University of Alberta

Dietary Intake and Weight Status of First Nation Children

by

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ABSTRACT

Dietary intake was determined using three 24-hour recalls in Cree children in grades 4 to 6 from Quebec. The majority of children (67.9%) was overweight (30.1 %) or obese (36.9%) based on IOTF cut-offs. The mean caloric intake was 2414 ± 724 kcal and the mean percentage of energy from fat was 30.0 ± 4.7%. The major contributors of calories and fat, respectively, were sweetened drinks and snack foods. Approximately three-quarters (76.9%) of children ate at least one restaurant or take-out meal in the three days of recall. Children who consumed three or more restaurant or take-out meals had a significantly greater caloric intake relative to those who consumed none ($p = 0.048$). There was an inverse relationship between waist circumference and calories consumed per kg body weight ($r = -0.62$, $p<0.001$). Culturally sensitive interventions to improve diet quality are needed in this community.

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LIST OF ABBREVIATIONS

AI: Adequate Intake

AMDR: Acceptable Macronutrient Distribution Range

ANOVA: Analysis of Variance

APS: Aboriginal Peoples Survey

BMI: Body Mass Index

CCHS: Canadian Community Health Survey

CDC: Center for Disease Control

DRI: Dietary Reference Intake

EAR: Estimated Average Requirement

FFQ: Food Frequency Questionnaire

GDM: Gestational Diabetes Mellitus

IOTF: International Obesity Task Force Cut-offs

RDA: Recommended Dietary Allowances

RHS: Regional Longitudinal Health Survey

SRT: Shuttle Run Test

WC: Waist Circumference

LIST OF APPENDICES

I. INTRODUCTION

There are approximately 15,000 Cree in northern Quebec who reside in the James Bay territory (350,000 km^2), surrounded by boreal forest on flat land close to waterways (http://www.creetourism.ca/fish-hunt-mistissini.asp?u=). The Cree of James Bay call themselves Eeyou, meaning simply "the people" (http://www.native-languages.org/cree.htm). They call the region in which they live Eeyou Istchee. Although the first language of the majority of the Cree is Cree, English and French are also often spoken. The traditional way of life in Cree communities can be characterized as the sub arctic culture of North American Indians (Brassard et al, 1993). Traditional food gathering activities in Cree communities, some of which are still performed today, included fishing, hunting and trapping.

There are nine communities in James Bay, six are remote and three are rural. The research described in this thesis was conducted in the rural community of Mistissini, the second largest (population 3,467) of the nine James Bay communities. Mistissini is a small inland community located ten hours by car or 830 kilometers north of Montreal. It is accessible by road and located one hour north of Chibougamau, a small city in Quebec. During the winter months Mistissini's average temperature is between –15°C and –18 °C; although with high wind chills, it can reach temperatures down to –52 °C.

Similar trends are emerging in Aboriginal communities in both Canada and the United States as a consequence of dramatic changes in lifestyle such as diet and activity. This has collectively resulted in a shift from the more traditional ways of life to a more westernized lifestyle. In recent years there has been growing concern in Cree communities of James Bay regarding increasing prevalence of type 2 diabetes and obesity

(Brassard, et al, 1993). Physical activity in Cree communities is thought to have greatly decreased as a result of the increased use of snowmobiles and other motorized vehicles.

The prevalence of overweight and obesity in children in Canada is rising (Tremblay and Willms, 2000). Aboriginal communities in both Canada and the United States have reported a recent increase in the prevalence of overweight and obesity in both adults and children (Hanley et al, 2000; Story et al, 1999). Childhood overweight and obesity is a significant concern, as it can lead to adult obesity in addition to other co-morbidities such as type 2 diabetes, heart disease, and some cancers (Birmingham and Jones, 2002). Styne (2001) stated that approximately 30% of adult obesity begins in childhood. High rates of obesity in children have been documented in remote Aboriginal communities such as Sandy Lake, Ontario (Hanley, et al, 2000), Kahnawake, near Montreal (Trifonopoulos et al, 1998), and in Chissasibi and Eastmain, communities located in the eastern James Bay territory (Bernard et al, 1995). Type 2 diabetes, a disease previously classified as adult onset diabetes, has been reported in adolescents in Aboriginal communities in central Canada (Dean, 2001).

SECTION 1.01 RESEARCH OBJECTIVES

The focus of this research was to investigate the dietary intake and eating habits of children in grades 4 to 6 in Mistissini. The objectives of the study were as follows:

1) To assess the diet quality of Cree children by examining total energy (kcal), fat, protein, carbohydrate, and micronutrients based on three non-consecutive 24-hour dietary recalls;

2) To describe the major food sources and food groups contributing to the diet.

3) To determine the prevalence of restaurant meals and take-out food.

4) To document the association of dietary intake with weight classifications, waist circumference and physical fitness.

5) To determine if boys and girls ate differently in the sample.

II. LITERATURE REVIEW

There is little information about the health of children in Cree communities in James Bay. There is a significant lack of knowledge on the correlates of obesity in Cree children. This literature review discusses topics related to Aboriginal health and a review of the risk factors, prevalence and health consequences of overweight and obesity in the general population and in the Aboriginal population. It also reviews the methods used to assess diet and adiposity. This will focuses on studies in Aboriginal children in both Canada and the United States that investigated diet, anthropometrics and physical fitness.

SECTION 2.01 ABORIGINAL PEOPLES

(a) Who are Aboriginal Peoples

"Aboriginal People" refers to all of the Aboriginal people in North America (Words First, 2002). The term "Aboriginal" in Canada applies to three distinct groups of individuals that include First Nations, Inuit and Métis (Words First, 2002). The term "First Nation" is now often used in place of the word "Indian" and describes both Status and Non-Status Indians (Words First, 2002). In the United States, "Native American Indian" is the term that is used to describe First Nations. First Nation includes many distinct cultural and linguistic groups including the Cree. The term Métis is used to describe individuals with mixed First Nations and European Ancestry. As determined by the 2001 Canadian census, the highest concentration of Aboriginal populations were in the North and on the Prairies (Statistics Canada, 2001). According to Statistics Canada in 2001, 47% of the Aboriginal population in Canada lived on an Indian reserve. Among those who identified themselves as Métis, 2.5% reported living on reserve, 29.4% rural non-reserve, and 68% reported living in urban areas (Statistics Canada, 2001). For the most part, Inuit live in Nunavut, the Northwest Territories and parts of northern Quebec (Words First, 2002).

SECTION 2.02 ABORIGINAL HEALTH IN CANADA

There are significant differences between the health of Aboriginal populations and the health of the Canadian population as a whole (Health Canada, 2002b). Health Canada (2002b) reported that in 2002, 38% of First Nations reported that their health was 'very good' to 'excellent' whereas 61.4% of Canadians reported that their health was 'very good' to 'excellent' (Health Canada, 2002b). An increased prevalence of obesity and type 2 diabetes are now being seen in many Aboriginal communities across Canada, with a strong negative impact on their quality of life. There have also been observations of various other diseases that are affecting Aboriginal populations at higher rates than non-Aboriginal groups, some of which include infectious diseases such as tuberculosis and Human Immunodeficiency Virus (HIV) (Health Canada, 2005). These examples demonstrate the disparity that exists in health between the Aboriginal population and Canada as a whole.

(a) Diabetes

The prevalence of diabetes in Canada is increasing. It is estimated that two and a quarter million Canadians have diabetes, with 90% of all cases being type 2 (Health Canada, http://www.phac-aspc.gc.ca/ccdpc-cpcmc/diabetes-diabete/english/facts/index.html). In Canada, it is estimated that Aboriginal populations are three to five times more likely than the general population to develop type 2 diabetes based on self-reported rates (Health Canada, 2002b). Aboriginal populations experience type 2 diabetes at earlier ages than do non-Aboriginals and exhibit more severe symptoms when they are diagnosed (Health Canada, 2000). In the United States, Aboriginal populations who have experienced similar changes in dietary patterns and lifestyle are also showing an increase in the rates of cardiovascular disease, type 2 diabetes, and obesity (Koehler et al, 2000). The reasons for the significant increases in prevalence are complex.

Different surveys have been conducted across Canada with the goal of estimating the prevalence of diabetes in Aboriginal populations using self-reported data (Health Canada, 2002a). However, it is believed that prevalence rates of type 2 diabetes are underestimated in these surveys as a result of self-reporting as well as non-inclusion of some Canadian reserves (Health Canada, 2002a). One such survey was the Aboriginal Peoples Survey (APS, 1991). Rates of type 2 diabetes, based on the APS (1991), were 6.4% for First Nations people, with higher rates among those living on reserve (8.5%) than off-reserve (5.3%) (Health Canada, 2000). In several First Nation communities, rates of type 2 diabetes have been shown to be higher among the female population. Approximately two-thirds of the First Nation people with type 2 diabetes in the APS were women (Health Canada, 2002a). The First Nations and Inuit Regional Health Survey (1997) found prevalence rates of 12% in First Nation people on reserve, with one in four individuals over the age of 45 years with diabetes (Health Canada, 2002a).

"Gestational diabetes mellitus (GDM) has been defined as glucose intolerance of variable severity with its onset or first recognition during pregnancy" (Canadian Diabetes

Association, 2003). A study was done by Rodrigues et al (1999) in James Bay Cree women to compare the predictors and risk of GDM with non-Aboriginal Canadians. This study concluded that overweight Cree women had a higher risk for GDM than non-Aboriginal overweight women (Rodrigues et al, 1999). Almost one-third of women (30%) with type 2 diabetes reported, in a First Nation and Inuit Regional Health Survey, that their diabetes was first diagnosed during pregnancy (National Aboriginal Health Organization, 1999). Higher rates of GDM have been reported among different ethnic groups such as Blacks, Hispanics, and Asians as well as North American Aboriginal groups (Rodrigues et al, 1999). Children born to women with gestational diabetes are considered at an increased risk for developing type 2 diabetes later in life (Health Canada, 2002a). It is thought that increasing rates of GDM could cause even higher rates of obesity and type 2 diabetes in future generations (Health Canada, 2002a).

The information available on Aboriginal health is less reliable than that of the Canadian population as a whole because there is inadequacy in the tracking of health for Aboriginal clients (Young, 2003; Health Canada, 2002b). Several factors make the tracking of health in Aboriginal populations a problem, including access to health care, living in remote and rural communities, and under-coverage in national surveys (Young, 2003; Health Canada 2002b). It is essential that reliable methods for the tracking of health in Aboriginal populations be developed. Further research needs to be conducted to determine why this group of individuals is at higher risk for certain diseases as well as implications of these chronic diseases in this population.

SECTION 2.03 OBESITY IN CANADA

(a) Description of Overweight and Obesity

Overweight and obesity is a growing problem in Canada and the United States. Overweight has been defined as having fat or other tissue in excess, with reference to an individual's height (Styne, 2001), while obesity has been defined as an excessive percentage of body fat that poses a health risk (Bray, 1996; Styne, 2001). Several factors such as an individual's socioeconomic status, as well as genetic environment, and cultural factors, could be involved in causing obesity in a population; however, extensive research is needed in this area to further understand the causes and consequences of obesity (Flegal, 1999).

(b) Lifestyle Changes

Overweight and obesity are thought to be caused by an imbalance of energy due to the chronic overconsumption of calories in excess of what is used and needed by the body, potentially in combination with decreased physical activity (Troaino et al, 1995; Nestle and Jacobson, 2000). Increased rates of obesity may also be explained by the increased consumption of foods of low nutritional value but high in calories, such as fast food and soft drinks (Swinburn and Egger, 2002). The increased consumption of high fat energy dense diets combined with a decrease in physical activity is being termed an 'obesogenic environment' (Swinburn and Egger, 2002). Recent data released by Statistics Canada suggest that children and adolescents with fruit and vegetable consumption of 5 or more times per day were less likely to be overweight or obese than those whose consumption was less frequent (Statistics Canada, 2005b). In children, increased television viewing and video game playing along with decreased physical activity are also factors contributing to the increase in weight (Dietz and Gortmaker, 2001). In a study by Janssen et al (2004), height, weight, dietary habits, and leisure-time activity were determined in 11 to 16 year-old Canadian youth. No clear links were found between the children's dietary habits and measures of overweight and obesity. Among the overweight and obese boys and girls compared with normal-weight children they found that the physical activity levels were lower and television viewing times were higher (Janssen et al, 2004a). Information from the 2004 CCHS suggests that the chance of being overweight or obese in children aged 6 to 11 years and adolescents aged 12 to 17 years, tends to increase as 'screen time' increases (time spent watching television, playing video games or using the computer) (Statistics Canada, 2005b).

(c) Definition of Obesity in Children

Obesity is said to be one of the most prevalent nutritional diseases of children and adolescents in the United States (Dietz, 1998a). In the literature there are different criteria used for defining overweight or obesity in children. Many studies use body mass index (BMI) to define overweight or obesity. The Center for Disease Control (CDC) in the United States defines risk of overweight as a BMI above the 85^{th} and $<95^{th}$ percentile for age and gender, while overweight has been defined as a BMI above the 95^{th} percentile for age and gender (Kuczmarski et al, 2000; Goran et al, 2003). Cole et al (2000) developed international cut-offs for overweight and obesity in children using data from six longitudinal international studies. They developed age and sex-specific cut-off points from 2 to 18 years of age. Further research into childhood obesity and cut-offs for overweight and obesity need to be carried out to determine how to best identify excess body weight in children.

(d) Prevalence Data in Children

The co-morbidities of overweight and obesity in adults are now being observed in children (Birmingham and Jones, 2002). Little is understood about how and why childhood obesity develops (Hill and Trownbridge, 1998). The interaction of genetics with environment and behavioural factors could all be linked in the cause of overweight in the pediatric population (Hanley et al, 2000). It is hypothesized that the most severe health impacts of obesity in today's children such as increased rates of chronic disease will not be seen for several decades and that the current generation of children in the United States will become the most obese (Hill and Trownbridge, 1998).

In Canada, between 1981 and 1996, the prevalence of overweight for boys increased from 15% to 35.4% and for girls it increased from 15% to 29.2% (Tremblay and Willms, 2000). In 1981 the prevalence of obesity in Canadian children was 5%, but by 1996 it had more than tripled to 16.6% for boys and 14.6% for girls (Tremblay and Willms, 2000). Findings from the 2004 Canadian Community Health Survey (CCHS) (where height and weight were directly measured by interviewers) showed that 26% of children and adolescents aged 2 to 17 years were overweight (18% overweight) or obese (8% obese), based on International Obesity Task Force BMI cut-offs for children (Statistics Canada, 2005b). In this age group, the overweight/obesity rate more than doubled, while the obesity rate tripled over the past 25 years (Statistics Canada, 2005b).

The United States has experienced a significant increase in the incidence of overweight and obesity in the past two decades (Hill and Trowbridge, 1998). Based on data in the US from the National Health and Nutrition Examination Survey (NHANES) 1999-2000, of children having a BMI above the 95th percentile, 15.5% were 12 to 19 year olds, 15.3% were 6 to 11 year olds, and 10.4% were 2 to 5 year olds (Ogden et al, 2002; Goran et al, 2003).

(e) Risk Factors for Obesity

It has been suggested that risks for overweight and obesity in children are linked to those of adults. There are several factors that can lead to an increased risk for obesity in children. There is an association between being overweight or obese as a child or adolescent and becoming overweight or obese as an adult (Troiano et al, 1995). Obesity during adolescence has been labeled the single best predictor for adult obesity (Dietz and Gortmaker, 2001). There are said to be three crucial periods that determine if obesity will persist into adulthood:

1) the gestational period (maternal environment, birth weight, gestational diabetes),
2) adiposity rebound period, and
3) adolescence (there is a greater chance that overweight will continue to adulthood) (Styne, 2001).

Adiposity rebound is defined as the period when body fatness increases following the normal decline in fatness in young children, to a minimum at about 5 or 6 years of age (Whitaker et al, 1998). Children may be at greater risk for obesity if they have a parent who is obese. Children born to a mother with gestational diabetes have an increased risk of becoming obese which is usually manifested by 6 to 10 years of age (Styne, 2001).

Recently geographic and sociodemographic factors, dietary habits, physical inactivity and school-based factors have been suggested as risk factors contributing to overweight and obesity (Veugelers and Fitzgerald, 2005). In a study by Veugelers and Fitzgerald (2005), children who did not eat breakfast were one and a half times more likely to be overweight than those who did eat breakfast, and that only buying lunch at school significantly increased the risk of overweight, after adjusting for other significant risk factors (Veugelers and Fitzgerald, 2005). Children who were sedentary for more than one hour per day had an increased risk of overweight, while children who participated in physical activity more than seven times a week had a decreased risk of overweight (Veugelers and Fitzgerald, 2005). When Veugelers and Fitzgerald (2005) looked at sociodemographic factors, they found that children of parents who had attained higher levels of education and had income greater than $60,000 were at decreased risk of overweight.

(f) Groups at Risk for Obesity

The data available for Aboriginal populations is limited (Young and Sevenhuysen, 1989; Willows, 2005). In Canada, data on obesity rates in Aboriginal children comes from the study of individual communities or populations, however children in Aboriginal populations as a whole have not been well studied. In 2004, a Canadian Community Health Survey determined that 37.6% of Aboriginal adults living off-reserve were obese, about 1.6 times the national average (Statistics Canada, 2005a).

Although the rates of obesity are increasing in the total population of Canada, the rates of increase in Aboriginal populations appear to be greater. Higher rates of obesity are appearing in both adults and children in these populations, where it is predominantly of the central type (abdominal adiposity) (Harris et al, 1997; Potvin et al, 1999). For example, in a study by Katzmarzyk and Malina (1998) with individuals of First Nation and European ancestry from Northern Ontario (aged 5 to 75 years), it was found that First Nation individuals demonstrated greater deposition of fat centrally. The trend towards higher overweight and obesity is having dramatic effects on Aboriginal populations and the health care system.

The studies that have been completed do indicate that the prevalence of obesity is greater in First Nation children than in Caucasian children across North America, regardless of tribal or cultural group (Dean, 1998). In a study done by Hanley et al (2000), the prevalence of overweight in children and adolescents between two to 19 years of age in a First Nations population in Northwestern Ontario was 27.7% in boys and 33.7% in girls. This was dramatically higher than the reference data used in NHANES III. Information from the Canadian Community Health Survey (CCHS) (2004), showed a significantly high combined overweight/obesity rate of 41% in young Aboriginal people. The obesity rate in this population was 20%, which is two and a half times the national average for children (Statistics Canada, 2005b). Based on preliminary findings of the First Nations Regional Longitudinal Health Survey (RHS) (2002-2003), 41.5% of First Nation children surveyed living on reserve were normal or underweight, 22.3% overweight and 36.2% obese using the IOTF cut-offs for overweight and obesity. The RHS found that 9 to 11 year olds were twice as likely to be overweight than younger children (28.8% vs. 13.1%) (National Aboriginal Health Organization, 2005). In a study by Zephier et al (1999) in American Indian school children in the US aged 5 to 17 years, the age-adjusted estimated prevalence of overweight was 39.1% in males and 38.0% in females. The prevalence of obesity in this same study was 22.0% in males and 18% in females (Zephier et al, 1999). Among Aboriginal populations, obesity is mainly of the central type, which itself is an independent risk factor for type 2 diabetes (Young et al, 2000).

(g) Health Consequences of Obesity

The problem of obesity is currently being labeled as an epidemic (Flegal, 1999) and is a global nutritional concern seen in places where malnutrition was once widespread (Styne, 2001). Obesity has been linked to many health outcomes such as type 2 diabetes, cardiovascular disease, hyperlipidemia, hypertension, some cancers, sleep apnea, and even death. Increased abdominal obesity in adults is a contributing factor for increased risk for chronic diseases such as cardiovascular disease and type 2 diabetes (Styne, 2001); and an increased prevalence of glucose intolerance, insulin resistance, elevated blood pressure, and elevated blood lipids in both males and females (Bray, 1996). In children and adolescents, waist circumference is a predictor of insulin resistance syndrome (Hirschler et al, 2005).

The outcome of metabolic changes of obesity and insulin resistance in adolescents can be hyperinsulinemia, dyslipidemia, hypertension, steatohepatitis, glucose intolerance, type 2 diabetes, acanthosis nigricans (a disorder that can cause light brown to black velvety rough areas or skin markings, usually on the back and sides of the neck), and polycystic ovarian syndrome (Dean and Sellers, 2002)

There are a number of widespread consequences linked to obesity. Many of these consequences may result in long lasting negative health and psychosocial problems (Hill and Trowbridge, 1998). There is a considerable amount of discrimination against overweight children that can have adverse effects on their socialization (Dietz, 1998a).

i) Type 2 Diabetes

"Diabetes Mellitus is a metabolic disease that is characterized by the presence of hyperglycemia due to defective insulin secretion, insulin action or both" (Canadian Diabetes Association, 2003). Diabetes mellitus has been classified into four different categories that include type 1 diabetes, type 2 diabetes, type 2 diabetes in youth, and gestational diabetes. Type 2 diabetes was once considered an adult-onset diabetes, but it is now increasing throughout the world in children wherever childhood obesity is prevalent (Styne, 2001). Type 2 diabetes can be classified as predominant insulin resistance with relative insulin deficiency to a mainly secretory defect with insulin resistance (Canadian Diabetes Association, 2003). Diabetes has many consequences for the individual with the disease, their family and friends, and the population as a whole. Complications of diabetes include heart disease, stroke, kidney failure, peripheral neuropathy, and retinopathy (Canadian Diabetes Association, 2003). Diabetes has the possibility to lead to a decrease in life expectancy due to its many complications. Type 2 diabetes also has a significant impact on the economy because it is a major contributor to health care costs (Health Canada, 2002a).

ii) Type 2 diabetes in Aboriginal Communities

Type 2 diabetes is of unique concern in Aboriginal populations due to its increasing prevalence in a population where it was once virtually unknown (Health Canada, 2001). There are an increasing number of Aboriginal populations with increased rates of type 2 diabetes mellitus, and it has become a serious health problem among many of these populations in North America (Young et al, 2000). Until the 1930's, diabetes mellitus was very seldom diagnosed in American Indians; however, it is now said to be of epidemic proportions due to the increasing prevalence of obesity (Story et al, 1999). The prevalence of diabetes has increased significantly since the 1950's in Canada; however, the prevalence of diabetes varies by language group, culture area, geographic location and degree of isolation (Young et al, 2000). Brassard et al (1993) demonstrated in eight James Bay Cree communities in Quebec that rates of type 2 diabetes among adults varied from 1.9% in the northernmost (remote) community to 9% in the southernmost. The prevalence of type 2 diabetes is as high as 25% among all adults and 80% among women aged 50 to 64 years in two Algonquin reserves in northeastern Quebec as well as among Oji-Cree of Sandy Lake (Young et al, 2000).

Each year, based on the Cree Diabetes Information System (CDIS), an annual report is written that provides information on the prevalence of diabetes and its related complications, as well as the state of clinical management of diabetes in the James Bay Cree of Quebec (Cree Board of Health and Social Services of James Bay, 2005). According to the Cree diabetes registry of James Bay (2004) the age adjusted prevalence rate of diabetes (age >20 years) was 20.6% (total of 1232 persons with diabetes, 7 with type 1 and 1225 with type 2). The rate of diabetes is 4.2 times greater than that of

Quebec as a whole (4.9% prevalence). Of the 1232 Eeyou diagnosed with diabetes, the percent of females with diabetes was 62.1%, while the percent for males was 37.9%. Among the Eeyou, almost half (46%) were diagnosed with diabetes before the age of 40 with the average age at diagnosis being 42. Of the 1232 individuals with diabetes, 445 people (36.2%) had one complication associated with the disease, while 158 (12.8%) had two. In Mistissini (Quebec), the crude prevalence (not adjusted for age) of diabetes was reported as 16.0% (Cree Board of Health and Social Services of James Bay, 2005).

iii) Type 2 Diabetes in Children

Type 2 diabetes is now emerging as a problem in Aboriginal children. This new emerging problem was first recognized in Pima Indian children in the 1970's in the United States (Dean, 1999). Children as young as eight years of age in some communities are now being diagnosed with the disease (Young et al, 2000). What was previously thought of as adult-onset diabetes, is now being seen as a critical health problem in overweight children, especially those within minority groups (Goran et al, 2003; Dean, 2001). There have only been a few population-based studies in Canada to determine the rates of type 2 diabetes in children in Aboriginal populations. In the Sioux Lookout, Ontario, between 1978 and 1994, it was determined that 2.5/1000 youth younger than 16 years of age had been diagnosed with NIDDM (now known as type 2 diabetes) (Harris et al, 1996). In the mid 1980's to 1990 in northern Manitoba, Dean et al (1992) identified 20 children with NIDDM (Type 2 diabetes), 16 of whom had at least one parent with the disease. Dean et al (1998) also completed a cross-sectional survey of children aged 4 to 19 years, between 1996 to 1997 in St. Theresa Point First Nation, and found six new cases of diabetes and 19 children with impaired fasting glucose (with fasting serum glucose of 6.1-6.9 mmol/L). In this same study the prevalence of obesity among girls was 48% and 51% for boys based on NHANES 90th percentile (Dean et al, 1998).

There may be several factors and causes involved in the increasing rates of type 2 diabetes in childhood. One hypothesis is that type 2 diabetes is becoming more prevalent in children because of the increased rates of obesity (Styne, 2001); although, the magnitude of the association and extent to which it might be influenced by family history are not well understood (Knowler et al, 1981). Young et al (2002) identified maternal diabetes – both gestational and type 2 diabetes – as a strong risk factor for the disease in children. A 40% increased risk of diabetes has been shown with both high and low birth weight (Young et al, 2002). Environmental factors that have been suggested to increase the risk for type 2 diabetes in Pima Indian youth in the US include maternal gestational diabetes, lack of breast feeding, and smoking during pregnancy (Dean and Sellers, 2002).

The problems associated with type 2 diabetes in children can be quite severe. This is a serious problem because there is an increased duration of the disease (because it is starting earlier) and microvascular and macrovascular complications are observed in young adults (Young et al, 2002). Some of these complications might include blindness, renal failure, amputations and cardiovascular disease (Young et al, 2002). It has been shown that the risk of end-stage renal disease in Aboriginal children in the Manitoba area is six times higher than that for children from other ethnic groups (Dean, 2001).

Another suggestion for the increased incidence of type 2 diabetes in Aboriginal populations is the possible genetic predisposition. It has been proposed that as a result of the nomadic lifestyles and feast and famine cycles of their ancestors, Aboriginal populations are perhaps genetically predisposed to store energy more efficiently from their diets with increases in the consumption of market foods (Health Canada, 2000). Aboriginal populations have evolved from eating a traditional diet composed of foods retrieved by hunting and gathering to diets that are higher in energy, saturated fat and simple sugars (market foods). Physical inactivity in these populations has increased and has been linked to increased rates of obesity (Young and Sevenhuysen, 1989). Therefore, the introduction of a continuous food supply in conjunction with increasing rates of sedentary behaviour and decreasing rates of physical activity has left many Aboriginal populations with an epidemic of obesity (Story et al, 1999).

SECTION 2.04 ASSESSMENT OF METHODOLOGIES

In order to gain a greater understanding of the causes of increased overweight and obesity in school children in Mistissini, the various methodologies used to evaluate the diet of children will be reviewed as well as cutoffs for overweight and obesity in children. The methods most suitable for use in children will be discussed in the following section.

(a) Dietary Intake

There are various methods available to determine dietary intake in individuals. These measures include food records, the 24-hour dietary recall, and the food frequency questionnaire. Each of the nutritional assessment measures has its strengths and weaknesses depending on the time required for the study, the study population, data required, and the resources available. Evaluating dietary intakes in children presents additional complications. Children often have difficulty with certain aspects of dietary measurements due to lower literacy, lack of knowledge of foods and food measurements, lack of experience in food preparation, lack of familiarity with components in mixed dishes, a general lack of interest, and short attention span (Crawford et al, 1994). However, by about 7 to 8 years of age, children's ability to self-report food intake increases (Livingstone and Robson, 2000). The problems that are involved in assessing the diets of adults can also be seen in children, such as response bias, recall bias, as well as problems in evaluating portion size (Berg et al, 1998; Lytle et al, 1993). Errors in the reporting of dietary intake are present when looking at a population's habitual diet (Berg et al, 1998). Misreporting of dietary intake is seen in children and adolescents, with the possibility of both under and overreporting (Livingtone and Robson, 2000). With adolescents, however, the possibility of misreporting increases because of a significant amount of out-of-home eating, unstructured eating patterns, concerns with self-image and rebellion against authority (Livingstone et al, 2004). Also, when working with Aboriginal populations, additional considerations must be made for any differences in language, and culture (Campbell et al, 1994).

i) Food Records

Food records are a common nutritional assessment method used to determine dietary intake. The food record is kept by the individual for a one to seven day period, and food items consumed are recorded for type and portion size (Pao and Cypel, 1996). In the case of children, the parent or primary caregiver can be responsible for recording the child's intake in the given period. In the Feasibility Study for the National Diet and Nutrition Survey of Children aged 1.5 to 4.5 years in Great Britain, weighed-food records were completed over a 4 day consecutive period (including weekend days) by the child's mother or caregiver (Atkin et al, 2000). The weighed food record does not rely on an individual's memory, and food omission is thought to be minimal (Biro et al, 2002). Crawford et al (1994) compared three day food records, 24-hour recalls, and five day food frequency questionnaires validated by direct observation in nine and ten year old girls. The three-day food records were shown to produce the best agreement between reported and observed intakes (Crawford et al, 1994). This measurement may not be practical for use in some Aboriginal communities because of the time commitment required for the children and caregivers, low English literacy levels, and the frequent consumption of meals away from home.

The food record is considered the gold standard for measuring food intakes in individuals, although errors or bias may still occur. Some of the common biases with reporting of energy intake in adults may be lapses of memory, knowingly omitting items from the food record because recording requires large subject burden, avoiding extra servings or snacks to simplify recording, not eating or not reporting foods that are thought of as 'unhealthy', and using the recording period to diet for weight loss (Black et al, 1991). Other disadvantages of the food record might include respondents' fatigue with recording and the omission of foods if meals are not recorded immediately following intake (Biro et al, 2002).

ii) 24-Hour Recalls

In adults, the 24-hour dietary recall has frequently been used to assess dietary intake. In the third National Health and Nutrition Examination Survey (NHANES III), the 24-hour recall was selected as the primary dietary assessment method to provide quantitative information on diet for nutrition monitoring and research purposes, in 7769 non-pregnant adults greater than or equal to 20 years of age (Briefel et al, 1997). Using the 24-hour recall, individuals are asked to recall and describe the kinds and amounts of all foods that were eaten during the previous 24-hour period (Pao and Cypel, 1996). Individuals are cued by the interviewer, using food models and measuring utensils, as to the type of food eaten, preparation used, brand name, and ingredients. Often, a multiple-pass 24-hour recall, consisting of three distinct passes, is conducted with the individual. The respondent is first asked to recall everything that s/he has eaten in the previous 24 hour period. The second pass involves a more detailed description of the foods listed in the first pass (eg. Asking the type of milk that is consumed with a cereal and amount used). A third pass is then conducted that reviews all of the foods that were mentioned to ensure that all information was collected. Johnson et al (1996) used three multiple-pass 24-hour recalls with children aged 4 to 7 years. They found that the multiple- pass 24-hour recalls provided enough information to make valid group estimates in their population. They also found that it was a practical method to use with children, and that it was less burdensome than other dietary collection methods (Johnson et al, 1996).

An individual's diet varies on a day to day basis. Random or non-consecutive day samples may therefore be preferable for describing dietary intake (Larkin et al, 1991), or when the estimates of usual nutrient intakes of individual children are required (Serdula et al, 2000). A single 24-hour recall calculates a population's mean nutrient intake; however, several recalls are required to estimate the prevalence of low or high intakes (Serdula, 2000). Story et al (1986) used three 24-hour dietary recalls on three non-consecutive days to determine the differences in food intake practices between lean and fat adolescents in grades 8, 9, and 10. Mean energy intakes in this group of Cherokee children were not found to be significantly different between the lean and fat individuals (Story, et al, 1986). In third grade children, Lytle et al (1993) validated 24-hour recalls assisted by food records using direct observation of intake and illustrated that 24-hour recalls are an appropriate nutritional assessment tool in children. They found that a 77.9% agreement was observed across all meals and snacks when food items reported as being consumed were compared with those observed by staff and parents (Lytle et al, 1993). The 24-hour recall can be time consuming for both the interviewer and the child; however, less so than the time that is required for the three-day food record (Crawford et al, 1994). In another study by Johnson et al (1996), three multiple pass 24-hour recalls were performed on non-consecutive days with 24 children between 4 to 7 years of age over a fourteen day period, using doubly-labeled water to assess total energy expenditure (TEE). This study found no difference between the TEE of the children in the group and their three-day mean energy intake (Johnson et al, 1996).

iii) Food Frequency Questionnaire

Another common nutritional assessment tool that has been used and validated in children is the food frequency questionnaire. The food frequency questionnaire is used as a measure to provide an individual's usual intake (Pao and Cypel, 1996). Food frequency questionnaires have been used with children in the First Nations communities of Sandy Lake (Ontario) and Kahnawake (Quebec). There are different types of food frequency questionnaires such as the qualitative method and the semi-quantitative. The aim of a qualitative food frequency questionnaire is to obtain the usual number of times that a food is eaten during a specified period of time, whereas the semi-quantitative questionnaire obtains information on portion size (Pao and Cypel, 1996). Time frames for the food frequency questionnaire can range from a few days, a week, a month, or 3 months up to = 1 year.

Crawford et al (1994) evaluated the use of a five-day food frequency questionnaire and found that it had the highest level of missing foods (underreporting) compared to the 24-hour dietary recall and the three day food record. They compared foods that were reported by the subjects with the results of direct observation. Longer time periods may not be appropriate for use in children as it would be unlikely that they would be able to complete a frequency time frame of greater than one week (Crawford et al, 1994). Kaskoun et al (1994) assessed the validity of a semi-quantitative food frequency questionnaire in 45 children by comparing it with the total energy expenditure (TEE) of the children by the doubly labeled water method. The food frequency questionnaire was completed by the children's mothers to reflect the usual dietary intake of the child over the last year (Kaskoun et al, 1994). It was determined that the food frequency questionnaire significantly overestimated the energy intake in the children ($p < 0.0001$) (Kaskoun et al, 1994). Some of the possible sources of error with food frequency questionnaires in children could be reflected in the wide range of their dietary intakes as well as the misreporting of energy intake (Kaskoun et al, 1994). In another study done in 7 to 12 year old girls, the reproducibility and validity of a food frequency questionnaire was assessed using seven-day food records (Arnold et al, 1995). The results of this study indicated that the food frequency questionnaire tended to overestimate nutrient intake values compared to those obtained in the seven-day food records, however it was in best agreement with the food records for fibre, vitamin B1, vitamin B2, vitamin C, and beta-carotene (Arnold et al, 1995).

It is important to note that there will be biases with each of the different dietary intake assessment methods used, however, it is necessary to choose that which is most suitable for use in the population that is being studied.

(b) Body Assessment Measurements

Debate has arisen recently regarding the most appropriate method to use in children for measurements of overweight and obesity status. Some of the common methods of measurement in adults are anthropometric measures including Body Mass Index (BMI), skinfold measurements, and waist circumference. Different measures may be chosen based on the cost to perform them, time and skill required to perform them, as well as burden to the individual.

i) Body Mass Index (BMI)

Anthropometry, which includes measures of height and weight, is one of the most basic tools for assessing nutritional status in individuals (Mei et al, 2002). It involves little cost, is straightforward, and it can assess body fatness and thinness (Mei et al, 2002). The body mass index (BMI) is defined as an individual's weight in kilograms divided by her/his height in metres squared (weight (kg)/ height (m^2)). The BMI has been widely used in studies of adults as a reliable tool to determine adiposity (Lindsay, et al, 2001) and is a preferred measure for routine clinical and public health purposes (Dietz, 1998b). Studies have shown links between increased BMI and the risk for increased morbidity and mortality rates in adults (Dietz, 1998b).

The use of BMI in children and adolescents has been controversial (Lindsay et al, 2001), as a child's BMI changes with age (Sabin et al, 2004). Weight for height measurements have previously been used in preschool children in a clinical setting to determine overweight or underweight status (Mei et al, 2002). Between 1981 and 1996, the BMI of children ages 7 to 13 years was researched and it was determined that BMI increased by almost 0.1 kg/m^2 per year for both sexes and at most ages (Tremblay and Willms, 2000). In a group of Pima Indian children and adolescents aged 5 to 20 years, Lindsay et al (2001) assessed the BMI as a measure of adiposity compared to percent body fat and fat mass established from dual x-ray absorptiometry (DEXA). This study showed that BMI had a linear relationship with total fat mass in all of the age groups (Lindsay et al, 2001).

BMI is a standard measure used to assess the presence of overweight and underweight in children but may not account for differences in body proportions and composition (Jackson, 1993). However, the use of BMI to estimate overweight and obese status in Native American children has been said to overestimate rates of obesity due to their tendency to have a higher proportion of fat-free mass (Lohman et al, 2000). It has been suggested that growth patterns for First Nations and Inuit children may differ somewhat from reference standards (Canadian Paediatric Society, 2004a). At birth, weight and height ratios for First Nation and Aboriginal children have been shown to be greater than the 50^{th} percentile than in other populations (Canadian Paediatric Society, 2004a).

ii) CDC Growth Charts

In children, growth charts have commonly been used to determine overweight or underweight status. The United States has recently revised their growth charts based on data that was collected from five national health examination surveys between 1963 and 1994, as well as five supplementary data sources combined (Kuczmarski, et al, 2000). The Center for Disease Control (CDC) established these growth charts for age and sex-specific BMI reference values (BMI-for-age) for children 2 to 20 years of age (Kuczmarski et al, 2000; Mei et al, 2002). The BMI-for-age charts can be used to determine if a child is overweight. Overweight is defined by the CDC as > 95th percentile, whereas the risk for becoming overweight is defined as >85th percentile and <95th percentile (Kuczmarski et al, 2000). The World Health Organization (WHO) has adapted the new growth charts and deemed them appropriate for worldwide use (Kuczmarski et al, 2000). The new percentile curves developed by the CDC include those for infants (birth to 36 months) and older children (2 to 20 years), and also include additions of the 3rd and 97th percentiles for all charts (Kuczmarski et al, 2000). It has been suggested that the new growth charts will provide a method for screening growth in children while also representing the racial and ethnic diversity as well as the combination of breast and formula feeding in the US (Kuczmarski et al, 2002).

iii) International Growth Reference

With the increasing prevalence of childhood overweight and obesity, it is essential that an internationally acceptable definition of child overweight and obesity be developed. Cole et al (2000) proposed the development of an international definition of child overweight and obesity using 6 international surveys of large nationally representative cross sectional growth studies in Brazil, Great Britain, Hong Kong, the Netherlands, Singapore, and the United States. They developed centile curves for BMI in children using data from the cross sectional growth studies in the six countries. In each of the 6 countries, differing incidence of overweight and obesity is present. The study included 97,876 males and 94,851 females between the ages of birth to 25 years (Cole et al, 2000). In adults the cut off point for overweight is a BMI of 25 kg/m^2 or greater and the cut off point for obesity is a BMI of 30 kg/m^2 or greater. Cole et al (2000) felt these cut off points were impractical for use in children. The cut off points of 25 kg/m^2 and 30 kg/m^2 were placed at 18 years of age where prevalence rates of overweight and obesity were matched (Cole et al, 2000). Using the centile curves, Cole et al (2000) also matched points throughout childhood that corresponded with overweight and obesity risk in adults. From these cut off points, a table was developed for children aged 2 to 18 years that included BMI values for males and females that are comparable to the overweight and obesity cut off points for adults. Standards at each half year were included in the table to provide clinicians with an unbiased estimate (Cole et al, 2000). The centile curves and table provide a quick and efficient way of matching age and sex to the defined at risk BMI values.

iv) International Growth Reference vs. CDC Growth Charts

Different measures exist to measure the change in body mass index (BMI) in children, some of which include raw units (kg/m^2), percentage, z-scores or centiles (Cole et al, 2005). It is however, unknown as to which method is most suitable for use in children. Two common methods that are being used to determine overweight or obesity in children are the Center for Disease Control (CDC) growth charts and the Cole's Equation (International Obesity Task Force Cut-Offs). The CDC growth charts are intended for use in US children and adolescents as the determined reference values are based on national survey data from the US (Flegal et al, 2001). The International Obesity Task Force Cut-Offs (IOTF) developed by Cole et al are intended for use in international comparisons because reference data included nationally representative data sets from the US, Brazil, Great Britain, Hong Kong, the Netherlands and Singapore (Flegal et al, 2001). The CDC uses fixed percentile points to estimate overweight and obesity (85^{th} and 95^{th} percentile), while Cole's method uses percentiles that correspond to adult BMI values of 25 and 30 kg/m^2.

The two methods do not give the same results for the prevalence of overweight and obesity in children. Flegal et al (2001) used the CDC growth charts, IOTF cut offs and values developed by Must et al to compare the prevalence of overweight children in the US. Data were used from the National Health Examination Surveys (cycles II and III) as well as from the first, second, and third National Health and Nutrition Examination Surveys (NHANES). They found that Cole et al's method gave lower prevalence estimates at younger ages in children and higher prevalence estimates at older ages than did the CDC method (Flegal et al, 2001). The different methods each have their strengths and limitations and therefore it is important to choose the method that is most appropriate for the research study being undertaken.

Recommendations from the Canadian Paediatric Society for assessing weight status in infants and children include: 1) use of CDC BMI for age growth charts for use in clinical and community settings; and 2) use of international (IOTF) BMI charts when comparing prevalence data among populations (Canadian Paediatric Society, 2004b). It is also recommended by the Canadian Paediatric Society that the CDC growth charts be used for Aboriginal children in Canada (Canadian Paediatric Society, 2004a).

v) Waist Circumference

Waist circumference (WC) is used to measure adipose tissue distribution. WC is an important anthropometric measure because it measures the amount of abdominal obesity in an individual. Increasing WC has been shown to be associated with increased health risks such as hypertension, diabetes, dyslipidemia and the metabolic syndrome (Janssen et al, 2002). Different sites on the body are used to determine waist circumference and include immediately below the lowest ribs, the narrowest waist, the midpoint between the lowest rib and the iliac crest, and immediately above the iliac crest (Wang et al, 2003). WC should be measured by an experienced observer using a heavy-duty inelastic plastic fiber tape measure (Wang et al, 2003). The tape measure should be placed on the skin while the subject stands balanced on both feet, with their feet touching each other and both arms hanging freely (Wang et al, 2003). Katzmarzyk (2004) used data from the Canadian Fitness Survey in children aged 11 to 18 years to develop smoothed weighted age and sex-specific WC percentile values. It was determined that WC increased with age in both boys and girls, and boys had higher values than girls at each age point and percentile point (Katzmarzyk, 2004). It has been proposed that WC is associated with increased health risk in children. Freedman et al (1999), in a community-based, cross-sectional study, showed that abdominal distribution of body fat was related to adverse concentrations of triacylglycerol, low density lipoprotein (LDL) cholesterol, high density lipoprotein (HDL) cholesterol and insulin in children and adolescents aged 5 to 17 years. This led to their conclusion that WC may help to identify those children with adverse concentrations of lipids and insulin (Freedman et al, 1999). Maffeis et al (2001) suggest that WC may be useful in clinical practice as it is associated with cardiovascular risk factors in prebubertal children.

b) Physical Activity vs. Physical Fitness

Physical activity and physical fitness are not defined the same. "Physical activity is any bodily movement produced by skeletal muscles, which results in energy expenditure" (Nieman, 1999; Center for Disease Control, 2005). Although all individuals perform physical activity, the amount of physical activity performed by each individual depends on personal lifestyles and other factors. Examples of physical activities include bicycling, dancing, home activities such as cleaning, running and self-care (e.g., bathing) (Nieman, 1999). "Physical fitness is a set of attributes a person has in regards to a person's ability to perform physical activities that require aerobic fitness, endurance, strength, or flexibility and is determined by a combination of regular activity and genetically inherited ability" (Center for Disease Control, 2005).

Physical fitness in children can be assessed using the 20-metre shuttle run test. This test has several strengths as a test of fitness. It can be administered in most school settings, and because it requires maximal effort only in the last minute or so of the test, it does not require the child to be motivated throughout. Finally, the test may eliminate the psychological burden for the less fit (Liu, Plowman and Looney, 1992).

SECTION 2.05 A REVIEW OF DIETARY INTAKE RESEARCH IN ABORIGINAL COMMUNITIES

The cause of obesity in Aboriginal populations across Canada has been hypothesized to result from an energy imbalance including increased energy intakes and a decrease in physical activity. The dramatic levels of obesity in this population have led several researchers to study some Aboriginal populations in detail. Several studies have begun to look at the dietary patterns and physical activity levels of children and adolescents in Aboriginal populations across Canada. The number of studies is small relative to the number of Aboriginal communities in Canada. Some of these studies include those done in Kahnawake (Quebec), Sandy Lake (Ontario), and James Bay (Quebec). There have also been various other studies, including the Pathways study, carried out in Native American children throughout the United States.

(a) Kahnawake Schools Diabetes Prevention Program

Like many other Aboriginal communities throughout Canada, the Mohawk community of Kahnawake, near to Montreal, has seen an increase in chronic diseases such as obesity and type 2 diabetes (Trifonopoulos, et al, 1998). As a result of this increase, the Kahnawake Schools Diabetes Prevention Project (KSDPP) was developed, with the goal of promoting healthy eating and physical activity among children and adults within the community. The long-term goal of the KSDPP is to prevent diabetes in future generations in this community (Trifonopoulos et al, 1998). Between 1994 and 1996, direct observation was used in the schools in Kahnawake. Observations were conducted in the school canteens and interviews were completed with the staff (Macaulay et al, 1997). As a result of the Macaulay et al (1997) study, new healthy foods were offered in school canteens and teachers incorporated 4 to 12 activities per year that coincided with the goals of KSDPP.

i) Methods Used in KSDPP 1994

Children in grades four to six from two different elementary schools in Kahnawake, comprising approximately 77% of school-aged children, were asked to provide information on their dietary intake and physical activity levels (Trifonopoulos et al, 1998). The first survey was completed from September to November of 1994 before the KSDPP intervention (Trifonopoulos et al, 1998). Given the time constraints, burden to children, age of children, and objective of estimating average intake, it was determined that a single 24-hour recall would be the best nutritional assessment method to determine intake in the children. Single 24-hour recalls were completed in 164 grade four to six children with parental consent (Trifonopoulos et al, 1998). The 24-hour recall was completed using food models, bowls, glasses, and measuring cups to estimate portion sizes. Foods were coded into UCB minilist (1987, University of California, Berkely). The number of times that children mentioned eating traditional and cultural foods was counted by the researcher (Trifonopoulos et al, 1998).

ii) Major Findings

Results included information on mean energy, total carbohydrate, sucrose, protein, and fat intakes. The single 24-hour recalls demonstrated that the percentage of energy from dietary fat was significantly lower (31.0% ±7.6) than the 35% reported in large epidemiologic studies, although results were comparable to the National Health and Nutrition Examination Survey (Phase I) (Trifonopoulos et al, 1998). A large proportion of total energy in the childrens' diets came from sucrose (16.5% ± 8.4), a value that exceeded the World Health Organization's (WHO) recommendation of a maximum 10% for all free sugars (Trifonopoulos et al, 1998). Forty-six (28%) of the children reported having eaten out or having take-out food for one or more meals on the day of recall (Trifonopoulos et al, 1998). Kahnawake children reported consuming more milk and milk products than has been previously shown in other North American Aboriginal children (Trifonopoulos et al, 1998). The average energy consumption of both boys and girls in this sample was 2190 kcal ± 842 kcal. The use of traditional foods was examined and it was found that there was limited consumption of common traditional foods. Using the information from the 24-hour recall, foods were ranked by how frequently they were consumed by the children who mentioned eating them on the day of their recall. Some of the results found by Trifonopoulos et al (1998) from the 164 children interviewed were:

1) White bread was the most important source of energy and carbohydrate. As such, 70.1% of children reported consuming white bread on the day of recall. White bread contributed 8.5% of total energy.
2) Cola and sweetened beverages were major sources of energy in the diet (38.4% of children).
3) The most important source of protein was 2% milk, with beef being the highest meat source of protein.

4) The top three sources of fat (24% of total fat) were french fries, frankfurters and hamburger.
5) Low vegetable intake was observed with french fries as the most frequently reported vegetable.

iii) Strengths and Limitations

Single 24-hour dietary recalls were used to collect information on children's intake, which was considered to be the most appropriate method to use given the factors such as time, burden to and age of respondent, and the objective of estimating a large group's average intake. Single 24-hour recalls, however, may not provide information on an individual's habitual intake as multiple 24-hour recalls on non-consecutive days are needed to estimate an individual's usual intake (Stein et al, 1991). Data collection included a standardized protocol with a single interviewer using food models, bowls, glasses, and household measuring cups and spoons (Trifonopoulos et al, 1998). This study looked specifically at food consumption of the children; this is of particular importance because it is more practical to educate individuals using specific food items rather than in terms of nutrients. Another strength of the study was that it made comparisons with other studies, such as the third National Health and Nutrition Examination Survey (Phase 1 - 1988-1991), Hopi, Sahtu Dene/Metis, and Northern Alberta Native schoolchildren.

iv) Methods Used in KSDPP 1998

Dietary data was collected in 1998 and compared to the data collected in 1994 by Trifonopoulos et al (1998). Comparisons between the studies done in 1994 and 1998 in Kahnawake were made between mean intakes of energy, fat and sucrose (Jimenez et al, 2003). Methods used in 1998 were similar to those used in Kahnawake in 1994. Six food groups were created as indicators of the children's diet quality. The six food groups included fruits, vegetables, and four food groups found to contribute the most to fat and sugar in the diet (Jimenez et al, 2003). These four food groups included (1) all high fat foods (e.g., meat (20% fat), french fries, chicken with skin), (2) all high sugar foods and drinks (e.g., white sugar, sodas, fruit drinks), (3) all foods containing a combination of high fat and high sugar (e.g., chocolate, ice cream, pies), and (4) all foods high in added fat (e.g., mayonnaise, margarine) (Jimenez et al, 2003). Single 24-hour dietary recalls were completed in 77% of grade four to six children (n=150) (Jimenez et al, 2003). This participation rate is similar to that from Trifonopoulos et al (1998). The minilist used was adapted at the Centre for Indigenous Peoples' Nutrition and Environment (McGill University).

v) Major Findings

Any difference in diet was measured by comparing mean intakes of energy, fat and sucrose, and the six food groups that were created as indicators of diet quality. In 1998, it was determined that there were no significant differences since 1994 in mean intake of energy, fat and sucrose (Jimenez et al, 2003). There was however, a noteworthy decrease in the frequency of consumption of fruits and higher fat foods, as well as a significant increase in the consumption of white sugars (Jimenez et al, 2003).

vi) Strengths and Limitations

In the study by Jimenez et al (2003), single 24-hour recalls were again used to estimate the group's mean intake. A strength of this study is that it was that the same measures were used to compare intakes from the same population after a certain time period. Mary Trifonopoulos, who conducted the study in 1994, trained Michelle Jimenez in the procedures that were used in 1998, which is another strength of this study (Jimenez et al, 2003).

(b) Sandy Lake, Ontario

Numerous studies have been done in Sandy Lake, Ontario to determine the factors associated with obesity and type 2 diabetes in both adults and children. Sandy Lake is one of 28 remote First Nations communities (population ~1600) located in the Sioux Lookout Zone. It is accessible only by air for most of the year (Hanley et al, 2000). The people of this community are Ojibwa-Cree (Gittelsohn et al, 1998b). In the past, this community was physically active and consumed diets that were high in protein from wild meats with the occasional supplementation from seasonal berries and fruit (Hanley et al, 1995).

i) Methods Used

Fitness level, television viewing, body image concepts, and dietary intake were assessed in 242 children and adolescents 10 to 19 years of age. Height and weight were measured in 445 children and adolescents aged 2 to 19 years. The objective was to determine the prevalence of overweight and obesity, and associated behavioural factors in a community exhibiting increased incidence of obesity and type-2 diabetes in adults. Dietary measures chosen for use in this population were the food frequency questionnaire that assessed the frequency of consumption of 34 commonly eaten foods over the previous three months, and a single 24-hour recall where subjects reported all foods that were eaten the day before (Hanley et al, 2000).

ii) Major Findings

Gittelsohn et al (1998b) studied the relationship between diabetes and obesity status, and usual dietary patterns of intake, fattiness of food preparation and consumption in a First Nation community in the northwest of Ontario. A 34-item food frequency questionnaire examining intake over the previous three months was used to examine patterns of food consumption (Gittelsohn et al, 1998b). The results of this study showed that the increased intake of bush foods and junk foods was associated with a higher risk for obesity (Gittelsohn et al, 1998b).

Another study in Sandy Lake had more than 98% of the population greater than 10 years of age complete 24-hour recalls. Wolever et al (1997b) described the diets of adolescents aged 10 to 19 years as higher in simple sugars, lower in protein, higher in fatty foods (potato chips, fried potatoes, hamburger and pizza), soft drinks and table sugar than adults 49 years and older. The results of this study demonstrated that factors such as a diet high in simple sugars, and low in dietary fibre in combination with a high fat diet may contribute to obesity and diabetes in Sandy Lake (Wolever et al, 1997a,b).

iii) Strengths and Limitations

The studies in Sandy Lake used the single 24-hour recall, which may not be indicative of usual intake of the individual. Another limitation of the study is that the food frequency questionnaire used a period of three months to assess the intake patterns of children. Crawford et al (1994) found it unlikely that children would be able to complete a food frequency of greater than one-week time. Some of the limitations suggested by Hanley et al (2000) included the use of Body Mass Index because it may not be a suitable measure to assess obesity in young children.

A strength of this research is that researchers have been working with members of Sandy Lake First Nation to implement a community based obesity and diabetes intervention strategy for children in grades three, four and five (Hanley et al, 2000). They were also able to compare their data to Aboriginal Canadian children and adolescents in other communities such as the Mohawk in Kahnawake and the James Bay Cree.

(c) James Bay Territory

There is limited data on the diets of Aboriginal children in the James Bay territory of Quebec. In two of the communities in the James Bay territory, Chisasibi and Eastmain, dietary intakes of the children in grades four and five, as well as those in grades eight and nine were examined between February and April of 1992 (Bernard et al, 1995). At the time of the study, Chisasibi was accessible by both road and plane, whereas Eastmain was only accessible by plane.

i) Methods Used

The objective of this study was to develop instruments that would aid in describing the eating habits and determinants among schoolchildren in these two communities (Bernard and Lavallee, 1993). This study used a single 24-hour recall as well as general lifestyle questions, such as hours of television viewing and frequency of physical activity (Bernard et al, 1995).

ii) Major Findings

It was determined that 38% of the 144 students in the two communities studied were classified as overweight (Bernard et al, 1995), or having a body mass index greater than the 90th percentile (Bernard and Lavallee, 1993). Those subjects who were classified as overweight had less variety in their diets, consumed fewer servings of milk products and fruit and vegetables, and were less active (Bernard et al, 1995). With regard to both variety and number of required servings, the younger age group was described as having a better quality diet than the adolescents (Bernard and Lavallee, 1993). There was no significant difference in junk food consumption between the younger and older subjects, although the children in Eastmain tended to consume more junk food (Bernard and Lavallee, 1993). The results from this study demonstrate the need to examine the dietary intake of children in other communities throughout the James Bay territory.

ii) Strengths and Limitations

The study in Eastmain and Chisasibi made use of the single 24-hour dietary recall which would be a limitation, as described above, because it may not provide information on usual intake. A strength of the study was that the researchers included a general lifestyle questionnaire, providing information on hours of television viewing and frequency of physical activity.

(d) Pathways Feasibility Study

Research has also been conducted in various Native American communities throughout the United States as the problem of obesity and type 2 diabetes continues to grow in both adults and children in these populations. The Pathways study was a research study that examined six Native American nations; specifically looking at schoolchildren in grades three through five (Gittelsohn et al, 1998a). It was a two-phase, multi-site clinical trial that was used to develop and test interventions in schools to prevent obesity in children (Gittelsohn et al, 1998a). This study involved formative research that was developed and used to produce obesity prevention interventions among the school children in the six Native American nations. The feasibility phase of the study took place from 1995 to 1996 of the academic school year. The different methods used in this study to determine behavioural risk factors were focus groups, in-depth interviews and direct observation (Gittelsohn et al, 1998a; Gittelsohn et al, 1999).

i) Methods Used

Information was collected from parents, children, teachers, administrators and community leaders using both qualitative and quantitative research (Gittelsohn et al, 1998a). Children (n=101) from four different schools (1 school from each of the Pathways field sites) whose parents consented, participated in a single 24-hour dietary recall (Lytle et al, 2002). The children were instructed on the day before the recall on how to keep a semiquantified food record and how to estimate portion sizes (Lytle et al, 2002). Lytle et al (2002) determined the top ten contributors of energy and total fat contributing to the diet based on the energy and fat content of the food and the proportion of children who recalled eating them on the day of their interviews.

ii) Major Findings

Eighty of the 101 children (80%) provided usable data (Lytle et al, 2002). Results from the study showed that all of the children in the school ate the school lunch provided while 56 children (70%) ate the school breakfast. The intakes of vitamins and minerals exceeded recommendations for Recommended Dietary Allowances (RDA) and Dietary Reference Intakes (DRI) (Lytle et al, 2002). Mean energy intake (for 7 to 11 year olds) was determined to be close to the recommended intake (1961 kcal actual versus 2000 kcal recommended), although greater amounts of energy and absolute amounts of fat and carbohydrate were consumed by children on the days when they were not in attendance at school (Lytle et al, 2002). One-third of the students' daily intake for all nutrients came from school meals. The top contributors of energy in the diet were breads, buns and tortillas, while beef was the top contributor of fat (Lytle et al, 2002). The top contributor of energy consumed out-of-school was sweetened beverages (example: pop, kool aid).

iii) Strengths and Limitations

The feasibility phase of this study used a needs assessment to address the four intervention components that would be used (classroom curriculum, food service, physical activity, and family) (Teufel et al, 1999). They made use of qualitative research by using focus groups and 10 in-depth interviews with each of the four communities. Limitations of the formative assessment were that small samples were used and respondents were often selected on the basis of expertise and special knowledge, rather than the use of random sampling (Gittelsohn et al, 1998).

SECTION 2.06 POPULATION HEALTH PERSPECTIVE

The increasing prevalence of chronic diseases in Aboriginal populations in Canada might be explained by a population health perspective. A population health approach involves looking at the entire range of factors that determine an individual's health and, in turn affects the health of the community (Health Canada, 1996). "Population health refers to the health of a population as measured by health status indicators and as influenced by social, economic and physical environments, personal health practices, individual capacity and coping skills, human biology, early childhood development, and health services" (Health Canada, 2001). In the past, the majority of Aboriginal communities led hunter and gatherer lifestyles. In Aboriginal communities across Canada the development of Indian reserves and residential school systems destroyed their traditional lifestyles and resulted in a welfare economy (Hanley et al, 1995), as well as an erosion of their culture. Aboriginal populations in general have high levels of unemployment, low educational status, poverty, problems with housing and food affordability, and a loss of identity and culture, all of which can have a negative effect on health (Public Health Agency of Canada, 1999; Health Canada, 2003) in part by influencing an individual's health practices (Jenkins et al, 2003). Preliminary results from the First Nations Regional Health Survey (RHS) 2002-03 reported that children whose health was reported as 'very good' to 'excellent' were more likely to have a mother who obtained a university degree and lived in a non-crowded household. Raphael et al (2003) discussed how patterns of health behaviours are significantly impacted by the surrounding social and economic environments.

Many Aboriginal communities in Canada are located in northern remote areas. Certain barriers to health may arise as a result of living in a remote community. Some examples might include barriers to education, health services, and hospitals (Jenkins et al, 2003). It has been reported that more women with university level education are from urban Aboriginal communities as opposed to rural and remote populations (Jenkins et al, 2003). Having little or no access to certain health services and hospitals can have a significant impact on a population. In some Inuit populations in Canada, the distance to the nearest hospital or tertiary care centre has been shown to be significant (Jenkins et al, 2003). An increased burden of diabetes among low-income Canadians including Aboriginal populations has been demonstrated (Raphael et al, 2003). In Aboriginal populations that are experiencing higher levels of obesity and type 2 diabetes, there may be little or no access to specialists or even general practitioners to treat the disease and its complications (Health Canada, 2000; Young et al, 2000).

Socioeconomic burden has been shown to be a risk factor for poor health outcomes in communities (Story et al, 1999). "The socio-economic environment of a population is a strong predictor of health status" (Jenkins et al, 2003). Studies have reported that those individuals with higher incomes are more likely to have better health than those who have little or no income (Jenkins et al, 2003). Income has been shown to influence several factors such as quality of early life, levels of stress, food availability and the quality of the diet (Raphael et al, 2003). According to the Canadian Council on Social Development (2000), in 1995, 55.6% of the Aboriginal population living in cities were living in poverty compared to 24% for non-Aboriginal. This is troublesome as Aboriginal peoples accounted for a relatively small proportion of most cities in Canada (Canadian Council on Social Development). In the 1990 US census, a larger percentage of American Indians (31%) were shown to be living below the poverty level when compared to other races in the US (13%) (Story et al, 1999). Some studies have also shown an association with income and overweight or obesity status. In a study by Alaimo et al (2001), it was found that among older non-Hispanic white children from low-income families, children had a higher likelihood of being overweight than children from families with higher incomes.

Some Aboriginal communities in Canada are accessible only by air. In these communities it is necessary to transport food and resources by plane. Often this can lead to an increased price for food, resulting in little access to healthy food at affordable prices (Willows, 2005). As discussed earlier, Bernard et al (1995) demonstrated that Aboriginal children in the remote community of Eastmain consumed higher intakes of 'junk food', which may be explained in part by the decreased access to healthy foods. Healthy food items are often more expensive and are also associated with decreased satiety as opposed to higher fat cheaper items (Dean, 1999). The stores in remote communities may also only supply those foods that are considered to be high turnover foods (Travers et al, 1995).

SECTION 2.07 CONCLUSION OF LITERATURE REVIEW

Aboriginal people are a unique group of individuals with their own unique needs. The lack of national data on Aboriginal populations suggests an urgent need to conduct health research in this population. Aboriginal populations are experiencing higher rates of obesity and type 2 diabetes than Canadians as a whole. Increased rates of childhood overweight and obesity are also becoming prevalent in this population along with new cases of type 2 diabetes in youth. Chronic diseases such as type 2 diabetes and heart disease were previously unknown in Aboriginal populations, and the drastic increase in incidence could be attributable to a dramatic change in lifestyle. Possible factors causing this increase are environmental, behavioural and genetic predisposition.

A goal of working with a small community of Aboriginal peoples to overcome childhood obesity could be to aid in the development of effective nutrition and physical activity programs in schools that meet the specific needs of the population. Nutrition and physical activity are an essential component of programs that promote change in health and lifestyle, leading to the prevention of diseases such as obesity and type 2 diabetes. Health programs for Aboriginal communities must be made to fit the needs of the community, showing sensitivity to cultural and language issues of the community (Willows, 2005). This can be termed participatory community research and is accomplished by working with the community to identify their specific needs.

Research in the area of child health is essential for the future development of programs in schools for diet and physical activity. To date there have been no effective prevention or treatment strategies providing good long-term results in childhood obesity (Sabin et al, 2004) and the lack of data on Canadian children limits evidence based decision making about how to approach the issue of childhood overweight and obesity (Raine, 2004). The information obtained from the assessment of diet and overweight or obese status in children can be used to facilitate policy and program decisions made by the respective Aboriginal communities (Wein et al, 1993). Health programs involving diet and physical activity can be taught to children of all ages and incorporated into different parts of the school curriculum. This is important because children are at a critical stage for learning new information (Story et al, 1999). There is also a potential to reach a larger number of individual children at once (Teufel et al, 1999). Other possible approaches could include public policies aimed at discouraging television viewing and junk food advertisements, promoting physical activity, and adjusting food prices (Nestle and Jacobson, 2000). In order to have successful outcomes with programs in Aboriginal populations, it is essential that researchers realize the unique developmental, emotional, cultural, linguistic, geographic, and socioeconomic issues associated with this population (Dean, 1999).

The following factors make health research in First Nation communities in Canada a vital step to be taken before meaningful improvements in Aboriginal health can be made: 1) First Nation children are uniquely predisposed to obesity; 2) there have been few studies conducted to assess dietary risk factors for obesity; 3) no data are available on usual intake of individuals considering the use of single 24-hour recalls; 4) food availability data and household characteristics are not available; 5) sample sizes are small; and 6) dietary data have not been linked to physical fitness. Without solid research into these areas, effecting change for the benefit of Aboriginal health is likely to be haphazard and have minimal effect.

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(Accessed on May 11, 2005)

III. SUBJECTS AND METHODS

SECTION 3.01 STUDY CONTEXT

(a) Rationale for Study

In Canada in 2004, results from the Canadian Community Health Survey (CCHS) (where height and weight were directly measured by interviewers) found that 26% of children and adolescents aged 2 to 17 years were overweight (18% overweight) or obese (8% obese), based on International Obesity Task Force cut-offs for children (Statistics Canada, 2005). In this age group, the overweight/obesity rate more than doubled, while the obesity rate tripled over the past 25 years (Statistics Canada, 2005). The prevalence of overweight and obesity is higher in both Aboriginal children and adults than in the non-Aboriginal populations in Canada (Statistics Canada, 2005; Harris et al, 1997; Potvin et al, 1999). Limited information exists on the health of First Nations children in Canada (Young, 2003); there is lack of knowledge related to dietary habits of children and barriers to healthy eating among children, and the adiposity (absolute and distribution) of children. The relationship between dietary intake, weight status, waist circumference and physical fitness has been seldom explored in children, and specifically not in First Nations children. The study aims to contribute to the knowledge of dietary intake, measured height and weight, waist circumference and fitness as determined from the 20-meter shuttle run test (SRT) in First Nation children in Canada.

SECTION 3.02 SUBJECT RECRUITMENT AND ETHICAL APPROVAL

The Emiyuu Ayayaachiit Awaash Project (The Active Kids Project) was given its name from the community members in Mistissini. The participants involved in the research study were students in grades four to six recruited from Voyageur Memorial Elementary School in Mistissini, Quebec. This school did not have a school lunch program and all children left the school at lunch time. A school milk program was available to students in the school and teachers from some of the classes provided their students with a snack of cookies or fruit. The school in Mistissini was made aware of the research study prior to its commencement in October 2004. Teachers attended information sessions in November 2003 and January 2004 and the study was described at a community health fair in February 2004. The research was pilot tested in the school in June 2004. Two members of the research team visited each classroom prior to the commencement of the study to explain the project to the children.

Ethical approval for the study was received from the Human Research Ethics Board at the University of Alberta, Faculty of Agriculture, Forestry and Home Economics. The Certificate of Approval from the University of Alberta is provided (Appendix A). The study was approved by the Public Health Department of Mistissini, the principal of Voyageur Memorial School and the Cree Board of Health and Social Services of James Bay. Children were given information sheets and consent forms by the researchers to take home to their parents/guardians. Only children whose parents/guardians completed a consent form were assessed (Appendix B, C).

SECTION 3.03 PILOT STUDY

In June of 2004, a pilot study was conducted in grade six school children at Voyageur Memorial School. Grade six children were chosen for the pilot study because it was assumed that they would be in grade seven in the following year when the data would be collected. Parental consent was received for 41 of the 59 students eligible to participate. Methods used for data collection were tested at this time. Methods of dietary collection that were piloted included the 24-hour dietary recall on three non-consecutive days and a seven-day food frequency questionnaire with a list of commonly eaten foods. A copy of the food frequency questionnaire that had been used in Kahnawake was obtained and tested with children. The food frequency questionnaire was not answered appropriately by the children in Mistissini as many of them selected all of the foods on the list as having been eaten. From the pilot study it was determined that the 24-hour dietary recall on the three non-consecutive days would pose less of a burden to the children and would provide a better picture of the children's usual dietary intake. This was because we were able to conduct 3 24-hour recalls with 26 (63%) of the 41 students during the pilot study. Other procedures that were pilot tested were the collection of anthropometric data (height, weight, sum of five skinfolds and waist circumference), body image and self-esteem questionnaires (Harter's self-perception scale), pedometers, a physical activity frequency questionnaire and the Leger 20-m shuttle run test of physical fitness.

SECTION 3.04 TRAINING IN METHODOLOGY

Two dietitians from the University of Alberta (one of whom was Amber Arnold) were responsible for conducting the 24-hour dietary recalls with the children. Dietary recalls had been pilot tested with grade six children in the community in June of 2004 at which point the dietitians were able to work together to determine the best method to interview the children. The interviewer cued the child as to portion sizes, types of food and method of preparation used. The dietitians were trained in anthropometric measurements for height and weight under the supervision of an exercise specialist prior to leaving for the community. These data were collected at the time of the first 24-hour recall with each child. Waist circumference, skinfolds and physical fitness data were collected by a graduate student in physical education.

SECTION 3.05 MEASURES

(a) Anthropometric Measures

The anthropometric measures were done in a private room at the school. Two of the researchers were present at all times during the anthropometric measures. Children were weighed and had height taken without shoes while in minimal indoor clothing. Weight was measured using a portable scale (Health-O-Meter Professional Scale, Model HAP300-01, Boca Raton, FL, US) and recorded to the nearest pound. Children's weights were later converted to kilograms by dividing weight in pounds by 2.2. Height was measured to the nearest 0.1 cm using a set square and tape measure. Children were instructed to take a deep breath in and hold, at which point their height was measured. Waist circumference was measured with a fiberglass tape measure at the level of the umbilicus and recorded to the nearest 0.2 centimeter. Waist circumferences were divided into tertiles for analysis.

Body Mass Index (BMI) was calculated from the child's height and weight ((weight (kg)/height (m)^2) to the nearest 0.01 kg·m^{-2}. Children were classified into three weight status groups (normal, overweight and obese) using the International Obesity Task Force Cut-offs (IOTF) age- and gender-specific definitions (Cole et al, 2000).

(b) Nutrition Assessment

i) 24-hour Recall Interview

Three standard 24-hour dietary recalls (Pao and Cypel, 1996) on non-consecutive days including one weekend day were conducted individually with each child (Appendix D). The interviewer cued the child as to portion sizes, types of food and method of preparation used. Children were taken from their classes individually by the dietitian to a private room where the interviews were conducted. The dietitian explained to the child why the interviews were being done and discussed the importance of listing all foods that they had eaten. It was explained to the children that all information obtained would remain confidential. Children were requested to describe everything that they had eaten in the previous 24-hour period starting after breakfast on the previous day. Two and three dimensional food models, measuring cups, utensils, and containers/packaging of different food items (for example, potato chips) were used to help the children estimate portion sizes. Pictures of foods from the local grocery store were used. The interviewers visited the local grocery store, convenience stores, and the restaurants that were frequently visited by children to determine common serving sizes and methods of preparation. Whenever possible, brand names of foods were obtained from the children. Two passes were used during the 24-hour recall process as opposed to a multiple pass (3 passes). Two passes were chosen as opposed to three passes because it was determined that the children may have become confused if they had to go back and recall amounts of foods eaten during the second pass. Children were asked what they had to eat at each meal and the amounts that they had of each. After the children had listed all foods eaten in the previous 24-hour period, their intake was reviewed with them to ensure that nothing was forgotten.

During the interview, the children were asked to describe where and with whom they had eaten their meals and snacks. Categories of where meals were eaten were: 1) at home, 2) at a home other than their own, 3) at a restaurant, 4) take out at home, and 5) take out at a home other their own.

For the second and third recall days, children were reminded of the recall procedure. The first 24-hour recalls took on average 25 minutes whereas the second and third averaged 15 minutes each because children knew what was expected.

Data obtained from the 24-hour dietary recalls were entered into Food Processor SQL for Windows (Food Processor SQL, Esha Research, Salem, Oregon) which includes Canadian nutrient data. All data entered into Food Processor was entered by the author of this thesis. The data from each child was also transferred to a Microsoft Excel spreadsheet. The information in the spreadsheet was used to count the number of times that the different foods were mentioned by each child.

Energy intakes per kilogram body weight (kcal/kg) were determined by taking the child's total calories averaged over the 3 days and dividing it by their weight in kg.

ii) Food Availability

A food availability questionnaire (Appendix E) was administered on the day of each child's first 24-hour recall to determine the types of foods available in a child's home or on a child's plate. The questionnaire asked if certain foods were available in the child's home (never, sometimes, usually or all the time).

iii) Dietary Quality

The three days of dietary recall information collected from each child were assembled into one Excel spreadsheet such that the dietary information could be assessed for the entire study group. To determine the total calories consumed by all participating children over the three days of recall, the sum of all calories contributed by all of the foods in all of the recalls was calculated. Individual food items were then classified into one of 38 food categories based on similarities or differences in macronutrient composition and dietary role (Appendix F). Foods were grouped by combining foods with similar macronutrient content (e.g., snack foods, fruit, fruit juices, vegetables), comparable to the method used to form food clusters reported by Wirfalt and Jefferey (1997). For example, all brands and flavors of potato chips reported were placed in the "Snack Foods" food category. The energy provided by each food category was determined by calculating the sum of calories contributed by each food item in a food category. For example, the calories provided by all food items in the "Snack Foods" category were added to determine the total energy contributed by this food category. This value was then divided by the total calories to find the percent of calories coming from the particular food category. The same procedure was performed for the energy derived from fat to determine the percentage of fat calories coming from the different items. The top 10 food categories contributing calories to the diet as well as the top 10 foods contributing fat to the diet were determined.

Average serving sizes were determined for foods that were commonly eaten by the children. The serving sizes in the Excel spreadsheet were added for each of the items and then divided by the total number of servings for that item to obtain the average serving size.

iv) Micronutrient analysis

Following are the micronutrients that were chosen for analysis in this study: iron (mg), vitamin D (μg), calcium (mg), zinc (mg), vitamin A (RAE) and vitamin C (mg). Iron was chosen for analysis as iron deficiency anemia is prevalent among infants in the James Bay region (Willows, 2000). Vitamin D and calcium were chosen as intakes of both have been shown to be lower in First Nation children in Canada (Paediatrics & Child Health, 2002). Zinc is a mineral that is essential for growth and development in children (Rivera et al, 2003). Vitamin A was chosen because a vitamin A deficiency has been associated with stunting and wasting in preschool age children (Hadi et al, 2000; Rivera et al, 2003). Vitamin C is a water soluble vitamin that is essential for human health and is found in fruits, vegetables and supplemented in many fruit drinks (Naidu, 2003).

(c) Physical Fitness

Physical fitness was determined by the 20-meter shuttle run test (SRT) (Leger and Lambert, 1982) which was completed during physical education class. Students run back and forth between two lines 20 meters apart at a progressively increasing pace set by an audio recorded beep until they were no longer able to maintain the pace or they voluntarily stopped running. The SRT score was equivalent to the time recorded when a student failed to reach within two strides of one of the end lines two consecutive times or when they voluntarily stopped running. Children were encouraged to reach maximal effort by verbal prompting from researchers and classmates. Comparative normative data from Quebec schoolchildren were available for this test (Leger et al, 1984).

(d) Number of People in the Home

On the day of the children's first food recall, each child was asked the number of people that lived in their home with them. This question was asked to determine the average number of people per household so as to describe community demographics.

SECTION 3.06 DATA ANALYSIS

Statistical analysis was performed using SPSS for Windows version 13.0. Data from Food Processor was transferred to an Excel spreadsheet before being transferred to SPSS. Anthropometric measures, food availability and physical fitness data were entered directly into SPSS for analysis.

Means and standard deviations were determined for energy (kcal), fat (% of energy), protein (% of energy) and carbohydrate (% of energy) provided from the diet, and vitamin A (RAE), D (μg), C (mg), calcium (mg), zinc (mg) and iron (mg). One-way analysis of variance (ANOVA) was used to determine if there were significant differences in dietary quality between number of take-out and restaurant meals, and the different weight status, waist circumference and fitness categories. The Bonferroni statistic was used to determine differences among groups. Where there were too few responses in a category, categories were collapsed for statistical analysis. For two category variables, the T-test was used to compare groups. The chi-square statistic was used when variables were categorical. Significant differences were considered where $p < 0.05$.

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IV. SUBJECT CHARACTERISTICS AND RESULTS

SECTION 4.01 DEMOGRAPHICS

Of the 151 students eligible for participation in the Active Kids Project, consent forms were returned for 115 students. Of the 107 students whose parents consented to them participating, 3 did not attend school regularly and therefore did not provide data. 104 children provided at least two dietary recalls: 3 children completed 2 dietary recalls while 101 children completed all three. Anthropometric data (height, weight and waist circumferences) were also available for the 104 children who provided dietary data, representing 68.9% of the study population in grades 4 to 6. Boys represented 41.3% of the sample while girls represented 58.7% **(Table 1)**. Students from grade 6 classes represented 44.2% of the sample, grade 5 students 26.0% of the sample, and grade 4 students 29.8%. The average number of people per household was 5.8 ± 1.5.

SECTION 4.02 RESULTS

(a) Anthropometric Characteristics

General characteristics including height, weight, BMI and waist circumference of the children are presented in Table 1. No significant differences were found between boys and girls for weight, BMI and waist circumference. Girls were significantly older ($p=0.027$) and taller than boys ($p=0.022$). The prevalence of normal weight, overweight, and obesity based on the International Obesity Task Force cut-offs (IOTF) are presented **(Table 2)**. As shown in Table 2, weight, height, BMI and waist circumference differed significantly among weight categories. Participants' age did not differ significantly among weight categories.

(b) Macronutrient Composition of the Diet

Table 3 presents the means, standard deviations, medians and ranges of macronutrients in the diet, while Table 4 presents the micronutrient composition of the diet. Absolute calorie (kcal), calorie per kilogram body weight, absolute fat (kcal), percent fat (%), protein (% of energy), and carbohydrate (% of energy) are presented in Table 3. The mean caloric intake was 2414.1 ± 724 kcal for boys and girls combined and the mean percentage of energy from fat in the diet was 29.9% ± 4.8%. Children, on average, were within the 25 to 35% recommendation for percent fat in the diet based on dietary reference intakes (DRI). There were no significant differences between boys and girls for the macronutrient composition of the diet.

(c) Micronutrient composition of the diet

Means and standard deviations are presented for vitamin A (RAE), vitamin D (μg), calcium (mg), iron (mg), zinc (mg) and vitamin C (mg) in Table 4. There were no significant differences between boys and girls for the micronutrient composition of the diet. For vitamin A (RAE), the mean intake was below the EAR for children aged 9-13 years. For both vitamin D and calcium, the mean intake for children was below the AI for children aged 9-13 years. For iron, zinc and vitamin C, the mean intake of the sample was above the EAR for children aged 9-13 years.

(d) Quality of the Diet

In the three days of recall, 23.1% of children ate no meals at a restaurant or take-out food, 62.5% of children ate one or two meals at a restaurant or as take-out food, and 14.4% of children ate three or more meals at a restaurant or as take-out food. Children who consumed three or more restaurant or take-out meals in the 3 days of recall had a significantly greater caloric intake relative to those who consumed no restaurant or take-out meals ($p = 0.048$) (**Table 5**). Children who consumed three or more restaurant or take out meals ate more calories per kg of body weight than did other children who ate no meals at a restaurant or as take-out ($p=0.039$). No significant differences were observed for fat intake or percentage of energy in the diet derived from fat. There was also not a significant difference in children's weight categories (overweight and obese combined) as a function of the number of restaurant or take-out meals.

No significant differences were found between dietary intake and home inventories. Items present in the home may not have necessarily been consumed by the children. The proportion of children stating that the following food items were always available in their homes are as follows (% of total): potato chips (8.7%), fruits and vegetables (67.3%), chocolate and candy (6.7%), vegetables on their plate at supper (26.9%), fruit juice (58.7%), soft drinks (16.5%) and milk (83.7%).

The ten greatest contributors of calories in the diet are listed in Table 6. The top ten contributors of fat in the diet are listed in table 7. Sweetened drinks (soft drinks, fruit drinks, sports drinks, and kool-aid) contributed the most to calories in the diet (7.74%) followed by milk (7.06%) (**Table 6**). Snack Foods contributed the most fat in the diet (12.49%), followed by cookies (9.1%) (**Table 7**). In order of frequency, traditional foods eaten by children in Mistissini were: moose meat, goose, moose stew, beaver, bear, fish, and rabbit. Traditional foods contributed to 2.75% of all calories and 2.12% of fat. Because children ate so few fruits and vegetables, vegetables contributed less than 2% of total caloric intake (1.32%) and fruit contributed only 3.25%. The vegetables most frequently reported by children, in order of frequency, were: mashed potatoes, carrots, tomato (canned), corn, peas, mixed vegetables, lettuce, salad, broccoli, baked potato and green beans.

(d) Weight Status and Caloric Intake

Table 8 presents the different IOTF weight categories with absolute caloric intake, calories per kilogram body weight (kcal/kg), absolute fat (kcal) and percent fat in the diet. No significant differences in absolute caloric intake were found among IOTF weight status categories **(Table 8)** ($p=0.053$), though a trend towards higher energy consumption among children in the normal weight category versus those in the overweight and obese categories was observed. When the children's absolute caloric intake was divided by their weight in kilograms (kg) a significant difference was found between calories per kg and the child's weight status ($p < 0.001$) **(Table 8)**; children in the normal weight category consumed significantly more calories per kilogram body weight ($p<0.001$) than those in the overweight or obese category. No significant differences were found for percent fat in the diet among weight categories, although a difference was found between absolute fat calories among the different weight categories ($p=0.040$), with normal weight consuming more absolute fat calories than overweight children.

(e) Waist Circumference and Caloric Intake

There was an inverse relationship between waist circumference and calories consumed per kilogram body weight ($r = -0.62$, $p<0.001$). Children's waist circumferences were divided into tertiles for analysis (bottom, middle and top tertiles). Waist circumference was significantly different among all weight categories. Obese and overweight children had greater waist circumferences than normal weight children, meaning increasing central deposition of fat (Table 2). Table 9 presents the waist tertiles with absolute calories, calories per kg body weight, absolute fat (kcal) and percent fat in the diet. No significant differences were found in absolute caloric intake among the different waist tertile categories. When analyzed as calories per kg body weight, a significant difference was found among all groups ($p<0.001$) (**Table 9**). Children with the greatest waist circumference consumed the least calories per kg of body weight. Absolute fat (kcal) intake was not significantly different among waist circumference groups; however, percent fat was significantly greater in the top tertile compared to the middle tertile of waist circumference.

(f) Fitness Level in Relation to Dietary Intake

Table 10 presents children's fitness level with calories, calories per kilogram body weight, absolute fat (kcal) and percent fat in the diet. Eighty-six and a half percent of children were classified as having low fitness based on the 20-m shuttle run test (**Table 10**). No significant differences were observed for absolute caloric intake between the fit and low fit categories (**Table 10**). Children with poor fitness consumed fewer calories per kg body weight than fit children ($p=0.002$). No significant differences were observed with absolute fat intake (kcal) or percent fat between fit and unfit children. No child classified as obese was considered fit **(Table 11)**.

(f) Fitness Level in Relation to Weight Status

It was not possible to examine the if there was a statistical difference in fitness level among the weight categories due to the small number of students classified as fit. There were 12 children classified as fit.

TABLES OF RESULTS

Table 1: General characteristics of children

Variable	Boys	Girls	Boys and Girls combined	p value (boys vs. girls)
Total n	43	61	104	-
Age (years)	10.5± 1.0	10.9 ± 1.0	10.8± 1.1	0.027
Height (cm)	147.3± 9.8	151.5 ± 8.7	149.8± 9.4	0.022
Weight (kg)	50.4 ± 15.3[a]	56.5± 17.1	54.0 ± 16.6	0.068
BMI (kg/m^2)*	22.4± 6.0[a]	24.2± 5.6	23.5 ± 5.8	0.103
Waist circumference (cm)	82.6± 14.2	83.1± 15.3[b]	82.9± 14.8	0.859

Results presented as mean ± standard deviation
* BMI based on measured heights and weights.
[a] n=42, [b] n=60

Table 2: IOTF Weight Categories

	Normal	Overweight	Obese	p value
n	34	31	38	-
%	33.0	30.1	36.9	-
% male	35.7	31.0	33.3	
% female	31.1	29.5	39.3	
Age	10.7 ± 1.18	10.7 ± 1.00	10.8 ± 0.98	0.851
Weight (kg) *	39.8 ± 7.1	49.7 ± 9.2	70.2 ± 13.2	<0.001
Height (cm)	146.5 ± 8.7	148.3 ± 10.0	153.8± 8.3	0.002
BMI (kg/m^2)	18.4 ± 1.6^a	22.4 ± 1.9^b	29.5 ± 3.6^c	<0.001
Waist Circumference (cm) *	67.8 ± 6.0^a	80.3 ± 8.2^b	97.6 ± 8.9^c	<0.001

Results presented as mean ± standard deviation.

*1 case missing from weight and waist circumference data as 1 participant did not have weight measured and another participant did not have waist circumference measured.

Superscripts differ significantly.

Table 3: Macronutrient composition of the diet

	Boys[a]	Girls[b]	Boys and Girls combined	p value[c]	DRI* or AI*
Calories (kcal)					
Mean ± S.D	2417 ± 745.7	2412 ± 714.5	2414 ± 724.0	0.973	-
Median	2228	2350	2259		
Range	1277-4327	968-4675	968-4675		
Calories per kg body weight (kcal/kg)	53.1 ± 25.3	46.4 ± 19.2	49.14 ± 22.03	0.131	-
Absolute fat (kcal) Mean ± S.D	704 ± 243.8	741 ± 267	729 ± 258.0	0.414	-
Median	655.0	705	678.0		
Range	238-1336	175-1476	175-1476		
Percent fat					
Mean ± S.D	29.0 ± 4.0	30.5 ± 5.2	29.9 ± 4.8	0.099	*4-18y: 25-35% percent of energy*
Median	29.2	30.6	29.8		
Range	18.6-34.1	18.1-42.0	18.1-42.0		
Percent saturated fat					-
Mean ± S.D	10.4 ± 1.7	11.1 ± 2.0	10.8 ± 1.9	0.062	
Median	10.6	10.8	10.7		
Range	7.2-13.5	7.9-16.5	7.2-16.5		
Protein (%)					
Mean ± S.D	14.2 ± 3.4	13.5 ± 2.8	13.8 ± 3.1	0.238	*4-18y: 10-30% of energy*
Median	14.3	13.0	13.4		
Range	9.5-25.2	7.1-21.1	7.1-25.2		
Carbohydrate (%) Mean ± S.D	58.4 ± 6.4	57.9 ± 5.7	58.1 ± 6.0	0.668	*4-18y: 45-65% of energy*
Median	57.2	57.7	57.6		
Range	40.5-71.0	45.6-71.1	40.5-71.1		

*DRI: dietary reference intakes represented as recommended dietary allowances (RDA)
*AI: Adequate intake is represented (in bold)
[a] One of the boys had only two 24-hour recalls.
[b] Two of the girls had only two 24-hour recalls.
[c] p value for difference between boys and girls in the sample.
Acceptable Macronutrient Distribution Ranges (AMDR's) represented in italics.

Table 4: Micronutrient composition of the diet

	Boys[a]	Girls[b]	Boys and Girls combined	p value[c]	DRI* or AI*
Vitamin A (RAE)[1]					
Mean ± S.D	397.4 ± 265.9	378.7 ± 245.1	386.4 ± 252.6	0.714	4-8y: 275 µg/d
Median	302.5	286.4	299.24		9-13y: 445µg/d
Range	69.5-1298.3	54.98-1035.7	55.0-1298.3		
Vitamin D (µg)					
Mean ± S.D	4.3 ± 3.4	4.5 ± 2.4	4.4 ± 2.8	0.687	**4-13y: 5µg/d**
Median	3.6	4.2	3.9		
Range	0.4-19.6	0.2-10.1	0.2-19.6		
Calcium (mg)					
Mean ± S.D	877.0 ± 428.3	937.4 ± 334.2	912.4 ± 375.2	0.421	**4-8y: 800mg/d**
Median	716.6	869.1	792.2		**9-13y: 1300mg/d**
Range	389.9-2488.3	393.9-1867.5	389.9-2488.3		
Iron (mg)					
Mean ± S.D	16.0 ± 6.9	14.2 ± 5.2	14.9 ± 6.0	0.140	4-8y: 4.1mg/d
Median	15.2	13.3	14.0		9-13y: 5.9mg/d
Range	6.8-36.96	6.1-35.3	6.1-37.0		
Zinc (mg)					
Mean ± S.D	8.1 ± 3.4	8. 5 ± 3.5	8.4 ± 3.5	0.588	4-8y: 4mg/d
Median	7.0	8.2	7.9		9-13y: 7mg/d
Range	3.1-18.1	2.7-23.4	2.7-23.4		
Vitamin C (mg)					
Mean ± S.D	140.6 ± 110.9	124.4 ± 77.6	131.1 ± 92.7	0.384	4-8y: 22mg/d
Median	119.5	106.4	112.7		9-13y: 39mg/d
Range	10.1-567.9	15.0-418.9	10.1-567.9		

[1] 1 RAE = 1 µg retinol
*DRI: dietary reference intakes represented as recommended dietary allowances (RDA), estimated average requirements for groups (EAR)
*AI: Adequate intake is represented (in bold)
[a] One of the boys had only two 24-hour recalls.
[b] Two of the girls had only two 24-hour recalls.
[c] p value for difference between boys and girls in the sample.

Table 5: Calories, calories per kg body weight, absolute fat and percent fat by number of meals eaten at restaurant or take-out food in 3 days of recall.

	Calories (kcal)	Calories per kg	Absolute fat (kcal)	Percent fat (%)
0 meals at restaurant or take-out food*	2172.4 ± 582.9 [a]	42.6 ± 17.3 [a]	648.6 ± 228.2	29.5 ± 6.8
1 or 2 meals at restaurant or take-out food*	2424.6 ± 749.1	48.9 ± 20.4	729.8 ± 266.6	29.8 ± 4.0
3, 4, or 5 meals at restaurant or take-out food*	2755.5 ± 712.5 [b]	60.9 ± 30.9 [b]	851.6 ± 228.4	31.0 ± 4.1
p value	0.048	0.039	0.056	0.599

Results presented as mean ± standard deviation.
* Meals at restaurant or take-out food in the three days of food recall.
Significant difference found between [a] and [b] within each column.

Table 6: Top 10 contributors of calories in diet

Food Item	% Energy
Sweetened Drinks	7.74
Milk (All)	7.06
Snack Foods	6.95
Fruit Juice	6.95
All Cookies	6.00
White Bread	5.62
Desserts	4.04
All Cereal	3.93
French Fries	3.88
Pizza	3.70

Table 7: Top 10 Contributors of fat in the diet

Food Item	% Fat
Snack Foods	12.49
All cookies	9.10
Milk (Total)	7.63
Spreads	5.73
Hot Dog/sausage	5.49
Chicken (all)	5.24
French Fries	5.10
Desserts	4.86
All Cheese (including spreads)	4.62
Pizza	4.61

*See appendix F for list of Food Categories

Table 8: Calorie consumption, calorie per kg body weight, absolute fat and percent fat in the diet by IOTF weight category.

	Calories (kcal)	Calories per kg body weight (kcal/kg)	Absolute fat (kcal)	Percent fat (%)
Normal	2641.2 ± 822.2	68.0 ± 23.5 [a]	798.1 ± 259.3 [a]	30.4 ± 4.4
Overweight	2210.3 ± 684.9	45.6 ± 15.3 [b]	637.9 ± 251.0 [b]	28.3 ± 5.1
Obese	2388.7 ± 622.9	35.2 ± 10.8 [c]	742.7 ± 250.0	30.7 ± 4.7
p value	0.053	<0.001	0.040	0.086

Results presented as mean ± standard deviation.
Superscripts are significantly different within each column.

Table 9: Calorie consumption, calories per kg body weight, absolute fat and percent fat by waist circumference tertile

Waist Circumference	Calories (kcal)	Calories per kg (kcal/kg)	Absolute fat (kcal)	Percent fat (%)
Bottom Tertile	2417.1 ± 819.5	64.0 ± 24.9 [a]	733.8 ± 264.8	30.3 ± 4.7
Middle Tertile	2332.7 ± 733.0	47.6 ± 18.2 [b]	660.6 ± 251.8	28.0 ± 4.8[a]
Top Tertile	2455.0 ± 613.4	35.6 ± 10.8 [c]	772.2 ± 245.4	31.1 ± 4.4[b]
p value	0.780	<0.001	0.193	0.020

Results presented as mean ± standard deviation.
Differing superscripts indicate significant differences at p=0.05 within columns

Table 10: Calories, calories per kg body weight, absolute fat and percent fat in diet by fitness level.

Fitness level	n	Calories (kcal)	Calories per kg (kcal/kg)	Absolute fat (kcal)	Percent fat (%)
Very Poor	76	2376.2 ± 697.8	46.6 ± 21.4	715.4 ± 263.8	29.6 ± 4.6
Fit	12	2707.9 ± 882.2	67.6 ± 21.6	768.0 ± 263.9	28.5± 4.9
p value		0.142	0.002	0.522	0.448

Results presented as mean ± standard deviation.

Table 11: Weight category by shuttle run classification

	Shuttle Run Classification n (%)		
Weight Category	**Very Poor**	**Fit**	**Total**
Normal	18 (62.1)	11 (37.9)	29
Overweight and obese	58 (98.3)	1 (1.7)	59

The overweight and obese categories were collapsed into 1 category for analysis
Results represented as n and % within weight category (descriptive only).
The child classified as fit in the overweight/obese category was overweight.

V. DISCUSSION

In order to develop appropriate interventions promoting healthy child development, it is essential to develop a greater understanding of obesity prevalence, dietary intake based on macro and micronutrient composition, dietary quality, as well as an understanding of fitness level in relation to dietary intake. The findings of this thesis provide evidence for a very high childhood obesity prevalence in an Aboriginal population and demonstrates the urgent need for obesity prevention efforts in Aboriginal communities.

SECTION 5.01 STRENGTHS AND LIMITATIONS

(a) Study Strengths

This study had several strengths. A pilot study was conducted with grade six children in June 2004 in the community. The use of a pilot study provided us with information on the methods that would be most appropriate for use with children in this community and allowed us to adjust our methods accordingly. It also familiarized the school with our presence.

To our knowledge, no other study in Canadian Aboriginal populations has examined the dietary intake of children using three 24-hour dietary recalls on non-consecutive days. For example, in Kawnawake, single 24-hour recalls were used. The advantage of using three 24-hour dietary recalls in comparison to a single 24-hour recall, is the ability to better estimate usual intake at the individual level (Stein et al, 1991).

Another important feature of our study is that we present data on household food availability and household characteristics. We also examined the number of meals eaten at restaurants or as take-out food. We did not look at macronutrient and micronutrient intake in relation to household food availability data because children may not consume food reported to be present in the home. In order to relate dietary intake and food availability, future studies are required to examine the results from the questionnaire about household food availability in comparison to what children were actually eating. This information may show a possible link to the increase in childhood overweight and obesity.

In our sample, dietary data of the children were compared with their fitness level based on the 20-metre shuttle run test. Many of the studies with Aboriginal children in Canada have used questionnaires based on self-report to determine physical activity in children such as the studies in Kahnawake, Sandy Lake and Chisasibi and Eastmain (Trifonopoulos et al, 1998; Jimenez et al, 2003; Hanley et al, 2000; Bernard et al, 1993).

(b) Study Limitations

We obtained informed consent from 104 children, which represented 68.9% of the study population in these grades. The generalizability of our findings may be limited as 31.1% of children were not represented. In other Aboriginal populations in Canada and the United States, participation rates for school based studies were 77% for Kahnawake (Trifonopoulos et al, 1998; Jimenez et al, 2003) and 80% for the Pathways study (Lytle et al, 2002). Our study was conducted in the fall of 2004, and therefore dietary intakes of the children may not necessarily be representative of intakes during other seasons. The problems that are involved in assessing the diets of adults can also be seen in children, such as response bias, recall bias, as well as problems in evaluating portion size (Berg et al, 1998; Lytle et al, 1993). We did not assess the underreporting or overreporting of children in our sample and are therefore unable to discuss this issue in this thesis.

Dietary intake results are presented as unadjusted means ± standard deviations, as well as medians and ranges. Therefore, no statements can be made about the percent of children above or below the estimated average requirements (EAR) based on dietary reference intakes (DRI). Daily food intake has a great amount of variability and therefore needs to be adjusted for this variation to provide a more accurate measure of mean intake (Livingstone and Black, 2003). We did not make this adjustment due to the statistical complexity of the task; therefore, dietary inadequacy was not discussed in this thesis. Future research will however focus on adjusting the dietary intake data in order to assess adequacy of intakes of the children. We used Food Processor SQL Esha (for microsoft, version 9.6.2, 2004) which provide both American and Canadian nutrient information. It does not however provide serving sizes based on Canada's Food Guide to Healthy Eating, and we therefore were unable to analyze the number of servings from each food group that children were consuming.

Despite the study limitations, we were able to provide an overview of what children in this community were eating. The results may therefore be useful to the community if it decides to develop intervention strategies.

SECTION 5.02 GENERAL DISCUSSION

(a) Obesity Prevalence

The International Obesity Task Force cut-offs developed by Cole et al (2000) were used to estimate the prevalence of normal, overweight and obesity in the sample.

The prevalence of overweight in the sample was 30.1% and 36.9% for obesity. This represents 67% of the children in our sample who were either overweight or obese. In a sample of Mohawk children from Kahnawake, 31% of children (aged 6 to 11 years) were found to be overweight based on the 85th percentile of the NHANES II distribution (Potvin et al, 1999). Studies by Bernard et al (1993 and 1995) found that 38% of children studied in Chisasibi and Eastmain (two communities in James Bay) were classified as overweight or having a BMI greater than the 90th percentile of NHANES reference data. Although our findings are not directly comparable to the results stated above as a different reference was used to determine overweight and obese status, the Cree children in our study have a much higher prevalence of overweight. Based on findings from the Canadian Community Health Survey (CCHS, 2004), 18% of Canadian children aged 2 to 17 years are overweight, while 8% are obese (26% in total) (based on IOTF cut-offs). This same survey found that 21% of young Aboriginal people living off-reserve were overweight and 20% were obese (41% in total). Findings from the First Nations Regional Longitudinal Health Survey (RHS, 2002-2003) demonstrate that 22.3% of First Nation children living on reserve were overweight, while 36.2% were obese (58.5% in total) (using IOTF cut-offs). In our population, overweight and obesity prevalence are greater than that found in the rest of Canada, although similarities are seen between obesity prevalence with that of the RHS. An interesting finding from the CCHS, was that the combined overweight and obesity rate for Quebec was 23%, although the obesity rate was similar to the national rate, for 2 to 17 year old children and adolescents (Statistics Canada, 2005). Our percentage of overweight and obesity in children in Mistissini, Quebec, far exceeded the prevalence rate for Quebec as a whole. In general, our findings support higher rates of obesity in Mistissini than found in other studies and indicates the urgent need for prevention programs in this community.

(b) Macronutrient Composition of the diet

Children's mean absolute caloric intake for boys and girls combined was 2414.1 ± 724.0, which is higher than results from Kahnawake, where children were of comparable age (2190 ± 842, based on single 24-hour recall) (Trifonopoulos et al, 1998). The mean percentage of energy from fat in the diet of children in Mistissini was 30.0% ± 4.7%. The children in our sample, were therefore on average, within the recommended ranges for percent fat in the diet based on the dietary reference intakes (DRI) (25 to 35%) for children aged 8 to 18 years. This finding is similar to that found by Trifonopoulos et al (1998), in Kahnawake where the mean percentage of energy from fat was 31.0% ± 7.6. In Sandy Lake, Ontario, single 24-hour recalls were used to assess the diets of youth aged 10 to 19 years. This study found fat intakes of 35.3% ± 10.7 for boys and 36.8% ± 10.4 for girls (Hanley et al, 2000). This finding is higher than that found in our community. Given the high prevalence of obesity in Mistissini children, but an intake of fat within the recommended range, it is clear that the focus of interventions should be improved energy balance and diet quality and not just dietary fat reduction.

Based on three 24-hour dietary recalls, obese and overweight children consumed significantly less total energy per kg body weight than normal weight children in the sample. This potentially could be attributed to the fact that normal weight children were more physically fit and therefore more active than overweight or obese children. There was not a significant difference among groups for total caloric intake. We found no significant differences for percent fat in the diet among weight categories. To our knowledge, no other studies with Aboriginal children in Canada have examined the difference between weight categories and their calories per kg body weight or percentage of energy based on fat.

It is commonly assumed that overweight or obese individuals have higher caloric intakes than normal weight individuals; however, this was not the case in our sample. The possibility exists that overweight and obese children underreported their intake. Similar findings based on three 24-hour recalls on non-consecutive days were found by Story et al (1986) in a sample of Cherokee children aged 8 to 10 years, where mean energy intakes did not differ between lean and fat individuals (Story et al, 1986). In a sample of New Zealand Pacific preschool children (aged 2 to 5 years), it was found that macronutrient intakes did not differ between obese and non-obese subjects (Grant et al, 2004). Based on our finding, the sole focus of interventions should not be caloric restriction, but an emphasis is also required to improve diet quality (e.g., reducing the number of take-out and restaurant meals, reducing snack food consumption) and to increase children's activity levels.

(c) Dietary Quality

Many of the children's meals were eaten at a restaurant or as take-out food in the three days of recall. Trifonopoulos et al (1998) found that in Kahnawake 28% of the children in their sample reported eating out or having take-out food for one or more meals (single 24-hour recalls). We found that 62.5% of children ate one or two restaurant or take-out meals, while 14.4% ate three or more restaurant or take-out meals in the three days of recall. This is a total of 76.9% of children who ate at a restaurant or take-out food in the three days of recall. Children who consumed three or more restaurant or take-out meals in the three days of recall had significantly greater caloric intake relative to those who consumed no restaurant or take-out meals in the three days. These children also consumed significantly more calories per kg of body weight than did other children in the sample. This finding suggests that children who do not eat home cooked meals may be at an increased risk for poor diet quality and being overweight or obese. In a study by Veugelers and Fitzgerald (2005) with grade 5 students in Nova Scotia, it was found that those children who bought their lunches at school were 47% more likely to be overweight. It was also found that those children who consumed suppers with family 3-4 and 5 or more times a week were at decreased risk for overweight and obesity (Veugelers and Fitzgerald, 2005). Bowman et al (2004) studied the diets of children aged 4 to 19 years in the United States (Continuing Survey of Food Intake 1994, 1996 and Supplemental children's survey 1998) and found that 30.3% of children reported eating fast food on a typical day. They also found that compared with children who did not eat fast food, those children who did, consumed more total energy (Bowman et al, 2004). Interventions in Mistissini should be aimed at decreasing the number of restaurant or take-out meals, and/or increasing options of healthy foods on the menu, and/or encouraging the consumption of healthy foods that may already be offered.

The major food sources and food groups contributing to calories in the diet of the study sample were sweetened drinks (pop, kool-aid, iced tea and fruit drinks), milk (all types) and snack foods (potato chips, buttered popcorn, nachos). The major contributors of fat in the diet were snack foods, cookies and milk. Although milk was an important source of fat and calories in children's diets, this was a positive finding as it indicates that children were drinking milk. At the time of our study a school milk program was available for children. Although a direct comparison cannot be made between the top contributors of calories and fat in the diet, Trifonoupoulos et al (1998) found that the top three contributors of energy to the diet in Kahnawake were white bread, french fries and 2% milk, while the top three contributors of fat were french fries, frankfurters and bologna, and ground beef. French fries and white bread were among the top ten contributors of energy in our sample; and french fries and hot dogs were among the top ten contributors to fat in the diet. Swinburn and Egger (2002) discussed the link that exists between the increased consumption of foods of low nutritional value but high in calories with that of increased overweight and obesity.

The high consumption of sweetened drinks in this community is of concern as it may be displacing other important foods in the diet, and could also lead to the increased prevalence of overweight and obesity among children. In a study by Ludwig et al (2001) it was found that with each additional serving of sugar-sweetened beverages consumed by children (mean age 11.7 years), BMI and frequency of obesity increased. Mrdjenovic and Levitsky (2003) found that consumption of sweetened drinks in the diets of children aged 6 to 13 years from the Cornell Summer Day Camp displaced milk consumption and was associated with high energy intake and greater weight gain.

In our study we observed a low consumption of both fruits and vegetables. Vegetables contributed to 1.32% of all calories in the diets of children, while fruits contributed 3.25%. Trifonopoulos et al (1998) had similar findings in Kahnawake, with children having low vegetable intake on the day of recall. The vegetables most commonly reported by children in our sample (in order of frequency) were: mashed potatoes, carrots, tomato (canned), corn, peas, mixed vegetables, lettuce, salad, broccoli, baked potato and green beans. The most frequently reported vegetable of children in Kahnawake was french fries followed by canned tomatoes, mashed potatoes and lettuce, while other vegetables were reported by less than 10% of children (Trifonopoulos et al, 1998). Trifonopoulos et al (1998) defined vegetable intake by the number of times children mentioned eating them on the day of recall. We did not include french fries as a vegetable in our sample, rather we included it in a category of its own, as it was reported frequently by children and because of its high fat content. Findings from the CCHS, where the frequency of fruit and vegetable consumption was assessed, found that 59% of Canadian children and adolescents were reported to consume fruit and vegetables less than five times per day (Statistics Canada, 2005). They also found that the children who consumed the least fruits and vegetables were more likely to be overweight and/or obese than those who ate fruits and vegetables more regularly (Statistics Canada, 2005). These findings represent the importance of promoting fruit and vegetable intake with children, with intervention strategies focusing on their increased consumption.

Traditional foods did not contribute a large amount to children's diets in Mistissini. This finding has been observed in other studies with Aboriginal children. For example, in the Pathways study Lytle et al (2002) found that traditional foods were not an important source of energy or fat in children's diets as only 11% of children mentioned eating them. Trifonopoulos et al (1998) also found a limited consumption of traditional foods in their sample of children from Kahnawake. They found that traditional foods were mentioned in 17.7% of recalls (Trifonopoulos et al, 1998). Future research might investigate why children are not consuming larger amounts of traditional foods and how to encourage its consumption.

(d) Waist Circumference and Caloric Intake

We observed an inverse relationship between waist circumference and calories per kg body weight, likely accounted for by the fact that overweight and obese children had greater waist circumferences and they consumed lower energy intakes. An increased waist circumference has been linked to increased adverse health effects in adults and in children (Janssen et al, 2002; Katzmarzyk, 2004). Waist circumference was not measured in the studies in Kahnawake or Sandy Lake and therefore a comparison cannot be made with Aboriginal populations in Canada. In a study by Goran et al (1995), body composition was compared with Mohawk children aged 4 to 7 years and Caucasian children of comparable age. The Mohawk children in the sample had significantly higher waist:hip ratios suggesting that body fat is more centrally distributed as compared to Caucasian children (Goran et al, 1995). Although we did not measure waist:hip ratio in our sample, we did find evidence that body fat was centrally distributed. Future studies in Aboriginal children should consider the use of waist circumference to identify children with increased risk for obesity related chronic diseases.

(e) Fitness Level in Relation to Dietary Intake

Physical fitness is a surrogate measure for physical activity. When children were placed into either very poor or fit categories based on the 20-meter shuttle run test, 86.5% of children were classified as having very poor fitness (12 children were classified as fit).

No significant differences were observed for absolute caloric intake between the two categories, however it was found that children with poor fitness consumed fewer calories per kg body weight than the fit children in the sample. Those children classified as obese were less physically fit than children in the normal weight and overweight categories, which likely explains the association. It is likely that children who were classified as overweight or obese moved less and therefore required less calories. This finding is similar to that found by Janssen et al (2004) in that overweight and obese children (aged 11 to 16 years) compared with normal weight children had lower levels of physical activity, although they found no clear links between dietary habits and overweight and obesity. The results from Janssen et al (2004) are based on self-report and can therefore not be directly comparable to the results found in our study. Low physical fitness levels were also found among Mohawk children in Kahnawake, with a mean age of 7.5 years, based on a run/walk fitness test (Horn et al, 2001). They found that 73.8% of girls and 62.5% of boys did not pass the run/walk fitness test (Horn et al, 2001). The CCHS found that low physical activity levels were significantly associated with overweight for 12 to 17 year old boys based on a questionnaire about leisure-time physical activities over the past three months (Statistics Canada, 2005). Bernard et al (1995) also found that overweight subjects in two Cree communities in James Bay participated in less physical activity than normal weight subjects. The findings by Bernard et al (1995) were however, based on a questionnaire regarding the frequency of physical activity and not a measure of the children's physical fitness such as the 20-metre shuttle run. An emphasis should be placed on increasing the number of gym classes being offered to children in school and increasing physical activity leading to increased physical fitness.

VI. CONCLUSIONS

SECTION 6.01 CONCLUSION

Based on the study findings, we were able to discuss the macronutrient and micronutrient intakes of Cree children, although statements could not be made with regard to inadequacy (Objective 1). Based on the mean intake of children, many were below the DRIs for vitamin A, calcium and vitamin D, but mean intakes were within the DRIs for vitamin C, iron and zinc. With respect to the top 10 contributors to calories and fat in the diet (Objective 2), it was apparent that many children were consuming low nutrient dense (but high caloric density) foods. For this reason, it is likely that fat and calorie content of children's diets would diminish if children were to consume more healthy, nutrient dense foods. Many meals were restaurant or take-out meals (Objective 3) and children consumed more calories if consuming more of these types of meals. For this reason, home-cooked meals might promote lower energy intake. Dietary intake varied by weight classification, waist circumference and physical fitness when reported as calories consumed per kilogram of body weight, but not when reported as absolute caloric intake (Objective 4). Children who had normal weight, a smaller waist circumference, and who were classified as physically fit consumed the most calories per kilogram body weight. Finally, we found no differences in dietary intake between boys and girls (Objective 5).

Aboriginal populations represent a unique group of individuals with their own particular needs. Research continues to be lacking in many important areas of Aboriginal health in Canada (Young, 2003). Rates of childhood overweight and obesity are becoming more prevalent in this population. This is troublesome as these increases could lead to negative health outcomes such as type 2 diabetes and heart disease.

Much like other Aboriginal populations in Canada, Mistissini has experienced a shift from a more traditional lifestyle to a more westernized lifestyle with decreased activity and increased consumption of market foods. A consequence of this dramatic change in lifestyle has been an increase in the prevalence of chronic diseases in this community. A significant difference is noted between the health of Aboriginal populations and that of the Canadian population as a whole (Health Canada, 2002). Efforts need to be made to remove this disparity that exists between Canada as a whole and Aboriginal populations.

6.02 RECOMMENDATIONS

Further research into lifestyle behaviours in this community through the use of qualitative research methods may be helpful in further understanding the growing epidemic of obesity in this population. In a study by Bobra et al (2003), qualitative research was used to gain a better understanding of children's, parents, and teacher's attitudes, perceptions and behaviours about preventing overweight in children, as well as to explore any potential avenues for communicating overweight prevention messages. A combination of direct observation, in-depth interviews and focus groups could be used to collect information in Mistissini. School and community-based culturally appropriate interventions must be developed within the community to promote healthy child development. These interventions must fit the needs of the community and provide information on local risk factors for the community (Willows, 2005). The Kahnawake

Schools Diabetes Prevention Project (KSDPP) used participatory research incorporating Aboriginal culture and expertise (Macaulay et al, 1997). The KSDPP managed to offer healthy foods in the school canteens and incorporated 4 to 12 classroom diabetes prevention-related activities taught by teachers in the school (Macaulay et al, 1997). Other intervention programs in Aboriginal communities include the Sandy Lake Health and Diabetes Project and the Pathways Feasibility Study (Hanley et al, 1995; Gittelsohn et al, 1999). A combination of quantitative and qualitative research in Mistissini would provide a broader and more in-depth understanding of the community and would aide in the development of culturally appropriate interventions.

It is crucial that the interventions focus on all factors that could potentially be contributing to the problem of overweight and obesity such as personal, behavioural and environmental factors, which are all associated with individual food habits (Davis et al, 1999). Future research might include further exploring the determinants of health within this community and other aspects that may lead to the increase in overweight and obesity among children. As stated in the document called Population Health: "At every stage of life, health is determined by complex interactions between social and economic factors, the physical environment and individual behavior." (http://www.phac-aspc.gc.ca/ph-sp/phdd/determinants/#determinants). Members of the community (ie. parents, elders, teachers, students and health professionals) need to all be involved when developing solutions to the obesity epidemic. Interventions that are "top down" or that involve victim blaming are not likely to succeed in the community (Minkler, 1999), rather a combination of both individual behaviour change and environmental change are more likely to succeed (Willows, 2005). Minkler (1999) discusses evidence in support of social responsibility, as opposed to personal responsibility for health, such as positive effects that have been seen with the taxing of tobacco products or automobile safety rules and regulations.

Intervention strategies should target this problem at multiple levels such as the school, community and government. Veugelers and Fitzgerald (2005) point out that school and family based factors are associated with overweight and obesity in children and therefore intervention strategies should focus on these areas. Strategies to improve the health of Cree children and to provide knowledge for healthier lifestyle behaviours might include: 1) a school lunch program, 2) education aimed at decreasing sweetened drink consumption, 3) increasing fruit and vegetable consumption, 4) promoting physical activity, and/or 5) afternoon and evening programs for children that are accessible and meet their needs (for example not necessarily sport focused as not all children are athletic). One other possible suggestion might be modifying the school year to accommodate hunting seasons and more traditional ways of life. Goose break already occurs in this community, however similar traditional breaks may also be considered.

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http://www.phac-aspc.gc.ca/ph-sp/phdd/determinants/#determinants

APPENDICES

Appendix A

Ethical Approval

Faculty of Agriculture, Forestry, and Home Economics
Human Research Ethics Board
Approval

is hereby granted to:

Noreen Willows, Principal Investigator for

04-16 The Active Kids Project

for a term of one year, provided there is no change in experimental procedures. Any changes in experimental procedures must be submitted in writing to the HREB.

Granted: May 20, 2004

for Rhonda Bell, Acting Chair, HREB

Appendix B

INFORMATION SHEET

Title of Project: **Emiyuu Ayayaachiit Awaash Project**
The Active Kids Project

Researchers at the University of Alberta:

Noreen Willows, PhD, Associate Professor, Department of Agricultural, Food and Nutritional Science, phone: (780) 492-3989, email: noreen.willows@ualberta.ca

Members of Steering Committee in Mistissini

Jane Blacksmith, Director, Public Health Department, Cree Nation of Mistissini, tel: 923-3461, ext. 205
Kitty Blacksmith, Assistant Director, Public Health Department, Cree Nation of Mistissini, tel: 923-3461, ext. 314
Paul Linton, Director of Uschiniichisuu, Cree Health Board, tel: 923-2332 ext. 355
Wally Rabbitskin, Program Officer in Physical Activity, Cree Health Board, tel: 923-2332, ext. 210
Bella Petawabano, Director of Awash Miyupimatsiiuun (children's health and well-being), Cree Health Board, tel: 923-2332, ext. 233

Background:

Major changes in the lifestyles of First Nations across North America have taken place. These changes have resulted in the appearance of diseases such as obesity, diabetes and heart disease. There is a possible connection between the diet and activity of children and obesity. In this study, we would like to find out what children in Mistissini are eating, how active they are, what they think about their bodies and themselves, and their body size. This study has been discussed with teachers at your child's school. The study is supported by Public Health Department, the Principal, and the Cree Board of Health and Social Services.

Purpose:

It is important to know if children are a healthy weight and if they feel good about their weight and themselves. It is also important to know the types of things that might cause a child to be too big or too small. For this reason, we would like to find out how active they are and what they are eating. This information can be used to develop programs and activities to keep kids a healthy size.

Procedures:

Diet: We will ask children about the foods they eat. They will be given a questionnaire during class and then will meet with a dietitian individually to go over what they eat. We might use an assistant fluent in Cree to help us. Children will be asked what they eat each day. Each child will be asked about three different days. The child will be asked how much food they ate, types of food, and method of preparation used. Children will be asked if they eat common foods.

What children think of their size and themselves: Your child will be shown pictures of children of different sizes, and they will be asked to select the one that looks the same size as them, the one they would like to look like, and the one they think might get diabetes. They will also be asked questions to try to understand what they think of themselves. The research team will give the questionnaires during class. Question will be read aloud so students understand the purpose of each question. Students will be told to spread themselves out around the classroom so that they are unable to see other students' responses and to choose the answer they think is the best response.

Size of children: To find out children's sizes, we will measure them (weight, height, and waist size) and find out how much fat is under their skin by measuring how thick it is. A member of the research team will measure your child's size. Skin folds will be measured at five on the body (back and front of the arm, on the back, on the hip, and the calf). Children will be required to lift up the back of their shirt and roll up their pant leg and sleeve. These measures will be taken in a private room with two testers present.

Activity and fitness: We will ask children how often they are active or inactive. We will ask children questions about the activity of people that they live with in their home. We will test how fit they are by asking them to run in the gym. We will ask children to attach to their clothing a small device called a pedometer that will measure how many steps they take in a day.

How Information will be used:

The information will be studied to find out if diet and activity levels are related to child size. It will also tell the researchers what children eat, if they are fit, and if they are happy with their bodies. The information may be compared to surveys in other parts of Canada and might be compared to future surveys. This information will be included as part of reports (theses) that university students will write, and will be used to write research papers that will be read by persons interested in child health.

Possible Benefits:

There is little information about what Cree children eat, what they think about the size of their bodies, what activities they do or if they are physically fit. There have been no studies of young children's diet, ideas of body image, self-esteem and levels of physical activity and fitness. The results from this study will help the community determine: (1) what children eat, (2) how they feel about their size, (3) if they have a proper weight and size, and (4) what activities children do. The information will help in the development of teaching materials and programs about healthy lifestyle and diet in the school.

Possible Risks:

The risks connected with participating in this study are minimal.

Confidentiality:

Your child's name will not appear in the computer and your child's name will never be reported. Personal records related to this study will be kept confidential. All files will be stored in a locked filing cabinet or on a private computer in the office of the researchers.

Time Commitment:

The entire test session should not exceed 3.5 hours per child in a 2-week period.

Withdrawal or non-participation in the study:

Children will be asked if they are willing to participate, and their wishes will be respected.

Children are free to withdraw from this study before or during the testing period.

If you have any questions, please contact:

Noreen Willows in Edmonton at (780) 492-3989 or by email: noreen.willows@ulberta.ca

Jane Blacksmith 923-3461 ext 205

Kitty Blacksmith 923-3461 ext 314

Appendix C

CONSENT FORM

A study to understand the health of Cree children
Emiyuu Ayayaachiit Awaash Project (The Active Kids Project)

Purpose:
This research project hopes to find out from children:

(1) what they are eating,
(2) how they feel about their bodies and themselves,
(3) how active they are,
(4) if they have a healthy size.

Methods:

(1) What are they eating?
A researcher will ask your child what they have eaten on three different days, what foods they eat on a regular basis, and where they eat their meals. Pictures of some commonly eaten foods, plastic copies of food, and measuring cups and spoons will be used to help children tell the researcher how much food they ate.
(2) How do they feel about their bodies?
Pictures of children will be used to find out what your child thinks their body size is, what body size they want to be, and what is an acceptable and healthy body size. Your child will also be asked a series of questions about what they think of themselves.
(3) How much they exercise and are they physically fit?
Children will do a test of physical fitness by running in the gym and will be asked questions about their activities. They will wear a small device on their clothing that will count the number of steps that they take in a day.
(4) Their size
In a private booth, we will measure your child's height, weight and waist size. The thickness of the skin will be measured in five places on the body.

Confidentiality: All information collected on your child will be recorded on paper and entered into a computer. All of the information recorded and typed will be private and your child's name will not appear in any report. Only people that are working on this study will have access to the information. A copy of the data with all names removed will be stored at the Cree Board of Health and Social Services of James Bay.

Benefits: This study may not have any direct benefits for your child. It is hoped that this information can be used to make good decisions about health programs for children.

Risks: The information provided by your child will be kept private. It is not expected that participating in this study will harm your child.

Withdrawal from the study: You can decide that you do not want your child to participate in the study. This can be done before they have started the study or before the testing is completed.

Consent Form Emiyuu Ayayaachiit Awaash Project

Please read the attached information sheet and circle your answer.

Do you understand that you have been asked to include your son or daughter in a health research study?

Yes No

Have you read and received a copy of the information sheet?

Yes No

Do you understand that there are minimal risks involved in including your son or daughter in this research study?

Yes No

Do you understand that your son or daughter can quit taking part in this study at any time?

Yes No

Do you understand that the information collected will be kept confidential?

Yes No

Do you understand who will be able to access the information collected from this study?

Yes No

Do you understand that the information collected may be compared to results from similar surveys in other parts of Canada, and that the information may also be compared to future surveys or used for other research studies?

Yes No

Do you consent to have the information collected used as described in the information sheet?

Yes No

Do you consent to have the information used for future research studies?

Yes No

Do you consent to having your son or daughter take part in this research study?

Yes No

____________________________ ____________________________

Signature of parent or guardian — Printed name of parent or guardian

____________________________ ____________________________

Date (dd/mm/yyyy) — Name of child

Appendix D

24-HOUR RECALL

Day of week:	FOOD			AMOUNT	
Time	Food Name	Method of Preparation	Where and with who food eaten	In Number	In Unit

Appendix E

Food Availability at Home

	Never	Sometimes	Usually	All the Time
Potato chips are in my house to eat				
Fruits and vegetables are in my house to eat				
Chocolate and candy are in my house to eat				
Vegetables are on my plate at dinner				
Real fruit juice (example: Oasis, Minute Maid, Del Monte) is in my house to drink				
Pop/soft drink is in my house to drink				
Milk is in my house to drink				

How many people live in your house?

Appendix F

Food Categories

Food Group	Food Item in group
French fries	Baked and fried french fries, hashbrowns
Sweetened drinks	Pop, iced tea, gatorade, fruit drinks (eg Sunny D), and Kool-aid
Diet drinks	Diet soda
Fruit Juice	Real fruit juice
Snack Foods	All types potato chips and nachos (Doritos), cheese puffs and buttered popcorn
Pizza	Store bought, restaurant, pizza pops
White bread	White bread, white buns, white bagels, crackers, tortilla
Brown bread	Brown bread
Candy	Hard and chewy
Cereal	Hot and cold, all brands
Chocolate	Chocolate bars (all types)
Chicken	Baked, fried, nuggets, chicken wings, roast, turkey
Baked goods (desserts)	Cake, cupcakes, pie, tarts, strudels, cheesecakes, pudding, banana bread
Doughnut	
Cookies	All types
Pasta	Pasta
Milk	Skim, 1%, 2%, homo
Fruit	Apple, banana, blueberries, orange, peaches, strawberries, mixed fruit, kiwi, melon, nectarine
Vegetables	Green beans, broccoli, cauliflower, carrots, celery, corn, cucumber, lettuce, peas, tomato, mixed vegetables, potatoes
Traditional foods	Bear, beaver, moose meat, goose, rabbit, moose stew, fish
Spreads	Butter and margarine
Peanut butter	Peanut butter, nuttella
Beef	Ground beef, ribs, meatloaf, meatballs, steak, corned beef, hamburger
Lunchmeat	Ham, bologna, chicken breast
Eggs	Fried, boiled, scrambled
Cheese	Block cheese, cheese whiz, cheese slice, cream cheese
Yogurt	All flavours
Hot dog	Hot dogs, pogos, sausages, bacon

Pork	Baked ham, pork chop
Rice	Rice (white and brown)
Condiments	Ketchup, mustard, soy sauce, plum sauce, BBQ sauce
Dressings	Salad dressing, dips, sour cream, miracle whip, mayonnaise
Ice cream	All flavours
Brown sauce	Canned brown sauce (poutine sauce)
Mixed dishes	Lasagna, meat sauce, meat pies
Macaroni and cheese	Homemade and boxed/prepared
Bannock	
Pancakes	Waffles, pancakes, and french toast

Appendix G

ANTHROPOMETRIC MEASURES

DATA SHEET

Name: ________________________________ ID: _____________

Gender: M F Age: _______ Class: _____________

Measurements

Height (cm): ______________

Weight (lb):_______________ BMI (kg/m^2): ____________

Waist (cm): _______________

Skinfolds

	1	**2**	**3**		**Average (closest 2)**
Triceps					
Biceps					
Medial Calf					
Subscapular					
Suprailiac					
				Total (mm)	

Comments: