 14 years of age (Gillman, et al.; Leise, et al.).

The differences of cohort age groups may indicate changes in acceptance and social factors with breast feeding over the past 60 years (Clifford, 2003). A large sample size and specific questions on breast feeding are strengths of the current study. This research contributes to the international debate of the role of breast feeding as a protective factor in the prevention of childhood obesity.

5.2.4 Gastrointestinal symptoms.

There was a strong association in this study with being overweight or obese and a report of current symptoms of nausea or diarrhea at least 3 times in the past 3 months. Tanasescu and colleagues (2000) explored parental reports of factors associated with obesity in Puerto Rican children. Obese 7 to 10 year old children (n = 53) in this American study were more likely than controls to have experienced diarrhea during the previous year. The frequency of fruit juice consumption was also associated with obesity in this study population. Although the sample size in this study was small, it is worthy of note that it supports the current findings in children of similar ages. Further support for the current findings were found in a study of adults from New Zealand (Talley, Howell & Poulton, 2004) and from America (Delgado-Aros, et al., 2004). Both of these studies found an increase in reports of diarrhea, nausea and/or abdominal pain as BMI increased.

The relationship between obesity and gastrointestinal tract function is unclear. Delgado-Aros et al. (2004) suggests the perception of sensations of hunger occurring from the gastrointestinal tract could be diminished in obese individuals and thus facilitate overeating, or excess food intake which in turn could lead to gastrointestinal symptoms in obese patients. Carbohydrates may be eaten to assist with relief of gastrointestinal symptoms such as nausea. The upper gastrointestinal symptom of nausea reported by children in the current study is common in children (Chitkara et al., 2003). It is possible that children report nausea when they may be experiencing dyspepsia [epigastric pain associated with nausea, burning, bloating (Kohli, 2004)]. Despite the high prevalence of these symptoms, there are few studies on the pathophysiology of functional dyspepsia in children (Chitkara; Hyams, 1999).

Other possible explanations for the strong association between obesity and gastrointestinal symptoms could include gastroesophageal reflux disease (GERD), malabsorption difficulties and irritable bowel syndrome. Obesity is a risk factor in developing GERD in adults (Ray, Secrest, Ch'ien & Corey, 2002). It is possible that obese children could be experiencing GERD but specific questions concerning symptoms of GERD such as heartburn and regurgitation (Ray, Secrest, Ch'ien, & Corey) were not asked in the original survey of asthma in children.

Children's eating behaviours are influenced by several factors, including parental behaviours and actions. Parents are often responsible for exposure and accessibility to food, modeling of eating behaviors, and the feeding practices used (Birch & Fisher, 1998). Individuals who choose fibre rich, unrefined food may reduce health associated risks such as obesity and diabetes (Tortara & Gabowski, 1996). These conditions are directly related to the digestion and metabolism of food within the body's digestive system (Tortara & Gabowski). An excess intake of sugars such as found in fruit juices, has been shown to be associated with gastrointestinal difficulties such as malabsorption (Dennison, Rockwell & Baker, 1997) and diarrhea (Tanasescu, et al., 2000). Irritable bowel syndrome, which can cause diarrhea, is a common functional gastrointestinal disorder affecting children; however a lack of consensus with diagnosis and treatment in children exists (Besedovsky & Li, 2004).

In this study it was not possible to identify if obesity causes gastrointestinal symptoms in these children or whether these children feel more intensely the gastrointestinal symptoms of hunger, nausea and therefore, overeat. We know that these children who were obese or overweight at this time were currently experiencing more

gastrointestinal symptoms. The relationship between gastrointestinal symptoms experienced by obese and overweight children should be examined more thoroughly.

5.3 Strengths and Limitations of Study

The use of a cross-sectional study was appropriate to assess the prevalence of childhood obesity in a school age population. This research has provided an opportunity to identify the prevalence of being overweight and obese using measured data and the international standards for classification. This study adds to the information about obesity in Canadian children residing in small urban centers of just over 10,000 people. The research provides exciting knowledge about familial and child associated factors in relation to childhood obesity in Saskatchewan.

5.3.1 Strengths and limitations of cross-sectional studies.

Cross-sectional studies are important because they provide an estimate at one point in time of the occurrence of a condition in a population (Rothman, 1986). A valid concern with cross-sectional studies exists when information about a condition and environmental factors are collected at the same time making it difficult to establish a temporal relationship between the exposure and the outcome (Rothman). In this study there were strong associations between being overweight or obese and the level of physical activity ($p < 0.001$), and maternal smoking during pregnancy ($p < 0.001$), two variables also reported by others as being strongly associated with overweight and obesity. It is difficult to know if childhood obesity led to lower physical activity or if the lack of exercise caused the obesity. The relationship between low physical activity and obesity is quite plausible based on previously reported literature. Although this was a cross sectional study, the link between physical activity and the prevalence of overweight and obesity is convincing and could be supported with longitudinal study.

5.3.2 Sample.

Precision is a reduction of random error in the measurement of an outcome (Rothman, 1986). A strength of this current study was the large sample size (n = 1241) enabling an estimation of the prevalence of overweight in the study population of two small urban centers in southern Saskatchewan. The sample size may not have been adequate for obesity (n = 69). However, many of the findings for obesity with the exception of physical activity in free time were consistent with findings for overweight in the multivariate analyses.

5.3.3 Validity.

Selection bias refers to how participants were selected into the study (Rothman, 1986). A strength of this study was that subjects were recruited using the same procedures and at the same time in both communities. With an overall response rate of greater than 90% this study population was representative of the target population of children in the study communities. Information was collected simultaneously in the two centers over the same time period using the same questionnaire, and using the same techniques for anthropometric measures by trained research assistants. In order to further evaluate potential response bias, participants and non-participants were assessed on a variety of factors. As illustrated in Table 4.1 non-participants did not differ significantly on most variables from the participants.

All studies that evaluate the physiological processes in children must attempt to control for maturity (Mirwald, Baxter-Jones, Bailey & Beunen, 2002). A limitation of this study is the possible confounding factor of the physical development during puberty and the pubertal growth spurt. Concerns of the general public suggest that children mature earlier than in the past; however this was not supported from a critical review of national

studies of puberty by Styne (2004). Styne reports that a secular trend towards earlier puberty in girls, within the past four to five decades, cannot be supported.

There are reports in the literature of the age of menarche significantly and inversely correlated to increase BMI (Mandel, et al., 2004; Styne, 2004). Freedman and colleagues (2003) report in their study of menarche with 1,179 girls who were examined as children, adolescents, and adults in the Bogalusa Heart Study, that the importance of early menarche in adult obesity has been overestimated. The authors concluded that adult obesity was more strongly associated with childhood obesity than with age of menarche. As this is a cross-sectional study and causal relationships cannot be determined, it is difficult to ascertain whether the increased BMI and increasing prevalence rates of overweight and obesity with the 9 year old girls is possibly related to early maturation. Further longitudinal studies are needed to obtain a comprehensive data base that encompasses various ethnic groups in order to determine maturation in Canadian and Saskatchewan children.

Measurement sensitivity is determined by the use of well-developed instruments which measure with precision (Rothman, 1986). The calculation of BMI to measure overweight and obesity in children has been proven to be a consistent and reliable tool to calculate adiposity (Cole, et al., 2000; Gei, Parhofer & Schwandt, 2001; Sarria, et al., 2001). In addition, BMI better reflects excess body fat in children over five years of age and with the use of the international standards it presents the smallest height bias in children (Kain, et al., 2002). Height and weight measurements techniques were standardized between study sites and were consistent with those used by other researchers (Burke, Beilin & Dunbar, 2001; Chen, Rennie & Reeder, 1995; Maffeis, Talamin & Toto, 1998; Young, et al., 2000).

In recent studies the international standards have tended to underestimate the prevalence of obesity when compared to bio-densitometry techniques and when compared to waist and skinfold measure (Rudolf, et al., 2004). Researchers have reported high sensitivity for overweight and low sensitivity and high specificity for obesity with the international standards (Fu, et al., 2003; Neovius, Linne, Barkeling & Rossner, 2004). Reilly et al., reported the use of cut-offs for overweight had high sensitivity (90% girls and 97% boys) with lower specificity; in addition the sensitivity was low for obesity with further gender differences (46% boys and 72% in girls; $p < 0.001$). Because of these reported findings in other studies that have also used the international standards to measure overweight and obesity, it is possible that in the current study there may be an overestimation of the prevalence of overweight and an underestimation of the prevalence of obesity.

Strengths of the current study were the use of a small age range (6 to 9 years) of prepubescent boys and girls, the use of measured BMI and the use of the international standards for classifying overweight and obesity. Both BMI and the international standards have been highly scrutinized and are readily accepted internationally as an appropriate method to classify children as overweight and obese in westernized countries (Sarria, et al., 2001). However, there still exists some possibility of misclassification of subjects, in particular with obese children, with some children being missed. This could make it difficult to identify trends for childhood obesity because of decreased power. Because no Canadian children were used in the development of the international standards there could be some misclassification for Canadian overweight and obese children (Canning, et al., 2004).

Recall bias, the accuracy of recall of information, can lead to questionable validity of the research study. To assist in limiting recall bias, the parent or guardian, most familiar with the child's activities, was asked to complete the questionnaire. Wake and colleagues (2002) found that parents were more likely to report poorer health for overweight and obese children, especially with obese boys. As this study was primarily conducted to examine respiratory complaints and report asthma (see Appendix E), potential reporting bias on obesity and overweight could be minimized. To examine this potential problem, a sub-analysis was conducted to examine potential differences in the use of health care between non-obese and non-overweight as compared to obese and overweight groups. No differences between groups were found in the use of health care. Some items on the questionnaire required recall of earlier past events (prematurity, breast feeding, and past history of disease). There is a potential for some bias for recalling these earlier events.

5.3.4 Summary of strengths and limitations.

In the current cross sectional study, validity was supported through the large sample size (n=1241), the small age range (6 to 9 years), the use of measured data and the use of the international standards (Cole, et al., 2000). Measurement sensitivity was strengthened through the process of simultaneous recruiting using the same procedures and simultaneous data collection in both communities. Recall bias was limited as the individual most familiar with the child completed the survey. One concern that was not addressed in the study includes not controlling for maturation, in particular with the nine year old overweight and obese girls in both communities.

Although, age and gender were controlled for using the international standards, there is potential for misclassifying children in this study. Therefore, it is possible that the prevalence of obesity was underestimated and the prevalence of overweight children was

overestimated. In summary, this was a robust cross sectional study that provided new information on the prevalence and associated factors of childhood overweight and obesity in Saskatchewan, Canada.

5.4 Findings in Relationship to Conceptual Framework

The review of the literature provided the basis for the conceptual model presented in Figure 2.1, Chapter 2. Variables in the original conceptual model that were strongly associated with childhood overweight and obesity in this study were age, gender, physical activity (both in free time and at school), and prenatal history (maternal smoking). These findings concur with current international literature on childhood obesity.

Variables such as genetics (parental history of diabetes and heart disease), socioeconomic status (parental education and single parent status) and nutrition (breast feeding history) were found to be associated with overweight and obesity initially, however no association was evident during the multivariate analyses. The lack of association at the multivariate level in the current cross-sectional study does not negate the prior research that determined these variables were associated risk factors or influences; although differences in methodologies between studies or differences in study populations could have influenced findings.

Two other variables, ethnicity and parental BMI, were included in the conceptual model and were not examined in this study. Ethnicity could not be examined as the majority of the children in this study were Caucasian (94.6%) and only a small percentage of children were First Nations/Metis (<2.0%). No anthropometric data, required to measure BMI, was collected from the parents of children participating in the current study.

Physiological (gastrointestinal) outcomes were strongly associated with being overweight and obese as a child whereas, asthma, allergies, diabetes and heart disease

were not. The association between current gastrointestinal symptoms and obesity and overweight was a new finding and requires further exploration in the research and inclusion of this variable in the conceptual framework.

Recommendations for the conceptual model would include adding arrows from the outcomes back to the influencing variables. For example, physiological (gastrointestinal) outcomes could be associated with socioeconomic status, nutrition, parental history, and parental BMI. Further, weight loss behaviours could be associated with physical activity, nutrition, and parental BMI. In this study, gender influenced the prevalence of being overweight and obese, and gender likely influenced outcomes such as physiological, weight loss behaviours and psycho-social issues although this interaction was not tested in the analyses. In summary, the conceptual model is useful to highlight the complexity and multifactoral nature of both variables and outcomes as related to being overweight and obese as a child.

5.5 Value of the Findings for Nursing Practice

The information gained from this research study contributes new knowledge on the prevalence rates of children who were overweight and obese in these two, small urban communities using measured data and the international standards. Our understanding of the characteristics associated with obesity and overweight children in southern Saskatchewan has been increased. The findings from this thesis have clinical significance for all registered nurses in settings such as public health, pediatric acute care, primary health care, and educational institutions. Because of the multifactoral nature of obesity, it provides a unique opportunity to conduct interdisciplinary team work with teachers, physical education instructors, nutritionists, physiotherapists, social workers, occupational

therapists, and physicians. Nurse scientists and clinicians have a significant role to play in assessing and preventing overweight and obesity in children.

5.5.1 Nurse scientist

Reorientation of health services on childhood obesity requires systematic research (McMurray, 1999). Nurse scientists, through sharing the research findings, can empower community members to make health care decisions which are congruent with primary health care principles of equity, access, self determination and cultural sensitivity (McMurray). Nurse researchers share an important role with government agencies, school boards, and teachers, other members of the health care team and parents to address issues around childhood obesity.

Cross-sectional population based studies are necessary to provide information that can be used to formulate better representation of Canadian populations in developing the international standards for measuring overweight and obesity. Further studies including rural and small urban communities in Canada are necessary. International studies of obesity using standardized questionnaires and measurements, similar to what has been used to monitor asthma prevalence internationally, (Asher, et al., 1995), would be useful in determining whether or not obesity is increasing worldwide. Additional research into the qualitative aspects of physical activity and inactivity which identifies reasons for choices and lifestyle approaches is needed.

Previous studies have generally shown there has been little success with decreasing or preventing childhood obesity through implementation of programs within school settings, such as focusing education on the benefits of physical activity and nutrition (Kain, et al., 2004; Mallan, Metcalf, Kirby, Voss & Wilkin, 2003). However, many of these interventions were conducted in a single school over short periods of time

(less than a school year). Jago and Baranowski (2004) completed a systematic review to identify research that evaluated the effectiveness of non-curricular interventions on the physical activity of children and adolescents. Extracurricular, school-based interventions had problems with low attendance and suggest that delivering programs through existing community organizations might increase attendance. They recommend future research focuses on enhancing the effectiveness of interventions.

A National Institute of Health initiative in the United States, funded 20 pilot studies designed to stimulate novel research for obesity prevention (Kumanyika & Obarzanek, 2003). Halfway through the research funding, a workshop was held which focused on concepts and experiences with initiating and conducting the obesity prevention studies. Theoretical perspectives and challenges were discussed, such as the difficulty of motivating individuals for preventing weight gain, relevant cultural and ethnic considerations and the need for valid and practical measure of energy balance, body composition and physical fitness. The researchers at this workshop concluded that there is a need to not only focus on evaluating obesity treatment but also to evaluate obesity interventions.

Future Canadian and international research on interventions, both physical activity and nutrition programs, should be broad and need to include larger populations of children. The long term effects of such programs need to be studied. Research identifying risk factors for obesity and precursors are essential for development of effective prevention programs. The impact of current gastrointestinal symptoms with children who are overweight or obese requires further investigation. These findings need to be validated by other studies using different populations and measured data.

5.4.2 Nurse clinician

The results of this study contribute to the data base on prevalence rates of Saskatchewan and Canadian children and the associated risk factors of childhood obesity using international standards and measured data. The findings from this research have clinical significance for primary health care nurse practitioners, public health nurses, pediatric nurses, general duty nurses, community health administrators, and educators. Nurses are viewed as an important source of information within communities and as such have opportunities to promote health for families, friends, neighbours, and clients. Nurses have an understanding of the importance of the determinants of health and are familiar with collaborating with other members of the health care team and communities in which they serve and live.

Nurses are an integral part of the health care team in many settings and the knowledge gained from this study can be applied to providing optimal nursing care and support to parents and children in a variety of settings such as primary health care sites, well baby clinics, home care, schools, and acute care sites. Communities and health regions need to implement programs in settings such as public health and primary health care sites that aim to promote healthy life styles. Successful intervention programs must recognize the powerful influence friends, peers, and popular culture have with the youth in our society.

Nurses, as health care professionals, have an opportunity to facilitate people in recognizing and strengthening community resources (McMurray, 1999). Communities in action can use a primary health care approach, by providing healthy choices in school vending machines and school lunches. Schools, together with families, need to emphasize the importance of sports as a lifelong physical activity. Sporting activities and recreational

facilities must be available to all in order to build strong, healthy children in our communities (McMurray).

Furthermore, families need support in order to facilitate health lifestyles. Time is a commodity in our society and often nutrition and physical activity are the first to be ignored when time is limited. Nurses can provide supportive environments at well baby clinics and primary health care sites. Nurses and dieticians can provide current, relevant information to parents in school and in community settings through encouraging and supporting families to develop healthy lifestyles, including nutrition and physical activity.

Nurses need to explore barriers to access of community programs and facilities and find innovative ways to address the barriers. The barriers will be unique to each community and through community participation public health nurses can design, implement and evaluate possible innovative programs that would target childhood obesity in their community. Topics focusing on healthy lifestyles such as nutrition and physical activity should be part of the programs. Community health care administrators and government officials need to provide resources of people and money in order to facilitate the process.

Educators within nursing and other health care professions should actively seek out new practicum settings for students that provide opportunities to educate and implement healthy lifestyle programs with children, youth and families. Partnerships could be formed with universities and school divisions in urban and rural communities. The health care students (such as those in programs of kinesiology, nursing, and nutrition) could assess children, youth and family needs within the community, plan and provide interventions to children and parents on topics of healthy lifestyles. Some examples could include education of the benefits of eating according to Canada Food Guide and how to

implement the guidelines within the home setting, mindful of economic and time constraints. Young children could be taught basic skills (such as how to throw a ball, how to jump and how to run), sports and simple games in order to encourage lifestyle choices that involve being physically active in free time and at school.

In order to be successful, nurses need to have knowledge of the prevalence rates of overweight and obesity. The recent Saskatchewan data from this study will be useful to community health care administrators and community nurses when planning and implementing programs to prevent childhood obesity. Nurses need to know of risk factors associated with childhood obesity in order to identify modifiable factors that can be addressed in their setting and community. The conceptual framework (Figure 2.1) identifies non-modifiable factors such as age, gender, and genetic factors as associated with obesity in children. However, all nurses can advocate for more green space and safe play areas in communities in which they play and work. Nurses have opportunities to serve as elected officials on town council and boards of education, and to be involved within their communities on sports and school committees contributing knowledge and expertise.

Public health nurses can talk at prenatal classes and well baby clinics about risk factors associated with childhood obesity such as prenatal smoking, breast feeding, low birth weight, paternal and maternal BMI, and the importance of diet and exercise in relation to healthy lifestyles for the family. Health care administrators and government officials can ensure there are resources of time and people in order to support implementation of this education to prevent childhood obesity. Faculty within health care fields can educate students about the associated risk factors of childhood obesity. Education about the role of parental BMI, nutrition and physical activity as associated

with an increased risk of childhood obesity can be done by pediatric nurses, primary health care nurse practitioners, public health nurses and educators.

Childhood obesity is a major public health concern. Education and prevention should begin early in life and involve parents. Any nurse, in any setting, has occasion to share knowledge with parents and children about the importance of physical activity and nutrition and promotion of healthy lifestyles. Nurses have an exciting opportunity to impact future generations through their actions addressing the prevention of childhood obesity.

Chapter 6: Conclusions

6.1 Summary

This thesis has provided information concerning childhood obesity and associated factors in two southern Saskatchewan communities thus generating hypotheses for future studies. The cross-sectional design was an appropriate method to assess the prevalence of overweight and obesity in this population which was enhanced by the excellent response rate and large sample size. The following highlights were identified in this study:

- The overall prevalence of being overweight was 17% for boys and 21.4% for girls. The prevalence of obesity was 4.7% for boys and 6.4% for girls.
- Gender differences for overweight and obesity exist within this sample with girls more at risk for being overweight than boys, which was consistent with international research but opposite of previously published Canadian findings.
- Age was a factor with girls; even after controlling with international standards, there was a trend for the prevalence of overweight to increase as age increased ($p < 0.10$). There was an increased prevalence of being overweight or obese with girls age 9. This is consistent with international research; however contrary to previously reported findings in Canada.
- There were proportionally more obese girls than boys at age 9, with no other statistical differences identified in the prevalence of obesity within this sample. Prevalence rates for obesity in this analysis were similar to European countries and Australia yet less than published Canadian findings.

- Physical activity in free time was negatively associated with being overweight in this sample. Physical activity in school was negatively associated with being overweight and obese in the study population. The role of physical activity in children, both in and out of school, concurs with national and international findings.
- This research provides new information on the presence of gastrointestinal symptoms (nausea or diarrhea more than three times in the past three months) being reported more frequently in children who were overweight or obese ($p \leq 0.05$).
- Maternal smoking during pregnancy was associated with an increase in being overweight and obese ($p < 0.001$). Smoking during pregnancy is contentious within the literature; however this study population adds to the previously published research which shows a significant effect on the risk of children becoming overweight or obese if the mother smokes during pregnancy.
- Breast feeding was not associated with childhood obesity or overweight in this study population despite the large sample size and excellent response rate. This was contrary to the majority of published international research.

6.2 Conclusions

Anthropometric measures and questions on the survey relating to childhood obesity have provided valuable information on the prevalence of childhood overweight and obesity and associated factors in this study population. Although the mean BMI was higher in Estevan than in Swift Current for the overall study population, once stratified for age and gender, there were no statistical differences in the overall prevalence of overweight and obesity between the two communities. This finding reinforces the importance of having international standards which considers age, gender, and BMI when categorizing overweight and obese children.

The prevalence of overweight and obesity in the two Saskatchewan communities was lower than expected based on Canadian and international data. One reason for this difference in prevalence rates could be explained through the use of measured data in this analysis; however these findings are preliminary and need to be verified in other populations. Significant findings for girls confirm previous reports for gender differences and girls should be considered at high risk for obesity. Sedentary lifestyles, both in school and at home, may be important for the development and continuation of obesity in childhood. Obese and overweight children could be experiencing significant digestive related health concerns and gastrointestinal symptoms deserve further research.

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Appendix A

International standards for overweight and obesity

Table 1. Classification of Obesity Using BMI (kg/m^2) *.

Age**	Males	Females
6	20.2	20.1
7	21.0	21.0
8	22.0	22.0
9	23.4	23.5

* Published cut offs for BMI for obese children by sex between age 6 and 9 years. The cut offs are defined to pass through BMI of 30 kg/m^2 (obese) at age 18 years (Cole et al., 2000).**For each child a whole age category was used with midpoint age values for BMI.

Table 2. Classification of Overweight Using BMI (kg/m^2) *.

Age**	Males	Females
6	17.7	17.5
7	18.2	18.0
8	18.8	18.7
9	19.5	19.5

* Published cut offs for BMI for overweight children by sex between age 6 and 9 years. The cut offs are defined to pass through BMI of 25 kg/m2 (overweight) at age 18 years (Cole et al., 2000).**For each child a whole age category was used with midpoint age values for BMI.

Appendix B

Ethics approval for original study

University of Saskatchewan
Advisory Committee on Ethics in Human Experimentation

August 5, 19

Certificate of Approval

PRINCIPAL INVESTIGATOR	DEPARTMENT	BMC#
D.C. Rennie	Nursing/Agricultural Medicine	1999-12

INSTITUTION(S) WHERE RESEARCH WILL BE CARRIED OUT

University of Saskatchewan

CO-INVESTIGATORS

A. Senthilselvan
H. McDuffie
D. Cockcroft
D. Allison
T. Herrick

SPONSORING AGENCIES

Saskatchewan Lung Association

TITLE:

Study of Asthma Prevalence in School Children in Estevan and Swift Current

APPROVAL DATE	TERM (YEARS)	AMENDED:	MODIFICATION OF:
August 5, 1999	3		

CERTIFICATION:

The protocol and consent form (if applicable) for the above-named project have been reviewed by the Committee and the experimental procedures were found to be acceptable on ethical grounds for research involving human subjects.

APPROVED.

D.W. Quest, Chair
University Advisory Committee on
Ethics in Human Experimentation

This Certificate of Approval is valid for the above term provided there is no change in experimental procedures, subject to annual re-approval.

Please send all correspondence to:

Office of Research Services
University of Saskatchewan
Room 207 Kirk Hall, 117 Science Place
Saskatoon, SK S7N 5C8
Phone: (306) 966-4053 Fax: (306) 966-8597

Appendix C

Copy of local school board consents

THE PUBLIC BOARD OF EDUCATION OF THE
ESTEVAN SCHOOL DIVISION
NO. 95 OF SASKATCHEWAN

130 King Street, Estevan, SK S4A 2T5
Telephone: (306) 634-4777
Facsimile: (306) 634-6768

November 3, 1999

Mr. Donna Rennie
Assistant Professor
Centre for Agricultural Medicine
University of Saskatchewan
P.O. Box 120, Royal University Hospital
Saskatoon, SK S7N 0W8

Dear Dr. Rennie:

Your letter dated October 18, 1999 was presented to the Board of Education for the Estevan School Division No. 95 at their meeting held on Monday, November 1, 1999. The Board has given its approval for you to involve our school division in your study regarding asthma prevalence in school-aged children. Therefore, you will find enclosed a listing of the schools in our division, along with names and telephone numbers of the principals at each of the schools. You can contact each school directly to arrange for your visit.

If you require any further information from me, however, please do not hesitate to give me a call.

Sincerely,

Larry Steeves

Larry E. Steeves, Ph.D.
Director of Education

LS/pc
#95
Enclosure

PS - The Board was hopeful that a copy of the completed study would be made available to them.
Larry S.

Excellence and Caring

Subject: A Study of Asthma
Date: Fri, 12 Nov 1999 09:24:37 +0000
From: Al Boutin <weyb.cent.director@sk.sympatico.ca>
To: rennied@sask.usask.ca

Dr. Rennie

The Estevan Catholic School Division passed a motion to approve participation in this study at our three schools.

Please let me know if you require any further information.

Please respond to this email so that I know that you received it.

Thanks,

Al Boutin
Director of Education
Weyburn Central School Divsion No. 73
Weyburn Roman Catholic Separate School Division No. 84
Estevan Roman Catholic Separate School Division No. 27
21 - 5th STREET N.E.
Weyburn, Saskatchewan S4H 0Y9

Fax: 306 842 1261
E-mail: weyb.cent.director@sk.sympatico.ca

Appendix D

Children's Respiratory Health Questionnaire

Children's Respiratory Health Questionnaire

Confidential when Completed

The following questionnaire has **four** parts. Please answer all parts as they concern your child and surroundings. **Part One** requests you and your child's permission for your child to participate in the breathing test, blood pressure, height and weight measurements. **Part Two** asks some general questions about your child and about your child's past and present health. **Part Three** asks about your child's surroundings. **Part Four** asks questions about your child's personal and family history.

ALL INFORMATION WILL BE KEPT CONFIDENTIAL AND USED ONLY TO GROUP YOUR RESPONSES WITH THE QUESTIONNAIRE RESPONSES OF OTHER PARENTS.

Please Note: **THE PERSON MOST FAMILIAR WITH THE CHILD'S HEALTH SHOULD COMPLETE THE QUESTIONNAIRE.**

The questionnaire can be answered by checking the best answer or by filling in the blank with number or words.

EXAMPLE 1:

Does your child usually have a cough at night ?

Yes_√_ No___

EXAMPLE 2:

How many years has your child lived in this home?

__6__Years

PART ONE

PERMISSION:

This survey is meant to study the respiratory health of children and the factors affecting it. I understand that this will involve filling out this questionnaire, measuring my child's height, weight and blood pressure. It will also involve a simple test of breathing that will measure how much air my child can blow out in a single breath. All information will be used for research purposes only. I understand that my child can refuse to participate at any time in any part of the study measurements and will have a chance to ask questions before the measurements are done. I have explained this permission slip to my child and my child agrees to participate.

_____

Signature of Parent or Guardian

_____

Signature of Child

Today's Date _____

◆ - ◆ - ◆ - ◆ - ◆

To assist with the breathing test we will need the following information

Name of School_____ Grade _____

Child's First Name_____

Last Name_____

Address _____

Telephone No. _____

◆ - ◆ - ◆ - ◆ - ◆

Person completing questionnaire:

Mother___

Father___

Other___ Relationship to child

_____

PART TWO

Cough

Has your child ever had a dry cough at night or first thing in the morning **NOT** associated with a cold or chest infection? *Tick all that apply*

___Yes, past 12 months
___Yes, before the last 12 months
___No

2. Does this child usually cough at all during the rest of the day?

No ___ Yes ___ Don't know ___

Congestion and Phlegm

3. Does this child usually have congestion in the chest or bring up phlegm or mucus **apart from colds?**

No ___ Yes ___ Don't know ___

If YES, has this congestion or phlegm been present for as much as 3 months in a row out of the year?

Tick all that apply
___ Yes, past 12 months
___ Yes, before last 12 months
___ No

Wheezing

4. Has this child ever had a wheeze or whistling noise that comes from the chest?

No ___ Yes ___ Don't know ___

If YES, *tick all that apply*
___ Yes, past 12 months
___ Yes, before last 12 months

***IF NO, GO TO QUESTION 9.**
***IF YES, CONTINUE ON TO QUESTION 5**

5. Does the wheezing or whistling in the chest occur:

___ apart from colds?
___ with colds?
___ both apart from colds and with colds?

6. How many attacks of wheezing or whistling in the chest has this child had in the past 12 months?

___none
___1-3
___4-12
___more than 12

7. Does wheezing or whistling in the chest occur most nights or days?

___ Nights only
___ Days only
___ Both nights and days

8. Has this child ever been short of breath with wheezing? (speech limited to one or two words between breaths) *Tick all that apply*

___ Yes, past 12 months
___ Yes, before last 12 months
___ No

9. Is this child **currently** taking medicine that your doctor prescribed for a breathing problem? ("taking" includes taking regularly or only when needed)?

No ___ Yes ___ Don't know ___

If **YES**, please name the medicine(s) below:

_____
_____
_____
_____
_____

10. Has your child's chest ever sounded wheezy during or after exercise/sports? *Tick all that apply*

___Yes, past 12 months
___Yes, before last 12 months
___No

11. **In the past 12 months** has this child been kept at home from school for 3 or more days with a chest illness?

No ___ Yes ___ Don't know ___

If **YES,** How many times?_____

12. Has this child ever been diagnosed as having asthma by a doctor?
No ___ Yes ___ Don't know___

***IF NO or DON'T KNOW, PLEASE GO TO QUESTION 21 (Other Illness)**
***IF YES, CONTINUE AT QUESTION 13**

13. At what age was the asthma diagnosed?
___years of age

14. How old was your child when you first noticed symptoms of asthma?
___years of age

15. **In the past 12 months**, how many times has your child required services for asthma from:
Number of times
___ Emergency Department
___ Doctor's office

16. **In the past 12 months**, how many asthma episodes has your child had?
___ (number of episodes)

17. Which of the following statements best describes this child's asthma medication use **in the past 12 months:**
___My child used asthma medications **every day**
___My child used asthma medications at least **once a week**
___My child used asthma medication at least **once a month**
___My child uses asthma medications at least **once in the past 12 months**

18. Do you have been given a written plan to manage your child's asthma?
No ___ Yes ___Don't know ___

19. At what time of the year does this child **usually** have asthma episodes? *Tick any that apply*
___ Spring ___ Summer ___ Fall
___ Winter ___ All year ___ Never

20. In the past 12 months how many days of school has your child missed because of asthma?
___ days

Other Illness

21. **During the past twelve months**, has a doctor ever said this child had any of the following illnesses:

Bronchitis	No ___	Yes ___
Pneumonia	No ___	Yes ___
Hay fever	No ___	Yes ___
Sinus trouble	No ___	Yes ___
Pulmonary tuberculosis	No ___	Yes ___
Whooping cough	No ___	Yes ___
Croup	No ___	Yes ___
Other chest illness (including chest operations and injuries)	No ___	Yes ___

22. **Before the past twelve months**, had a doctor ever said this child had any of the following illnesses and at what age:

Bronchitis	No ___	Yes___	Age ___
Pneumonia	No ___	Yes___	Age ___
Hay fever	No ___	Yes___	Age ___
Sinus trouble	No ___	Yes___	Age ___
Pulmonary tuberculosis	No ___	Yes___	Age ___
Whooping cough	No ___	Yes___	Age ___
Croup	No ___	Yes___	Age ___
Other chest illness (including chest operations and injuries)	No ___	Yes ___	Age ___

23. Has this child ever had an allergy (hives, runny nose, swelling, itchiness and/or wheezing) to any of the following:

House dust	No ___	Yes___	
Grain dust	No ___	Yes___	
Pollen	No ___	Yes___	
Trees	No ___	Yes___	
Grasses	No ___	Yes___	
Mold or mildew	No ___	Yes___	
Dog or Cat	No ___	Yes___	
Birds/feathers	No ___	Yes___	
Farm animals	No ___	Yes___	If **YES**, what kind?_____
Chemicals	No ___	Yes___	If **YES**, what kind?_____
Foods	No ___	Yes___	If **YES**, what kind?_____

Other (please name)_____

If NO TO QUESTION 23, Go to QUESTION 26

. . Has you child been tested for allergies?

No ___ Yes ___

If YES, at what age?_____

25. In the past, has your child needed Adrenalin (Anakit or Epipen) for allergic reactions?

No ___ Yes ___

26. **In the past three months**, has your child experienced any of the following symptoms at least **three** times?

itchy eyes	No ___	Yes___
itchy skin	No ___	Yes___
runny stuffy nose	No ___	Yes___
sneezing	No ___	Yes___
throat irritation	No ___	Yes___
hoarse voice	No ___	Yes___
headaches	No ___	Yes___
muscle aches	No ___	Yes___
fever and chills	No ___	Yes___
nausea or diarrhea	No ___	Yes___
cough when waking up	No ___	Yes___
cough at night	No ___	Yes___
tremors of hands	No ___	Yes___

Past Illnesses - General

27. Has a doctor ever said this child had:

1. Diabetes	No ___	Yes ___
2. Heart disease or defect	No ___	Yes ___
3. High blood pressure	No ___	Yes ___
4. Cystic fibrosis	No ___	Yes ___
5. Ear infections	No ___	Yes ___
6. Eczema	No ___	Yes ___

If YES, is this child currently being treated for:

1. Diabetes	No ___	Yes ___
2. Heart disease or defect	No ___	Yes ___
3. High blood pressure	No ___	Yes ___
4. Cystic fibrosis	No ___	Yes ___
5. Ear infections	No ___	Yes ___
6. Eczema	No ___	Yes ___

28. Has this child have an operation to remove the tonsils or adenoids?

No ___ Yes ___

29. **During the past twelve months**, was this child seen by a doctor for an accident or injury?

No ___ Yes ___

30. **During the past twelve months**, was this child kept over night in the hospital for any illness?

No ___ Yes ___

If YES, how many times? Times ____

Please specify:

	Diagnosis	Length of stay (days)
1.	_____	_____
2.	_____	_____
3.	_____	_____

31. **Before the past twelve months**, was this child ever kept over night in the hospital for any illness?

No ___ Yes ___ Don't know ___

If YES, how many times? Times ___

Please Specify:

	Diagnosis	Length of stay (days)
1.	_____	_____
2.	_____	_____
3.	_____	_____

Lifestyle

32. Which of the following describes your child the best?

Please read all of the following statements before deciding on the answer that best describes your child

A.____All or most of my child's free time (out of school) is spent doing such things such as watching TV, playing video games, reading, homework.

B.____All or most of my child's free time (out of school) is spent doing physical things such as playing sports, running, bike riding, swimming, dancing.

33. Does your child participate in sports/physical education at school?
____ Never
____ Some of the time
____ All of the time

34. Has your child ever tried to lose weight?
No __ Yes __

35. Is your child presently trying to lose weight, gain weight or neither?
Lose weight __
Gain weight __
Neither __

36 If your child is presently trying to lose weight, which of the following methods are being used?
Dieting No __ Yes __
Exercising No __ Yes __
Other, specify: _____

PART THREE

Environment - General

37. How long has your child lived in or near this town? ____ Years

38. Where is your home located?
____ Farm
____ Acreage
____ In town

39. On average, how many hours on a Saturday or Sunday does this child spend outdoors...
From September to March ____ hours
From April to August ____ hours

Environment - Home

40. Which best describes the type of housing unit in which you live?
one family house ____
a duplex ____
a building for 3 or more families ____
a mobile home or trailer ____
other, please specify_____

41. About which year was this building originally built? Year ____
Don't know __

42. Have renovations been done to the home?
No __ Yes __ Don't know __

If YES, in what year(s)?_____

43. How many rooms are there in your home (**not including bathrooms, porches, balconies, halls or entrance ways**)?
Rooms __

44. How many people live in your home?
Number __

45. How is your home heated?
____ Gas furnace
____ Electricity
____ Hot Water
Other, specify _____

46. Do you have any of the following in your home?
Air conditioners No __ Yes __
Air filter No __ Yes __
Humidifier No __ Yes __
Dehumidifier No __ Yes __
Fireplace No __ Yes __

47. Does your house have any damage caused by dampness (e.g., wet spots on walls, floors)?
No __ Yes __

48. Are there signs of mold or mildew in any living areas in your home?
No __ Yes __

49. Do you have any pets living inside your home?
No __ Yes __
If YES, please specify kind(s)_____

50. Have you ever had a pet living in your home?
No __ Yes __
If YES, please specify kind(s)_____

51. Does the **child's father** currently smoke?
__Yes
__No, but former smoker
Year stopped ____
__No, never smoked

52. Does the **child's mother** currently smoke?
___Yes
___No, but former smoker
Year stopped _____
___No, never smoked

53. On average, how many cigarettes are smoked in your home a day? (Please take into account everyone who smokes in your home)
_____ Cigarettes/day

54. Is this child exposed to smoke in a car?
No ___ Yes ___ Don't know ___

PART FOUR

Information - Child

55. Child's sex: Male____ Female____

56. Date of Birth: ___ ___ ___
Mo. Day Yr.

57. Child's age: _____

58. What was the child's weight at birth? _____

59. Was this child born before mother's due date?
No ___ Yes ___ Don't know ___
If **YES**, how many weeks early? _____weeks

60. Did the mother breast feed this child?
No ___ Yes ___ Don't know ___
If **YES**, was it for :
____Less than 6 months
____6 months or longer

Information - Family

61. Did the mother smoke during the pregnancy?
No ___ Yes ___ Don't know ___

62. Does the child's natural mother have any of the following conditions? (*Tick any that apply*)

___Chronic bronchitis or other lung disease
___Asthma
___Hayfever, allergies, eczema
___ Diabetes
___Heart Disease or defect
___ High blood pressure
___ None of the above

63. Does the child's natural father have any of the following conditions? *Tick any that apply*

___Chronic bronchitis or other lung disease
___Asthma
___Hayfever, allergies, eczema
___ Diabetes
___Heart disease or defect
___ High blood pressure
___ None of the above

64. How many of the child's natural brothers or sisters have had the following conditions?

1. Asthma	Number ___
2. Diabetes	Number ___
3. Heart disease or defect	Number ___
4. High blood pressure	Number ___
5. Hayfever, allergies or eczema	Number ___

65. What is the highest level of education completed by the child's mother?
___Public school
___Grade 12
___Technical school
___University degree

66. What is the highest level of education completed by the child's father?
___Public school
___Grade 12
___Technical school
___University degree

67. Type of household
___ Single parent home
___ Two parent/partner home

68. What is the child's major ethnic background?
___Caucasian
___Aboriginal
___Other Please specify _____

THE END

Thank you for completing the questionnaire. Please make any comments you wish below.

FOR OFFICE USE ONLY

Height: _____ (cm)

Weight: _____ (kg)

	1	2
Systolic BP (mmhg):	_____	_____
Diastolic BP (mmhg):	_____	_____

Lung Function testings:

Done _____

Not done _____

Reason why:

1. Subject could not perform test _____
2. Refused _____
3. Other, specify _____

Room temperature: _____ (C.)

Today's Date: _____ _____ _____
Mo. Day Yr.

Tester (initials): _____

Appendix E

Cover letter for questionnaire

Study of Children's Respiratory Health

Dear Parent or Guardian,

Enclosed is a questionnaire asking about your child's breathing and other factors. This study is being done to learn more about the respiratory health of school age children and has the support of your local school board. All children living in Estevan and Swift Current attending Grades 1 to 6 are being asked to participate in the study.

All students attending Grades 1 to 6 will receive a questionnaire. A separate questionnaire should be completed for each child. The questionnaire takes about 15 minutes to answer and should be filled out by the parent who knows more about the child's health. Please read and follow the instructions on the first page. When you have completed the questionnaire, seal it in the envelope supplied and return it to the child's school. We will collect all of the questionnaires from the schools.

If your child is attending any Grade from 1 to 4, we would like to measure his or her breathing, height, weight and blood pressure. No needles will be required. The breathing test involves blowing a few times into a cardboard tube under the guidance of a qualified tester. Your child will have a chance to ask questions prior to the testing. We require your permission to do this testing. If you and your child agree to participate, please sign the permission slip located on the second page of the questionnaire. If you have any concerns or questions, please call us at 1-306-966-7886 or you can leave a message at your child's school. We will return your call.

All personal information will be kept strictly confidential and used only for this research. The part of the questionnaire with your child's name or other information that could identify your child will be kept separate from your other answers and will be held in a secure place by the principal investigator. No information that could identify your child or family will be used when we report the results. Your answers will be combined with the answers from other parents.

Your participation in this study will be very helpful in understanding the respiratory health of other children living in Saskatchewan. If for some reason you can not participate, we ask that you kindly return the questionnaire to the school. Please keep this letter for future reference.

Thank you for your cooperation.

Sincerely,

Donna Rennie

Dr. Donna C. Rennie
Principal Investigator and Associate Professor
College of Nursing and Centre for Agricultural Medicine
University of Saskatchewan
ph: 1-306-966-7886
fax: 1-306-966-8799
email: rennied@sask.usask.ca

Appendix F

Copy of consent for participation

Confidential When Completed

Questionnaire for Study of Children's Respiratory Health

PERMISSION To PARTICIPATE:

This survey is meant to study the respiratory health of children and the factors affecting it. I give permission for my child to participate in this health survey. I understand that this will involve filling out this questionnaire, measuring my child's height, weight and blood pressure. It will also involve a simple test of breathing that will measure how much air my child can blow out in a single breath. All information will be used for research purposes only. I understand that my child can refuse to participate at any time in any part of the study measurements and will have a chance to ask questions before the measurements are done. I have explained this permission slip to my child and my child agrees to participate.

_____

Signature of Parent or Guardian

_____

Signature of Child

Date _____ _____

Child's Name (*Please Print*)

_____

Last First

_____

Street Address Town Telephone number

_____

Grade Teacher

****

This questionnaire can be answered by checking the best answer or filling in a blank space with a number or word(s).

Example 1 (checking the best answer):
Does this child have a cough?
No____Yes√___

Example 2 (Filling in a blank space):
How long have you lived at this residence?
Years____ (If it is 10 years, please write in 10)

Appendix G

Ethics approval for the current study

UNIVERSITY OF SASKATCHEWAN
BEHAVIOURAL RESEARCH ETHICS BOARD

NAME: Donna Rennie (Janice Seeley)
Agricultural Medicine

BSC#: 03-1242

DATE: October 27, 2003

The University of Saskatchewan Behavioural Research Ethics Board has reviewed the Application for Ethics Approval for your study "The Prevalence of Obesity and Being Overweight in Children Living in Saskatchewan" (03-1242).

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 five years on the condition that a status report form is submitted annually to the Chair of the Committee. 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. David Hay, Acting Chair
University of Saskatchewan
Behavioural Research Ethics Board

DH/ck

Appendix H

SPSS multivariate analyses output

Overweight:

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B) Lower	Upper
Step 1[a]	TOWN(1)	.160	.150	1.145	1	.284	1.174	.875	1.575
	AGE	.131	.067	3.783	1	.052	1.140	.999	1.302
	SEX(1)	.233	.148	2.474	1	.116	1.263	.944	1.688
	GI(1)	.444	.172	6.638	1	.010	1.560	1.112	2.187
	PREGSMK(1)	.419	.162	6.659	1	.010	1.520	1.106	2.089
	PARENTS(1)	-.048	.217	.049	1	.825	.953	.623	1.458
	EDUCAT(1)	-.120	.156	.592	1	.442	.887	.653	1.204
	BFEEDCAT			1.184	2	.553			
	BFEEDCAT(1)	.205	.191	1.153	1	.283	1.227	.844	1.784
	BFEEDCAT(2)	.105	.204	.266	1	.606	1.111	.745	1.656
	PRE4(1)	-.681	.412	2.731	1	.098	.506	.226	1.135
	FIT2(1)	-.472	.182	6.759	1	.009	.623	.437	.890
	FAMD(1)	.564	.300	3.531	1	.060	1.758	.976	3.168
	FREE3(1)	-.423	.159	7.072	1	.008	.655	.480	.895
	Constant	-2.341	.594	15.535	1	.000	.096		

a. Variable(s) entered on step 1: TOWN, AGE, SEX, GI, PREGSMK, PARENTS, EDUCAT, BFEEDCAT, PRE4, FIT2, FAMD, FREE3.

Obesity:

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B) Lower	Upper
Step 1[a]	TOWN(1)	.185	.258	.514	1	.474	1.203	.726	1.995
	AGE	.020	.115	.030	1	.863	1.020	.814	1.278
	SEX(1)	.272	.256	1.132	1	.287	1.313	.795	2.168
	GI(1)	.553	.281	3.858	1	.050	1.738	1.001	3.017
	PREGSMK(1)	.901	.263	11.740	1	.001	2.462	1.471	4.123
	PARENTS(1)	.260	.385	.458	1	.498	1.297	.610	2.757
	EDUCAT(1)	-.151	.264	.325	1	.568	.860	.512	1.444
	BFEEDCAT			1.365	2	.505			
	BFEEDCAT(1)	.076	.305	.063	1	.802	1.079	.594	1.961
	BFEEDCAT(2)	-.295	.357	.685	1	.408	.744	.370	1.498
	PRE4(1)	-.699	.741	.891	1	.345	.497	.116	2.123
	FIT2(1)	-.920	.276	11.094	1	.001	.398	.232	.685
	FAMD(1)	.089	.549	.026	1	.871	1.093	.373	3.207
	FREE3(1)	-.512	.287	3.182	1	.074	.599	.342	1.052
	Constant	-2.882	.982	8.604	1	.003	.056		

a. Variable(s) entered on step 1: TOWN, AGE, SEX, GI, PREGSMK, PARENTS, EDUCAT, BFEEDCAT, PRE4, FIT2, FAMD, FREE3.