**Investigating the Impact of "other foods" on Aboriginal Children's Dietary Intake
Using the Healthy Eating Index – Canada (HEI-C)**

by

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**A thesis
presented to the University of Waterloo
in fulfilment of the
thesis requirement for the degree of
Master of Science
in
Health Studies and Gerontology**

Waterloo, Ontario, Canada, 2010

Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Introduction:

The high prevalence of obesity in Aboriginal Canadian youth is a major public health concern. Although little is known about the diets of children on-reserve, it is hypothesized that high intake of low nutrient dense foods has a negative impact on overall diet quality.

Objectives:

To describe the dietary quality of First Nation students using a Canadian adaptation of the Healthy Eating Index (HEI-C) and determine the relationships between HEI-C and BMI, intake of non-food group ("other") foods, game consumption, frequency of eating outside the home and remoteness (latitude, °N).

Methods:

Between 2004-2009, from a 24 h dietary recall data were obtained using a validated web-based food behaviour questionnaire, from students in grades 6,7 & 8 from the First Nations communities of Georgina Island, Christian Island, Fort Albany, Attawapiskat, Peawanuck, Moose Factory, Kashechewan and Ouje-Bougoumou (Quebec). HEI-C was assessed as good (81-100), needs improvement (51-80) or poor (0-50).

Results:

Mean community HEI-C scores ranged from 57.38-70.04, with differences by community (p=0.027) and season (p=0.007); more northerly communities seemed to have lower HEI-C scores and fall seemed to have higher HEI-C scores compared to winter and spring. A non-significant negative correlation between BMI and HEI-C was observed (r=-0.107, NS). As percent energy from 'other foods' increased, the HEI-C score tended

iii

to decrease. Game consumption appeared to contribute to higher HEI-C scores. Eating outside the home did not seem to affect HEI-C.

Conclusions:

Poor diet quality in remote on-reserve youth populations is a concern. Lack of consistent access to healthy foods may have a negative impact on diet quality. Programs that help improve the provision of healthy foods, decrease the intake of "other foods" and that emphasize game may help to improve diet quality.

Aknowledgements

First of all, I would like to thank my supervisor, Dr. Rhona Hanning, who has been there to help me throughout this endeavour. From that first day Dr. Hanning took the time to chat with me, a recent university graduate, who lacked direction and focus on what my next step in life should be with the exception of knowing that I was very interested in nutrition and enjoyed working with children. Dr. Hanning believed in me and under her guidance, found a place for me to further my education that included the involvement of my two passions.

I would also like to thank Dr. Len Tsuji who has provided me with a unique perspective on the area of not only Aboriginal nutrition, but on their way of life, by allowing me to travel with him to the communities. This provided me with the opportunity to have a glimpse into their lives, the joys and the struggles they face on a daily basis that I may never had been exposed to had I not been welcomed into their homes. For this experience, I am truly grateful.

I would also like to thank Sarah Woodruff-Atkinson for her expertise and direction throughout this entire process.

A special thank you goes out to all of my family and friends who have been there through the ups and the downs of this project. Thank you for believing in me and motivating me when I did not believe in myself.

Table of Contents:

List of Tables

List of Figures:

1.0 Introduction:

The Aboriginal population in Canada has faced many lifestyle changes that have affected them emotionally, mentally and physically. The term 'Aboriginal' includes First Nations, Métis and Inuit peoples. These groups also include several distinct communities and cultures within them, each of which has encountered unique issues, but also many similar issues. The Aboriginal culture and way of life was dramatically changed with the creation of reserves, for example, by lowering their reliance on hunting and traditional foods and increasing the accessibility of market and convenience foods. This in turn has had a negative affect on the health of the population which has seen a dramatic increase in obesity, diabetes and other associated diseases. There are several factors that are working synergistically to cause the obesity and diabetes epidemic that Aboriginals are currently facing. The following literature review reveals a comprehensive picture of the Aboriginal population in Canada and the concerns they presently face with respect to healthy eating and healthy lifestyles, including the diet choices that are made, the foods and facilities that are available, as well as the role that genetics play in chronic diseases. The current study will look at the quality of Aboriginal children's diet and the impact that "other foods" may have.

2.0 LITERATURE REVIEW

2.1 Issues: Obesity and Related Diseases in Aboriginal People

2.1.1 Population Information

According to the Canadian Census conducted in 2006, there are 1, 172, 790 Canadians who identify as having Aboriginal ancestry (Statistics Canada, 2006a). Most Aboriginals reside in Ontario and the western provinces with 242, 495 in Ontario, and 196,075 in British Columbia, 188, 365 in Alberta, 175, 395 in Manitoba and 141, 890 in Saskatchewan. There are 108, 430 living in Quebec and the others are spread throughout the rest of the provinces and territories with less than 25, 000 in each (Statistics Canada, 2006a). Although there are fewer Aboriginals living in the territories, they make up a large percentage of the total population. In Nunavut, 85% of their population is Aboriginal, 50% in the Northwest Territories and 25% in the Yukon (Statistics Canada, 2006a).

The Aboriginal population is considerably younger, with a median age of 27 years, than the rest of Canada which has a median age of 40 years (Statistics Canada, 2006a). This may be due to the much more rapid pace that the Aboriginal population is growing at compared to the non-Aboriginal population. The Aboriginal population had grown by 45% between the years of 1996 and 2006, while the non-Aboriginal population only grew 8% over the same time period (Statistics Canada, 2006a). Even though the Aboriginal growth rate is much higher, they continue to have a lower life expectancy than the rest of Canadians by approximately five years (Statistics Canada, 2006a). This overall lower life expectancy shows that there may be certain health disparities that the

Aboriginals in Canada are facing that the rest of the Canadian population are not as susceptible too.

The previously mentioned numbers are only representative of Aboriginals living off-reserve. Much of the information gathered on the Aboriginal population does not include those living on-reserve. For example, the following national surveys only represent Aboriginals living off-reserve: the Canadian Census, the Canadian Community Health Survey and the Aboriginal Peoples Survey (Sheilds, 2005; Statistics Canada, 2006a). The Aboriginal population that live on the reserves are facing some similar issues, but also very different problems than the Aboriginal population that live off-reserve. There have been several studies conducted which show that the health of Aboriginals seems to be poorer than non-Aboriginals in several areas of health including higher infant mortality, lower life expectancy, as well as higher rates of mental health diseases, accidental deaths and infectious diseases (Statistics Canada, 2001a). Another large area of concern in Aboriginal populations is that they seem to be especially susceptible to obesity (Downs, Marshall, Ng, & Willows, 2008; Hanley, Harris, Gittelsohn, Wolever, Saksvig & Zinman, 2000; Horn, Paradis, Potvin, Macaulay, & Desrosiers, 2001; Katzmarzyk, 2008) as well as associated chronic diseases such as type 2 diabetes mellitus, cardiovascular disease (CVD) and metabolic syndrome (Anand et al., 2001; Anand et al., 2003; Harris et al., 1997; Liu et al., 2006; Young, Reading, Elias, & O'Neil, 2000).

Despite the lack of information available for the on-reserve population, the 2001 census reports that just under half of the North American Aboriginal population (47%)

lived on reserves (Statistics Canada, 2001a). Therefore, there is a strong need for studies looking at the health and determinants of on-reserve populations.

2.1.2 Overweight/Obesity

The prevalence of children who are overweight and/or obese varies between Aboriginal communities ranging between approximately 20 and 64% of children 9-12 years of age (Downs et al., 2008; Katzmarzyk, 2008). In comparison, 26% of the non-Aboriginal Canadian youth 2 – 17 years old are considered overweight or obese (Sheilds, 2005). According to the 2004 Canadian Community Health Survey (CCHS), the prevalence of obesity alone in children between the ages of 2 – 17 years was 15.8% in off-reserve Aboriginals, while only 8.2% of non-Aboriginal children 2 – 17 years of age were considered obese (Katzmarzyk, 2008).

Classifications of overweight or obese status are determined by the Body Mass Index (BMI; weight (kg)/height (m)^2). When calculating BMI and classifying whether someone is overweight or obese there are different cut-offs for children then there are for adults. The BMI ranges that define overweight and obesity slowly rise as age increases and are different for girls and boys up until the age of 18 years (Cole, Bellizzi, Flegal, & Dietz, 2000). For example, the International BMI cut-off for two year old boys to be considered overweight or obese are 18.41 and 20.09, respectively, and for two year old girls would be 18.02 and 19.81, respectively. For eight year old boys to be considered overweight or obese the BMI cut-offs are 18.44 and 21.60, respectively, and for eight year old girls, it would be 18.35 and 21.57, respectively (Cole et al., 2000). For males and females 18 years and older, the cut-offs are the same and are similar to adults, with a

BMI of 25 – 29.9 being considered overweight and a BMI of 30 and higher being considered obese (Cole et al., 2000; Health Canada, 2008).

Several studies have investigated the overweight/obesity prevalence in Aboriginal populations. The CCHS has attempted to use a countrywide representative sample to determine Aboriginal obesity rates; however, it only includes Aboriginals living off-reserve. Even though off-reserve Aboriginal children seem to have a lower prevalence of obesity than on-reserve Aboriginal children (CCHS, 2004; Katzmarzyk, 2008), it is still higher than non-Aboriginal children, showing that there are influences other than geographic location that are possibly contributing to higher obesity rates in the overall Aboriginal population. Rates of obesity alone in children living on-reserve have been documented as high as 45% in some reserves (Hanley et al., 2000). Aboriginals living on-reserve and those living off-reserve may share some of the precursors for obesity such as genetics (Hegle, Cao, Harris, Hanley, & Zinman, 1999, Hegle & Pollex 2005), but may differ in some of the obstacles they face. Reserves are generally in the rural northern parts of the country and away from the urban sprawl. If fresh produce needs to be transported into the community this increases the cost, while the food itself depreciates in nutritional value (as it tends to arrive in poor conditions from having to travel so far). There are certain environmental barriers that also factor into the higher rates of obesity seen such as weather and road conditions which discourage outdoor physical activity, access to physical activities facilities and equipment, as well as lack of programs available (Anand et al., 2007; Ho, Gittlesohn, Harris, & Ford, 2006).

Obesity has become an epidemic in this country and the Aboriginal population is at an even higher risk for obesity than the general population. Not only is obesity a risk

factor for the development of several other chronic diseases such as CVD, metabolic diseases and type 2 diabetes, but being of Aboriginal ancestry also increases the susceptibility for the development of these diseases (Garriguet, 2008).

2.1.3 Cardiovascular Diseases and Metabolic Diseases

Obesity has been linked to other chronic diseases, such as, the metabolic syndrome (MetS) and cardiovascular diseases (CVD) (Liu et al., 2006; Retakaran, Hanley, Connelly, Harris, & Zinmann, 2006). The MetS, defined by the National Cholesterol Education Program as disturbed carbohydrate and insulin metabolism that is clinically defined by elevated blood pressure, dysglycemia, dyslipidemia and central obesity threshold values (Expert Panel, 2001), has been identified as a risk factor for the development of type 2 diabetes (Laaksonen et al., 2002) and could also lead to CVD (Harris, & Zinmann, 2006). The risk factors for MetS include a combination of environmental (e.g., unhealthy, high caloric diet and/or a physically inactive lifestyle) and genetic factors (e.g., a genetic mutation causing insulin resistance, familial partial lipodystrophy (FPLD)). Familial partial lipodystrophy 3 is a mutation in the encoding peroxisomal proliferator-activated receptor-y (PPARG). PPARG is responsible for encoding the peroxisome proliferator-activated receptor-y (PPAR-y), which induces transcription of genes that are involved in insulin sensitivity, adipocyte differentiation and inflammation (Spiegelman, 1998). The discovery of FPLD3 has shown that there may be a genetic component to FPLD due to the influence on PPAR-y and in turn metabolism and adipogenesis (Hegele & Pollex, 2005).

Studies looking at the Keewatin Inuit and the Oji-Cree of Northern Ontario have shown that the prevalence of MetS is connected to the prevalence of diabetes and CVD

(Hegele, & Pollex, 2005). The Inuit population had a low prevalence of MetS and also a low prevalence of diabetes (Pollex et al., 2004), whereas the Oji-Cree had a high prevalence of MetS and also a high prevalence of diabetes (Pollex et al., 2006). In both populations, females were much more likely to have MetS compared to males. The Oji-Cree females with MetS typically had depressed HDL cholesterol and increased abdominal obesity (Pollex et al., 2006).

A study conducted by Retnakaran et al (2006) using the information collected from the Sandy Lake Health and Diabetes Prevalence Project, found that the inflammatory biomarker c-reactive protein (CRP) was much higher in the children in this Aboriginal community when compared to the Third National Health and Nutrition Examination Survey (NHANES III) (Retakaran et al., 2006). The subclinical inflammation seen in this isolated north-western Ontario community may be the result of obesity and may be a precursor to cardiovascular and metabolic diseases. Retnakaran et al., found that as CRP levels (i.e., fasting blood samples after an 8 – 12 hour overnight fast) increased in children aged 10 – 19 years old (n=236), there was also an increase in their cardiovascular risk profile, which includes increased adiposity, insulin resistance, and an unhealthy lipid profile (Retakaran et al., 2006). It was found that 15.8% of these children fell in the ranges of CRP levels that correspond to levels that would put adults at high risk for CVD (Retakaren et al., 2006). This study also showed as CRP levels increased, so did BMI, percentage body fat and waist circumference ($p < 0.001$). This study did not take into account whether children had concomitant infectious or inflammatory conditions that may have influenced their CRP levels. Regardless, there

seems to be a strong association seen between subclinical inflammation and childhood

obesity and there are several children within this population that are at high risk of CVD.

In North American populations there has been a steady decline in the prevalence

rates of CVD and associated diseases, while in the Aboriginal populations a trend in the

opposite direction has been seen. Between the years of 1981 and 1997 the number of

Aboriginals hospitalized for ischemic heart disease (IHD) was seen to double as

hospitalization for IHD in the rest of the Canadian population declined (Retakaran et al.,

2006). This may reflect increased accessibility to hospitals, or may also suggest that

there are factors that are affecting this population, which are not affecting the general

population.

2.1.4 Diabetes

Likely in association with the high rates of obesity, the prevalence of type 2

diabetes in Aboriginals is also very high. Diabetes in the Aboriginal population is

approximately 3 to 5 times higher than in the non-Aboriginal population (Bobet, 1998;

Harris et al., 1997).

Type 2 diabetes is a metabolic disorder in which the body has a decreased ability

to store glucose as energy resulting in high levels of blood glucose or hyperglycemia

(Type 2 Diabetes, 2009). Since insulin is the hormone that allows glucose to be picked

up by the body's cells and stored, this disease can be developed if either the pancreas

does not produce enough insulin or the body is not able to utilize the insulin that is

available (Type 2 Diabetes, 2009). This can lead to a number of other co-morbidities

such as high blood pressure, high cholesterol, atherosclerosis and other cardiovascular

diseases. Lower extremity amputations, adult blindness and end stage renal disease are

also caused through complications of living with diabetes (Nelson, Knowler, Pettitt, & Bennett, 1995; Reiber, Boyko, & Smith, 1995).

Diabetes was very rare before the 1950s but the prevalence of the disease has since increased dramatically. Type 2 diabetes was originally considered to be a disease that was developed later in life and therefore only affected adults. Around the mid 1980s, it was becoming apparent that within the Aboriginal population an increasing number of children and youth were being diagnosed with type 2 diabetes (Dean, Young, Flett, & Wood-Steiman, 1998). It is now well documented that the Aboriginal population has a much earlier onset of type 2 diabetes compared to the non-Aboriginal population (Harris et al., 1997) and that females seem to be more at risk than males (Bruce, Kliewer, Young, Mayer, &Wajada, 2003).

Risk factors for type 2 diabetes include a poor diet that is high in fat and sugars as well as lack of physical activity. Aboriginal populations are susceptible to both of these risk factors, but also face a genetic component with respect to developing type 2 diabetes. A study by Hegle et al., (1999) looked at the gene encoding hepatic nuclear factor-1-α (HNF-1 α) and its connection with the development of type 2 diabetes in Northern Ontario Oji-Cree. The study showed that a new amino acid variant, (i.e., G319S), in the gene encoding HNF-1α was found in approximately 40% of the 117 diabetic Oji-Cree subjects studied (Hegele et al., 1999). The amino acid variant, G319S, was also associated with an earlier age of onset of type 2 diabetes, higher postchallenge plasma glucose levels and a lower body mass (Hegele et al., 1999). Several other Canadians from six different ethnic groups including Caucasians, Chinese, South Asians, Africans,

9

Inuit and Ojibwa, were also studied in search of the variant G319S in which it was absent, suggesting that it is unique to the Northern Ontario Oji-Cree (Hegele et al., 1999).

There is still much to learn about specific communities and groups that are included within the umbrella term 'Aboriginal'. It is very apparent that each group, regardless of so many similarities, is very different from others. The Métis in particular are lacking data on their current health situation, but appear to resemble the First Nations people with respect to rates of diabetes (Bruce et al., 2003).

Gestational diabetes mellitus (GDM), which is impaired glucose tolerance during pregnancy, is also a concern for Aboriginal women. Aboriginal women have a higher rate of GDM compared to non-Aboriginal women (Dyck, Klomp, Leonard, Turnell, & Boctor, 2002). This is also linked to the development of type 2 diabetes as women who have GDM are at a greater risk to develop type 2 diabetes and so is their child (Rodrigues, Robinson, & Gray-Donald, 1999). One of the first prospective studies to look at the rates of GDM in Aboriginal women (n=252) and non-Aboriginal women (n=1,360), found that the rates of GDM were 11.5% for Aboriginal women and 3.5% for non-Aboriginal women overall and 6.4% and 3.7%, respectively, for women living within the Saskatoon Health District (Dyck et al., 2002). It was also shown that Aboriginal ethnicity is an independent predictor of GDM with Aboriginal women having two times the risk after adjustment for all other variables (Dyck et al., 2002).

This interconnecting web of obesity, diabetes, and cardiovascular disease and the increasing number of Aboriginals who are suffering will no doubt cause a strain on the communities and the health care system in the coming years. Prevention in the youth population is a key component to lowering the incidence rates as well as the prevalence

rates in this population, which seem to continue to increase. There are several factors that work synergistically to contribute to the high rates of obesity, type 2 diabetes and other associated health risks. These include genetics, shifts away from their traditional lifestyle, food insecurity and nutritional concerns, physical inactivity and environmental barriers (Dyck, 2005; Hanley et al., 2000; Horn et al., 2001). Therefore, in order to grasp the entire picture, the following will try to encompass and describe the main determinants involved.

2.2 Determinants of Health

2.2.1 History of Diet Change

The traditional diet of Aboriginal people stemmed from the process of hunting and gathering their food (Willows, 2005). The animals and vegetation that were available in their immediate surroundings determined what they ate. The physical hunt was very much a part of their lifestyle as well as dealing with the climate such as extreme cold. This meant that their daily activities were calorically demanding and therefore required a large amount of food to fill that demand. However, due to the unreliability of hunting and the different seasons, food was not always available in abundance. It has been thought that Aboriginals, especially young women and their children, have a natural tendency for their bodies to conserve calories as they were faced with periods of feasting and famine (Dyck, Klomp, & Tan, 2001). This may have caused a natural adaptation in genetics, which was passed on through to present generations.

As reserves and permanent settlements began to emerge in the second half of the 20th century, much of the traditional lifestyle of the Aboriginals was lost. Often the

11

Aboriginal people were enticed to settle on the reserves in exchange for starchy, non-perishable type foods such as rice, wheat, and potatoes. The idea of not having to worry about when the next kill would be made or whether there were enough berries to be picked was very attractive. Along with the food offerings, they were also offered work on the local ranches (Tombs, 2004a). They no longer needed to hunt or fish for their food, which reduced the amount of daily physical activity. At the same time, store bought food was readily available for them to purchase (Anand et al., 2001; Tombs, 2004a). It was a relatively fast lifestyle change for the whole population and it is thought that there was not enough time for their genetic makeup and their natural tendency of preserving calories to change with them. Therefore, the instant access to food and the dramatic decrease in physical activity has possibly caused a shock to their bodies and ultimately, may have contributed to the high increase in the number of Aboriginals suffering from obesity, type 2 diabetes and the associated chronic diseases (Gittlesohn et al., 1998; Kriska, Hanley, Harris, & Zinman, 2001).

Solomon Awashish, a chronic disease prevention officer for the Cree Board of Health and Justice in James Bay Cree Territory, explains it from a more personal perspective: "[The government] told our people, 'If you stop hunting, and you live in the community year-round, we're going to give you some houses and we're going to give you jobs.' [So they stopped hunting] and now they have a shack. They took away our traditional food – our moose, our bear, our goose – and gave us bologna and klick [Spam]." (Tombs, 2004a).

2.2.2 Food Insecurity

Although there was an increase in the amount of food readily available to the Aboriginals when they were placed on reserves, it was very different from their traditional diets and did not support a balanced diet. The foods that have become staples in their diet are largely processed foods that are high in fat, sugar and/or salt and low in nutrients (Downs et al, 2008; Taylor et al., 2007). Reserves are mainly placed in parts of the country that are remote and do not have fertile soil. They are often in very northern parts of the country where it is difficult to grow fresh food and because they are often so remote, the cost of shipping in fresh food is not economically feasible. This lack of availability of affordable nutritious foods has caused a state of food insecurity. Food insecurity can work on a continuum that ranges from complete depletion of food stores to being uncertain about where the next meal will come from (Che & Chen, 2003). It can be defined as, "whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in a socially acceptable way is limited or uncertain.", as discussed in Che & Chen (2003).   In 2004, 8.8% of the entire Canadian population (or 2.7 million people) lived in food insecure households (CCHS, 2004). Aboriginal populations are at a higher risk with 33.3% of off-reserve households dealing with food insecurity compared to 8.8% of non-Aboriginal households being food-insecure (CCHS, 2004). When comparing the lowest, lower middle, middle, upper-middle and highest income categories, the percentage of households experiencing food-insecurity decreased as income increased (48.3%, 29.1%, 13.6%, 5.2% and 1.3% respectively) (CCHS, 2004).

In an often-misunderstood relationship, food insecurity is very closely connected to obesity (Che & Chen, 2003). There are several reasons why this connection is seen,

such as food insecure people tend to choose foods that are higher in calories or have a high energy density, binge eating when food is available, and going through periods of famine when food is not as readily available. Additionally, the fact that it is often simply more expensive to purchase healthy foods than the less nutritious processed foods. For example, a 2004 report found that four litres of milk in a Northern Aboriginal community can cost as much as $15 (Tombs, 2004a) compared to an average of $5 for the same milk here in Southern Ontario.

The link between food insecurity and obesity is also seen when contrasting the statistics. According to Statistics Canada's National Population Health Survey in 1998/99, approximately 15% of food insecure households contained residents who were considered to be obese which was significantly higher than the food secure households with 12% of them containing obese habitants (Che & Chen, 2003). The overall higher rates of obesity seen in Aboriginals, as discussed in the previous section (1.2 Obesity), coincides with their overall higher rates of food insecurity.

2.2.3 Foods that are Available and Food Choices that are Made

Certain healthy foods such as vegetables and fruits and foods high in fibre have been shown to have protective effects against obesity (Merchant et al., 2005; Rolls, Ello-Martin, & Tohill, 2004), and diabetes and impaired glucose tolerance (Gittlesohn et al., 1998). The inclusion of these types of foods into the diet on a regular basis can be very beneficial.

It has been well documented that the diets of Aboriginals largely contain high calorie dense and low nutrient dense foods such as sweetened beverages, french fries and processed foods (Downs et al, 2008; Taylor et al., 2007). It has also been well

14

established that they lack high fibre foods such as vegetables and fruits (Downs et al., 2008; Harvey-Berino et al., 1997; Taylor et al., 2007). For example, in a study conducted in the Mi'kmaq reserve in Prince Edward Island, out of 55 children, only one child reported consuming the minimum recommended amount of vegetables and fruits of five servings per day (Taylor et al., 2007). In general, the nutritional concerns seen in Aboriginal children are similar to those seen in non-Aboriginal children but there are a few key differences in the diets such as higher french fry and sweetened beverage consumption (Downs et al., 2008; Gittelsohn et al., 1998; Hanley et al., 2000; Taylor et al., 2007).

A recent study in a Northern Quebec Cree community in grades four to six found that children who ate three or more daily servings of vegetables or fruits were less likely to have central adiposity (CA); however, only approximately 16% of children actually consumed three or more vegetables and fruits (Downs et al., 2008). The number of servings of vegetables and fruits consumed by children with no CA was 1.7 ± 1.3 and was 1.3 ± 1.1 for children with CA ($p = 0.012$). Eating more than three servings of vegetables and fruits a day had an unadjusted odds ratio of 0.419 (confidence interval = 0.182, 0.961) and when adjusted for age and sex had an odds ratio of 0.426 (confidence intervals 0.184, 0.985) (Downs et al., 2008). Therefore, this shows the importance of vegetable and fruit consumption.

The location of food preparation and consumption may influence the nutritional value found in those foods. When people eat meals outside of the home, they tend to consume a higher percentage of fat, sugar and salt compared to homemade meals (O'Dwyer, McCarthy, Burke & Gibney, 2005). It has been shown that when a group of

grades six, seven and eight students from various locations in northern and southern Ontario and Nova Scotia, ate meals that were prepared outside the home (ie., fast food, restaurants, convenience store, vending machine or other) had diets that were lower in quality (Woodruff & Hanning, 2009a). In several of these northern communities there are very few, if any, fast food restaurants. However, The Northern store is a type of convenience store that is in almost all of these communities and is often the main (and sometimes, the only) source of not only food, but also of all other everyday necessities.

There is a very clear consensus with respect to what type of diet will prevent obesity in children and will help to reduce the prevalence of obesity in Aboriginal populations. Increasing vegetable and fruit consumption, as well as decreasing the amount of high-fat/high-sugar, low nutrient dense snack foods and adopting a diet closer to what is recommended by Eating Well with Canada's Food Guide (2007) would aid in the fight against the obesity epidemic (Receveur, Morou, Gray-Donald & Macaulay, 2008; Taylor et al., 2007). It seems like a fairly straight forward plan to implement however, there are other factors at work that prevent Aboriginals from adopting a diet such as this. Presenting the knowledge and the information on how to achieve a balanced diet and therefore achieve a healthy weight is the first step of action that needs to be taken. There is still a large need for the discovery of information that explores the specific restraints faced by the Aboriginal population. Advising people what changes to make in order to be healthier is the first step to helping them, but if they do not have the physical means of incorporating this knowledge into their daily lives then no changes can or will be made. Relevant information, programs, policies and research can help to provide additional and necessary opportunities to this population.

2.3 Behaviours That May Protect or Contribute to Problems: What is Known

   2.3.1 Eating a Traditional Diet vs. a Store Bought Diet

Hunting, fishing and gathering is a large part of the traditional Aboriginal lifestyle. Diets traditionally included wild game such as moose, caribou, beaver and goose, as well as berries and local vegetation. The placement of Aboriginals onto reserves in the remote northern parts of Canada had a large impact on the foods that were available to them and the foods that they included in their diet. The extreme cold and northern location of many of the reserves has made for land that was not ideal for farming and that did not have an abundance of wild game and vegetation. Convenience and store bought foods, such as, processed and pre-packaged foods displaced the traditional foods (Kuhnlein & Receveur, 2007).

The current status of Aboriginal children's diets tends to be low in several vitamins and minerals such as vitamin A, vitamin D, folacin, iron, calcium, fibre, low in vegetables and fruits, and high in sugar and fat (Jimenez et al., 2003; Kuhnlein & Receveur, 2007; Willows, 2005). This is due in part to the decrease in traditional food intake and increase in store bought, processed foods.

The inclusion of traditional foods in the diet seems to work on an age gradient with older Aboriginals consuming the most and young children consuming the least (Kuhnlein & Receveur, 2007; Willows, 2005). A recent study by Kuhnlein and Receveur (2007) looked at three surveys conducted over two seasons which consistently showed that Canadian Arctic Indigenous adults are consuming more traditional foods ranging from 17 – 28% of their diets, while their children's range was much smaller at 0.4 – 15% of total energy (Kuhnlein & Receveur, 2007). The study used a list of traditional foods in

comparison with a list of purchased market foods, both lists were compiled with input

from the community members. This study also showed that the more traditional foods

that were consumed, the more likely the dietary recommendations were met for several

nutrients including protein, iron, zinc, copper, magnesium, phosphorus, potassium,

vitamin E, riboflavin, and vitamin B-6 (Kuhnlein & Receveur, 2007). This does not

come as a surprise, considering that approximately 55% of the children's total energy was

provided by foods characterized as fat (21%), sweet (20%), and mixed savoury dishes

(14%) which are all considered market foods. When children's diets are lacking in

traditional foods, they tend to be consuming much more fat and sugar as a percentage of

their energy (Gittelsohn et al., 1998; Kuhnlein & Receveur, 2007). As children become

further removed from traditional foods they become more vulnerable to obesity and

related diseases. However, re-introducing traditional foods into Aboriginal children's

diets seems promising as the majority express a preference for traditional foods (Willows,

2005). Encouraging traditional diets and limiting processed and store bought foods may

contribute to the prevention of nutrient deficiencies and obesity.

2.3.2 Physical Activity

Nutrition and the foods that we eat are a large determinant of our weight and

health. However, another component, which may be just as important, is physical

activity. It is well documented in the Aboriginal population that physical activity aids not

only in weight loss but also in the prevention of weight gain (Downs et al., 2008; Hanley

et al., 2000; Horn et al., 2001; Katzmarzyk, 2008).

As mentioned earlier in section 2.1, when Aboriginals were moved to reserves

their lifestyles changed dramatically in a relatively short period of time. They went from

being physically active on a daily basis as a way of survival, such as hunting and trapping, to leading a fairly sedentary lifestyle (Hanley et al., 2000; Liu et al., 2006). "Hunting today is a little different, I remember my dad used to go for half-day walks hunting, and he'd come back with 20 ducks or something around his belt. [Today] our food sources are so scarce and people don't want to go hunting anymore, but if they do, they usually just drive their vehicle, open the window, shoot out the car or truck and then shoot the moose." recounts Kathleen Cardinal, a program co-ordinator for the Aboriginal Diabetes Wellness Program in Edmonton (Tombs, 2004a). As hunting is no longer a means of survival and is practiced less often, other forms of physical activity need to be implemented in their daily lives.

When physical activity becomes a regular part of a child's life, it will more likely be a part of their lives in adulthood as childhood is an important time when lifelong habits are formed (Centre for research in girls and women in sport, 1997). There are certain demographics that have been found in correlation with physical activity participation among Aboriginal children. Typically girls are less active than boys (Findlay& Kohln, 2007; Horn et al., 2001), children with less educated parents, that come from single parent households, and that live on the reserve are also less active then children who have parents with a higher education level, live in a two parent household and who live off –reserve (Findlay & Kohln, 2007). Aboriginal children who are overweight or obese tend to spend more hours watching television and less time being physically active (Adams, Receveur, Mundt, Paradis, & Macaulay, 2005; Hanley et al., 2000; Horn et al., 2001; Kuperberg & Evers, 2006). There is a greater chance that

healthy body weight will be achieved the more time that is spent being involved in physical activity and the less time that is spent being sedentary watching TV.

Environmental and financial barriers and opportunities are a few of the major deterrents of physical activity in the Aboriginal youth population (Tombs, 2004a). In a study investigating the Cree in Attawapiskat, Ontario, 61% of the children surveyed were active two times or less in the previous seven days (Sutherland, Skinner, Hanning, Montgomery, & Tsuji, 2007). However, if more sporting activities were available through their schools, 79% said they would participate more and 85% of children would participate in more sporting activities if they were offered outside of the school (Sutherland et al., 2007).

Environmental barriers include cars and dusty roads, unleashed dogs roaming the community, and overall lack of safe environments available to exercise in (Anand et al., 2007; Ho, et al., 2006). This implies that more organized sports and activities for children need to be implemented inside and outside of the school. The provision and promotion of safe and affordable activities would seem to increase the number of children involved in them. There have also been surveys conducted to determine which sports Aboriginal children would like to participate in if they had the opportunity. The top choices tend to be hockey, jogging, walking, ice-skating, active games, soccer and basketball (Sutherland et al., 2007).

2.3.3 Decreasing Poverty and Increasing Education

The differences observed in the Aboriginal population and the non-Aboriginal population with respect to obesity, chronic diseases and physical activity levels, may be due to disparities in education and poverty. An estimated 50% of all Aboriginal children

are living in poverty (Health Canada, 2000), compared to approximately 16% in the general population (Petten, 2005a).

According to the 2006 Canadian Census, only 58% of Aboriginal children lived with both parents (Statistics Canada, 2006a) compared to 83% of non-Aboriginal children (Statistics Canada, 2001a). Aboriginal children are also less likely to live in desirable living conditions. As of 2006, 28% of Aboriginals lived in houses that were considered to need major repairs compared to 7% of the non-Aboriginal population (Statistics Canada, 2006b). Aboriginals are also more likely to live in homes that are considered crowded at 15%, with only 3% of non-Aboriginals living in these crowded conditions (Statistics Canada, 2006b). These types of housing issues cannot only cause emotional stress, but financial stress as well. If homes are in need of major repair and cannot be taken care of, there may be less justification for spending extra money on more expensive healthy food options or extra-curricular sporting events.

The further away the community is, the more expensive the market foods are, as they need to be transported farther distances. As reviewed by Skinner and Hanning (2005), the food is often sent in by truck or boat, but sometimes airplane is the only available mode of transportation into the community, which makes the shipping costs much higher, resulting in an increase in the cost to purchase those foods (Skinner & Hanning, 2005). Yet, the cost is not the only limiting factor; the shelf life of the foods also plays a role in deciding whether or not to purchase it. Fresh vegetables and fruits often will not last the length of the trip or tend to go bad shortly after arriving. The inconsistent access to these foods can also be an issue to incorporating them into a diet.

This makes processed and pre-packaged foods the more frequent choice as they have much longer shelf lives (Skinner & Hanning, 2005).

2.3.4 Determining a Universal Comparison of Healthy Diets

The Aboriginal population faces many different obstacles with respect to obtaining healthy foods and incorporating them into their diets. Not only are there different barriers to healthy eating between on-reserve and off-reserve Aboriginals, but also different barriers seen from community to community. The variations in eating patterns can make it difficult to compare the overall diets seen in the communities, not only between Aboriginal communities but also with other Canadian populations.

The current dietary recommendations are provided in the Eating Well with Canada's Food Guide (Health Canada, 2007). There is a version of the food guide for First Nation, Inuit and Metis people, however, the main difference is the layout and look of the guide; the recommendations are the same for all of the versions of the food guide. The recommendations are made in order to educate people on healthy eating with the ultimate goal of improving their quality of life and preventing chronic diseases (Health Canada, 1997). By having a measure of dietary quality that is a reflection of the national recommendations, comparisons can be made easily between studies and populations. It would allow for further exploration of the role that social inequalities and environmental barriers play in the obtainment of a nutritious diet. A diet quality index takes into account the whole diet and compares it to the national guidelines.

There are several healthy eating indices that have already been developed such as Patterson's Diet Quality Index (Patterson, Haines, & Popkin, 1994), Huijbregts' Healthy Diet Indicator (Huijbregts et al., 1997) and the Healthy Eating Index (Kennedy, Ohls,

Carlson & Fleming, 1995 and Guenther, Reedy, &Krebs-Smith, 2008). There have not been any diet quality indicators that have been validated using an on-reserve Aboriginal population, however, the diet quality indicators have been validated using a wide variety of people. The Healthy Eating Index seems to be the best diet quality indicator to use on the Canadian population as validated by Dubois, Girard & Bergeron (2000) and has since been altered by Glanville & McIntyre (2006) to better fit with the Canadian nutritional guidelines.

The Canadian version of the Healthy Eating Index (referred to as HEI-C) has been used in previous studies and has proven very useful. Glanville and McIntyre (2006) used the HEI-C when looking at the diet quality of single mothers of low-income and their children living in Atlantic Canada. They collected 24-hour diet recalls and then calculated HEI-C scores using the nutritional recommendations set out by Canada's Food Guide to Healthy Eating. Their results showed that not one of the low-income mothers had a diet that fell in the "good diet" category and that the younger children had better quality diets than older children. Since the HEI-C takes into consideration the whole diet being consumed, the findings can be used and compared at a population level. There are other ways of analysing the quality of a diet such as looking at specific food group or nutrient inadequacies, however, while considering the entire population and trying to assess healthy eating, it is a more comprehensive and useful approach to include the whole diet. The HEI-C also compares intakes to the current recommendations, whereas the other approaches do not.

Another example of the use of the HEI-C is in a study conducted by Woodruff, Hanning, Lambraki, Storey & McCarger (2008) that looked at the weight concerns,

23

dieting in order to lose weight, and meal skipping of adolescents. Woodruff et al. (2008) found that those teenagers, who were dieting, concerned with their weight, and those who skipped breakfast were more likely to have a lower HEI-C score. This further shows how the use of a diet quality index can help to explore and understand nutritional issues at a population level and can help to explain social impacts on healthy eating.

2.4 Problems That Seem Amenable to Change

2.4.1 Sweetened Beverage and French Fry Consumption

There is much concern with the amount of sweetened beverages that Aboriginal children are consuming. Several studies have linked the high rates of overweight and obesity seen in Aboriginal children with the intake of sweetened beverages (Downs et al., 2008; Gittelsohn et al., 1998; Ludwig, Peterson, &Gortmaker, 2001; Taylor et al., 2007). Sweetened beverages such as soda pop, juices, and kool-aid type products contain high amounts of sugar. They are energy dense and contain little nutrients, which make them empty calories that do not contribute to the health of the child and only raises their caloric intake. Children in the Kahnawake community consumed a large amount of added sugar, which was mainly contributed by soft drinks (Adams et al., 2005). Those children who consumed less sugar in Kahnawake were more likely to have a lower BMI (Adams et al., 2005). A study conducted by Downs et al (2008), looked at a group of 9 – 12 year old Aboriginals, in which 52.2% had CA, of those children 2.2% were normal weight children, 35.7% of overweight children and 97.4% of obese children. It was found that sweetened beverage intake was positively correlated with their waist circumference (r=0.250, p=0.016).

Arguably, high-energy, low-nutrient dense drinks are thought to be replacing more nutritious drinks. A child who consumes a higher amount of milk may tend to drink less soft drinks and less drinks containing high sucrose content (Adams et al., 2005) or vice versa, the consumption of sweetened beverages displaces the consumption of milk. Having a low calcium and milk intake seems to be a particular concern for Aboriginal children (Adams et al, 2005; Bernard, Lavallee, Gray-Donald, & Delisle 1995). Calcium inadequacy has been documented as high as 60% in northern Cree children (Wolever et al, 1997b). The perishable nature of milk and dairy products may contribute to the low intake seen in Aboriginal communities. However, having a higher intake of milk and dairy products may be associated with the achievement of a healthy body weight (Adams et al 2005, Bernard et al 1995). A group of 144 Cree schoolchildren in grades 4, 5, 8 and 9 found that the overweight children consumed a significantly lower amount of milk products compared to the children in the normal weight category (Bernard et al, 1995), which may be, in part, credited to a decrease in sweetened beverages.

Some studies have suggested that another food item linked with overweight and obesity in Aboriginal children is french fries (Receveur et al., 2007; Taylor et al., 2007; Trifonopoulos, Kuhnlein, & Receveur, 1998). In the Mohawk community of Kahnawake, french fries were one of the top three contributors to fat intake (Trifonopoulos et al., 1998). French fries were also the most frequently reported vegetable eaten by children in grades 4 – 6 (Trifonopoulos et al., 1998). There are two fatty acids, stearic and palmitic, that tend to be found in large quantities in french fries and potato chips. These two particular fatty acids have a very low oxidation rate and

therefore, regardless of overall energy intake they have been connected to weight gain in humans (DeLany, Windhausser, Champagne, & Bray, 2000; Kien, Bunn, & Ugrasbul, 2005).

The common factors of low intake of vegetables and fruits along with a high intake of "other" foods have been observed in Aboriginal populations, which are similar to the Canadian population as a whole (Garriguet, 2008 & Garriguet, 2006). There needs to be more research that investigates the concerns relative to and within the context of the Aboriginal diet, population and across communities in order to investigate them with respect to the whole diet.

2.4.2 Overall Nutritional Changes

Several studies have shown that consuming more vegetables and fruits, as well as having a diet high in fibre are linked to Aboriginal children being a healthy weight and less likely to have diabetes (Downs et al., 2008; Hanley, et al., 2000; Wolever et al., 1997). Data from the 2004 CCHS show that children and adolescents who consumed less than the minimum recommendation of five servings of vegetables and fruits/day were significantly more likely to be overweight and or obese compared to the children and adolescents that ate a higher number of vegetables and fruits/day (Sheilds, 2005). Due to an abrupt change in lifestyle, Aboriginals have had a rapid diet shift that now includes processed, high-fat and high sugar foods compared to their traditional diet (Wolever et al., 1997).

Foods that are plant based have antioxidant components, folate, n-3 polyunsaturated fatty acids, and L-arginine which may help to protect against inflammation and endothelial damage that is seen in people with CVD or MetS (Brown &

26

Hu, 2001). A study involving 171 Australian Aboriginals showed an inverse relationship between dietary antioxidants and vascular inflammatory markers (Rowley et al., 2003). The lack of nutritious foods, such as vegetables and fruits, in the diet is thought to contribute to the inflammation associated with CVD and MetS (Rowley et al., 2003).

The obvious answer to improving overall health and achieving a healthy weight is to include a variety of nutritious foods and to limit the intake of high calorie, non-nutritious foods. However, people can have all of the nutritional information that they need to eat healthy, and stay in their normal weight range which may reduce the risk of developing chronic diseases, but if they do not have the physical means to do this, the nutritional information may not be that useful. The provision of fresh vegetables and fruits in a way that makes them physically and financially available to all is also needed. There are also other things to consider when trying to understand why people choose the foods they do. Factors such as taste, cost, time of preparation, seasonality, peer-pressure, commercials and advertisements, cooking skills and social norms have all been shown to influence the foods that Aboriginals choose to purchase and eat (Pierre, Receveur, Macaulay, & Montour, 2007).

2.4.3 Increase Amount of Physical Activity and Resources Available

Physical activity is another well-established approach to supporting healthy weights (Bernard et al., 1995; Downs et al., 2008; Hanley et al., 2000; Horn et al., 2001; & Katzmarzyk et al., 2008). The opportunities to participate in sports and activities for Aboriginal children are limited. This is due to environmental as well as financial barriers, as mentioned in section 4.3 Physical Activity Levels. There have been several grass roots programs that have offered a chance for children to be more physically active.

This includes programs such as BOOST, which was started in St. Mary's First Nation School in New Brunswick. The program encourages healthier eating and physical activity while emphasizing feeling good. The community health nurse at the school became concerned about the obesity rate at the school and was troubled that there was no structured physical education program in the school (Tombs, 2004b). There have been several other programs like this one that have started at the community level such as The Sunshine and Raine Society boxing program in Regina (Young, 2005), the Swing into Action golf program in Calgary (Laskaris, 2007), and the Little Wolf basketball program in Batchewana, Ontario (Petten, 2005b). By offering more opportunities and programs, children may be able to increase their participation levels.

2.4.4 Prevention: Children and Obesity

Weight gain can occur when energy intake exceeds energy expenditure. Excess calories that are ingested and not burned are ultimately stored as fat in the adipose tissue. Fats cells are capable of expanding in size as well as in number as required by the body. As energy expenditure exceeds energy intake fat cells will decrease in size, however, they do not decrease in number (Whitney & Rolfes, 2008). In a study conducted by Spalding et al., (2008) it was shown that childhood and adolescence are critical times for the establishment of the number of adipose cells that a person will have in adulthood. Spalding et al. (2008) found that even though the total fat cell number increased in childhood and adolescence, the numbers were constant in obese and lean adults. Spalding et al., (2008) also investigated how bariatric surgery would affect fat cells. The surgery was successful in decreasing fat cell volume and BMI, however, two years post-surgery the number of adipocyte cells was not lower than they had been prior to the

surgery. This indicates that by early adulthood the number of adipose cells has been set and is tightly regulated. It also shows that weight gain and loss are controlled by the changing of the volume of adipose cells (Spalding et al., 2008). Therefore, someone who has already developed a high number of fat cells and is overweight or obese will have a harder time losing weight and keeping it off compared to someone who is at a healthy weight and trying to maintain it. Overweight and obesity tend to track into adulthood significantly increasing their chances of becoming an overweight or obese adult.

Adolescence is a time of growth and development which requires slightly more energy, however, if too much energy is consumed it will be stored as fat and more fat cells than needed will be created (Whitney & Rolfes, 2008). It is much harder to maintain a healthy weight after one has already been overweight, then to remain at a healthy weight if a person has not been overweight previously (Splading et al., 2008). This is why prevention in children and adolescents is so important.

Introducing children to new lifestyle habits is much easier than adults who tend to exhibit consistent health behaviours. By helping them to develop healthy eating and physical activity patterns at a young age, they will more likely persist into adulthood (Kelder, Perry, Klepp, &Lytle, 1994; Stone, Baranowski, Sallis, & Cutler, 1995).

As mentioned in Section 1.1, the Aboriginal population is younger than the non-aboriginal population with one third of the population being 14 years of age and younger according to the 2001 census (Statistics Canada, 2001a). By targeting Aboriginal youth in interventions, the largest group will benefit.

3.0 Study Rationale and Objectives

3.1 Rationale

The prevalence of childhood obesity is on the rise throughout all of Canada (Sheilds, 2005), especially in the Aboriginal populations (Downs et al., 2008; Katzmarzyk, 2008). These growing rates of obesity are contributing to the increased incidence of chronic diseases that have also been seen in Aboriginal children. There are several contributing factors to this problem, but at the root it is an issue of positive energy balance due to an increase in sedentary activities, decrease in physical activity and an adaptation to unhealthy diets in recent years.

Even though it is known that obesity and related chronic diseases are major concerns in the Aboriginal population, there is very little information on obesity and diet of children living on-reserve. The limited evidence suggests that Aboriginal children share many of the same dietary risk factors as non-Aboriginal children (such as, low intake of vegetables and fruits, and an increased percentage of total energy from "other" foods). Moreover, the limited data available suggests Aboriginal children may have additional areas of dietary concerns, specifically higher intakes of sweetened beverages, higher intakes of high fat snack foods such as french fries, and, possibly in relation to the sweetened beverages, a lower intake of milk products.

There is a desire from the communities to obtain information that is specific to their own population and that explains problems relevant to them. Between November 2003 and June 2009, data using 24 hour diet recalls and food frequency were obtained, using a First Nation validated web-based survey, from the communities of Georgina Island, Christian Island, Fort Albany, Attawapiskat, Peawanuck, Moose Factory, Ouje-

Bougoumou and Kashechewan. Having these recent data provides a unique opportunity to look at the factors associated with the different types of diets these children are consuming. The approach of this study is to use these data to investigate the consumption of "other foods" and how they are linked to overall diet quality and overweight/obesity.

3.2 Study Objectives:

The overall goal of this research is to contribute to lowering the incidence and prevalence rates of obesity and type 2 diabetes in the Aboriginal youth population. This research will investigate how "other foods" are contributing to eating patterns and overweight/obesity in these communities.

Using data on food intake and food related behaviour of on-reserve Aboriginal students, the specific objectives of the study are:

1) To describe the quality of the children's diets using the HEI-C and to assess differences in HEI-C by sex, grade, survey location and season where the conditions are comparable.

Determine associations between the

2) Child's HEI-C score and

a) Body Mass Index (BMI) as a categorical variable (obese, overweight or other (children with a BMI lower than lower than the overweight category)) and as a continuous variable

b) The consumption of "other foods" based on i) the percent energy from "other foods" using the 24 hour recall and ii) the percentage of variability in the HEI-C score will be assessed by looking at contribution of all of the components

c) The consumption of traditional foods such as moose, goose and duck based on the food frequency questionnaire and

d) The frequency of eating outside of the home such as from convenience stores, school cafeteria (including pizza days, etc.), fast food restaurants, other snack bars and vending machines and

e) The latitudinal location of their community.

The associations will control for sex, grade, season and location if needed. Season and year will be controlled for through pairing of the data sets. Surveys that were conducted in the same year and season will be grouped together.

3.3 Hypothesis:

It is hypothesized that the following outcomes will be seen when the data are analyzed:

a) It is expected that as the child's HEI-C score decreases their BMI will increase.

b) Eating a higher number of "other foods" may lead to displacement of healthier foods in a child's diet; therefore, the HEI-C score will decrease as the intake of "other" foods increases.

c) The increased consumption of traditional foods will be positively associated with the HEI-C.

d) As the frequency of eating outside of the home increases, it is expected that the child's HEI-C will decrease.

e) It is expected that the more remote and further north the community, the higher the child's HEI-score will be.

4.0 Data Sets and Sample Population:

4.1 Data Sets

The data sets are summarized in the table below.

Community	Date Collected	Season Collected	# of Children	Grade Range	Gender Distribution
Georgina Island	Dec 8, 2003	Winter	12	Gr 6 – 8	6 females 6 males
Christian Island	Oct 18 – 20, 2004	Fall	44	Gr 6 – 8	19 females 25 males
Fort Albany	Nov 10-13, 2004	Fall	63	Gr 6 – 11	35 females 28 males
Fort Albany	Dec 12 – 13, 2007	Winter	37	Gr 6 – 10	22 females 15 males
Fort Albany	June 2009	Spring	30	Gr 6 – 8	20 females 10 males
Attawapiskat	Feb 22, 2006	Winter	62	Gr 6 – 9	34 females 28 males
Peawanuck	Dec 2005	Winter	11	Gr 6 – 8	7 females 4 males
Moose Factory	Feb 20-23, 2007	Winter	84	Gr 7 – 12	39 females 45 males
Ouje-Bougoumou	April 24, 2007	Spring	35	Gr 2 – 11	13 females 22 males
Kashechewan	June 2009	Spring	44	Gr 6 – 7	18 females 26 males

Table 4.1 – Subject Characteristics from Available Datasets

4.2 Community Profiles:

4.2.1 Georgina Island

Georgina Island is a Chippewa's First Nation community for which Ojibway is the traditional native language. It is located approximately one hour north of Toronto off of the east shore of Lake Simcoe at a latitude of 44º 23' 59" N (National Resources of Canada, 2007). It is made up of the following three islands; Snake, Fox and Georgina

(Aboriginal Communities, 2009). The land area is approximately 14.55 square km (Statistics Canada, 2006a) and the closest urban centre is the Village of Sutton (Aboriginal Communities, 2009). Access to the island is by Aazhaawe, a car ferry, in the spring and summer and once the water of Lake Simcoe begins to freeze travel is by the airboat. In the winter months when the ice has formed, residents will walk across or drive all terrain vehicles and snowmobiles across and can also drive cars across when the ice is thick enough (Aboriginal Communities, 2009).

The population in the 2001 Census was 273 and in the 2006 Census the population was recorded as 353 which is a 29.3% increase (Statistics Canada, 2006a). The community includes a police station, community centre, administration office, fire station and ambulance service, Library, Health Centre, water treatment plant, a public works building, landfill site, United Church and graveyard, the Georgina Island School (grades JK – 5) and the Niigan Naabiwag Daycare Centre (Aboriginal Communities, 2009).

The health centre offers several programs to the community focusing on diabetes and nutrition; a diabetic screening program, a diabetic support group, and a Take Action Now Diabetes Program, community gardens, community kitchens, and a Weight Watchers program. There are several family support programs such as Healthy Babies, Healthy Children Program, breast feeding support and Parenting Workshops in the community. The school also has breakfast program for the children (Aboriginal Communities, 2009). Children in grades 6, 7, and 8 generally attend Morning Glory Public School (part of the York Region District School Board and is located off –reserve in Pefferlaw, ON), which is where the survey was conducted.

As of 2006, there were 548 private dwellings with only 129 private dwellings occupied by usual residents (Statistics Canada, 2006a). The population density per square kilometre was 24.3 compared to 13.4 for Ontario (Statistics Canada, 2006a). There were no further statistics available from the 2006 census.

4.2.2 Christian Island

This Beausoleil First Nation community is home to Chippewa people whose traditional Native language is Ojibway. It is located on the southern tip of Georgina Bay on Christian, Beckwith and Hope Islands (Beausoleil First Nation, 2009). The islands are approximately an hour and a half north of Toronto, 3 km from the mainland and 65 km from Barrie (Beausoleil First Nation, 2009) at a latitude of 44º 47' 59" N (National Resources of Canada, 2007). There are two ferries that service the island, the M.V. Indian Maiden which is a passenger only vehicle that can carry 70 people and the M.V. Sandy Graham which can carry 98 people and 28 vehicles (Beausoleil First Nation, 2009). The island has a fire department, paramedics, a United Church (Aboriginal Communities, 2009), and an elementary school which goes from JK to grade 8.

In 2006, the population was 584 which was a 13.4% rise from the 2001 population of 515 (Statistics Canada, 2006a). There were 434 total private dwellings with 188 occupied by usual residents (Statistics Canada, 2006a). It has a land area of 52.13 square kilometres with a population density of 11.2 per square kilometre compared to 13.4 per square kilometre for Ontario (Statistics Canada, 2006a).

The median age of the community is 27.7 years, which is considerably younger than Ontario which has a median age of 39.0 years (Statistics Canada, 2006a).

4.2.3 Fort Albany

Fort Albany is located on the west coast of the James Bay along the Albany River and is part of the James Bay Cree. It is located at a latitude of 52º 19' 59" N (National Resources of Canada, 2007). The Cree people here are part of the Muschkegowuk Tribal Council and the Native language is Cree. According to the 2006 Census, the population was 1,805 which was a large increase of 309.3% from the population counted in the 2001 Census of 441 people (Statistics Canada, 2006a). There are 357 private dwellings, which 339 are inhabited by usual residents, on 3.31 square kilometres of land (Statistics Canada, 2006a). This means that the population density is 545.1 per square kilometre (Statistics Canada, 2006a). These numbers may be skewed as the Census may be including the community of Kashechewan which used to be part of Fort Albany but separated several years ago. The approximate population of Fort Albany alone is currently 850 people.

Fort Albany is a remote community which is accessible mainly by air year round and by the ice/winter road in the winter months. The children in the community attend The Peetabeck Academy, which is an elementary and a secondary school that includes grades JK to 12. The community also has a Northern Store that sells a variety of necessities, a restaurant located in a local couple's house that is intermittently open, a hospital, a health centre, an airport, a water treatment plant, a police station, and two convenience stores/gas stations. There is also an outdoor hockey rink that is flooded in the winter months.

4.2.4 Attawapiskat

Attawapiskat is located approximately 130km north of Fort Albany at the mouth of the Attawapiskat River which drains into the James Bay and is at a latitude of 53º 33'

0" N (National Resources of Canada, 2007). The people of this community are also part of the James Bay Cree and the Mushkegowuk Tribal Council (NationMaster, 2005). There were no statistics available from the 2006 census; however, as of 2001, Attawapiskat had a population of 1,293 and a land area of 2.02 square kilometres, which is a population density of 640.1 people/square kilometre (Statistics Canada, 2001a). The median age of the population was 19 years (Statistics Canada, 2001a).

Travel into the community is possible by air year round and during the winter months by the ice/winter road that is constructed and connects Attawapiskat to the surrounding coastal communities around the James Bay region. There is a primary school, J.R. Nakogee School, which was closed in the year 2000 due to a diesel leak that had happened several years prior. The elementary school is now situated in portables. The Vezina Secondary School was established in the early 1990s and includes grades 9 - 12 (NationMaster, 2005). The community also has a hospital, a Northern store (which contains a Kentucky Fried Chicken and a Pizza Hut) and a police station. Attawapiskat also has a hockey arena which hosts games and tournaments for children from other communities along the western James Bay. For the past few years Attawapiskat has been involved with the DeBeers (the diamond company) mine which has created several jobs, but has also caused controversy with respect to the impact it is having on the community.

4.2.5 Peawanuck

Peawanuck is a Cree community in the Kenora District (Statistics Canada, 2006a) which is also part of the Mushkegowuk Tribal Council (Weenusk, 2009). Originally the reserve was named Winisk and was located at the juncture of the Winisk River and the Shamattawa River (Aboriginal Communities, 2009). In 1986, after facing severe

flooding, the community was moved 30 km up river to the new community of

Peawanuck. Peawanuck, which is Cree for "flintstone", is situated on the edge of the

Polar Bear Provincial Park at a latitude of 54º 15' 0" N (National Resources of Canada,

2007).

The population as of the 2006 census was 221, which is a 14.5% increase from

the 2001 census population count of 193 people (Statistics Canada, 2006a). Peawanuck

has a land area of 1.51 square kilometres and a population density of 145.6 per square

kilometre (Statistics Canada, 2006a). The median age of the population is 25.5 years

(Statistics Canada, 2006a).

Peawanuck can be accessed year round only by air. The community does not

have any permanent roads but in the winter month's travel can be done on the ice/winter

roads. The closest city and service centre is Timmins (Weenusk, 2009). There is a

school in Peawanuck called Matahamao for kindergarten to grade 8 students, a police

station, and a nursing station (Weenusk, 2009). At the time of the survey, there was no

Northern Store in the community. There were two independently owned grocery stores

and an independently owned convenience store.

4.2.6 Moose Factory

Moose Factory is located at the mouth of the Moose River near the southern tip of

the James Bay (Moose Cree First Nation, 2009) at a latitude of 51º 6' 5" N (National

Resources of Canada, 2007). According to Statistics Canada, it has a land area of 168.82

square kilometres (Statistics Canada, 2006a). There were no other statistics available on

the 2001 or the 2006 census. There are approximately 2,700 residents in Moose Factory

(Moose Cree First Nation, 2009). The off-reserve town of Moosonee is on the mainland

and is about 5 kilometres away from Moose Factory. Travel to Moose Factory is available by plane year round, and as with the communities explained above, can be accessed via the ice/winter road in the winter months. Transportation from the mainland of Moosonee to Moose Factory can also be via ferry and boats when the river permits (Moose Cree First Nation, 2009).

Moose Cree First Nation (the governing First Nation organization for Moose Factory) is also part of the Mushkegowuk Tribal Council and has several conveniences that the other communities do not have. Some examples are the Moose Cree First Nation Daycare, The Moose Band Development Corporation, The Finance and Graphics departments of the Mushkegowuk Council, the Moose Factory Island District School Area Board, a Northern store, The Bank of Montreal, The Cree Craft Shop, The Gift Basket, Mooshom's Gabesho-Inn, The Lighthouse Bookstore, Gookum's Grill, Moose Factory Health Factory, Moose Factory Cable Inc., Pizza Hut, several chip trucks and a Canada Post Corp. There is also a sports centre named Thomas Cheecho Jr. Memorial Complex located on the reserve with the Weeneebayko General Hospital and a fire hall located off-reserve. The Moose Factory Ministik School is off-reserve and includes children from JK to grade 8 (Moose Cree First Nation, 2009). On the reserve there is a secondary school called the Delores D. Echum Composite School which includes children from grades 7 to 12 (Moose Cree First Nation, 2009). Students attend secondary school off-reserve (Northern Lights Secondary School) (Moose Cree First Nation, 2009).

4.2.7 Ouje-Bougoumou

Ouje-Bougoumou is a Cree community on the eastern side of the James Bay in

Quebec, situated beside Lac Opemiska at a latitude of 49º 55' 32" N (National Resources of Canada, 2007). This community has been through tough times, as many Aboriginal reserves have. Over the past 50 years, they have had to relocate their community seven times due to mining camps and the Quebec and Canadian governments (Ouje-Bougoumou, 2009). The population in 2001 was 553 and in 2006 was 606, which is an increase of 9.6% (Statistics Canada, 2006a). It has a land area of 2.54 square kilometres and a population density of 238.4 residents per square kilometre compared to 5.6 residents per square kilometre in Quebec (Statistics Canada, 2006a). The median age for the community is 24.2 compared to 41 years old for the province of Quebec (Statistics Canada, 2006a).

The community has been set up in a circular arrangement reflecting the tradition of sharing circles (Ouje-Bougoumou, 2009). Services available within the community include the Healing Centre (clinic), the Waapihtiiwewan School (pre-kindergarten to grade 11), a peacekeeper station, a youth centre, a fire hall, church, a lodge/restaurant, an arena containing a snack bar, heating plant, gas station, day care centre, a pavilion and a traditional Cree village (Ouje-Bougoumou, 2009). It is an Aboriginal community that has been constructed with the input of the people and has been planned to represent the traditional living arrangements of Aboriginals.

4.2.8 Kashechewan

Kashechewan is a Cree First Nation community that is located on the western side of the James Bay at a latitude of 52º 17' 26" N (National Resources of Canada, 2007) and has a population of approximately 1,200 people. It sits on the northern shore of the Albany River and was once a part of the Fort Albany reserve and is also part of the

Mushkegowuk Tribal council. It is also an isolated community that is accessible by air year round, by the ice/winter roads in the winter months and by boat in the summer and spring months. When the community of Kashechewan separated from the Fort Albany community, the name chosen for the community was originally KEEshechewan, which means "where the water flows fast" in Cree; however, when the government sent up the sign for the post office it had the miss-spelled name KAshechewan and that became the official name of the community, which has no meaning in Cree.

Within the community of Kashechewan there is only one store, the Northern Store (which is quite big compared to the neighbouring Fort Albany Northern Store and has much more selection). There is also the Nishnawbe–Aski Police Service, Kashechewan Health Services, St. Andrew's Elementary School (grades JK to 8), and the Francine J. Wesley Secondary School. The elementary school was condemned due to toxic mould infestation and was later burned to the ground. The elementary and secondary schools had to share the secondary school facilities for a period of time until the elementary school was provided with temporary portables. These portables are limited in space and therefore there was no room for a gymnasium, computer lab, or a library.

The community has dealt with several hardships including poor water quality and flooding. In October/November of 2005 Escherichia coli (E. coli) bacteria was discovered in the water supply and approximately 800 residents were evacuated. There have been several boil water advisories with some lasting as long as two years. The community was evacuated once again in April of 2006 due to severe flooding.

5.0 METHODS:

5.1 Theoretical Framework:

The Social Cognitive Theory, with respect to behaviour changes in health, is the interaction between one's knowledge base, perceived self-efficacy to make the change, the outcomes one foresees and the goals one has set, and the perceived facilitators and obstacles that may influence the change one considers making (Bandura, 2004). It recognizes that in order to make changes to behaviour, the reciprocal interactions between individual factors and one's physical and social environment also have an effect.

The way in which the behaviour, in this case diet, is carried out in Aboriginal communities depends not only on the motivation of the individual to want to eat healthier, but also on the social norms of eating, as well as on the environment and availability of healthy foods.

The current study will provide some new information on associations between individuals (e.g., grade, sex), behaviour (e.g., HEI-C, "Other" foods) and environment (e.g., fast food, latitude). This information may be useful in the future planning and use of healthy eating interventions in Aboriginal communities.

5.2 Sample: Demographic Information

The data being used in this study were collected using the validated web-based Food Behaviour Questionnaire (Hanning et al., 2009) from the seven communities discussed above in section 4.2 Community Profiles and presented in Table 4.1.

5.3 Tools:

5.3.1 Web Based Survey:

5.3.1.1 General

The web based Food Behaviour Questionnaire (FBQ) was developed at the University of Waterloo and has been used since 2001 to survey over 15, 000 students in Canada (Hanning, Royall, Toews, Blashill, Wegener, & Driezen, 2009; Minaker et al., 2006; Woodruff & Hanning, 2009). The FBQ asks students to perform a recall of all the foods and beverages that they have consumed in the past 24 hours as well as to fill out demographic information such as age, grade, self-reported height, weight, sex, food frequency questions and questions asking about physical activity.

The 24 hour recall section is very interactive and asks the children to report foods consumed in the categories of breakfast, lunch, dinner and snacks. The screen displays options for the children to either choose the foods from an alphabetical list of 500 - 850 foods or by food group such as vegetables and fruits, grain products, milk and alternatives, meat and alternatives, and other foods. Prior to the 2006 surveys, the food list was expanded to include foods that were consumed in Aboriginal communities, especially traditional foods. There are pictures of the foods in order to help the children remember which foods they ate and for every food item chosen they are prompted to report a serving size. There are also pictures of the different serving sizes for children to have a better recollection of how much they actually ate. There are prompts to help the children remember to include beverages and extras such as dressings and sauces. All of these cues help to jog the children's memories and therefore make the results of the survey more accurate (Gibson, 2005). The fact that the survey is anonymous and that the

information is being input into a computer instead of divulging the information to a researcher or dietitian may also encourage more truthful answers.

The food frequency questions inquire about how often certain foods are eaten outside the home, how often foods (pizza, candy or chocolate bars) are eaten in a day, week, or month (Appendix A). Throughout the survey children have the opportunity to change their answers and add or remove foods. The 24 hour recall concluds with a summary of what the child has input and once again gives a final chance to alter their answers. The summary disseminates information by comparing what the child has eaten in the last 24 hours with the recommendations for their age group as suggested by Eating Well with Canada's Food Guide (2007). Appendix B illustrates a few of the screens from the 2005-2009 survey.

5.3.1.2 Validity

The web-based survey has been previously validated in a group of Aboriginal children in Fort Albany. The study involved 24 children from grades 6 – 10 who completed the survey and also subsequently completed a 24 hour diet recall interview with a registered dietitian, for the same recalled day, so the survey results of the food groups and nutrient intakes could be compared with what was reported in the interview process. The results showed a strong correlation between the FBQ and the interviews with an intra-class correlation coefficient of 0.67 for key nutrients and energy (Hanning et al., 2009).

The FBQ was validated in a study conducted by Hanning et al., (2009) in which they conducted qualitative interviews to help improve the survey as well as comparing the survey results with nutritional assessments of dietitian experts. The researchers

45

methods included cognitive interviews with 11 dietitian experts and 21 grade six students in order to gain informative feedback on the contents of the survey and also had a heterogeneous sample of 201 southern Ontario students from grades 6 – 8 complete the survey. The 201 children then had a 24-hour recall interview with a registered dietitian (Hanning et al., 2009).

The results of the study showed that the web-based survey has very good validity with significant positive correlations for all of the nutrients between the interview recalls and the survey recalls. Intraclass correlation coefficients (ICC) for energy were found to be 0.56 and for the macronutrients of carbohydrates were 0.48, protein was 0.58 and fat was 0.52 (Hanning et al., 2009).

5.3.2 Data:

The data being used for this study have been collected through the web-based FBQ. The data are from eight different communities and were collected, at school, between December of 2003 and June 2009. There were approximately 414 children that participated and were between grades 6 – 12. Although surveys are self-administered, a research assistant was present to respond to questions and help with height and weight measurements.

5.3.2.1 Body Mass Index

The Body Mass Index is a commonly used measurement that places a person into a category of either underweight, normal weight, overweight or obese. For the purposes of this study, the BMI classifications specified by Cole et al (2000), as described in the above section 2.1.2 Overweight/Obese will be used.

Height and weight were self-reported confidentially on the survey, however, scales and wall-mounted measuring tapes were available for the children to check with the aid of a research assistant if they were not sure. Weight can be a sensitive issue and has a tendency to be under-reported (Kuczmarski & Flegal, 2000). The survey format of entering the number onto a computer rather than having to tell someone and knowing that the survey is anonymous may encourage a more truthful answer. In a validity study, conducted in a group of 50 non-Aboriginal children in grades 6 – 8, the survey reported height and weight showed to be highly correlated with measured height and weight among girls and boys (r = 0.94, 0.84, respectively). The intraclass correlation estimates for height and weight were 80% and 87%, respectively, which shows agreement overall.

5.3.2.2 Twenty Four Hour Recall

The 24 hour diet recall asks the child to report everything that they have consumed in the 24 hours prior to the survey. This allows for a detailed look at the diet, which can be broken down and analysed at the level of the macro and micronutrient content of everything that was eaten. For the purpose of this study, the 24 hour recalls were used to determine the HEI-C score as well as determine the number of servings and percentage of total energy contributed by "other foods" and traditional foods. The data from the 24 hour recalls were analyzed in accordance to the Canadian Nutrient File Database (Health Canada, 2001) using ESHA food processor software (version 7.9, Salem, Oregon http://www.esha.com/products/foodpro). This software was used to calculate total energy, macro- and micro-nutrient intakes.

A cross-sectional survey can be useful in obtaining baseline nutritional data and gathering data on the current nutritional status of a population in order to gain a

perspective on their current situation and health needs (Gibson, 2005). All of the data in this study represent what the children ate on a weekday. This is most relevant to these communities as the focus is on school children and any intervention that may take this information into consideration would be based in the school setting.

When conducting 24 hour recalls, a multiple pass technique should be used in order to help ensure the information given is accurate (Gibson, 2005). There are generally four stages which include: first, obtain a complete list of all foods and beverages consumed in the last 24 hours; second, describe foods in as much detail as possible such as cooking methods and sauces added; thirdly, determine portion sizes using visual aids and prompts; and fourthly, review the recall to make sure all foods were recorded properly (Gibson, 2005). The web survey mimics all four of these stages that are typically used by dietitians. The food list is obtained in detail with several options and prompts to remember beverages and toppings. There are pictures and descriptions of portion sizes for each food chosen. Finally, changes can be made throughout the entire survey as well as at the very end when the summary is given in order to support accurate reporting.

5.3.2.3 Food Frequency Questions

Within the FBQ, after the 24 hour recall, there are several food frequency questions. For the purpose of this study, the questions referring to the frequency of traditional food consumed, the frequency of eating outside the home, and the frequency of consumption of "other foods" were included. Food frequency questions are a useful way of investigating the usual patterns of consumption of specific foods (Gibson, 2005).

One of the food frequency questions asked in the survey is, "how often do you eat or drink these foods?" For objective 2e), the responses with respect to game were included. Another food frequency question on the survey is, "how often do you eat meals or snacks prepared away from the home?" For objective 2d) the responses such as convenience store, school cafeteria, fast food restaurant, vending machines and snack bars were included. The FFQ and responses for each community data set can be seen in Appendix A.

The amounts of traditional foods consumed as well as the amount of "other foods" consumed were looked at as the amount of total energy that they contributed to the child's diet.

5.4 HEI-C:

5.4.1 General

The Healthy Eating Index (HEI) was used in this study to determine the overall quality of the children's diet. The HEI was first developed in the United States by Kennedy et al., (1995). The score includes 10 components (each receive a maximum of 10 points) for a possible high score of 100. The first five components are based on food groups (grains, vegetables, fruits, milk and meats), the next four reflect dietary nutrient guidelines (total fat, saturated fat, cholesterol, and sodium) and the final score is for the variety of a person's diet. All of the components have guidelines for a perfect score of 10 and a minimum score of 0, which relate to the USDA Food Guide Pyramid's recommendations. The total score is out of 100, which represents that an individual is meeting his/her recommendations exactly. A total score less than or equal to 50 lies in

the "poor" diet category, a total score between 51 and 80 is considered to be in the "needs improvement" category and a total score above 80 is in the "good diet" category (Kennedy et al, 1995).

This HEI was later changed by Glanville & McIntyre (2006) to fit better with its use in Canada (now termed HEI-C). It was adapted to reflect the serving amounts recommended by Canada's Food Guide to Healthy Eating (CFGHE, 1992) as well as the Nutrition Recommendations for Canadians (Health and Welfare Canada, 1990). There were two other changes which affected the scoring of the HEI-C. First, in place of the sodium category, servings of "other foods" was included in the scoring as it was felt that since the sodium category did not take into consideration the use of table salt, that it was not a true representation. As described by the CFGHE, "other foods" are considered foods which are mostly sugar, mostly fat, high fat or high salt snack foods, and beverages such as soft drinks, coffee, tea and condiments such as ketchup. The variables used in the Glanville & McIntyre (2006) study to define "other foods" was; fats, oils, sugar, coffee creamer, confectionary, soft drinks, fruit drinks, packaged snacks, jams and condiments.

The second change in the HEI-C scoring was with respect to the scoring of the variety category. In the original HEI, the number of different foods consumed was the criteria for the variety score; however, Glanville and McIntyre (2006) altered it to be based on eating foods from all four food groups. This approach was developed and validated by Dubois et al., (2000).

Sections of the HEI-C are based on the energy intake of the child. There are three energy categories; ≤ 1600 kcal, $1600 - 2200$ kcal, and ≥ 2200 kcal, which affect the grain, vegetable/fruit, milk, meat and other food components of the score. The total fat,

saturated fat, cholesterol and variety scores are independent of calories consumed

(Appendix C). As the category of calories consumed increases, the number of servings

that need to be eaten in order to obtain a perfect score also increases. With other foods,

higher vs. lower energy categories are more lenient in that a higher number of servings

can be consumed and still a perfect score can be obtained (Appendix C). The children

who ingest more calories are allowed to consume a higher amount of other foods, but

more servings are needed to reach a perfect score for the nutrient-rich food groups.

Hence, the quality or healthfulness of the diet per unit energy is what is being assessed.

5.4.2 Validity/reliability:

The original HEI was developed from the Continuing Survey of Food Intake by

Individuals (CSFII) conducted in 1989/90. The CSFII included 7500 individuals who

were 2 years of age and older who completed a 2-day food diary and a 24-hour diet recall

(Kennedy et al, 1995).

The HEI was tested along with two other diet indicators, Patterson's diet quality

index (DQI) and Huijbregts' healthy diet indicator (HDI), in order to determine which

one would be most appropriate to use to look at Canadian data (Dubois et al, 2000).

These diet indicators had been chosen because of their current and regular use at the time.

All three were altered to reflect the 1990 Canadian nutrition recommendations and were

applied to the Quebec Nutrition Survey data that were collected in 1990.

The overall findings suggested that HEI was the best suited to analyse the Quebec

data. Both the DQI and the HDI are expressed as ordinal variables whereas the HEI is

expressed as a continuous variable which allows for a wider variety of statistical analysis

to be conducted. When comparing the three indicators, they were all similar with respect

to determinants of diet quality and when looking at total calories and alcohol consumption. They were then compared using the mean adequacy ratio (MAR), which is a measurement that averages the proportion of dietary recommendations met by an individual for each nutrient (Gutherie & Scheer, 1981). A Spearman correlation was used due to the non-normal MAR distribution. The HEI produced a correlation coefficient that was distinctly higher than the DQI and the HDI. The HEI also showed the best correlation when comparing each of the indicators with the individual's own perceptions of their diets (Dubois et al, 2000).

5.4.3 Positives/limitations

In order to compare results of dietary intake surveys among different populations, it helps to have a universal way of looking at them and a diet quality index is one way of doing that. The indicators which include the whole diet tend to be more representative and useful compared to indicators only looking at individual foods or nutrients, when analysing at the population level due to their comprehensiveness and inclusion of the different aspects of the diet (Kant, 1997).

The HEI-C works by comparing a child's diet with the recommendations of Canada's Food Guide to Healthy Eating (which was in use when the HEI-C was developed). It also takes into account the nutrient recommendations for fat and cholesterol. Since the HEI-C was developed, Canada's Food Guide has been revised and is now called Eating Well with Canada's Food Guide (EWCFG). The food guide has become more specific and provides recommendations for different age groups. There is also a new version of the food guide that is tailored to First Nation peoples. It is very similar to the national food guide, but includes more traditional foods listed and pictured

in the guide. However, the HEI-C has not yet been validated for use with the EWCFG or

the Aboriginal version of the food guide. It is noteworthy that most of the current

research was collected between the years of 2003 and 2007 which was before the release

of the newer versions. Therefore, the CFGHE, on which the HEI-C is based on, was the

national standard for dietary intake recommendations at the time of most of the data

collections (with the exception of the 2009 Fort Albany and Kashechewan data

collections) (Health Canada, 2007). The HEI is a validated tool that has been previously

used in conjunction with the Canadian Food Guide (Dubois et al., 2000; Glanville &

McIntyre, 2006; and Woodruff et al., 2008). However, neither of these tools has been

validated specifically for the use on Aboriginal populations.

Nevertheless, in the absence of a tailored index, the HEI-C was selected as a

means of describing and comparing the composite diet quality amongst the participants in

the web-based surveys of Aboriginal communities.

5.5 Statistics:

The data collections in the different communities were conducted in different

years as well as in different seasons. Due to seasonal effects, such as variations in

hunting, and yearly effects, such as environmental barriers, there are several factors that

may alter what foods are available or abundant throughout the seasons and from year-to-

year. Therefore, the objectives were looked at including all data sets, as well as in paired

data sets. The paired data sets were as follows: Christian Island and Fort Albany 2004,

Attawapiskat and Peawanuck 2005/06, Fort Albany and Moose Factory 2007, and Fort

Albany and Kashechewan 2009. With respect to objectives 2a – 2e (HEI-C vs. BMI,

HEI-C vs. "other foods", HEI-C vs. Game consumption, HEI-C vs. Eating outside the home and HEI-C vs. Latitudinal variance), the tests referred to as including "all data" did not include the Fort Albany 2007 collection as it may have sampled some of the same children who were involved in either the Fort Albany 2004 or the Fort Albany 2009 collection (See Appendix D: Data Sets Included in Each Objective).

Only students who were in grades six to eight that completed the survey were included in the analysis in order to keep the age range consistent.

The computer program used for statistical analysis in this study was SPSS 17.0. (IBM SPSS Statistics, 2010).

In order to control for multiple comparisons, the Bonferroni correction was used in all applicable statistical tests. The Bonferroni method adjusts the significance level depending on how many statistical tests are being performed by dividing the significance level by the number of comparisons being made (Norusis, 2006). For example, when making 10 comparisons and using a significance level of 0.05, the observed significance level for each comparison must be less than 0.05/10 or 0.005 in order to consider a finding significant. The Bonferroni method assumes that the variances in all of the groups are the same, if not, the Levene Test can be used (Norusis, 2006).

5.5.1 Overall Descriptive Statistics

All of the data sets were included when looking at the overall descriptive statistics (including the Fort Albany 2007 collection). Frequencies were calculated for the communities, seasons, grades, sexes and BMI categories.

5.5.2 Objective #1 – HEI-C

The first objective of this study was to describe the quality of the children's diets using the HEI-C. Descriptive statistics were conducted including frequencies, means and standard deviations with respect to communities and seasons. Several analyses using one way ANOVA were also conducted looking at the continuous HEI-C scores of the students by community, season, grade and sex.

5.5.3 Objective #2a) HEI-C vs. BMI

The HEI-C scores (continuous and categorical) were compared against BMI scores (continuous and categorical). The BMI cut-offs were defined according to International (Cole et al., 2000) cut-offs. For the categorical variables, chi square analysis was conducted whereas regression analysis was conducted when using the continuous versions of both HEI-C and BMI. When looking at BMI as a categorical variable and HEI-C as a continuous variable, a one way ANOVA was conducted.

5.5.4 Objective #2b) HEI-C vs. "Other Foods"

The HEI-C score was compared with the total percent energy coming from the consumption of "other foods" in the children's diets. This data was taken from the 24 hour diet recall.

The CNF definition (2001) for "other foods" was used to categorize foods and to decide which were included when looking at the percent of total energy. As explained in section 5.4.1 General, "other foods" includes foods that are considered mostly fat, mostly sugar, high salt/high fat, high sugar/high fat and higher calorie beverages. Foods in the lower calorie beverage and miscellaneous categories were not included. Appendix E shows a list of foods originally considered to fall in the "other" food category in previous

reports based on the FBQ but that were not included in the analysis because of low calorie contribution or because they were part of a combination food that could not be broken down into the "other" foods components based on existing data.

A multiple regression analysis was conducted looking at the HEI-C and all of the separate components that make up the HEI-C score in order to determine how much of the variability of the score is explained by the other foods category as well as the remaining components.

5.5.5 Objective #2c) HEI-C vs. Game Consumption

The continuous variable of HEI-C was compared to game consumption frequency using regression as well as a one way ANOVA. A regression was run using the continuous HEI-C score and the altered frequency of game consumption. The answers to this FFQ were assigned a number that was the consumption per week in order to allow it to become a continuous variable. For example, the following are the different frequencies that the children could select and the numbers that they were assigned; rarely/never=0, 2-4 times a month=0.75, 2-4 times a week=3, 5-6 times per week=5.5, once a day=7, and at least twice a day=14.

A one way ANOVA was conducted with the continuous variable of HEI-C score and the categorical food frequency answers to game consumption. The Fort Albany 2007 data collection did not ask any of the food frequency questions as it was a shortened version of the survey.

5.5.6 Objective #2d) HEI-C vs. Eating Outside the Home

The FFQ with respect to eating outside the home was asked slightly differently in the Georgina Island data collection compared to the other community surveys. When the

survey was conducted in Georgina Island, the possible answers for eating at the school cafeteria (pizza days, etc.) offered different frequency options than when inquiring about fast food restaurants, other restaurants, vending machines, snack bar, and at a convenience store. When asking about eating at the school, the options in Georgina Island were: *once a day*, *2 to 6 times a week*, *once a week*, *once a month* and *rarely or never*. However, for the rest of the locations, the possible answers were*: at least twice a day*, *once a day, 5 to 6 times a week*, *2 to 4 times a week*, *2 to 4 times a month*, *rarely or never*. The first set of frequencies, which were given for the school location in Georgina Island were the possible answers given for all of the other surveys. Therefore, the *at least twice a day* category and the *once a day* category were collapsed, as well the *5 to 6 times per week* category was collapsed with the *2 to 4 times a week* category so that all of the frequencies were consistent.

There were two other minor differences between the surveys collected in the different communities. The Christian Island data collection did not ask about eating at a friend's or relative's house therefore, that option was not included in any of the current analyses. As mentioned in 5.5 Objective #2c) HEI-C vs. Game consumption, the Fort Albany 2007 collection did not ask the FFQ as it was a shortened version of the survey.

The answers to the FFQ were assigned a number in order to allow the variable to become continuous as described above in Objective #2c. This allowed a regression to be run of the HEI-C score and the frequency of eating outside the home at different locations.

57

A regression was also run using the HEI-C score and a composite score of eating outside the home which was created by adding the frequencies of the different locations together.

5.5.7 Objective #2e) HEI-C vs. Latitudinal Variation

The relationship between the latitudinal positions of the communities and their HEI-C scores was investigated by running a regression analysis. The latitude was analysed using the degrees and feet as a number with decimal points. The communities are listed in order of the most southern to the most northern; Georgina Island (44º 23' 59" N), Christian Island (44º 47' 59" N), Ouje-Bougoumou (49º 55' 32" N), Moose Factory (51º 6' 5" N), Fort Albany (52º 19' 59" N), Kashechewan (52º 17' 26" N), Attawapiskat (53º 33' 0" N) and Peawanuck (54º 15' 0" N). For example, Georgina Island was entered in as 44.23, Christian Island was entered in as 44.47 and so on.

6.0 RESULTS

6.1 Overall Descriptive Statistics:

There were a total of 336 students who participated in the Food Behaviour Surveys that were included in the present study. Samples from eight communities were included in the initial descriptive data; Christian Island (n=44), Georgina Island (n=12), Moose Factory (n=38), Fort Albany (n=105), Kashechewan (n=44), Attawapiskat (n=57), Ouje-Bougoumou (n=25) and Peawanuck (n=11).
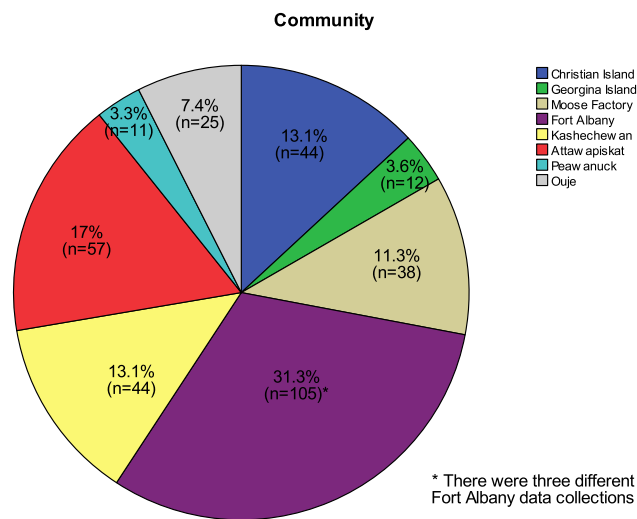
Community

Figure 6.1 Community Frequencies

The FBQ was conducted in three different seasons; winter (n=155), spring (n=99) and autumn (n=82).
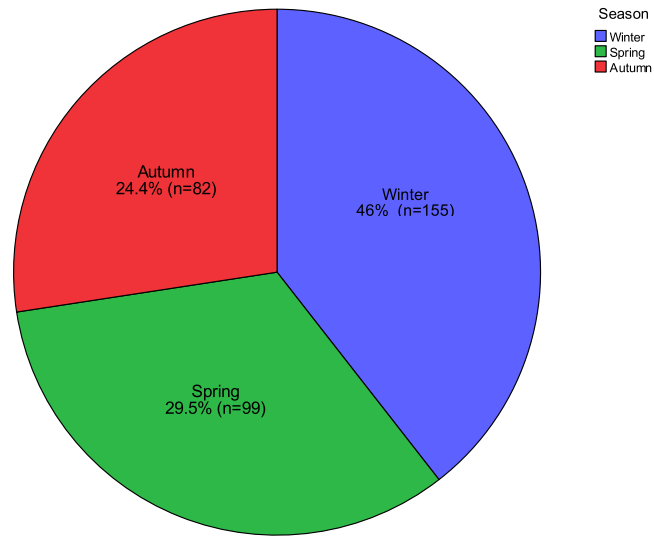
Figure 6.2 Season Frequencies

Students in grades 6 (n=104), 7 (n=130) and 8 (n=98) were included in the analysis.
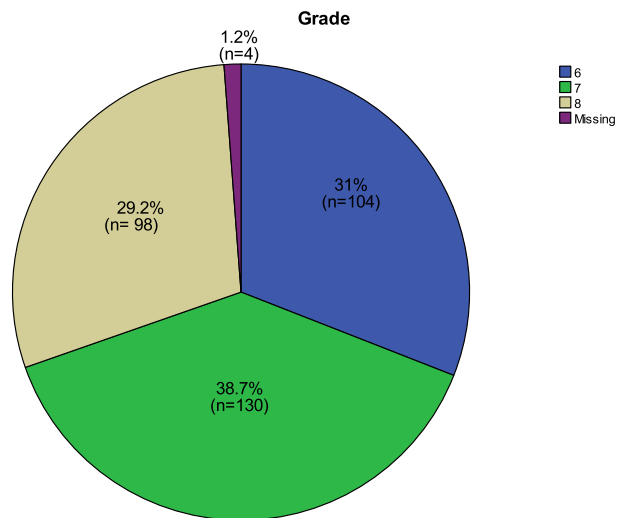
Figure 6.3 Grade Frequencies

Participation between boys and girls was very similar, with 163 boys and 173 girls completing the survey.

Sex

51.5%
(n=173)

48.5%
(n=163)

Boy
Girl
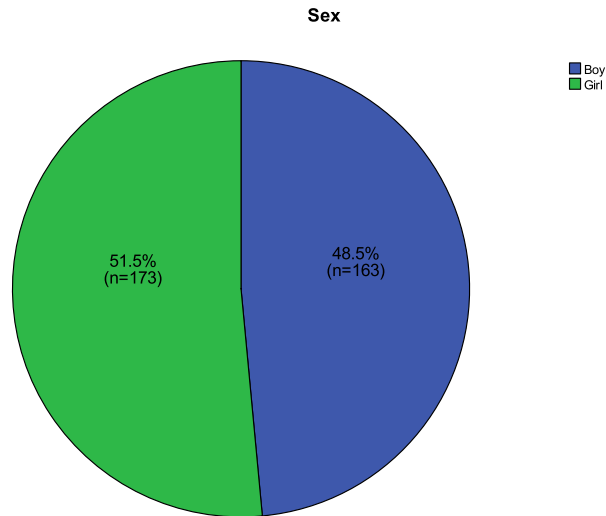
Figure 6.4 Sex Frequencies

BMI scores were calculated for all of the students who provided height and weight data on the survey (n=251). Of these students, they were divided into the overweight (n=89) and obese (n=40) categories as described by Cole et al., 2000. The other (n=122) children are all of the students who had a lower BMI then the overweight category. More than half of the students (where height and weight information was available) are considered to be overweight/obese (n=129, 51.4%).
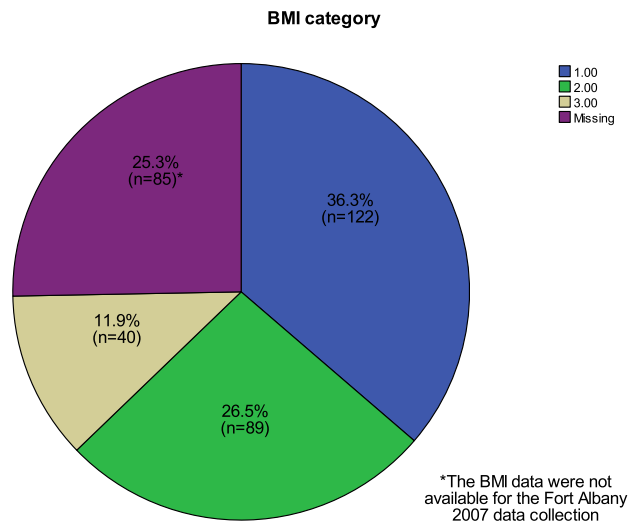
BMI category

Figure 6.5 Body Mass Index Category Frequencies

6.2 Objective #1 – HEI-C Score Descriptive Statistics

6.2.1 All data

In order to get a better understanding of the relationships between the HEI-C scores and the communities, seasons, grades and sexes, one-way ANOVAs were conducted.

Community	Season	HEI-C category	HEI-C Mean	Std. Deviation	N	%
Christian Island	Autumn	Good	88.091	5.660	8	18.2
		Needs Improvement	68.222	7.542	33	75
		Poor	46.321	3.613	3	6.8
		Total	*70.341*	*12.267*	*44*	
Georgina Island	Winter	Good	82.963	.654	2	16.7
		Needs Improvement	66.449	8.222	9	75
		Poor	44.785	.	1	8.3
		Total	*67.396*	*11.852*	*12*	

Moose Factory	Winter	Good	84.956	4.585	4	10.5
		Needs Improvement	65.584	9.709	26	68.4
		Poor	44.473	4.078	8	21.1
		Total	*63.179*	*14.126*	*38*	
Fort Albany	Winter	Needs Improvement	65.564	8.188	22	68.8
		Poor	42.742	8.525	10	31.3
		Total	*58.432*	*13.491*	*32*	
	Spring	Good	87.003	1.565	3	10
		Needs Improvement	66.209	7.292	21	70
		Poor	44.879	2.594	6	20
		Total	*64.022*	*13.112*	*30*	
	Autumn	Good	85.770	3.995	12	31.6
		Needs Improvement	66.285	9.064	22	57.9
		Poor	40.200	6.775	4	10.5
		Total	*69.692*	*15.488*	*38*	
	Total	Good	86.017	3.627	15	15
		Needs Improvement	66.016	8.104	65	65
		Poor	42.875	6.799	20	20
		Total	*64.388*	*14.809*	*100*	
Kashechewan	Spring	Good	83.139	4.099	6	14
		Needs Improvement	63.278	7.407	30	69.7
		Poor	46.233	4.611	7	16.3
		Total	*63.275*	*12.153*	*43*	
Attawapiskat	Winter	Good	88.389	5.092	6	10.5
		Needs Improvement	68.888	8.048	43	75.5
		Poor	42.000	6.059	8	14
		Total	*67.167*	*14.017*	*57*	
Peawanuck	Winter	Needs Improvement	62.240	5.883	6	60
		Poor	41.267	8.242	4	40
		Total	*53.851*	*12.616*	*10*	
Ouje	Spring	Good	84.601	4.019	4	16.67

63

		Needs Improvement	69.184	5.824	16	66.60
		Poor	39.380	7.457	4	16.67
		Total	*66.563*	*14.606*	*24*	
Total	Winter	Good	86.340	4.756	12	8.1
		Needs Improvement	66.804	8.499	106	71.1
		Poor	42.873	6.511	31	20.81
		Total	*63.399*	*14.168*	*149*	
	Spring	Good	84.481	3.734	13	13.4
		Needs Improvement	65.607	7.322	67	69.1
		Poor	44.142	5.318	17	17.5
		Total	*64.375*	*13.100*	*97*	
	Autumn	Good	86.699	4.733	20	24.4
		Needs Improvement	67.447	8.159	55	67.1
		Poor	42.823	6.165	7	8.5
		Total	*70.040*	*13.768*	*82*	
	Total	Good	85.962	4.480	45	13.7
		Needs Improvement	66.607	8.082	228	69.5
		Poor	43.259	6.043	55	16.8
		Total	*65.348*	*13.990*	*328*	

Table 6.1 HEI-C Scores by Community and Season

6.2.1.1 HEI-C by Community

When comparing the means of the HEI-C by community, it was seen that the communities were significantly different (F=2.213, p=0.033, n=329). Christian Island had the highest mean score (70.34) while Peawanuck had the lowest mean score (53.85). When taking a closer look, the post-hoc Bonferroni showed that these were also the two groups that were significantly different (p=0.029).
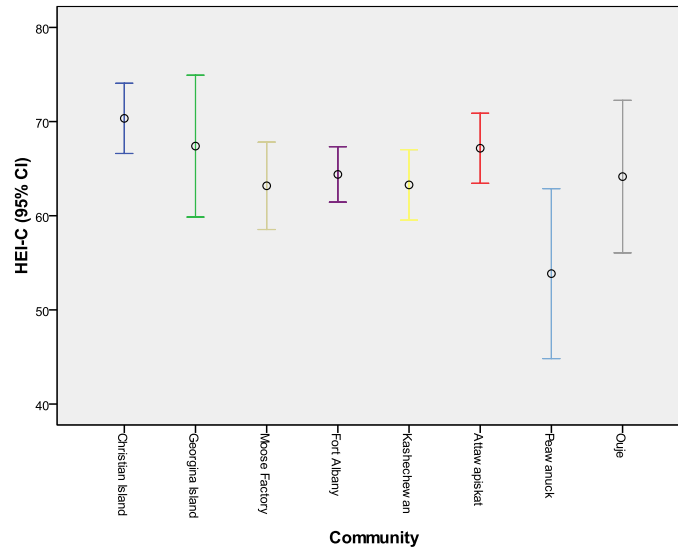
Figure 6.6 HEI-C Scores by Community

6.2.1.2 HEI-C by Season

There was significant difference seen between the seasons overall (F=6.510, p=0.002, n=329). The Bonferroni post hoc test shows that winter is significantly different from autumn (p=0.002) and that autumn is also significantly different from spring (p=0.009). Winter had a mean score of 63.40, spring had a mean score of 63.72 and autumn had a mean score 70.04.
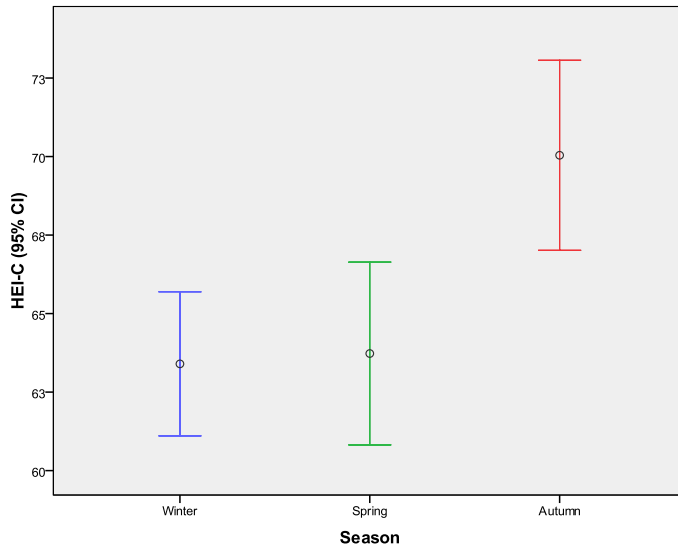
Figure 6.7 HEI-C Score by Season

6.2.1.3 HEI-C by Grade

The ANOVA showed that there is no significant difference between grades with respect to the HEI-C scores (F=1.538, p=0.216, n=325). The children in grade 6 had a mean score of 67.14, the children in grade 7 had a mean score of 63.97, while the children in grade 8 had a mean score of 64.37.

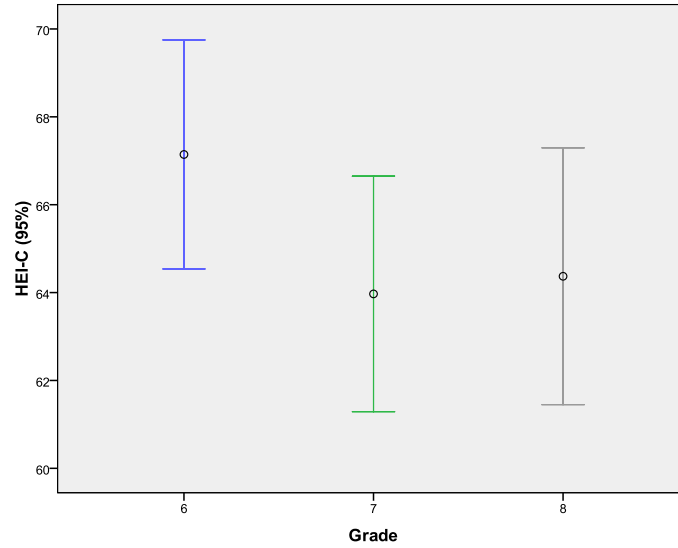**Figure 6.8 HEI-C Score by Grade**

6.2.1.4 HEI-C by Sex

There was no significant difference between boys and girls (F=0.293, p=0.589, n=329). Boys had a mean score of 65.60 and girls had a mean score of 64.73.
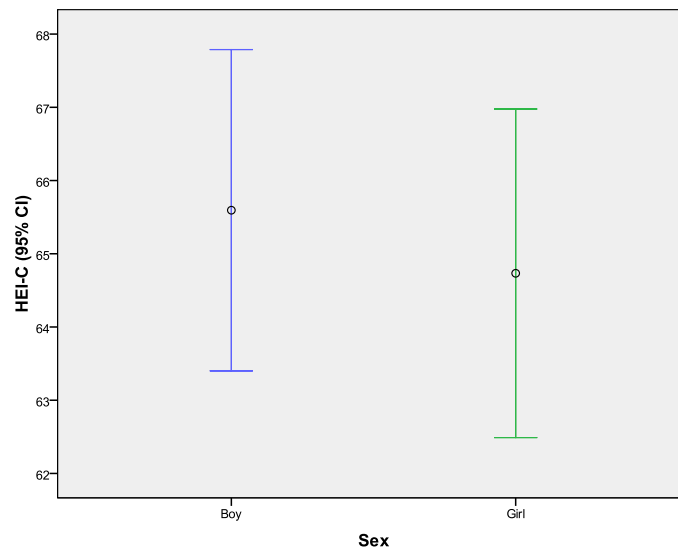
Figure 6.9 HEI-C Score by Sex

6.3 Objective 2a: HEI-C vs. BMI

  6.3.1 All data

There were two students whose reported BMI's were not included in the analysis that included BMI. One of these was from the Moose Factory survey and one was from the Peawanuck survey. These were not included in the analysis since they were reported as BMI's of 79 and 74.

  6.3.1.1 HEI-C Category vs. BMI Category

There was no significant difference between students BMI categories with respect to their HEI-C categories (p=0.386, n=251).

  6.3.1.2 HEI-C vs. BMI

A regression of the continuous variables of HEI-C and BMI did not show a significant correlation (r = -0.061, p=0.168, n=250). The ANOVA (F = 0.928, p = 0.336) and coefficients were also not significant.

  6.3.1.3 HEI-C vs. BMI Category

There was no significant difference between the categories of BMI with respect to continuous HEI-C scores (F = 0.394, p = 0.675, n=251).

  6.3.2 Fort Albany and Christian Island

  6.3.2.1 HEI-C Category vs. BMI Category

The categorical variables of HEI-C and BMI were not significantly associated (p = 0.241, n=73)

6.3.2.2 HEI-C vs. BMI

The regression showed a negative correlation, however it was not significant (r=-0.145, p=0.109, n=74). The ANOVA (F=1.544, p=0.218) and coefficients (p=0.218) did not show significant differences either.

6.3.2.3 HEI-C vs. BMI Category

There was no association between HEI-C and BMI (F=0.725, p=0.488, n=75).

6.3.3 Fort Albany and Kashechewan

6.3.3.1 HEI-C Category vs. BMI Category

The HEI-C category was not significantly associated with the BMI category (p=0.284, n=67).

6.3.3.2 HEI-C vs. BMI

The Pearson correlation shows a negative relationship that was not significant (r = -0.011, p = 0.465, n=67). The ANOVA was also non significant (F = 0.008, p = 0.930), as well as the coefficients (p = 0.930).

6.3.3.3 HEI-C vs. BMI Category

The one-way ANOVA (n = 67) shows no significant variation between students HEI-C scores based on the BMI category that they belong to (F = 0.355, p = 0.703, n=67). These results showed that a students BMI category can not be predicted based on their HEI-C score.

6.3.4 Attawapiskat and Peawanuck

6.3.4.1 HEI-C vs. BMI

The regression did not show any significant relationships between HEI-C and

BMI in this group (r = -0.142, p = 0.171, n = 47). The ANOVA was also non-significant

(F = 0.922, p = 0.342).

6.3.4.2 HEI-C Category vs. BMI Category

The category variables of HEI-C and BMI were not significantly associated (p =

0.667, n = 47).

6.3.4.3 HEI-C vs. BMI Category

The children's HEI-C scores were not significantly related to their BMI category

(F = 1.416, p = 0.254, n = 47).

6.4 Objective #2b: HEI-C vs. "Other Foods"

6.4.1 All Data

6.4.1.1 HEI-C vs. Percent Energy from "Other Foods"

As children consumed a higher amount of their total energy from 'other foods',

their HEI-C score significantly decreased (r = -0.217, p = <0.005, n=276). The ANOVA

(p = <0.005) was also significant, as well as the coefficients (p = <0.005).

6.4.1.2 HEI-C Score vs. Components of HEI-C

In order to see how much of the variability in the composite HEI-C score was

accounted for by its component parts, a regression was run including all of the data. The

highest to lowest correlations seen were as follows; vegetables and fruits ($r^2 = 0.486$),

variety ($r^2 = 0.316$) percent fat ($r^2= 0.69$), percent saturated fat ($r^2 = 0.175$), grains ($r^2 =$

0.088), other foods ($r^2 = 0.084$), cholesterol ($r^2 = 0.079$), milk products ($r^2 = 0.063$), and

meat ($r^2 = 0.043$). All of the correlations were positive and all had the same significance

(p = <0.005). The ANOVA (F = 719.785, p = <0.005, n=296) and coefficients (p =

<0.005) were both significant.

	Components of HEI-C								
Data Sets	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**	**9th**
All Data	V & F* *(0.468)*	Variety *(0.316)*	% Fat *(0.270)*	% Sat Fat *(0.175)*	Grains *(0.088)*	Other Foods *(0.084)*	Chol *(0.078)*	Milk *(0.063)*	Meat *(0.043)*
FA & CI	V& F* *(0.380)*	% Fat *(0.341)*	Variety *(0.324)*	Other Foods *(0.179)*	Milk *(0.168)*	% Sat Fat *(0.100)*	Chol *(0.100)*	Grains *(0.086)*	Meat *(0.055)*
FA & Kash	V & F* *(0.551)*	% Fat *(0.210)*	% Sat Fat *(0.187)*	Chol *(0.167)*	Variety *(0.167)*	Milk *(0.064)*	Grains *(0.062)*	Other Foods *(0.058)*	Meat *(-0.001)*
Att & Peaw	V& F* *(0.579)*	Variety *(0.530)*	% Fat *(0.166)*	Meat *(0.193)*	% Sat Fat *(0.180)*	Grains *(0.118)*	Milk *(0.110)*	Chol *(0.023)*	Other Foods *(-0.0003)*
FA & MF	Variety *(0.410)*	% Fat *(0.352)*	V & F* *(0.336)*	% Sat Fat *(0.303)*	Milk *(0.185)*	Grains *(0.152)*	Other Foods *(0.091)*	Chol *(0.081)*	Meat *(0.034)*

*Vegetables and fruits were a single component for the HEI-C, however they were allotted a score out of 20, whereas all of the remaining components were allotted a score out of 10 points.

Table 6.2 – Variability (r^2) of HEI-C Components

6.4.2 Fort Albany and Christian Island

6.4.2.1 HEI-C vs. Percent Energy from "Other Foods"

A significant, negative correlation ($r = -0.392$, $p = <0.005$, $n=81$) showed that as the total percent energy from other foods increased, the HEI-C score decreased. The ANOVA ($p = <0.005$) and the coefficients ($p = <0.005$) were also significant.

6.4.2.2 HEI-C Score vs. Components of HEI-C

The components of the HEI-C were all significantly, positively correlated. The highest to lowest correlations seen were as follows; vegetables and fruits ($r^2 = 0.380$, $p = <0.005$), percent fat ($r^2 = 0.341$, $p = <0.005$), variety ($r^2 = 0.324$) $p = <0.005$), other foods ($r^2 = 0.179$, $p = <0.005$), milk ($r^2 = 0.168$, $p = <0.005$), percent saturated fat ($r^2 = 0.100$, $p = 0.002$), cholesterol ($r^2 = 0.100$, $p = 0.002$), grains ($r^2 = 0.086$, $p = 0.004$), meat ($r^2 = 0.055$, $p = 0.017$). The ANOVA ($F = 1177.053$, $p = <0.005$, $n=82$) and coefficients (all $p = <0.005$) were significant as well.

6.4.3 Fort Albany and Kashechewan

6.4.3.1 HEI-C vs. Percent Energy from "Other Foods"

Data from the sample of students from Fort Albany and Kashechewan show a negative correlation between HEI-C scores and percent energy from other foods, however it is not significant ($r = -0.116$, $p = 0.166$, $n = 72$). The ANOVA ($F = 0.953$, $p = 0.332$) and coefficients were also not significant.

6.4.3.2 HEI-C Score vs. Components of HEI-C

All components of the HEI-C score had positive significant correlations with the HEI-C score, with the exception of meat which had a negative correlation that was not significant. The following are the correlations from highest to lowest seen in the

regression; vegetables and fruits ($r^2 = 0.551$, p = 0.017), percent fat ($r^2 = 0.211$, p = <0.005), percent saturated fat ($r^2 = 0.187$, p = <0.005), cholesterol ($r^2 = 0.167$, p = <0.005), variety ($r^2 = 0.167$, p = <0.005), milk ($r^2 = 0.064$, p = 0.015), grains ($r^2 = 0.062$, p = 0.017), other foods ($r^2 = 0.058$, p = 0.020), and meat ($r^2 = -0.0008$, p = 0.402). The ANOVA (F = 742.111, p = <0.005, n=82) and coefficients (all p<0.005) were significant as well.

6.4.4 Attawapiskat and Peawanuck

6.4.4.1 HEI-C vs. Percent Energy from "Other Foods"

There was no correlation seen between the HEI-C score and the total percent energy from "other foods" (r = -0.236, p = 0.053, n = 48). The ANOVA was also non-significant (F = 2.707, p = 0.107).

6.4.4.2 HEI-C vs. Components of HEI-C

The regression run on this group of the components shows that all components were significantly correlated, with the exception of cholesterol and other foods. The following are the correlations from highest to lowest see in the correlation; vegetables and fruits ($r^2 = 0.579$, p = <0.005), variety ($r^2 = 0.530$, p = <0.005), meat ($r^2 = 0.193$, p = <0.005), percent saturated fat ($r^2 = 0.180$, p = <0.005), percent fat ($r^2 = 0.166$, p = <0.005), grain ($r^2 = 0.118$, p = 0.002), milk ($r^2 = 0.110$, p = 0.003), cholesterol ($r^2 = 0.023$, p = 0.113) and other foods ($r^2 = -0.0003$, p = 0.443).

6.4.5 Fort Albany and Moose Factory

6.4.5.1 HEI-C vs. Percent Energy from "Other Foods"

The regression for this group shows a negative correlation between a child's HEI-C score and the total percent energy from other foods that they consumed, however it was non-significant (r = -0.175, p = 0.201, n = 71).

6.4.5.2 HEI-C Score vs. Components of HEI-C

The regression of the components of the HEI-C score for this group (n = 71) were mostly seen to be significant with the exception of meat. The correlations are listed from highest to lowest as followed; variety (r^2 = 0.410, p = <0.005), percent fat (r^2 = 0.352, p = <0.005), vegetables and fruit (r^2 = 0.336, p = <0.005), percent saturated fat (r^2 = 0.303, p = <0.005), milk (r^2 = 0.185, p = <0.005), grains (r^2 = 0.152, p = <0.005), other foods (r^2 = 0.091, p = 0.005), cholesterol (r^2 = 0.081, p = 0.008), meat (r^2 = 0.034, p = 0.062).

6.5 Objective #2c: HEI-C vs. Game Consumption

6.5.1All Data:

6.5.1.1 HEI-C Score vs. Game Consumption

A positive correlation was suggested based on the association between HEI-C and the amount of game consumed, however it was not significant (r = 0.018, p = 0.388, n=261). The ANOVA (F = 0.081, p = 0.776) and coefficients (p = 0.776) were also non significant.

6.5.1.2 HEI-C vs. Frequency of Game Consumed per Week

There was no significant difference seen between the different categories of game consumption and the HEI-C score (F = 0.627, p = 0.680, n=260).

6.5.2 Fort Albany and Christian Island:

6.5.2.1 HEI-C Score vs. Game Consumption

A positive, non-significant correlation was seen between HEI-C score and the amount of game consumed ($r = 0.065$, $p = 0.305$, n=63). The ANOVA ($F = 0.262$, $p = 0.611$) and coefficients ($p = 0.611$) were also non significant.

6.5.2.2 HEI-C vs. Frequency of Game Consumed per Week

The HEI-C score was not significantly associated with the frequency of game consumed each week ($F = 0.444$, $p = 0.816$, n=63).

6.5.3 Fort Albany and Kashechewan

6.5.3.1 HEI-C Score vs. Game Consumption

A positive, non significant correlation was seen ($r = 0.039$, $p = 0.372$, n=72). The ANOVA ($F = 0.107$, $p = 0.745$) and coefficients ($p = 0.745$) were also non significant.

6.5.3.2 HEI-C vs. Frequency of Game Consumed per Week

There was no relationship seen between the HEI-C and the frequency of game consumed per week ($F = 0.835$, $p = 0.530$, n=72).

6.5.4 Attawapiskat and Peawanuck

6.5.4.1 HEI-C Score vs. Game Consumption

The regression for this group showed a non significant correlation between HEI-C score and game consumption ($r = -0.136$, $p = 0.159$, n = 56). The ANOVA was also non significant ($F=1.016$, $p = 0.318$).

6.5.4.2 HEI-C vs. Frequency of Game Consumed per Week

There was no association seen between the HEI-C score and how much game was consumed on a weekly basis ($F = 1.694$, $p = 0.153$, n = 56).

6.6 Objective #2d: HEI-C vs. Eating Outside the Home

6.6.1 All Data

6.6.1.1 HEI-C vs. Eating at Different Locations Outside of the Home

There were no associations seen between HEI-C score and eating at the following locations outside of the home: fast food restaurants (r = -0.030, p = 0.332), other restaurants (r = -0.090, p = 0.099), school (r = 0.024, p= 0.367), vending machines (r= 0.002, p=0.486), snack bars (r=0.013, p=0.427) and convenience stores (r=0.74, p=0.145). The ANOVA (F = 0.749, p = 0.611, n=206) and coefficients were also not significant.

6.6.1.2 HEI-C vs. Composite Score of Eating Outside the Home

There was no association seen between HEI-C score and eating outside the home (r = 0.038, p = 0.255, n=297). The ANOVA (F = 0.436, p = 0.510) and coefficient (p = 0.510) were non significant as well.

6.6.2 Fort Albany and Christian Island

6.6.2.1 HEI-C vs. Eating at Different Locations Outside of the Home

There were no associations seen between HEI-C and eating at different locations outside of the home (School r = 0.082, p = 0.272; fast food r = 0.025, p = 0.426; other restaurants r = -0.210, p = 0.058; vending machines r = 0.109 p = 0.210; snack bars r = 0.094, p = 0.244; convenience stores r = 0.128, p = 0.171). The ANOVA (F = 0.990, p = 0.455, n=57) was not significant and none of the coefficients showed significance with the exception of eating at other restaurants (p = 0.050).

6.6.2.2 HEI-C vs. Composite Score of Eating Outside the Home

The regression showed a positive, non-significant correlation of eating outside the home and the HEI-C score (r = 0.095, p = 0.197, n=82). The ANOVA (F = 0.733, p = 0.394) and coefficients (p = 0.394) were also not significant.

6.6.3 Fort Albany and Kashechewan

6.6.3.1 HEI-C vs. Eating at Different Locations Outside of the Home

There were no significant correlations seen between the HEI-C score and all of the different places that the children eat at, (school r = -0.112, p = 0.181; fast food r = -0.139, p = 0.129; other restaurants r = -0.148, p = -0.115; vending machines r = - 0.128, p = 0.150; snack bar r = -0.119, p = 0.166; convenience r = -0.0.043, p = 0.362). The ANOVA (F = 0.370, p = 0.895, n=73) was not significant and there were no coefficients that were significant.

6.6.3.2 HEI-C vs. Composite Score of Eating Outside the Home

The regression did not show any significant correlations between the composite score of eating outside the home and the HEI-C score (r = -0.191, p = 0.052, n=73). The ANOVA (F = 2.698, p = 0.105) and the coefficient (p = 0.105) were not significant.

6.6.4 Attawapiskat and Peawanuck

6.6.4.1 HEI-C vs. Eating at Different Locations Outside of the Home

The regression showed no significant correlations (School r = 0.102, p = 0.262; fast food r = 0.090, p = 0.289; other restaurants r = -0.105, p = 0.257; vending machines r = -0.058, p = 0.359; snack bars r = 0.152, p = 0.172; convenience stores r = -0.055, p = 0.366). The ANOVA was also non-significant (F = 0.447, p = 0.842, n = 41).

6.6.4.2 HEI-C vs. Composite Score of Eating Outside the Home

There was no significant correlation seen between the HEI-C score and the composite score of eating outside the home (r = 0.182, p = 0.071). The ANOVA also did not show any association (F = 2.220, p = 0.141).

6.7 Objective #2e: HEI-C vs. Latitude

6.7.1 All data

A regression was run including all of the communities. A significant negative correlation was shown between latitude and HEI-C score (r = -0.117, p = 0.022, n=297); the higher the latitude, the lower the HEI-C score. The ANOVA (F = 4.073, p = 0.044) and coefficient (p = 0.044) were also significant.

6.7.2 Fort Albany and Christian Island

When the regression was run with this paired data set, there was not a significant correlation between latitude and HEI-C score (r = -0.024, p = 0.417, n = 82). The ANOVA was also non-significant (F= 0.045, p=0.833).

6.7.3 Fort Albany and Kashechewan

The regression ran on this group did not show a significant correlation (r= 0.030, p = 0.401, n = 73). The ANOVA was also non-significant (F = 0.063, p = 0.803).

6.7.4 Attawapiskat and Peawanuck

The regression run with this pair showed a significant, negative correlation (r = -0.329, p = 0.003, n = 67). The ANOVA was also significant (F = 7.885, p = 0.007).

6.7.5 Fort Albany and Moose Factory

The regression showed a non-significant correlation ($r = -0.036$, $p = 0.382$, $n = 71$). The ANOVA was also non-significant ($F = 0.092$, $p = 0.763$).

7.0 Discussion

The main goal of this study was to investigate the diets of Aboriginal children in eight northern communities. The Healthy Eating Index (HEI-C) was used in order to describe the diets and investigate the impact of food components of the diet, especially "other foods", to the overall healthfulness of grade six to eight students' diets.

The overweight/obese rates seen in these children are of concern with over half of the children falling into this category (51.4%). The location of the community may have an impact on how well the children's diets are as the highest HEI-C scores were seen in Christian Island, one of the most southern communities while the lowest HEI-C scores were seen in the most northern community of Peawanuck. Season also seems to have an impact on the children's diets as autumn was seen to have significantly higher HEI-C scores than spring and winter.

The following section will look further into the results of the specific objectives of this study. Possible explanations for the findings will be discussed, as well as possible implications for future action and research.

7.1 Overall Descriptive Statistics

When looking at the individual communities, Fort Albany (n=105) had the highest number of children surveyed. This is because there were three different surveys conducted in Fort Albany in different years. When addressing the objectives using data from all of the communities and surveys combined, the Fort Albany 2007 data were not included. The Fort Albany data from 2004 and 2009 were both included due to the four year gap, which implies that it would most likely not be the same children sampled in both surveys. The next largest sample was surveyed in Attawapiskat (n=57), then

Kashechewan (n=44), Christian Island (n=44), Moose Factory (n=38), Ouje (n=25), Georgina Island (n=12), and finally Peawanuck (n=11). The differences in sample sizes could not be avoided as all of the grades six, seven and eight students who were attending school on the day of the survey were sampled. These northern communities are relatively small and some, such as Peawanuck, are quite small. This may be one of the reasons research including on-reserve populations is not conducted as often as research looking at off-reserve populations. Also, the opportunities to enter these communities can be limited due to several factors (e.g., remote communities, expensive to fly to and to stay in, tend to be private communities). This means that whatever data can be collected and that are available for analysis are very valuable. All of the survey data that had been previously collected (Christian Island 2004, Georgina Island 2003, Fort Albany 2004 & 2007, Attawapiskat 2006, Peawanuck 2005, and Moose Factory 2007) and the data that was prospectively collected (Fort Albany 2009 and Kashechewan 2009) and were appropriate to include, were used in this study. Nevertheless, it is recognized that each community is unique in itself and that the children within this study may differ depending on which community they live in. When all of the data were included in the analysis, there were two samples included from Fort Albany. They were taken 4 years apart and therefore are very unlikely to have sampled the same students', however; it does mean that there are more students sampled in Fort Albany then in any other community. As the overall sample size is relatively small, the larger sample from Fort Albany allows us to have a more accurate view of this community rather than contributing to a less accurate view of the overall study. It allows for the confidence intervals surrounding Fort Albany to be more precise and therefore smaller. In order to try to address the community

81

influences, tests were conducted using paired data to control for season and year. The only pair that was seen as significantly different with respect to mean HEI-C score was Attawapiskat and Peawanuck, however, the distribution of residuals was comparable.

There seemed to be similar sample sizes with respect to students surveyed in the different seasons, between the different grades and between the different sexes. There were 155 students sampled in the winter, 99 in the spring and 82 in the fall. There were 104 grade 6 students, 130 in grade 7 and 98 students in grade 8 (there were 4 students sampled who did not enter their grade into the survey). There were 163 females sampled and 173 males.

Of the total 336 students surveyed, there were a total of 251 students who entered both their height and their weight which allowed for the calculation of their BMI. The Fort Albany 2007 survey was a shortened survey and therefore did not ask the students for their height and weight (n=37). The remaining missing BMI calculations were due to the student not entering their height, weight or both. There were no differences seen in HEI-C scores between the students who entered their height and weight (HEI-C = 66.34, ±13.61) and those who did not (HEI-C = 65.31, ±15.25). There were also two BMIs that were disregarded as they were most likely reported incorrectly, one from each of Peawaunck (BMI=74) and Moose Factory (BMI=79). Overall, there were a total of 89 students considered overweight and 40 were considered obese. This is a combined percentage of 51.4% of the total children surveyed that were considered overweight/obese. The percentages seen in this current study are much higher than the 26% seen in non-Aboriginal Canadian populations (Sheilds, 2005). However, this falls in the range that has been previously documented in Aboriginal youth with numbers

between 20% and 64% of youth being considered overweight/obese (Downs et al., 2008; Katzmarzyk, 2008).

7.2 Objective #1: HEI-C Score

The list of communities in order of highest mean HEI-C score to lowest mean score is: Christian Island (70.341), Georgina Island (67.396), Attawapiskat (67.167), Ouje-Bougoumou (66.786), Fort Albany (64.388), Kashechewan (63.275), Moose Factory (63.179) and Peawanuck (53.851). It was found that the children's HEI-C scores were significantly different between communities. When breaking up the HEI-C into categories, 15% of the children were in the Poor category, 70% in the Needs Improvement category and 15% fell in the Good category. Glanville and McIntyre(2006) used the HEI-C to look at families headed by single mothers who were living below the poverty line in Atlantic Canada. Of the children in the study between the ages of 9 – 14 years 15% fell in the Poor diet category, which is similar to the current study, however, in Glanville and McIntyre's study the remaining 85% were classified as having a diet that Needs Improvement (Glanville & McIntyre, 2006).

The season also seemed to have a significant impact on the HEI-C. The children who were surveyed in the fall tended to have higher HEI-C scores than children who were surveyed in the winter and spring.

Christian Island was surveyed in autumn, which is the season that seems to have a higher HEI-C score and Peawanuck was surveyed in the winter, which seems to have lower HEI-C scores. However, when HEI-C scores in Peawanuck were compared to scores in Attawapiskat, which were surveyed in the same year as well as the same season,

Peawanuck was still seen to have a significantly lower mean scores (F=7.885, p=0.007). This would suggest that there is something other than seasonal and year effects at work to cause Peawanuck to score so poorly on the HEI-C.

Peawanuck is a small community of only approximately 221 people (Statistics Canada, 2006a) and therefore has a smaller youth population as well. It is noted that the sample size of 11 students is very small; however, that is how many children were attending school in grades six, seven and eight at the time. With that in mind, there are several factors that may have influenced the HEI-C scores. Peawanuck is the most remote and the most northerly of the communities in the analysis as it is only accessible by air year round. Since Peawanuck is such a remote community, the accessibility to healthy foods, or even any foods, may be an even larger challenge than what the more southern communities face. Originally, it was hypothesized the more southern communities may have lower HEI-C scores due to lower intakes of traditional foods and higher consumption of more readily available "other foods". In the case of Peawanuck, it seems that the lack of availability of food in general may have been the biggest contributor to the poor HEI-C scores and not the lack of consumption of "other foods". The HEI-C does adjust for different total calorie intakes, however, the lowest classification in the HEI-C is a total intake of less than or equal to 1600 kcals. Peawanuck had a mean total energy intake of 850 kcals, this is just over half of the last HEI-C classification. Therefore, even though the HEI-C tries to account for different energy intakes, the extremely low intake of the children in Peawanuck is still reflected in the HEI-C scores.

After Peawanuck, Moose Factory was the second lowest scoring community with respect to HEI-C. Through further investigation the total percent of energy coming from "other foods" was compared across communities and was found to be significantly different (p=0.028) with Moose Factory having the highest mean of total percent energy from "other foods" (28.5%) and Peawanuck having the lowest total percent of energy coming from "other foods" (9.85%) out of all of the communities. This would imply that since both communities scored poorly on the HEI-C, there are two different issues at work in each of these communities to contribute to a poor HEI-C score. One may be dealing with lack of available food in general (Peawanuck), and one may be dealing with an excessive intake of energy coming from "other foods" (Moose Factory).

The overall energy intake for the communities was also significantly different (F=3.949, p=<0.005). The following is the mean caloric intake for communities in order of highest to lowest; Kashechewan (2209), Attwapiskat (2157), Moose Factory (2027.14), Georgina Island (1832), Fort Albany (1709), Ouje-Bougoumou (1602), Christian Island (1546) and Peawanuck (850). Some of these intakes are consistent with the literature. Trifonopoulos et al., (1998) found a mean caloric intake of 2190 kcal (±842) in a group of grades four to six Mohawk students. Similarly, Harvey-Berino et al., (1997) found a mean intake of 1,980 kcal (±762) in a group of Mohawk children from ages four to nine years old. The post hoc test showed that Peawanuck was significantly different from all of the other communities with the exception of Georgina Island (the Tamhane post hoc test was used as the Levene statistic was significant (p=0.028)).
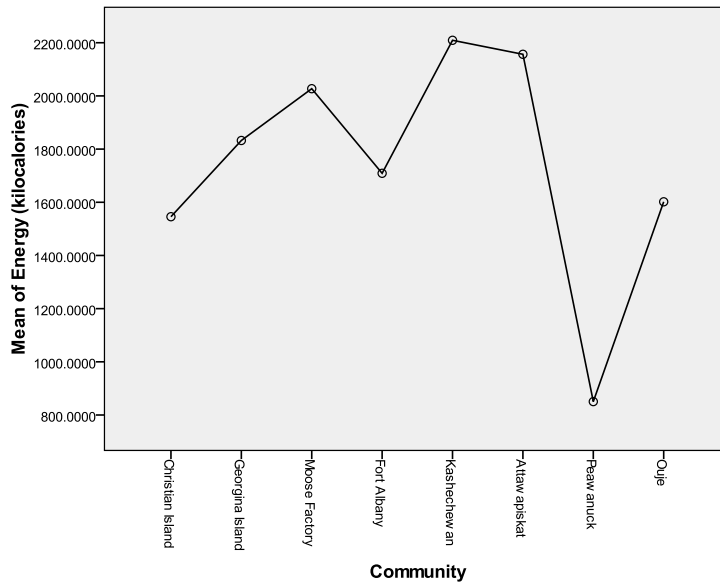
Figure 7.1 Community vs. Mean Energy Intake

The low energy intake also contributes to the idea that Peawanuck may have reported poor diets due to an overall lack of food. It has also been observed on previous trips to Peawanuck, that there can be times of food insecurity within the community. At the time of the survey there was no Northern Store, there were two independent grocery stores and an independently owned convenience store. A Northern store has since opened in Peawauck (Indian and Northern Affairs Canada, 2008). The opening of the new Northern store may help with consistently providing access to a variety of foods, but also may still have weather and flight issues to overcome. Due to the extremely remote location of this community, there can be even more obstacles to transporting food into the communities. There is no access via winter roads in the winter or by sea in the summer months. All of the foods must be flown in therefore this would not only contribute to higher costs, but may also contribute to food insecurity.

When looking at the mean numbers with respect to the food groups, it is quite apparent that Peawanuck is lacking in almost all groups.

86

	Food Guide	Peaw.	Ouje	Atta.	Kash	FA	MF	GI	CI
Gr	4-6	2.84 (±2.12)	5.78 (±4.25)	5.63 (±4.75)	7.26 (±4.72)	5.05 (±2.78)	5.12 (±2.78)	4.39 (±3.51)	4.65 (±3.62)
V&F	5-6	0.48 (±0.96)	3.23 (±2.45)	3.34 (±3.23)	2.78 (±2.41)	4.02 (±3.76)	2.61 (±2.25)	5.06 (±5.14)	4.99 (±3.15)
Milk	2-4	1.23 (±0.57)	1.97 (±2.33)	2.62 (±2.70)	2.77 (±1.90)	1.80 (±1.50)	1.81 (±1.53)	2.13 (±1.75)	0.89 (±1.27)
Meat	1-2	1.33 (±1.78)	1.91 (±1.98)	3.61 (±3.71)	1.43 (±1.53)	2.10 (±2.14)	2.76 (±2.16)	3.21 (±3.94)	1.80 (±1.45)
Oth	limit	2.55 (±1.72)	3.65 (±2.60)	5.82 (±4.50)	6.38 (±4.65)	4.66 (±3.51)	7.67 (±6.51)	4.42 (±3.29)	4.16 (±3.28)

Table 7.1 - Mean (±SD) Food Group Servings from each Community

In order to investigate further, the components of the HEI-C were analysed against the HEI-C score for the Peawanuck data alone. The results are listed in order of most variance explained to least variance explained; percent saturated fat ($r^2=0.517$), percent fat ($r^2=0.523$), variety ($r^2=0.413$), meat ($r^2=0.216$), other foods ($r^2=0.172$), milk ($r^2=0.097$), cholesterol ($r^2=0.062$), grains ($r^2=0.060$), and vegetables and fruits ($r^2=0.013$). Even though the vegetables and fruits counted for 20 of the 100 points in the HEI-C score, they are still the lowest category. The mean vegetable and fruit serving/day for Peawanuck is 0.48, this is of concern as vegetables have been linked to healthy body weights (Downs et al., 2008). The percent saturated fat and percent fat are the components that account for the most variance in the HEI-C in Peawanuck. This is interesting because Peawanuck has the lowest mean of total saturated fat calories however; they have the highest *percentage* of saturated fat calories compared to all of the other communities. When looking at total fat calories, Peawanuck again has the lowest mean and also has the lowest percentage of total fat calories.

The HEI-C score was also looked at in relation to grade and sex. It was found that grade and sex did not have any effect on the how the children scored on the HEI-C.

7.3 Objective #2a) HEI-C vs. BMI

In the literature and in clinical settings BMI is most often referred to in a categorical sense, as is HEI-C. Therefore, HEI-C and BMI were compared both as categorical variables, with both as continuous variables and with HEI-C as a continuous and BMI as a categorical variable. It was hypothesized that as the HEI-C score increased, BMI would decrease, however, none of the current comparisons showed significant associations between HEI-C and BMI. This could not be attributed to season or year as the paired data did not yield significant results. It is of interest that all associations, albeit non-significant, were negative (e.g., as HEI-C increased, BMI decreased). It would be interesting to see if further research with a larger sample found such an association. Obesity has been linked with low intakes of vegetables and fruits as well as milk products (Downs et al., 2008; Bernard et al., 1995). Although there were no significant correlations seen between the children's BMIs and their food group consumptions in this study, it apparent that they are lacking with respect to vegetable and fruit consumption, as well as milk products consumption. Only two of the communities (Georgina Island and Christian Island) ate an average of the minimum recommendation of 5-6 servings/day of vegetables and fruit and the average of the entire sample was 3.53 servings/day (See above, Table 7.1). Most communities also consumed just under or just above the minimum recommendation of 2-4 servings/day of milk products with the overall average being 1.97 servings/day. Bernard et al., (1995) found in a group of Aboriginal youth, the overweight children consumed a significantly lower amount of milk products than the children in the normal weight category. The overweight/obese students in the current study did not consume a significantly lower amount of milk

products, however, there was a trend towards this. The mean milk products intake of obese students was 1.60 servings/day, for overweight children was 1.98 servings/day and for the other children was 2.05 servings/day.

The lack of association seen between the HEI-C and BMI may have to do with how the HEI-C is normalized for energy intake, which has three different scoring ranges depending on how much total energy is consumed; ≤1600kcals, 1600 – 2200kcals, and ≥2200kcals (Appendix C). If the scoring was the same regardless of how much total energy was consumed, someone who generally eats a large amount of foods may automatically score higher than someone who generally consumes a lower amount of calories by the simple fact that they consume more food. However, this still may occur if a child falls in the greater than 2200kcals category, they may still just consume a lot of foods and therefore satisfy the food group components. Out of the 299 students, 135 fall in the ≤1600 kcal category, 85 in the 1600-2200 kcal category and 79 in the ≥2200 kcal category.

The BMI index can be a useful tool when determining whether children are of a healthy weight or not, however, it does only use height and weight to determine this. Although it is a validated and much used tool, it has not been validated in an Aboriginal youth population. The physical build of Aboriginal children may be different from non-Aboriginal youth and this may alter the validity of the BMI index within this population.

The small sample sizes may also have impaired the ability to find a significant relationship between HEI-C and BMI (See Appendix K).

7.4 Objective #2b) HEI-C vs. "Other Foods"

When looking at the relationship between the HEI-C score and the total percent energy in the child's diet that is coming from "other foods", it was expected that a negative relationship would be seen. Even though they are two different measures of "other foods", the number of servings of "other foods" consumed is one of the components of the HEI-C scoring system.

For all of the data combined, the regression showed a significant negative association between the amount of "other foods" consumed and the HEI-C score. When looking at the paired data of Fort Albany and Christian Island there was a significant, negative correlation showing that as the total percent energy consumed from "other foods" increased, the HEI-C score decreased. When looking at the pairs of Fort Albany & Kashechewan and Attwapiskat & Peawanuck and Moose Factory & Fort Albany, there were no significant associations seen. The regression including the Attawapiskat and Peawanuck pair rounds off to be significant (p=0.053).

A second regression was then run to look at all of the components that make up the HEI-C in order to see how much of the variability in the HEI-C score was accounted for by each of the components. The significant associations between the HEI-C score and its components are expected. The chart showing all of the regressions and how the different components ranked in each test can be found in section 6.4 Objective #2b): HEI-C vs. "other Foods".

The table shows that meat tends to be at the lower end of variance explained. Cholesterol and "other foods" also tend to explain the least amount of variance. At the other end of the spectrum, vegetables and fruits almost always explain the most variance; however they were scored out of 20, compared to all of the other components that were scored out of 10. Another component that seems to explain a large portion of the variance was the variety score, followed by percent fat and percent saturated fat. To see more information on the components of the HEI-C, see Appendix F for the mean and SD.

The fact that "other foods" tended to explain a smaller amount of variance may have contributed to the lack of association seen between total percent energy from "other foods" and the HEI-C score as discussed above.

7.5 Objective #2c) HEI-C vs. Game consumption

When looking at the HEI-C and game consumption, it was expected that as game consumption increased, so would the HEI-C score. However, there were no significant associations seen when all of the data were combined or in any of the paired data sets. With this in mind, all of the correlations, with the exception of the Attawapiskat and Peawanuck pair, were positive correlations.

Of the total 299 students included in the analysis, there were 39 that did not answer the question concerning game consumption. Of the 260 students that answered the game consumption question, there were 54 that answered 1) rarely or never eating game, 67 that reported eating game 2) two to four times per month, 28 students reported eating it 3) two to four times per week, 29 said that they eat game 4) five to six times per week, 47 eat it 5) once a day and 35 reported consuming it 6) at least twice a day.
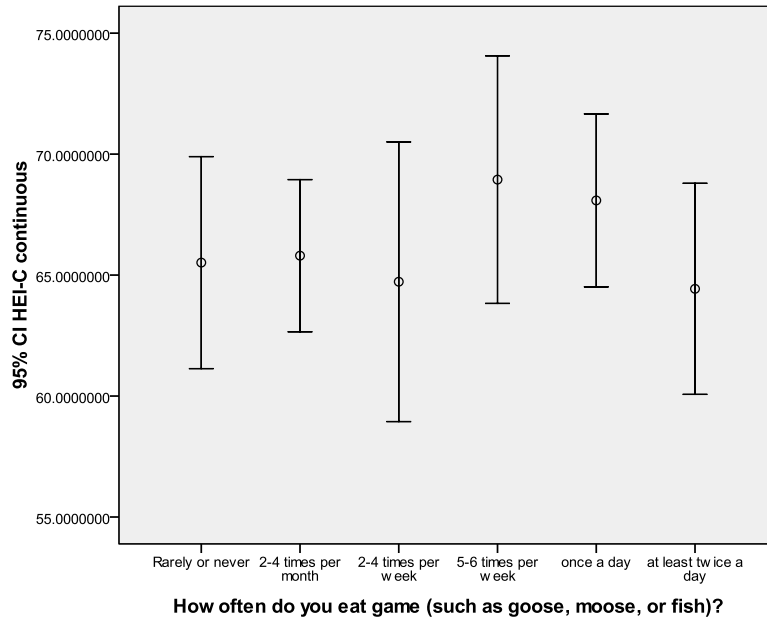
Figure 7.2 All Data: HEI-C vs. Game Frequency

When looking at the different communities, game consumption as a continuous variable of times per week was significantly different between them (F=2.354, p=0.024). The following lists the communities from highest game consumption to lowest game consumption in servings per week; Attawapiskat (5.33), Fort Albany (5.09), Ouje-Bougoumou (4.76), Kashechewan (4.60), Peawanuck (4.34), Moose Factory (2.89), Christian Island (2.80), Georgina Island (1.03) (See Appendix I: Game Consumption by Communtiy). Note that the three most southern communities are also the three lowest with respect to game consumption; however, the most northern community is not the highest with respect to game consumption. Season may play a role in these results as Moose Factory, Georgina Island and Peawanuck were surveyed in the winter and Christian Island was sampled in the fall. However, Attawapiskat was also surveyed in the winter and was the community with the highest game consumption.

92

The two communities that scored the highest on the HEI-C are also the two communities that consume the least amount of game (Christian Island and Georgina Island). However, the community with the third highest HEI-C score is also the community that consumes the most game (Attawapiskat). These differences seen may be the reflection of an adaption of a more western diet by the southern communities and the following of a more traditional diet by the more northern community. The more southern communities of Christian Island and Georgina Island may not consume a high amount of game, but still score high on the HEI-C. Attawapiskat may be a community that follows a more traditional diet, having the highest amount of game consumption and also scored well on the HEI-C because of this.

Game consumption was also significantly different between seasons (F=5.103, p=0.007). Spring was significantly higher than autumn (p=0.006). Traditionally, there were six different hunting seasons, summer (after break-up), fall, early winter, winter, early spring, and late spring (Tsuji & Nieboer, 1999). Different species were hunted depending on the season and just enough game would be harvested as was needed. Due to several advances in technology such as transportation, refrigeration and hunting weapons, the hunts have changed over the years and are presently quite different than they were 60 years ago. There now seems to be two major hunting seasons, one in the spring and one in the fall where waterfowl are harvested (Tsuji & Nieboer, 1999).

7.6 Objective #2d) HEI-C vs. Eating Outside the Home

It was expected that eating outside of the home would decrease the HEI-C score, but this was not seen. When looking at the HEI-C score and eating outside of the home

at different locations none of the associations were significant. When looking at the HEI-C score and the composite score of eating outside the home, there were again no associations found.

The Fort Albany and Kashechewan data rounds off to a significant relationship (p=0.052) with a negative association between the composite score of eating outside the home and the HEI-C score. The pair of Attawapiskat and Peawanuck data were approaching significance (p=0.071), however, this time with a positive relationship between the composite score and the HEI-C score. When investigating further, there was also no association seen between BMI and eating outside of the home. It was hypothesized that children who ate outside of the home more often would have a lower HEI-C score as the literature shows that meals eaten outside of the home are often higher in calories and fat then when meals are prepared and eaten at home (O'Dwyer et al., 2005).

More northern, on reserve populations have fewer options when it comes to restaurants and fast food eateries in comparison to more southern off reserve populations. This may contribute to why no association was seen between eating outside the home and the HEI-C score. Peawanuck, the most northern community, had the lowest overall frequency of eating outside the home (1.66 times/week). Out of all of the different locations asked about in this community (school cafeteria, fast food restaurants, other restaurants, vending machines, snack bars and convenience stores) the only two locations that had responses were snack bar and convenience store. The community with the highest mean of eating outside the home was the most southern community of Georgina Island (17.50 times/week). Georgina Island is located approximately an hour north of

94

Toronto and has access to urban centres year round. The ability for residents to travel to larger cities is relatively easy and therefore they would have more opportunities and more of a variety when it comes to eating outside of the home. Also, the grades six, seven and eight children attend Morning Glory School which is part of the York School Board and is located on the mainland in Pefferlaw, ON. At the time of the survey, there were no restaurants or food outlets surrounding the school, however, since the children are already on the mainland, it may have been easier to access local restaurants or snack bars.

Out of all of the possible locations, Georgina Island had the highest response rates for all of the locations with the exception of school cafeteria and snack bar. Those two locations were eaten at most by the children in Attawapiskat, which had the second highest overall mean of eating outside the home (11.57 times/week). Attawapiskat is one of the communities located on the western side of the James Bay. It is accessible year round by air and by the ice roads in the winter months. It was surveyed in the winter and has a hockey arena that hosts tournaments and games for the surrounding communities and also has a canteen inside the arena. The Northern Store in Attawapiskat also has a Kentucky Fried Chicken and Pizza Hut inside of it, which may have been considered a snack bar by the children being surveyed.

Moose Factory was the community with the second lowest mean of eating outside the home, which is somewhat unexpected as it is one of the more southern communities. The population of Moose Factory can easily access the mainland and is only 5 km away from Moosonee.

Christian Island is the second most southern community, located near Georgina Island; however, it had the third lowest mean with respect to eating outside of the home.

Unlike Georgina Island, the children in grades six, seven and eight attend the public
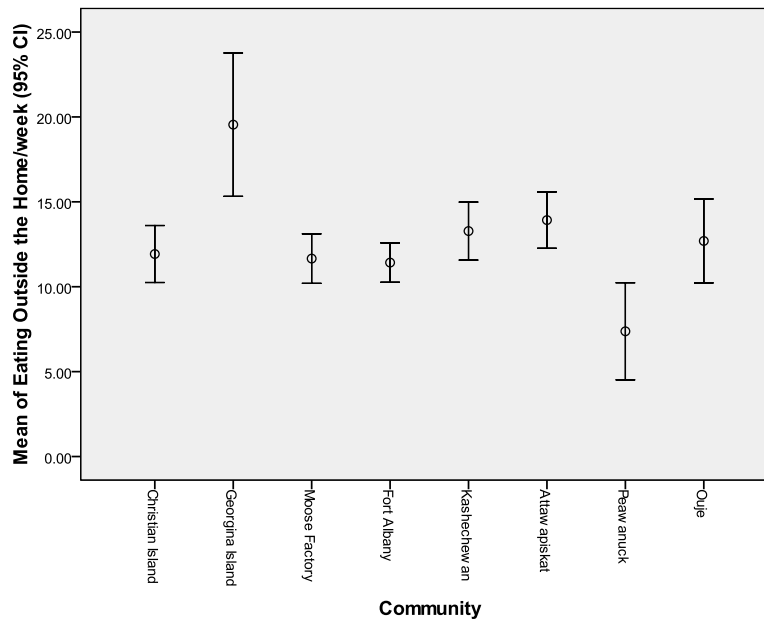
school on the island.

Figure 7.3 Frequency of Eating Outside the Home Times per Week

	School café	Fast food	Other Rest	Vending Machine	Snack Bar	Conv Store	Composite Score / wk
Christian Island	1.39 (±2.69)	1.35 (±1.72)	0.69 (±1.26)	0.76 (±1.41)	1.11 (±1.69)	2.45 (±2.35)	6.13 (±6.11)
Georgina Island	1.00 (±2.32)	*4.60* (±*1.90*)	*4.30* (±1.70)	*4.00* (±2.45)	2.80 (±2.10)	*4.67* (±2.50)	*17.50* (±11.40)
Moose Factory	0.33 (±1.13)	1.20 (±2.05)	0.80 (±1.47)	0.69 (±1.87)	1.23 (±1.90)	2.46 (±2.61)	5.80 (±6.59)
Fort Albany	1.06 (±2.30)	0.79 (±1.79)	0.60 (±1.68)	0.51 (±1.51)	1.37 (±2.40)	2.95 (±2.80)	6.45 (±6.54)
Kashechewan	1.43 (±2.55)	1.62 (±2.74)	0.61 (±1.69)	0.71 (±1.89)	2.83 (±3.18)	3.10 (±3.07)	9.97 (±9.62)
Attawapiskat	*2.74* (±3.30)	2.20 (±2.64)	1.29 (±2.40)	1.41 (±2.57)	*3.51* (±3.02)	3.52 (±2.81)	11.57 (±9.57)
Peawanuck	0.00 (±0.00)	0.00 (±0.00)	0.00 (±0.00)	0.00 (±0.00)	0.75 (±1.48)	1.86 (±2.67)	1.66 (±2.96)
Ouje-Bougoumou	0.85 (±1.89)	1.69 (±2.12)	1.88 (±2.20)	1.07 (±1.69)	2.24 (±3.06)	2.81 (±2.63)	8.50 (±8.43)

Table 7.3 Mean of Eating Outside the Home at Different Locations (±SD)

7.7 Objective #2e) HEI-C vs. Latitudinal Variance

The latitudinal position of the communities seems to have an effect on the HEI-C score. It was originally thought that the more northern communities would consume more game and more of a traditional diet since they were further away from the urban sprawl however, the opposite relationship was seen. The HEI-C scores were lower in the more northern communities. The main difference was seen between Christian Island and Peawanuck, with Peawanuck having a lower mean HEI-C score than Christian Island. This was the opposite of what was hypothesized. The analysis was also run with the paired data, however, the only pair that showed a significant relationship was between Attawapiskat and Peawanuck (p=0.007). This is most likely due to the remoteness of Peawanuck, as discussed above. These communities are located far from each other, which may also contribute to the differences seen.

There may be some disparities seen between northern and southern communities due to the simple availability of foods. Only the two most southern communities consumed closer to the recommended vegetable and fruit servings, which is concerning since it has been shown that children who eat more servings of vegetables and fruits are less likely to have central adiposity (Downs et al., 2008). However, Peawanuck was the community with the lowest consumption of vegetables and fruits (with a mean of 0.48 servings/day); it was also the community with the lowest percentage of energy coming from "other foods" and was also the lowest overall with respect to total calories consumed (850 kcals). The estimated energy requirement (EER) for children in this age group is much higher. Males and females between the ages of 9 – 13 years old have an EER of 2279 kcal/day and 2071 kcal/day, respectively (Whitney & Rolfes, 2008). All of

these factors may be the result of food insecurity. Surveys such as Canada's National Population Healthy Survey and the Canadian Community Health Survey, which do not even include on-reserve populations, show that Aboriginals are at a higher risk of being food insecure (Che & Chen, 2003; Sheilds, 2006). That fact combined with a remote community may increase the risk of dealing with food insecurity.

The community that had the second lowest score on the HEI-C, Moose Factory may have scored so poorly for opposite reasons. This community ranked second lowest on vegetable and fruit consumption (2.61 servings/day), but also had the highest mean of total percent energy coming from "other foods"; however, their overall calorie intake which was third highest (2027 kcals) is very close to the recommended EERs stated above. This may suggest that "other foods" are displacing healthier, nutrient dense foods.

The community that scored the highest on the HEI-C was one of the most southern communities, Christian Island. This community was second highest with respect to vegetable and fruit consumption (4.99 servings/day), it was third highest of their total percent energy coming from "other foods" and had the second lowest overall energy intake (1545.7 kcals).

7.8 Overall Discussion and Future Research Possibilities

One very important finding in this research is that overweight and obesity in these eight Aboriginal communities are high. This has been seen in several Aboriginal youth populations and still seems to be an issue that needs to be addressed. This concern has several contributing factors and how these factors are working synergistically to affect a child's health still needs much more investigation.

The HEI – C has been a very useful tool in evaluating the diets of children at a population level. In order to obtain an overview of several children's diets with adjustments made for how many total calories they consume, the HEI-C is an easily computable and obtainable way of using 24 hour diet recall data to do so. The overall results are similar to results seen in the southern Ontario population (Woodruff, Hanning, McGoldrick, & Brown, 2010). A study conducted with schools in the Peel District School Board consisted of 1, 293 grade six, seven and eight students, in which the mean HEI-C score was 64.5 (S.D. 12.9) (Woodruff et al., 2010). The overall mean in the Aboriginal youth population of the current study was 65.9 (S.D. 14.34). When looking at the HEI-C in terms of categories, the scores between the two groups are also very similar. In the study including the Peel region students 13% fell in the Poor category, 75% in the Needs Improvement and 12% in Good (Woodruff et al., 2010). In this current research, 15% of the Aboriginal children were in the Poor category, 70% were in the Needs Improvement category and 15% were classified as having a Good diet. However, when comparing the BMIs between the two groups of students, large discrepancies can be seen. As discussed above, in section 6.1 Overall Descriptive Statistics, the rates of overweight and obesity seen in this Aboriginal group were 36% and 15% respectively. In the Peel region students, the self-reported overweight and obesity rates were much lower at 15% and 3% respectively (Woodruff et al., 2010). Considering the HEI-C scores are similar, but the BMIs are quite different between these two groups, this might point to some of the differences seen other than diet quality such as physical activity. Another form of measurement of overweight and obesity may be needed in the Aboriginal community. Future studies may also want to record central adiposity as a secondary form of

measurement. A study including Cree children conducted by Downs et al. in 2008 used BMI and central adiposity measures, this may be a better approach to help to understand their body composition.

There may be some limitations to the HEI-C score in this population as well. The component that explained the least variance of the HEI-C was cholesterol. This may not be an appropriate measure to include, as children tend not to have issues with cholesterol. Females over the age of 50 and males over the age of 40 are considered to be at risk for high cholesterol (HealthyOntario.com, 2009). As well, current studies have shown us that dietary cholesterol may not affect blood cholesterol, rather it is how the body handles the cholesterol as well as the intake of saturated fat and total fat that may play a more important role in blood cholesterol levels (Edington et al., 1987; Fernandez, 2006). Another change may be to change the vegetable and fruit score from the current combined component worth 20 points, to two separate components each worth 10 points. This would allow insight into whether the child is scoring high in that section due to consuming more fruit alone, more vegetables alone, or if there is a balance between the two.

This study did not see any significant associations between game consumption and may have been limited when looking into this area. Traditional foods have been shown to be part of a healthy diet in the Aboriginal population (Kuhnlein & Receveur, 2007), however, this study only looked at game, which is a large part of traditional foods but not the only part of traditional foods. Future research should include all traditional foods and should also look at the individual traditional foods and how they contribute to eating a healthy diet. There have been several studies that have shown that including

traditional foods in the diet is beneficial to the overall diet quality (Kuhnlein & Receveur, 2007; Willows, 2005). However, there may also have been no association seen in this study as Aboriginal children tend to consume less traditional foods compared to their elders (Kuhnlein & Receveur, 2007; Willows, 2005).

The location of the community also has an impact on their mean HEI-C score. It seems that the more northern communities in remote locations may face even more difficulty when trying to import food. Although it did not show up as a significant relationship in the present study, it seems that the southern communities have a higher percentage of their total energy coming from "other foods" compared to more northern communities.

The Aboriginal population has endured several lifestyle changes over the past 50 or 60 years. The creation of reserves and residential schools has left a large hole in their traditional ways. The shift from what was an extremely active way of life through hunting and gathering across a vast amount of land to a more sedentary life of small communities, higher consumption of market foods, and lack of physical activity. The remoteness of their communities contributes to their lack of access to fresh and healthy foods, but it is also what keeps them connected to their roots, their traditional way of life. This study has shown that the latitudinal position of the communities has an impact on the quality of their diets. This may be due to higher risk of overall food insecurity in the more northern communities, as well as lack of fresh fruits and vegetables which was significantly different between latitudes with the more northern communities consuming less. Therefore, the further north and more remote the community, the less healthy their diet is. The season also had a significant impact on the quality of diet they consumed

with fall having a significantly higher HEI-C score than winter and spring. This may be connected to the weather and the availability to travel in and out of the communities.

From the findings of the current research, there are several areas that need to be investigated further with respect to the quality of diets in Aboriginal populations living on reserve. The impact of season and hunting seasons on diet quality, the remoteness of the communities and what exactly is causing what may be food insecurity as seen in Peawanuck.

Some limitations to this research were a small sample size in some of the analysis. If possible, a larger number of children surveyed may yield more significant findings (See Appendix K). This can be hard to accomplish as the overall population in these communities tend to be small and therefore, the number of children in grades six, seven and eight are lower than would be in an off-reserve school. A larger sample size would have also allowed the data to be tested for normal distribution and to ensure that the data was not skewed in any way. In order to truly test for normal distribution there should be approximately 1000 subjects (Norusis, 2006). This may be a difficult number of students to survey, not only because of the lower populations but also due to the conditions within the communities.

The HEI-C was a very useful tool in assessing the diets of the children. Cholesterol may be an inappropriate measure for children and as shown in the analysis, did not explain much of the HEI-C scores. The measurement of BMI may need to be paired with another measure such as central adiposity as BMI alone may not be an accurate measure for the Aboriginal population.

The use of a 24 hour diet recall may have caused a lower estimate of the caloric intake as participants tend to underreport their intake (Gibson, 2005), however, in this case, there were always people to help the children if they needed it, there were several built in prompts to encourage the children to not forget anything and the anonymity of the survey may also encourage accurate reporting.

Another limitation may be that the data were collected over several years and in different seasons. If this study were to be conducted again, collecting the survey information in the communities as close together as possible would rule out any possibility of the yearly and seasonal effects altering the analysis.

There are several obstacles that can get in the way of conducting the surveys in these communities such as slow or non-functioning internet connections, lack of computers for the children to use and transportation into the communities. Gathering three days of survey information is possible, however, can be difficult. Surveying 1000 students may pose to be a greater challenge.

This study has shed a little more light onto the area of on-reserve Aboriginal children and the current state of their diets. Through the use of the HEI-C, it was shown that the average diet of children living on-reserve "needs improvement". The high rates of overweight/obesity seen in the children in this study, which are concurrent with rates seen in past studies, are extremely concerning. If we truly want to decrease obesity and in turn decrease the risk for diabetes and other chronic diseases, we need to start at the root of the problem and address dietary concerns and their underlying causes. Low vegetable and fruit consumption stands out in this study as a major concern.

Access is another clear issue in northern communities. There may be some levels of food insecurity due to remoteness that need to be researched further. Returning to Social Cognitive Theory (Bandura, 2004), it is recognized that there are many contributing factors that may not all be understood. Nutritional concerns and access issues are ones that were found in this study to be contributing to the prevention of healthy eating.

Students may benefit form programs that aim to increase access to healthy foods as well as increasing knowledge on making healthy choices. The Aboriginal youth population is different from non-Aboriginal youths for many reasons including location, genetics, lifestyle, and physical build. Programs need to be tailored to be the most effective in each community. There may be no improvement in the health of on-reserve Aboriginals if the constraints are not changed beyond the discreet and often unsustainable programs. Solutions to the high rate of obesity and type 2 diabetes need to be found. Obesity and chronic diseases are prevalent throughout Canada. All Canadians need to work to improve their own diets, as well as the diets of future generations.

On-reserve Aboriginal youth may face more difficult obstacles to achieving healthy eating. These obstacles need to be addressed and overcome in order to give them the opportunity to lead a healthy life.

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Appendices:

Appendix A: Food Frequency Questions and Responses

The following data sets; Georgian Island, Christian Island, Attawapiskat, Peawanuck, Moose Factory, Fort Albany 2004, Fort Albany 2007, Fort Albany 2009, Kasheshewan & Ouje-Bougoumou asked:

Question: "How often do you eat/drink the following foods?"

Choices: Candy/chocolate bars, Pizza, Salty snacks, Cola/non-cola, French fries, & Game

*Georgina Island, Christian Island and Fort Albany 2004 only ask about candy consumption and not chocolate bars and Fort Albany 2004 only asks about cola and not about non-cola.

Possible answers for Attawapiskat, Peawanuck, Moose Factory and Ouje-Bougoumou:

At least once/day, 5 – 6 times/week, 2-4 times/month, rarely/never

Possible answers for Georgina Island, Christian Island and Fort Albany 2004:

At least once/week, 2-4 times/month, rarely/never

Possible answers for Fort Albany 2009 and Kasheshewan:

At least twice/day, once a day, 5-6 times a week, 2-4 times a week, 2-4 times a month, rarely/never

The following data sets; Georgina Island, Christian Island, Peawanuck, Attawapiskat, Moose Factory, Ouje-Bougoumou, Fort Albany 2009 and Kashechewan asked:

Question: "How often do you eat meals or snacks prepared away from home?"

The following choices were offered by Georgina Island, Christian Island, Peawanuck, Attawapiskat, Moose Factory, Ouje-Bougoumou, Fort Albany 2009 and Kashechewan:

Choices: School cafeteria, Fast food restaurants, Other restaurants, Vending machines,

Snack bars, Convenience store, Friend/relatives home

The Fort Albany 2004 data set asked:

Question: "How often do you eat meals or snacks from a convenience store?"

And offered the answers:

Answers: Once a day, at least once a week, once a month, rarely/never

Appendix B: Screens from 2005 – 2009 Survey

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About You?

**Youth Food
Behaviour Survey**

Q. How old are you?

I am 13   years old

Q. What grade are you in?

I am in grade 8 .

Q. Boy or Girl?

I am a - gender -

boy
girl
- gender -

<< Previous   Next >>

73 - 24 - 64

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Height and Weight

How do you describe yourself?

Height

I am - select - inches tall OR - select - cm tall

☐ I don't know

I would describe my height as:

○ below average ○ average ○ above average ⦿ not answered

Weight

I weigh about - select - lbs or - select - kgs

☐ I don't know

I would describe my weight as:

○ below average ○ average ○ above average ⦿ not answered

Next >>

Breakfast?

Q. How often do you usually eat breakfast?
○ every day
○ more than half of the week (four or more days each week)
○ less than half of the week (three or fewer days each week)
○ on weekends only
○ rarely or never
⦿ not answered

Q. Did anything prevent you from your normal eating patterns yesterday?
(e.g. sickness, trip, party)
○ yes
○ no
⦿ not answered

<< Previous   Next >>

25 - 26 - 27

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Breakfast / Snack

Youth Food Behaviour Survey

Q. How often do you participate in the school snack/breakfast program?

○ every school day

○ more than half of the week (three or more days each week)

○ less than half of the week (two or fewer days each week)

○ rarely or never

○ my school does not have a snack/breakfast program

◉ not answered

[<< Previous]   [Next >>]

26 - 27 - 28

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Meal Times?

Youth Food Behaviour Survey

Q. At which times did you eat anything yesterday?
(Check all that apply)

☐ school snack/Breakfast Program

☐ breakfast

☐ middle of the morning snack

☐ lunch

☐ middle of the afternoon snack

☐ after school snack

☐ dinner/supper

☐ early evening snack

☐ later evening snack

[<< Previous]   [Next >>]

27 - 28 - 23

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121

Food Habits

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Youth Food Behaviour Survey

Q. How often do you eat or drink these foods?

	at least twice a day	once a day	5-6 times a week	2-4 times a week	2-4 times a month	rarely or never	not answered
milk (any type)	○	○	○	○	○	○	◉
salty snacks (like chips or cheesies)	○	○	○	○	○	○	◉
french Fries or other fried potatoes (Wedges, Poutine, etc.)	○	○	○	○	○	○	◉
cola-type pop (such as Coke, Pepsi, Rootbeer)	○	○	○	○	○	○	◉
non-cola type pop (such as Sprite, 7up, Orange Crush)	○	○	○	○	○	○	◉
vitamin-mineral pills (Supplements/vitamins)	○	○	○	○	○	○	◉
pizza	○	○	○	○	○	○	◉
candy, chocolate bars	○	○	○	○	○	○	◉
game (such as goose, moose, or fish)	○	○	○	◉	○	○	◉

<< Previous | Next >>

28 - 23 - 29

Done | Internet | 100%

Eating Out?

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Youth Food Behaviour Survey

Q. How often do you eat meals or snacks prepared away from home?

	once a day	2-6 times a week	once a week	once a month	rarely or never	not answered
school cafeteria (including pizza days and other special meals)	○	○	○	○	○	◉
fast food restaurant or take out	○	○	○	○	○	◉
other restaurants	○	○	○	○	○	◉
vending machines	○	○	○	○	○	◉
tuck shop/snack bar at school or an arena	○	○	○	○	○	◉
convenience stores	○	○	○	○	○	◉
at a friend/relative's home	○	○	○	○	○	◉

<< Previous | Next >>

23 - 29 - 47

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Done | Internet | 100%

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What did you eat for Breakfast and Morning Snacks yesterday?

Youth Food
Behaviour Survey

(click on the item to add it to your plate) We tried to include all of the foods that people eat, but we may have missed some. Choose the foods that most closely match what you ate.

My Breakfast and Morning Snacks Plate

Finished Breakfast and Morning Snacks

There are no items to show!
Click on ☒ to delete an item

Exit ALL Food Screens
(Only if done all meals and an error occured)

Vegetables & Fruits   Grain Products   Meats & Alternatives   Dairy Products

Combination Foods   Beverages   Other Foods   **All Foods**

OR Choose a Starting Letter
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z ALL

This screen allows you to tell us what you had to eat yesterday.

In order to enter your meal follow these instructions

1. choose the **food category of the food you ate**
2. click on the **first letter of the name of the food name**
3. look through the food list and find the **food that most closely matches what you ate - if the food you ate is not on the list, pick something that is similar**
4. click on the name of the food you ate
5. enter the **number of servings of the food that you ate**
6. if your food had toppings on it, **choose the appropriate toppings from each toppings group as they appear**
7. when you have added all the foods for the meal, click on the **"finished" button on the left side**

Internet | 100%

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What did you eat for Lunch and Afternoon Snacks (at school and home) yesterday?

Youth Food
Behaviour Survey

(click on the item to add it to your plate) We tried to include all of the foods that people eat, but we may have missed some. Choose the foods that most closely match what you ate.

My Lunch and Afternoon Snacks (at school and home) Plate

Finished Lunch and Afternoon Snacks (at school and home)

There are no items to show!
Click on ☒ to delete an item

Exit ALL Food Screens
(Only if done all meals and an error occured)

Vegetables & Fruits   Grain Products   Meats & Alternatives   Dairy Products

Combination Foods   Beverages   Other Foods   **All Foods**

OR Choose a Starting Letter
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
ALL
0 foods listed

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index - Windows Internet Explorer

http://uweatwell.com/surveymanager/external/foodintake/index.aspx?surveyID=13850184

Google | G▼ | Go | 157 blocked | Check | AutoLink | AutoFill | Send to▼ | Settings▼

index

University of **Waterloo**

What did you eat for Lunch and Afternoon Snacks (at school and home) yesterday?

Youth Food Behaviour Survey

(click on the item to add it to your plate) We tried to include all of the foods that people eat, but we may have missed some. Choose the foods that most closely match what you ate.

My Lunch and Afternoon Snacks (at school and home) Plate

Finished Lunch and Afternoon Snacks (at school and home)

There are no items to show!

Click on ☒ to delete an item

Exit ALL Food Screens
(Only if done all meals and an error occured)

Your plate was empty, Is this because you did not eat anything or you chose not to answer the question?

Did not eat anything

Did not answer the question

Oops, let me go back

Aboriginal: 13850184

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index.aspx?surveyID=13850184

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125

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Meal Summary Screen

Breakfast and Morning Snacks			Lunch and Afternoon Snacks (at school and home)	
#	Food		#	Food
1	Cheerios		1	Meat and cheese sandwich
1	Milk (1%)		1	Whole Wheat Bread
2	Orange juice		1	Cheddar Cheese
0.5	Banana		1	Ketchup, Mustard or Relish
1.5	Brita water		1	Mayonnaise
			1	Turkey Breast
			1	Salami Slice
			1	Lettuce
			1	Sweet Pepper (Green/Red)
			1	Apple
			1	Carrots (raw)
			1	Chocolate pudding
			2	Snack type crackers
			1	Cheddar cheese
			2	Apple Juice

Right column (partially visible):
#	Food
3	Cranb...
1.5	Black...
1.5	Boiled...
1.5	Pat o...
1.5	Gravy...
1.5	Peas...
1.5	Pat o...
1	Caesa...

Add more to Breakfast and Morning Snacks | Add more to Lunch and Afternoon Snacks (at school and home) | Add m...

Finished with Meals, Next>>

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meal	Grains	Veg/Fruit	Dairy	Meats	Other
Breakfast and Morning Snacks	1	2.5	1	0	0
Lunch and Afternoon Snacks (at school and home)	6	4.4	3.1	1.76	2
Supper	0	8.5	0	1.5	5.5
Other Times	0	0	0	0	6.75

TOTAL	Grains	Veg/Fruit	Dairy	Meats	Other
	7	15.4	4.1	3.26	14.25

Recommended Range of Servings

Category	Age 9-13	Age 14-18		Age 19-50	
	Girls and Boys	Females	Males	Females	Males
Vegetables and Fruit	6	7	8	7-8	8-10
Grain Products	6	6	7	6-7	8
Milk and Alternatives	3-4	3-4	3-4	2	2
Meat and Alternatives	1-2	2	3	2	3
Oils and Fats	2-3 tablespoons of unstaurated fat each day				
Other	In moderation				

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126

Appendix C: HEI-C Scoring

Component	HEI-C Maximum Scores	Minimum Scores
Grains (10 points)	≤1600 kcal: 5 svg 1600 – 2200 kcal: 9 svg ≥2200 kcal: 12 svg	0 svg
Vegetables/fruits (20 points)	≤1600 kcal: 5 svg 1600 – 2200 kcal: 7 svg ≥2200 kcal: 10 svg	0 svg
Milk (10 points)	≤1600 kcal: 2 svg 1600 – 2200 kcal: 2 svg ≥2200 kcal: 3 svg	0 svg
Meat (10 points)	≤1600 kcal: 2 svg 1600 – 2200 kcal: 2.5 svg ≥2200 kcal: 3 svg	0 svg
Other (10 points)	≤1600 kcal: ≤4 svg 1600 – 2200 kcal: ≤6 svg ≥2200 kcal: ≤8 svg	≤1600 kcal: >8 svg 1600 – 2200 kcal: >11 svg ≥2200 kcal: >14 svg
Total Fat (10 points)	≤30% energy from fat	≥45% energy from fat
Saturated Fat (10 points)	≤10% energy from saturated fat	≥15% energy from saturated fat
Cholesterol (10 points)	<300 mg	≥450 mg
Variety (10 points)	At least once serving from each food group	Failure to eat a serving from any food group
TOTAL SCORE	**100**	**0**

* individuals with servings between the minimum and maximum cut-offs are assigned a proportional score for the category

Appendix D: Data Sets Included in Each Objective

	Community and Year									
Objective	GI 03	CI 04	FA 04	FA 07	FA 09	Att 06	Peaw 05	MF 07	Ouje 07	Kash 09
Beginning Descrip.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
#1: HEI-C score Descriptives	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
#2a) HEI-C vs. BMI										
• All data	✓	✓	✓		✓	✓	✓	✓	✓	✓
• CI & FA 04		✓	✓							
• Att & Peaw 05/06						✓	✓			
• FA & MF 07										
• FA & Kash 09					✓					✓
#2b) HEI-C vs. % energy fr other food										
• All data	✓	✓	✓		✓	✓	✓	✓	✓	✓
• CI & FA 04		✓	✓							
• Att & Peaw 05/06						✓	✓			
• FA & MF 07				✓				✓		
• FA & Kash 09					✓					✓
Regression: Components of HEI-C										
• All data	✓	✓	✓		✓	✓	✓	✓	✓	✓
• CI & FA 04		✓	✓							
• Att & Peaw 05/06						✓	✓			
• FA & MF 07				✓				✓		
• FA & Kash 09					✓					✓
#2c) HEI-C vs. Game Frequency										
• All data	✓	✓	✓		✓	✓	✓	✓	✓	✓
• CI & FA 04		✓	✓							
• Att & Peaw 05/06						✓	✓			
• FA & MF 07										
• FA & Kash 09					✓					✓

	1	2	3	4	5	6	7	8	9	10
#2d) HEI-C vs. Eating Outside the Home										
• All data	✓	✓	✓		✓	✓	✓	✓	✓	✓
• CI & FA 04		✓	✓							
• Att & Peaw 05/06						✓	✓			
• FA & MF 07										
• FA & Kash 09					✓					✓
#2e) HEI-C vs. Latitude										
• All data	✓	✓	✓		✓	✓	✓	✓	✓	✓
• CI & FA 04		✓	✓							
• Att & Peaw 05/06						✓	✓			
• FA & MF 07				✓				✓		
• FA & Kash 09					✓					✓

Data sets I AM using:
*Georgina Island Dec 03 (Winter)
Christian Island Oct 04 (Fall)
Fort Albany Nov 04 (Fall)
Fort Albany Dec 07 (Winter)
Moose Factory Feb 07 (Winter)
Fort Albany June 09 (Spring)
Kash June 09 (Spring)
Attawapiskat Feb 06 (Winter)
Peawanuck Dec 05 (Winter)
*Ouje April 07 (Spring)
* Ouje and Georgina Island are NOT paired

Data sets NOT included:
Christian Island Nov 03 (Fall)
Fort Albany May 05 (Spring)
Fort Albany July 05 (Summer)
Fort Albany May 08 (Spring)
Kash May 2009 (Spring)

Appendix E: Foods NOT Included in "Other Foods" Category:

- Hot tea
- Bottled water
- Tuna/salmon sandwich
- Chicken salad sandwich
- Other meat pie
- Ketchup/relish/mustard
- Coffee
- Egg salad sandwich
- Cheese and meat burrito
- Macaroni and cheese
- Chicken fingers
- Rice krispie square
- Diet coke
- Kraft dinner
- Sheperd's pie
- Cheeseburger
- Other sandwhich
- Caesar salad
- Beef burger
- Tea blos
- Chicken nuggets
- Beef pie
- Spaghetti and meatballs
- Pizza
- Garlic bread
- Pumpkin pie
- Goose and dumplings
- Chicken pie
- Grilled cheese sandwich
- Chicken casserole
- Plain granola bar
- Milk (instant)
- Gum

Appendix F: HEI-C Components by Community

HEI-C Components	Mean	±SD	Minimum	Maximum
Grain Products (servings/day)	4.65	3.62	0.00	16.01
Vegetables and Fruit (servings/day)	4.99	3.15	0.14	17.19
Milk and Alternatives (servings/day)	0.89	1.27	0.00	5.63
Meat and Alternatives (servings/day)	1.80	1.45	0.00	6.50
Other Foods (servings/day)	4.16	3.28	0.00	14.53
Percent Fat	29.59	10.61	1.66	52.05
Percent Saturated Fat	9.54	4.22	0.16	20.24
Cholesterol (milligrams)	135.10	146.73	0.00	641.7
Variety (score out of 10)	7.21	2.30	0.00	10.00

Christian Island: HEI-C Components

HEI-C Components	Mean	±SD	Minimum	Maximum
Grain Products (servings/day)	4.39	3.51	0.00	10.0
Vegetables and Fruit (servings/day)	5.06	5.14	0.00	19.75
Milk and Alternatives (servings/day)	2.13	1.75	0.00	4.50
Meat and Alternatives (servings/day)	3.21	3.94	0.00	14.50
Other Foods (servings/day)	4.42	3.29	0.00	12.50
Percent Fat	32.33	11.77	6.67	50.52
Percent Saturated Fat	11.55	4.96	1.07	17.87
Cholesterol (milligrams)	283.42	371.39	0.00	1346.23
Variety (score out of 10)	7.92	2.34	2.50	10.00

Georgina Island: HEI-C Components

HEI-C Components	Mean	±SD	Minimum	Maximum
Grain Products (servings/day)	5.12	2.78	0.00	12.99
Vegetables and Fruit (servings/day)	2.61	2.22	0.00	7.60
Milk and Alternatives (servings/day)	1.81	1.53	0.00	5.17
Meat and Alternatives (servings/day)	2.76	2.16	0.00	6.95
Other Foods (servings/day)	7.67	6.51	0.00	34.65
Percent Fat	29.31	10.23	6.52	46.37
Percent Saturated Fat	9.59	4.06	1.95	16.77
Cholesterol (milligrams)	201.26	168.55	15.00	612.72
Variety (score out of 10)	7.76	2.08	2.5	10.00

Moose Factory: HEI-C Components

HEI-C Components	Mean	±SD	Minimum	Maximum
Grain Products (servings/day)	5.05	2.78	0.5385	11.61
Vegetables and Fruit (servings/day)	4.01	3.76	0.00	15.72
Milk and Alternatives (servings/day)	1.80	1.50	0.00	8.13
Meat and Alternatives (servings/day)	2.10	2.14	0.00	10.50
Other Foods (servings/day)	4.66	3.51	0.00	14.51
Percent Fat	31.12	8.85	14.67	54.87
Percent Saturated Fat	11.26	3.94	3.48	21.00
Cholesterol (milligrams)	224.55	231.97	4.25	1058.17
Variety (score out of 10)	7.65	2.36	10.00	10.00

Fort Albany: HEI-C Components

HEI-C Components	Mean	±SD	Minimum	Maximum
Grain Products (servings/day)	7.27	4.71	0.00	19.00
Vegetables and Fruit (servings/day)	2.78	2.41	0.00	11.50
Milk and Alternatives (servings/day)	2.77	1.90	0.00	7.20
Meat and Alternatives (servings/day)	1.43	1.53	0.00	4.95
Other Foods (servings/day)	6.38	4.65	0.00	22.00
Percent Fat	30.56	9.78	6.67	48.71
Percent Saturated Fat	11.83	4.34	2.34	19.24
Cholesterol (milligrams)	273.73	355.94	0.00	1496.77
Variety (score out of 10)	7.73	2.37	2.5	10.00

Kashechewan: HEI-C Components

HEI-C Components	Mean	±SD	Minimum	Maximum
Grain Products (servings/day)	5.63	4.75	0.00	20.10
Vegetables and Fruit (servings/day)	3.34	3.23	0.00	16.44
Milk and Alternatives (servings/day)	2.62	2.70	0.00	11.61
Meat and Alternatives (servings/day)	3.61	3.71	0.00	15.99
Other Foods (servings/day)	5.82	4.50	0.00	24.36
Percent Fat	32.96	12.19	0.05	56.13
Percent Saturated Fat	7.97	5.31	0.00	23.53
Cholesterol (milligrams)	212.19	257.10	0.00	1201.36
Variety (score out of 10)	8.03	2.25	0.00	10.00

Attawapiskat: HEI-C Components

HEI-C Components	Mean	±SD	Minimum	Maximum
Grain Products (servings/day)	2.84	2.12	0.00	5.73
Vegetables and Fruit (servings/day)	0.49	0.96	0.00	2.92
Milk and Alternatives (servings/day)	1.23	0.57	0.00	2.20
Meat and Alternatives (servings/day)	1.33	1.78	0.00	4.50
Other Foods (servings/day)	2.55	1.71	0.00	4.93
Percent Fat	27.57	16.11	1.38	55.18
Percent Saturated Fat	12.37	8.93	0.45	33.68
Cholesterol (milligrams)	166.11	190.69	0.00	637.23
Variety (score out of 10)	5.50	1.97	2.50	7.50

Peawanuck: HEI-C Components

HEI-C Components	Mean	±SD	Minimum	Maximum
Grain Products (servings/day)	5.78	4.25	0.68	14.65
Vegetables and Fruit (servings/day)	3.23	2.45	0.00	7.90
Milk and Alternatives (servings/day)	1.97	2.33	0.00	11.20
Meat and Alternatives (servings/day)	1.91	1.98	0.00	8.59
Other Foods (servings/day)	3.65	2.60	0.00	9.38
Percent Fat	28.11	9.76	10.46	46.30
Percent Saturated Fat	10.92	4.25	4.57	20.05
Cholesterol (milligrams)	230.91	239.85	23.68	805.11
Variety (score out of 10)	7.60	2.50	0.00	10.00

Ouje-Bougoumou: HEI-C Components

Appendix G: BMI by Community

Community	n	Mean	Median	±SD	Min	Max	% Obese	% Over-weight	% Other
Christian Island	38	22.26	21.52	3.71	15.73	31.24	18.92	37.84	43.24
Georgina Island	8	18.92	18.34	4.87	13.89	29.62	12.50	0	87.50
Moose Factory	33	22.04	20.43	6.33	16.30	53.87	11.76	20.59	67.65
Fort Albany	61	22.06	21.67	3.97	13.59	33.52	6.56	39.34	54.10
Kashechewan	42	23.84	22.68	6.00	16.71	50.94	21.43	33.33	45.24
Attawapiskat	40	21.63	22.14	4.66	10.42	30.86	15.00	45.00	40.00
Peawanuck	7	22.87	24.71	3.86	18.61	27.18	37.50	25.00	37.50
Ouje-Bougoumou	21	26.39	25.47	7.62	17.52	45.82	28.57	47.62	23.81
Total	250	23.04	21.87	7.17	10.42	53.87	15.94	35.46	48.61

BMI by Community

Appendix H: Total Percent Energy from "Other Foods" by Community

Community	Mean	Median	±SD	Minimum	Maximum
Christian Island	19.54	16.89	17.41	0.00	59.67
Georgina Island	18.85	18.60	16.52	0.00	46.82
Moose Factory	28.49	24.38	17.23	0.00	60.29
Fort Albany	17.44	14.20	16.51	0.00	75.08
Kashechewan	17.56	11.47	19.30	0.00	72.71
Attawapiskat	20.77	14.58	22.97	0.00	100.00
Peawanuck	9.85	9.26	10.23	0.00	30.01
Ouje-Bougoumou	15.83	15.04	14.64	0.00	50.26
Total	19.41	15.41	18.17	0.00	100.00

Total Percent Energy from "other foods"

Appendix I: Game Consumption by Community

Community	Mean	Median	±SD	Minimum	Maximum
Christian Island	2.80	0.75	4.63	0.00	14.00
Georgina Island	1.03	0.00	1.95	0.00	5.50
Moose Factory	2.89	0.75	4.13	0.00	14.00
Fort Albany	5.09	5.50	4.44	0.00	14.00
Kashechewan	4.60	3.00	4.5	0.00	14.00
Attawapiskat	5.32	5.50	4.73	0.00	14.00
Peawanuck	4.34	3.00	4.36	0.00	14.00
Ouje-Bougoumou	4.76	3.00	4.80	0.00	14.00
Total	4.25	3.00	4.63	0.00	14.00

Game Consumption: Times Eaten per Week

Appendix J: Eating Outside the Home by Community

Community	Mean	Median	±SD	Minimum	Maximum
Christian Island	11.93	4.25	5.32	2.00	22.00
Georgina Island	19.55	16.5	6.28	4.00	28.00
Moose Factory	11.66	4.25	4.24	4.00	24.00
Fort Albany	11.42	4.88	4.63	4.00	22.00
Kashechewan	13.28	7.75	5.55	6.00	30.00
Attawapiskat	13.93	12.00	6.02	3.00	30.00
Peawanuck	7.38	0.00	3.42	1.00	12.00
Ouje-Bougoumou	12.70	5.00	5.72	2.00	22.00
Total	12.60	6.25	5.53	1.00	30.00

Composite Score of Eating Outside the Home: Times per week

Appendix K: Sample Calculations

BMI Category Comparisons	n Needed to See Difference
Other – Overweight	5, 516, 265
Other – Obese	2, 043
Overweight - Obese	1, 968

HEI-C vs. BMI Category

Game Frequency Comparisons	n Needed to See Difference
Rarely/never – 2-4 times/month	227, 136
Rarely/never – 2-4 times/week	27, 828
Rarely/never – 5-6 times/week	1, 518
Rarely/never – once a day	2, 682
Rarely/never – at least twice a day	14, 994
2-4times/month – 2-4 times/week	15, 270
2-4times/month – 5-6 times/week	1, 800
2-4times/month – once a day	3, 372
2-4times/month – at least twice a day	9, 492
2-4 times/week - 5-6 times/week	1, 002
2-4 times/week – once a day	1, 566
2-4 times/week – at least twice a day	211, 740
5-6 times/week – once a day	24, 654
5-6 times/week – at least twice a day	876
Once a day – at least twice a day	1, 326

HEI-C vs. Game Frequency

These sample size calculations are with respect to the one-way ANOVAs that were run looking at differences in the BMI categories and game frequency categories with respect to HEI-C scores. They are based on a power of 80%