University of Alberta

Dietary assessment of First Nations elementary school children

By

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Abstract

The prevalence of child overweight/obesity in Canada has increased over the last 25 years. The prevalence is 2-3 times higher in Aboriginal compared to non-Aboriginal children. Some dietary behaviors are directly associated with obesity. The consumption of vegetables and fruit, milk, and traditional Aboriginal food is associated with healthier weights. The goals of this study were to refine two dietary assessment tools and employ them to determine the dietary intakes of First Nation children living in a community in central Alberta. Children in this study (n=28) presented high levels of both overweight/obesity (63%) and abdominal obesity (26%). Consumption of vegetables and fruits, and milk were below the daily recommendations according to "Eating Well with Canada's Food Guide". Few children ate traditional foods. In contrast, intakes of foods that should be limited were much higher than recommendations. Information from this study will serve to tailor future interventions to improve healthy dietary practices in Aboriginal school children.

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List of Abbreviations

ANFB: Alberta Nutritious Food Basket

BMI: Body Mass Index

CBPR: Community Based Participatory Research

CCHS: Canadian Community Health Survey

CDC: Center for Disease Control and Prevention

DILQ: The Day in the Life Questionnaire

EWCFG: Eating Well with Canada's Food Guide

FFQ: Food Frequency Questionnaire

NCD: Non-Communicable Diseases

RDA: Recommended Dietary Allowance

RHS: Regional Health Survey

SCT: Social Cognitive Theory

SPSS: Statistical Package for the Social Sciences

T2DM: Type 2 Diabetes Mellitus

VFFQ: Vegetable and Fruit Frequency Questionnaire

WC: Waist Circumference

WHO: World Health Organization

YAQ: Youth/Adolescent Food Frequency Questionnaire

1. Introduction

In recent years, global obesity levels have increased dramatically in both adults and children (World Health Organization, 2011). A relationship between the presence of obesity and the development of major chronic diseases in adults has been demonstrated. The problems usually progress from childhood into adulthood. Obesity levels among children and youth in Canada have nearly tripled over the past 25 years (Canadian Institute of Health Research, 2010). There is an alarming increase in obesity levels among Aboriginal children with rates of obesity 2 to 3 times higher than those presented by non-Aboriginal children. Dietary intake is associated with weight status (Champagne et al., 2011; Canfi et al., 2011). Aboriginal people's diet has undergone a transition as the result of factors such as changing work habits, better food packaging, availability of refrigeration and freezer storage and the growth of modern air transportations (Health Canada, 1995). While modern technology has created many time-saving benefits, it has also introduced soft drinks, candy bars, and high energy, low nutrient snack foods (Popkin, 2006). Furthermore**,** dietary practices have changed as a result of the loss of indigenous cultural practices which should therefore be preserved not only from a cultural standpoint but also from a nutritional perspective.

The Eating Well with Canada's Food Guide- First Nations, Inuit and Métis was created to promote healthy eating by reflecting the unique values, traditions and food choices of Aboriginal populations (Health Canada, 2007). It promotes the consumption of vegetables and fruits in sufficient quantities, encouraging consumption of a minimum of 500 ml of milk per day, limiting fat and salt consumption, as well as snacks and sugary drinks. Despite the publication of this guide which was designed in an effort to maintain healthy dietary habits, consumption of vegetables and fruits in the Aboriginal population is still below the recommended number of servings and processed food is highly consumed (Hopping et al., 2010; Downs et al., 2009; Garriguet, 2007).

Different factors (social, individual, socio-economic and environmental) are related with poor dietary behaviors in Aboriginal people (Willows, 2005). Food choice is potentially influenced by a large range of factors; it is not determined entirely by physiological or nutritional need, but is also influenced by social, economical and cultural factors (Sheperd, 1999). Moreover, food insecurity among Aboriginal people may be a strong determinant of dietary behaviours. Food security in Canada is defined as the requirement of adequate amounts of safe, nutritious, culturally acceptable food, accessible to all in a dignified and affordable manner (Koc & MacRae 2001). According to the Canadian Community Health Survey (CCHS), food insecurity is disproportionately higher in Aboriginal compared to non-Aboriginal population (Health Canada, 2007). Therefore, currently more attention is focused on the modification of environments through interventions by removing barriers and creating opportunities to facilitate healthy behaviour (Sharma, Gittelsohn, Rosol, & Beck, 2011; Wenrich, Brown, Wilson, & Lengerich, 2012).

In order to promote healthy eating behaviours, several interventions have taken place in Aboriginal communities (Foulds, Bredin & Warburton, 2009; Anand et al., 2007; Harvey-Berino & Rourke, 2003). Modification of eating habits and increased physical activity were the main objectives of the aforementioned interventions with the ultimate goal of preventing obesity in children. Some of the studies showed significant improvements in different aspects such as dietary behaviours, physical activity, weight status and/or waist circumference measurements. For example, after an intervention conducted by Foulds et al (2009) in British Columbia, Aboriginal participants of a physical activity intervention reduced their waist circumference measurement. Moreover, in a nutrition intervention based on the modification of environmental factors, positive changes occurred in the dietary behaviours and weight status of Aboriginal children (Saksvig et al, 2005). Therefore, based on existing evidence, nutrition interventions should be considered as an option to modify obesogenic behaviours of children.

In order to promote consumption of fruits and vegetables in a First Nation community school in central Alberta, a nutrition intervention called "EarthBox Gardens" was implemented. The intervention was based on Social Learning and Social Cognitive Theory (Bandura, 1997), recognizing the complex and reciprocal relationship between dietary habits, environmental and personal factors. This theory was selected as previous studies and reviews indicated that factors such as taste preferences, availability and accessibility are important determinants of vegetables and fruit consumption among children (Blanchette & Brug, 2005). Through the modification of the environment by increasing the availability and exposure of a variety of vegetables and fruits, the EarthBox Gardens intervention sought to increase the preference for these foods, and therefore, to positively change the eating habits of children.

The study presented in this thesis is part of the aforementioned garden-based nutrition education intervention to improve the dietary preferences, habits and vegetable and fruit intake of First Nation schoolchildren. To measure the impact of this intervention, baseline data collection of dietary behaviours and anthropometric measures were necessary.

As part of the formative evaluation, we conducted a feasibility study of two dietary assessment tools. A feasibility study is a piece of research done before the main study which is used to estimate important parameters that are needed to design the main study (e.g. Willingness of participants to be randomised, number of eligible patients, characteristics of the proposed outcome measure, etc.) (Arain, Campbell, Cooper & Lancaster, 2010). Moreover, a feasibility study identifies areas of weakness and strength, pinpoints needs that might otherwise be overlooked, spots opportunities early, and begins planning how to best achieve goals (Dimitrios & Aristomeni, 2009).

Both tools have been administered to children in other populations with age and language similarities, but they never been used in Aboriginal populations, and therefore, required specific adaptations. Children in the study had English as a first language and were instructed in English at school. The study was approved

by a University of Alberta ethics review board (PER/ALES/NS) and the community Wisdom Committee.

1.1 Purpose of the study

The overall purpose of this study was to refine two dietary assessment tools and to employ these to determine specific elements of the dietary intake of First Nation children. The present study is part of a larger study, the goal of which was to use a community-based participatory research approach to determine the effectiveness of a garden-based nutrition education intervention on the dietary preferences, habits and intake of First Nation schoolchildren in grades 4, 5 and 6.

This thesis is divided into two phases:

I. Refinement of two dietary assessment tools for cultural adaptability in a First Nation elementary school (chapter 2).
II. Characterization of specific aspects of the diet in First Nation school children using the aforementioned tools (chapter 3).

1.2 Hypotheses

1. It was expected that the vegetable and fruit intake of schoolchildren would be below the national recommendations for age and sex based on the Eating Well with Canada's Food Guide- First Nations, Inuit and Métis (EWCFG).
2. It was expected that intakes of "food to be limited" would be higher than recommended by the EWCFG.
3. It was expected that vegetable and fruit intake of schoolchildren would be higher during the weekdays compared to the weekend. It was also expected that "foods to be limited" consumption, would be higher during the weekend compared to the weekdays.

4. It was expected that intake of "food to be limited" would be higher in overweight/obese children or those presenting abdominal obesity compared to children with lower adiposity levels.

During phase I of the study, the objective is to conduct process and formative evaluation of food aides and dietary assessment tools for administration with children in a group setting. Afterwards, we used the refined tools to collect dietary information based on the objectives of the study.

1.3 Objectives of the study

1) To collect dietary (instances of vegetables and fruit, "foods to be limited", traditional Aboriginal foods, and milk) and anthropometric (height, weight and waist circumference) data from 4^{th}, 5^{th} and 6^{th} grade children.
2) To compare dietary intake data to national recommendations (EWCFG) and reference data (Canadian Community Health Survey).
3) To compare dietary intakes of vegetables and fruit, traditional food, milk and foods to be limited across normal weight, overweight and obese groups.

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2. Literature review

2.1 Aboriginal People in Canada

"Aboriginal people" is a collective name for the first habitants of Canada and their descendants. The three groups of Aboriginal people that the Canadian Constitution recognizes are the Indians (commonly referred to as First Nations), Métis and Inuit. These are three distinct peoples with unique cultural practices and spiritual beliefs (Aboriginal Affairs and Northern Development Canada, 2010) as well as unique food patterns which were historically often high in animal protein and low in fat and carbohydrates (Schaefer, 1977).

Aboriginal populations have been susceptible to transitions that have affected their health, such as the nutrition transition, which results from large shifts in the structure and composition of the diet as well as a change in activity patterns (Popkin, 2006). In addition to the nutrition transition, the traditional active lifestyle (characterized by hard physical activities such as fishing, hunting and gathering) has been replaced by a more sedentary lifestyle influenced in part by the increased use of motorized vehicles (Curtis, Kvernmo, & Bjerregaard, 2005) and availability of non-traditional or 'market' foods (Sharma, 2010a). The transition of both diet and physical activity patterns has resulted in Aboriginal peoples having a high burden of obesity and resultant metabolic complications (Pollex et al., 2006).

A major contributing factor to the global nutrition transition is the increased access to vegetable oils and relatively inexpensive and fast foods, which consequently result in increased total fat consumption in populations with low incomes and accelerated urbanization. A westernization of indigenous diets is characterized by a lower consumption of foods like fish, meat, fruits, berries, tubers etc., and a higher consumption of processed foods and drinks, high in refined carbohydrates and saturated fat (Soueida, & Egeland, 2004). Some groups, such as children and Aboriginal populations are more affected and are more

vulnerable to the harmful side effects that this transition represents. According to Kuhnlein and Receveur, in the Canadian Artic, the range of consumption of traditional food among children was from 0.4 – 15% of the total energy of their diets and 40% of their total energy was contributed by ‘‘sweet’’ and ‘‘fat’’ food sources (Kuhnlein. & Receveur, 2007). This is important if we consider that children with a limited consumption of traditional food tend to consume more fat and sugar as a percentage of their energy (Kuhnlein & Receveur, 2007). A traditional diet represents a significant source of energy, protein, calcium, iron, zinc, niacin, polyunsaturated fatty acids (omega 3 fatty acids) and is low in saturated fats (Assembly of First Nations Environmental Stewardship Unit, 2007). Furthermore, traditional diet and an active lifestyle can act as protective factors against chronic diseases such as diabetes, heart disease, cancer, and other health conditions (Assembly of First Nations Environmental Stewardship Unit, 2007).

It is important not just from a health and dietary perspective, but also from a historical and cultural one, that we do everything in our power to assist the Aboriginal peoples of Canada to deal with the nutrition transition while we at the same time, remain sensitive to the requirements of their deep heritage.

2.2 Dietary trends in Aboriginal people

In order to advise the population about a healthy diet and prevention of chronic disease, while avoiding the negative effects of consuming too much of any individual nutrient, the Eating Well with Canada’s Food Guide- First Nation, Inuit and Métis (EWCFG) was created. The EWCFG is a food guide designed to reflect traditions and food choices of Aboriginal people and an important tool for individuals, families and communities to learn about and share ways of eating well, including traditional and store-bought foods (Health Canada, 2007). The food guide is based on the Dietary Reference Intakes (DRI) which summarizes research findings about the amount of each nutrient and calories needed for good health (Health Canada, 2007). The EWCFG recommends consumption of four

different groups in different quantities based on the requirements for each group based on age and gender. These four groups are: 1) vegetables and fruits (source of carbohydrate, vitamins A and C, potassium, magnesium and some B vitamins such as folate), 2) grain products (providing carbohydrate, B vitamins (e.g., thiamin, riboflavin, niacin, and folate), iron, zinc, magnesium and other components such as fiber, 3) milk and alternatives (principal source of calcium, vitamins A, D and B12, riboflavin, zinc, magnesium, potassium, protein and fat) , and 4) meat and alternatives (rich source of iron, zinc, magnesium, B vitamins (thiamin, riboflavin, niacin, vitamin B6 and vitamin B12), protein and fat). Moreover, the EWCFG recommends limiting consumption of some other foods due to their high content of calories, fat, sugar and salt (Health Canada, 2007).

Aboriginal men consumed significantly less milk products than non-Aboriginal men, about half a serving less per day (Garriguet, 2008). Before the development of agriculture and animal husbandry, Aboriginal dietary choices would have been limited to minimally processed, wild plant and animal foods (Cordain et al., 2005). Traditional foods such as wild plants, seaweed or fish with bones provided the calcium in the diet (Health Canada, 1995). Due to the reduction of traditional food consumption in Aboriginal people (Kuhnlein, Receveur, Soueida & Berti, 2007) other foods should supplement the nutrients lacking in the modern diet. Milk is a good source of many of the nutrients that were available to this population solely through traditional foods such as calcium, vitamins A, D and B12, riboflavin, zinc, magnesium, potassium, protein and fat (Health Canada, 2007). An additional benefit of drinking milk is the finding that milk consumption has been inversely related to soft drinks and fast food consumption (Larson, Story, Wall, & Neumark-Sztainer, 2006). Therefore, the EWCFG recommends drinking 500 mL (2 cups) of skim, 1% or 2% milk each day for all groups of age (Health Canada, 2011).

Following recommendations from the EWCFG may help to maintain a healthy diet providing the essential nutrients and at the same time, preventing overconsumption of food groups (Health Canada, 2007). However,

recommendations from the EWCFG are not totally fully met by many Aboriginal people (Garriguet, 2008). Overconsumption of energy-dense foods is associated with obesity which is an increasing problem not only in the Aboriginal, but also in the global population (World Health Organization, 2011). Dietary behaviour is a significant determinant for obesity; however other contributory factors will also be reviewed later in this study.

2.3 Obesity an increasing problem among Aboriginal people

Obesity has become one of the most important public health problems in recent times, with concomitant increased morbidity and mortality. Obesity increases the risk of high blood pressure, high blood cholesterol, type 2 diabetes, insulin resistance, coronary heart disease, and many other physical ailments (Dietz, 1998). The increasing prevalence of overweight and obesity is associated with both direct and indirect costs that affect both individuals and communities. Several smaller, community-specific studies of childhood obesity in Canada suggest very high rates of overweight among boys (27.7%) and girls (33.7%) in non-specified Aboriginal communities (Hanley et al., 2000). In a study conducted by Pigford (2010), a high prevalence of overweight and obesity was found in a First Nation elementary school. Of the participating students, approximately half (47.6%, n=50) were overweight (27.6%, n=29) or obese (20.0%, n=21), while the remaining (52.4%, n=55) students had normal weight status (Pigford, 2010). In general, the etiology of the obesity is not well understood but different determinants have been associated with the problem.

2.4 Determinants of Obesity in Aboriginal People

Several factors can act together and determine the health status of a population and these are known as the Determinants of Health (WHO, 2010). In Canada, there is a relationship between the economic and the social conditions of

health (Mikkonen & Raphael, 2010). In 1974, Canadians identified human biology, environment, lifestyle, and health care organization as determinants of health (Health Canada, 1981). Nowadays, according to the Public Health Agency of Canada, there are twelve key determinants of health: income and social status, social support networks, education and literacy, employment and working conditions, social environments, physical environments, personal health practices and coping skills, healthy child development, biology and genetic endowment, health services, gender and culture- (Public Health Agency of Canada, 2011). All determinants play an important role in the obesity problem, but only key ones related to income and social status, physical environments, biologic and genetic endowment, and personal health practices and coping skills will be addressed in this review.

2.4.1 Income and social status

The economic environment of Aboriginal Peoples makes them more vulnerable to obesity development. Kuhnlein stated "Aboriginal ethnicity together with poverty is often a key determinant of poor health" (Kuhnlein. Receveur, Soueida, & Egeland, 2004). Given that Aboriginal people are more susceptible to poverty and marginality, the choice of food necessary for a healthy and sufficient diet is often out of their hands. Poverty may lead to the selection of low-cost diets that are both energy dense and shelf stable which are predominantly dry packaged foods (Drewnowski & Popkin, 1997.) According to a study conducted by Kirkpatrick and Tarasuk (2007), consumption of higher energy density food was associated with household food insecurity for females in the 19–30 years and 31–50 years age groups.

Moreover, household food insecurity was associated with a higher proportion of energy obtained from carbohydrates for most subgroups and was negatively associated with consumption of fruits and vegetables and milk products (Kirkpatrick & Tarasuk, 2005; Ricciuto & Tarasuk, 2007). The income

and social status is related to the food security status of a community. The World Health Organization (1996) defined food security as "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life". In the 1998/1999 National Population Health Survey, the prevalence of food insecurity among Aboriginal respondents living off-reserve was 27.0% with 24.1% having a compromised diet (Che & Chen, 2001).

In a recent study, it was found that rates of food insecurity for First Nations living on reserve vary from 21% to 83% (Power, 2007), meaning that they do not have enough food to eat or that they cannot eat the quality or variety of foods they want given their lack of economic resources (Willows et al., 2009). Food security depends principally on three variables: availability of food, access to food and a nutritious diet, and proper use of food to ensure maximal nutrition and hygiene (USAID, 1995).

Food availability in isolated Aboriginal communities has been compromised because of environmental and social factors. The economic status is another factor that affects this group of people. Food insecurity is largely the result of low income and financial insecurity. To obtain low-cost nutritious food is difficult and shopping options are limited to low-nutritional-quality food that provides satiety, however also contain an excessive amount of fat and sugar. There is an inverse relationship between energy density and energy cost, such that energy-dense foods composed of refined grains, added sugars, or fats may represent the lowest-cost option to the consumer (Drewnowski & Specter, 2004). In an article published by The American Journal of Clinical Nutrition, in more-developed countries, overweight among women with a low socioeconomic status was high in both rural (38%) and urban (51%) settings (Mendez, Monteiro & Popkin, 2005). This data demonstrates the relationship between low income, food insecurity and obesity.

Aboriginal people living in remote communities may experience all or most aspects of food insecurity due to limited economic opportunities, the high cost of market food, and limited food choice (Lawn & Harvey, 2003). As the effects of climate-change and urbanisation may further isolate Aboriginal communities, it is important that novel methods to help these communities become financially self-

sustainable are found so that economics will not play such an influential role on their dietary choices.

2.4.2 Physical and food environments

In remote locations where many Aboriginal communities are located, it is difficult and even impossible to find high quality foods in the local grocery store (Smoyer-Tomic, Spence & Amrhein, 2009). Food availability in isolated communities has been compromised because of environmental and social factors.

The physical environment may contribute to the food being unattainable to these communities, and transport and conservation challenges result in expensive food costs. Fifty-seven percent of First Nations people live in reserve communities and twelve percent of reserves are located in remote locations without year-round road access (First Nations and Northern Statistics Section, 2005). On the other hand, the recent proliferation of very large centralized grocery stores (referred to as "big box" stores or "hypermarkets") in middle- and higher-income neighbourhoods has resulted in limited accessibility to food outlets in some lower-income geographic areas (Smoyer-Tomic, Spence & Amrhein, 2006).

The food choice of people living in remote locations is then limited to cheap foods with a longer storage life, usually high in simple carbohydrates and fats (Darmon, Briend & Drewnowski, 2004). It is our duty as a society to ensure that groups marginalized by geographical factors do not have to choose between affordable food and quality food. We must do more to provide them with means of accessing their nutrient rich traditional foodstuffs, or provide modern quality alternatives.

2.4.3 Biological and genetic endowment

Another determinant of health is the biological and genetic endowment of individuals. Alongside the problems regarding the accessibility and availability of healthy food brought about by economic or physical environments, genetic contributions are estimated to contribute between 20% to 75% of variability in body weight and composition within a population (Hill, Wyatt & Melanson, 2000). The thrifty genotype hypothesis (Neel, 1999) suggests that the body has mechanisms for defense against famine periods by storing energy as fat in the body. This theory has been proposed as a factor for the development of obesity in the Aboriginal population (Raine, 2004). Alongside the genetic factor, personal health practices such as diet and a lack of physical activity play an important role in development of obesity and will be discussed below.

2.4.4 Dietary and physical behavior

The dietary and physical activity behaviours are determinants for the development of obesity. The world is experiencing a change in dietary patterns. Physical activity is needed for healthy weight control, but lately, exercise is more difficult to practice because most jobs are sedentary. Inactivity results in lower energy expenditures (Van Baak, 1999). In previous years, hunting, fishing and gathering were labour-intensive activities that kept Aboriginal people in constant movement. Nowadays, the need to have monetary income to survive creates the necessity to change from traditional activities to more sedentary jobs. Moreover, the change in lifestyle amongst Aboriginal people coupled with a lack of time to cook due to work schedules, cause people to replace their traditional diet (higher in protein, vitamins and minerals from meat, fruits and vegetables) with a western one (Kuhnlein, Receveur, Soueida, & Egeland, 2004). The traditional diets of Aboriginal peoples was high in animal protein and low in fat and carbohydrates, and provided adequate amounts of energy and micronutrients for health (Health Canada, 1995). With the westernization of indigenous diets, it has resulted in the reduced consumption of foods accessed through fishing, hunting, herding, gathering or own self-production (like fish, meat, fruits, berries, tubers) and

increased dependence on a purchased diet which is usually high in fat and simple carbohydrates and low in protein (Kuhnlein, Receveur, Soueida, & Egeland, 2004).

Consumption of processed foods, characterized by being high in calories, sugar, fat and sodium content, are recommended to be limited by the EWCFG (Health Canada, 2007). The foods that the EWCFG recommends to limit are "candy and chocolate, cakes, pastries, doughnuts and muffins, granola bars and cookies, ice cream and frozen desserts, potato chips, nachos and other salty snacks, French fries, corndog and pop and fruit flavored drinks" (Health Canada, 2007). However, studies have shown increased consumption of these among children over recent years. According to a study conducted in northern Quebec, during three days of food recall, 77% of Cree children consumed at least one restaurant or take-out meal (Downs et al., 2009). A strong relationship among processed foods consumption and obesity has been found by several studies (Popkin, Adair & N.G., 2011; Asfaw A, 2008).

A higher intake of processed foods has been reported during weekend compared to weekdays. Higher consumption of fat, snacks and soft drinks was found during weekends when television watching was increased (Matheson, Killen, Wang, Varady, & Robinson, 2004). Increased television viewing has been associated with increased energy intake (Crespo et al., 2001; French, Story, Neumark-Sztainer, Fulkerson, & Hannan, 2001). Television viewing may contribute to obesity by negatively influencing food choices (Ludwig & Gortmaker, 2004). In a study conducted by Racette et al., people increased fat consumption during the weekend but decreased carbohydrates and protein consumption (Racette et al., 2008). Higher levels of TV viewing in early childhood and later childhood and adolescence have been associated with higher body mass index (BMI) in cross-sectional studies (Crespo et al., 2001). According to a study conducted in Canada, television watching was a strong predictor of obesity among both Aboriginal and non-Aboriginal youth (Ng, Young & Corey, 2010).

Therefore, it is of great importance to implement actions that focus on these determinants to stop or minimize the development of obesity with a notable urgency in children.

2.5 Increasing vegetable and fruit intake for a healthy weight

Vegetable and fruit consumption has been proposed as an obesity prevention strategy (He et al., 2004). Vegetable and fruit consumption as part of the daily diet could help prevent major non-communicable diseases (NCD) such as obesity, the prevalence of which has increased over the last twenty-five years in children in Canada (Shields, 2006).

Fruit and vegetables are low-energy-dense foods that contribute to satiety and satiation; they may also displace other high-energy-dense foods from the diet such as salty snacks or baked goods (Newby, 2009). Some literature indicates that a diet rich in fruits and vegetables is associated with smaller gains in body mass index (Lin & Morrison, 2002) yet studies directly relating intake of fruits and vegetables with risk of obesity and long-term weight gain are limited. Eating Well with Canada's Food Guide for First Nations, Inuit and Métis recommends a daily intake of five to six servings of vegetables and fruit (Health Canada, 2007). However, there is little information available regarding First Nation children's vegetable and fruit intake. In a recent study by Robinson-O'Brien et al., the exposure of First Nations schoolchildren to fruit and vegetable education programs resulted in a positive effect on the nutrition knowledge of children (Robinson-O'Brien et al., 2009). Therefore, examining vegetable and fruit intake of children in Aboriginal communities is a logical initial step in the efforts to tackle childhood obesity in this vulnerable population.

2.6 Vegetable and fruit intake in children

Dietary guidelines worldwide recommend increased consumption of fruits and vegetables as good sources of dietary fiber, essential nutrients, and beneficial phytochemicals, to improve overall health and reduce chronic disease risk (Havas et al., 1994). Vegetable and fruit consumption is important throughout life providing vitamins and minerals (Lampe, 1999) and contributing to displace high-energy dense foods from the diet such as salty snacks or baked goods (Newby, 2009). Currently, only a small minority of the world's population consumes the generally recommended high intake of fruits and vegetables (World Health Organization, 2004). Besides the direct nutritional benefits that vegetable and fruit consumption provide, there is the need to raise adequate dietary habits in children that may last until adulthood (Vanhala, Vanhala, Kumpusalo, Halonen & Takala, 1998). Childhood health behaviors may be easier to change than adult behaviors, as children can be reached in large numbers through school settings, and their dietary habits may be less fully formed than in adulthood (Moore et al., 2007).

2.7 Determinants of vegetables and fruit consumption in children.

The consumption of vegetable and fruit is a complex phenomenon that may be influenced by different factors. Ecological models of health behaviour emphasize environmental models while incorporating social and psychological influences (Glanz, Rimer & Viswanath, 2008). One example of health behaviour change theory is the Social Learning and Social Cognitive Theory (SCT) (Bandura, 2004) which was designed mainly to guide behavioural interventions (Glanz, Rimer & Viswanath, 2008). According to the SCT, environmental and personal factors affect children's dietary behaviours (Bandura, 1997). Environmental factors include availability, accessibility, parent's modeling consumption, parent child-feeding practices, television viewing and school snack bar access. On the other hand, personal factors comprise taste and preference, self-efficacy, skills, knowledge and culture. A brief explanation of how they determine vegetable and fruit consumption is explained below.

2.7.1 Environmental determinants of vegetable and fruit consumption

Home and school provide the main support networks for children. Schools and homes that promote healthy options and avoid low nutrient density foods may positively shape the dietary behaviors and preferences of children. In children, home food availability is closely related to food intake (Hanson, Neumark-Sztainer, Eisenberg, Story, & Wall, 2005) and maternal consumption of fruit is positively associated with a child's intake (Ginson et al., 1998). In order to obtain more evidence related to the socio-environmental, personal, and behavioral factors associated with diet, Neumark-Sztainer et al., designed a project named EAT (Eating Among Teens) with adolescents of middle and high school in Minessota (Neumark-Sztainer, 2006). The highest vegetable and fruit intake was reported amongst those girls with the most home availability of these food types (Hanson et al., 2004). In addition, parental influence on eating behaviors was a significant factor identified as having an influence on adolescent food choices (Neumark-Sztainer, 2006).

School-based interventions promoting healthier foods have been associated with better diets among children (French & Stables, 2003). Nutrition interventions are commonly used to promote health and prevent disease given the established links between diet and chronic disease (Doak, 2002).Through nutritional interventions, schools can contribute toward the education and modification of the eating habits of children (Sasksvig et al., 2005; Heim et al., 2009; Morris, Briggs & Zidengerg-Cherr, 2002).

The media may potentially exert some influence on the food choices of a population and the prospects for a healthy meal by exposing children to low nutrient and high energy dense foods. Television viewing and advertisements were inversely associated with vegetables and fruit consumption intakes among eleven year-old students (Boynton-Jarrett et al., 2003). According to Shields (2006), children aged 6 to 11 who watched television for 2 or more hours/day,

were twice as likely to be overweight/obese (35%) as were those watching 1 or less hour of television (18%) (Shields, 2006). To counteract the effect of the media, various countries have regulated advertising addressed to children. In 1980, a law to ban junk food ads aimed at children was established in the province of Quebec. A result of this prohibition was the reduction of fast food consumption in children translating to 2.2 to 4.4 billion fewer calories consumed from 1984 to 1992 (Dhar & Baylis, 2011).

2.7.2 Personal determinants of vegetable and fruit consumption

Taste preference is probably the first and foremost personal determinant contributing to vegetables and fruit consumption (Birch, 1999). When there is a low availability of vegetables and fruits, exposure to these foods will be limited which may lead to a low preference for the taste of these foods (Birch, 1999). Some nutrition interventions aim to promote the vegetable and fruit availability and accessibility in children; such as the one conducted in an Ojibway-Cree elementary school where there were significant increases in dietary intention, dietary preference, knowledge, and dietary self-efficacy, and in the curriculum knowledge scale between baseline and follow-up (Sasksvig et al., 2005). Knowing the recommended number of vegetable and fruit servings may also contribute to their consumption (Blanchette & Brug, 2005).

In order to increase children's preferences for vegetables and fruit, interventions have combined nutrition education with hands-on gardening (Morris, Briggs & Zidengerg-Cherr, 2002). Constant exposure to hands-on gardening could result in increased consumption since the origins of the vegetable and fruit and the preparation requirements are known to the child, and exposure and acceptability are often related (Birch et al., 1995). This was shown in a recent study where hands-on gardening was found to be important to increase vegetable preferences and willingness to test them (Ratcliffe et al., 2011). Based on the experiential learning theory, Kolb defines learning as "the process whereby

knowledge is created-through the transformation of experience. Knowledge results from the combination of grasping and transforming experience "(Kolb & Kolb, 2009). Therefore, promoting hands-on gardening to improve knowledge, preferences and intake of vegetables has great potential.

2.8 Nutrition interventions to increase vegetable and fruit intake

Many nutrition interventions focused on one or more of the aforementioned determinants have been developed. Garden-based nutrition interventions, for example, seek to increase preferences, as well as improve vegetable and fruit intake (Morris, Briggs & Zidengerg-Cherr, 2002; Viola, 2006; Heim, Stang & Ireland, 2009). School and home settings are very important in the development of children's habits as these are the environments where children spend the most time. The school food environment has the potential to have a large impact on children's and adolescents' diets because they consume a substantial proportion (between 19 and 50 percent) of their total daily calories at school (Gleason & Suitor 2001).

Nutritional and activity interventions are likely to be more successful when factors that influence choices related to health behaviour change are well understood (Fitzgibbon, Stolley, Dyer, VanHorn, & KauferChristoffel, 2002). Without accurate knowledge of dietary intake it is difficult to track changes in food intake and to develop culturally appropriate dietary interventions for the reduction of chronic diseases (Sharma et al., 2010).

There is a little knowledge of the First Nation children's vegetable and fruit intake. Given the lack of information on fruit and vegetable consumption in First Nation children, it is important to select adequate techniques to be applied in group settings before and after the interventions to evaluate a possible change in children's dietary behaviours. Despite the plentiful information that may be measured in a nutrition intervention, for this review, we focused on the dietary assessment tools to measure food intake.

2.9 Dietary assessment in children

Dietary intake assessment is the most widely used indirect indicator of nutritional status (Lee & Nieman, 2007). The principle uses of dietary intake data are: assessing and monitoring food and nutrient intake, formulating and evaluating government health and agricultural policy, conducting epidemiological research, and for commercial purposes (Murphy, 2003). A range of dietary assessment tools are commonly used to collect total diet information namely food records, 24-hour dietary recalls, food frequency questionnaires and diet histories (Magarey et al., 2011). In order to choose the best dietary assessment method, the objectives of the study should be considered as well as the characteristics of the studied group (Gibson, 2005). Considerations of age, cognitive ability, weight status, physical activity level, respondent burden, and reliability and validity in the context of program goals are important when choosing a dietary assessment method (Magarey et al., 2011).

Other issues to be taken into account are the specific purpose of the study, the need for group versus individual data, the timeframe of interest, and the available resources (World Health Organization, 2004).

Accurate dietary assessment in children is challenging, and is of increasing importance given the rising obesity prevalence in this age group (Gibson, 2005) and the need to address concerns about promotion of healthy environments among children (Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008).

The following is a summary of the most common methodologies used to assess children's dietary intake at present. A description of the food record and the twenty-four hour recall as well as the food frequency questionnaire, the diet history, and the brief instruments will be addressed in this review.

2.9.1 Food record

A dietary food record is a written report of the food and beverages consumed over a particular period of time usually 3, 5 or 7 days (Thompson & Subar, 2001). The dietary food record has been used for both epidemiological and clinical studies. A single food record is appropriate for estimating group means but do not predict individual-level health outcomes (Lee & Nieman, 2007). Furthermore, food records often assist as a validation standard because the information is recorded at the time of consumption and therefore there is a reduction in the memory loss (McPherson, Hoelscher, Alexander, Scanlon, & Serdula, 2000). To report with precision every food consumed, weights or standard household measures, food models and pictures are used. For the use of food records in young populations, the method may include attractive aids for children, and therefore facilitate an accurate report. One example is a successful pictographic food record (Higgins et al., 2009). To prove its success, the child took a picture of the plate with food before and after eating it, while at the same time completing a diary reporting all food eaten. Results from the diary and picture estimations were compared to the actual amount consumed (weighed diet) and the pictographic food record resulted as a valid method to accurately assess dietary intake. Pictures may be innovative and fun for children, encouraging them to follow the instructions of the food record.

On the other hand, distinct results were found in a study conducted by Lindquist and colleagues in which a tape-recorded food record was concluded to be an inaccurate method to assess children's intake (Lindquist, Cummins & Goran, 2000). Food records tend to be an extremely subject-dependent technique that requires individual motivation and skills. In the study conducted by Lindquist et al., children mainly reported the major meals consumed and overlooked the snacks, condiments and beverages; moreover, contrary to the instructions some children did not report immediately what they ate and waited until the end of the day to do it (Lindquist, Cummins & Goran, 2000). It may be possible that the pictographic method yielded more positive results as it provided an interesting and fun way for the child to maintain motivation about recording food. Based on the aforementioned studies, if the dietary record method tends to be time

consuming, tedious and laborious results in a large responsibility for the child. Also, as was seen in the Lindquist and colleagues study, the non-engagement of the child in the study results in less accurate data. The food record may be a good choice to collect quantitative information from children, but the aforementioned factors which affect its accuracy should be considered to further increase parents and/or children's performance during the process.

2.9.2 Twenty-four hour recall

In the 24-hour recall, the subject has to report all of the food, beverages, and sometimes supplements that have been ingested during the previous day. The variability of intake at weekends and across seasons is an important factor to be acknowledged. A single 24-hour recall is appropriate for estimating group mean but if accurate individual-level health outcomes are required, multiple recalls should be considered (McPherson et al., 2000). No more than three recalls are recommended as it may result in fatigue in the children and cause a decrease in intakes reported (Gersovitz, Madden, & Smiciklas-Wright, 1978) and therefore, inaccurate information. Usually, the recall is conducted by personal interview, and can be completed by using a computer or by recording the intake on paper. The interview may be face-to-face or can occur via telephone (Coulston & Boushe, 2011). A 24-hour recall can be administered to children as it has been demonstrated that children aged 8 years and over can accurately self-report their food intake (Livingston & Robson, 2000; Lytle et al., 1993; Weber et al., 2004; Johnson, Driscoll & Goran, 1996). Children have provided recalls of intake at school and for national surveys (Berenson & Burghardt, 1993) and for research studies (Moore, Braid, Falk, & Klentrou, 2007).

The 24-hour recall in children can be self-reported or parent assisted. In children younger than 8 years old, due to limitations in cognitive development, parental assistance may be required (Parrish et al., 2003; Burrows, Martin & Collin, 2010). Children over 8 years may be able to provide a more accurate

report of their own diet (Burrows, Martin & Collin, 2010) and parental assistance may not be required.

The 24-hour recall has been usually carried out through individual interviews (Domel et al., 1997; Moore, Braid, Falk, & Klentrou, 2007); however, in nutrition interventions that require measurement of the dietary intake of a large population, a method that could be completed accurately by a group would be beneficial. In order to optimize resources and to avoid disturbance to third parties, group 24 hour recalls have been developed. However, to our knowledge, evaluation of group dietary recall has been reported only twice, once used in the adult population (Scott et al., 2007) and the other within a child population (Berenson, Frank, Farris, & Webber, 1985). Both studies concluded that the method is useful to assess dietary intake of large samples or repeated measure. The group 24-hour recall seems very useful but further study is necessary as there is insufficient evidence of its validity and reliability in both children and adults.

2.9.3 Food frequency questionnaire

The food frequency questionnaire (FFQ) is a limited checklist of foods and beverages with a frequency response section for subjects to report how often each items was consumed over specified periods of time. The FFQ evaluates long-term diet unlike 24-hour dietary recalls or food records (Yang, 2010). For studies where the objective is to find a relationship between intake and risk of disease, the FFQ is the most used assessment, due to its ability to rank individuals by level of intake than to giving absolute estimates of intake (World Health Organization, 2004).

The food frequency questionnaire can be quantitative, semi-quantitative or non-quantitative. Portion size information is not collected in non-quantitative FFQ, rather how many times a year, month, week or day a person eats a specific food is reported (Lee & Nieman, 2007) providing descriptive qualitative information about food-consumption patterns.

On the other hand, the semi-quantitative FFQ asks how many times a year, month, week or day a person eats standardized portions of food items (Lee & Nieman, 2007). Additionally to the frequency of portions consumed, a quantitative FFQ reports the size of serving (small, medium or large) relative to standard portions (Lee & Nieman, 2007). However, it should be noted that the "standard" portion used for adult questionnaires differ from those suitable for children (Wright, 2005). For example, in the study conducted by Wright (2005), about the habitual consumption of food, in the question referring to consumption of raw tomato per occasion, the mean for the whole population (2-60 and over years) was 53g, but it was 42g for the 6-11years group. This may explain the overestimation of total energy when using this method in children, using "standard" portion sizes developed for adults (Kaskoun, M.C., Johnson, R.K., & Goran, M.I. 1994).

The FFQ has been used in children over 9 years-old (Rockett, Colditz, & Wolf 1995; Shatenstein, Amre, Jabbour, & Feguery, 2010; Roumelioti & Leotsinidis, 2009). However, just a few FQQ have been specifically developed for assessing school children's intake (Rockett, Colditz & Wolf, 1995; Field et al., 1999). An example of an adapted FFQ for children is the Youth/Adolescent Food Frequency Questionnaire (YAQ), a semi-quantitative FFQ that was based on a validated FFQ for adults. In order to adapt it for children, each food portion size was determined by a review of different studies that evaluated the food and serving sizes commonly eaten between the ages of 9 and 18 years (Rockett, Breitenbach, Frazier, Witschi, Wolf, Field, & Colditz, 1997) as well as the ''natural'' serving size (e.g., bread—slice, apple—1). The method used for the development of the YAQ can be adapted in the creation of other semi-quantitative FFQ for child populations in countries other than the United States.

2.9.4 Diet history

The diet history assesses the past diet of an individual in the form of usual meal patterns, food intake, and food preparation practices through an extensive

interview or questionnaire (Thompson & Subar, 2008). Because it is a long and complicated questionnaire that requires recall of long-term memory, this tool is not often used to assess children's diets (McPherson, Hoelscher, Alexander, Scanlon, & Serdula, 2000).

2.9.5 Brief instruments to measure dietary intake

In a variety of studies, accurate quantitative dietary information is not required and the traditional assessment methods have proven to be inadequate. Brief instruments or "screeners" focus on the data required to meet the objectives without expending energy on collecting information not relevant to the study (National Cancer Institute, 2009). Brief instruments can be FFQs or questionnaires that focus on specific eating behaviors (Thomson & Subar, 2008). Several brief instruments have been developed for interventions to measure the change in intake of specific foods (Thomson & Subar, 2008; National Cancer Institute, 2009). Some of the uses of these screeners are: characterizing a population's median intakes, discriminating among individuals or population with regard to higher vs. lower intakes, and examining interrelationships between diet and other variables (National Cancer Institute, 2009).

2.10 Advantages and disadvantages of dietary assessment methods

Every dietary assessment method has different strengths and weaknesses. The selection of an ideal tool should be based on the objectives of the study. The 24-hour recall method for example, has a lot of strengths but also limitations. It is inexpensive, provides detailed information on specific foods, requires only short term memory and is well accepted by the participants because the effort is relatively low (Briefel, Wilson, & Gleason, 2009). On the other hand, children may alter information about what they ate not just because of poor memory but

also due to embarrassment or to please or impress the interviewer (Thompson & Subar, 2008).

Obesity as well as diet and weight consciousness is frequently associated with misreporting (Livingstone & Robson, 2000). A study conducted by Champagne et al., with children 9 to 12 years, showed a greater degree of under-reporting of energy intake as relative adiposity increased (Champagne, Harsha, Bray, Baker, & DeLany, 1998). On the other hand, FFQ is less expensive to administer than other dietary assessment methods and can evaluate long-term diet (Yang, 2010). A disadvantage of the FFQ is that the respondents tend to report items that they commonly eat rather than only reporting items eaten for the specific time frame of the FFQ (Gibney, 2009). Table 1-1 (adapted from Gibson, 1993; Lee & Nieman, 2007; Thompson & Subar, 2008) shows the advantages and disadvantages of the three most common dietary assessment methods used for children.

Table 2-1: Advantages and disadvantages of common dietary assessment methods for children.

24 hour recall	
Advantages	*Disadvantages*
• Inexpensive • Easy to administer • Requires short- term memory and children of 8 years old and over can accurately self-report their food intake • No literacy requirements of the participants • A single 24-h recall is appropriate for estimating group mean • Provides detailed information on specific foods • Considered by some to be more objective than the food frequency questionnaire	• Interviewer must be well-trained • Parent assistance is required to complete the recall in children under 8y. • High burden of participation and time are required to complete 24 hour recall of big groups. • Underreporting consumption of non-healthy foods and over-reporting consumption of perceived healthy foods commonplace in some children. • Over-reporting consumption of name-brand foods • One single day's diet, no matter how accurate, cannot be used to evaluate an individual's usual nutrient intake • Data entry can be labour intensive

Food frequency questionnaire	
Advantages	*Disadvantages*
• Less expensive to administer than other dietary recall methods • Can be self-administered in children over 8 year old. • Evaluates long-term diet. • Useful for health service programs as well as research. • Design can be based on large population data • Completed quickly • Only basic literacy	• Retrospective method that relies on the respondent's memory • Less sensitive to measures of absolute intake for specific nutrients. • Depends on ability of subject to describe diet. • If portion sizes are not standardized according to the specific child population, it may overestimate total energy intake.
Food Record	
Advantages	Disadvantages
• Provides detailed intake data • Does not depend on memory • Provides data about eating habits • Multiple-day data valid up to 5 days.	• Requires high level of commitment • Requires a lot of time • Analysis is expensive • Affects eating behaviour

Source: Adapted from Gibson, 1993; Lee & Nieman, 2007; Thompson & Subar, 2008

2.11 Errors associated with dietary assessment in children

Even though dietary-assessment methods have been refined for a long time, obtaining accurate data of dietary intake of children continues to be problematic (Kubena, 2000). According to the literature, children younger than approximately 8 years-old cannot accurately recall foods, estimate portion size, and cannot conceptualize frequency of food consumption (Livingston, 2000). However, it has also been acknowledged, that there is a period between the ages of 8 and 12 years, when a child becomes a more accurate reporter of his/her own dietary intake (Burrows, Martin & Collins, 2010). Therefore, reliable data on intake in the previous 24 hours can be self-reported by children older than 8 years (Cameron & Van Staveren, 1988).

According to Baranowski and Domel (1994), errors associated with children's self-report could be categorized into the following classes: attention, perception, organization, retention, and retrieval and response errors. An attention error is, for example, when children did not notice what they were eating because it was not seen or because it is so common that the food was eaten without any memory of doing so. On the other hand, a perception error occurs, for example, when children might not know the difference between whole and skimmed milk. An organization error may occur when any event of the day is forgotten and the information concerning any associated meal of food eaten during the event will also be forgotten. Furthermore, retention errors frequently occur when lengthy time periods pass between the consumption and the response time (Baranowski et al., 1986). For example, if information can be collected immediately after meal, if feasible, it will be more accurate than information collected one day later (Moore, Braid, Falk, & Klentrou, 2007).

A retrieval error arises when children recall foods that they commonly eat even when the food has not been consumed due to the constant exposure of children to those foods; and finally, a response error may be caused by the social stigma of what is correct or incorrect to report. Children might feel under pressure to respond in a manner that they consider correct, even if they under or over-

report different kind of foods. There is evidence that children who are obese tend to underreport high intakes, probably in an effort not to present themselves as overeaters (Van Horn, et al., 1990). Therefore, it is crucial to consider the possible errors and their cause before the implementation of a dietary assessment as well as to rely on external elements that facilitate children's cognitive process.

2.12 Alternative aids and techniques for accurate dietary assessment in children

Dietary assessment often requires information on details that can be difficult to extract from children and therefore, additional supplements to facilitate the process are often needed. To assist the process, different approaches to assess dietary intake have been developed. In order to avoid errors of perception and retention, a number of visual aids have been developed. Commonly used aids include food pictures of different portion sizes, photographs, plastic food models and household utensils (Gibney, 2009). The aforementioned aids may be useful to complement the assessment in order to collect information regarding portion sizes of the food consumed, brand names, ingredients of mixed dishes, and food preparation. According to Gibney (2009), the most effective method is a combination of food photographs and household utensils, but it is very important to consider the type of study, target population, place of the interview, and the availability of the aids. Furthermore, different methodologies have been developed to avoid reporting errors amongst children. A blended instrument has been proposed to assess children's dietary intake. One objective of this approach is to minimize time between the intake and the recall time. One example of a blended instrument is the record assisted 24-hour recall (children record only the names of foods and beverages consumed throughout a 24-hour period, serving as a guide for a later 24-hour recall interview) conducted in an American Indian population, in which the children were able to accurately report the food consumed (Weber et al., 2004). The use of the dietary recall as memory prompts

for a 24-hour recall was successful to accurately report school meals. Another example of a successful blended instrument is the automated image-capture to assist a 24-hour recall. In a study conducted by Arab and colleagues (2011), 14 participants used a camera equipped mobile phone during eating periods on three independent days and then used the pictures while completing the 24-hour recall (Arab, Estrin, Kim, Burke, & Goldman, 2011). Given that camera-enabled mobile phones are needed for each participant, the method may be challenging in large groups or with young populations and therefore, alternative means to capture images should be considered.

An alternative technique to collecting dietary information is the write and draw technique (Pridmore & Bendelow, 1995), which "allows children to enhance their reporting by drawing their meals and presenting a pictorial memory in addition to a written or verbal one" (Edmunds & Ziebland, 2002). This is an inexpensive and fun experience for children that also may motivate them to provide dietary information.

Regardless of the capacity of children over 8 years-old to accurately report dietary intake (Lytle et al., 1993), parental assistance is commonly provided (Johnson, Driscoll & Goran, 1996; Mullenbach et al., 1992). Parents can provide details such as the preparation methods or ingredients of a complex dish that a child may forget or may simply be unaware. On the other hand, the presence of a parent during the child recall may affect data accuracy (Baranowski & Domel., 1994). Parents may be able to report what the child had at home but they do not know what their children may have consumed outside of the home (Baranowski, Sprague, Baranowski, & Harrison, 1991). An additional limitation is that the child may feel pressured to provide an answer that pleases the parent, for example, underreporting prohibited food such as candies or chips or over reporting vegetables (Van Horn et al., 1990). Therefore, it may be better for schoolchildren to be interviewed privately (Holaday & Turner-Henson, 1989). Parental assistance may complement details but it should not be considered the main source of information. If the cognitive ability is not an issue (children over 8 years) then accurate data may be directly obtained from children using the appropriate

questionnaire. The quality of the data will depend on the capacity of the respondent to remember but also depends on how the questions are presented (Livingston, Robson & Wallace, 2004), which highlights the importance of instruments specifically adapted for children.

An alternative technique to recalling more precise information is the three-pass 24-hour recall method in which the interviewer and respondent review the previous day's eating episode several times (Lee & Nieman, 2007). The first pass corresponds to a list of the consumed food over the last 24 hours, the second pass details about the foods consumed (portion size, brand), and the third pass is a review to ensure that information is accurate and complete. The technique improves the quality of the recall information by providing additional memory cues while reducing underreporting (Jonnalagada et al., 2000).

2.13 Culturally sensitive dietary assessment

Cultural sensitivity is a term often used to indicate recognition of culture's effect on health-related behaviours (Teufel, 1997). Dietary behaviours among cultures might differ significantly, thus modifications to dietary intake assessment methods are often necessary for various populations (Cassidy, 1994). For example, the different meal times among countries, may result in structural changes of a questionnaire. Some countries like Canada or the United States usually eat the main course at the evening meal, while others such as Mexico, do so in the afternoon. Another example of varied meal service is the different ways of serving a dish during meals. Communal sharing of food from the same dish is commonly practiced in China, while in countries such as France or England, food is served family-style or individually. In these cases, methods that simplify quantification of the intake may be required.

Regardless of the instrument, issues of language and conceptualizations are likely to arise. According to Teufel, cultural awareness is a cognitive function that

implies recognition of cultural unique behaviours (Teufel, 1997). Jelliffe & Jelliffe write, "The cultural pattern, learned from parents and others in the community by subconscious observation and by explicit instruction, classifies items as appropriate or inappropriate, as food or non-food" (Jelliffe & Jelliffe, 1989). Consequently, the researcher must be sure that what is asked is appropriate and correctly understood by the children in order to reduce underreporting of important foods and miscommunication, thereby improving the validity of the data.

There are two ways to gather data in a culturally sensitive manner: 1) revalidating an existing culturally sensitive instrument in the new setting, and 2) create and validate a new culturally sensitive instrument (Cassidy, 1994). A minimal revalidation will entail conducting a pretest by asking individuals similar to potential participants to critique the questions and language of the questionnaire. This process may be facilitated by a community-based participatory research (CBPR) approach which seeks collaborative research and critical reflection on community health practice (Hills, Mullett, & Carroll, 2007).

The 24-hour recall tends to be a culturally sensitive method because it recalls exactly what a person ate the previous day and cannot be affected by dietary variations (Cassidy, 1994). In addition, the 24-hour recall results are convenient as it is noninvasive method and it is appropriate for low literacy populations (Berti, Soueida & Kuhnlein, 2008; Longstreet et al., 2008; Johnson et al., 2009).

Diet history and FFQ have been also validated in different cultural populations (Hebert et al., 1998; Wentzel-Vilijoen and Kruger, 2009). An example of this is the culturally sensitive FFQ developed in a Canadian First Nation community (Sharma et al., 2008) in which, initial dietary information was obtained through a 24-hour recall and the results were used to develop a draft of the FFQ that would be piloted with people in the community. The development and validation of dietary methods for populations, such as Aboriginal

communities requires planning and pretesting due to the emerging changes in food patterns (Whiting & Mackenzie, 1998) and increasing problems related to dietary habits such as high prevalence of obesity (Haman et al., 2010). Methods to accurately assess dietary intake in minority populations with obesity-related diseases are necessary to track changes in food intake and to develop culturally appropriate dietary interventions for reduction of the aforementioned health problems.

2.14 Vegetable and fruit assessment in children

Measuring dietary intake of vegetables and fruit is an important aspect of public health research (Neuhouser, Patterson, Kristal, Eldridge, & Vizenor, 2000). Food guides around the world recommend eating vegetables and fruit everyday as a part of a healthy diet. Vegetable and fruit consumption has been associated with reduced cancer and cardiovascular disease (Crowe et al., 2010) and due to their high fiber content with weight management (He et al., 2004).

Studies which aim is to rank vegetable and fruit consumption require a different method than those studies measuring specific nutrients from vegetable and fruit intake. To estimate vegetable and fruit consumption, the most commonly used instruments are: brief instruments that keep the format of the 24-hour dietary recall and the FFQ (Champagne, Harsha, Bray, Baker, & DeLany, 1998) These brief instruments or "screeners" have been developed either for population surveillance at the national or local level (Centers for Disease Control, 2011) or to study associations between some specific aspects of diet and other exposures (Colón-Ramos et a., 2009). Due to their specialization in one aspect of the diet, these screeners are quick to administer and cheaper than broader methods.

An example of a brief instrument is the Day in The Life Questionnaire (DILQ), which aims to assess the number of servings of vegetables and fruit and not the whole diet (Edmunds & Ziebland, 2002). This instrument recalls the

activities carried out in the past 24 hours including the meals and has been validated in children aged 7-9 years (Edmunds & Ziebland, 2002) and 9-11 years (Moore et al., 2007). The fact that the DILQ can be administered as a group activity makes it an effective method for collecting more data in a shorter time period than the amount of effort required by a 24-hour recall or dietary record.

A semi-quantitative FFQ has also been developed for ranking individuals according to their usual intake of fruit, juice and vegetables (Carlsen et al., 2011). This semi-quantitative FFQ includes 270 questions with a time frame ranging from several times a day to once a month, with options of portion sizes based on household units such as slices, glasses, cups, pieces, spoons and teaspoons. The use of semi-quantitative FFQ requires adapted portion sizes for the target population. For example, Rocket and colleagues (1995) adapted a child FFQ that was originally developed for adults. For each question, the portion size represented the average consumed by children and not by adults (Rocket, Colditz & Wolf, 1995). The semi-quantitative FFQ is the most common method, but non-quantitative FFQ may be more readily completed by the children and it also may provide descriptive information about food-consumption patterns when assessing nutrients is not an objective. Therefore, the selection of a tool for the assessment of vegetable and fruit intake depends on the purpose of the study, the population characteristics, timeframe and available resources (Agudo, 2004).

2.15 Conclusions

Dietary assessment methods commonly used in child population are the 24-hour recall, FFQ and brief instruments or scanners. Dietary records (weighed or not) are also used, but they are tedious and hard work for the respondent. Observation of dietary intake is most commonly used to validate a dietary assessment method. Given the fact that the process of reporting the daily intake requires cognitive abilities, studies agree that children over 8 years-old are capable of self-reporting their daily consumption, as well as their food frequency. Parental assistance may be recommended if the total energy intake needs to be obtained by a 24-hour recall, but children should be interviewed individually and privately. It is also important to consider the most suitable assessment tool according to the objective of the study, characteristics of the population and available resources. If the objective is to assess a partial aspect of the diet, brief instruments or "screeners" may be adequate for children as they do not require the same time and effort to remember what was eaten as other assessment methods which aim to evaluate the whole diet.

Adaptations to make the dietary assessment culturally sensitive are required when research is conducted in a different cultural background. Language and format adaptations may be necessary when using a method developed for another population. Moreover, time and location are other aspects to be considered. When assessing children's intake in the school setting, the amount of time allocated for the researcher-student interaction has to be minimized to avoid interference with classes and affecting children and teachers. Also, when the assistance of parents is required, every aspect of the process should be well organized so that the respondent is not burdened to the extent of negatively affecting the effectiveness of the study or the quality of the data collected.

Therefore, further research in children's dietary assessment needs to be performed in order to refine the methods that capture the information required but do so in a timely and sensitive manner.

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3. Refinement of two dietary assessment tools for cultural adaptability in a First Nation elementary school.

3.1 Introduction

According to the Canadian Community Health Survey, 26% of Canadian children and adolescents aged 2 to 17 were overweight or obese, which is 2.5 times higher than in 1978/79 (Shields, 2006). The problem is even more alarming in the Aboriginal population where the obesity level is 2 to 3 times higher (Public Health Agency of Canada, 2010). According to the First Nations Regional Longitudinal Health Survey 2002/03 (2005) only 41.5% of First Nations children have a normal weight or are underweight. Of the remaining First Nations children, approximately one-third are considered to be obese and a further 22.3% are considered overweight (RHS National Team, 2007*)*. Childhood obesity is a serious problem given its strong relationship with the development of type 2 diabetes and cardiovascular diseases (Young et al., 2000).

The promotion of vegetable and fruit consumption has been proposed as an obesity prevention strategy (WHO, 2002; He et al., 2004). Based on data from the 2004 Canadian Community Health Survey (CCHS), children and youth who ate fruit and vegetables at least five times a day were substantially less likely to be overweight or obese than those who ate these foods less often (Shields, 2008).On the other hand, higher consumption of sweetened beverages and snacks is an important factor associated with the development of obesity. Aboriginal children's diets are undergoing a food transition characterized by increased store-bought food and decreased intake of traditional food (Kuhnlein et al., 2004) along with low vegetable and fruit consumption (RHS National Team, 2007*)*. A study conducted by Downs and colleagues (2008) demonstrated a positive correlation of central adiposity with sweetened beverage intake in Cree children aged 9-12 years (Downs et al., 2008). Moreover, in a study conducted in First Nation school children, those who were at risk of overweight and those who were

overweight tended to eat more potato chips and French fries, respectively (Receveur, 2008). According to the First Nations Regional Longitudinal Health Survey (2002/03), only one-half (55.4%) of First Nations children are eating a nutritious balanced diet and consequently, there is room for improvement. Therefore, interventions to improve healthy dietary patterns in Aboriginal children may play an important role in obesity prevention (Blanchette & Brug, 2005).

Home and school are the two main environments where children spend the majority of their time. The availability of foods at home has a strong positive relationship with its preference and consumption (Hanson, Neumark-Sztainer, Eisenberg, Story, & Wall, 2005). The school setting is also an important environment providing up to two meals for children each day (Story, Nanney, & Schwartz, 2009). Therefore, information regarding dietary patterns and food environments is of great value to have as a starting point to determine which dietary habits may be corrected or strengthened, or which environments need to be modified.

In nutrition-intervention research to change home or school environments, it is important to consider the sensitivity of dietary assessment instruments to document the changes in nutrient intake or dietary patterns under study (Kristal, Lazovich & Beresford, 1995). One important consideration is the dietary cultural practices of the study population. Food diversity and dietary patterns differ amongst different populations, so the development of a locally appropriate dietary assessment instrument is crucial for accurately assessing diet in cultural groups (Teufel, 1997).

The assessment of food intake in First Nation children is important for different reasons: 1) to provide a description of their dietary patterns, 2) to track the transition of their dietary patterns, and 3) to assess changes in the diet resulting from nutrition interventions taking place in these populations.

The aim of this study was to determine the feasibility of two child-focused dietary assessment tools for assessing children's vegetable and fruit consumption

in a First Nation elementary school in an Alberta Cree community. Children had English as a first language and were instructed in English at school. Moreover, a high prevalence of overweight and obesity among elementary school children in this community was observed in a previous study (Pigford et al., 2011). An intervention had been developed to encourage children to consume more vegetables and fruit, and baseline data on vegetable and fruit consumption were required to evaluate the intervention mediated changes in dietary intakes.

This chapter describes the process and results of a feasibility study that examined two brief assessment tools to document vegetables and fruit consumption in a First Nations elementary school. The feasibility study was important in reducing uncertainties for planning the definitive study and deciding the best approach to adopt (Pollit, Beck & Hungler, 2001).

The aims of the feasibility study were: (1) to describe the challenges of using the brief assessment method "The Day in The Life Questionnaire" (DILQ) to measure fruit and vegetable consumption in 5th grade, (2) to assess the feasibility of the DILQ as a 24-hour recall to get more detailed information about children´s diet, (3) to develop a Vegetable and Fruit Frequency Questionnaire (VFFQ) to describe the frequency of vegetable and fruit consumption of children and, (4) to describe the challenges of using the VFFQ in 4th grade children.

3.2 Methods

We conducted a feasibility study of two dietary assessment tools that are described below. .

The Day in the Life Questionnaire (DILQ)

The DILQ is a tool used to recall activities carried out in the past 24 hours including the meals. The DILQ is a self-administered 17-item questionnaire developed for children aged 7-9 years that uses words and pictures to estimate vegetable and fruit consumption (Edmunds & Ziebland, 2006). This tool has also been used to measure foods eaten at breakfast and at lunch (Moore et al., 2007; Wallen, Cunningham-Sabo, Auld, & Romaniello, 2011).

The fact that it can be administered as a group activity makes it an effective method for collecting more data in a shorter period than what is required by a 24-hour recall or dietary record. The DILQ was chosen for this study due to its appropriate structure and design for obtaining information from this population for this study. The use of the DILQ was approved by the community steering committee for the research as it was considered appropriate to be used in this school. It is a screening assessment method that has been used in previous intervention evaluations and has been previously validated in children aged 7-9 years (Edmunds & Ziebland, 2002) and 9-11 years (Moore et al., 2007), which is similar to our study population (9-11 y). Notably, the DILQ has never been used among First Nation children.

The DILQ was pilot tested on all grade 5 children in the school (n = 14). Although the DILQ was intended to be completed individually without assistance from adults, for this study, it was completed as a classroom exercise and questions were projected sequentially on a screen at the front of the classroom. The DILQ is a valid method to recall breakfast and lunch information (Moore et al., 2007), and given the fact that children over 8 years can self-report their dietary intake (Burrows, Martin & Collin, 2010), we considered the use of the DILQ as a group 24-hour recall method in children. With the addition of experienced facilitators and visual aids, we assisted children to recall more detailed information on what they specifically ate (Appendix A). Instructions and questions were read aloud; children were instructed to put up their hands if they needed help or did not understand a question. Four facilitators helped children to complete the questionnaire; two facilitators assisted three children and the others assisted four. The three-pass 24-hour recall method (Lee & Nieman, 2007) was followed in

which the first pass corresponds to a list of the food over the last 24 hours, the second is a pass to get more detailed information about the food consumed (e.g., portion size, brand), and the third pass is a review. To assist children in quantifying portion sizes of food consumed, cups and bowls of different colors and sizes (125 ml, 250 ml, 375 ml and 500 ml) were visible to the children. Each color corresponded to a different serving size. Three sets of food models were displayed which were within reach of the facilitators. Additionally, four tailored catalogues with photographs food products (made up of local brands of milk, chips, cookies, cereals, granola bars, juice and punch) was developed by the investigator and provided to the facilitators (Appendix A). Each facilitator had a notebook to record difficulties and other observations.

Vegetable and Fruit Frequency Questionnaire (VFFQ)

The VFFQ is a food frequency questionnaire developed for this study to quantify children's frequency of consumption of vegetables and fruit in the community. The VFFQ includes common vegetables and fruits available at supermarkets and vegetables which may be grown in a home garden. It focuses on vegetables and fruit eaten by children in the past month. The VFFQ was developed from adaptations of the vegetable and fruit questions of the Youth and Adolescent Questionnaire (YAQ) including content changes to make questions appropriate to the community context. The YAQ measures the foods eaten by children and adolescents aged 9-18 years over the previous year (Rockett, Colditz & Wolf, 1995). It has been validated for use with grade 5 students in Canada (Florence, Asbridge & Veugelers, 2008).

Thirty questions from the YAQ pertinent to vegetable and fruit consumption were adapted to develop the VFFQ and additional questions added. The timeframe used in the YAQ was modified from the past year to the past month. The portion size of each vegetable and fruit in the YAQ was not used given that the YAQ was developed for US children and thus portion sizes were standardized for an American population. Furthermore, the VFFQ was developed to rank

vegetable and fruit consumption, not to quantify nutrients. The YAQ is intended to be self-administered (that is, individual children complete questions at their own pace without assistance from adults). The VFFQ was meant for group administration with adult facilitators being available to address any difficulties encountered by children. Before administering the questionnaire to children, each question was reviewed by the researchers for relevance to the local context and modified if necessary. For instance, since potatoes are consumed frequently in Canada, a question about the consumption of baked, boiled or mashed potatoes was included. For all questions, "Never" was included as a response option for the frequency of consumption to obtain data about which vegetables or fruits were not ever consumed. This is an important aspect to be evaluated because this will help to identify changes in fruit and vegetable consumption before and after the intervention and introduction of new foods. To assist with literacy and implementation of the questionnaire, a corresponding image of the vegetable or fruit that was being asked about was included in case children were unfamiliar with the word being used.

The VFFQ was pilot tested on all grade 4 children in the school (n = 23). It was completed as a classroom exercise and questions were projected sequentially on a screen at the front of the classroom. All instructions and each question were read aloud and children were instructed to put up their hands if they needed help or didn't understand a question. Two facilitators helped children answer questions.

3.3 Results

The Day in the Life Questionnaire

The process was completed in 45 minutes. For some of the questions, problems with comprehension were noted and alternative word choices were made and recorded. Modifications to the DILQ based on pilot testing are presented in Table

3-1. Minor revisions in wording were required (e.g., children did not understand the meaning of "morning break" or "evening meal"). Despite the availability of visual aids to help children determine serving sizes and brands, they were unable to recall sufficient detail about what they ate for the DILQ to function as a 24-hour recall.

Table 3-1. Modifications to the DILQ

The Day in the Life Questionnaire DILQ		
Original	*Modification*	*Reason for modification*
Prior to pilot test		
Children completed the questionnaire at their own pace.	The researcher determined the time allotment for each question.	To complete DILQ as a group 24 hour recall with facilitators assisting and memory aids.
Self-administered paper questionnaire	Group administered questionnaire, with children completing questions as they were projected at the front of the classroom.	To minimize time
No clues about brands or serving sizes.	Visual aids were provided to prompt children to recall brands and serving sizes.	To help children to remember details from their diet
After pilot test		
Question #5 "Did you have anything to eat or drink at morning break yesterday?"	Did you have anything to eat or drink at recess yesterday?	Comprehension difficulty
Question #11 "After school yesterday, did you go to a club (e.g., brownies, cubs, swimming, football)?	"After school, yesterday, did you play hockey or any sport?	Activities and sports in the original tool were unfamiliar to children

Question #14 "Did you have an evening meal yesterday?	Did you have supper yesterday?	Comprehension difficulty

Vegetables and Fruit Frequency Questionnaire (VFFQ)

The process was completed in 40 minutes. Development of the VFFQ is presented in the table 3-2.

Table 3-2. Development of VFFQ

The Vegetable and Fruit Frequency Questionnaire (VFFQ)		
Original YAQ	*Modification for the VFFQ*	*Reason for modification*
Prior to pilot test		
152 questions from different food groups	29vegetables and fruit questions	Interest in measuring only frequency of vegetable and fruit consumption
Portion size of each vegetable and fruit analyzed in YAQ.	Portion size not analyzed in VFFQ.	Interest in ranking vegetable and fruit consumption. Standard portion size for US children may not be appropriate for aboriginal children.
Questionnaire used only words	Pictures of each vegetable or fruit were included next to the question.	To increase familiarity with the word
"Never" was not a frequency response option	"Never" was included as a frequency response option	To understand which fruits and vegetable were never consumed by children in the population.

No question about potatoes	A question for mashed, boiled or baked potatoes was added	Potatoes are commonly consumed
After pilot test		
Question #26 asks about lettuce or tossed salad.	It was revised to also mention green salads.	Another type of salad containing lettuce.
Children completed the questionnaire at their own pace.	The researcher determined the time allotment for each question.	To minimize time. To avoid distractions amongst children.
Self-administered paper questionnaire	Group administered questionnaire, with children completing questions as they were projected at the front of the classroom.	To minimize administration time.. To increase familiarity of the children with the vegetables and fruits (projected at the front) To avoid distractions amongst children.

3.4 Discussion

Although research suggests that children in grade 5 are able to recall what they ate with accuracy (Thomson & Byers, 1994), children in the present study were unable to recall serving sizes or brands, distinguish the individual components of complex dishes (e.g., soup, stews, etc.), or describe how foods were prepared (e.g., fried, boiled, etc.). Thus, in this population, the DILQ could not be used as a tool to assess the total diet unless an adult responsible for the child's food preparation was included to provide complementary information. Children seemed able to recall the time of the day and the location where vegetables and fruit were consumed, in addition to the frequency of consumption. This type of information may be possible to retrieve because the DILQ presents daily activities in chronological segments which provide a context that helps

children to remember. Our findings verify the use of the DILQ as an instrument to measure vegetable and fruit intake (Edmunds & Ziebland, 2002).

In this population, the VFFQ may be useful to measure the success on change of vegetables and fruit intake as children seemed able to recall the consumption of vegetables and fruit over the previous month. If the activities focused on certain vegetables or fruit, any trends in change in consumption of these items could be reported.

3.5 Relevance to practice

Evaluating the appropriateness of dietary assessment tools is an important first step in studies seeking to measure dietary intake. Children can remember eating single foods such as vegetables and fruits on the previous day. The inclusion of the parent or caregiver who prepares meals for children may be necessary to accurately recall mixed meals and food portions.

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4. Characterization of specific aspects of the diet in First Nation school children

4.1 Introduction.

Populations around the world are experiencing an epidemiological transition from infectious to chronic diseases caused by many factors, one of which is the global change in feeding patterns. This transition has been characterized by a shift from excess malnutrition and starvation, to overweight and obesity as predominant nutrition patterns among members of a population, based on large shifts in diet structure related to changing economic and social factors (Popkin, 2004). Diets previously characterized by sufficient energy and high content of natural and nutritious foods are now replaced by diets with low nutritional value and high energy content and processed foods. These diets tend to be economically and logistically more accessible to populations worldwide. The developing world is the most affected by this transition, but some populations in the developed countries are also part of this transition. According to a study conducted in the Canadian Arctic among Aboriginal populations, non-nutrient-dense foods are increasingly selected as alternatives to traditional foods, while fruit and vegetables are still rarely consumed (Erber et al., 2010).

A disadvantage of this transition is the displacement of vegetables and fruits by more affordable foods in disadvantageous populations due to the difficulty and high cost to import fresh food through the mainstream system (Stroink & Nelson, 2009). This shift, deprives individuals of essential nutrients and likely contributes to the high levels of obesity in the population.

Childhood obesity has become a serious public health problem all over the world. According to data from the 2007–2008 National Health and Nutrition Examination Survey, an estimated 16.9% of American children and adolescents aged 2–19 years are obese (Ogden, Flegal & Carroll, 2012). In China, overweight and obesity levels in children and adolescents have increased gradually over the

past 15 years (Cui, Huxley, Wu, & Dibley, 2010) and obesity in Mexican children aged 5 to 11 year increased by 26% from 1999 to 2006 (Instituto Nacional de Salud Pública, 2010).

Canada is not exempt from the problem. The prevalence of overweight among Canadian children aged 6 to 11 years old has doubled from 13% in 1977/8 to 26% in 2004 (Shields, 2006). Small regional studies have revealed a higher prevalence of overweight among children and adolescents of First Nations ancestry, compared with those of European ancestry (Katzmarzyk & Malina, 1998) and obesity rates are two to three times higher in Aboriginal compared to non-Aboriginal children (Naylor et al., 2010). Childhood obesity has important short-term medical implications such as adverse effects on blood lipids, blood pressure, and glucose metabolism (Urrutia-Rojas et al., 2006) and is also the most important risk factor in developing type two diabetes mellitus (T2DM) in young people (Tamasan et al, 2010). Moreover, a study conducted by Guo and colleagues, shows that overweight during childhood is an important risk factor for overweight at 35 years (Guo, Roche, Chumlea, Gardner, & Siervogel, 1994) increasing the probability of developing health complications in later life. Furthermore, obesity in childhood may have psychological and social impacts such as low self-esteem. According to Jansen and colleagues, overweight and obese school-aged children are more likely to be the victims and perpetrators of bullying behaviors than their normal-weight peers (Janssen, Craig, Boyce, & Pickett, 2004). Moreover, children who are obese not only experience lowered self-esteem as a result of peer taunting, they also show significantly elevated levels of loneliness, sadness, and nervousness (Strauss, 2000). Increasing vegetable and fruit consumption to the recommended level has been proposed as an obesity prevention strategy (He et al., 2004). Vegetables and fruit are low-energy-dense foods that contribute to satiety and satiation due to a high content of water and fiber (Slavin, 2005). They may also displace other high-energy-dense foods from the diet such as salty snacks or baked goods (Newby, 2009). Moreover, vegetables and fruit contain vitamins and minerals required by the body such as vitamin A, C, E, folic acid, and magnesium and potassium (Lampe,

1999). In general, Canadian children are consuming an adequate level of vitamins; however, according to the Canadian Community Health Survey (CCHS), there is concern that Canadian children may not be meeting their needs for potassium and fibre (Health Canada, 2009). Besides providing vitamins and minerals, vegetables and fruit contain fibre, which if consumed daily in sufficient amounts could help prevent major diseases such as cardiovascular diseases and certain cancers (World Health Organization, 2004).

Despite the aforementioned benefits of vegetables and fruit consumption, only a small minority of the world's population consumes fruits and vegetables as is recommended by diverse food guides. In Canada, more than 60% of children ages 9 to 13 did not meet the recommendation of more than 5 vegetables and fruit per day (Shields, 2006) and this situation is not improving despite public health efforts to encourage change. In 2010, 43.3% of Canadians aged 12 and older reported that they consumed fruit and vegetables five or more times per day, down from 45.6% in 2009 (Statistics Canada, 2011). Aboriginal communities in Canada are not exempt from this trend (Hopping et al., 2010; Garriguet, 2006, Downs et al., 2009). In a study conducted in Québec with 201 Cree children from grade 4 to 6, results showed that 98.5 % of children consumed less than 5 fruit and vegetables daily (Downs et al., 2009).

Eating Well with Canada's Food Guide for First Nations, Inuit and Métis (EWCFG) recommends a daily intake of five to six servings of vegetables and fruit (Health Canada, 2007). However, there is little known about the vegetable and fruit intake of First Nation children living on reserve in Alberta.

This chapter reports on a component of the Garden-Based Nutrition Education intervention, which is an ongoing community-based child health project that seeks to create a culture of knowledge and positive attitudes, preferences, and behaviours around vegetables and fruits. Moreover, the intervention incorporates healthy eating into the school curriculum and promotes a healthy diet including vegetables and fruits. Given there is little known about the eating habits of Aboriginal children living on reserve and the health promotion efforts in this setting, this cross-sectional study addressed this gap in the literature.

Thus, the overall aim of this part of the thesis was to investigate the consumption of fruit and vegetables of children living on reserve in a First Nation community in Alberta at the initiation of the nutrition intervention.

The hypotheses of the study are:

1. It was expected that the vegetable and fruit intake of schoolchildren would be below the national recommendations for age and sex based on the Eating Well with Canada's Food Guide- First Nations, Inuit and Métis (EWCFG) and similar to other Aboriginal communities.
2. It was expected that intakes of "food to be limited" would be higher than recommended by the EWCFG.
3. It was expected that vegetable and fruit intake of schoolchildren would be higher during the weekdays compared to the weekend. It was also expected that "foods to be limited" consumption would be higher during the weekend compared to the weekdays.
4. It was expected that intake of "food to be limited" would be higher in overweight/obese children or those presenting abdominal obesity compared to children with lower adiposity levels.

The objectives of the study are:

1. To collect dietary (instances of vegetables and fruit, "foods to be limited", traditional Aboriginal foods, and milk) and anthropometric (height, weight and waist circumference) data from 4^{th}, 5^{th} and 6^{th} grade children.

2. To compare dietary intakes of vegetables and fruit, traditional food, milk and foods to be limited across weight groups.

4.2 Methods

The study took place in a First Nation community in Alberta located about an hour drive from large urban centre. According to the Canadian census of 2006, the median income in this community for all private households was about $40,000, which was 24% lower than the median income of $52,940 for the province of Alberta (Statistics Canada, 2007). Moreover, a previous environmental scan of the community resources demonstrated that availability of healthy foods at the local store was limited (Pigford, 2010).

Dietary and anthropometric data (height, weight and waist circumference) were obtained from children in 4th, 5th and 6th grades in the elementary school of the community. During the month of November of 2010, dietary surveys were administered in fourth, fifth and sixth grades of the First Nation community school by using repeated dietary recalls on three non-consecutive days (eighty-four in total) and a single food frequency questionnaire (twenty-eight in total). Dietary intake was reported for two weekdays and weekend (Monday, Thursday and Sunday). The Day in the Life Questionnaire (Edmunds & Ziebland, 2002) and a Vegetable and Fruit Frequency Questionnaire were used. The DILQ was developed by Oxford University, with the intention of being administered as a supervised classroom exercise to measure vegetable and fruit consumption among children during the previous day. The questionnaire was used with consent from the developers and the questionnaire manual was purchased from the University of Oxford. The DILQ has been previously validated in children aged 7-9 years (Edmunds & Ziebland, 2002) and 9-11 years (Moore et al., 2007). The DILQ has never been used with First Nation children. The VFFQ development was an adaptation of vegetable and fruit questions from the Youth Adolescent Food Frequency Questionnaire (YAQ), a questionnaire developed at Harvard School of Public Health by Rocket and others (Rockett, Colditz, & Wolf, 1995), which asks about a child's dietary intake over the past year. This tool was previously used by Veugelers in over 5000 children in Alberta (Florence, Asbridge, & Veugelers,

2008). Both the VFFQ and the DILQ were refined to be used in this First Nations community as described in the previous chapter. The VFFQ and the adapted DILQ were approved by the community steering committee for the research and were considered appropriate to be used in this First Nation school.

Each report of vegetable / fruit / milk was scored as one serving outlined in the EWCFG (Health Canada, 2007), with the purpose of comparing results to current dietary standards (Health Canada, 2007). Prior to the study initiation, ethical approval was obtained from the First Nation community and Ethics Review Board at the University of Alberta. Furthermore, informed consent (for parents) and assent (for children) procedures were completed (Appendix B).

4.2.1 Item coding DILQ

The DILQ is composed of 17 questions about food and activities, but only responses to 8 items that related to food intake were used although children completed all questions. The other 9 items were excluded due to irrelevance for the study. In previous studies, the DILQ has been applied only once to the group being studied (Moore et al., 2007), however, to account for the variability in dietary intake during the week, we repeated the DILQ during three different days (Monday, Thursday, Sunday). For comparison purposes, we obtained the median of Monday and Tuesday to represent the week days. The data from the study was widespread, and the means were skewed by outliers, therefore we considered the median as the best measure to represent the central tendency of the data.

We divided the responses into four different groups: instances of vegetables and fruits reported (group 1), instances of foods and drinks to be limited (group 2), instances of milk reported (Group 3), and instances of traditional food reported (Group 4). The Day in the Life Questionnaire was developed to obtain simple descriptions of the foods without estimating portion sizes. Therefore, no quantities were attached to the food items recorded and consequently portion sizes could not be estimated.

In this section, we will describe the steps taken to adapt the original DILQ scoring process used by Edmunds and Ziebland (2001) to determine the scores for vegetable and fruit consumption. In the first group, we calculated the number of occasions that vegetables and fruit were consumed. We made two changes to the coding system used by Edmunds & Ziebland, namely potatoes were quantified as vegetables, and fruit juice was also scored as fruit. A score of one was given for each time a fruit, vegetable or juice was consumed, assuming that each instance reported corresponded to one single serving. A single fruit or serving of vegetables, multiples of smaller fruit (grapes, half a banana, 2 plums), stewed fruit, tinned fruit, dried fruit, fruit, vegetables, salads with constituents itemized, fruit salad (apple, orange, melon, strawberry), salad (pepper, cucumber, lettuce, tomato), and meals where salad items were listed separately (lettuce, tomato, red

pepper) received a score of one (Edmunds & Ziebland, 2001). If two different kinds of fruits or vegetables were consumed at the same time, both were scored (i.e., a pear and berries eaten at the same meal would be scored as 2). Foods where the actual content could not be disaggregated from the rest (e.g., pizza, apple crumble, soup) were not coded.

In the second group, we calculated the number of times foods from the "foods to be limited" group were consumed. A score of one was given for each time a food high in calories, sugar, fat or salt was reported. This group included candy and chocolate, cakes, pastries, doughnuts and muffins, granola bars and cookies, ice cream and frozen desserts, potato chips, nachos and other salty snacks, French fries, corndog and pop and fruit flavored drinks (Health Canada, 2007).

In the third group, we calculated the number of occasions that fluid milk was consumed. A score of one was given each time milk (skimmed, partially skimmed, and whole), including chocolate milk was reported, assuming that each instance reported corresponded to a single serving of milk. Any dairy product other than liquid milk was excluded (such as yogurt or cottage cheese).

In the fourth group, we recorded the consumption of traditional foods. A score of one was given for each time a traditional food or dish was reported (i.e., bannock, traditional meats, wild game, berries, wild plants).

4.2.2 Item Coding VFFQ

The VFFQ is a non-quantitative food frequency questionnaire that asks about children's vegetables and fruit consumption during the previous month. It consisted of 29 questions; eighteen referred to vegetables and eleven to fruits. Answers options were "less than 1 per month", "1-3 times per month", "once per week", "2-4 times per week", "2-6 times per week", "5 or more times per week", and "one or more times per day" with variations for each item. The variations in scoring options are the result of the code of the YAQ questionnaire from which

some questions were derived. To codify the VFFQ, three categories were established as shown in Table 4-1. Foods that were consumed once per week were categorized as 'medium consumption'. Foods consumed more or less frequently than this were categorized as "high or low consumption", respectively. Foods were reported as high, medium or low consumed foods when a high frequency of children reported the food in one of the three categories. When the frequency of consumption fell into two categories, the food type was reported at both consumption rates. In order to collect information about which food was never eaten by the children, answer "Never" was evaluated independently and not as part of the "low consumption" category (Table 4-1).

4.1 Coding system for the VFFQ

Categories based on frequency of consumption			
Never	Low consumption	Medium consumption	High consumption
Food never consumed	Foods consumed less than once per week	Foods consumed once per week	Foods consumed more than once per week

4.2.3 Weight status measurement

The age and sex specific body mass index (kg/m²) or BMI is the most common method for assessing weight status and health risk in children (Janssen et al., 2005). Children's weight status was based on BMI derived from measured heights and weights using the World Health Organization (WHO) child growth reference (Dietitians of Canada, 2010). Children were classified as normal weight <+1 SD from the reference median (equivalent to BMI 19 kg/m^2 at 10 years) and overweight/obese >+1 SD from the reference median (equivalent to BMI 19 kg/m² at 10 years). The two categories (overweight/obese) were collapsed due to the low number of children in the study. Weight and height were measured and recorded to the nearest 0.1kg and 0.1 cm, respectively, using an electronic

platform scale and stadiometer (Seca 220). Abdominal obesity (>85th percentile for age and sex) is associated with obesity-related disorders (National Institutes of Health, 1998). Therefore, waist circumference was measured to the nearest 0.1 cm with a non-stretch measuring tape at the top of the iliac crest (National Health and Nutrition Examination Survey, 2004) and abdominal obesity status was classified at a waist circumference >85th percentile of sex-and-age (McDowell, Fryar, & Ogden, 2009).

A female researcher measured all females and a male researcher measured all males. A female member from the community was present at the time of measurement to ensure children felt comfortable. Children wore light clothing without shoes and all measurements were taken in private by researchers trained in standardized measurement techniques. Two consecutive measurements were taken. Values needed to be within 0.5 kg (weight) or 0.5 cm (height and waist circumference). Otherwise, a third measurement had to be taken and the average from the 2 closest values was calculated. If the three measurements were not within 0.5 kg or 0.5 cm of each other, an average of all three measurements was calculated (Appendix D).

4.2.4 Statistical Analysis

In order to complete objective 1, 2 and 3 (to collect dietary and anthropometric data from 4th, 5th and 6th grade children and to compare dietary intake data to national recommendations (EWCFG) means, standard deviations, medians, frequencies and percentages were calculated. Measures of central tendency (mean and median) were derived using Microsoft Excel 2007. Frequencies were obtained using the SPSS for Windows v. 17 (SPSS Inc., Chicago, IL).

In order to complete objective 4 (to compare dietary intakes across normal weight, overweight and obese groups), statistical analyses were carried out using SPSS for Windows v. 17.0 (SPSS Inc., Chicago, IL). Descriptive statistics were used for the independent variables and Whitney-Mann U tests were used to examine statistical differences in dietary intake amongst adiposity groups.

Whitney-Mann U test is the non-parametrical version of Independent – samples T-tests for assessing whether one of two samples of independent observations tends to have larger values than the other. Non-parametrical tests do not make assumptions about the population distribution and can be used for small sample size ($n < 30$). The p value of significance for all statistical analyses was 0.05 (5%). Considering the small sample size of this study, a value of 0.20 was used to indicate trends in the data.

4.3 Results

In this section general information about the study population (Tables 4-2) as well as outcomes from the DILQ (Tables 4-3, 4-4, 4-5 &4-6) and the YAQ (Table 4-7) are presented. Descriptive data is followed by comparisons between different groups (Tables 4-8, 4-9, 4-10) and food intake.

4.3.1 Characteristics of study population

A total of 28 students from the 4^{th} (n=11), 5^{th} (n=9) and 6^{th} (n=8) grade were included in the dietary analysis, which was 51% of eligible children (Table 4-2). For the anthropometric analysis, data for one child were excluded due to the lack of parental consent. A significant percentage of the children (63%) were either overweight or obese and a quarter (26%) of the children presented abdominal obesity (Table 4-2). All students who assented to participate and had provided parental consent completed the two questionnaires (DILQ and VFFQ).

Table 4-2. General study population information (Age, gender, adiposity and grade).

Mean Age (SD)	Boys n=14	Girls n=14	Grade 4	Grade 5	Grade 6	Normal weight[1]	Overweight / obese[2]	Abdominal obese[3]
10 ± 1.03	n=14 50 %	n=14 50 %	n=11 39.2%	n=9 32.1%	n=8 28.5%	n=10 37%	n=17 63%	n=7 26%

[1]Normal weight status was classified at a BMI<+1 SD but < 2 SD from the reference median from the WHO cohort.

[2]Overweight/obese status was classified at a BMI >+1 SD from the reference median from the WHO cohort.

[3]Abdominal obesity status was classified at a waist circumference >85th percentile of sex-and-age matched children from the NHANES III cohort

4.3.2 Description of food intake

The Day in the Life Questionnaire: Results.

The EWCFG recommends the consumption of 5 to 6 servings of vegetables and a fruit per day for this age group. This recommendation was only met by three students on one out of the three days evaluated; all during Thursday. 25 children did not meet the recommendation for vegetables and fruit in any of the evaluated days, 19 children did not consume the two servings of milk recommended by the EWCFG any of the days, and 25 children did not consume any traditional food during the evaluated days. Moreover, only one child did not consume food to be limited during the three days (Table 4-3). When we examine the total number of food records collected, we can see only three reports (3.5%) of children consuming the recommended amount of fruits and vegetables during the study compared to 73 reports (87%) of consumption of foods to be limited (Table 4-4).

Table 4-3. Number of children reporting consumption of vegetables and fruit, milk, traditional food and food to be limited over three days of dietary recall.

	Never	1 day	2 days	All 3 days
Number (%) of children meeting the recommended number of servings of vegetables and fruit.	25 (89.3%)	3 (10.7%)	0 (0%)	0 (0%)
Number (%) of children having at least 2 servings of milk.	19 (67.8%)	4 (14.2%)	4 (14.2%)	1 (3.6%)
Number (%) of children having at least 1 instance of traditional food.	25 (89.3%)	2 (7.1%)	1 (3.5%)	0 (0%)
Number (%) of children having at least 1 instance of foods to be limited.	1 (3.5%)	1 (3.5%)	6 (21.4%)	20 (71.4%)

Table 4-4. Number of recalls of consumption of vegetables and fruit, milk, traditional food and food to be limited from total of dietary recalls.

	Total of records 84 (100%)
Number (%) of food records containing the recommended number of servings of vegetables and fruit.	3 (3.5%)
Number (%) of food records containing at least 2 servings of milk.	15 (17.8%)
Number (%) of food records containing at least 1 instance of traditional food.	4 (4.7%)
Number (%) of food records containing at least 1 instance of foods to be limited.	73 (87%)

Intake of "foods to be limited" was greater than vegetable and fruit intake in terms of frequency of consumption (Table 4-3). Children reported a higher consumption of "foods and drinks to be limited" during the Sunday unlike Monday and Thursday. Consumption of traditional food was only reported by three students who consumed bannock, duck soup and berries soup. The remaining 25 students reported no instances of traditional food consumption on any day. Milk was only consumed as recommended (based on the EWCFG recommendation) by one boy out of the twenty-eight children, who consumed two glasses of milk (500 ml) each of the analyzed days. No significant difference of milk consumption was found among adiposity groups.

Table 4-5. Food group's intakes[1] among adiposity groups (median)(range)

	Evaluated day	*Total*	*Normal weight (n=10)*	*Overweight/ Obese (n=17)*	*Not abdominally obese (n=20)*	*Abdominally Obese (n=7)*
Vegetables and fruit	All 3 days[3]	2 (3)	2 (2)	1 (3)	1.5 (3)	1 (2)
	Weekdays[4]	1.5 (3.5)	1.5 (3.5)	1.8 (2)	1.5 (3)	1 (2)
	Sunday	1 (4)	2 (4)	1(4)	1 (4)	1 (4)
Food to be limited[2]	All 3 days[3]	2 (5)	2 (4)	2 (4)	2 (5)	2 (2)
	Weekdays[4]	1.5 (4)	1.8 (3)	1.5 (4)	1.8 (4)	1.5 (2.5)
	Sunday	4 (8)	3.5 (7)	4(6)	3 (8)	5 (7)
Traditional foods	All 3 days[3]	0 (1)	0 (1)	0 (0)	0 (1)	0 (1)
	Weekdays[4]	0 (1)	0 (1)	0 (0)	0 (1)	0 (1)
	Sunday	0 (4)	0 (4)	0 (0)	0 (0)	0 (1)
Milk (glass)	All 3 days[3]	1 (2)	1 (2)	1 (2)	1 (2)	1 (2)
	Weekdays[4]	1 (2.5)	1 (2.5)	.5 (2.5)	1 (2.5)	1 (2.5)
	Sunday	1 (2)	1 (2)	1 (2)	1 (2)	1 (2)

[1] Based on assumption that each report corresponds to a single serving

[2] Food and drinks high in calories, sugar, fat or salt (sodium) according to the EWCFG (Health Canada, 2007)

[3] Median of Monday, Thursday and Sunday

[4] Median of Monday and Thursday

Table 4-6. Median and frequency of vegetable and fruit intake[1] among the weekday and weekend day.

	Weekday[2]	*Sunday*
Median	2 (3.5)	1(4)
Frequencies	**number of children (%)**	
0 vegetable and fruit	0 (0%)	4 (14%)
.5 vegetable and fruit	1 (3.5%)	0 (0%)
1-2 vegetables and fruit	18 (64%)	12 (43%)
More than 2 vegetables and fruit	9 (32%)	12 (43%)
5 or 6 vegetables and fruit (CFG recommendation)	0 (0%)	0 (0%)

[1] Based on assumption that each report corresponds to a single serving

[2] Median from Monday and Thursday

Based on results from the Vegetable and Fruit Frequency Questionnaire (Table 4-7), the frequency of vegetables and fruit are presented based on "high", "medium", "low" and "never". While several foods were categorized as high, low and never, no vegetables and fruit were classified in the medium group.

Table 4-7. Frequency of vegetables and fruit consumption.

Vegetables and Fruit Frequency Questionnaire (VFFQ)

HIGH Foods consumed more than once per week.	MEDIUM Foods consumed once per week	LOW Food consumed less than once per week	NEVER Foods reported as never consumed
Apple or apple sauce Apple juice Bananas Broccoli Corn Celery Grapes Lettuce/tossed salad Mixed vegetables Orange Orange juice Strawberries		Carrots Cooked Carrots raw Celery Lettuce/tossed salad Oranges Peaches/plums/apricots Pears Potato baked, boiled or mashed Potato salad Tomato/spaghetti sauce	Beets Cantaloupe Coleslaw Greens/kale Green/red pepper Raisins Spinach Tomatoes Yam/sweet potatoes Zucchini, summer squash, eggplant

Based on vegetables and fruits listed in the VFFQ.

The EWCFG recommends the consumption of at least two glasses of milk (500 ml) per day for this age group, a recommendation only met by one child (male) of the twenty-eight on all three days; however, 11% (n=3) of the children did not report milk consumption any of the days, 21% (n=6) of the children did not consume milk in one of the analyzed weekdays and 36% (n=10) did not consumed milk on Sunday (Table 4-8).

Table 4-8. Frequency of milk intake in weekdays and weekend[1]

	Monday/Thursday[2] ***# of children (%)***	***Sunday*** ***# of children (%)***
0 glass of milk	6 (21%)	10 (36%)
.5 glass of milk	6 (21%)	0 (0%)
1-1.5 glasses of milk	12 (43%)	15 (53%)
2-4 glasses of milk (CFG recommendation)	4 (14%)	3 (11%)

[1]Based on assumption that each report corresponds to a glass of milk (250 ml)
[2] Mean of Monday and Thursday

4.3.3 Comparison of food intake based on adiposity

A Mann- Whitney U test showed no statistically significant difference of vegetable and fruit consumption between normal weight and overweight/obese group ($p = 0.58$). However, there was a trend ($p=0.11$) of the normal weight group to consume more vegetables and fruit during the weekend than the overweight/obese group (Table 4-9). Also, our findings showed a trend for the non-abdominally obese group to consume more vegetables and fruit than the abdominally obese group during the weekday (median= 1.5 vs. median=1 respectively), however, this did not reach statistical significance ($p=0.08$).

Table 4-9. Consumption of vegetables and fruit based on adiposity. (Mann-Whitney U test)

Variable	n	Median (range)	Normal weight (n=10)	Overweight-obese (n=17)	p Value
V&F 3 days[1]	27	2 (3)	2 (2)	1 (3)	0.58
V&F weekday[2]	27	1.5 (3.5)	1.5 (3.5)	1.8 (2)	0.45
V&F weekend day	27	1 (4)	2 (4)	1(4)	0.11
Variable	**n**	**Median (range)**	**Non-abdominally obese (n=20)**	**Abdominally obese (n=7)**	**p Value**
V&F 3 days[1]	27	2 (3)	1.5 (3)	1 (2)	0.94
V&F weekday[2]	27	1.5 (3.5)	1.5 (3)	1 (2)	0.08
V&F weekend day	27	1 (4)	1 (4)	1 (4)	0.84

V&F = vegetable and fruit

[1]Median of Monday, Thursday and Sunday

[2]Median of Monday and Thursday

A Mann-Whitney U Test showed no statistically significant difference of "food to be limited" consumption between different groups based on adiposity (p=0.7). However, there was a trend (p=0.12) of abdominally obese group to consume more "food to be limited" during the weekend than non-abdominally obese group (Table 4-10).

Table 4-10. Consumption of food to be limited based on adiposity. (Mann-Whitney U test)

Variable	n	Median (range)	Normal weight (n=10)	overweight-obese (n=17)	p Value
Food to be limited 3 days	27	2 (5)	2 (4)	2 (4)	0.71
Food to be limited weekday	27	1.5 (4)	1.8 (3)	1.5 (4)	0.87
Food to be limited weekend day	27	4 (8)	3.5 (7)	4(6)	0.30
Variable	**n**	**Median (range)**	**Non-abdominally obese (n=20)**	**Abdominally obese (n=7)**	**Mann-Whitney U test p Value**
Food to be limited* 3 days	27	2 (5)	2 (5)	2 (2)	0.73
Food to be limited Weekday	27	1.5 (4)	1.8 (4)	1.5 (2.5)	0.38
Food to be limited weekend day	27	4 (8)	3 (8)	5 (7)	0.12

*Food and drinks high in calories, sugar, fat or salt.

4.4 Discussion

Overall, the findings suggest that children in this study are eating low amounts of vegetables and fruit and contrary to the recommendations they have a high consumption of foods that should be limited. None of the participants met the recommendation for fruits and vegetables (5-6 servings/daily) consumption established by the EWCFG over all three evaluated days. Only three children met the recommendation in one of the three days. Only one child met the recommendation for milk consumption (500 ml/daily) during the three evaluated days. The EWCFG was devised to meet basic requirements based on the Recommended Dietary Allowance (RDA). The RDA is the average daily dietary

intake of a nutrient that is sufficient to meet the requirement of nearly all (97-98%) healthy persons. This is the number to be used as a goal for individuals (Health Canada, 2010). For children this age, the EWCFG recommends a daily intake of 5-6 servings for vegetables and fruit and at least 500 ml of milk. The EWCFG for First Nations, Inuit and Métis, also offers traditional Aboriginal foods options for each food group; however, 89% of the children did not reported consumption of traditional Aboriginal food on any of the evaluated day while consumption of "foods to be limited" was highly reported.

The first objective of the study was to collect anthropometric and dietary data (vegetables and fruit consumption) among 4th, 5th and 6th grades. Overweight and obesity was highly presented among participants (63%). A previous study conducted in this community also reported a high prevalence of adiposity in the school (Pigford, 2010). Based on reports from the DILQ, vegetables and fruit were consumed few times during the day and in some children never consumed on one of the analyzed days. Considering the importance of vegetables and fruit in the diet of children as principal source of vitamins, minerals and fiber efforts need to be made to encourage children to consume more vegetables and fruit. During weekdays, the school lunch meal was the principal source of vegetables and fruits.

The school lunch program was accessible to all students and consisted of different combinations of food every school day, with the common characteristic of always providing one serving of vegetables or fruit. Increasing carbohydrate and fibre intake by eating more vegetables and fruit may enhance satiation and reduce caloric and fat intake (Rolls, 1995). Therefore, children participating in the school lunch program may benefit by obtaining one serving of vegetable or fruit and also reducing their consumption of other foods with less nutritional value such as chips, cookies, chocolates and pop amongst others sold in the school. Furthermore, knowing that food insecurity exists in Aboriginal communities (Power, 2007), children may be obtaining their only vegetable or fruit at school hours. Increasing availability of healthy foods in school settings may be a first step to increasing healthy food consumption, as the majority of children participate in the school lunch program which provides vegetable and fruit

choices. At the same time, home environment should be targeted with programs that include all family members.

Based on the frequency of consumption of vegetables and fruit from the VFFQ, we noticed a high number of items reported as never consumed by the children and also a high number of items in the low consumption category. This information is important to obtain in order to evaluate the impact of an intervention in frequency of consumption of certain vegetables and fruits. For example, in the intervention taking place at the community, some of the "never consumed" vegetables (Beets, green/red peppers, and zucchini) were integrated into the school garden. If in subsequent data collections, these items belong to another category, it is possible that the intervention played an important role in the change of dietary consumption.

For the second objective of the study, we aimed to quantify instances of consumption of traditional food and milk. This was possible due to the questionnaire (DILQ) format that asks for overall consumption of food during the day. However, the DILQ does not allow the determination of the intake of other food groups such as grain products, meat and alternatives and other alternatives of milk due to the difficulty children have in reporting the exact composition of complex foods. For example, cream can be a complementary ingredient in a dessert or onions may be used as a complementary ingredient in a soup. Consequently, there might be an underestimation of food groups based on aggregated foods not being included in this study.

Only 3 children reported consumption of a traditional dish, and the majority of children instead showed a consumption trend towards more processed food. The three traditional food consumed were bannock, duck soup and berries soup. Nowadays, traditional foods are less plentiful and one reason is because people must travel further to hunt and fish which increases cost. Climate change plays an important role in the scarcity of traditional Aboriginal food in communities. Changes in the physical and biogeochemical environment either caused naturally or influenced by human activities such as deforestation, fossil

fuel consumption, urbanisation, land reclamation, agricultural intensification, freshwater extraction, fisheries overexploitation and waste production, contribute to global environmental change (Kuhnlein, Harriet, Soueida & Receveur, 1995). Traditional food consumption is important because it contributes to the physical, social and spiritual well-being of Aboriginal people (Lambden, Receveur, & Kuhnlein, 2007). Food preparation activities bring individuals in the community together, helping to maintain social relationships and spiritual connections with the land (Lambden, Receveur, & Kuhnlein, 2007). Furthermore, traditional food and lifestyle can act as protective factors against chronic diseases (Assembly of First Nations Environmental Stewardship Unit, 2007).

Not only was traditional food infrequently consumed, milk consumption was also lower than recommendations for this age group (Health Canada, 2007). The community school provided children with cereal and milk every morning; however this meal is optional and not all children reported its consumption. The milk provided at school (250ml), if exclusive, is not sufficient to achieve the daily recommendation (500 ml). Low reports of milk consumption may be explained by a preference for other milk alternatives such as yoghurt bars or cheese products which were highly reported by children. According to the CCHS, by ages 10 to 16, about 61% of boys and 83% of girls do not meet the recommendation for milk consumption (Health Canada, 2010). Moreover, the Department of Agriculture and Agri-Food Canada state that in the general population, fluid milk consumption has declined by 15% over the past 20 years while cheese and cream consumption has increased 44% and 86%, respectively (Agriculture and Agri-Food Canada, 2011). Alternative dairy products such as yogurt, cream and cheese are a good source of calcium; however, consumption of alternative dairy products may not guarantee vitamin D requirements. The significance of vitamin D consumption should be emphasized to this population which is already vulnerable to deficiency by its geographical situation (Huotari & Herzig, 2008). Moreover, consumption of sweetened drinks is strongly associated with a decrease in milk consumption (Mrdjenovic and Levitsky, 2003). This finding is noteworthy due to the perception that milk is more expensive than sweetened beverages. Also, a

recent study noted that milk consumption is associated with household income where milk consumption was higher at the time of the month when there was more disposable income (Glanville & McIntyre, 2009). The possible relationship between the increased consumption of cheaper sweetened beverages and lower consumption of milk is worthy of study in the future.

Food availability in isolated communities has been compromised because of environmental and social factors. The physical environment may contribute to the food being unattainable to these communities, and transport and conservation challenges result in expensive food costs resulting into food insecurity in the community. Furthermore, besides the availability of foods, adequate income is essential to ensure reliable access to food. Food costing contributes to the monitoring of household food insecurity by estimating the cost and affordability of a basic nutritious diet (Cotton, 2008). The Alberta Nutritious Food Basket (ANFB) is a food-costing tool that is a measure of the cost of healthy eating based on current nutrition recommendations. The ANFB consists of 51 representative food items and it is determined through a partnership between the Provincial Community Nutritionists of Alberta and Alberta Agriculture and Rural Development (Government of Alberta, 2012). In June 2008 in Alberta, the average monthly cost of the nutritious food basket, for a family of four, was $774 (Government of Alberta, 2012). Aboriginal families are more likely to be large families. According to the First Nations Regional Survey, 63% of the First Nations children living on reserve age 11 and under lived in families with three or more children (First Nations Information Governance Committee, 2007). Larger families with school age children have to spend more money in order to maintain a healthy diet. Moreover, a high number of food items from the Alberta Nutritious Food Basket - including vegetables and fruit - may not be found in the community and getting to them implies higher expenses. Moreover, diets high in fats and sweets represent a low-cost option to the consumer, whereas the recommended healthy diets cost more (Drewnowsk, Darmon & Briend, 2004).

Therefore, the low intake of vegetables and fruit of children in this study may be due to the shortage of fresh produce and limited economical resources considering the community's rural location..

The last objective was to compare dietary intake across adiposity levels. Despite the lack of statistically significant differences of dietary intake across normal and overweight/obese groups, there was a trend for overweight/obese children to eat more "food to be limited" during Sunday compared to Monday and Thursday. It has been shown that the meal patterns and food choices of children and adolescents differ from weekdays to weekends due to a disruption of the daily routine. According to different studies intake of snacks increases during the weekend (Samuelson, Bratteby, Enghardt & Hedgren, 1996; Haines, Hama, Guilkey & Popkin, 2003). This information is important due to the long term negative consequences (weight gain among others) that may result from the incremental increase in unhealthy dietary behaviors during the weekend. Our results show that during the weekend, overweight and obese children tend to reduce their vegetable and fruit intake. This trend may be a result of food availability at home during weekend. School and home food environments play an important role in children dietary behaviors. One example of this, is the influence that environment has on obesity development. Environment obesogenicity has been defined as the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations (Swinburn, Egger & Raza, 1999). Therefore, it is always important to consider environmental factors when dietary behaviors are studied.

The strengths of this study lie in the setting and design. The study was developed in a First Nation school where the community was actively involved at every level from design onwards. The community based design of the research, allowed participation from different sectors of the school and the community facilitating the process which proved particularly useful in identifying aspects of the study which would have been culturally sensitive to the community. One of

the limitations of this study was the low participation level (51%) which is typical of school-based research that requires parental consent (Esbensen, Melde, Taylor, & Peterson, 2008). Studies requiring active parental consent are less likely to recruit those students most at risk or already involved in the targeted risky behaviors. According to Esbensen et al, achieving the targeted consent rate of 70% requires different strategies such as allocating several weeks to the process, attaching consent forms to official school forms requiring parental signatures, and providing incentives to teachers and students (Esbensen, Melde, Taylor, & Peterson, 2008). Even though we were present in the community and school several times for different activities before the data collection, parents were not met for the purposes of obtaining consent forms and this may have been a disadvantage. Although specific and clear information about the study was attached to the consent forms, official school stationery was not used. In the future, this may be an option in order to present information to parents in a "secure and familiar" manner. Furthermore, incentives were not offered to the children or teachers to participate, and this may be modified in for a higher participation rate.

Participation among girls tended to decrease in grade 6 compared to grade 4. A reason for this reduction may be the awareness of older girls about health issues related with diet and weight status and a consequent fear of judgment. In addition, some children feel uncomfortable with the anthropometric procedures. To reduce this discomfort, a teacher from school was always present at the moment of the anthropometric measurements. However, training in anthropometric measurement procedures of people from the community and familiar to all children may be beneficial for future studies to increase participation. Despite the low participation rate within the target group, we determined that the prevalence of overweight and obesity found amongst participants (63%) is in line with previous obesity rate studies undertaken in the same community (Pigford, 2011).

The present study identified certain dietary components of children in a First Nation community. Similar results have been found in previous studies where Aboriginal children did not meet the recommendations for vegetables and fruit, had a low intake of traditional food and on the other hand, consumed highly amounts of "food to be limited" (Gates et al., 2011; Downs et al., 2009; Kuhnlein & Receveur, 2007; Taylor et al., 2007).

This information provides evidence that dietary intake did not meet recommendations among this small group of First Nation children. The environment plays an important role in their dietary choices which differs from those of their ancestors. However, further study of children's dietary intake, including intake of other family members should be done in order to improve the diet quality of these children.

4.5 Conclusion

Based on our findings, children are not eating the 5-6 vegetables and fruits servings that the Canada's foods guide recommends for 4-13 year old children. Moreover, consumption of milk is below the recommended amount and traditional food is rarely consumed. At the same time, foods and drinks that should be limited are highly consumed replacing the foods that children need for their physical and mental development. It is likely that no one factor is the sole reason for this dietary trend, but more likely a combination of the effects of accessibility, due to factors such as economic restraints and availability.

Strategies to improve children's dietary behaviors in both the school and home environment needs to be implemented. Also, interventions including all the members of the family are necessary to have a greater impact in children's dietary behaviors. The information will be used to determining the effectiveness of the garden-based intervention.

4.6 References

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5. Conclusion

The studies presented in this thesis contribute to both the refinement of two vegetable and fruit assessment tools appropriate for First Nations children and the description of specific dietary habits of this population. The refinement of the tools served as a first step to provide an adequate method for data collection in this population. First Nation children require particular dietary assessment tools that reflect their traditions and common language terminology. Despite the tools having been previously validated in children of the same age and language group, culturally sensitive assessment tools were necessary and therefore wording modifications and additional instructions for specific questions, among other changes, were carried out. For the study presented in this thesis, the DILQ was completed by the children on three separate occasions, however, in future research, only two applications may be necessary to achieve the objective of describing intake of this group. Children seemed less interested in answering at the third application of the questionnaire and this may have led to inaccurate information. Moreover, individual variation did not affect robustness of group data (Thomson & Subar, 2001). An interesting observation was the high capacity of children to remember brands of processed foods such as hamburgers, chips, chocolates and beverages, among others, perhaps indicating the large influence of marketing on children. On the other hand, children were unable to report serving sizes of the food or ingredients within a complex meal. For more precise information, inclusion of parental participation may be required to provide the information that children are not able to deliver.

Furthermore, when it comes to the VFFQ, simplification and standardization might be required for future research. A reduced number of response options may make the VFFQ more understandable to children and simplify the codification. Both instruments can be applied in a group setting decreasing data collection time and avoiding interruption of class hours. Therefore, the present study represents a starting point for future research on

dietary assessment methods for evaluation in First Nations schools. Regardless of the aspects of the questionnaires that may be improved for future research, the VFFQ and refined DILQ were appropriate assessment tools to measure frequency and instances of consumption of vegetable and fruit as well as other components of the diet.

A low vegetable and fruit consumption was reported among all children. Consumption was significantly lower than the recommendation based on the "Eating Well with Canada's Food Guide -First Nations, Inuit and Métis". This confirms results from previous studies in Aboriginal populations (Downs et al., 2009; Anand et al., 2007), which also showed that vegetable and fruit consumption was lower than recommended. In addition to vegetables and fruit consumption being below the recommended levels, milk consumption did not meet the requirements suggested by EWCFG. Sweetened beverages and food with high sugar and fat content were consumed by children in higher quantities than vegetables and fruit. Furthermore, consumption of traditional food was seldom reported.. Increased consumption of traditional food may help to reduce unhealthy food intake such as fast food or snacks with high contents of sugar and fat. Traditional food provides a more balanced diet to the children as well as promoting other social benefits such as a sharing culture and more physical activity which is a determinant of healthy weight maintenance (Jeffery, Wing, Sherwood, & Tate, 2003).

Children presented a high prevalence of overweight and obesity confirming results of a previous study in the community where 47.6% of the children were overweight or obese (Pigford, 2010). Abdominal obesity was also present in 26% of the children. No significant association between weight status and vegetable and fruit intake was revealed. In further studies, a higher number of participants would be recommended as the small sample size may have been one of the limitations for statistical analysis in this study. Moreover, more detailed information including serving sizes of food is necessary to analyze weight-intake relationships more precisely.

School and home environments have a big influence on children's dietary behaviors as they are where children spend the majority of their time. School lunch meals remain the main source of vegetables and fruits during the week, possibly due to vegetable or fruit provided by the lunch program. Unfortunately, provision of more than one vegetable or fruit was an economic challenge for the school kitchen. If more financial resources were designated to include more variety and a higher quantity of vegetables and fruits into the school program, children may increase their vegetables and fruit preference and therefore daily intake. Moreover, a higher exposure to this food group at school may be a determinant to increase children's preference and intake at home. As some studies have shown, repeated exposure to new foods may increase their acceptance among children (Wardle, Herrera, Cooke, & Gibson, 2003; Sullivan, 1994). We also found that during Sunday, children reported a higher consumption of foods and beverages that contain large amounts of fat and sugar. This may be due to the availability at home of these foods as well as other factors such as more television or videogames exposure is related to the consumption of foods that are high in sugar and fat or requiring little preparation (Dixon, Scully, Wakefield, White, & Crawford, 2007) as processed food presents the characteristic of being easy to obtain and eat.

These results will be used as part of the baseline of an ongoing garden intervention at the school and also may be used as a starting point for future research in this Aboriginal population. Understanding dietary behaviors may assist in the development of targeted interventions to address obesity in order to avoid the harmful consequences of childhood obesity for Aboriginal people.

5.1 References

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6. Appendices

6.1 Appendix A. Complementary aids (DILQ)


Food models

Cups and plates

Catalogue

6.2 Appendix B. Consent forms.

UNIVERSITY OF ALBERTA

EarthBox Kids – A school project to increase the number of vegetables and fruit that children eat (Grades 4 – 7)

(TO BE COMPLETED BY THE CHILD'S CAREGIVER)

Principal Investigators: Noreen Willows, PhD Phone:
Anna Farmer, PhD

Agreement to participate	**Yes**	**No**
Have you read the attached Information Sheet?	☐	☐
I agree to have the information about my child's diet, fruit and vegetable preferences, and home food environment (PART ONE) used in the study.	☐	☐
I agree to have my child's height, weight, and waist circumference measured (PART TWO) and used in the study.	☐	☐

If you said yes to either of the above statements then please answer the following questions:

Do you understand the benefits and risks in having your child take part in the study?	☐	☐
Do you understand that your child's participation in the study is voluntary?	☐	☐
Do you understand that the information from the study will be used to write reports and manuscripts, and to make presentations?	☐	☐
Do you understand that your child's name will not appear in any reports, manuscripts, or presentations?	☐	☐
Do you understand that you can decide to withdraw your child from the study up to the point where data have been entered?	☐	☐

SIGNATURE OF CAREGIVER _____

PRINTED NAME OF CAREGIVER _____

PRINTED NAME OF THE CHILD _____

DATE _____

UNIVERSITY OF ALBERTA

EarthBox Kids – A school project to

increase the number of vegetables and fruit that children eat

Grades 4 to 7

(TO BE SIGNED BY THE CHILD)

It is important that children eat healthy foods. A study is being done at the school. For the next two years you will be growing vegetables at the school. You will also eat fruits and vegetables as snacks. Your teacher will ask you to write down what you eat, the vegetables and fruit you like to eat, and if there are vegetables and fruits at home. Your teacher next year will ask you the same questions.

If you agree, we will record your answers as part of a study.

We would like to know your weight. If you agree, we would like to measure your height, weight, and waist size. We will do this in November and next year.

It is okay if you say "no." You can change your mind about being in the study. If you do, please tell your teacher before the study starts.

All information will be kept private. No one will know your name if you participate.

Please check (√) one of the following choices:

I **want** people to know about what I eat: _____

I **do not want** people to know about what I eat: _____

Please check (√) one of the following choices:

I **want** to have my height, weight, and waist size taken: _____

I **do not want** to have my height, weight, and waist size taken: _____

My name is: _____

6.4 Appendix C. Anthropometric data sheet.

DATA SHEET

Participant information   Survey date : _______________

mm/dd/yy

Sex : _____   Grade : _____

Measurements

Height (cm):   1st measurement = ______________

2nd measurement = _______________

3rd measurement = _ _ _ _ _ _ _ _ _ _

(only when |1st - 2nd | ≥ 0.5 cm)

Weight (kg):   1st measurement = ______________

2nd measurement = _______________

3rd measurement = _ _ _ _ _ _ _ _ _ _

(only when |1st - 2nd | ≥ 0.5 kg)

Waist circumference: 1st measurement = ______________

2nd measurement = _______________

3rd measurement = _ _ _ _ _ _ _ _ _ _

(only when |1st - 2nd | ≥ 0.5 cm)

Measurer comments (if any) : _
_ _
_ _

Measurer:_______________