

**Investigation of vegetable and fruit intake of First Nation schoolchildren:
Do school nutrition programs make a difference?**

by

Allison Gates

A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Master of Science
in
Health Studies & Gerontology

Waterloo, Ontario, Canada, 2010

© Allison Gates 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

Objectives: To investigate the vegetable and fruit, “other” foods, fibre, folate, vitamin A, and vitamin C intakes of First Nations children and adolescents residing in seven communities in northern and southern Ontario, including variations by year and community, and comparisons to current dietary standards and national averages based on age and sex. Also, to implement and assess the impact of two school nutrition programs (in Kashechewan and Fort Albany, Ontario) on dietary intakes of vegetable and fruit, “other” foods, fibre, folate, vitamin A, and vitamin C. Also, to evaluate the two school nutrition programs, one a simple food provision program in Kashechewan, Ontario and the other a more comprehensive school nutrition program in Fort Albany, Ontario, in terms of student and teacher impressions and program integrity. For the program in Fort Albany, the impact of the program on nutrition knowledge, self-efficacy, and intentions to eat more vegetables and fruit will also be assessed. Finally, to investigate the association between Body Mass Index (BMI) and vegetable and fruit and fibre intake in First Nations children and adolescents living on reserve in Ontario.

Methods: Dietary intakes were evaluated using 24-hour dietary recall data collected via the validated Web-Based Eating Behaviour Questionnaire (WEB-Q) between 2003 and 2010 in seven First Nations communities in northern (Attawapiskat, Fort Albany, Kashechewan, Moose Factory, and Peawanuck) and southern (Christian Island and Georgina Island) Ontario. Vegetable and fruit, “other” foods, fibre, folate, vitamin A, and vitamin C intakes were compared to current dietary standards and Canadian Community Health Survey Cycle 2.2 (CCHS). Yearly and community differences in intakes were assessed using specific dataset pairs to control for season, year, and community, where conditions were comparable. The association between vegetable and fruit and fibre intake and BMI was investigated using the weight classifications described by Cole and colleagues (2000) and based on self-reported heights and weights. The impact of a simple food provision program in Kashechewan First Nation was examined in terms of vegetable and fruit, “other” foods, fibre, folate, vitamin A, and vitamin C intakes pre-, one-week post, and one-year post program using the WEB-Q. Finally, the impact of a comprehensive school vegetable and fruit education program was evaluated in terms of vegetable and fruit, “other” foods, fibre, folate, vitamin A, and vitamin C intakes, nutrition knowledge and preferences, and intentions and self-efficacy to eat more vegetables and fruit pre- and post-program using validated questionnaires. Within each program, parent/guardian, student, and teacher impressions of the program were evaluated via questionnaires and focus groups.

Results: The majority of participants (n=443 students from seven communities) had intakes of vegetables and fruit and relevant nutrients below current standards, with the exception of vitamin C. Mean intakes of vegetables and fruit fell below Canadian Community Health Survey averages. Mean intakes of “other” foods exceeded vegetable and fruit intakes in all age and sex groups in terms of servings. There was no significant association between vegetable and fruit or fibre intake and BMI. In certain instances, significant variation in intakes existed between different years and communities. Under ideal conditions (short-term, investigator-run portion of the program), the school food provision program in Kashechewan First Nation produced improvements in vegetable and fruit intakes (n.s.). Long-term intakes did not improve. Teacher and principal impressions of the program were overwhelmingly positive. In the short term, the vegetable and fruit, relevant nutrient, and “other” foods intakes of students in Fort Albany did not significantly change following a comprehensive school nutrition education program, and neither did intentions or self-efficacy to eat more vegetables and fruit. However, the program resulted in significantly improved nutrition knowledge, as well as significant improvements in the number of vegetables and fruit that participants had been exposed to and liked. The majority of parents, teachers, and students had positive impressions of the program.

Conclusions: Overall, the dietary intakes of the study participants were characterized by poor intakes of vegetables and fruit and intakes of “other” foods that exceeded vegetable and fruit intakes in all age and sex groups. Rates of overweight and obesity were higher than those reported in the CCHS. With adequate resources and support, school nutrition programs have the potential to improve the vegetable and fruit intakes of children and adolescents living in the communities involved in this research. However, it is probable that the numerous barriers to healthy eating identified in the communities examined blunted the positive effects of the program piloted in this study. Future initiatives should include community-based approaches to improve accessibility of affordable, healthy foods of reasonable quality. In conjunction with school nutrition programs, such programs may have the ability to positively impact the dietary intakes of children and adolescents living on reserve in Ontario.

Acknowledgements

I would like to thank the First Nation communities for participating in this research. This research was funded by the Canadian Institutes of Health Research, Canada's Research-Based Pharmaceutical Companies Health Research Foundation (Rx&D), Health Canada's First Nations and Inuit Health Branch, the Danone Institute of Canada, and the Ontario Ministry of Research and Innovation. Personal support from a master's studentship award from the Heart and Stroke Foundation of Ontario is greatly appreciated. I would also like to acknowledge those who made valuable contributions to this research: Dr. Dan McCarty for helping with the school programs in both Kashechewan and Fort Albany, for aiding in data collection, and for guiding thesis development; Dr. Ian D. Martin for statistical advice; Michelle Gates for help with thesis development and data collection; Megan Chard for helping initiate the snack program in Kashechewan and aiding with data collection; Jenn Toews, Vicky Edwards, and Tina Hlimi for help with data collection; Andrea Isogai for coordinating the school nutrition education program in Fort Albany and aiding with data collection; Kim Stephens for coordinating the school snack program in Kashechewan; principals Bob Salvisburg and George Combden in Kashechewan for their effort and enthusiasm; Joan Metatawabin for aiding with the school nutrition education program and community event in Fort Albany; and finally, Alex Stephens for field transportation. I would like to thank my supervisors Drs. Rhona R.M. Hanning and Leonard J.S. Tsuji for their continued guidance, support, and advice in terms of thesis development, data collection, and analyses.

Table of Contents

List of Figures	xi
List of Tables	xii
1.0 Chapter 1: Introduction and Overview	1
1.1 Statement of the Problem.....	1
1.2 Rationale	2
2.0 Chapter 2: Literature Review	3
2.1 Aboriginal People In Canada: Population Characteristics and Demographics.....	3
2.2 Dietary Concerns, Eating Habits, and Food Availability.....	4
2.2.1 Acculturation and the Nutrition Transition.....	4
2.2.2 Patterns of Dietary Intake.....	5
2.2.3 Food Insecurity.....	7
2.3 Health Concerns Related to Diet, Morbidity, and Mortality.....	10
2.3.1 Health Disparities.....	10
2.3.2 Body Composition as a Risk Factor for Chronic Disease.....	10
2.3.3 Type 2 Diabetes – Morbidity and Mortality.....	13
2.3.4 Type 2 Diabetes – Possible Genetic Associations.....	15
2.3.5 Metabolic Syndrome.....	16
2.4 Possible Health Improvement Strategies.....	17
2.4.1 Targeting Schoolchildren.....	17
2.4.2 A Focus on Vegetable and Fruit Intake.....	19
2.4.3 Framework for Effective School-Based Interventions.....	21
2.4.3.1 Policy Implementation.....	22
2.4.3.2 Healthy Curriculum and Environment.....	24
2.4.3.3 Integration of School Food Service.....	25
2.4.3.4 Training for Teachers and Staff.....	26
2.4.3.5 Family and Community Involvement.....	26
2.4.3.6 Program Evaluation.....	27

2.4.3.7 Possible Challenges and Solutions.....	28
3.0 Chapter 3: Objectives and Hypotheses.....	31
3.1 Objectives.....	31
3.1.1 Objectives for Chapter 4.....	31
3.1.2 Objective for Chapter 5.....	32
3.1.3 Objectives for Chapter 6.....	32
3.2 Hypotheses.....	33
3.2.1 Hypotheses for Chapter 4.....	33
3.2.2 Hypothesis for Chapter 5.....	34
3.2.3 Hypotheses for Chapter 6.....	34
4.0 Chapter 4: Vegetable and Fruit Intakes of On-Reserve First Nations Schoolchildren in Ontario Fall Short of Canadian Averages and Current Dietary Standards.....	35
4.1 Introduction.....	35
4.2 Methods.....	36
4.2.1 Participants.....	36
4.2.2 Vegetable and Fruit and Nutrient Intakes.....	37
4.2.3 Anthropometric Variables and Body Mass Index Classification.....	38
4.2.4 Data Analysis.....	38
4.3 Results.....	40
4.3.1 Comparison of Intakes to Current Dietary Standards and CCHS Data.....	40
4.3.2 Comparison of Intakes by Year.....	42
4.3.3 Differences in Dietary Patterns by Age and Sex.....	47
4.3.4 Comparison of Intakes by Community.....	48
4.3.5 Relationship Between BMI and Vegetable and Fruit and Fibre Intake.....	51
4.4 Discussion.....	52
4.4.1 Conclusions.....	55
4.4.2 Study Limitations.....	55

5.0 Chapter 5: A School-Based Healthy Snack Program in Kashechewan First Nation: Impact on Vegetable and Fruit Intakes	57
5.1 Introduction.....	57
5.2 Methods.....	58
5.2.1 Participants.....	58
5.2.2 Procedures.....	59
5.2.3 Web-Based Eating Behaviour Questionnaire.....	59
5.2.4 Data Analysis.....	60
5.3 Results.....	62
5.3.1 Changes in Food Group and Nutrient Intakes.....	64
5.3.2 Student Impressions of the Program.....	67
5.3.3 Impressions of the Teachers and Principal.....	68
5.3.4 Program Integrity.....	68
5.4 Discussion.....	69
5.4.1 Conclusions.....	71
5.4.2 Implications for School Health.....	71
5.4.3 Study Limitations.....	72
6.0 Chapter 6: Impact of a Comprehensive School Nutrition Education Program on Vegetable and Fruit Consumption, Knowledge, Intentions, and Self-Efficacy of Grade Six to Eight First Nations Students	73
6.1 Introduction.....	73
6.2 Methods.....	75
6.2.1 Participants.....	75
6.2.2 Comprehensive School Vegetable and Fruit Program.....	75
6.2.3 Program Evaluation.....	76
6.2.4 Data Analysis.....	78
6.3 Results.....	79
6.3.1 Nutrient and Food Group Intakes.....	79

6.3.2 Knowledge, Self-Efficacy, and Intentions.....	81
6.3.3 Program Integrity.....	82
6.3.4 Student Impressions.....	83
6.3.5 Teacher Impressions.....	83
6.3.6 Parent/guardian Impressions.....	84
6.4 Discussion.....	85
6.4.1 Study Limitations.....	88
7.0 Chapter 7: Conclusions and Future Directions	89
References	95
Appendices	105
Appendix A: Datasets Used for Each Objective.....	105
Appendix B: Web-Based Eating Behaviour Questionnaire Screen Shots.....	106
Appendix C: Sample Parent Information/Consent Letters.....	109
Appendix D: Program Nutrition Policy and Shopping Guidelines.....	112
Appendix E: Student Handouts.....	117
Appendix F: Parent Resources.....	133
Appendix G: Knowledge, Self-Efficacy and Intention Questionnaire.....	144
Appendix H: Parent/guardian Impressions Questionnaire.....	150

List of Figures

Figure 4.1: Map of participating communities.....37

Figure 4.2: Sex differences in energy-adjusted dietary PC-1 scores.....48

Figure 5.1: Comparison of vegetable and fruit intakes pre-program to one week post-program.....66

Figure 5.2: Comparison of vegetable and fruit intakes pre-program to one year post-program.....66

Figure 5.3: Comparison of vegetable and fruit intakes one week post-program to one year post-program.....67

Figure 6.1: Comparison of vegetable and fruit intakes pre- and post-program.....81

List of Tables

Table 4.1: Dietary standards used to compare student intakes (Adequate Intakes (AIs), Estimated Average Requirements (EARs), Canada’s Food Guide (CFG) recommendations, and Canadian Community Health Survey (CCHS) Averages.....	39
Table 4.2: Characteristics of the study participants.....	41
Table 4.3: Nutrient and food group intakes as compared to current dietary standards	42
Table 4.4: Comparison of study participants in dataset pairs.....	44
Table 4.5: Food group and nutrient intakes by year, controlled for age, sex, season, and community.....	45
Table 4.6: Principal component (PC) analysis scores for vegetables and fruit, related nutrients, and “other” foods.....	47
Table 4.7: Characteristics of study population in dataset pairs.....	49
Table 4.8: Food group and nutrient intakes by community, controlled for age, sex, season, and year.....	50
Table 4.9: Investigation of the relationship between Body Mass Index (BMI), vegetable and fruit, and fibre intakes controlled for age and sex.....	52
Table 5.1: Estimated Average Requirements (EARs), Adequate Intakes (AIs), Canada’s Food Guide recommendations, and Canadian Community Health Survey data to be used in comparing student intakes.....	62
Table 5.2: Characteristics of the study population.....	63
Table 5.3: Intakes of vegetables and fruit, “other” foods, fibre, folate, vitamin A, and vitamin C compared to current recommendations.....	63
Table 5.4: Comparison of changes in intakes between program stages.....	65
Table 6.1: Estimated Average Requirements (EARs), Adequate Intakes (AIs), Canada’s Food Guide recommendations, and Canadian Community Health Survey data to be used in the analysis.....	79
Table 6.2: Characteristic of the study population in the comparison of nutrient and food group intakes pre- and post-program.....	80
Table 6.3: Comparison of nutrient and food group intakes pre- and post-program.....	81
Table 6.4: Characteristics of the study population in the comparison of Knowledge, Self-Efficacy, and Intentions Questionnaire responses pre- and post-program.....	82

Table 6.5: Comparison of Knowledge, Self-Efficacy, and Intentions Questionnaire responses pre- and post-program.....82

1.0 Chapter 1: Introduction and Overview

1.1 Statement of the Problem

Aboriginal people in Canada have experienced a rapid acculturation that has drastically changed their traditional way of life. Canadian Aboriginal populations now rely heavily on market foods, generally of low nutritional quality, in substitute for the traditional foods that had previously been dietary staples. Typical hunting, gathering, and fishing practices have also considerably declined. In terms of health, the detrimental effect that acculturation has had on the diets and lifestyles of Aboriginal people has left them at an increased risk for a number of chronic diseases, namely overweight, obesity, type 2 diabetes and the metabolic syndrome. Explanations for the health disparities in Canada's Aboriginal population include environmental factors such as diet and physical activity, as well as the possibility of a genetic predisposition that may exist in this population. That being said, although unhealthy diets and physical inactivity are immediate contributors to overweight and obesity in this population, the etiology of obesity is complex. The reasons for which a person consumes certain foods are the result of individual factors (physiological factors, psychological factors, food preferences, perceptions of healthy eating, knowledge, and attitudes) and environmental factors (physical, interpersonal, and social factors), all which interact to determine what we eat (Woodruff & Hanning, 2008).

Aboriginal people are one of the most marginalized subpopulations, and consequently face unequal access to resources such as education, health care, and employment, only to name a few. The health disparities facing Aboriginal Canadians are only compounded by high rates of poverty and food insecurity. School nutrition programs may have the potential to reach a large proportion of the population and to improve diets and physical activity levels. The current study will investigate the vegetable and fruit intakes of Aboriginal schoolchildren in Ontario, Canada, and the impact of a school snack program and a comprehensive school nutrition program on the schoolchildren of the Mushkegowuk Territory, on the western coast of Hudson & James Bay, Ontario.

1.2 Rationale

Overweight, obesity, and type 2 diabetes have reached epidemic proportions in Aboriginal populations in Canada, mainly due to poor diets, a lack of physical activity, and possible genetic susceptibility. Poverty and food insecurity only amplify the health problems that this population faces. Even more concerning are the rising prevalences of overweight, obesity, and type 2 diabetes in Aboriginal children. The poor health of many Aboriginal children is setting them up for a lifetime of health problems and most likely a shortened lifespan. Without any intervention, the situation will likely only continue to worsen.

Unfortunately, only limited data are available concerning the diets of Aboriginal children living on reserve in Canada. The paucity of such data makes it difficult to design effective interventions that target the root of the problem. Nevertheless, school-based nutrition and physical activity interventions may be a promising approach, as overweight children are more likely to become overweight adults. Also, as the lifestyle habits of adults are likely to be reflective of what they learned as children, intervening early will set children up for a lifetime of healthy eating and physical activity. Vegetable and fruit intakes are also a promising target, considering the relationships that have been identified between vegetable and fruit intakes, obesity and chronic disease risk.

The communities of the Mushkegowuk Territory desire data from their own communities on which to base interventions to decrease the rates of overweight, obesity, and type 2 diabetes in their people. Between the years of 2003 and 2010, the validated Web-based Eating Behaviour Questionnaire has been used to collect data concerning the dietary and physical activity habits of children in the northern, remote, isolated communities of Attawapiskat, Fort Albany, Kashechewan, Moose Factory, and Peawanuck, Ontario and the southern communities of Christian Island and Georgina Island, Ontario. This research aims to utilize these data as a foundation for the implementation of a pilot healthy school snack program at St. Andrew's School in Kashechewan and a pilot comprehensive school nutrition education program at Peetabeck Academy in Fort Albany.

2.0 Chapter 2: Literature Review

The following literature review aims to present the challenges faced by Aboriginal people in terms of diet and lifestyle concerns, poverty and marginalization, and a possible genetic predisposition to certain chronic diseases. It will also present possible health improvement strategies, namely school nutrition programs targeting Aboriginal children and adolescents.

2.1 Aboriginal People in Canada: Population Characteristics and Demographics

In Canada, 1 172 790 people identify themselves as Aboriginal according to 2006 Census data (Statistics Canada, 2008a). The term “Aboriginal” refers to people of First Nations (FN), Inuit, or Métis heritage. In Canada, 60% of the total Aboriginal population is FN, 33% Métis, and 4% Inuit (Statistics Canada, 2008b). The Aboriginal population in Canada is much younger than the non-Aboriginal population. Nearly half (48%) of the population consists of children and youth aged 24 years or less (Statistics Canada, 2008a), and the median age is 27 years (Statistics Canada, 2008b). For comparison, in the Canadian non-Aboriginal population, 31% are aged 24 years or less and the median age is 40 years. The Aboriginal population is also fast growing, experiencing a growth of 45% between 1996 and 2006, nearly six times the rate of growth seen in the non-Aboriginal population of eight percent (Statistics Canada 2008a). The majority of Canadian Aboriginal people live in Ontario and the western provinces (80%), and they are also reportedly becoming increasingly urban (Statistics Canada, 2008a). In 2006, 54% of Aboriginal Canadians were living in urban areas (Statistics Canada, 2008a), with 25% residing in nine of Canada’s 33 census metropolitan areas (Statistics Canada, 2008b). Census data indicate that ten percent of Aboriginal Canadians live in Winnipeg, making the city the most popular place for Aboriginal people to call home (Statistics Canada, 2008b). Following Winnipeg, Aboriginal people are most likely to live in Edmonton, Vancouver, Toronto, Calgary, Saskatoon, and Regina (Statistics Canada, 2008b).

Of note, census data as well as data from the Canadian Community Health Survey (CCHS) are reflective only of Aboriginal people living off reserve. The lives of Aboriginal people on reserve share similarities but are also different from that of Aboriginal people living off reserve, however, much research targets only off reserve populations. However, no matter where they dwell, Aboriginal people are often among the most marginalized of society (Kuhnlein, Erasmus, Creed-Kanashiro, Englberger, Okeke & Turner, 2006). Poverty and food insecurity

are important issues, and in recent decades, chronic disease, obesity and type 2 diabetes have become epidemic in the Aboriginal population, more so even than in the general population (Young, Reading, Elias & O'Neil, 2000).

2.2 Dietary Concerns, Eating Habits, and Food Availability

2.2.1 Acculturation and the Nutrition Transition

In recent decades, Aboriginal people in Canada have experienced a period of rapid acculturation, characterized by a loss of the traditional lifestyle that typically included hunting, trapping, gathering, and fishing and the consumption of traditional foods including wild plants, fish, and game meats (Kuhnlein, Receveur, Souieda & Egeland, 2004; Willows, 2005a). Prior to acculturation, many Aboriginal people met most, if not all, of their energy requirements through traditional food sources (Kuhnlein et al., 2004). Traditional foods are those that are culturally acceptable and available from local natural resources (Willows, 2005a). Nowadays, Aboriginals are experiencing what has been described as a “nutrition transition”, characterized by the adoption of a more Westernized diet, notably the inclusion of a greater proportion of market foods and a reduction in the proportion of energy being consumed from traditional food sources (Willows, 2005a; Kuhnlein et al., 2004). Today, the percentage of Aboriginal peoples who include traditional foods in their diets is greatly reduced, estimated at only 4-60%, depending on the population (Kuhnlein et al., 2004). In general, market foods are of lower nutritional quality when compared to traditional ones (Willows, 2005a; Kuhnlein et al., 2004). Market foods are generally low in nutrient density, defined as a measure of the nutrients a food provides relative to the energy it provides (Whitney & Rady Rolfes, 2008); and higher in carbohydrate, fat, and sucrose compared to traditional foods (Kuhnlein et al., 2004). Because in many Aboriginal communities (especially remote, isolated ones) market foods of high nutrient density (milk, whole grains, fresh vegetables and fruit) are not available or very expensive, research has indicated that when traditional foods are included in the diet, even in small quantities, micronutrient intakes are improved (Kuhnlein et al., 2004). Although most Aboriginal people believe that traditional foods are inherently healthy (Willows, 2005a), barriers to their consumption are abundant, including a lack of equipment or skills for the procurement of traditional foods, environmental contamination which has made the consumption of some traditional foods unsafe, and changes in migratory patterns secondary to climate change which make traditional foods less available (Power, 2005). Consequently, although Aboriginal children may exhibit a taste preference for traditional foods (Bernard, Lavallee, Gray-Donald & Delisle, 2005);

market food consumption is abundant, and traditional food consumption is declining with every passing generation (Kuhnlein et al., 2004). Today, children tend to consume less traditional foods than adults, young adults less than middle-aged adults, and middle-aged adults less than elders, an indication that younger generations are losing the knowledge of harvesting and preparing traditional foods (Willows, 2005a).

The loss of the traditional lifestyle among Aboriginal Canadians is concerning, as many disease risk factors can be attributed to acculturation and the lifestyle changes it has imposed (Waldram, Herring & Young, 2006). First and foremost, the dietary changes which have led to an increase in market food consumption in combination with a change in lifestyle characterized by a diminished energy expenditure has led to an epidemic of obesity in Aboriginal populations more severe than in the general Canadian population (Canadian Paediatric Society [CPS], 2005; Garriguet, 2008; Tjepkema, 2006; Tremblay, Perez, Ardern, Bryan & Katzmarzyk, 2005). Data from the 2004 CCHS indicate that the odds of obesity in Aboriginal people are more than two and a half times greater than for non-Aboriginals living in Canada (Garriguet, 2008). Overweight and obesity are of particular concern in Aboriginal people as they have been identified as a population particularly susceptible to type 2 diabetes; a metabolic condition for which overweight and obesity are known precursors (Whitney & Rady Rolfes, 2008).

2.2.2 Patterns of Dietary Intake

According to CCHS data, the average energy intakes of Aboriginal people living off reserve are not significantly different in comparison to the general population (Garriguet, 2008). Of note, among women aged 19 to 30 years, the average energy intake is 359 kcal higher for Aboriginal women compared to the general population, even though Aboriginal women do not expend more energy (Garriguet, 2008). They also do not have significantly greater energy needs, and are not significantly more likely to be active during leisure time (Garriguet, 2008). Eating Well with Canada's Food Guide (CFG), as well as its Aboriginal adaptation (Eating Well with Canada's Food Guide for First Nations, Inuit, and Métis), recommends a pattern of eating that describes the types and amounts of foods to be eaten in order to meet current nutrient standards in Canada and to reduce the risk of chronic disease (Health Canada, 2007). The Aboriginal adaptation of CFG recommends foods that are culturally appropriate for this population, while maintaining the same goals as the original version of the guide. As a whole,

many Aboriginal people have intakes below CFG recommendations for food groups, often consuming inadequate vegetables and fruit, milk and alternatives, and grain products (Garriguet, 2008). Even more concerning is the excessive inclusion of “other foods” in the Aboriginal diet. “Other foods” are those foods that do not fit into any of the food groups in CFG, are generally high in fat, sugar, and sodium, and should thus be avoided. Soda consumption is also a concern, as high intakes were reported in the off reserve population (Garriguet, 2008). As soda and other sugar-sweetened beverages are generally very high in sugar but not significant sources of any valuable nutrients, it is a concern that they may be replacing the consumption of milk and 100% fruit juice. Food items from the sandwich category, which includes not only sandwiches but also pizza, subs, hamburgers, and hotdogs are another popular choice among many Aboriginal people, which is concerning as such foods are generally high in saturated fat and sodium, and are considered the number one contributors of fat in the Canadian diet (Garriguet, 2008).

Overall, the diets of Aboriginal populations in Canada are of concern, exhibiting a pattern consistent with poor health outcomes including overweight, obesity and diabetes; Aboriginal children are no exception. Research in Québec, Canada has indicated that the diets of FN children are energy dense yet low in foods of high nutrient density, and that 98.5% of children consume fewer than five servings of vegetables and fruit per day (Downs, Arnold, Marshall, McCargar, Raine & Willows, 2009). Research in the United States has revealed similar data; a study of Native American youths living on reserve revealed higher intakes of certain high fat, salt-cured, nitrite-cured, smoked, and pickled foods (notably American cheese, bacon, and potato chips) than non-Aboriginal children of the same age (Di Noia, Schinke & Contento, 2005). Overall, Aboriginal children in the study had a greater consumption of “other foods” and an infrequent intake of vegetables and fruit, except for potatoes and apples (Di Noia et al., 2005). Less than half of on reserve youth consumed vegetables and fruit on a regular basis (Di Noia et al., 2005). Further research in an Aboriginal population in Australia revealed that children consumed inadequate portions of fresh fruit, resulting in low vitamin C intakes, theoretically making them more infection prone (Jones, 2006).

There is evidence that the diets of Aboriginal children are contributing to the burden of overweight and obesity in the population. For example, research in the FN community of Sandy Lake, Ontario indicated that

children who had greater fibre intakes were less likely to be overweight (Hanley, Harris, Gittlesohn, Wolever, Saksvig & Zinman, 2000). Likewise, CCHS data confirmed that children who consumed vegetables and fruit more frequently were less likely to be overweight or obese (Shields, 2005). Research in the Mohawk community of Kahnawake, Quebec suggested that children who chose to eat potato chips rather than crackers were more likely to be at risk for overweight (Receveur, Morou, Gray-Donald & Macaulay, 2008). CCHS data also indicated that health regions in Canada exhibiting low levels of vegetable and fruit consumption also had higher rates of obesity (Vanasse, Demers, Hemiari & Courteau, 2006).

The diets of Aboriginal people today are largely the result of acculturation and the adoption of a more Westernized lifestyle. As previously discussed, traditional food intake is becoming more and more of a rarity with every passing generation. Unfortunately, especially in remote, northern communities, healthy food choices are not always an option due to the inadequate availability of healthy foods of consistent quality at a reasonable cost. Dietary intake may therefore be governed more by availability and cost than preference or concerns for health. For example, research in the remote, isolated northern FN community of Fort Albany, Ontario indicated that community members were not oblivious to the lack of healthy foods available for purchase at the grocery store, and had made attempts to discuss the issue with management, to no avail (Skinner, Hanning & Tsuji, 2006). Fresh produce was scarcely available, variety was poor, and even when it was available, often it was of poor quality, and very expensive (Skinner et al., 2006). Community members also saw the school snack and breakfast program, which serves fresh produce and healthy meals to the community's schoolchildren, as a valuable resource (Skinner et al., 2006). This research indicates that although the diets of Aboriginal populations may be of low quality, it is something that they often have little power in changing, no matter how much they recognize that it is a problem. In a population where food insecurity is also a major concern (Kuhnlein et al., 2006), the available choices at a reasonable price are most often not the healthiest.

2.2.3 Food Insecurity

Worldwide, Aboriginal people often face extreme poverty, making them among the most marginalized and vulnerable human populations (Kuhnlein et al., 2006). According to the Food and Agriculture Organization, "food security exists when all people, at all times, have physical and economic access to sufficient, safe and

nutritious food to meet their dietary needs and food preferences for an active and healthy life. The four pillars of food security are availability, stability of supply, access, and utilization” (Food and Agriculture Organization [FAO], 2005). According to this description, many Aboriginal people are facing all aspects of food insecurity. CCHS data have indicated that food insecure people are more likely to report poor/fair health, multiple chronic conditions, obesity, distress, and depression; likely secondary to inadequate nutrition and possibly longstanding nutrient deficiencies (Che & Chen, 2001). People who are food insecure may also have difficulty managing chronic health conditions requiring dietary modification; a serious implication for Aboriginal people as they are at increased risk for type 2 diabetes (Power, 2005).

Food security has been shown to decline along with a decline in income, and although the relationship is not linear, analyses have indicated that food insecurity is definitely a product of poverty (Power, 2005; Kuhnlein et al., 2004). Not surprisingly, data indicate that the attainment of basic needs, including a healthy diet, is not affordable for low-income household members living on social assistance (Power, 2005). Further evidence from the CCHS shows that 17.8% of Aboriginal households receive social assistance, compared to 3.5% of households in the general population (Willows, Veugelers, Raine & Kuhle, 2008). Additionally, of Aboriginal households where the main source of income is neither wages nor salaries, 47% receive social assistance, and 51% are food insecure (Willows et al., 2008). Figures for the general population are 12% and 13%, respectively (Willows et al., 2008).

Congruent with income data for Aboriginal people, CCHS data have indicated that Aboriginal people living off reserve have a dramatically greater prevalence of food insecurity in comparison to non-Aboriginals (Office of Nutrition Policy and Promotion [ONPP], 2007). The Household Food Security Module of the CCHS focused on self-reported uncertain, insufficient, or inadequate food access, availability, and utilization due to limited financial resources and the compromised eating patterns that may result (ONPP, 2007). The module was comprised of an 18-item food security scale, with ten items being specific to adults and eight being specific to children (ONPP, 2007). Based on this scale, food security is defined as “no, or one indication of difficulty with income-related food access” (no or one affirmed responses for both adults and children) (ONPP, 2007). Using the same scale, food insecurity is defined as an “indication of compromise in quality and/or quantity of food

consumed” (two to five affirmed responses for adults; two to four affirmed responses for children) and severe food insecurity is defined as an “indication of reduced food intake and disrupted eating patterns” (six or more affirmed responses for adults; five or more affirmed responses for children) (ONPP, 2007). Based on these definitions, one third of Canadian Aboriginal households (33.3%) are food insecure, and of the food insecure, 43% (14.4% of the population) are considered severely food insecure (ONPP, 2007). For comparison, the rates for the general Canadian population are 8.8% and 31% (2.7% of the population), respectively (ONPP, 2007). These figures leave no doubt that food insecurity is a serious issue in Aboriginal populations. Additionally, food insecurity among Aboriginal children is common, a phenomenon seen with lesser frequency in the general population (ONPP, 2007). It is not uncommon for parents living in food insecure households to sacrifice their own dietary intake so that their children can eat. In Aboriginal households, however, children tend to consume less traditional foods than adults, so while their parents may turn to traditional foods when market foods are unavailable, children may go hungry (Power, 2008).

In terms of food insecurity, the availability of traditional foods must not be ignored. In Aboriginal populations, as market foods are often unavailable, of poor quality, and typically of poorer nutritional value compared to traditional foods, food security relates to the availability of traditional and market foods alike (Lambden, Receveur, Marshall & Kuhnlein, 2006; Power, 2005). For some Aboriginal populations, the safe access to traditional foods is a fundamental component of cultural health, spirituality, and social cohesion (Power, 2008). Additionally, to many Aboriginal people, the use of traditional foods is associated with health and wellbeing, as traditional foods are seen as fundamentally healthy (Kuhnlein et al., 2004). This introduces Power’s (2008) concept of “cultural food security”, which emphasizes the ability of Aboriginal people to reliably access traditional foods through traditional means. Indicators of cultural food security include levels of traditional knowledge, access to traditional food systems, and the safety of traditional food consumption (Power, 2008). Unfortunately, many Aboriginal people can no longer rely on traditional foods in order to meet their energy and nutrient requirements. Barriers to traditional food consumption include a lack of the traditional knowledge for the procurement of such foods secondary to acculturation and the adoption of a more Westernized lifestyle, environmental contaminants which make many traditional foods unsafe to eat, and climate change which has led to changes in migratory patterns meaning that some traditional foods are no longer available (Power, 2008).

Poverty affects traditional and market food consumption alike, as many Aboriginal people do not have adequate money for the equipment necessary for hunting and fishing (Lambden et al., 2006).

2.3 Health Concerns Related to Diet, Morbidity, and Mortality

2.3.1 Health Disparities

In Canada, research has indicated widespread disparities in morbidity and mortality between Aboriginal and non-Aboriginal people (Young, 2003). The health and wellness of Aboriginal people in Canada has been compared, by some, to that of those living in a developing nation (Cooke, Beavon & McHardy, 2004). Given the great diversity of Aboriginal populations in Canada, health status can vary significantly across and within communities (Kmetz, Reading & Estey, 2008). However, there appears to be a common theme of disproportionate rates of type 2 diabetes in Aboriginal people compared to the general population (Young et al., 2000; Yu & Zinman, 2007), likely linked to the effects of acculturation and possible genetic susceptibility. Research in Manitoba has indicated that the heavy burden of type 2 diabetes and its related co-morbidities has resulted in dramatically higher health costs in Aboriginal people as compared to non-Aboriginals, as well as higher hospitalization rates for complications related to type 2 diabetes (Jacobs, Blanchard, James & Depew, 2000). Such health disparities, among other causes, are a contributing factor to why Aboriginal people have a significantly shorter life expectancy compared to the general population (Thompson, Bradshaw, Veroni & Wilkes, 2003).

2.3.2 Body Composition as a Risk Factor for Chronic Disease

Over the past 25 years, the prevalence of overweight and obesity has steadily risen in Canada, consequently reaching epidemic proportions (Shields & Tjekema, 2006; World Health Organization [WHO], 2000). Overweight and obesity are becoming increasingly problematic in Aboriginal people, even more so than in the general population (Canadian Paediatric Society [CPS], 2005; Tjekema, 2006; Tremblay et al., 2005). Weight classifications (underweight, healthy weight, overweight, and obese) are based on body mass index (BMI) (Whitney & Rady Rolfes, 2008). BMI describes relative weight for height, and is calculated by dividing weight in kilograms by height in meters, squared (Whitney & Rady Rolfes, 2008). In adults, a BMI greater than or equal to 25 is considered overweight, while a BMI greater than or equal to 30 is considered obese (Whitney & Rady

Rolfes, 2008). CCHS data have indicated that the odds of obesity among Aboriginal people are more than two and a half times greater than in non-Aboriginals (Garriguet, 2008). In the off reserve Aboriginal population, 67% of people aged 19 to 50 years are overweight or obese (38% obese), compared to 55% in non-Aboriginals (19% obese) (Garriguet, 2008). Children are no exception, as Aboriginal children are known to have higher rates of overweight and obesity in comparison to children of other ethnic backgrounds (Story, Stevens, Himes, Stone, Rock & Ethelbah, 2003; Shields, 2005; Willows, 2005b). In 2004, the prevalence of overweight and obesity in Aboriginal children living off reserve in Canada was 41% (20% obese) (Shields, 2005). In the average Canadian population, youth aged 12 to 17 had overweight and obesity prevalence rates of 29% and 9%, respectively.

The First Nations Regional Longitudinal Health Survey (FNRHS) reports on the health of FN people living on reserve in Canada. The most recent FNRHS data indicated that, of FN adults, 37% were considered overweight, 31.2% were obese, and 4.8% were morbidly obese based on self-reported heights and weights (FNRHS, 2003). Of FN youths aged 12 to 17 years, 28.1% were overweight and 14.1% were obese (FNRHS, 2003). These figures suggest a similar rate of overweight and obesity in Aboriginal youth living on reserve compared to off reserve, although a higher rate of obesity compared to overweight was reported in the off reserve data (FNRHS, 2003; Shields, 2005). Based on these data, Aboriginal adults living on reserve have higher overweight and obesity prevalences than those living off reserve (FNRHS, 2003; Garriguet, 2008).

The epidemic of obesity and overweight in Aboriginal populations is of particular concern because obesity is considered the strongest risk factor for type 2 diabetes, a metabolic disorder to which Aboriginal people may be especially susceptible, and BMI is a standard predictor for diabetes, elevated plasma glucose levels, and elevated glycosylated hemoglobin (HbA_{1c}) (Young & Sevenhuysen, 1989; Young, Sevenhuysen, Ling & Moffatt, 1990; Harris, Gittlesohn, Hanley, Barnie, Wolever & Gao et al., 1997). Type 2 diabetes is a chronic metabolic disorder characterized by high blood glucose levels secondary to the body's decreased or lack of response to the blood glucose-lowering hormone, insulin. Over time, high levels of glucose in the blood leads to micro- and macrovascular complications, including nephropathy, neuropathy, retinopathy, and cardiovascular disease. HbA_{1c} is a standard measure of long-term blood glucose control. FNRHS data indicated that in Aboriginal people, being diagnosed with diabetes was associated with excess body weight, as most adults without diabetes were of a

healthy weight or overweight, while most adults with diabetes were obese (FNRHS, 2003). Additionally, of those with diabetes, 6.6% were at a healthy body weight compared to 29.7% of those without diabetes (FNRHS, 2003).

Just as important, if not more important, than BMI in terms of health outcomes, is waist circumference (WC). Research in Canadian Aboriginal people has indicated that they tend to have higher WCs and body fat percentages on average compared to other ethnic groups (Lear, Humphries, Kohli, Chockalingam, Frohlich & Laird Birmingham, 2007; Oster & Toth, 2009). Equivalently, Australian research has indicated that Aboriginal people are characterized by long-leggedness and low sitting height to stature ratio, a body shape not characteristic of the general population (Norgan, 1994). But why is WC such a concern? WC is a measure of visceral adiposity, or the amount of fat that is surrounding the internal organs. Research has confirmed an association between WC and cardiovascular disease risk in that those with a higher WC have a higher risk for cardiovascular disease, independent of other risk factors (Wang & Hoy, 2004c). Research by Daniel and colleagues (1999) found that in overweight, but not obese Aboriginal individuals, a predominance of abdominal adiposity is a strong indication of risk for poor glycemic status and consequently type 2 diabetes. Similarly, Australian research has indicated that WC is the best predictor of type 2 diabetes in Aboriginal people (Wang & Hoy, 2004b). Thus it is not just body fatness, but the distribution of body fat that is important in terms of chronic disease risk, and WC is an important screening tool in Aboriginal people who may not be significantly overweight (Daniel, Marion, Sheps, Hertzman & Gamble, 1999). It has also been suggested that genetic determinants regulating adipose tissue distribution in Aboriginal people may explain, in part, their susceptibility to type 2 diabetes (Hegele, Harris, Hanley, Sadikian, Connelly & Zinman, 1996; Hegele, Young, & Connelly, 1997). Indeed, research has indicated that WC, alone or in combination with other measures, is superior to BMI as an indicator of health risks in Aboriginal people (Connelly, Hanley, Harris, Hegele & Zinman, 2003; Wang & Hoy, 2004). As is the case with overweight and obesity, Aboriginal children are not immune to this phenomenon. Research in Canadian Cree schoolchildren has indicated that they have high rates of visceral adiposity (Ng, Marshall & Willows, 2006). Recent research by Watts and colleagues (2008) indicated that WC in children is superior even to BMI in predicting cardiovascular risk, defined by cut-offs for lipid values identified by the National High Blood Pressure Education Program Working Group on Hypertension Control in Children and Adolescents (National High Blood Pressure Education Program Working Group on Hypertension Control in Children and Adolescents, 1996).

Therefore, in children, WC may be a simple and non-invasive screening tool, in addition to BMI, to help identify children who may be at subsequent risk for diabetes and other metabolic or cardiovascular complications (Watts, Bell, Byrne, Jones & Davis, 2008).

Finally, it is notable that although Aboriginal people may experience an astounding rate of overweight and obesity, preferences and norms for body size in Aboriginal populations may be different from those shared by the average population. For example, the Oji-Cree of Sandy Lake have a preference for large body size, especially among the elders, because they associate thinness with memories of infectious diseases, such as tuberculosis (Gittlesohn, Harris, Thorne-Lyman, Hanley, Barnie & Zinman, 1996). The Cree of northern Québec also attach positive associations to large body size, seeing it as a marker of robustness and strength (Boston, Jordan, MacNamara, Kozolanka, Bobbish-Rondeau & Iserhoff et al., 1997). Therefore, issues of overweight and obesity in Aboriginal populations must be approached with sensitivity to cultural norms.

2.3.3 Type 2 Diabetes – Morbidity & Mortality

As with obesity, the burden of type 2 diabetes in Aboriginal populations is greater than that in the general population (Yu & Zinman, 2007). The prevalence among the Oji-Cree of Sandy Lake, Ontario, is among the world's highest at 26% for type 2 diabetes and 14% for impaired glucose tolerance (pre-diabetes), for a total of 40% (Hanley, McKeown-Eyssen, Harris, Hegele, Wolever & Kwan et al., 2001; Harris et al., 1997). This is the third highest prevalence of any subpopulation and approximately five times higher than the general Canadian population (Hanley et al., 2001; Harris et al., 1997). Before the 1950s, type 2 diabetes was rare in Aboriginal populations (Young et al., 2000). A recent systematic review found that there is still a virtual absence of type 2 diabetes in Aboriginal populations that maintain a traditional lifestyle (Yu & Zinman, 2007). Furthermore, more urbanized Aboriginal populations have greater rates of type 2 diabetes in most cases, suggesting the role of acculturation in the high prevalence of the disease (Yu & Zinman, 2007). This association has also been noted in other research (O'Dea, 1992). FNRHS data indicated that 19.7% of FN people were diagnosed with diabetes, 78.2% of cases being type 2 diabetes, likely an underestimate as the disease commonly goes undiagnosed for quite some time (FNRHS, 2003).

Type 2 diabetes is of particular concern, because in the Aboriginal population it tends to have an earlier onset, a higher rate of complications and co-morbidities, and there is a higher rate of diabetes-related death (Thommasen, Patenaude, Anderson, McArthur & Tildesley, 2004). Research by Thommasen and colleagues (2004) with an Aboriginal population in British Columbia noted increased rates of cerebrovascular disease, limb amputations, nephropathy, and retinopathy as a result of type 2 diabetes, relative to the non-Aboriginal population. Further research into the prevalence of complications as a result of type 2 diabetes has found that the prevalence of such complications is significantly increased in Aboriginal people, as much as two to four times that of the general population, and that there is an increased prevalence among young people (O’Dea, 1992; Young et al., 2000; Young, Marens, Taback, Sellers, Dean, & Cheang et al., 2002). Research in Australia and New Zealand found that the most frequent complication from type 2 diabetes in Aboriginal people is nephropathy, with an incidence of end-stage renal failure that is an astonishing 20 to 30 times that of the general population (McDonald & Russ, 2003). Research in Sandy Lake, Ontario yielded similar results, noting that Aboriginal peoples may be especially prone to the renal complications of diabetes - some of which may be accounted for by poor glycemic control (Hanley, Harris, Mamakeesick, Goodwin, Fiddler & Hegele et al., 2005). FNRHS data indicated that of FN people with diabetes, 88.7% reported complications, including problems with feeling (37.1%), vision problems (36.8%), circulatory problems (21.6%), problems with the lower limbs (20.9%), impaired kidney function (15.9%), infections (14.7%) and heart problems (11.3%) (FNRHS, 2003). Of those with diabetes, 24.1% reported having four or more of the previously named consequences, and 34.5% reported one consequence (FNRHS, 2003). Further, Australian research has demonstrated that both Aboriginal men and women with diabetes had higher blood pressure, total cholesterol and triglyceride levels, as well as a higher BMI and WC and lower high density lipoprotein cholesterol (HDL) as compared to those without diabetes (Wang & Hoy, 2004a). Participants with diabetes also had a higher risk of cardiovascular disease, and the difference was much greater for women – not only did they have a greater risk than women without diabetes, but they also seemed to develop, over time, a greater risk than men with diabetes (Wang & Hoy, 2004a). The increased prevalence of complications in Aboriginal people may be partly due to reduced access to care in remote locations, as those residing in remote areas are three times more likely to suffer acute, avoidable complications of diabetes (Booth, Hux, Fang & Chan, 2005a).

2.3.4 Type 2 Diabetes – Possible Genetic Associations

Acculturation plays a role in the development of obesity, a risk factor for type 2 diabetes in Aboriginal people. The dietary and lifestyle changes that have come with the nutrition transition are obesogenic, but this alone cannot explain why Aboriginal people suffer a prevalence of type 2 diabetes above and beyond that seen in the general population (Yu & Zinman, 2007). For example, data from the Fremantle Diabetes Study indicated that despite similar glycemic control, Aboriginal people with type 2 diabetes had markedly higher HbA_{1c} levels compared to non-Aboriginals with type 2 diabetes (Davis, McAullay, Davis & Bruce, 2007). Consequently, the age at death for Aboriginal people stricken with type 2 diabetes was a full 18 years younger than that of the general population (Davis et al., 2007). These are all indicators that Aboriginal people may be genetically susceptible to type 2 diabetes and its co-morbidities (Yu & Zinman, 2007). Numerous hypotheses have arisen as to why Aboriginal people suffer from a rate of type 2 diabetes far greater than in the rest of the industrialized world. One popular theory is the “thrifty genotype hypothesis”, first proposed by Neel in 1970 (Neel, 1970). Neel (1970) proposed that Aboriginal people, and the general population alike, possess an energy-conserving genotype that was previously adaptive in the hunter-gatherer era of feast and famine. Nowadays, in an era of feasting but rarely famine, in addition to a much more sedentary lifestyle, the result is a phenotype for type 2 diabetes (Neel, 1970).

As previously noted, the Oji-Cree of Sandy Lake have a particularly high prevalence of type 2 diabetes, in fact one of the highest in the world. Consequently, much research has gone into the study of possible genetic predispositions in this population (Hegele, Cao, Hanley, Zinman, Harris & Anderson, 2000a; Hegele, Cao, Harris, Hanley & Zinman, 1999a, 1999b; Hegele, Cao, Harris, Hanley, Zinman & Connelly, 2000b; Hegele, Zinman, Hanley, Harris, Barrett & Cao, 2003). Because of the dramatically high prevalence of type 2 diabetes in this population, it is suggested that they may have a certain genetic predisposition to the disease, in addition to other factors such as a poor diet and inadequate physical activity which also evidently play a role (Hegele et al., 2003). Research in the Oji-Cree population has indicated that greater than 40% of the Oji-Cree people of Sandy Lake who have type 2 diabetes also have the HNF1A G319S allele (Hegele et al., 1999a, 1999b, 2003). Those who are heterozygous for HNF1A G319S have increased odds of type 2 diabetes (Hegele et al., 1999a, 1999b, 2003). However, 60% of the Oji-Cree people are homozygous for the allele, suggesting that other environmental factors

must be involved in the increased prevalence for type 2 diabetes in this population (Hegele et al, 1999a). The allele was also found to be associated with early onset of type 2 diabetes in adolescents (Hegele et al., 1999a, Hegele, Hanley, Zinman, Harris & Anderson et al., 1999c), and may be a potentially useful predictive test for type 2 diabetes in the Oji-Cree (Hegele et al., 2000a, b). Such a predictive test would allow for early intervention prior to the disease becoming symptomatic, which could reduce the risk of later complications. Although this research only included the Oji-Cree of Sandy Lake and cannot be generalized to all Aboriginal people, it is just one example of a possible genetic susceptibility present in this population. Such findings are indicative that the issues of overweight and obesity must be tackled that much more urgently in Aboriginal populations. However, whatever the genetic propensity for diabetes in the Aboriginal population, given the difficulty of treating obesity and type 2 diabetes, emphasis should be on a preventative approach.

2.3.5 Metabolic Syndrome

The metabolic syndrome (MetS) is a cluster of metabolic abnormalities that increase a person's risk for cardiovascular disease and diabetes (National Institutes of Health [NIH], 2008). An individual diagnosed with MetS has a greater risk of cardiovascular mortality than would present with any of the individual components of the MetS definition (Isomaa, Almgren, Tuomi, Forsen, Lahti & Nissen et al., 2001). Although the specific definition of the syndrome is controversial, for the purpose of this review the cut-offs used are those defined by the National Cholesterol Education Program (NCEP). According to the NCEP, a person is diagnosed with MetS if they have any combination of three of the following five factors: a WC > 102 cm in men or 88 cm in women, triglycerides ≥ 1.70 mmol/L, HDL < 1.0 mmol/L in men and 1.3 mmol/L in women, blood pressure $\geq 130/85$ mm Hg, and a fasting blood glucose level ≥ 6.1 mmol/L (NIH, 2008). The same cut-offs can be adapted for the use in children; a child would be diagnosed with MetS if they had a combination of three of the following five factors: a BMI $\geq 95^{\text{th}}$ percentile based on age and sex, triglycerides ≥ 1.10 mmol/L, HDL < 1.3 mmol/L, hypertension (the lesser of systolic or diastolic blood pressure $\geq 90^{\text{th}}$ percentile based on age, sex, and height or systolic blood pressure ≥ 130 mm Hg or diastolic blood pressure ≥ 85 mm Hg) or antihypertensive therapy, and impaired glucose metabolism (Sanders, Lubsch & West, 2006). In Aboriginal populations, rapid acculturation, including a detrimental change in diet and physical activity levels, and the high prevalence of type 2 diabetes has raised concerns about the prevalence of MetS (Kaler, Ralph-Campbell, Pohar, King, Laboucan & Toth, 2006; Young et

al., 2000). Although acculturation and lifestyle changes may explain some of the prevalence of MetS, once again genetic factors are likely important players in the equation (Pollex, Hanley, Zinman, Harris, Kahn & Hegele, 2005). We turn once again to the Oji-Cree of Sandy Lake. In a sample of Oji-Cree, the prevalence of MetS in adults was 29.9%, significantly greater than the rate in a comparable sample of non-Aboriginals (21.8%) (Ford, Giles & Dietz, 2002; Pollex et al., 2005). In the entire sample of Oji-Cree people, 57.7% had abdominal adiposity, 48% had low HDL levels, 32.8% had high levels of triglycerides, 31.1% had high fasting glucose levels, and 10.1% had high blood pressure (Pollex et al., 2005). Of note, BMI and leptin were significantly higher in Oji-Cree with MetS (Pollex et al., 2005). Leptin is a protein in adipose tissue (Whitney & Rady Rolfes, 2008). It is suggested that leptin in adipose tissue signals adequate energy stores and thus helps regulate appetite (Whitney & Rady Rolfes, 2008). Clearly, results of research on the MetS in the Oji-Cree cannot be generalized to all Aboriginal populations. Nevertheless, they suggest a possible susceptibility to the syndrome in Aboriginal people, once again indicating the urgency for interventions targeting overweight and obesity in the population. Adequate screening is also necessary to expedite disease prevention.

2.4 Possible Health Improvement Strategies

2.4.1 Targeting Schoolchildren

As previously discussed, Aboriginal people face a disproportionately heavy burden of obesity and overweight, placing them at increased risk for numerous chronic diseases. Interventions targeting the diets and physical activity habits of Aboriginal people have the potential to blunt the epidemic of obesity and overweight in this population. Targeting schoolchildren preferentially is a promising approach. The physical and psychological consequences of overweight and obesity in childhood are a cause for concern, but what may be more significant in terms of the burden of chronic disease in the general population, is the tracking of obesity over time. Tracking is defined by two general concepts – the relationship between early measurements and measurements later in life, or the maintenance of a relative position within a distribution of values in a population over time, and the predictability of future values by early measurements (Singh, Mulder, Twisk, van Mechelen & Chinapaw, 2008). In simpler terms, the tracking of obesity over time indicates that obese children tend to become obese adults (Freedman, Khan, Dietz, Srinivasan & Berenson, 2001; Nicklas, Baranowski, Cullen & Berenson, 2001). Data from the Bogalusa Heart Study indicated that only seven percent of the 1 317 normal weight children who

participated in the study became obese adults, while 77% of overweight children experienced adulthood obesity (Freedman et al., 2001). In support of these data, a recent systematic review found that the risk for overweight children to become overweight adults is at least twice as high compared to normal weight children (Singh et al., 2008). An additional review notes the “dismal” future health of overweight children once they reach adolescence, indicating that the probability of an overweight child becoming an obese adult increases incrementally with age (Budd & Volpe, 2006). It is undoubtedly concerning that overweight children are at an increased likelihood to become obese adults, but this is compounded by the fact that childhood obesity is also predictive of adult morbidity (Freedman et al., 2001). Childhood obesity is associated with several risk factors for cardiovascular disease and has been shown to be predictive of hypertension and diabetes in adulthood (Nicklas et al., 2001). The reverse relationship has also been noted, as adverse risk factors for cardiovascular disease in adults have been associated with obesity in childhood (Freedman et al., 2001). The Bogalusa Heart Study determined that this association resulted entirely from the strong tracking of overweight and obesity from childhood into adulthood (Freedman et al., 2001). Additional studies have consistently demonstrated that blood pressure, blood cholesterol, insulin levels, and obesity tend to cluster and track with age (Dietz, 1998). The evidence from such research suggests that early interventions in children may be the most promising approach to reducing the risk of obesity and chronic disease in adults. In Aboriginal populations this may be especially important, considering their predisposition to type 2 diabetes and its co-morbidities.

Just as obesity and its complications have been shown to track over time, so do dietary patterns (American Dietetic Association [ADA], 1999). Research indicates that both childhood fat intake and milk consumption tend to track over time, thus affecting lifetime fat and milk consumption (ADA, 1999). For example, one study of elderly adults found that the frequency of milk consumption during childhood was the strongest predictor of current milk intake (ADA, 1999). In combination with the tracking of weight status over time, this additional information provides further support, in the absence of strong prospective longitudinal cohort studies, that early prevention and school based programs aimed at promoting healthy eating and physical activity may have a substantial impact on adult obesity and chronic disease in the future. Because overweight adults are likely to continue to gain more weight and very unlikely to return to a normal weight (Shields, 2005), early interventions to prevent obesity in Aboriginal children would be optimal and would consequently help prevent

adult obesity and its related co-morbidities. In this way, programs aimed at preventing obesity in Aboriginal children can be a viable strategy for preventing adult obesity and chronic disease (Daniels, Arnett, Eckel, Gidding, Hayman & Kumanyika et al., 2005).

For reasons already discussed, the burden of overweight and obesity in Aboriginal children is a major concern, especially considering the predisposition of this population for type 2 diabetes. Schools are a natural venue for intervening in childhood obesity because children generally spend six or more hours per day in the school environment, five days per week, and one to two meals are normally consumed there, plus snacks (Budd & Volpe, 2006). Additionally, resources such as physical education teachers, fitness facilities, food service personnel, and school nurses and health staff are normally already in place, facilitating the implementation of healthy eating and physical activity interventions (Budd & Volpe, 2006; Story, Kaphingst & French, 2006). Although the availability of these resources in the communities participating in this research may not be what it is in some non-Aboriginal communities, school is still the ideal location for intervention. Most importantly, many of the factors leading to childhood obesity, including poor diet quality and lack of physical activity, are modifiable. With this in mind, the school environment has the broad potential to impact on students' eating habits and physical activity patterns (Constante Jaime & Lock, 2009). The ability of the school environment to improve the health of its students should not be under-stated. School nutrition policies have been identified as powerful tools for improving the wellbeing of students, including improved nutritional status and academic achievement (McKenna, 2003).

2.4.2 A Focus on Vegetable and Fruit Intake

As previously discussed, the nutrition transition experienced by Aboriginal people has led to the Westernization of their diets and a reduction in the energy consumed from traditional food sources. Additionally, in northern remote, isolated communities, foods of high nutrient density may be hard to come by or very expensive. This, in combination with the high prevalence of food insecurity in Aboriginal populations, means that many Aboriginal people are consuming diets inadequate in nutrient dense foods such as vegetables, fruit, whole grains, milk products, and lean meat, poultry, or fish. In Aboriginal populations, vegetable and fruit consumption is of particular concern because fresh produce is a rarity in many communities, and even when it is available, it is

often in poor condition and extremely expensive, making it out of reach for most people. Research has confirmed that children and adolescents living in food-insecure households have the lowest mean intakes of vegetables and fruit (Lorson, Melgar-Quinonez & Taylor, 2009). When vegetables are consumed, the most popular choice is French fries (Lorson et al., 2009). Vegetables and fruit are excellent sources of vitamins A and C, fibre, and folate. They are also sources of a myriad of health-promoting phytochemicals and antioxidants. A diet low in vegetables and fruit, may be lacking in these essential nutrients and may lead to an increased risk for multiple chronic diseases (Lorson et al., 2009). A review by Lock and colleagues (2005) suggested that about 15% of disease worldwide can be attributed to the effects of under-nutrition and deficiencies in micronutrients, and that a similar number can be attributed to risk factors that have significant dietary components, including overweight, hypercholesterolemia, hypertension, and low vegetable and fruit intake. The work of Lock and colleagues also suggests that 2.6 million deaths worldwide and 31% of cardiovascular diseases may be attributed to inadequate vegetable and fruit consumption (Lock, Pomerleau, Causer, Altmann & McKee et al., 2005). It also confirms that suboptimal vegetable and fruit intake is an important risk factor for a wide range of chronic, non-communicable diseases (Lock et al., 2005). Furthermore, CCHS data indicated that only 59% of Canadian children and adolescents consumed the recommended number of servings of vegetables and fruit each day (Shields, 2005). Those who did not consume the recommended number of servings were more likely to be overweight or obese than those who ate vegetables and fruit more frequently (Shields, 2005). Further research has suggested that children who are abdominally obese tend to consume fewer vegetables and fruits (Downs, Marshall, Ng & Willows, 2008). Consuming three or more vegetables and/or fruits per day has been associated with reduced odds of abdominal adiposity in other research (Downs et al., 2008). Further studies have noted the possible protective effect of vegetables and fruit against metabolic disorders (Feldeisen & Tucker, 2007; Lindquist, Gower & Goran, 2000).

Evidently, there are many dietary factors contributing to the prevalence of overweight, obesity, and type 2 diabetes in Aboriginal children and adults, including high intakes of “other foods” and increasing soft drink consumption, only to name a few. However, vegetable and fruit intake is often an overlooked factor that can have a significant impact on weight and chronic disease risk. Because Aboriginal children have especially low intakes of vegetables and fruit, they would benefit preferentially from an intervention promoting vegetable and fruit

consumption. As previously noted, targeting children is a viable approach to reducing the risk of adulthood obesity and overweight, which are risk factors for many chronic diseases including type 2 diabetes. It would be assumed that if children and adolescents were to consume more vegetables and fruit that not only would their micronutrient intakes improve, but that vegetables and fruit would displace less healthy choices which are also contributing to the obesity epidemic. A recent systematic review by de Sa and Lock (2008) synthesized the worldwide evidence for the effectiveness of school vegetable and fruit programs. Of the programs reviewed, 70% resulted in a significant increase in vegetable and fruit intakes among the participating students (de Sa & Lock, 2008). The review also indicated the possibility of improving vegetable and fruit intakes among a wide age range (not only younger grades), and noted the effectiveness of vegetable and fruit intakes in reducing social and health inequalities, as children of lower social economic status tend to consume fewer vegetables and fruit and be in poorer health (de Sa & Lock, 2008). Additionally, research by Pereira and Ludwig (2001) has indicated that diets rich in fibre, including fibres from non-starchy vegetables and fruits, may be effective in the prevention and treatment of childhood obesity. Overall, evidence suggests that the improvement of vegetable and fruit intakes in the Aboriginal population would have numerous benefits, including a possible reduction in overweight and obesity, over time.

2.4.3 Framework for Effective School-Based Interventions

In 1996, the United States Centers for Disease Control and Prevention (CDC) proposed a framework for school-based health and nutrition programs in order to guide program development and ensure program success (CDC, 1996). The framework is based on the concept that in order to be as effective as possible, school-based interventions should be comprehensive (CDC, 1996; Constante Jaime & Lock, 2008). A comprehensive school health and nutrition program includes classroom lessons, access to healthy food and the support of children by those around them (teachers, peers, etc.) (CDC, 1996). Additionally, comprehensive school health and nutrition programs have the ability to empower students with the knowledge, attitudes, and skills required to make positive health decisions as well as the environment, motivation, services and support necessary to develop and maintain such healthy behaviours (CDC, 1996). Finally, the CDC notes that comprehensive school health and nutrition programs involve health education, a healthy environment, health services, counseling, psychological and social services, integrated school and community efforts, physical education, nutrition services, and a school-based

health program for teachers and staff (CDC, 1996). Without all of these components, programs may have limited success. Since the release of the CDC's framework, many school health programs have followed its approach and yielded success (ADA, 1999). A recent review suggested that school programs that followed the CDC's framework were more effective in achieving dietary change in comparison to those that did not (Veugeliers & Fitzgerald, 2005). Similarly, within Aboriginal school programs, the CDC framework was associated with plausible programs that more often achieved their a-priori outcomes than programs that did not adhere to these criteria (Gates & Hanning, unpublished data). In combining literature from a variety of sources and using the CDC as a guide, a framework can be developed with the aim of guiding the implementation of effective and successful school-based health and nutrition programs.

2.4.3.1 Policy Implementation

A major tenet of successful school-based health and nutrition programs is policy implementation. In order to be successful, school-based health and nutrition programs should adopt a nutrition policy that not only promotes healthy eating through classroom lessons but also through a supportive school environment (Brant County Health Unit, 2005; CDC, 1996; FRESH, 2008; Jeffery & Leo, 2008; Ontario Society of Nutrition Professionals in Public Health School Nutrition Workgroup Steering Committee [OSNPPH], 2004; Perez-Rodrigo & Aranceta, 2001; Veugeliers & Fitzgerald, 2005). The policy should include both issues of healthy eating and physical activity (ADA, 1996; CDC, 2008; CDC 2009; WHO, 2004). It is important that all potential stakeholders be involved in the development of the policy, including teachers, staff, students, parents, families, and the wider community (Brant County Health Unit, 2005; Flynn, McNeil, Maloff, Mutasingwa, Wu & Ford et al., 2006; Perez-Rodrigo & Aranceta, 2001; Perez-Rodrigo & Aranceta, 2003; WHO, 2008). The policy should take into account cultural background, gender issues, and ethnic minorities (Perez-Rodrigo & Aranceta, 2003; WHO, 2008).

The involvement of teachers and other school staff is important, as they play a central role in improving nutrition and physical activity in schools. Because of the association between diet quality and academic achievement, teachers are likely to have direct interest in such policies, and thus should be involved in their development (WHO, 2008). Teachers also have an impact on the actions of children by acting, ideally, as positive

role models for healthy behaviours, and thus should be aware of all of the elements of a school policy and be involved in its implementation.

Parents and families are important because it is the parents who control most of the food choices at home, do most of the home cooking and preparation of school lunches, and their support encourages the physical activity of their children while at home (Perez-Rodrigo & Aranceta, 2003; WHO, 2008). Also, if parents are involved in the implementation of school-based health and nutrition policies, they will have a better understanding of what the policy entails and why it has been put in place. This way, children will be less likely to experience inconsistencies between suggestions and practices at home versus those at school (Perez-Rodrigo & Aranceta, 2003; WHO, 2008).

The input of students is also invaluable in order to ensure the feasibility and acceptability of the policy (Perez-Rodrigo & Aranceta, 2001; Perez-Rodrigo & Aranceta, 2003; WHO, 2008). School nutrition policies can be perceived as problematic if they impair the ability of students to fundraise for important school events or cause them to lose their freedom of choice. Therefore, student input into policy development can help reduce the risk of encountering such challenges. Additionally, students often have new, creative, and innovative ideas for improving diet and physical activity in the school that may be more attractive to them than more traditional ideas (Perez-Rodrigo & Aranceta, 2001; Perez-Rodrigo & Aranceta, 2003; WHO, 2008).

Finally, community involvement is important because the broader community plays a role in creating awareness, publicity, and visibility for healthy diets and physical activity (Perez-Rodrigo & Aranceta, 2003; WHO, 2008). Children are influenced by their external environment, which includes their community, when making choices about nutrition and physical activity. The “built environment” (including urban design factors, land use, and available public transportation options) can either facilitate or hinder physical activity and healthy eating (Booth, Pinkston, Walker & Poston, 2005b), providing more reason to involve the community in healthy policy implementation. For example, an area with few recreational facilities or poor lighting may hinder physical activity, while one with ample walking and bicycling paths may promote it (Booth et al., 2005b). Similarly, an area with a high density of fast food outlets and convenience stores may promote unhealthy dietary habits (Booth

et al., 2005b). All of these community factors should then be taken into account when implementing a school-based health and nutrition policy. Even if the school environment is modified to encourage healthy eating habits and physical activity, if it is contradicted by an environment that hinders the practice of healthy habits, this may become an issue. Similarly, it is often recommended that a situational analysis be conducted during policy development in order to determine the current health status of the students, the knowledge, attitudes, beliefs, values, behaviours and conditions that the students associate with health eating and physical activity, and to assess what resources are already available within the school to promote healthy eating and physical activity (Daniels et al., 2005; Perez-Rodrigo & Aranceta, 2001; WHO, 2008). This will help avoid any unnecessary conflict and ensure the cultural appropriateness of the program. It will also allow for adaptation and improvement of the program and give time for the program to gain acceptance (Perez-Rodrigo & Aranceta, 2003). Of note, since the current research was initiated, the Ontario Ministry of Education has implemented a School Food and Beverage Policy (Ontario Ministry of Education, 2010). Other groups, including Cancer Care Ontario, are currently working to help Aboriginal Schools to implement school food policies specific to their culture (Cancer Care Ontario, 2010).

2.4.3.2 Healthy Curriculum and Environment

For school-based health and nutrition initiatives to be effective, they should also involve a curriculum for nutrition education that is sequential, implemented at preschool and continuing through secondary school (Brant County Health Unity, 2005; CDC, 1996). Healthy eating and physical education should be integrated across the curriculum, in all subject areas (ADA, 1996), and be fun and culturally relevant (CDC, 1996; CDC, 2008; WHO, 2004). For example, a mathematics lesson could involve counting servings of food from different food groups of CFG on a plate. This is only one example of how nutrition messages can be applied across the curriculum, as opposed to only in health class. As previously noted, environmental approaches are another key to success – nutrition messages within the school must be consistent by providing a healthy food and physical environment that is congruent with what is taught in the classroom (ADA, 1996; Brant County Health Unit, 2005; CDC, 2008; Flynn et al., 2006; Perez-Rodrigo & Aranceta, 2003). It is difficult for children to make healthy choices when they are surrounded by unhealthy foods which may often seem much more attractive than healthier ones, no matter what was learned in the classroom. If unhealthy foods are offered within the school, this may also send

counterproductive or confusing messages to the students (Taylor, Evers & McKenna, 2005), which will not promote success of the program. Research has shown that eating habits are influenced by the interaction between individuals and the environments that they live in, and not simply by the knowledge of which foods are healthy and which are not (ADA, 1999), which is why an environmental approach is such a vital component of a school health program if it is to be successful. Ideally, the school should ensure that all foods available are consistent with classroom messages, reinforce healthy eating, are culturally appropriate, and facilitate making a healthy choice (ADA, 1999; Brant County Health Unit, 2005; Budd & Volpe, 2006; Flynn et al., 2006; OSNPPH, 2004; Perez-Rodrigo & Aranceta, 2001; WHO, 2004). The environment also extends to things like healthy meal and snack scheduling, eliminating negative media messages (posters etc.), and keeping healthy foods affordable so that nothing within the school environment impairs any student from consuming a healthy diet, at least during the hours when they are in school (ADA, 1996; Perez-Rodrigo & Aranceta, 2001).

2.4.3.3 Integration of School Food Service

Another essential element of successful school-based health and nutrition programs is the integration of school food service and nutrition education in order to reinforce classroom messages about healthy eating (Brant County Health Unit, 2005; CDC, 1996; Perez-Rodrigo & Aranceta, 2003). This idea encompasses all areas of school food service, including safe food handling practices and the provision of an allergy-free environment (Brant County Health Unit, 2005). If school food service staff are not already trained, it would be advised that they be provided with in-service training on a regular basis to ensure that they are kept up to date. Also, the school should make an effort to ensure that the foods provided within the school are healthy, reasonably priced, and culturally appropriate (Brant County Health Unit, 2005; OSNPPH, 2004; WHO, 2004). The school may even want to include the students themselves when it comes to planning a healthy menu, as the program is more likely to be a success if the students are accepting and excited about the meals that are offered. Variety, quality, presentation, and texture of the offered food items also contribute to the acceptability of the menu (Perez-Rodrigo & Aranceta, 2001), and should thus be taken into account during menu planning. Overall, the food service environment in the school should be treated as a laboratory for learning, and should promote a healthy diet and make it easy for children to make healthy choices and apply what they have learned within the classroom. They

should be given adequate time to eat in a comfortable environment in order to ensure program success (OSNPPH, 2004).

2.4.3.4 Training for Teachers and Staff

Adequate pre-service and in-service training for teachers and school staff is another tenet of successful school-based health and nutrition programs (Brant County Health Unit, 2005; CDC, 1996; CDC, 2008; FRESH, 2008; OSNPPH, 2004; Perez-Rodrigo & Aranceta, 2001; Perez-Rodrigo & Aranceta, 2003; WHO, 2008). It is interesting to note that enthusiastic teacher modeling of healthy eating behaviours has been found to increase the acceptance of healthy food choices in pre-schoolers (Taylor et al., 2005). Teachers therefore need to be trained not only in effective nutrition education strategies for behavioural change, but also need to be made aware of their position as role models to students and others (Brant County Health Unit, 2005; OSNPPH, 2004; Perez-Rodrigo & Aranceta, 2001; WHO, 2008). One reason why some school-based health and nutrition initiatives fail is because teachers are not sufficiently knowledgeable about how to integrate nutrition and physical education messages into the curriculum, and adequate training should help alleviate this problem. Also, if teachers do not model healthy habits, at least while in the school, students may feel little motivation to do so themselves or be prone to not take the nutrition messages that they are being taught in the classroom seriously. It is recommended that schools go even further, if possible, by providing opportunities for school staff to improve their own health status through activities such as health assessments, health education and health related fitness activities just for staff (CDC, 2008). In participating in such activities, teachers and staff will feel a greater commitment to the health of the students and be more apt to act as positive role models (CDC, 2008).

2.4.3.5 Family and Community Involvement

Family and community involvement in supporting and reinforcing nutrition education helps foster success for school-based health and nutrition programs (ADA, 1996; ADA, 1999; Brant County Health Unit, 2005; CDC, 1996; CDC, 2008; Daniels et al., 2005; Flynn et al., 2006; OSNPPH, 2004; Perez-Rodrigo & Aranceta, 2001; Perez-Rodrigo & Aranceta, 2003; Taylor et al., 2005; WHO, 2008). Family involvement is a well-documented predictor of program effectiveness (Perez-Rodrigo & Aranceta, 2001). As previously discussed, it is the parents who control most of the food purchasing, provision, and preparation within the home, and they

therefore have a significant influence on the eating habits of their children. If they are not involved at all with the school's health program, healthy eating messages within the school may conflict with what is happening within the home, only leading to confusion for the child and a greater chance that the program will be unsuccessful. Additionally, it has been shown that nutrient intakes tend to aggregate in families (ADA, 1999) and that children's eating behaviours are influenced by characteristics within the family unit, including the number of meals regularly eaten together around a table (ADA, 1999). Children's preferences for high fat foods, total fat intakes, and time spent in sedentary activities have been positively associated with parental adiposity (ADA, 1999). This evidence should provide adequate incentive for school based programs to involve parents and families in school based health initiatives. It is imperative that family practices be congruent with what is being taught within the classroom, because of the undeniable influence that the family unit has on a child's eating habits, no matter what they are taught within the school. Oftentimes, the parents who are most involved in the school community already are those who are the most keen and concerned about their child's welfare when it comes to diet and physical activity. They may not be working and thus have more time to spend cooking home meals or promoting physical activity within their family. They are also more in touch with what is going on in the school because they may actually be present at the school more often (volunteering etc.). Therefore a special effort needs to be made to make those who are less present aware of what is happening during the school day and what they can do to provide an environment that supports classroom education. Community involvement is equally important and has also been correlated with program success (Perez-Rodrigo & Aranceta, 2001). The broader community can help by endorsing, collaborating, and co-sponsoring various programs for children that are supportive of what is being learned in school (Perez-Rodrigo & Aranceta, 2001; WHO, 2008).

2.4.3.6 Program Evaluation

All successful school-based health and nutrition programs must include a program evaluation component. School-based health and nutrition programs must be regularly evaluated for their effectiveness in promoting healthy eating and physical activity, and be modified as appropriate in order to maximize effectiveness (CDC, 1996; CDC, 2008; Daniels et al., 2005; Flynn et al., 2006; WHO, 2004; WHO, 2008). Through consistent monitoring and evaluation of the program, the progress of ongoing program activities can be assessed, and constraints that need corrective action may be identified. Effectiveness and efficiency of the program may be

evaluated and outcomes can be measured to see if the program is meeting its goals and objectives (Perez-Rodrigo & Aranceta, 2001; Perez-Rodrigo & Aranceta, 2003; WHO, 2008). As with all other processes within the program, evaluation should involve the contributions of all stakeholders, including the students themselves, who may provide an interesting perspective into the success of the program, and whether or not it is meeting its goals and objectives (Flynn et al., 2006; Perez-Rodrigo & Aranceta, 2003). Overall, periodic updating, evaluation, and improvement are essential components of any successful school-based health and nutrition program (CDC, 2008). Without these elements, it is impossible to know whether or not the program is having its desired effect or even if it is being well accepted among the students.

2.4.3.7 Possible Challenges and Solutions

Optimally, all schools would have the resources available to implement effective nutrition and physical activity programs and policies to create a healthy environment for its pupils. Unfortunately, this is not always the case. The challenges facing schools related to implementing effective health and nutrition programs include profit issues, freedom of choice, policy interpretation, ineffective approaches to program implementation, and lack of consultation with all possible stakeholders during program development (McKenna, 2003). Competing issues such as available time for implementation, available resources, and motivation on the part of school staff are also important barriers that would need to be overcome, among others (Perez-Rodrigo & Aranceta, 2001).

Profit issues are major obstacles when it comes to the implementation of school-based health and nutrition programs (McKenna, 2003). Unfortunately, the profits that a school makes from vending machines and snack shops, which may be primarily selling foods of low nutritional value, are often considered more important than the health of the students (McKenna, 2003). Fundraisers and school councils also often depend on the sale of soft drinks, chocolate bars, and other unhealthy food items, and school policies that ban the sale of these products may be considered by the school as an infringement on their ability to fundraise (McKenna, 2003). Schools are thus often hesitant and uncooperative when it comes to the implementation of nutrition policies and programs, as they may value profits over the health of their students. Fortunately, research has indicated that these issues can be overcome, and that schools do not necessarily have to sacrifice profits for the health of their students (Fox,

Meinen, Pesik, Landis & Remington, 2005; French, Jeffrey, Story, Breitlow, Baxter & Hannan et al., 2001). A recent review found that schools have been successful in improving their nutrition environment without suffering financial losses (Fox et al., 2005). When promoted through various means, including price reductions and strategic advertising within the school, children have been found to choose nutrient dense foods more often (Fox et al., 2005). Another study on vending machine sales found that a ten percent reduction in price resulted in a nine percent increase in low-fat snack sales (French et al., 2001). A 25% and 50% reduction in prices of low-fat snacks resulted in a 39% and 93% increase in sales of these foods, respectively, without a change in total profits from vending machine sales (French et al., 2001). When it comes to fundraising, healthy alternatives to unhealthy food sales include things like cookbooks of healthy recipes, school calendars, tooth brushes, stationary or school supplies, or even healthy bake sales or food stands (DASH BC, 2007). Therefore, although schools may be concerned that implementation of a healthy policy may affect profits, a policy that is carefully implemented will not necessarily yield such results. In terms of the Aboriginal schools involved in this research, bake sales involving the sales of unhealthy foods are common. The replacement of such sales with those selling healthy alternatives may prove just as popular, thus not affecting profits.

Oftentimes, schools are also of the belief that by removing foods of low nutritional value and providing an environment where only a variety of healthy foods are available, that students and staff are being denied their freedom of choice (McKenna, 2003). Some schools even go as far as claiming that by eliminating unhealthy foods and offering only healthy ones, children will be getting only a “very narrow education” (McKenna, 2003). Although this may be true in some respects, it is very difficult for young children to make healthy choices when they are bombarded with a vast variety of unhealthy foods, which in many cases, may seem much more appealing. A healthy environment is necessary in order to support classroom education and encourage children to make healthy choices. Some schools even counter this argument by claiming that by eliminating less healthy foods, schools are not sticking with the basic concepts provided by CFG, which encourages variety and does not distinguish between “good” and “bad” foods (McKenna, 2003). Fortunately, in terms of the Aboriginal schools involved in this research, all schools have been more than happy to encourage healthy eating and food provision programs.

Unfortunately, policy interpretation is yet another barrier to implementing healthy school programs for obesity prevention (McKenna, 2003). Schools are often unsure about how to interpret new policies and therefore implementation is inconsistent. In some cases, implementation may not even occur at all (McKenna, 2003). But schools themselves are not always to blame – they are often provided with inadequate funds, time, and expertise (McKenna, 2003) to implement a new policy, which only leads to disorganization, confusion, and a lack of proper program implementation. In terms of the Aboriginal schools involved in this research, policy implementation may prove to be a problem. Frequent communication with program coordinators and flexibility in the adaptation of guidelines based on the needs of the specific communities will help overcome potential policy implementation problems that may arise.

In order to overcome potential program implementation problems, schools must be open and motivated to implement policies that will improve the health of the students who attend them, and should be provided with the necessary resources to do so. Also, consultation of all potential stakeholders before implementing a policy (staff, teachers, administration, parents, the community, etc) may help in foreseeing potential problems (McKenna, 2003) when it comes to budget or implementation. This way, viable solutions to these issues can be agreed upon by all stakeholders before they become problematic.

Overall, school nutrition programs may have the potential to reach a large proportion of the Canadian Aboriginal population, and may play an important role in helping to reduce the prevalence of childhood and adolescent overweight in Aboriginal people by providing them with an environment conducive to healthy living. The current research will investigate the effectiveness of school nutrition programs in two First Nations communities in northern Ontario in terms of improving vegetable and fruit, fibre, folate, vitamin A, and vitamin C intakes, decreasing intakes of “other” foods, and improving nutrition knowledge, and self-efficacy and intentions to eat more vegetables and fruit.

3.0 Chapter 3: Objectives and Hypotheses

3.1 Objectives

The main goal of this research is to contribute to lowering the prevalence and incidence of overweight, obesity, and type 2 diabetes in the participating FN communities. The current research will investigate the relationship between vegetable and fruit intakes and childhood overweight and obesity in on-reserve Aboriginal populations. As childhood prevention is a viable approach to reducing the prevalence and incidence of adulthood overweight, obesity, and type 2 diabetes, it will also investigate the impact of a pilot school snack program on dietary intakes and the impact of a pilot comprehensive school nutrition program on nutrition knowledge, self-efficacy, and intention, with a particular emphasis on vegetables and fruit.

Using data on the dietary habits of on reserve Aboriginal school children in the northern communities of Attawapiskat, Fort Albany, Kashechewan, Moose Factory, and Peawanuck, and the southern communities of Christian Island and Georgina Island, Ontario the specific objectives of this research are:

3.1.1 Objectives for Chapter 4

1 – To describe the vegetable and fruit, “other” foods¹, and relevant micronutrient intakes (vitamin A, vitamin C, fibre, and folate) of on reserve Aboriginal schoolchildren in relation to current dietary standards in Canada (Estimated Average Requirement (EAR), Adequate Intake (AI) and recommended CFG servings) and current Canadian intakes in the general population based on 2004 CCHS data, with respect to age and sex. Data were derived from 24-hr diet recalls completed between 2003 and 2010 by schoolchildren in grades six to eleven in the communities of Attawapiskat, Fort Albany, Kashechewan, Moose Factory, Peawanuck, Christian Island, and Georgina Island, Ontario, as part of the Web-Based Eating Behaviour Questionnaire (Appendix A, B).

2 – To evaluate the variation in vegetable and fruit, “other” foods, and relevant nutrient intakes of Aboriginal schoolchildren with regard to a) year and b) community; through comparing intakes between years (where season

¹ “Other” foods were defined as those foods included in the Canadian Nutrient File category of “other” foods, which includes saturated and/or trans fats and oils, foods that do not belong to any category of Canada’s Food Guide, foods high in fat and/or sugar (including some bakery products), high salt and/or high fat snacks, both higher and lower calorie beverages not including 100% juices and milk, and alcohol. The category does not include unsaturated fats and oils or water (Health Canada, 2009a).

and community were constant) and between communities (where season and year were constant). Data were derived from 24-hour dietary recalls completed between 2003 and 2010 by schoolchildren in grades six to eleven in the communities of Attawapiskat, Fort Albany, Kashechewan, Moose Factory, Peawanuck, Christian Island, and Georgina Island, as part of the Web-Based Eating Behaviour Questionnaire (Appendix A, B). The following dataset pairs were used to identify yearly variation in intakes: Attawapiskat (Winter 2006 & 2010), Christian Island (Fall 2003 & 2004), Fort Albany (Spring 2005 & 2009), and Kashechewan (Spring 2009 & 2010) (Appendix A). The following community dataset pairs were used to identify variation in intakes across communities: Christian Island and Fort Albany (Fall 2004), Attawapiskat and Peawanuck (Winter 2005/2006), Moose Factory and Fort Albany (Winter 2007), and Kashechewan and Fort Albany (Spring 2009) (Appendix A).

3 – To investigate a possible association between vegetable and fruit and fibre intakes and BMI in Aboriginal schoolchildren, controlled for age and sex. The BMI cutoffs used in the analysis were those described by Cole and colleagues (2000). BMI was investigated as a categorical variable (healthy (includes underweight), overweight, or obese). Vegetable and fruit and fibre intakes were investigated continuously. Data were derived from 24-hour dietary recalls completed between 2003 and 2010 by schoolchildren in grades six to eight in the communities of Attawapiskat, Fort Albany, Kashechewan, Moose Factory, Peawanuck, Christian Island, and Georgina Island, Ontario, as part of the Web-Based Eating Behaviour Questionnaire (Appendix A, B).

3.1.2 Objective for Chapter 5

1 – To investigate the short- (one week) and long-term (one year) changes in vegetable and fruit, “other” foods, and relevant nutrient intakes of schoolchildren (grades six to eight) as a result of a pilot food provision (breakfast and snack) program at St. Andrew’s School in the FN community of Kashechewan, Ontario. Data were derived from 24-hour recalls completed in May and June 2009 and May 2010 by schoolchildren in grades six to eight at St. Andrew’s School in Kashechewan, Ontario (Appendix A).

3.1.3 Objectives for Chapter 6

1 – To evaluate the vegetable and fruit, “other” foods, and relevant nutrient intakes of schoolchildren (grades six to eight) before and after a comprehensive school nutrition program in the FN community of Fort Albany,

Ontario. Pre-program data were derived from 24-hour dietary recalls completed by schoolchildren in grades six to eight in June 2009 as part of the Web-Based Eating Behaviour Questionnaire (Appendix A, B). Post-program data was derived from 24-hour dietary recalls completed by schoolchildren in grades six to eight, following the completion of the program in June 2010, as part of the Web-Based Eating Behaviour Questionnaire (Appendix A, B).

2 – To evaluate students' nutrition knowledge, self-efficacy and intentions to eat vegetables and fruit before and after a comprehensive school nutrition program in the FN community of Fort Albany, Ontario. Pre-program data were derived from the Knowledge, Self-Efficacy, and Intentions Questionnaire (Appendix G), which was administered to grade six to eight students prior to the start of the program in March 2010. Post-program data were derived from the same questionnaire, which was administered to grade six to eight students following the completion of the program in April 2010.

3.2 Hypotheses

The following hypotheses relate to the specific objectives as outlined in section 3.1 Objectives.

3.2.1 Hypotheses for Chapter 4

1 – It is expected that the mean vegetable and fruit and related nutrient intakes of schoolchildren living in the Aboriginal communities of Attawapiskat, Fort Albany, Kashechewan, Moose Factory, Peawanuck, Christian Island, and Georgina Island, Ontario, will be below national standards (based on Dietary Reference Intakes and CFG), as well as below the mean intakes seen in the general Canadian population of the same age and sex group based on 2004 CCHS data. Mean intakes of “other” foods are expected to be higher than mean intakes from the vegetable and fruit food group of CFG.

2 – It is expected that mean vegetable and fruit, “other foods”, and related nutrient intakes of schoolchildren living in the more northern, remote, isolated communities will be significantly different as compared to children living in more southern, less isolated and remote communities. In all communities, mean vegetable and fruit and related

nutrient intakes are expected to decline with increasing age. Significant variations in mean vegetable and fruit, “other” foods, and related nutrient intakes are expected.

3 – Using the BMI cutoffs defined by Cole and colleagues (2000) to describe healthy, overweight, and obese body weight categories in children and adolescents based on age, sex, weight, and height, it is expected that children with a lower intake of vegetables and fruit or fibre will be more likely to be overweight or obese.

3.2.2 Hypothesis for Chapter 5

1 – As the school snack program at St. Andrew’s School in Kashechewan, Ontario, provides vegetables and fruit to the schoolchildren on a daily basis, it is expected that mean vegetable and fruit, “other” foods, and related nutrient intakes will improve significantly in the short term (as compared to mean pre-program intakes). In the long term, it is expected that, although mean vegetable and fruit, “other” foods, and related nutrient intakes will have improved significantly from baseline, they will be poorer than in the short-term analysis.

3.2.3 Hypotheses for Chapter 6

1 – It is expected that the mean vegetable and fruit, “other” foods, and related nutrient intakes of grade six to eight schoolchildren at Peetabeck Academy in Fort Albany will not improve significantly from baseline as a result of the comprehensive school nutrition program. As poverty and the availability of fresh produce are major concerns in the communities in question, although improvements are to be expected at school, the barriers to sufficient intake on a 24-hour basis will not change. Additionally, as the school already has a longstanding school food provision (breakfast/snack) program in place, significant further improvement in mean vegetable and fruit, “other” foods, and related nutrient intakes are not expected.

2 – It is expected that the nutrition knowledge, self-efficacy, and intentions of schoolchildren in grades six to eight at Peetabeck Academy in Fort Albany to eat more vegetables and fruit will improve significantly as a result of the comprehensive school nutrition program. As the school currently does not have a nutrition education program in place, children are expected to learn a lot from the program to be piloted in this research.

4.0 Chapter 4: Vegetable and Fruit Intakes of On-Reserve First Nations Schoolchildren in Ontario Fall Short of Canadian Averages and Current Dietary Standards

4.1 Introduction

Over the past 25 years, the prevalence of overweight and obesity has risen steadily in Canada, reaching epidemic proportions (Shields & Tjepkema, 2006; World Health Organization, 2000). Rates of overweight and obesity in Aboriginal populations are becoming increasingly problematic, even more so than in the general population (Canadian Paediatric Society, 2005; Tjepkema, 2006; Tremblay et al., 2005; Garriguet, 2008). Children are no exception; Aboriginal children have higher rates of overweight and obesity compared to children of other ethnic backgrounds (Story et al., 2003; Willows, 2005a). The First Nations Regional Longitudinal Health Survey (FNRHS) reports on the health of First Nations (FN) people living on-reserve in Canada. The most recent FNRHS indicated that of FN youths aged 12 to 17 years, 28.1% were overweight and 14.1% were obese (FNRHS, 2003). For Canadian Aboriginal children aged twelve to 17 years living off-reserve, the 2004 prevalence rates of overweight and obesity were 20% and 21%, respectively. Meanwhile, for Canadian children as a whole (aged two to 17 years), the figures were 18% and 8%, respectively, markedly lower compared to figures for Canadian Aboriginal populations (Shields, 2005). The epidemic of obesity and overweight in Aboriginal populations is of particular concern as obesity is the strongest risk factor for type 2 diabetes, a metabolic disorder for which Aboriginal people may be especially susceptible (Young & Sevenhuysen, 1989; Young et al., 1990; Harris et al., 1997).

Although the etiology of overweight and obesity in Aboriginal children is complex, dietary intake is an immediate, potentially modifiable contributor. Data from the 2004 CCHS have specifically pinpointed a relationship between poor vegetable and fruit intakes in Canadian children and overweight and obesity (Shields, 2005). A review by Pereira and Ludwig (2001) also noted evidence to support an inverse relationship between dietary fibre intake and body weight or body fat, which may be related to a number of plausible mechanisms (Pereira & Ludwig, 2001). Aboriginal people aged 19-50 years in Canada tend to consume diets inadequate in vegetables and fruit and high in “other” foods; those that do not fit into any category of CFG, that are generally high in fat, sodium, and sugar, and should thus be avoided (Garriguet, 2008; n=561). Children are likely no exception. These data, however, exclude Aboriginal people living on-reserve and do not describe the eating

habits of Aboriginal children. An investigation of the vegetable and fruit, “other” foods, and related nutrient intakes of children and adolescents living on-reserve is warranted.

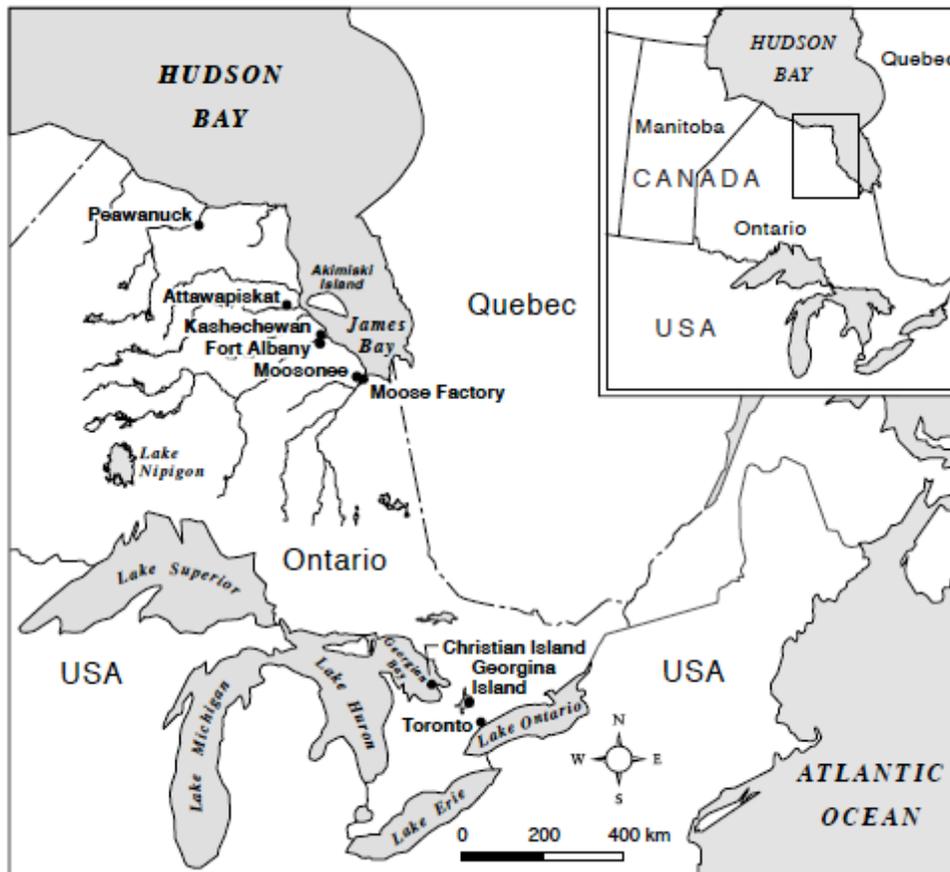
In this study, the vegetable and fruit and relevant nutrient intakes of FN schoolchildren living on reserve, in Ontario, were described relative to current dietary standards and average intakes of Canadian children, based on CCHS data. The dietary contribution of “other” foods was also examined. Variations in vegetable and fruit and “other” foods intakes by year and community were also investigated, where conditions were comparable. Finally, the relationship between vegetable and fruit consumption, as well as dietary fibre intake, and BMI was investigated. Data were collected using a validated, web-based 24-hour recall and questionnaire, developed at the University of Waterloo (WEB-Q) (Hanning, Jessup, Lambraki, MacDonald & McCargar, 2003) (Appendix B). Twenty-four hour recall data were collected between December 2003 and June 2010 in FN communities of northern (Peawanuck, Attawapiskat, Fort Albany, Kashechewan, and Moose Factory) and southern (Christian Island and Georgina Island) Ontario.

4.2 Methods

4.2.1 Participants

Data were collected in students aged ten to 18 years in seven FN communities. The remote (at a great distance from a major city) Cree communities of Peawanuck, Attawapiskat, Fort Albany, Kashechewan, and Moose Factory, Ontario, lie in the Mushkegowuk Territory, on the western coast of James Bay and Hudson Bay. All communities are accessible only by air year-round, and by winter road after freeze-up. Peawanuck (55°15'N 85°12'W) is the most northern of all of the communities, followed by Attawapiskat (52°56'N 82°24'W), Kashechewan (52°18'N 81°37'W), Fort Albany (52°15'N 81°35'W), and finally Moose Factory (51°16'N 80°32'W) (Figure 4.1) (MOW, 2010). The more southern, Ojibway communities of Christian Island (44°50'N 80°12'W) and Georgina Island (44°22'N 79°17'W), Ontario, are not remote, but isolated (not readily accessible by land) (Figure 4.1) (Maps of World [MOW], 2010). Data were collected in partnership with the communities and with approval from the Office of Research Ethics at the University of Waterloo, Ontario, Canada (Appendix C).

Figure 4.1: Map of participating communities



4.2.2 Vegetable and Fruit and Nutrient Intakes

Intakes of vegetables and fruit, “other” foods, vitamin A, vitamin C, fibre, and folate were assessed via the 24-hour recall portion of the Web-based Eating Behaviour Questionnaire, developed at the University of Waterloo (Hanning et al., 2003). The WEB-Q has been used since 2001 to survey over 20 000 Canadian students (Hanning et al., 2003; Forbes, Storey, Fraser, Spence, Plotnikoff & Raine et al., 2009; Hanning, Royall, Toews, Blashill, Wegener & Driezen, 2009; Woodruff & Hanning, 2007; Hanning, Woodruff, Lambraki, Jessup, Driezen & Murphy, 2007; Storey, Forbes, Fraser, Spence, Plotnikoff & Raine, 2009). It was recently validated in grade six to eight students, including students from Fort Albany FN, Ontario (n=25, 2004) (Hanning et al., 2009). The 24-hour recall component, where students are asked for recall of all the foods and beverages they consumed the previous day, has good relative validity when compared to dietitian-administered interviews in both non-Aboriginal and Aboriginal students (Hanning et al., 2009). Children are prompted to choose from over 800 foods,

including numerous traditional foods such as game meats and fish that may be consumed by FN children and adolescents. Portion size selection is facilitated by actual photos of foods on a plate, scaled by the place setting. The 24-hour recall portion of the WEB-Q mimics the multiple-pass technique, a five-step method used by dietitians in face-to-face dietary recalls, which includes probing for forgotten foods, specific quantities, and any additions (condiments, spreads, etc.) (United States Department of Agriculture, 2010).

4.2.3 Anthropometric Variables and Body Mass Index Classification

Students were measured for height by a trained research assistant using a tape measure affixed to a wall, to the nearest inch. After being measured, students were told their height and they would then enter it into the appropriate section of the WEB-Q. In an effort to maintain confidentiality, students weighed themselves using a standard portable weigh scale, to the nearest pound. Students would then enter their weight into the appropriate section of the WEB-Q. Although diet and measurements were self-reported, the privacy and confidentiality of the WEB-Q as compared to dietitian-administered interviews may have decreased potential social desirability bias (Probst & Tapsell, 2005).

BMI was calculated to the nearest 0.1 kg/m² based on the heights and weights self-reported in the WEB-Q. Students were classified into three BMI categories (normal, overweight, and obese) based on age- and sex-specific cut-offs described by Cole and colleagues (Cole, Bellizzi, Flegal & Dietz, 2000).

4.2.4 Data Analysis

Twenty-four hour recall data were analyzed using the ESHA nutrient analysis software (Salem, Oregon, version 7.1), in accordance with the 2007 Canadian Nutrient File (CNF) (Health Canada, 2009a). The 2007 version of Canada's Food Guide and CNF serving size specifications were used to analyze food guide servings of vegetables and fruit and "other" foods. "Other" foods were those that fit the CNF definition of "other", including saturated and/or trans fats and oils, foods that do not fit into any food group of CFG, high fat and/or high sugar foods (including some bakery products), high salt and/or high fat snacks, higher and lower calorie beverages not including 100% juice or milk, and alcohol (Health Canada, 2009a). "Other" foods did not include unsaturated fat or oils, nor water (Health Canada, 2009a). Nutrient data were compared to Dietary Reference Intakes (1999-2003

version) including the Estimated Average Requirement (EAR) for vitamin A, vitamin C, and folate, and the Adequate Intake (AI) for fibre, specific to age and sex (Table 4.1) (Health Canada, 2006). Food group intakes were compared to 2007 CFG recommendations (excluding the recommendation for green and orange vegetables) (Health Canada, 2009b) and mean intakes reported in the CCHS (Statistics Canada, 2010), specific to age and sex (Table 4.1). Because nutrient intakes are influenced by total energy intake in that those who consume greater energy also eat, on average, more of all specific nutrients, nutrient and food group intakes were adjusted for energy intake using the nutrient density method, to reflect intakes per 1000 kilocalories (kcal) (Willett, Howe & Lawrence, 1997).

Table 4.1: Dietary standards used to compare student intakes (Adequate Intakes (AIs), Estimated Average Requirements (EARs), Canada’s Food Guide (CFG) recommendations and Canadian Community Health Survey (CCHS) averages

Age Group	Nutrient or food group	EAR, AI, or CFG recommendation		CCHS mean intake	
		Male	Female	Male	Female
9-13 years	Vegetables and fruit (servings)	6	6	4.53	4.40
	“Other” foods (servings)	-	-	-	-
	Fibre (g/day)*	31	26	-	-
	Folate (µg/day)**	250	250	-	-
	Vitamin A (RAE µg/day)**	445	420	-	-
14-18 years	Vitamin C (mg/day)**	39	39	-	-
	Vegetables and fruit (servings)	8	7	4.87	4.67
	“Other” foods (servings)	-	-	-	-
	Fibre (g/day)	38	26	-	-
	Folate (µg/day)	330	330	-	-
	Vitamin A (RAE µg/day)	630	485	-	-
	Vitamin C (mg/day)	63	56	-	-

Note: Servings of “other” foods were not compared as there is no formal recommendation or standard; RAE refers to retinol activity equivalents (vitamin A activity)

*Adequate Intake; **Estimated Average Requirement

Statistical analyses were carried out using SPSS (Chicago, Illinois, version 17.0). Descriptive statistics were computed for food group and nutrient intakes, compared to current standards and CCHS average intakes by age and sex. A multivariate analysis of variance (MANOVA) was used to detect differences in intakes by year, controlled for season and community. A principal components analysis (PCA) was used to identify differences in dietary patterns by age and sex. The PCA was used to reduce the inter-correlated nutrient and food group variables to fewer uncorrelated variables, for ease of examination. A MANOVA was used to identify significant differences in PCA scores based on age and sex. In addition, MANOVAs were used to detect differences in intakes by community, controlled for season and year. Finally, MANOVAs were also used to investigate the possible relationship between BMI and fibre intake and vegetable and fruit intake. Homogeneity of variances were tested for all variables, and appropriate transformations were computed when necessary to yield equal variances. Because homogeneity of variances could not be achieved for the Fort Albany analysis comparing years, the data were split by sex. This allowed for equality of variances for all variables and the results for these data are therefore presented by sex. The p-value of statistical significance for all analyses was 0.05 (5%).

4.3 Results

4.3.1 Comparison of Intakes to Current Dietary Standards and CCHS Data

A total of 443 students from seven FN communities were included in the analysis (Table 4.2). All students in the grades investigated who were present at school on the day of the survey completed the questionnaire. One student from Moose Factory and four students from Christian Island were excluded based on age (>18 years or no age reported). Eight students were excluded from Attawapiskat because they were unable to complete the survey due to an Internet shutdown. Finally, one student was excluded from Peawanuck because he/she did not complete the dietary survey. In all age and sex groups, the majority of students did not meet current dietary recommendations, with the exception of vitamin C (Table 4.3), and mean intakes of vegetables and fruit were inferior to those reported in the CCHS for the same age and sex groups (3.5 versus 4.53 servings for males aged nine to 13 years, 3.3 versus 4.87 servings for males aged 14 to 18 years, respectively; 3.5 versus 4.40 servings for females aged nine to 13 years, 3.6 versus 4.67 servings for females aged 14 to 18 years, respectively). The poorest intakes of vegetables and fruit were in boys aged 14 to 18 years. The average intake of “other” foods

was greater than the average vegetable and fruit intake in all age and sex groups, in terms of servings. Prevalence rates of overweight and obesity in the sample population were 31.8% and 19.6%, respectively.

Table 4.2: Characteristics of the study participants

Community	Season, Year	N	Mean Age (SD)	Males (%) 9-13; 14-18 y	Females (%) 9-13; 14-18 y	Over-weight (%)	Obese (%)
Attawapiskat	Winter, 2006	62	12.5 (1.0)	28 (45.2) 22; 6	34 (54.8) 30; 4	20 (45.5)	7 (15.9)
Attawapiskat	Winter, 2010	69	12.2 (1.1)	25 (36.2) 25; 0	44 (63.8) 36; 8	20 (20.9)	24 (38.1)
Christian Island	Fall, 2004	40	11.8 (1.0)	23 (57.5) 23; 0	17 (42.5) 17; 0	12 (33.3)	7 (19.4)
Fort Albany	Winter, 2004	63	13.5 (2.0)	28 (44.4) 14; 14	35 (55.6) 22; 13	15 (25.4)	6 (10.2)
Fort Albany	Winter, 2007	50	13.0 (1.9)	22 (44.0) 12; 10	28 (56.0) 21; 7	n/a	n/a
Georgina Island	Winter, 2003	12	11.5 (0.7)	6 (50.0) 6; 0	6 (50.0) 6; 0	0 (0)	1 (8.3)
Kashechewan	Spring, 2009	43	13.1 (1.0)	26 (60.5) 18; 8	17 (39.5) 15; 2	17 (42.5)	7 (17.5)
Moose Factory	Winter, 2007	81	14.4 (1.5)	44 (54.3) 10; 34	37 (45.7) 14; 23	16 (24.2)	7 (8.6)
Peawanuck	Winter, 2005	10	11.5 (0.9)	4 (40.0) 4; 0	6 (60.0) 6; 0	2 (28.6)	2 (28.6)
Peawanuck	Spring, 2010	13	12.8 (0.7)	7 (53.8) 6; 1	6 (46.2) 5; 1	5 (38.5)	5 (38.5)
Total	-	443	13.0 (1.6)	213 (48.1) 140; 73	230 (51.9) 172; 58	107 (31.8)	66 (19.6)

*Height and/or weight information was not available for 107 participants therefore body mass index (BMI) could not be determined.

Table 4.3: Nutrient and food group intakes as compared to current dietary standards*

Sex (n)	Age group (years)	Nutrient or food group	Median intake	Mean intake (SD)	% intakes below recommen- dations
Male (n=140)	9-13	Vegetables and fruit (servings)	2.8	3.5 (3.2)	82.1
		“Other” foods (servings)	4.5	5.5 (4.4)	-
		Fibre (g/day)**	8.6	10.9 (8.3)	97.1
		Folate (µg/day)	178.5	215.5 (160.8)	63.6
		Vitamin A (RAE µg/day)	406.8	494.7 (479.9)	57.1
		Vitamin C (mg/day)	72.8	112.0 (120.7)	38.6
(n=73)	14-18	Vegetables and fruit (servings)	3.3	3.3 (2.7)	93.2
		“Other” foods (servings)	7.0	8.4 (5.7)	-
		Fibre (g/day)	10.4	11.2 (7.6)	98.6
		Folate (µg/day)	244.2	293.1 (212.6)	64.4
		Vitamin A (RAE µg/day)	535.0	656.9 (492.8)	61.6
		Vitamin C (mg/day)	81.5	110.2 (108.1)	46.6
Female (n=172)	9-13	Vegetables and fruit (servings)	2.9	3.6 (3.1)	82.0
		“Other” foods (servings)	4.4	5.1 (3.8)	-
		Fibre (g/day)	9.2	10.0 (6.9)	98.3
		Folate (µg/day)	168.1	202.6 (171.0)	72.1
		Vitamin A (RAE µg/day)	370.7	489.4 (568.2)	55.8
		Vitamin C (mg/day)	89.8	120.7 (136.6)	33.1
(n=58)	14-18	Vegetables and fruit (servings)	2.7	3.6 (3.4)	84.5
		“Other” foods (servings)	4.6	5.6 (4.0)	-
		Fibre (g/day)	7.7	8.3 (6.1)	100.0
		Folate (µg/day)	147.6	204.2 (175.0)	81.0
		Vitamin A (RAE µg/day)	364.4	427.5 (330.2)	62.1
		Vitamin C (mg/day)	87.1	128.6 (154.7)	44.8

*Table shows unadjusted intakes

**Recognizing that the Adequate Intake is an estimation of adequacy and not a recommendation, per se

4.3.2 Comparison of Intakes by Year

Yearly variation of intakes was examined using the following data set pairs, controlling for season and community: Attawapiskat (Winter 2006 and 2010), Christian Island (Fall 2003 and 2004), Fort Albany (Spring

2005 and 2009) and Kashechewan (Spring 2009 and 2010) (Table 4.4). Comparisons of intakes by year are shown in Table 4.5.

In terms of yearly variation, in Attawapiskat, the energy-adjusted intakes of fibre ($p < 0.001$) were significantly higher in 2006 as compared to 2010, while energy-adjusted vitamin A ($p = 0.002$) intakes were significantly lower in 2010 as compared to 2006. In Fort Albany females, no significant differences in intakes by year were observed. A significant AGE_{GROUP} × YEAR interaction was noted for “other” foods in Fort Albany females ($p = 0.044$). In Fort Albany males, energy-adjusted intakes of “other” foods ($p = 0.033$) and folate ($p = 0.048$) were significantly higher in 2005 as compared to 2009. Fort Albany males also had significantly higher energy-adjusted intakes of fibre ($p = 0.014$) in 2009 as compared to 2005. There was a significant AGE_{GROUP} × YEAR interaction for fibre for Fort Albany males. No significant differences in energy-adjusted intakes between years were observed in Christian Island or Kashechewan.

Table 4.4: Characteristics of study participants in dataset pairs*

Community	Season, Year	N	Mean Age (SD)	Males (%) 9-13; 14-18 y	Females (%) 9-13; 14-18 y	Over-weight (%)	Obese (%)
Attawapiskat	Winter, 2006	62	12.5 (0.9)	28 (45.2) 22; 6	34 (54.8) 30; 4	20 (45.5)	7 (15.9)
	Winter, 2010	69	12.2 (1.1)	25 (36.2) 25; 0	44 (63.8) 36; 8	20 (20.9)	24 (38.1)
Christian Island	Fall, 2003	36	11.8 (1.0)	19 (52.8) 18; 1	17 (47.2) 17; 0	6 (19.4)	3 (9.7)
	Fall, 2004	40	11.8 (1.0)	23 (57.5) 23; 0	17 (42.5) 17; 0	12 (33.3)	7 (19.4)
Fort Albany	Spring, 2005	45	13.4 (1.4)	21 (46.7) 8; 13	24 (53.3) 20; 4	11 (28.2)	5 (12.8)
	Spring, 2009	30	13.0 (1.0)	10 (33.3) 5; 5	20 (66.7) 15; 5	15 (60.0)	2 (8.0)
Kashechewan	Spring, 2009	43	13.1 (1.0)	25 (58.1) 16; 9	18 (41.9) 16; 2	13 (31.0)	10 (23.8)
	Spring, 2010	67	13.5 (1.1)	32 (47.8) 12; 20	35 (52.2) 20; 15	13 (19.4)	15 (22.4)

*Overweight and obesity prevalence rates represent those where sufficient height and weight data were available to calculate Body Mass Index.

Table 4.5: Food group and nutrient intakes by year, controlled for age, sex, season, and community (values in bold are statistically significant)*

Food group/nutrient	Year	N	Median	Mean	SD	p-value
Attawapiskat						
Vegetables and fruit (servings)	2006	62	2.9	3.5	3.3	0.951
	2010	69	3.0	3.7	3.1	
“Other” foods (servings)	2006	62	4.9	5.7	4.5	0.891
	2010	69	4.0	5.0	3.3	
Fibre (g/day)	2006	62	6.9	7.8	6.6	<0.001
	2010	69	10.6	12.4	7.0	
Folate (µg/day)	2006	62	218.6	273.3	215.4	0.385
	2010	69	289.6	319.4	199.1	
Vitamin A (RAE µg/day)	2006	62	512.5	717.6	878.9	0.002
	2010	69	227.9	290.1	228.9	
Vitamin C (mg/day)	2006	62	103.5	151.9	198.3	0.494
	2010	69	125.7	147.7	139.1	
Christian Island						
Vegetables and fruit (servings)	2003	36	4.0	5.7	3.9	0.975
	2004	40	4.3	5.1	3.2	
“Other” foods (servings)	2003	36	3.9	4.0	3.0	0.225
	2004	40	3.9	4.3	3.4	
Fibre (g/day)	2003	36	12.0	13.4	7.8	0.733
	2004	40	11.6	12.1	8.5	
Folate (µg/day)	2003	36	246.3	284.7	160.5	0.607
	2004	40	250.4	266.7	167.8	
Vitamin A (RAE µg/day)	2003	36	411.8	690.5	863.6	0.154
	2004	40	409.7	434.8	298.6	
Vitamin C (mg/day)	2003	36	90.5	141.1	154.9	0.709
	2004	40	108.6	134.9	112.8	
Fort Albany: Males						
Vegetables and fruit (servings)	2005	21	2.4	3.1	2.8	0.722
	2009	10	2.7	3.1	1.9	
“Other” foods (servings)	2005	21	6.8	7.8	4.7	0.033
	2009	10	4.8	4.8	3.7	
Fibre (g/day)	2005	21	7.4	9.5	7.2	0.014
	2009	10	11.7	13.3	7.9	

Folate ($\mu\text{g}/\text{day}$)	2005	21	322.4	304.8	154.7	0.048
	2009	10	176.8	198.7	158.7	
Vitamin A (RAE $\mu\text{g}/\text{day}$)	2005	21	441.8	529.1	331.2	0.060
	2009	10	306.6	306.0	178.9	
Vitamin C (mg/day)	2005	21	103.7	125.9	113.0	0.840
	2009	10	123.3	118.8	84.5	
Fort Albany: Females						
Vegetables and fruit (servings)	2005	24	3.0	3.1	1.7	0.183
	2009	20	2.6	3.3	3.7	
“Other” foods (servings)	2005	24	3.6	4.0	3.4	0.297
	2009	20	3.8	4.0	3.3	
Fibre (g/day)	2005	24	8.3	8.6	4.9	0.731
	2009	20	9.8	10.2	7.1	
Folate ($\mu\text{g}/\text{day}$)	2005	24	239.8	241.6	115.6	0.463
	2009	20	180.3	258.8	211.1	
Vitamin A (RAE $\mu\text{g}/\text{day}$)	2005	24	419.8	439.9	238.3	0.125
	2009	20	218.3	257.4	177.0	
Vitamin C (mg/day)	2005	24	117.4	122.1	78.6	0.192
	2009	20	67.8	124.6	126.6	
Kashechewan						
Vegetables and fruit (servings)	2009	43	2.1	2.8	2.4	0.295
	2010	67	1.4	1.7	1.6	
“Other” foods (servings)	2009	43	5.0	6.4	4.7	0.748
	2010	67	4.5	4.6	3.2	
Fibre (g/day)	2009	43	12.9	13.8	8.0	0.154
	2010	67	9.5	9.5	5.8	
Folate ($\mu\text{g}/\text{day}$)	2009	43	242.8	290.0	183.0	0.108
	2010	67	183.4	213.8	152.5	
Vitamin A (RAE $\mu\text{g}/\text{day}$)	2009	43	304.8	376.7	402.3	0.081
	2010	67	142.3	203.7	207.9	
Vitamin C (mg/day)	2009	43	112.2	126.6	115.9	0.219
	2010	67	33.6	70.3	90.9	

*Table shows unadjusted intakes; p-values of significance are for energy-adjusted intakes (per 1000 kcal)

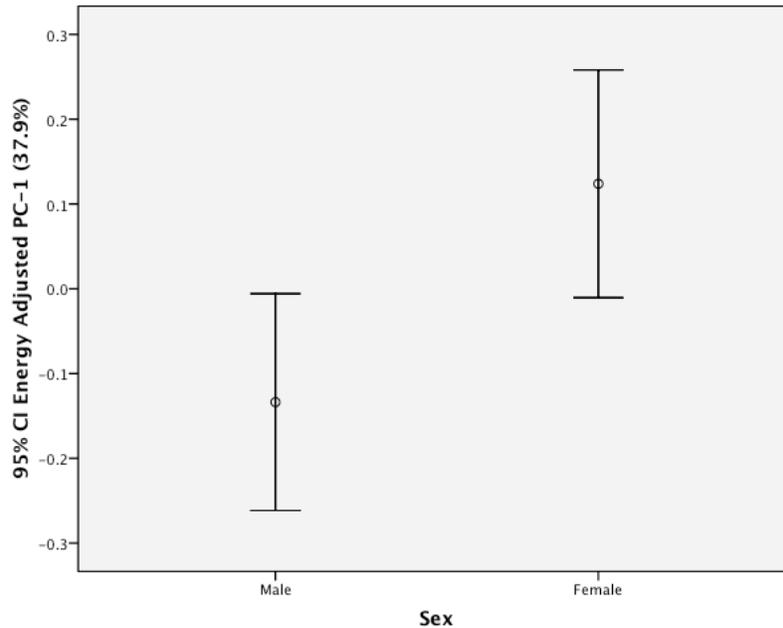
4.3.3 Differences in Dietary Patterns by Age and Sex

A PCA was used to gain insight into the dietary patterns of the study participants. In the PCA, the majority of the variation in dietary intakes was explained by the first (PC-1) and second (PC-2) principal component (PC) axes. These first two axes accounted for 57% of the total variance, with PC-1 and PC-2 explaining 37.9% and 19.1% of the variance, respectively. Individuals with high scores on the PC-1 axis consumed diets rich in vegetables and fruit, fibre, folate, and vitamin C, and low in “other” foods, while those with high scores on the PC-2 axis consumed diets rich in “other” foods, vitamin A, and folate (Table 4.6). The MANOVA revealed significant sex differences in PC-1 scores ($p=0.006$), with females having significantly higher scores on the PC-1 axis (Figure 4.2). There were no significant differences in PC-1 scores by age group, nor were there any significant differences in PC-2 scores by sex or by age group. There were no AGE_{GROUP}xSEX interactions.

Table 4.6: Principal component (PC) analysis scores for vegetables and fruit, related nutrients, and “other” foods (relatively large positive and negative values are in bold)

Food group/nutrient	Principal component	PC-1	PC-2
	Variance explained	37.9%	19.1%
Vegetables and fruit (servings)		0.843	-0.034
“Other” foods (servings)		-0.356	0.372
Fibre (g/day)		0.549	-0.251
Folate ($\mu\text{g}/\text{day}$)		0.728	0.306
Vitamin A (RAE $\mu\text{g}/\text{day}$)		0.115	0.893
Vitamin C (mg/day)		0.804	-0.034

Figure 4.2: Sex differences in energy-adjusted dietary PC-1 scores



4.3.4 Comparison of Intakes by Community

To control for season and year, variation in food group and nutrient intakes by community was assessed using data that were collected in different communities during the same season and year. The following dataset pairs were investigated: Christian Island and Fort Albany (Fall 2004), Attawapiskat and Peawanuck (Winter 2005/2006), Moose Factory and Fort Albany (Winter 2007), and Kashechewan and Fort Albany (Spring 2009) (Table 4.7). Comparisons of intakes by community are shown in Table 4.8.

In the comparison of Christian Island and Fort Albany, significant differences in the energy adjusted intakes of vegetables and fruit ($p=0.030$) and fibre ($p=0.025$) were noted, with mean intakes for Christian Island being significantly higher than those in Fort Albany for both variables (Table 4.8). None of the remaining food group and nutrient intakes were statistically different between communities. In the comparison of Attawapiskat and Peawanuck, significant differences in the energy-adjusted intakes of fibre ($p<0.001$) and folate ($p=0.033$) were observed, with intakes of both nutrients being significantly higher in Peawanuck. In the comparison of Moose Factory and Fort Albany, only the energy-adjusted vitamin A intake ($p=0.028$) was significantly different between communities, with students in Fort Albany consuming, on average, significantly more of this nutrient.

Finally, in the comparison of Kashechewan and Fort Albany, no significant differences between communities were observed.

Table 4.7: Characteristics of study population in dataset pairs*

Season, Year	Community	N	Mean Age (SD)	Males (%) 9-13; 14-18 y	Females (%) 9-13; 14-18 y	Over-weight (%)	Obese (%)
Fall, 2004	Christian Island	40	11.8 (1.0)	23 (57.5) 23; 0	17 (42.5) 17; 0	12 (33.3)	7 (19.4)
	Fort Albany	63	13.5 (2.0)	28 (44.4) 14; 14	35 (55.6) 22; 13	15 (25.4)	6 (10.2)
Winter, 2005/2006	Attawapiskat	62	12.5 (0.9)	28 (45.2) 22; 6	34 (54.8) 30; 4	20 (45.5)	7 (15.9)
	Peawanuck	10	11.5 (0.9)	4 (40.0) 4; 0	6 (60.0) 6; 0	2 (28.6)	2 (28.6)
Winter, 2007	Moose Factory	81	14.4 (1.5)	44 (54.3) 10; 34	37 (45.7) 14; 23	16 (24.2)	7 (10.6)
	Fort Albany	50	13.0 (1.9)	22 (44.0) 12; 10	28 (56.0) 21; 7	n/a	n/a
Spring, 2009	Kashechewan	43	13.1 (0.9)	26 (60.5) 18; 8	17 (39.5) 15; 2	17 (42.5)	7 (17.5)
	Fort Albany	30	13.0 (1.0)	10 (33.3) 5; 5	20 (66.7) 15; 5	15 (60.0)	2 (8.0)

*Overweight and obesity prevalence rates represent those where sufficient height and weight data were available to calculate Body Mass Index.

Table 4.8: Food group and nutrient intakes by community, controlled for age, sex, season, and year (values in bold are statistically significant)*

Food group/nutrient	Community	N	Median	Mean	SD	p-value
Fall 2004						
Vegetables and fruit (servings)	Christian Island	40	4.3	5.1	2.2	0.030
	Fort Albany	63	4.5	4.9	3.9	
“Other” foods (servings)	Christian Island	40	3.9	4.3	3.4	0.915
	Fort Albany	63	4.9	6.0	4.3	
Fibre (g/day)	Christian Island	40	11.6	12.1	8.5	0.025
	Fort Albany	63	9.4	11.6	10.0	
Folate (µg/day)	Christian Island	40	250.4	266.7	167.8	0.100
	Fort Albany	63	272.7	647.5	211.5	
Vitamin A (RAE µg/day)	Christian Island	40	409.7	434.8	298.6	0.374
	Fort Albany	63	524.8	647.5	485.8	
Vitamin C (mg/day)	Christian Island	40	108.6	134.9	112.8	0.102
	Fort Albany	63	102.6	141.4	131.4	
Winter 2005/2006						
Vegetables and fruit (servings)	Attawapiskat	87	2.9	3.7	3.4	0.978
	Peawanuck	10	3.1	2.7	2.2	
“Other” foods (servings)	Attawapiskat	87	4.7	5.5	4.3	0.102
	Peawanuck	10	3.4	3.3	2.0	
Fibre (g/day)	Attawapiskat	87	7.5	9.5	7.8	<0.001
	Peawanuck	10	9.3	10.3	3.9	
Folate (µg/day)	Attawapiskat	87	169.0	225.0	208.5	0.033
	Peawanuck	10	299.8	300.0	100.2	
Vitamin A (RAE µg/day)	Attawapiskat	87	423.7	601.8	769.6	0.360
	Peawanuck	10	338.1	386.6	215.7	
Vitamin C (mg/day)	Attawapiskat	87	112.5	152.0	188.8	0.952
	Peawanuck	10	120.0	104.9	84.3	
Winter 2007						
Vegetables and fruit (servings)	Moose Factory	81	2.3	2.6	2.2	0.763
	Fort Albany	50	2.2	2.5	2.1	
“Other” foods (servings)	Moose Factory	81	6.5	7.4	5.8	0.345
	Fort Albany	50	5.3	6.6	5.6	
Fibre (g/day)	Moose Factory	81	9.0	8.3	5.7	0.819
	Fort Albany	50	7.1	8.1	6.2	

Folate ($\mu\text{g}/\text{day}$)	Moose Factory	81	191.5	221.0	163.5	0.523
	Fort Albany	50	218.2	232.3	153.2	
Vitamin A (RAE $\mu\text{g}/\text{day}$)	Moose Factory	81	384.2	509.0	458.8	0.028
	Fort Albany	50	511.9	620.8	456.3	
Vitamin C (mg/day)	Moose Factory	81	58.0	94.9	95.4	0.511
	Fort Albany	50	29.0	68.3	75.0	
Spring 2009						
Vegetables and fruit (servings)	Kashechewan	43	1.8	2.3	2.0	0.804
	Fort Albany	30	2.7	3.2	3.2	
“Other” foods (servings)	Kashechewan	43	5.5	5.5	3.2	0.680
	Fort Albany	30	4.0	4.3	3.4	
Fibre (g/day)	Kashechewan	43	9.5	11.0	6.4	0.919
	Fort Albany	30	10.4	11.2	7.4	
Folate ($\mu\text{g}/\text{day}$)	Kashechewan	43	242.8	290.0	183.0	0.352
	Fort Albany	30	177.0	238.1	194.5	
Vitamin A (RAE $\mu\text{g}/\text{day}$)	Kashechewan	43	235.1	319.6	275.7	0.837
	Fort Albany	30	245.1	273.6	176.1	
Vitamin C (mg/day)	Kashechewan	43	41.7	75.3	80.6	0.457
	Fort Albany	30	108.5	122.7	112.8	

*Table shows unadjusted intakes; p-values of significance are for energy-adjusted intakes (per 1000 kcal)

4.3.5 Relationship Between BMI and Vegetable and Fruit and Fibre Intake

The height and/or weight measurements required to calculate BMI were missing for 107 participants; analyses were run on the 336 remaining participants. The associations between BMI and vegetable and fruit intake and BMI and fibre intake are shown in Table 4.9. None of these associations was statistically significant.

Table 4.9: Investigation of the relationship between Body Mass Index (BMI), vegetable and fruit, and fibre intakes controlled for age and sex*

Nutrient/Food group	BMI category	N	Median	Mean	SD	p-value
Vegetables and fruit (servings)	Normal	163	3.0	3.9	3.7	0.911
	Overweight	107	2.8	3.4	3.0	
	Obese	66	3.0	3.5	2.7	
Fibre (g/day)	Normal	163	9.1	11.1	8.5	0.237
	Overweight	107	8.5	10.0	7.1	
	Obese	66	10.1	11.1	7.1	

*Table shows unadjusted intakes; p-values of significance are for energy-adjusted intakes (per 1000 kcal)

4.4 Discussion

The majority of students who participated in the present study had intakes of vegetables and fruit, fibre, folate, and vitamin A that were less than national standards by age and sex. In addition, mean intakes of vegetables and fruit were less than the average intakes of Canadian children of the same age and sex group as described in the CCHS. In contrast, mean intakes of “other” foods seemed high (above five servings) in all age and sex groups, especially considering the low intakes of vegetables and fruit. This is concerning as “other” foods are not a major source of micronutrients, being generally high in fat, sugar, and sodium, and may displace the intake of more nutritious foods, including vegetables and fruit. The dietary patterns of the youth involved in this study, characterized mainly by poor intakes of vegetables and fruit and excessive intakes of “other” foods, are in line with current research involving Canadian and American Aboriginal populations (Shields, 2005; Downs et al., 2009; DiNoia et al., 2005; Jones, 2006).

Rates of overweight and obesity in the sample are equally concerning, exceeding figures quoted in the CCHS of 20% and 21%, respectively (total 41%), for Aboriginal youth aged 12 to 17 years (measured heights and weights; off reserve data) (Shields, 2005). It is likely that the poor dietary patterns of the children and adolescents participating in this study are only one of the many environmental contributors to excess weight. As no

statistically significant relationship was noted between vegetable and fruit and fibre intakes and BMI, our data do not support CCHS data that identified a relationship between poor vegetable and fruit intakes and overweight and obesity (Shields, 2005). No significant difference was identified in terms of fibre intake as it relates to BMI categories. This is in contrast to other research that has identified an inverse relationship between dietary fibre intake and body weight (Pereira & Ludwig, 2001; Hanley et al., 2000). However, in both the case of vegetables and fruit and fibre intakes, lack of variability in the data (the majority of values were low compared to standards) may have contributed to the lack of association between BMI and vegetable and fruit and fibre intakes. Also, waist circumference data may have provided a better measure of adiposity as opposed to BMI.

The data collected in the present study provide information to the participating communities to help in designing strategies to improve the dietary intakes of children and adolescents in their own communities. Unfortunately, there are numerous barriers to healthy eating in remote FN communities, including food insecurity (World Health Organization, 2010) and inadequate access to reasonably priced, healthy foods of consistent quality. Often, “other” foods are inexpensive and energy dense, and therefore a top choice for those shopping on a budget. One way to overcome this barrier is through school nutrition programs. The ability to target a large proportion of the population at a time when they are still highly impressionable is advantageous. The Northern Fruit and Vegetable Pilot Program (NFVPP) is a school nutrition program that was piloted in 18 communities in northern Ontario (He, Beynon, Sangster Bouck, St. Onge, Stewart & Khoshaba, 2007). Results from the pilot project suggest that a combination of daily food provision and nutrition education is superior in terms of increasing vegetable and fruit intakes as compared to either food provision or nutrition education, alone (He et al., 2007). The FN communities that participated in the present study may benefit from a combination of food provision and nutrition education programs to improve vegetable and fruit and relevant nutrient intakes in schoolchildren. At the time of data collection, Fort Albany FN already had a healthy school snack program in place for numerous years, providing one to one and a half servings of vegetables and fruit per student per day (all Fort Albany datasets). The program has helped the community overcome barriers including high prices and inconsistent quality of fresh produce by flying in food for the snack program rather than buying it at the local store. This program should serve as an example for other communities that are struggling with similar issues.

Augmenting such programs with a nutrition curriculum may be beneficial to further improve vegetable and fruit and relevant nutrient intakes of the schoolchildren.

Finally, it should be noted that no significant community variation in vegetable and fruit and “other” foods intakes were noted in the pairs examined in this study, with the exception of the Christian Island and Fort Albany pair, where those in Fort Albany had significantly lower intakes of vegetables and fruit. As Fort Albany is more isolated and remote as compared to Christian Island, it is not surprising that mean intakes of vegetables and fruit would be lower in Fort Albany. As Fort Albany is a northern community and food needs to be flown in, fresh foods are often scarce, of poor quality (not fresh), and very expensive. “Other” foods, such as chips, cookies, and other packaged foods are generally less expensive and more accessible. Those living in Christian Island may have better access to reasonably priced, fresh foods year round, and may therefore rely less heavily on packaged items. The variation that was seen in the intakes of other nutrients among all of the community pairs examined in this study are most likely reflective of a myriad of differences between the communities that are beyond the scope of this study. Additionally, no significant variation in yearly intakes of vegetables and fruit or “other” foods was noted, however in some communities, yearly intakes of certain nutrients varied significantly. However, significant yearly and community differences in intakes should be interpreted with caution; keeping in mind that dietary intakes vary on a day-to-day basis and that data were not paired. Results may therefore have been affected by inter-individual variation in intakes. In 2008, Skinner and colleagues collected 24-hour dietary recall data in First Nations students in Fort Albany every week day in order to determine day-to-day variation in nutrient and food group intakes (unpublished data; n=6). The coefficients of variation for energy adjusted vegetable and fruit, “other” foods, fibre, folate, vitamin A, and vitamin C intakes were 1.14, 0.62, 0.53, 0.36, 1.01, and 1.74, respectively (excluding Monday as a Monday recall would reflect weekend intake and would not be consistent with the recalls used in the data used in the current study, which excluded weekend data). Therefore, it is possible that some of the significant differences in intakes by year and community observed in the current study may be the result of simple day-to-day or inter-individual variation. In the current study, the significant differences seen in fibre and folate between Christian Island and Fort Albany, and the significant difference in yearly intakes of fibre in Fort Albany males all fell within normal day-to-day variation of intakes of these nutrients. Other significant findings did not fall into ranges of normal day-to-day variation based on the data

collected by Skinner and colleagues (2008), but may be the result of inter-individual variation. Therefore, although the results suggest that year of data collection and community may be confounding factors, it should be noted that these results may simply be the result of inter-individual or day-to-day variation in intakes, as the data examined were not paired and were a comparison of two one-day recalls.

4.4.1 Conclusions

Overall, the current study suggests that the FN children and adolescents living on reserve in Ontario have similar dietary patterns to those reported for other off reserve and on reserve Aboriginal populations (Shields, 2005; Downs et al., 2009; DiNoia et al., 2005; Jones, 2006); the diet being characterized by poor vegetable and fruit and intakes of “other” foods exceeding those of vegetables and fruit in terms of servings. Prevalence rates of overweight and obesity are in excess of those reported by the CCHS (Shields, 2005). Although no relationship was identified between BMI and vegetable and fruit or fibre intake, the dietary intakes of the participants in the present study, on a whole, are likely obesogenic. School nutrition programs, specifically multi-component programs integrating both a nutrition curriculum and healthy food provision, may be a viable tool to help overcome the barriers to healthy eating in the participating communities. Finally, community and year of data collection may be confounding factors, but differences in intakes may simply be due to inter-individual and normal day-to-day variation in intakes. Ideally, multiple days of intake are needed to provide a more complete picture of community and yearly variation in intakes. User-friendly electronic dietary assessment tools would support this need.

4.4.2 Study Limitations

The sample size used in this study was limited, meaning that there was a reduced ability to detect statistical differences in intakes. This study used the 24-hour recall to examine nutrient and food group intakes – this self-reporting method of dietary recall is prone to inaccuracy and underreporting, however, the WEB-Q used in this study has been validated and mimics the multiple-pass method, helping to address this limitation (Hanning et al., 2009). Although a one-day recall does not necessarily give a true value of mean population intakes, the number of recall days required to obtain a true value of mean intakes for many nutrients would take away from classroom time and be unfeasible in some cases (e.g., 39 to 44 days for vitamin A) (Basiotis, Welsh, Cronin,

Kelsay & Mertz, 1987). Self-reported heights and weights were used to calculate BMI therefore these figures may not be as accurate as researcher-recorded data. However, measurements were available to students. Moreover, the fact that the WEB-Q is private and confidential, as compared to dietitian-administered interviews, may have decreased or eliminated social desirability bias (Probst & Tapsell, 2005). As FN communities worldwide are extremely diverse, the results of this study cannot automatically be generalized.

5.0 Chapter 5: A School-Based Healthy Snack Program in Kashechewan First Nation: Impact on Vegetable and Fruit Intakes

5.1 Introduction

The prevalence of overweight and obesity in Canada has steadily risen over recent decades, reaching epidemic proportions (Shields & Tjepkema, 2006; World Health Organization, 2000). Childhood overweight and obesity is especially concerning; even in children and adolescents, overweight and obesity has been associated with numerous deleterious health outcomes, including dyslipidemia, glucose intolerance and type 2 diabetes, hepatic steatosis, cholelithiasis, hypertension, sleep apnea, orthopedic complications, and polycystic ovary disease (Dietz, 1998). Medical complications aside, children and adolescents who are overweight or obese are frequent targets of early and systemic discrimination (Dietz, 1998). Childhood overweight and obesity is especially concerning because those who are overweight or obese as children are more likely to become overweight or obese in adulthood (Freedman et al., 2001). The risk of overweight children becoming overweight adults is estimated at least twice as high compared to normal weight children (Singh et al., 2008). Childhood obesity is also predictive of adult morbidity, including hypertension, diabetes, and hypercholesterolemia (Dietz, 1998; Freedman et al., 2001; Nicklas et al., 2001). As a result of the rising prevalence of childhood overweight and obesity in Canada, the House of Commons Standing Committee on Health has suggested that today's children may be the first generation for some time to live sicker, short lives than their parents (House of Commons Canada, 2007).

There exist widespread disparities in morbidity and mortality between Aboriginal and non-Aboriginal populations in Canada (Young, 2003). Aboriginal people often live in conditions and experience health outcomes comparable to those in developing nations (Cooke et al., 2004). In recent decades, chronic disease, obesity, and type 2 diabetes have become epidemic in Aboriginal peoples, more severely so than in the general population (Young et al., 2000). Data from the 2004 CCHS have indicated that the odds of obesity in Aboriginal people living off reserve in Canada are more than two and a half times greater than in the general population (Garriguet, 2008). Aboriginal children also experience higher rates of overweight and obesity compared to children of other ethnic backgrounds (Story et al., 2003; Willows, 2005).

The disproportionate burden of overweight and obesity in Aboriginal Canadians justifies the need for preventative interventions. Diet is an important contributor to obesity in Aboriginal populations, as poverty, food insecurity (World Food Summit, 1996), and poor availability and quality of healthy foods in geographically remote communities are major barriers to healthy eating (Skinner et al., 2006). Research in Quebec, Canada, has indicated that the diets of FN children are energy dense yet low in foods of high nutrient density, and that 98.5% of children consume fewer than five servings of vegetables and fruit per day (Downs et al., 2009). A study of Native American youth also indicated that they consumed very few vegetables and fruit, with the exception of potatoes and apples, and had high intakes of “other” foods (Di Noia et al., 2005). “Other” foods are those that do not fit into any food group of CFG, and are generally high in fat, sugar, and sodium, and should thus be avoided. Further research has linked the poor intakes of vegetables and fruit in Aboriginal children to overweight and obesity. For example, in the FN community of Sandy Lake, Ontario, children who had greater fiber intakes were less likely to be overweight (Hanley et al., 2007). Likewise, CCHS data suggested that children who consumed vegetables and fruit more frequently were less likely to be overweight or obese (Shields, 2005).

The school is the ideal milieu for intervening in the diets of Aboriginal children, as they generally spend six or more hours per day there, five days per week. While nutrition education may be a powerful tool in improving the diets of children, in remote, isolated FN communities, food insecurity and the inaccessibility of healthy food are serious barriers to the success of such programs. Food provision programs, however, may hold promise in improving the diets of children living in remote, isolated FN reserves by giving them the opportunity to have foods that would be otherwise inaccessible. This study aims to examine the short- and long-term impact of a pilot school snack program on the vegetable and fruit and “other” food intakes of grade six to eight students in the remote, isolated FN community of Kashechewan, Ontario.

5.2 Methods

5.2.1 Participants

Kashechewan is located on the northern shore of the Albany River, 10 kilometres upstream from James Bay and approximately 300 kilometres north of Timmins, Ontario (Mushkegowuk Council, 2010). The community is accessible only by air year-round, by barge during the ice-free months, and by winter road after

freeze-up. St. Andrew's School, consisting of eight portables, replaced the previous school, which was condemned due to toxic mould (Paradis, 2010). Similar to other remote communities, living standards in Kashechewan are poor. There exists only one grocery store in the community, and fresh produce is extremely expensive, often of poor quality, and availability is unpredictable. The pilot snack program was administered to approximately 400 students in pre-kindergarten to grade eight at St. Andrew's School in Kashechewan, Ontario. Only students in grades six to eight completed the 24-hour recalls used to assess dietary intakes. Data were collected in partnership with St. Andrew's School in Kashechewan FN and with approval from the Office of Research Ethics at the University of Waterloo, Ontario, Canada (Appendix C).

5.2.2 Procedures

The pilot school snack program was initiated in May 2009 for students in pre-kindergarten to grade eight. The program was planned in collaboration with advisors, including the coordinator of a similar program in Fort Albany FN, Ontario, and the school principal. The original menu was based on foods available in the local store. It emphasized fresh vegetables and fruit, low-fat milk products, and whole grains. The aim of the program was to serve at least one serving of vegetables and fruit and one serving of milk and alternatives daily. Additional foods (grain products and/or meat and alternatives) were encouraged, but not compulsory. Snacks were prepared in the main portable every morning, and distributed to individual classrooms, where children would eat at their desks. Immediately before and after the first week of the program, students in grades six to eight completed the WEB-Q. The program was then continued under the direction of a volunteer program coordinator, who was provided with detailed guidelines of what types of foods to serve, including a sample shopping list (Appendix D). Contact with the program coordinator was maintained throughout the following year, and program modifications were made in consultation with the investigators in order to account for changes in food availability and storage. One year following the initial implementation of the program, students in grades six to eight repeated the WEB-Q.

5.2.3 Web-Based Eating Behaviour Questionnaire

The Web-based Eating Behaviour Questionnaire (WEB-Q), developed at the University of Waterloo, was used to assess vegetable, fruit, and nutrient intakes (Hanning et al., 2003) (Appendix B). The WEB-Q incorporates a 24-hour diet recall, a food frequency questionnaire, and questions addressing knowledge, attitudes,

intentions, and food related behaviours (Hanning et al., 2003). It has been used since 2001 to survey over 20 000 Canadian students, and was recently validated in grade six to eight students, including FN students from Fort Albany, Ontario (n=25, 2004) (Hanning et al., 2003; Hanning et al., 2009; Storey et al., 2009; Forbes et al., 2009; Hanning et al., 2007; Woodruff & Hanning, 2008). The 24-hour recall portion of the WEB-Q has good relative validity when compared to dietitian-administered interviews in both Aboriginal and non-Aboriginal students (Hanning et al., 2009). The tool is interactive and user-friendly, including several methods for searching for over 800 foods (by menu of common choices, typing key words, and alphabetical and food group listings). Portion size is selected from six choices displayed on the screen as actual photos of food on a plate, scaled by the place setting. It mimics the multiple-pass technique commonly used by dietitians when conducting one-on-one dietary recalls by incorporating prompts for forgotten foods, beverages, condiments, and toppings, and providing several opportunities to review and revise intake.

5.2.4 Data Analysis

Dietary data were analyzed using the ESHA nutrient analysis software (Salem, Oregon) version 7.1, in accordance with the 2007 Canadian Nutrient File (CNF) (Health Canada, 2009a). The CNF is a comprehensive database that reports up to 143 nutrients in over 5 500 foods (Health Canada, 2009a). Analysis of food guide servings was based on the 2007 version of Canada's Food Guide (CFG) (Health Canada, 2009b). Descriptive statistics for the sample were used to compare intakes to current standards, based on Estimated Average Requirements (EARs) for folate, vitamin A, and vitamin C, Adequate Intakes (AIs) for fibre, and CFG recommendations for vegetable and fruit servings (Health Canada, 2006). "Other" foods were defined as those foods included in the Canadian Nutrient File category of "other" foods, which includes saturated and/or trans fats and oils, foods that do not belong to any category of CFG, foods high in fat and/or sugar (including some bakery products), high salt and/or high fat snacks, both higher and lower calorie beverages not including 100% juices and milk, and alcohol. The category does not include unsaturated fats and oils or water (Health Canada, 2009a). The intakes of students in Kashechewan at all stages of the program were also compared to mean intakes of Canadian children of the same age and sex, based on CCHS data (Statistics Canada, 2010). Standards and mean intakes used in the comparison are shown in Table 5.1. Students were assigned a BMI category based on the cut-offs described by Cole and colleagues (2000) (normal, overweight, or obese) and based on self-reported heights and

weights. Wilcoxon signed-ranks tests were used for comparisons of median intakes at baseline to one-week and one-year post-program median intakes, as well as the comparison of one-week to one-year post-program intakes. Analyses were paired, so because all students did not complete all three WEB-Qs, the pairs were different for each analysis (pre-program to one-week post-program pairs versus pre-program to one-year post-program pairs, for example). Because nutrient intakes are influenced by total energy intake in that those who consume greater energy also eat, on average, more of all specific nutrients, nutrient and food group intakes were adjusted for energy intake using the nutrient density method, to reflect intakes per 1000 kcal (Willett et al., 1997). One-tailed analyses were used for the comparison of baseline to one-week post-program intakes, as we predicted an increase in vegetable and fruit and related nutrient intakes; while two-tailed analyses were used in the comparison of baseline to one-year and one-week to one-year post-program intakes; as we did not make any predictions due to the logistics of delivering the snack program in a remote community. Statistical analyses were carried out using SPSS (Chicago, Illinois) version 17.0. The p-value level of statistical significance for comparisons was 0.05 (5%).

Table 5.1: Estimated Average Requirements (EARs), Adequate Intakes (AIs), Canada’s Food Guide recommendations, and Canadian Community Health Survey data to be used in comparing student intakes

Age Group	Nutrient or food group	EAR, AI, or CFG recommendation		CCHS mean intake	
		Male	Female	Male	Female
9-13 years	Vegetables and fruit (servings)	6	6	4.53	4.40
	“Other” foods (servings)	-	-	-	-
	Fibre (g/day)*	31	26	-	-
	Folate (µg/day)**	250	250	-	-
	Vitamin A (RAE µg/day)**	445	420	-	-
	Vitamin C (mg/day)**	39	39	-	-
14-18 years	Vegetables and fruit (servings)	8	7	4.87	4.67
	“Other” foods (servings)	-	-	-	-
	Fibre (g/day)	38	26	-	-
	Folate (µg/day)	330	330	-	-
	Vitamin A (RAE µg/day)	630	485	-	-
	Vitamin C (mg/day)	63	56	-	-

Note: “Other” foods is excluded as there is no formal recommendation or standard

*Adequate intake; **Estimated average requirement

5.3 Results

Characteristics of the study population for each time period are shown in Table 5.2. Over the course of the study, 156 WEB-Qs were completed. Two students were excluded from the analysis because they did not complete the 24-hour recall portion of the WEB-Q due to technical difficulties with the computer system. The sample had high prevalence rates of overweight and obesity at baseline, 42.5% and 17.5%, respectively, totaling 60% (one student was excluded due to incomplete data on height and weight). This figure far surpasses the prevalence rates of combined overweight and obesity reported in the CCHS of 38% for youth aged 12-17 years and 41% for off-reserve youth of the same age (Shields, 2005). Intakes of vegetables and fruit, “other foods”, fibre, folate, vitamin A, and vitamin C as compared to CFG recommendations, EARs, AIs, and average Canadian intakes for children and youth aged nine to 13 years and 14-18 years are shown in Table 5.3. At baseline, the vast majority of participants had intakes of all nutrients investigated that fell below current standards, with the

exception of vitamin C, with just over half (51.2%) of the study population meeting the recommendation for this nutrient. Nearly all participants had inadequate intakes of vegetables and fruit based on minimum CFG recommendations, and the mean intakes of vegetables and fruit were lower than the Canadian average for youth of same age and sex based on CCHS data (2.6 and 1.6 servings for males aged nine to 13 and 14-18 years, respectively; 2.3 and 2.6 servings for females aged nine to 13 and 14-18 years, respectively).

Table 5.2: Characteristics of study population

	Baseline	One-week post-program	One-year post-program	Baseline to one-week pairs	Baseline to one-year pairs	One-week to one year pairs
N	43*	43*	67*	37	23	24
Age in years (SD)	13.1 (0.9)	13.1 (1.0)	13.5 (1.1)	13.1 (0.9)	13.1 (0.6)	13.1 (0.7)
% Males	60.5	58.1	47.8	62.2	56.5	54.2
% Females	39.5	41.9	52.2	37.8	43.5	45.8
% Overweight	42.5	31.0	22.8	44.4	50.0	47.8
% Obese	17.5	23.8	26.3	13.9	4.5	8.7

*N is based on all students who completed the questionnaire at the specified time, not the matched samples

Table 5.3: Intakes of vegetables and fruit, “other” foods, fibre, folate, vitamin A, and vitamin C compared to current recommendations

Food group/nutrient	% not meeting minimum recommendation pre-program (n=43)	% not meeting minimum recommendation one-week post-program (n=43)	% not meeting minimum recommendation one-year post-program (n=67)
Vegetables and fruit (servings)	95.3	90.7	98.5
Fibre (g/day)*	100.0	93.0	100.0
Folate (µg/day)	55.8	51.2	68.7
Vitamin A (RAE µg/day)	76.7	67.4	91.0
Vitamin C (mg/day)	48.8	37.2	55.2

*Recognizing that the Adequate Intake is an estimation of adequacy and not a recommendation, per se

5.3.1 Changes in Food Group and Nutrient Intakes

Paired data were used to compare median intakes pre-program to one-week and one-year post-program median intakes, as well as one-week to one-year post-program median intakes. Thirty-seven, 23, and 24 student pairs were included in the baseline to one-week post-program, baseline to one-year post-program, and one-week to one-year post-program analyses, respectively. Note that there were no statistically significant differences in intakes of any food groups or nutrients between the paired and unpaired samples in any of the comparisons.

Differences in food group and nutrient intakes one-week and one-year post-program as compared to pre-program are shown in Table 5.4. Comparisons of vegetable and fruit intakes for each program stage are shown in Figures 5.1, 5.2, and 5.3. Following one week of the program, significant increases in intakes of fibre ($p=0.015$) and vitamin C ($p=0.024$) were observed. No significant changes were observed in intakes of vegetables and fruit (servings), folate, vitamin A, or “other” foods (servings). On the day recalled, the snack program provided approximately two servings of vegetables and fruit per student. Despite one-week post-program improvements in nutrient intakes, the majority of students still had nutrient and food group intakes inferior to current dietary standards (EARs and AIs) and CFG recommendations, respectively, with the exception of vitamin C. Mean intakes of vegetables and fruit in all age and sex groups were still sub-par as compared to mean intakes of youth of the same age and sex based on CCHS data (3.1 and 1.9 servings for males aged nine to 13 and 14-18 years, respectively; 3.0 and 2.4 servings for females aged nine to 13 and 14-18 years, respectively).

Following one year of the program, no significant changes in intakes were observed as compared to baseline. However, intakes of vegetables and fruit had decreased significantly one year post-program as compared to one-week post-program (0.95 to 0.58 servings/1000 kcal; $p=0.033$), although one year post-program intakes did not differ significantly from baseline. There were no other significant differences in intakes one year post-program as compared to one week post-program. On the day recalled, the snack program provided approximately one serving of vegetables and fruit per student. After one year of a pilot snack program, the majority of students were not meeting the EAR, AI, and CFG recommendations for nutrients and food groups. Most notably, 98.5% of students had inadequate intakes of vegetables and fruit compared to minimum CFG recommendations. In addition, one year into the program, mean intakes of vegetables and fruit in all age and sex

groups remained inferior to those of children of the same age and sex based on CCHS data (1.7 and 1.8 servings for males aged nine to 13 and 14 to 18 years, respectively; 1.9 and 1.3 servings for females aged nine to 13 and 14 to 18 years, respectively).

Table 5.4: Comparison of changes in intakes between program stages*

Comparison	Food group or nutrient	Mean Intakes (SD)			p Value
		Baseline	One week post-program	One year post-program	
Baseline to one-week post-program (n=37)	Vegetables and fruit (svgs)	2.2 (1.8)	2.7 (2.0)	-	0.383
	“Other” foods (svgs)	5.6 (3.1)	6.6 (4.9)	-	0.296
	Fibre (g/day)	10.8 (6.1)	13.9 (8.3)	-	0.015
	Folate (µg/day)	247.6 (145.8)	299.1 (183.7)	-	0.430
	Vitamin A (RAE µg/day)	307.8 (243.9)	404.1 (422.5)	-	0.271
	Vitamin C (mg/day)	69.3 (78.8)	126.7 (114.8)	-	0.024
Baseline to one-year post-program (n=23)	Vegetables and fruit (svgs)	2.1 (1.8)	-	1.1 (1.0)	0.158
	“Other” foods (svgs)	5.7 (3.1)	-	3.9 (2.7)	0.059
	Fibre (g/day)	10.0 (5.4)	-	8.0 (4.5)	0.855
	Folate (µg/day)	243.0 (151.4)	-	193.4 (156.1)	0.272
	Vitamin A (RAE µg/day)	304.0 (271.3)	-	197.9 (222.6)	0.301
One-week post-program to one-year post-program (n=24)	Vitamin C (mg/day)	55.7 (74.5)	-	55.5 (70.2)	1.000
	Vegetables and fruit (svgs)	-	2.2 (1.6)	1.1 (1.0)	0.033
	“Other” foods (svgs)	-	5.4 (3.4)	3.9 (2.7)	0.424
	Fibre (g/day)	-	12.3 (6.6)	8.0 (4.5)	0.059
	Folate (µg/day)	-	311.5 (194.7)	193.1 (152.7)	0.188
	Vitamin A (RAE µg/day)	-	287.3 (261.5)	197.2 (217.7)	0.265
Vitamin C (mg/day)	-	107.6 (102.9)	53.6 (69.3)	0.052	

*Intakes shown in table are unadjusted; p-values of significance are for energy-adjusted intakes (per 1000 kcal)

Figure 5.1: Comparison of vegetable and fruit intakes pre-program to one week post-program

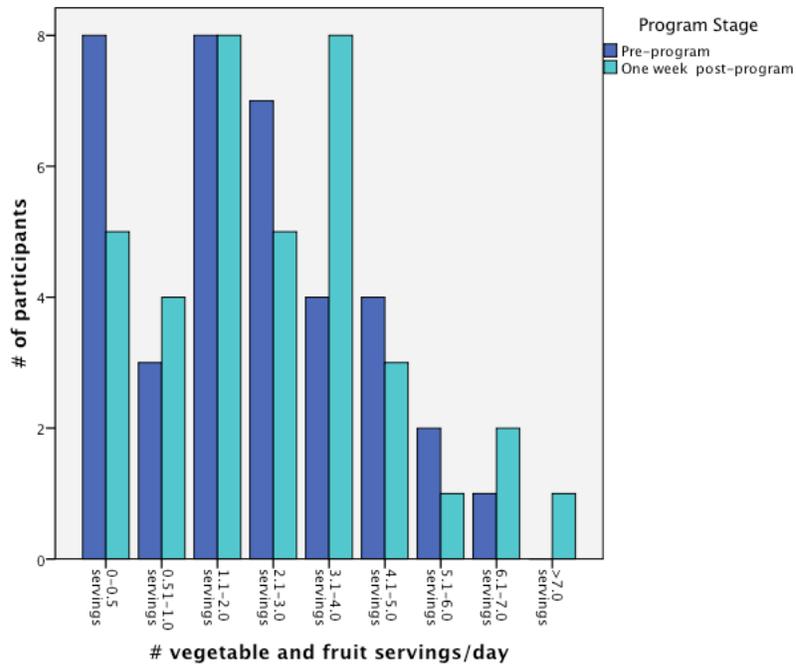


Figure 5.2: Comparison of vegetable and fruit intakes pre-program to one year post-program

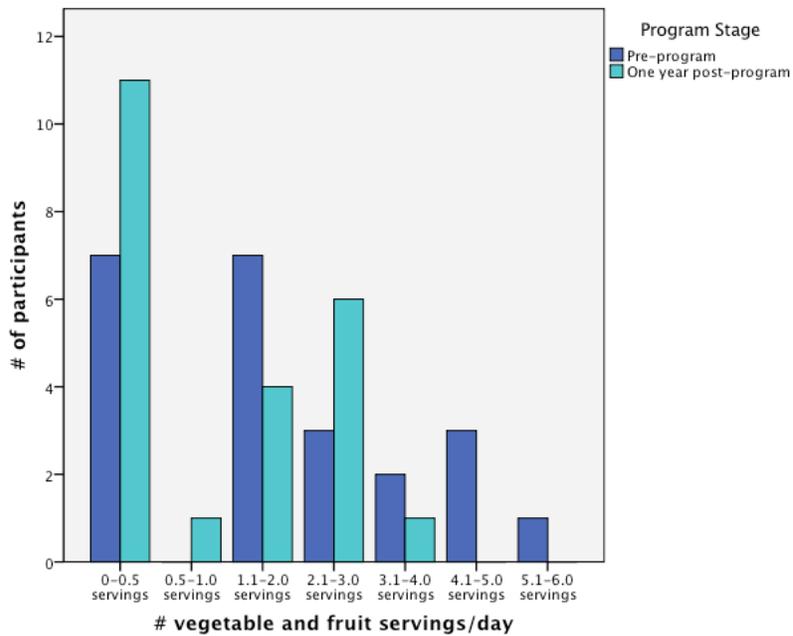
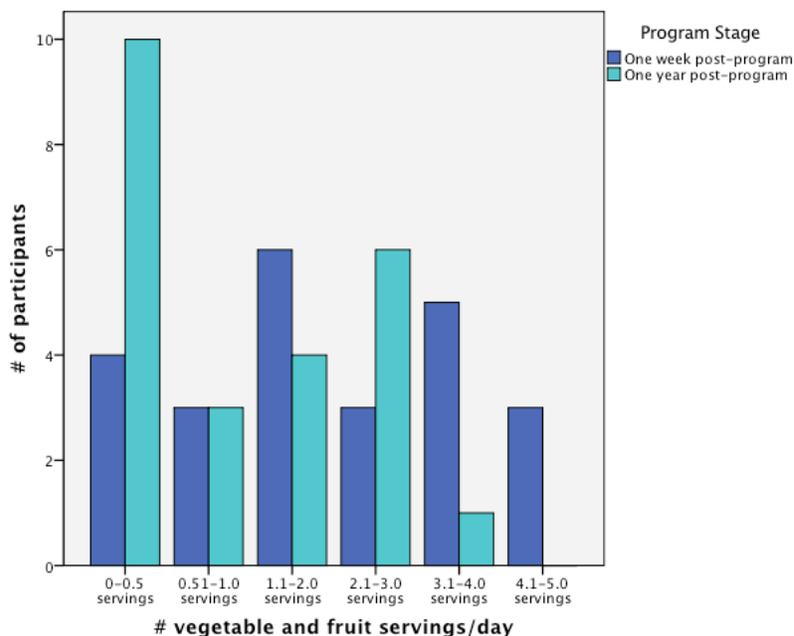


Figure 5.3: Comparison of vegetable and fruit intakes one week post-program to one year post-program



5.3.2 Student Impressions of the Program

Students were generally very enthusiastic about the program. They expressed a desire to receive more vegetables, fruit, and milk products as part of the snack program. Sixty-four percent of students reported that they were motivated to eat healthier as a result of the program, and 67% reported making better choices about what they eat. Forty-eight and 81% of students reported eating more vegetables and fruit, respectively. Finally, 48% of students asked their parents to buy or serve the vegetables or fruit that they had tried at school. Students reported liking the program because they were less hungry and more ready to learn after having their snacks. One student said “I like having food in the morning because I’m hungry”, while another liked the program because “it fills my stomach”. Students were very thankful and made cards for the investigators for starting the program. “Thank you for introducing us to new food”, “I’d never tasted kiwis before and cantaloupe. Thanks”, “I never knew cantaloupe tasted good. We’re glad you brought us snacks”, “Thank you for giving us healthy food” and “I’m so glad that you guys were here to give us snacks” were only a few of the positive messages that students shared with the investigators.

5.3.3 Impressions of the Teachers and Principal

During a focus group discussion attended by all teachers present at the school that day (June 2010) and the principal of St. Andrew's School, teachers described the snack time as the "high point" of the day, and also thought that it improved motivation in the students. They thought it was especially important because most students do not eat breakfast and come to school hungry. They pointed out the need for the program to be more consistent and but otherwise, feedback was overwhelmingly positive. The principal expressed concerns about a lack of reliable volunteers. He was, however, extremely optimistic and expressed that with consistent funding, adequate resources, and dedicated volunteers, the program could be very successful. Similar to the teachers, he thought that the program was especially important because so many of the students come to school hungry.

5.3.4 Program Integrity

Sustaining a healthy school food provision program in a remote FN community poses numerous opportunities and challenges. The program piloted in Kashechewan FN provided the opportunity to improve the dietary intakes of a large proportion of the population who would otherwise not have access to vegetables and fruit at an affordable price. The students were eager to try new foods, and teachers indicated that students seemed more attentive and ready to learn during class time after eating the morning snack. Unfortunately, the challenges to the continuation and success of the program were numerous, as is reflected by the lack of improvement in intakes following one year of the program. During the first week of the program, investigators were able to provide an "ideal" snack program, with five investigators working throughout the entire day to provide both a breakfast and snack. Generally, investigators were able to provide two servings of vegetables and fruit per student per day. In the year following, the program was maintained by a single volunteer, which made it much more difficult to consistently provide fresh vegetables and fruit, which may explain, partially, why food group and nutrient intakes did not improve over the long-term. As a result of staffing issues, limited storage facilities, school closure, and limited funding, the program was not continuous throughout its first year, and when it was re-initiated, it only ran twice per week, as compared to five days per week at its primary initiation. The program later returned to five days per week, but snacks were limited to one item per day (not necessarily a vegetable or fruit) in order to spare the remaining funds, which is far from ideal. Limited storage capacity was another major

program barrier, as the school only had one fridge, one freezer, and extremely limited storage space for food. There was also limited space for food preparation. The quality and availability of healthy foods at the store was limited, meaning that substitutions were common, sometimes with less healthy alternatives such as canned fruits or 100% fruit juices. Funding was also a major barrier to program continuation. Because bulk food prices are not available, the need for funding is even more pressing. The availability of personnel was a final barrier to the continuation of the program. Although the program is presently made possible by a volunteer coordinator, if she is unavailable for any reason, there is nobody available to take her place. Although teachers are ready to help, they are less available as they are often busy with other tasks. The acquisition of at least one more volunteer would be ideal. Finally, it should be noted other factors, including school closure due to the H1N1 pandemic, may have negatively affected the pilot snack program.

5.4 Discussion

Overall, the findings suggest that 11 to 16 year-old youth attending St. Andrew's School in the remote community of Kashechewan FN accrued short-term benefits from the school snack program, but over the long-term, experienced no improvement in intakes of vegetables and fruit and associated nutrients. Intakes of vitamin C, folate, and fibre improved significantly over the short term, but no changes were seen in the long-term comparison. After one year of the program, the majority of students still consumed inadequate servings of vegetables and fruit and still had poor nutrient intakes as compared to EARs, AIs and CFG recommendations. Intakes of vegetables and fruit remained inferior to those of the general population of the same age and sex. These results reflect the numerous challenges that emerged throughout the year following the initiation of the snack program. While investigators were able to provide an "ideal" program during the week following its initiation, continuation of the program once the investigators had left the community was a constant struggle.

The results of this study suggest the need for continued program improvement. A more comprehensive program, including nutrition education, family and community involvement, and food provision, to further target the vegetable and fruit intakes of this population is merited, but would require significant resources in terms of staff and funding. Data from the Northern Fruit and Vegetable Pilot Program, a nutrition education and food provision program piloted in 18 schools in northern Ontario, indicated that food provision combined with nutrition

education resulted in a greater improvement in vegetable and fruit intakes as compared to food provision or nutrition education alone (He et al., 2007). Similarly, the current program in Kashechewan First Nation may benefit from a more comprehensive approach in order to further improve food group and nutrient intakes, bringing them closer to dietary standards.

Some of the barriers to the continuation of the program have been, at least partially, resolved. Sources of funding are being investigated so that the program can begin to offer snacks of more consistent quality, every school day. The snack program coordinator in the neighboring community of Fort Albany FN is an invaluable resource in terms of knowledge of funding possibilities, as a similar program in Fort Albany FN has been running successfully for over 20 years (Skinner et al., 2006). Although two new freezers have been purchased, storage remains a problem, and will be nearly impossible to improve without the construction of a new, permanent school building. Ideally, further initiatives would include continuation of the program five days per week, the recruitment of reliable volunteers, and the implementation of a more comprehensive approach in order to further improve vegetable and fruit and nutrient intakes among the participating students.

Despite barriers, the program will be continuing into the next school year. The principal is optimistic, expressing that as long as he can acquire more dedicated volunteers and consistent, adequate funding, the program will be beneficial. The need for the program cannot be understated; in the words of the principal “the kids are always hungry”. Teachers expressed that the program is crucial and overwhelmingly thought that it should be continued, especially as it introduced students to foods that they would never otherwise have had the opportunity to try. In Canada, it is unacceptable for children to be going hungry. The results of the current study indicate that the vegetable and fruit and relevant nutrient intakes of students in grades six to eight in Kashechewan FN have room for improvement. With adequate funding and resources, this program has the potential to have a positive impact on the dietary intakes of children in Kashechewan FN. The program in the neighbouring community of Fort Albany FN serves as an example of the positive outcomes which may be possible if a snack program is run continuously, with reliable volunteers, adequate resources, and consistent funding (Skinner K, personal communication).

5.4.1 Conclusions

The findings of this study suggest that with adequate funding, personnel, and resources, healthy school provision programs have the potential to improve food group and nutrient intakes in FN schoolchildren living on-reserve who would otherwise not have access to high quality, fairly priced, healthy foods. Inadequate funding, personnel, and resources, however, are serious barriers to program success and should be seriously considered prior to the implementation of any program. More research is needed to determine the impact of such programs in other and similar populations, as well as to examine the potentially synergistic effect of nutrition education and food provision programs on vegetable and fruit and related nutrient intakes of FN schoolchildren living on reserve.

5.4.2 Implications for School Health

The current findings have important implications for the implementation of school food provision programs in remote FN communities. Recognition that the sustainability of such programs is dependant on overcoming numerous barriers, some unique to each community, is important. The short-term improvements in intake as a result of this program suggest that simple food provision programs have the potential to improve vegetable and fruit and relevant nutrient intakes of schoolchildren living in a remote FN community. However, in the long term, serious consideration has to be put into sources of funding, personnel, and other resources to maintain improved intakes. Recent research in Nova Scotia, Canada, revealed an independent association between overall diet quality, vegetable and fruit intake, and academic performance (Florence, Asbridge & Veugelers, 2008). The teachers in Kashechewan FN indicated that students were more eager and ready to learn and more attentive after having their snack. This finding is supported by a recent systematic review that indicated that school breakfasts improved cognitive performance and increased student attendance (Hoyland, Dye & Lawton, 2009). Therefore schools in remote FN communities may wish to investigate the feasibility for the implementation of healthy food provision programs in order to improve these parameters, in addition to improving nutritional status and reducing the risk of childhood overweight and obesity.

5.4.3 Study Limitations

The great diversity in Aboriginal populations in Canada means that the results of this study cannot be generalized to other populations. The sample size used in this study was limited, meaning that there was a reduced ability to detect changes in intakes. Although 100% of grade six to eight students in school on the day of the WEB-Q completed the questionnaire, the size of the community limited the sample size. Finally, the self-reporting nature of the 24-hour dietary recall method makes it prone to underreporting and inaccuracy, however, the WEB-Q used in this study has been validated and mimics the multiple-pass method, overcoming this limitation (Hanning et al., 2003). Although one day of intake does not provide the most accurate representation of true nutrient intakes, estimating nutrient intakes with any greater degree of accuracy would take away too much classroom time and be infeasible in some circumstances (e.g., 39 to 44 days for a true estimate of vitamin A intake) (Basiotis et al., 1987).

6.0 Chapter 6: Impact of a Comprehensive School Nutrition Education Program on Vegetable and Fruit Consumption, Knowledge, Intentions, and Self-Efficacy of Grade Six to Eight First Nations Students

6.1 Introduction

The prevalence of childhood and adolescent overweight and obesity has increased over the past 25 years in Canada, and continues to rise (Shields, 2005; Public Health Agency of Canada, 2009). The problem is especially critical in Canadian Aboriginal populations; they have, in recent years, experienced drastic cultural and lifestyle changes that have led to an epidemic of obesity more severe than in the general population (Canadian Pediatric Society, 2005; Garriguet, 2008; Tjepkema, 2006; Tremblay et al., 2005). Overweight and obesity are especially concerning as Aboriginal people have been identified as a population particularly susceptible to type 2 diabetes, typically a condition of adult-onset which is now being observed with increasing frequency in Aboriginal youth (Kmetz et al., 2008).

Although the etiology of childhood and adolescent obesity is multi-factorial, a poor diet and inadequate physical activity are two potentially modifiable contributors. Aboriginal people, in general, have poor intakes of vegetables and fruit, milk and alternatives, and grain products; “other” foods, those that are nutrient-poor and high in fat, sugar, and sodium, are often substituted for more healthy choices (Garriguet, 2008). A study of FN children in Quebec indicated that 98.5% of the children consumed less than five servings of vegetables or fruit per day (Downs et al., 2009). Research in Native American youth in the United States found that less than half of reservation youth consumed vegetables or fruit on a regular basis (Di Noia et al., 2005). Increasing vegetable and fruit intakes is an important goal in interventions targeting childhood obesity in the Canadian Aboriginal population, as poor intakes have been associated with obesity. Data from the 2004 CCHS suggested that children who consumed vegetables and fruit more frequently were less likely to be overweight (Shields, 2005). Moreover, regions in Canada where vegetable and fruit consumption is lower have higher levels of obesity (Vanasse et al., 2006). Analogously, research in the FN community of Sandy Lake, Ontario, indicated that children who had greater fibre intakes were less likely to be overweight (Hanley et al., 2000).

Improving the vegetable and fruit intakes of Aboriginal children is challenging due to the many barriers faced by many Aboriginal families in terms of the procurement of healthy foods. Food insecurity (World Food

Summit, 1996) is a major problem, and in remote (located at a great distance from a major city), isolated (not accessible at all times of year by road) communities, fresh produce is often very expensive, unavailable, or of questionable quality. School nutrition programs are tools to bypass these barriers by providing children with an environment conducive to healthy eating, including the provision of healthy snacks for all children (World Food Summit, 1996). Schools are a natural venue for addressing childhood obesity, because children generally spend six or more hours there per day, five days per week, and one to two meals are usually eaten there (Budd & Volpe, 2006). Effective school nutrition programs have the ability to empower students with the knowledge, attitudes, and skills required to make positive health decisions (CDC, 1996). A recent European review by van Cauwenberghe and colleagues (2010) concluded that there is strong evidence for multi-component school interventions to have a positive effect on vegetable and fruit intakes in children. The Northern Fruit and Vegetable Pilot Program (NFVPP), a school vegetable and fruit program integrating nutrition education and food provision was implemented in 18 schools in northern Ontario (He et al., 2007). The research employed a cluster-randomized controlled trial design; Intervention Group I included both a vegetable and fruit provision program and enhanced nutrition education, Intervention Group II included only a food provision component, and the third group was the control (He et al., 2007). Results indicated that the children involved in Intervention I consumed the most vegetables and fruit at school and also had favourable preference changes for some vegetables and fruit (He et al., 2007). Students in the Intervention II group consumed more vegetables and fruit than those in the control group, but less than those in the Intervention I group, thus the more comprehensive program was the most effective at improving intakes (He et al., 2007).

The current study investigates the impact of a pilot multi-component school fruit and vegetable program at Peetabeck Academy in the FN community of Fort Albany, Ontario. The primary aim of the program was to improve nutrition knowledge, self-efficacy and intentions to consume a variety of vegetables and fruit, and to increase vegetable and fruit intake.

6.2 Methods

6.2.1 Participants

This research investigated a comprehensive six-week vegetable and fruit school program in the remote, isolated FN community of Fort Albany, Ontario from March to April 2010. The program involved children in grades pre-kindergarten to eight at Peetabeck Academy, the First Nation-administered school in the community. Fort Albany is accessible only by air year-round, by barge or boat in the ice-free months, and by winter road after freeze-up. It is located on the south shore of the Albany River, 15 kilometres upstream from James Bay and 128 kilometres north of Moosonee, Ontario (Chiefs of Ontario, 2005; Five Nations Energy, 2005). As with many remote, isolated FN communities of its size, living standards are poor (Fort Albany First Nation, 1999). The current research was conducted in partnership with Peetabeck Academy in Fort Albany FN, with permission from the Office of Research Ethics at the University of Waterloo. Passive parental consent procedures were used (Appendix C).

6.2.2 Comprehensive School Vegetable and Fruit Program

In 1996, the U.S. Centers for Disease Control and Prevention (CDC) proposed a framework to guide successful school-based nutrition program development (CDC, 1996). A review by Veugelers and Fitzgerald indicated that school-based nutrition programs that applied the CDC framework were more successful in achieving dietary change as compared to those that did not (Veugelers & Fitzgerald, 2005). The CDC framework and a variety of other sources stress that comprehensive school nutrition programs should integrate health education, a healthy environment, healthy policy implementation, community and family involvement, physical education, healthy school food service, training for teachers and staff, and program evaluation (CDC, 1996; Veugelers & Fitzgerald, 2005; Brant County Health Unit, 2005; OSNPPH, 2004; Perez-Rodrigo & Aranceta, 2001). Such a framework is in line with Bandura's (2004) social cognitive theory, which describes the reciprocal relationship between individual, behavioural, and environmental factors in terms of behaviour change.

The program evaluated in this research was modeled after the NFVPP, and was adapted for the specific needs of the community by the investigators and community advisors, including the school snack program coordinator. The program included all of the previously discussed components of comprehensive school

programs. Although it did not include formal training for teachers, the majority of teachers remained in the class to observe the lessons. The program was delivered by a senior undergraduate student with previous teaching experience, who resided in the community for the duration of the program. The program involved 30-minute sessions per class that were integrated into the Ontario education curriculum (Ontario Ministry of Education, 2009), once per week, for five weeks. Each week, students were engaged in interactive lessons about vegetables and fruit (Appendix E), and were given informative handouts to bring home to their parents (Appendix F), including recipes and meal ideas. Lessons included topics such as how to distinguish 100% fruit juice from other beverages, tasting and describing the sensory characteristics of different vegetables and fruit (including cantaloupe, pineapple, grapefruit, blueberries, asparagus, and blackberries), active games and weight bearing activity, CFG, and a vegetable and fruit challenge where each class was encouraged to eat as many vegetables and fruit as they could over the period of a week (Appendix E). The program also involved a healthy food provision component building on a snack program that has existed at the school for over 20 years. The snack program coordinator was provided with specific policy guidelines and a sample shopping list to aid in making healthy choices (Appendix D). These guidelines were adapted from recommendations from the Ontario Society of Nutrition Professionals in Public Health Steering Committee (OSNPPH), the Cancer Care Ontario Healthy Eating Guidelines for School Nutrition Programs Pilot Project (CCO), and the Ontario Ministry of Education, by two registered dietitians (OSNPPH, 2004; Cancer Care Ontario, 2010; Ontario Ministry of Education, 2010). In the final week of the program, students were involved in a healthy eating community event, where they applied their knowledge by baking and distributing healthy pizzas. The event also included a free healthy traditional community feast; a raffle for fresh produce and other healthy food items (e.g., milk, yogurt), and physical activity equipment; and free healthy recipes of the dishes served at the event. The traditional community feast included game meats provided by community members, which were incorporated into healthy dishes. Some students and community members helped in food preparation as well as set-up, clean-up, and dish washing. The event was publicized via posters in key locations within the community (stores, school, etc.).

6.2.3 Program Evaluation

All program materials were previewed during a formative evaluation with the school's snack program coordinator, to ensure the appropriateness of the program's components, culturally and otherwise. Suggested

changes were completed before starting the program. Program integrity was documented, throughout the course of the program, by the undergraduate student delivering the lessons, including what was delivered, participation rate, and in-classroom modification to the original program.

Changes in dietary intake were evaluated in grade six to eight students using 24-hour dietary recalls via the University of Waterloo Web-based Eating Behaviour Questionnaire (WEB-Q) (Appendix B), which has recently been validated in grade six to eight students, including students from Fort Albany, Ontario (n=25, 2004) (Hanning et al., 2003, 2009). The 24-hour recall uses a multiple pass approach, with probes and photo images of food portions to help children search a list of over 800 foods for what they consumed the previous day. It includes traditional foods like game meats and fish that may be consumed by Aboriginal students and locally photographed portion images.

Changes in vegetable and fruit knowledge, intentions, and self-efficacy were evaluated using the Knowledge, Self-Efficacy, and Intentions Questionnaire (KSIQ) (Appendix G), which was delivered on paper. The KSIQ was adapted from the Pro Children questionnaire, which was first designed to assess the potential determinants related to vegetable and fruit consumption in ten to 11 year old European children (De Bourdeaudhuij, Klepp, Due, Perez Rodrigo, de Almeida & Wind, 2005). It includes questions asking students to self-rate intake, knowledge, attitudes, liking, subjective norm, active parental encouragement, general self-efficacy, intention, habit, preferences, availability, and perceived barriers (De Bourdeaudhuij et al., 2005). Test-retest reliability of the questionnaire has been reported as good to very good, and the predictive validity of the questionnaire to assess potential determinants related to vegetable and fruit intakes in ten and 11-year-old children was noted as moderate to good (De Bourdeaudhuij et al., 2005). Although the questionnaire has not been validated in an Aboriginal population, a formative evaluation with the snack program coordinator aided in ensuring its appropriateness and confirming the face validity for students in Fort Albany FN. The WEB-Q and KSIQ were both administered in-class to all grade six to eight students, before and after the education program. Only school day intakes were assessed (Tuesday to Friday dietary recalls).

Finally, student, teacher, and parent impressions of the program were gathered in order to guide future program delivery in the community. Student impressions were gathered via open-ended questions added to the WEB-Q about what aspects they liked and disliked about the program. Teacher impressions were gathered during a focus group with the investigators following program completion. Finally, parent impressions were gathered via a questionnaire during the final community event component of the program (Appendix H). A Simple Measure of Gobbledygook (SMOG) test for readability on the parent questionnaire ensured a grade six reading level, so as to not exclude any community members (Government of South Australia, 2006). A Cree translator was available for those who did not speak English

6.2.4 Data Analysis

Data from the 24-hour recalls were analyzed using the ESHA nutrient analysis software (Salem, Oregon), version 7.1 in accordance with the 2007 Canadian Nutrient File (Health Canada, 2009a). The 2007 version of CFG was used in analyzing food guide servings from the 24-hour recalls (Health Canada, 2009b). “Other” foods were defined as those foods included in the Canadian Nutrient File category of “other” foods, which includes saturated and/or trans fats and oils, foods that do not belong to any category of CFG, foods high in fat and/or sugar (including some bakery products), high salt and/or high fat snacks, both higher and lower calorie beverages not including 100% juices and milk, and alcohol. The category does not include unsaturated fats and oils or water (Health Canada, 2009a). Statistical analyses were carried out using SPSS (Chicago, Illinois) version 17.0. Descriptive statistics for the sample were used to compare intakes to current standards, based on Estimated Average Requirements (EARs), Adequate Intakes (AIs) and CFG recommendations (Health Canada, 2006, 2009b). Mean intakes of students in Fort Albany pre- and post-program were also compared to mean intakes of Canadian children of the same age and sex, based on CCHS data (Statistics Canada, 2010). Standards and mean intakes used in the comparison are shown in Table 6.1. Changes in intakes were evaluated using a two-tailed Mann-Whitney U test. Because nutrient intakes are influenced by total energy intake (i.e., those who consume greater energy also eat, on average, more of all specific nutrients), nutrient and food group intakes were adjusted for energy intake using the nutrient density method, to reflect intakes per 1000 kcal (Willett et al., 1997). The KSIQ was scored in terms of knowledge, intention/attitude, and self-efficacy questions, as well as the number of vegetables and fruit tried and liked pre- and post-program. Knowledge, intention/attitude, and self-efficacy

sections of the questionnaire were scored out of eight, 18, and 16 points, respectively. Students were given a list of 40 vegetables and fruit to choose from in terms of having tried them and liking them, for a possible score of 40 for each of these sections. Changes in KSIQ responses pre- and post-program were evaluated using a one-tailed Wilcoxon signed-ranks test, as it was predicted that all scores would improve as a result of the program. The p-value of significance for all statistical analyses was 0.05 (5%).

Table 6.1: Estimated Average Requirements (EARs), Adequate Intakes (AIs), Canada’s Food Guide recommendations, and Canadian Community Health Survey data to be used in the analysis

Age Group	Nutrient or food group	EAR, AI, or CFG recommendation		CCHS mean intake	
		Male	Female	Male	Female
9-13 years	Vegetables and fruit (servings)	6	6	4.53	4.40
	“Other” foods (servings)	-	-	-	-
	Fibre (g/day)*	31	26	-	-
	Folate (µg/day)**	250	250	-	-
	Vitamin A (RAE µg/day)**	445	420	-	-
	Vitamin C (mg/day)**	39	39	-	-
14-18 years	Vegetables and fruit (servings)	8	7	4.87	4.67
	“Other” foods (servings)	-	-	-	-
	Fibre (g/day)	38	26	-	-
	Folate (µg/day)	330	330	-	-
	Vitamin A (RAE µg/day)	630	485	-	-
	Vitamin C (mg/day)	63	56	-	-

Note: Recommended intake of “other” foods based on complete dietary exclusion of these foods; RAE refers to retinol activity equivalents (vitamin A activity)

*Adequate intake; **Estimated Average Requirement

6.3 Results

6.3.1 Nutrient and Food Group Intakes

Baseline and post-program dietary intakes were obtained using the WEB-Q. Thirty students in grades six to eight were present to complete the pre-program WEB-Q, and ten were present for the post-program WEB-Q.

Thirty-nine students were enrolled in grades six to eight for the period of the program, but because the post-program WEB-Q was completed near the end of the school year, attendance was poor (26%). Additionally, a number of students were no longer attending school due to behavioural issues. However, all students present at school on the days the WEB-Q was administered completed the questionnaire. Characteristics of the study population are found in Table 6.2. Overall, no significant changes in the intake of vegetables and fruit, “other” foods, fibre, folate, vitamin A, or vitamin C were observed post-program as compared to pre-program (Table 6.3). A comparison of pre- and post-program vegetable and fruit intakes are shown in Figure 6.1. Both pre- and post-program mean intakes were below those reported by the CCHS for same age and sex groups (pre-program, male students aged nine to 13 and 14 to 18 years had average intakes of 3.2 and 3.1 servings, respectively, and females had average intakes of 3.8 and 1.5 servings, respectively; post-program, male students aged nine to 13 years had an average intake of 3.2 servings while females had an average intake of 2.1 servings (there were no students older than 13 years old in the post-program analysis)). Students generally received one to one and a half servings of vegetables and fruit per day as part of the school snack program (including a cup of fruit juice).

Table 6.2: Characteristics of study population in the comparison of nutrient and food group intakes pre- and post-program*

Characteristic	Pre-program (June 2009)	Post-program (May 2010)
N	30	10
Mean age in years (SD)	13.0 (1.0)	11.8 (0.8)
Male (%)	10 (33.3)	7 (70)
Female (%)	20 (66.7)	3 (30)
Vegetable and fruit intake below recommendation (%)	27 (90)	9 (90)
Fibre intake below AI (%)**	29 (96.7)	10 (100)
Folate intake below EAR (%)	22 (73.3)	3 (30)
Vitamin A intake below EAR (%)	26 (86.7)	6 (60)
Vitamin C intake below EAR (%)	14 (46.7)	5 (50)

*Intakes in relation to Estimated Average Requirements (EARs), Adequate Intakes (AIs), and Canada’s Food Guide standards (“other” foods not included as there exists no formal recommendation or standard)

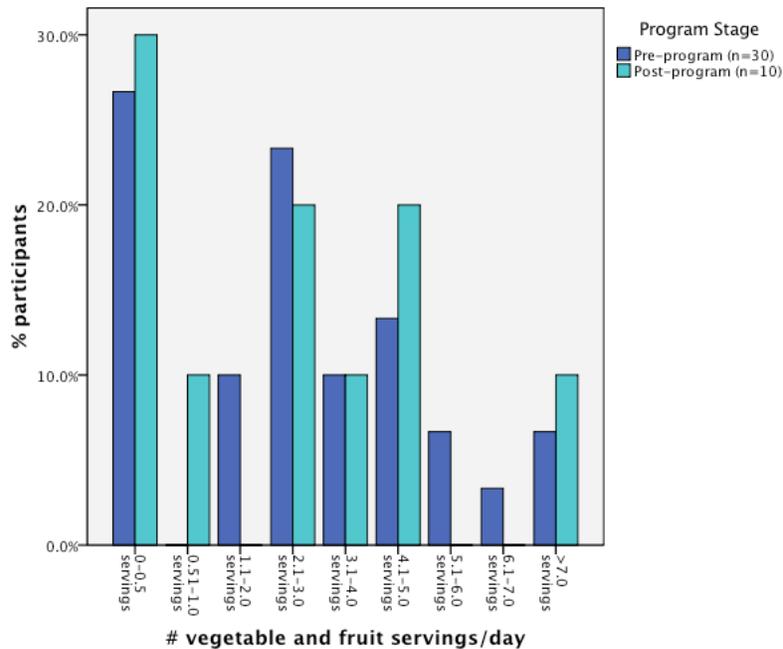
**Recognizing that the Adequate Intake is an estimation of adequacy and not a recommendation, per se

Table 6.3: Comparison of nutrient and food group intakes pre- and post-program*

Food group or nutrient	Baseline intakes	Post-program intakes	p Value
	Median; Mean (SD)	Median; Mean (SD)	
Vegetables and fruit (svgs)	2.7; 3.2 (3.2)	2.9; 2.9 (3.1)	0.595
“Other” foods (svgs)	4.0; 4.3 (3.4)	2.0; 3.4 (3.5)	0.287
Fibre (g/day)	10.4; 11.2 (7.4)	11.0; 12.3 (9.0)	0.399
Folate (µg/day)	177.0; 238.1 (194.5)	310.4; 348.4 (225.6)	0.303
Vitamin A (RAE µg/day)	245.1; 273.6 (176.1)	305.7; 550.1 (571.4)	0.512
Vitamin C (mg/day)	108.5; 122.7 (112.8)	36.6; 107.3 (174.1)	0.512

*Intakes shown in table are unadjusted; p-values of significance are for energy-adjusted intakes (per 1000 kcal)

Figure 6.1: Comparison of vegetable and fruit intakes pre- and post-program



6.3.2 Knowledge, Self-Efficacy, and Intentions

A total of 30 students in grades six to eight completed the pre-program KSIQ (77% students enrolled; 100% students present at school). At post-program, 27 students were present to complete the KSIQ (69% students enrolled; 100% students present at school). Eighteen students were included in the paired analysis to detect changes in responses post-program as compared to pre-program (Table 6.4). Note that there were no significant differences in any questionnaire component scores between the paired sample and the full sample (paired sample

was representative). Comparison of responses to the KSIQ pre- and post-program are presented in Table 6.5. Students showed significant improvements in nutrition knowledge ($p=0.003$) and the number of vegetables and fruit that they had tried ($p=0.004$) and liked ($p=0.003$) post-program, as compared to pre-program. No significant changes in intentions or self-efficacy to eat more vegetables and fruit were observed post-program as compared to pre-program.

Table 6.4: Characteristics of the study population in the comparison of Knowledge, Self-Efficacy, and Intentions Questionnaire responses pre- and post-program

Population Characteristics			
	Pre-program	Post-program	Pairs
N	30	27	18
Mean age in years (SD)	12.9 (0.9)	13.0 (0.8)	13.0 (0.9)
Male (%)	18 (60)	12 (44.4)	11 (61.1)
Female (%)	12 (40)	15 (55.6)	7 (38.9)

Table 6.5: Comparison of Knowledge, Self-efficacy, and Intentions Questionnaire responses pre- and post-program

KSIQ section (highest possible score)	Median pre- program score	Mean pre- program score (SD)	Median post- program score	Mean post- program score (SD)	p value
Knowledge (8)	3.5	3.6 (2.5)	5.0	4.7 (2.3)	0.003
Intentions/Attitudes (18)	9.5	8.7 (3.3)	9.0	8.7 (3.4)	0.479
Self-Efficacy (16)	8.0	7.4 (2.9)	7.0	6.9 (2.6)	0.089
Vegetables and fruit tried (40)	31.5	28.9 (7.5)	32.5	31.6 (6.6)	0.004
Vegetables and fruit liked (40)	20.0	18.8 (6.7)	25.0	23.6 (9.0)	0.003

6.3.3 Program Integrity

Overall, program attendance was 76%, 48%, 71%, 76%, and 82% for weeks one through five, respectively. Attendance was lowest during the second week because many grade seven students were on a school trip. One class could not be completed because student attention could not be maintained. Several lessons

were modified to make them more interactive, as this style of teaching was seen to be more effective by the co-operative student delivering the program. Other modifications were made to make the program more culturally relevant and/or relevant to the lives of the students involved, by using examples that they would be familiar with. Otherwise, the program went according to plan.

6.3.4 Student Impressions

Student impressions of the program were collected via the post-program WEB-Q (n=10). Student impressions of the program were overwhelmingly positive. When asked about their favourite part of the program, most students enjoyed the interactive lessons involving kinesthetic learning, where students were physically involved in what they were learning (tasting, cooking, playing games), best. One such lesson involved the preparation of healthy vegetable pizzas to teach students how to prepare healthy, homemade versions of their favourite foods. One student in the sixth grade said “we all loved the pizza!” while another from grade seven said “I really liked the part where the class made pizzas”. Another lesson involved the tasting of a number of vegetables and fruit, where students were asked to describe the colour, texture, taste, and smell of the vegetable or fruit, as well as their opinion. A sixth grade student said “I liked trying new foods”, another said “I liked tasting new foods”, while a third said “making pizza and tasting food!!” when asked about their favourite part of the program. Students also expressed a desire to learn more, saying they would like to know “how many fruits there are” and learn “about the benefits of vegetables and fruits”.

6.3.5 Teacher Impressions

Teachers impressions of the program were collected via a focus group with all of the teachers present that day (June 2010; n=16, response rate 94%). Most teachers had positive impressions of the program, while others did not express an opinion (favourable or otherwise). Nevertheless, the teachers echoed what was expressed by the students, saying “kids really liked the taste testing”. They saw special value in the tasting lesson as most students had never heard of many of the vegetables or fruit before, and it was good for them to be exposed to vegetables and fruit that they would otherwise not have the opportunity to try. Teachers also said that the students especially liked the physical activity components of the program. One teacher noted that she saw a “huge difference” in the students as a result of the program, in that they now knew the four food groups and were excited

about nutrition. Teachers saw it as especially valuable to have somebody who is not the teacher who has the energy and time to come into the classroom and make nutrition a priority. In terms of future initiatives, all teachers thought that the program should continue. One teacher expressed a need for more visual teaching materials and more teaching about the amounts of sugar in foods and type 2 diabetes. Although teachers were not formally trained, most stayed in the classroom to observe while lessons were being taught. However, teachers expressed a lack of time and energy to focus on nutrition and that having someone come to the class was most effective.

6.3.6 Parent/guardian Impressions

Parent/guardian impressions were collected via questionnaires at the community feast at program completion (n=47; 100% of available surveys). Any community member who stated that they had a child attending the school was welcome to complete the survey (included parents, grandparents, and other guardians). Parent/guardian impressions of the program were very positive. Overall, 87% of parents/guardians who completed the questionnaire knew that the program existed. Seventy-three percent of parents/guardians reported that their child/children had either told them about or asked them to buy the vegetables and fruit they had tried at school. The major barriers to consuming vegetables and fruit expressed were that they were too expensive (68%) and/or not fresh at the store (49%). No parents/guardians reported the fact that vegetables and fruit do not taste good being a barrier. In the words of one parent/guardian, “by the time they (vegetables and fruit) get here, they get rotten”. Other parents/guardians said they would serve more vegetables and fruit at home “if there was a fresh stock at the store” or if there was “fresh produce and lower prices”. Overall, 100% of parents/guardians thought the program should continue to run. In the words of one parent/guardian, “This is a good program for our problem, which some homes don’t receive these kinda good healthy food” while, another said that the program should continue because “I know there is good going into my children”. Another said “I love this program. I think nutrition classes should happen more often” while, one parent/guardian stated that “kids learn and are alert when they don’t feel hungry”. Parents/guardians also expressed a desire for more community events including farmer’s markets, where fresh foods would be available at a reduced cost. The community feast was well attended (over 150 attendees) and well appreciated, and parents/guardians expressed a desire for future similar events. Most parents/guardians thought that the education material they had received through the program was useful.

Some suggestions for information that could be included in the future included a “food programme for picky eaters” and information on “cost effective healthy foods”.

6.4 Discussion

Overall, the findings suggest that a multi-component fruit and vegetable education program was beneficial in terms of improving the exposure of students at Peetabeck Academy in Fort Albany to a variety of vegetables and fruit, and improving their nutrition knowledge about vegetables and fruit. The intakes of vegetables and fruit and associated nutrients of students in Fort Albany did not significantly improve as a result of the program, which is in contrast to the results of the NFVPP, after which this program was modeled (He et al., 2007). However, because a school snack program was already in place prior to the start of the comprehensive program in conjunction with the barriers to eating more vegetables and fruit (as expressed by parents/guardians), this result is not surprising. It is possible that if vegetables and fruit were more readily available within the community, that dietary change would have been more likely; however, such barriers to healthy eating were not addressed by the program and should be the focus of future initiatives. Additionally, the small sample size limited the power to see any significant dietary changes. Still, although the school snack program serves approximately one to one and a half servings of vegetables and fruit per student per day, there is room for improvement. One serving of vegetables and fruit is provided through fruit juice, which is not ideal, and the variety of vegetables and fruit served is limited (mostly apples and oranges) due to availability. Because of this, the healthy school policy portion of the program was only followed only as closely as was possible, considering limited availability. No significant improvements in self-efficacy and intentions to eat more vegetables and fruit were observed. These findings are likely largely reflective of the numerous barriers faced by those living in remote, northern communities when it comes to the acquisition of fresh produce. As revealed in the parent questionnaires, the fact that vegetables and fruit at the store are usually not fresh and extremely expensive, make them inaccessible to most community members, especially considering the high rate of food insecurity experienced in the community (Skinner K, personal communication). It is not that parents do not find vegetables and fruit appealing, but rather that they do not have adequate access to them. Although the program piloted in this study employed a comprehensive, multi-component approach shown to be more effective in improving dietary intakes (Veugelers & Fitzgerald, 2005), the characteristics of the community in question may have impeded any improvements in intake

beyond that seen via simple food provision. As the school snack program was already in place at the time of the pre-program dietary recall, whether or not the food provision itself improved intakes could not be measured. However, the snack program generally provides students with one fruit or vegetable serving per day that they are likely not receiving at home. The fact that self-efficacy and intentions to consume more vegetables and fruit did not improve as a result of the program is also reflective of such barriers. It cannot be expected that students would intend to consume more vegetables and fruit or feel that they are more able to make healthy choices as a result of improved nutrition knowledge, when these choices are not even available to them. Although the school snack program, which has been in effect at Peetabeck Academy for more than 20 years, is an invaluable resource for the promotion of healthy eating for the community's children (Skinner et al., 2006), the vegetable and fruit and related nutrient intakes of the students involved in this study can still be improved (Table 6.5). The findings of this study suggest that improved nutrition knowledge does not necessarily translate into improved intakes, especially in communities that face numerous barriers to the acquisition of fresh, affordable healthy foods. A recent review by McClain and colleagues (2009) suggests that nutrition knowledge is not necessarily associated with healthy eating. In addition, research by Bihan and colleagues (2010) suggested that a lack of financial means for purchasing vegetables and fruit is associated with poor vegetable and fruit intakes among a low-income French population. Such is likely also the case in the community examined in the current study, because of high food insecurity rates (Skinner K, personal communication). Therefore, further initiatives should include more community-based health improvement strategies to help improve the access to healthy foods at a reasonable cost (fresh or otherwise). This could involve more farmer's markets based on foods flown into the community, community gardens, co-operative buying programs, or healthy community feasts.

The findings of this study are supported by earlier research in Fort Albany by Skinner and colleagues (2006), which identified the barriers and supports to healthy eating in the community via qualitative interviews and an environmental scan. Identified barriers included food insecurity related to the cost, availability, variety, and quality of foods available at the store, lack of exposure to different foods, and remoteness, among others (Skinner et al., 2006). These same themes emerged in the responses to the parent questionnaire that were a part of the current study, and remain critical barriers to the improvement of diet quality in the community as a whole. Additionally, Skinner and colleagues identified the school snack program, and the expansion of such programs, as

important opportunities for healthy eating within the community (Skinner et al., 2006). The vegetable and fruit education program piloted in this study builds on such opportunities, but failed to demonstrate improved dietary intakes, likely due to limited power and the fact that the school snack program was already in place prior to the start of the program. However, even though knowledge is not consistently associated with healthier eating (McClain, Chappuis, Nguyen-Rodriguez, Yaroch & Spruijt-Metz, 2009), with the reduction of barriers concerning the cost and availability of healthy foods, the knowledge gained by students in this program may allow them to make healthier choices and thus improve their dietary intakes. This is where community based initiatives, like farmer's markets and community gardens, would be vital.

The program was very well received. Students, parents, and most teachers were all very enthusiastic, especially in light of the barriers to healthy eating within the community, and the high prevalence of obesity and type 2 diabetes in Aboriginal communities in Canada. The process evaluation revealed the need to be flexible when implementing programs in Aboriginal populations, and sensitive to culture. The classes that involved kinesthetic learning were most enjoyed by the students, and in future initiatives, interactive lessons would be encouraged as they were very well received and kept the attention of the students, while helping them learn in a positive environment. The tasting sessions were also very well received by both students and teachers, and may have special relevance in remote, northern communities where a large variety of fresh produce is not normally available. A recent review by Cooke (2007) indicated that children who have many opportunities to sample a variety of healthy foods from an early age tend to have healthier diets throughout childhood. Cooke's review suggests that simple food exposure may be enough to change food preferences (Cooke, 2007). As previously noted, tasting may therefore be especially important in programs in schools in remote, northern communities where healthy foods are often not available, and students may never have tasted a wide variety of vegetables and fruit. In combination with sound nutrition education and the reduction of serious barriers to healthy eating that exist in many remote, northern communities, exposure to healthy foods in school may have the ability to improve the dietary intakes of children in such communities.

Perhaps in a less remote community, a similar program may have been more effective in improving dietary intakes as well as self-efficacy and intentions to eat more vegetables and fruit, as fresh produce would be

readily available. Although knowledge, self-efficacy, attitudes, and intentions are antecedent to behaviour change, these act reciprocally with the environment (Bandura, 2004). While improving the school environment is a step in the right direction, it is not sufficient in relation to the total food intake as was measured. The barriers faced by community members in Fort Albany, including inadequate and inconsistent access to healthy foods at a reasonable cost, were major impediments to health behaviour change in the context of this study.

Overall, the current study suggests that a comprehensive multi-component vegetable and fruit education program positively influenced the preferences for and exposure to a number of vegetables and fruit in grade six to eight students at Peetabeck Academy in Fort Albany FN. These results are encouraging as it is suggested that children who are exposed to more healthy foods at a young age are more likely to have a healthy diet throughout childhood (Cooke, 2007). This is especially relevant in communities such as Fort Albany FN, where students would otherwise likely not have access to most vegetables and fruit.

6.4.1 Study Limitations

The great diversity in Aboriginal populations in Canada means that the results of this study cannot be automatically generalized to other populations. The sample size used in this study was limited, meaning that there was a reduced ability to detect changes in intakes. Finally, the self-reporting nature of the 24-hour dietary recall method makes it prone to underreporting; however, the WEB-Q used in this study has been validated and mimics the multiple-pass method, which may help to overcome this limitation (Hanning et al., 2009). Although one day of intake does not provide the most accurate representation of true nutrient intakes, estimating nutrient intakes with any greater degree of accuracy would be take too much time away from the classroom and be infeasible in some cases (e.g., 39 to 44 days for a true estimate of vitamin A intake)(Basiotis et al., 1987).

7.0 Chapter 7: Conclusions and Future Directions

This thesis investigated the vegetable and fruit intakes of FN children and adolescents living on-reserve in Ontario; included were data from seven FN communities collected from 2003 to 2010. The results of this study are particularly relevant considering the paucity of data regarding the dietary intakes of FN children and adolescents living on-reserve in Canada. Overall, the findings indicated that the participants had high rates of overweight and obesity, low intakes of vegetables and fruit, and intakes of “other” foods that exceeded vegetable and fruit intakes, in terms of servings. Because mean intakes of “other” foods exceeded those of vegetables and fruit in all age and sex categories, it is possible that “other” foods are displacing vegetable and fruit intakes. This is likely reflective of the availability of these foods in the participating communities, where “other” foods are generally more readily available and less expensive than vegetables and fruit. These data are in agreement with those from Aboriginal children and adolescents living off reserve in Canada (Garriguet, 2008). Data for children and adolescents living on reserve are less extensive, but results of a number of studies were also in agreement with the results of the current investigation (FNRHS, 2003; Di Noia et al., 2005; Downs et al., 2009).

The overweight and obesity rates observed in this study (seven communities) were 31.8% and 19.6%, respectively. These figures are similar to those of other on-reserve FN children aged 12 to 17 years as reported by the FNRHS of 28.1% and 14.1%, respectively (FNRHS, 2003; self-reported height and weight data). In contrast to other research suggesting a relationship between vegetable and fruit and fibre intakes and BMI, the current study did not support this association in the population investigated (Shields, 2006; Pereira & Ludwig, 2001; Hanley et al., 2000). This may be due, in part, to the fact that there was not much variation in fibre intakes among the sample (most participants had low vegetable and fruit and fibre intakes, as compared to standards). It is therefore unlikely that vegetable and fruit or fibre intakes were contributing to satiety, which may be more likely with intakes at or above current standards, and therefore intakes were not significantly associated with BMI. This study was limited by the fact that height and weight data were self reported, which may have lead to inaccuracies in the BMI calculation. However, students were given adequate tools to accurately measure height and weight and the survey was completely anonymous, which reduced bias. This study was also limited by the lack of waist circumference data, which may have provided more insight into the relationship between adiposity and vegetable and fruit and fibre intakes. Additionally, statistical power to observe significant associations was limited by the

sample size. It is therefore possible that a relationship between vegetable and fruit and fibre intakes and BMI does exist in this population but that the sample size was insufficient to observe any significant associations. Future research in this population should include using measured heights, weights, and waist circumferences along with 24-hour dietary recalls, which may provide more insight into the relationship between body mass, adiposity, and vegetable and fruit and fibre intakes.

The poor intakes of vegetables and fruit (especially relative to intakes of “other” foods) in the participants merit the implementation of population health interventions to promote a healthy diet, enhance food security, and improve access to healthy food. In Fort Albany, parents expressed a desire for more farmer’s markets or other types of interventions that would provide consistent access to affordable, healthy foods (community gardens, community feasts, etc.). The primary reasons for not consuming vegetables and fruit expressed by parents in Fort Albany were that they were too expensive and not fresh. It is likely that the other communities of the Mushkegowuk Territory are experiencing a similar situation. Although the school programs piloted in this research did not improve vegetable and fruit intakes, school nutrition programs may still be a viable approach to improving intakes, if barriers such as price, availability, and quality can be addressed, as children spend much of their time in school and make up a large proportion of the population. In Kashechewan FN, results suggested that, under ideal circumstances, a simple food provision program could improve the fruit and vegetable intakes of grade six to eight students. Although improvements in intakes were not significant, considering the small sample size, the fact that intakes changed in a positive direction is encouraging. However, the program also brought to light the fact that in order to be successful, school food provision programs require adequate dedicated personnel, sufficient funding, and adequate resources including storage space (refrigerators, etc.). Such barriers should be addressed prior to the implementation of similar programs in other communities in order to encourage program success in terms of improved intakes and consistent program delivery.

In contrast to current research indicating that comprehensive, multi-component programs are more effective at improving dietary intakes as compared to simple food provision programs, the results of the pilot comprehensive nutrition education program in Fort Albany FN did not support this association (He et al., 2007; Van Cauwenberghe, Maes, Spittaels, van Lenthe, Brug & Oppert et al., 2010). As hypothesized, vegetable and

fruit intakes in grade six to eight students who participated in the program did not improve beyond intakes pre-program, when the snack program was already in place. It is hypothesized that this was a reflection of the numerous barriers to healthy eating in remote, northern communities, including inadequate access to produce of consistent quality at a reasonable price. As previously noted, parents/guardians expressed that the major barriers to eating more vegetables and fruit were price and freshness. No parents/guardians said that they did not consume more vegetables and fruit because they did not like them. However, because physical barriers to healthy eating in the community were not removed as part of the program, intakes did not improve, despite the significant improvement in fruit and vegetable nutrition knowledge among grade six to eight students. It should be noted, however, that the school snack program, which provides approximately one and one half servings of vegetables and fruit per student per day, contributed to 42.9% of vegetable and fruit intakes pre-program (3.2 servings), and 51.7% to post-program intakes (2.9 servings) (assuming all students participated in the snack program the day before the recall). Even with the school snack program, intakes remained below CFG recommendations, which emphasizes the importance of the program, considering how much it contributes to the vegetable and fruit intakes of the students involved. The program did not have any impact on intentions or self-efficacy to eat more vegetables and fruit, presumably due to the physical barriers to healthy eating within the community, as expressed by parents/guardians. Encouraging, though, is the fact that the participating students had significant improvements in the number of vegetables they had tried and liked. Unfortunately, in a community such as Fort Albany, intake is not necessarily determined by food preferences but may be more influenced by food price and availability. Therefore, initiatives that would remove barriers to healthy eating by making vegetables and fruit more accessible and more reasonably priced could lead to improved intakes of vegetables and fruit by students, as exposure to and preferences for these foods improved significantly. Finally, it must be noted that the pilot school nutrition program in Fort Albany was only a short-term initiative. Dietary change does not happen overnight, nor can it be expected to change significantly in only a few short weeks. The fact that the children and adolescents involved in the program experienced significant improvements in nutrition knowledge and in the number of vegetables and fruit that they tried and liked is encouraging. More consistent, long-term initiatives may still have the potential to improve intakes, self-efficacy, and intentions, especially if interventions to help reduce community-level barriers to healthy eating, such as food insecurity and the availability of healthy, affordable food.

Overall, the research presented in this thesis suggests that comprehensive school nutrition programs have the potential to influence food preferences, improve exposure to vegetables and fruit, as well as improve nutrition knowledge. However, it also indicated that these positive changes were not enough to improve dietary intake of vegetables and fruit and associated nutrients. This may be a reflection of the length and intensity of the programs, which may not have been sufficient to initiate significant dietary change, as well as the presence of community-level barriers to healthy eating which were not the focus of the school nutrition program. Unfortunately, as expressed by parents/guardians, there remain numerous barriers to the success of such programs and to the improvement of dietary intakes in remote, isolated FN communities; namely food insecurity and the inaccessibility of healthy foods for the majority of the population. Future research, as suggested by community members, should therefore include further community-based interventions, including farmer's markets, healthy community feasts, and community gardens to help improve access to affordable, healthy foods of consistent quality. Such initiatives are very well received within the community and may have the potential to further improve the dietary intakes of children and adolescents residing in these communities. Although the school nutrition programs involved in the current research did not improve intakes, the fact that nutrition knowledge and exposure to and preferences for vegetables and fruit improved suggests that with the removal of the barriers to healthy eating in the involved communities, intakes may improve. Therefore combined interventions, including school nutrition programs and community interventions directed at reducing barriers to healthy eating may be effective at improving intakes.

The Aboriginal communities involved in this research are in need of further knowledge to allow them to collaborate with researchers to take positive steps toward improving the health and well-being of their community members. A participatory approach is ideal, and would allow the participating communities to build on their own strengths and resources to implement viable health improvement strategies. The extensive dietary, physical activity, and eating intentions data collected in this research may be used in future health improvement initiatives in the involved communities, and future steps should involve the input of the target communities as to be of benefit to both the communities and researchers. A review by Willows (2005a) revealed gaps in current Aboriginal health research related to dietary intake; the gaps identified could be the inspiration for future research using the data collected using the WEB-Q over the past seven years and data to be collected in the future. For

example, Willows (2005a) identified health beliefs about different foods (traditional versus market foods), and how these health beliefs affect dietary intake as a topic area that is currently under-researched in Aboriginal populations. It would be extremely interesting to determine whether or not health beliefs really do affect dietary intake in the participating communities, or whether dietary intake is influenced more by other variables such as food insecurity, price, and availability, among others. Such information would inform the implementation of future initiatives aimed at dietary improvement. Another area of research that is understudied is the influence of store managers and store policies in remote Aboriginal communities in terms of the types of foods available in the store, prices, and how price and availability affect choice and dietary intake on a whole (Willows, 2005a). Research by Skinner and colleagues (2006) in Fort Albany revealed that community members were frustrated with the prices and food availability at the store, but that they felt they had no power over the issue. Community members expressed that because store managers changed every three years, they felt no connection to the community (Skinner et al., 2006). Moreover, some community members had requested specific items from the store, without success (Skinner et al., 2006). A further investigation into store policies and managements and whether or not this affects food availability, price, and diet would be of value. Although all Aboriginal people living in remote communities deserve equal access to reasonably priced, healthy foods, if price and availability were found to be significant impediments to a healthy diet, this would provide an even stronger argument for action. A final area of research which could prove extremely interesting would be an investigation into the balance of the benefits accrued through traditional food intake and the harms of contaminant exposure (Willows, 2005a). Literature into traditional food intake generally posits that a diet rich in traditional foods is healthier than one rich in market foods, which are generally of lower nutritional quality (Kuhnlein et al., 2004; Willows, 2005a). However, a serious barrier to traditional food intake is environmental contamination (Power, 2005). Therefore, the simple recommendation to consume more traditional foods could prove harmful; a balance between what amounts and types of traditional foods are beneficial in terms of health and what amount and types are harmful must be identified in order to make sound recommendations for traditional food intake.

Overall, the current research revealed valuable information regarding the dietary intakes and weight status of Aboriginal children and adolescents living in northern and southern Aboriginal communities in Ontario. It also provided a unique look into the benefits of school nutrition programs in remote communities, and the

numerous barriers to program maintenance. The communities involved in this research are in need of further investigations to help guide future health promotion initiatives. The investigations previously proposed would help the communities understand where resources should be applied in terms of future health improvement strategies. It is certainly unjust that Aboriginal people living in northern, remote communities in Canada do not have equal access to affordable, healthy foods; identified by community members in Fort Albany as a major hindrance to healthy eating. The accurate identification of major obstacles to healthy eating in Aboriginal communities will help guide future participatory action involving the communities and researchers, with the aim of allowing Aboriginal Canadians an equal opportunity to lead healthy lives.

References

1. American Dietetic Association. (1996). Position of the American Dietetic Association: child and adolescent food and nutrition programs. *J American Diet Assoc*, 96(9), 913-917.
2. American Dietetic Association. (1999). Position of the American Dietetic Association: dietary guidance for healthy children aged 2 to 11 years. *J Am Diet Assoc*, 99(1), 93-101.
3. Bandura A. (2004). Health promotion by social cognitive means. *Health Educ Behav*, 31(2), 143-64.
4. Basiotis P, Welsh S, Cronin F, Kelsay J, Mertz Q. (1987). Number of days of food intake records required to estimate individual and group nutrient intakes with defined confidence. *J Nutr*, 117(9), 1638-41.
5. Bernard L, Lavallee C, Gray-Donald K, Delisle H. (2005). Overweight in Cree schoolchildren and adolescents associated with diet, low physical activity, and high television viewing. *J Am Diet Assoc*, 95(7), 800-2.
6. Bihan H, Castetbon K, Mejean C, Peneau S, Pelabon L & Jellouli F et al. (2010). Sociodemographic factors and attitudes toward food affordability and health are associated with fruit and vegetable consumption in a low-income French population. *J Nutr*, 140(4), 823-30.
7. Booth GL, Hux JE, Fang J & Chan BTB. (2005a). Time trends and geographic disparities in acute complications of diabetes in Ontario, Canada. *Diabetes Care*, 28(5), 1045-50.
8. Booth KM, Pinkston MM, Walker S & Poston C (2005b). Obesity and the built environment. *J Am Diet Assoc*, 105(Suppl), S110-S117.
9. Boston P, Jordan S, MacNamara E, Kozolanka K, Bobbish-Rondeau E & Iserhoff H et al. (1997). Using participatory action research to understand the meanings aboriginal Canadians attribute to the incidence of diabetes. *Chron Dis Can*, 18(1), 5-12.
10. Brant County Health Unit. (2005). Creating a healthy school nutrition environment. A resource for school decision makers. Retrieved May 22, 2009, from www.bchu.org/pdf/healthy_school_environment.pdf.
11. Budd GM & Volpe SL. (2006). School-based obesity prevention: research, challenges, and recommendations. *J Sch Health*, 76(10), 485-495.
12. Canadian Paediatric Society. (2005). Risk reduction for type 2 diabetes in Aboriginal children in Canada. *Paediatr Child Health*, 10(1), 49-52.
13. Cancer Care Ontario. (2010). *Healthy Eating Guidelines for School Nutrition Programs Pilot Project*. Toronto, Ontario.
14. Centers for Disease Control and Prevention. (1996). Guidelines for school health programs to promote lifelong healthy eating. *MMWR CDC Surveill Summ*, 45(RR-9), 1-42.
15. Centers for Disease Control and Prevention. (2008). Coordinated school health program. Retrieved on June 9, 2009 from <http://www.cdc.gov/HealthyYouth/CSHP/>.
16. Centers for Disease Control and Prevention. (2009). REACHing Eastern Band of Cherokee Indians in Cherokee, North Carolina. Retrieved July 6, 2009 <http://www.cdc.gov/reach/>.
17. Che J & Chen J. (2001). Food insecurity in Canadian households. *Health Rep*, 12(4), 11-22.

18. Chiefs of Ontario. (2005). *Community Profiles*. Retrieved January 25, 2010 from <http://www.chiefs-pf-ontario.org/profiles>
19. Cole TJ, Bellizzi MC, Flegal M & Dietz WH. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*, *320(7244)*, 1240-3.
20. Connelly PW, Hanley AJ, Harris SB, Hegele RA & Zinman B. (2003). Relation of waist circumference and glycemic status to c-reactive protein in the Sandy Lake Oji-Cree. *Int J Obes Relat Metab Disord*, *27(3)*, 347-54.
21. Constante Jaime P & Lock K. (2009). Do school based food and nutrition policies improve diet and reduce obesity? *Prev Med*, *48*, 45-53.
22. Cooke L. (2007). The importance of exposure for healthy eating in the childhood: a review. *J Hum Nutr Diet*, *20*, 294-301.
23. Cooke M, Beavon D & McHardy M. (2004). Measuring the well-being of Aboriginal people: an application of the United Nations Human Development Index to Registered Indians in Canada, 1981-2001. *Indian and Northern Affairs Canada*.
24. Daniel M, Marion SA, Sheps SB, Hertzman C & Gamble D. (1999). Variation by body mass index and age in waist-to-hip ratio associations with glycemic status in an aboriginal population at risk for type 2 diabetes in British Columbia, Canada. *Am J Clin Nutr*, *69(3)*, 455-60.
25. Daniels SR, Arnett DK, Eckel RH, Gidding SS, Hayman LL & Kumanyika S. et al. (2005). Overweight in children and adolescents: pathophysiology, consequences, prevention, and treatment. *Circulation*, *111(15)*, 1999-2012.
26. DASH BC. (2007). *Healthy fundraising for schools. A practical guide for parents and educators*. Retrieved July 17, 2009 from www.dashbc.org/.../Healthy%20Fundraising%20For%20Schools.pdf.
27. Davis TME, McAullay D, Davis WA, Bruce DG. (2007). Characteristics and outcome of type 2 diabetes in urban Aboriginal people: the Fremantle Diabetes Study. *Intern Med J*, *37(1)*, 59-63.
28. De Bourdeaudhuij I, Klepp K-I, Due P, Perez Rodrigo C, de Almeida MDV & Wind M et al. (2005). Reliability and validity of a questionnaire to measure personal, social and environmental correlates of fruit and vegetable intake in 10-11-year-old children in five European countries. *Public Health Nutr*, *8(2)*, 189-200.
29. De Sa J & Lock K. (2008). Will European agricultural policy for school fruit and vegetables improve public health? A review of school fruit and vegetable programmes. *Eur J Public Health*, *18(6)*, 558-68.
30. Dietz WH. (1998). Health consequences of obesity in youth: Childhood predictors of adult disease. *Pediatrics*, *101(3 Pt 2)*, 518-525.
31. Di Noia J, Schinke SP & Contento IR. (2005). Dietary patterns of reservation and non-reservation Native American youths. *Ethn Dis*, *15(4)*, 705-12.
32. Downs SM, Arnold A, Marshall D, McCargar LJ, Raine KD & Willows ND. (2009). Associations among the food environment, diet quality and weight status in Cree children in Quebec. *Public Health Nutr*, *12(9)*, 1504-11.
33. Downs SM, Marshall D, Ng C & Willows ND. (2008). Central adiposity and associated lifestyle factors in Cree children. *Appl Physiol Nutr Metab*, *33(3)*, 476-82.

34. Dyck R, Klomp H, Tan LK, Turnell RW & Boctor MA. (2002). A comparison of rates, risk factors, and outcomes of gestational diabetes between aboriginal and non-aboriginal women in the Saskatoon Health District. *Diabetes Care*, 25(3), 487-93.
35. Feldeisen SE & Tucker KL. (2007). Nutritional strategies in the prevention and treatment of metabolic syndrome. *Appl Physiol Nutr Metab*, 32(1), 46-60.
36. First Nations Regional Longitudinal Health Survey (FNRHS) 2002/03. (2003). Results for adults, youth and children living in First Nations communities.
37. Five Nations Energy. (2010). *Community Profiles*. Retrieved January 25, 2010 from <http://www.fivenations.ca>
38. Florence MD, Asbridge M, Veugelers PJ. (2008). Diet quality and academic performance. *J Sch Health*, 78(4), 209-15.
39. Flynn, MAT, McNeil DA, Maloff B, Mutasingwa D, Wu M & Ford C. et al. (2006). Reducing obesity and related chronic disease risk in children and youth: a synthesis of evidence with 'best practice' recommendations. *Obes Rev*, 7(Suppl 1), 7-66.
40. Food and Agriculture Organization of the United Nations. (2005). Voluntary guidelines to support the progressive realization of the right to adequate food in the context of national food security. Rome.
41. Ford ES, Giles WH, Dietz WH. (2002). Prevalence of the metabolic syndrome among US adults: findings from the Third National Health and Nutrition Examination Survey. *JAMA*, 287(3), 356-9.
42. Forbes LE, Storey KE, Fraser SN, Spence JC, Plotnikoff RC & Raine KD et al. (2009). Dietary patterns associated with glycemic index and glycemic load among Alberta adolescents. *Appl Physiol Nutr Metab*, 34(4), 648-58.
43. Fort Albany First Nation. (1999). *Fort Albany First Nation Community Profile*. Retrieved January 25, 2010 from <http://www.wakenagun.ca/PDF/Fort%20Albany%20Profile.pdf>
44. Fox S, Meinen A, Pesik M, Landis M & Remington PL (2005). Competitive food initiatives in schools and overweight in children: a review of the evidence. *Wis Med J*, 104(5), 37-43.
45. Franks PW, Looker HC, Kobes S, touger L, Tataranni PA & Hanson RL et al. (2006). Gestational glucose intolerance and risk of type 2 diabetes in young Pima Indian offspring. *Diabetes*, 55(2), 465-5.
46. Freedman DS, Khan LK, Dietz WH, Srinivasan SR & Berenson GS. (2001). Relationship of childhood obesity to coronary heart disease risk factors in adulthood: the Bogalusa Heart Study. *Pediatrics*, 108(3), 712-718.
47. French SA, Jeffery RW, Story M, Breitlow KK, Baxter JS & Hannan P. et al. (2001). Pricing and promotion effect on low-fat vending snack purchases: the CHIPS study. *Am J Public Health*, 91(1), 112-117.
48. FRESH. (2008). Focusing resources on effective school health: a FRESH start to improving the quality and equity of education. Retrieved on June 9, 2009 http://www.freshschools.org/Pages/FRESH_Framework.aspx
49. Garriguet D. (2007). Canadians' eating habits. *Health Rep*, 18(2), 17-32.
50. Garriguet D. (2008). Obesity and the eating habits of the Aboriginal population. *Health Rep*, 19(1), 1-15.

51. Gates A & Hanning RM. (unpublished data). A review of Aboriginal school nutrition and health programs: the CDC framework relates to plausibility but not strength of evidence of effectiveness.
52. Gittlesohn J, Harris SB, Thorne-Lyman AI, Hanley AJ, Barnie A & Zinman B. (1996). Body image concepts differ by age and sex in an Ojibway-Cree community in Canada. *J Nutr*, 126(12), 2990-3000.
53. Government of South Australia. (2006). *Readability Tools*. Retrieved July 20, 2010 from www.chdf.org.au/library/Readable%20health%20info.pdf
54. Hanley AJ, Harris SB, Gittlesohn J, Wolever TM, Saksvig B & Zinman B. (2000). Overweight among children and adolescents in a Native Canadian community: prevalence and associated factors. *Am J Clin Nutr*, 71(3), 693-700.
55. Hanley AJ, McKeown-Eyssen G, Harris SB, Hegele RA, Wolever TM & Kwan J et al. (2001). Cross-sectional and prospective associations between proinsulin and cardiovascular disease risk factors in a population experiencing rapid cultural change. *Diabetes Care*, 24(10), 1240-7.
56. Hanley AJG, Harris SB, Mamakeesick M, Goodwin K, Fiddler E & Hegele RA. (2005). Complications of type 2 diabetes among Aboriginal Canadians. *Diabetes Care*, 28(8), 2054-7.
57. Hanning RM, Jessup L, Lambraki I, MacDonald C & McCargar L. (2003). A web-based approach to assessment of food intake and behaviour of school children and adolescents. *Can J Diet Pract Res*, 64(2), s110.
58. Hanning RM, Royall D, Toews J, Blashill L, Wegener J & Driezen P. (2009). Web-based food behaviour questionnaire: validation with grades six to eight students. *Can J Diet Pract Res*, 70(4), 172-8.
59. Hanning RM, Woodruff SJ, Lambraki I, Jessup L, Driezen P & Murphy CC. (2007). Nutrient intakes and food consumption patterns among Ontario students in grades six, seven, and eight. *Can J Public Health*, 98(1), 12-6.
60. Harris SB, Gittlesohn J, Hanley AJG, Barnie A, Wolever TM & Gao J et al. (1997). The prevalence of NIDDM and associated risk factors in Native Canadians. *Diabetes Care*, 20, 185-7.
61. He M, Beynon C, Sangster Bouck M, St. Onge R, Stewart S & Khoshaba L. (2007). *Northern fruit and vegetable pilot program: Final report*. London, Ontario: Middlesex-London Health Unit. Retrieved July 21, 2010 from www.mhp.gov.on.ca/en/healthy-eating/NFVP-English-Final_EN.pdf
62. Health Canada. (2006). *Dietary Reference Intakes Tables*. Retrieved July 21, 2010 from <http://www.hc-sc.gc.ca/fn-an/nutrition/reference/table/index-eng.php#rvv>
63. Health Canada. (2008). *Nutrient Data*. Retrieved January 27, 2009 from <http://www.hc-sc.gc.ca/fn-an/nutrition/fiche-nutri-data/index-eng.php>
64. Health Canada. (2009a). *Canadian Nutrient File*. Retrieved July 20, 2010 from <http://webprod.hc-sc.gc.ca/cnf-fce/index-eng.jsp>
65. Health Canada. (2009b). *Eating Well with Canada's Food Guide*. Retrieved July 21, 2010 from <http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/index-eng.php>
66. Hegele RA, Cao H, Hanley AJG, Zinman B, Harris SB & Anderson CM. (2000a). Clinical utility of HNF1A genotyping for diabetes in Aboriginal Canadians. *Diabetes Care*, 23(6), 775-8.
67. Hegele RA, Cao H, Harris SB, Hanley AJG & Zinman B. (1999a). Hepatocyte nuclear factor-1 α G319S: a private mutation in Oji-Cree associated with type 2 diabetes. *Diabetes Care*, 22(3), 524.

68. Hegele RA, Cao H, Harris SB, Hanley AJG & Zinman B. (1999b). The hepatic nuclear factor-1 α G319S variant is associated with early onset type 2 diabetes in Canadian Oji-Cree. *J Clin Endocrinol Metab*, 84(3), 1077-82.
69. Hegele RA, Cao H, Harris SB, Hanley AJG, Zinman B & Connelly PW. (2000b). The private hepatocyte nuclear factor-1 α G319S variant is associated with plasma lipoprotein variation in Canadian Oji-Cree. *Arterioscler Thromb Vasc Biol*, 20(1), 217-22.
70. Hegele RA, Hanley AJG, Zinman B, Harris SB & Anderson CM. (1999c). Youth-onset type 2 diabetes mellitus associated with HNF1A S319 in aboriginal Canadians. *Diabetes Care*, 22(12), 2095-6.
71. Hegele RA, Harris SB, Hanley AJ, Sadikian S, Connelly PW & Zinman B. (1996). Genetic variation in intestinal fatty acid-binding protein associated with variation in body mass in aboriginal Canadians. *J Clin Endocrinol Metab*, 81, 4334-7.
72. Hegele RA, Young TK & Connelly PW. (1997). Are Canadian Inuit at increased risk for coronary heart disease? *J Mol Med*, 75(5), 364-70.
73. Hegele Ra, Zinman B, Hanley AJG, Harris SB, Barrett PH & Cao H. (2003). Genes, environment and Oji-Cree type 2 diabetes. *Clin Biochem*, 36(3), 163-70.
74. House of Commons Canada. (2007). Healthy Weights for Healthy Kids: Report of the Standing Committee on Health. Retrieved July 21, 2010 from <http://www2.parl.gc.ca/HousePublications/Publication.aspx?DocId=2795145&Language=E&Mode=1&Parl=39&Ses=1>
75. Hoyland A, Dye L, Lawton CL. (2009). A systematic review of the effect of breakfast on cognitive performance of children and adolescents. *Nutr Res Rev*, 22(2), 220-43.
76. Isomaa B, Almgren P, Tuomi T, Forsen B, Lahti K & Nissen M et al. (2001). Cardiovascular morbidity and mortality associated with the metabolic syndrome. *Diabetes Care*, 24(4), 683-9.
77. Jacobs P, Blanchard JF, James RC & Depew N. (2000). Excess costs of diabetes in the Aboriginal population of Manitoba, Canada. *Can J Public Health*, 91(4), 298-301.
78. Jeffery B & Leo A. (2008). School nutrition policies across Canada: are schools making the grade? Retrieved June 9, 2009, from www.ctf-fce.ca/e/publications/health.../Issue5_Article4_EN.pdf
79. Jones R. (2006). Are there health benefits from improving basic nutrition in a remote Aboriginal community? *Aust Fam Physician*, 35(6), 453-4.
80. Kaler SN, Ralph-Campbell K, Pohar S, King M, Laboucan Chief R & Toth EL. (2006). High rates of the metabolic syndrome in a First Nations community in Western Canada: prevalence and determinants in adults and children. *Int J Circumpolar Health*, 65(5), 389-402.
81. Kmetc A, Reading J & Estey E. (2008). Taking a life course perspective on cardiovascular disease and diabetes in First Nations peoples. *CJNR*, 40(3), 58-78.
82. Kuhnlein H, Erasmus B, Creed-Kanashiro H, Englberger L, Okeke C & Turner N et al. (2006). Indigenous peoples' food systems for health: finding interventions that work. *Public Health Nutr*, 9(8), 1013-9.
83. Kuhnlein HV, Receveur O, Souieda R & Egeland GM. (2004). Arctic indigenous peoples experience the nutrition transition with changing dietary patterns and obesity. *J Nutr*, 134(6), 1447-53.
84. Kuperberg K & Evers S. (2006). Feeding patterns and weight among First Nations children. *Can J Diet Pract Res*, 67(2), 79-84.

85. Lambden J, Receveur O, Marshall J & Kuhnlein H. (2006). Traditional and market food access in arctic Canada is affected by economic factors. *Int J Circumpolar Health*, 65(4), 331-40.
86. Lear SA, Humphries KH, Kohli S, Chockalingam A, Frohlich JJ & Laird Birmingham C. (2007). Visceral adipose tissue accumulation differs according to ethnic background: results of the Multicultural Community Health Assessment Trial (M-CHAT). *Am J Clin Nutr*, 86(2), 353-9.
87. Lindquist CH, Gower BA & Goran MI. (2000). Role of dietary factors in ethnic differences in early risk of cardiovascular disease and type 2 diabetes. *Am J Clin Nutr*, 71(3), 725-32.
88. Lock K, Pomerleau J, Causer L, Altmann DR & McKee M. (2005). The global burden of disease attributable to low consumption of fruit and vegetables: implications for the global strategy on diet. *Bulletin of the World Health Organization*, 83(2), 100-8.
89. Lorson BA, Melgar-Quinonez HR & Taylor CA. (2009). Correlates of fruit and vegetable intakes in US children. *J Am Diet Assoc*, 109(3), 474-8.
90. Maps of World. (2010). *Canadian Latitude and Longitude*. Retrieved January 25, 2010 from http://www.mapsofworld.com/lat_long/canada-lat-long.html
91. McClain AD, Chappuis C, Nguyen-Rodriguez ST, Yaroch AL & Spruijt-Metz D. (2009). Psychosocial correlates of eating behaviour in children and adolescents: a review. *Int J Behav Nutr Phys Act*, 12(6), 54.
92. McDonald SP, Russ GR. (2003). Burden of end-stage renal disease among indigenous people in Australia and New Zealand. *Kidney Int*, 63, S123-7.
93. McKenna ML. (2003). Issues in implementing school nutrition policies. *Can J Diet Pract Res*, 64(4), 208-213.
94. Mushkegowuk Council. (2010). *Community Profiles*. Retrieved on January 25, 2010 from <http://www.mushkegowuk.ca/communityprofiles.html>
95. National High Blood Pressure Education Program Working Group on Hypertension Control in Children and Adolescents. (1996). Update on the 1987 task force report on high blood pressure in children and adolescents: a working group report from the national high blood pressure education program. *Pediatrics*, 98(4 Part 1), 649-58.
96. National Institutes of Health. (2008). *Do you know your cholesterol?* Retrieved January 12, 2010, from <http://www.nhlbi.nih.gov/health/public/heart/other/latino/chol/metabolic.htm>.
97. Neel JV. (1970). The genetics of diabetes mellitus. *Adv Metab Disord*, 1(Suppl 1), 3-10.
98. Neel JV. (1999). The “thrifty genotype” in 1998. *Nutr Rev*, 57(5), S2-9.
99. Ng C, Marshall D & Willows ND. (2006). Obesity, adiposity, physical fitness and activity levels in Cree children. *Int J Circumpolar Health*, 65(4), 322-30.
100. Nicklas TA, Baranowski T, Cullen KW & Berenson G (2001). Eating patterns, dietary quality and obesity. *J Am Coll Nutr*, 20(6), 599-608.
101. Norgan NG. (1994). Interpretation of low body mass indices: Australian aborigines. *Am J Phys Anthropol*, 94(2), 229-37.
102. O’Dea K. (1992). Diabetes in Australian aborigines: impact of the western diet and life style. *J Intern Med*, 232(2), 103-17.

103. Office of Nutrition Policy and Promotion. (2007). *Canadian Community Health Survey, Cycle 2.2, Nutrition – Income-related household food security in Canada*. Retrieved January 18, 2010 from www.hc-sc.gc.ca/fn-an/surveill/nutrition/commun/index_e.html
104. Ontario Ministry of Education. (2009). *The Ontario Curriculum*. Retrieved January 18, 2010 from <http://www.edu.gov.on.ca/eng/curriculum/elementary/grades.html>
105. Ontario Ministry of Education. (2010). *Appendix: Nutrition Standards for Ontario Schools*. Retrieved January 22, 2010 from <http://www.edu.gov.on.ca/extra/eng/ppm/150.html>
106. Ontario Society of Nutrition Professionals in Public Health School Nutrition Workgroup Steering Committee. (2004). Call to action: creating a healthy school nutrition environment. Retrieved June 9, 2009 from <http://www.osnp-ph.on.ca/resources/index.php>.
107. Oster RT & Toth EL. (2009). Differences in the prevalence of diabetes risk-factors among First Nations, Metis and non-Aboriginal adults attending screening clinics in rural Alberta, Canada. *Rural Remote Health, 9(2)*, 1170.
108. Paradis S. (2007). *Kashechewan First Nation to get portable classrooms before new school is built*. Retrieved January 25, 2010 from <http://media.knet.ca/node/2919>
109. Pereira MA & Ludwig DS. (2001). Dietary fiber and body-weight regulation. Observations and mechanisms. *Pediatr Clin North Am, 48(4)*, 969-80.
110. Perez-Rodrigo C & Aranceta J. (2003). Nutrition education in schools: experiences and challenges. *Eur J Clin Nutr, 57(Suppl 1)*, S82-S85.
111. Perez-Rodrigo C & Aranceta J. (2001). School-based nutrition education: lessons learned and new perspectives. *Public Health Nutr, 4(1A)*, 131-139.
112. Pollex RL, Hanley AJG, Zinman B, Harris SB, Khan HMR & Hegele RA. (2005). Metabolic syndrome in aboriginal Canadians: prevalence and genetic associations. *Atherosclerosis, 184(1)*, 121-9.
113. Power E. (2005). Individual and household food insecurity in Canada: position of the Dietitians of Canada. *Can J Diet Pract Res, 66(1)*, 43-6.
114. Power EM. (2008). Conceptualizing Food Security for Aboriginal People in Canada. *Can J Public Health, 99(2)*, 95-7.
115. Probst YC & Tapsell LC. (2005). Overview of computerized dietary assessment programs for research and practice in nutrition education. *J Nutr Educ Behav, 37(1)*, 20-6.
116. Public Health Agency of Canada. (2009). *Obesity in Canada – Snapshot*. Retrieved July 20, 2010 from <http://www.phac-aspc.gc.ca/publicat/2009/oc/index-eng.php#tot>.
117. Receveur O, Morou K, Gray-Donald K & Macaulay AC. (2008). Consumption of key food items is associated with excess weight among elementary-school-aged children in a Canadian First Nations community. *J Am Diet Assoc, 108(2)*, 362-6.
118. Rodrigues S, Robinson E & Gray-Donald K. (1999). Prevalence of gestational diabetes mellitus among James Bay Cree women in northern Quebec. *CMAJ, 160(9)*, 1293-7.
119. Sanders BH, Lubsch LM & West DS. (2006). Prevalence and treatment of metabolic syndrome in adolescents with type 2 diabetes. *Ann Pharmacother, 40(9)*, 1517-21.

120. Sharma M, Wagner DI & Wilkerson J. (2006). Predicting childhood obesity prevention behaviors using social cognitive theory. *Int Q Community Health Educ*, 24(3), 191-203.
121. Shields M. (2005). Nutrition: Findings from the Canadian Community Health Survey – overweight Canadian children and adolescents. *Statistics Canada*, 82-620-MWE(1), 2-34.
122. Shields M & Tjepkema M. (2006). Trends in adult obesity. *Health Rep*, 17(3), 53-9.
123. Singh AS, Mulder C, Twisk JWR, van Mechelen W & Chinapaw MJM. (2008). Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obes Rev*, 9(5), 474-486.
124. Skinner K, Hanning RM & Tsuji LJS. (2006). Barriers and supports for healthy eating and physical activity for First Nation youths in northern Canada. *Int J Circumpolar Health*, 65(2), 148-61.
125. Statistics Canada. (2008a). *2006 Census: Aboriginal Peoples in Canada in 2006: Inuit, Metis and First Nations, 2006 Census: Highlights*. Retrieved January 12, 2010, from <http://www.statcan.gc.ca/bsolc/olc-cel/olc-cel?lang=eng&catno=97-558-X2006001>
126. Statistics Canada. (2008b). *Aboriginal peoples*. Retrieved January 12, 2010, from http://www41.statcan.ca/2008/10000/ceb10000_000_e.htm
127. Statistics Canada. (2010). *Overview of Canadians' Eating Habits (Nutrition: Findings from the Canadian Community Health Survey)*. Retrieved July 21, 2010 from [http://www.statcan.gc.ca/cgi-bin/af-fdr.cgi?!=eng&loc=http://www.statcan.gc.ca/pub/82-620-m/82-620-m2006002-eng.pdf&t=Overview%20of%20Canadians%20Eating%20Habits%20\(Nutrition:%20%20Findings%20from%20the%20Canadian%20Community%20Health%20Survey\)](http://www.statcan.gc.ca/cgi-bin/af-fdr.cgi?!=eng&loc=http://www.statcan.gc.ca/pub/82-620-m/82-620-m2006002-eng.pdf&t=Overview%20of%20Canadians%20Eating%20Habits%20(Nutrition:%20%20Findings%20from%20the%20Canadian%20Community%20Health%20Survey))
128. Storey KE, Forbes LE, Fraser SN, Spence JC, Plotnikoff RC & Raine KD et al. (2009). Diet quality, nutrition and physical activity among adolescents: the Web-SPAN (Web-Survey of Physical Activity and Nutrition) project. *Public Health Nutr*, 12(11), 2009-17.
129. Story M, Kaphingst KM & French S. (2006). The role of schools in obesity prevention. *The Future of Children*, 16(1), 109-142.
130. Story M, Stevens J, Himes J, Stone E, Rock BH & Ethelbah B et al. (2003). Obesity in American-Indian children: prevalence, consequences and prevention. *Prev Med*, 37(6 Pt 2), S3-12.
131. Taylor JP, Evers S & McKenna M. (2005). Determinants of healthy eating in children and youth. *Can J Public Health*, 96(Suppl 3), S20-S26.
132. Thommassen HV, Patenaude J, Anderson N, McArthur A & Tildesley H. (2004). Differences in diabetic co-morbidity between Aboriginal and non-Aboriginal people living in Bella Coola, Canada. *Rural Remote Health*, 4(4), 319.
133. Thompson PL, Bradshaw PJ, Veroni M & Wilkes ET. (2003). Cardiovascular risk among urban Aboriginal people. *Med J Aust*, 179(3), 143-6.
134. Tjepkema M. (2006). Adult obesity. *Health Rep*, 17(3), 9-25.
135. Tremblay MS, Perez CE, Ardern CI, Bryan SN & Katzmarzyk PT. (2005). Obesity, overweight and ethnicity. *Health Rep*, 16(4), 23-34.
136. United States Department of Agriculture. (2009). *5-Step Multiple-Pass Approach*. Retrieved January 28, 2010 from <http://www.ars.usda.gov/Services/docs.htm?docid=7711>

137. Vanasse A, Demers M, Hemiari A, Courteau J. (2006). Obesity in Canada: where and how many? *Int J Obes (Lond)*, 30(4), 677-83.
138. Van Cauwenbergh E, Maes L, Spittaels H, van Lenthe FJ, Brug J & Oppert JM et al. (2010). Effectiveness of school-based interventions in Europe to promote healthy nutrition in children and adolescents: systematic review of published and 'grey' literature. *Br J Nutr*, 103(6), 781-97.
139. Veugelers PJ & Fitzgerald AL. (2005). Effectiveness of school programs in preventing childhood obesity: a multilevel comparison. *Am J Public Health*, 95, 432-435.
140. Waldram JB, Herring DA, Young TK. (2006). Aboriginal health in Canada: Historical, cultural and epidemiological perspectives. 2nd Ed. Toronto: University of Toronto Press.
141. Wang Z & Hoy WE. (2004). Waist circumference, body mass index, hip circumference and waist-to-hip ratio as predictors of cardiovascular disease in Aboriginal people. *Eur J Clin Nutr*, 56(6), 888-93.
142. Wang Z & Hoy WE. (2004a). Association between diabetes and coronary heart disease in Aboriginal people: are women disadvantaged? *Med J Aust*, 180(10), 508-11.
143. Wang Z & Hoy WE. (2004b). Body size measurements as predictors of type 2 diabetes in Aboriginal people. *Int J Obes Relat Metab Disord*, 28(12), 1580-4.
144. Wang Z & Hoy WE. (2004c). Waist circumference, body mass index, hip circumference and waist-to-hip ratio as predictors of cardiovascular disease in Aboriginal people. *Eur J Clin Nutr*, 58(6), 888-93.
145. Watts K, Bell LM, Byrne SM, Jones TW & Davis E. (2008). Waist circumference predicts cardiovascular risk in young Australian children. *J Paediatr Child Health*, 44(12), 709-15.
146. Whitney E & Rady Rolfes, S. (2008). *Understanding Nutrition*. Belmont, California: Thomson Wadsworth.
147. Willett WC, Howe GR, Lawrence HK. (1997). Adjustment for total energy intake in epidemiologic studies. *Am J Clin Nutr*, 65(Suppl), 1220-8S.
148. Willows ND, Veugelers P, Raine K & Kuhle S. (2008). Prevalence and sociodemographic risk factors related to household food security in Aboriginal peoples in Canada. *Public Health Nutr*, 12(8), 1150-6.
149. Willows ND. (2005a). Determinants of healthy eating in Aboriginal peoples in Canada: the current state of knowledge and research gaps. *Can J Public Health*, 96(Suppl 3), S36-41.
150. Willows ND. (2005b). Overweight in Aboriginal children: prevalence, implications and solutions. *J Aboriginal Health*, 2, 76-85.
151. Woodruff SJ & Hanning RM. (2008). Associations between family dinner frequency and specific food behaviors among grade six, seven, and eight students from Ontario and Nova Scotia. *J Adolesc Health*, 44(5), 431-6.
152. World Food Summit. (1996). World Food Summit Plan of Action. Retrieved July 20, 2010 from http://www.fao.org/wfs/index_en.htm.
153. World Health Organization. (2000). Obesity: preventing and managing a global epidemic: report of a WHO consultation. *WHO Technical Report Series 894*, Geneva.
154. World Health Organization. (2004). Global strategy on diet, physical activity and health. Retrieved May 22, 2009 from <http://www.who.int/dietphysicalactivity/strategy/eb11344/en/index.html>.

155. World Health Organization. (2008). School policy framework: implementation of the WHO global strategy on diet, physical activity and health. Retrieved on May 22, 2009, <http://www.who.int/dietphysicalactivity/schools/en/>.
156. Young T, Reading J, Elias B & O'Neil J. (2000). Type-2 diabetes in Canada's first nations: status of an epidemic in progress. *CMAJ*, 163(9), 561-6.
157. Young T. (2003). Review of research on aboriginal populations in Canada: relevance to their health needs. *BMJ*, 327(7412), 419-22.
158. Young TK & Sevenhuysen G. (1989). Obesity in northern Canadian Indians: patterns, determinants, and consequences. *Am J Clin Nutr*, 49(5), 786-93.
159. Young TK, Marens PJ, Taback SP, Sellers EA, Dean HJ & Cheang M et al. (2002). Type 2 diabetes mellitus in children: prenatal and early infancy risk factors among Native Canadians. *Arch Pediatr Adolesc Med*, 156(7), 651-5.
160. Young TK, Sevenhuysen G, Ling N & Moffatt M. (1990). Determinants of plasma glucose levels and diabetic status in a northern Canadian Indian population. *Can Med Assoc J*, 142(8), 821-30.
161. Yu CHY & Zinman B. (2007). Type 2 diabetes and impaired glucose tolerance in aboriginal populations: a global perspective. *Diabetes Res Clin Pract*, 78(2), 15

Appendices

Appendix A: Datasets Used for Each Objective

Objective	Att Feb 06 W	Att Feb 10 W	CI Nov 03 F	CI Oct 04 F	FA Nov 04 F	FA May 05 Sp	FA July 05 Su	FA Dec 07 W	FA June 09 Sp	FA June 10 Sp	GI Dec 03 W	Kash May 09 Sp	Kash June 09 Sp	Kash Oct 09 F	Kash May 10 Sp	MF Feb 07 W	P Dec 05 W	P June 10 Sp
CHAPTER 4																		
1	X	X		X	X			X			X	X				X	X	X
2a	X	X	X	X		X			X			X			X			
2b	X			X	X			X	X			X				X	X	
3	X	X		X	X			X			X	X				X	X	X
CHAPTER 5																		
1												X	X		X			
CHAPTER 6																		
1									X	X								
2*										X								

Legend to Appendix A:

Communities: **Att:** Attawapiskat; **CI:** Christian Island; **FA:** Fort Albany; **GI:** Georgina Island; **Kash:**

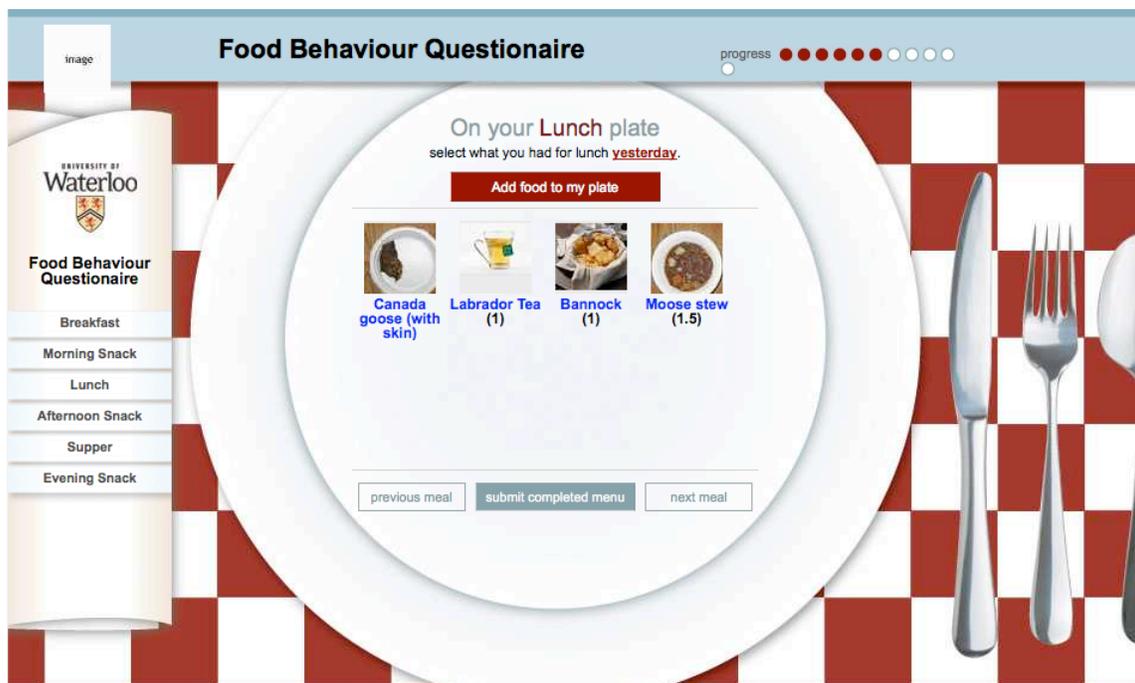
Kashechewan; **MF:** Moose Factory; **P:** Peawanuck

Seasons: **W:** Winter; **F:** Fall; **Sp:** Spring; **Su:** Summer

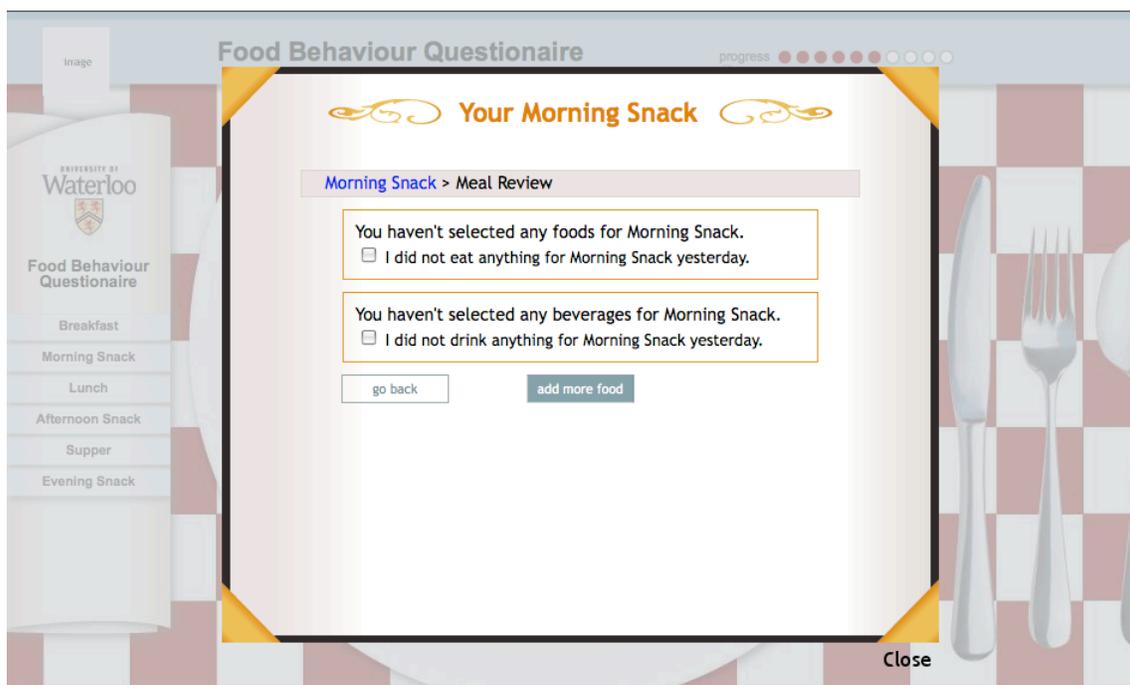
*Collection included only the KSIQ and not the WEB-Q

Appendix B: Web-Based Eating Behaviour Questionnaire Screen Shots

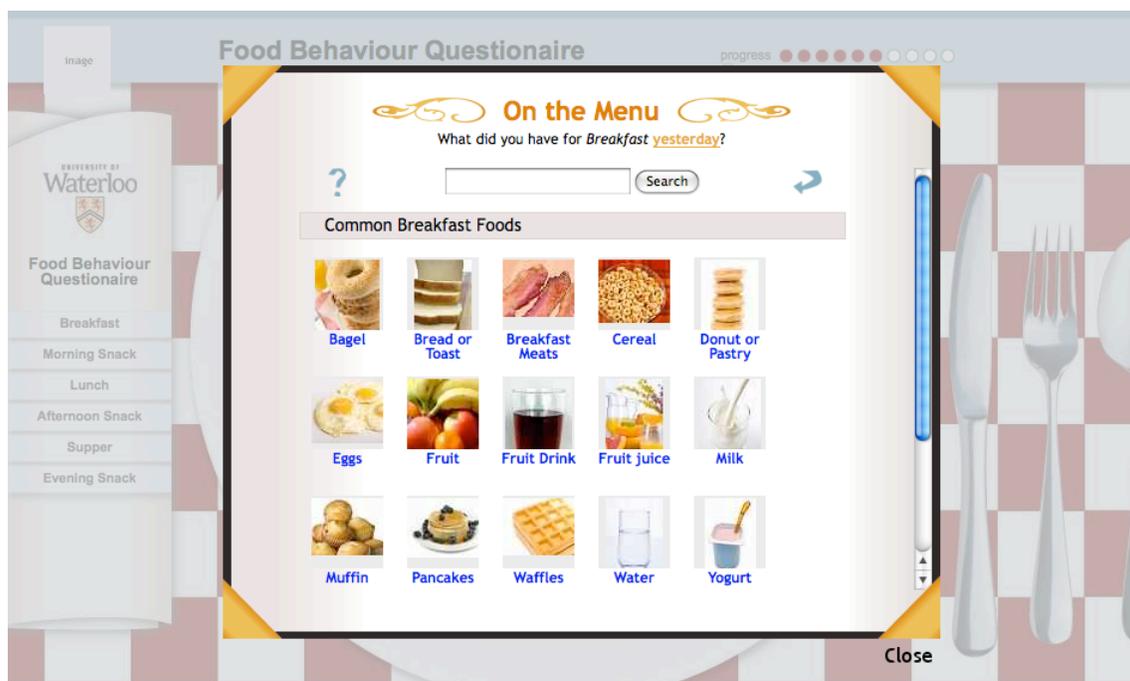
Screen shot I: Example of 24-hour recall, including traditional foods



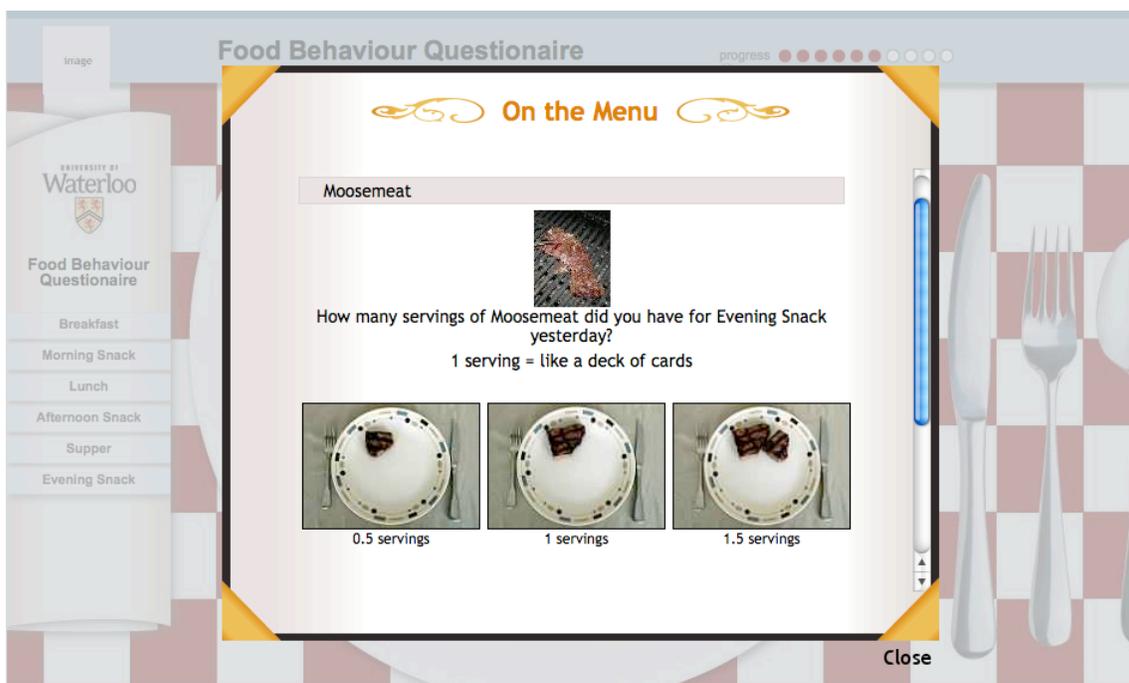
Screen shot II: Example of prompts, mimicking the multiple-pass method



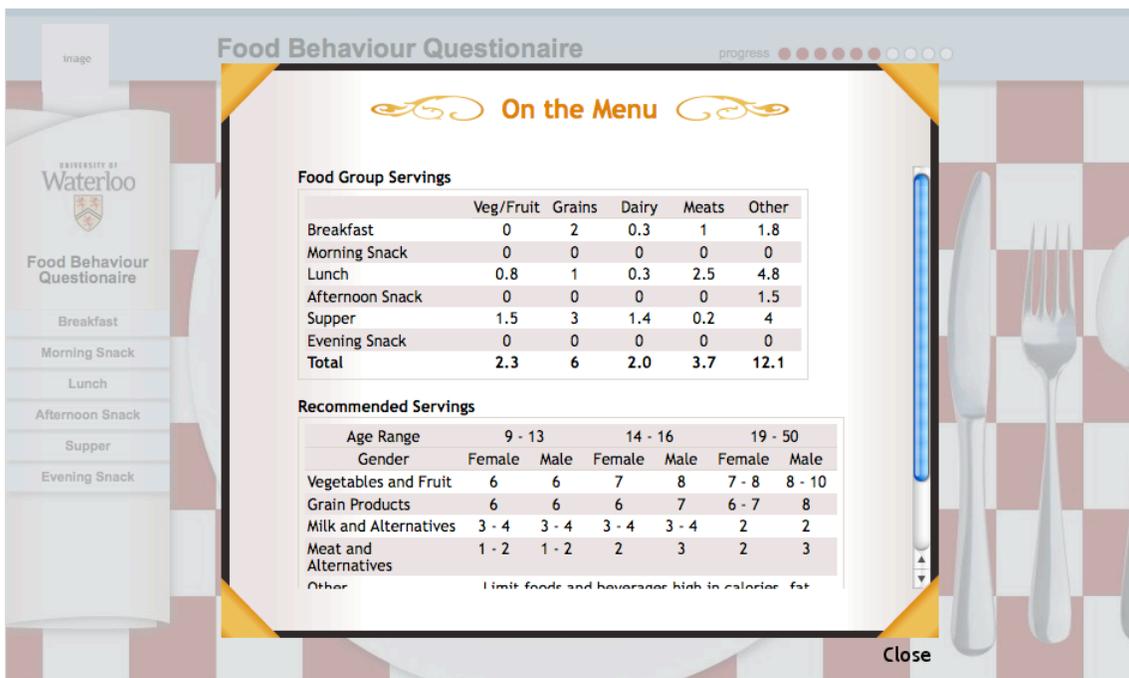
Screen shot III: Example of food selection for 24-hour recall



Screen shot IV: Example of serving size selection, including traditional foods



Screen shot V: Example of summary page, educational/interactive component



Appendix C: Sample Parent Information/Consent Letters

Dear Parent or Guardian:

Your child will be participating in a nutrition educational program at Peetabeck Academy that is given in conjunction with the breakfast/snack program. This nutrition educational program is being implemented by Professors Len Tsuji and Rhona Hanning of the University of Waterloo in partnership with the Mundo Peetabeck Education Authority. The program consists of educational modules that take approximately 8 weeks to complete and will focus on the benefits of fruits and vegetables, as well as milk products (the power 4 bones program). Your child will also have the opportunity to learn about a healthy diet, the importance of physical activity and taste a variety of different fruits and vegetables in the classroom.

If there are any health concerns, such as, **food allergies**, the student does not have to participate in the tasting portion of the program. Please notify the school of any food allergy.

The objective of the program is to increase the student's knowledge of nutrition with respect to fruits, vegetables, and calcium/vitamin D containing foods; as well as improve the student's intake of the related nutrients. A pre- and post-confidential evaluation of your child's current knowledge of nutrition will be done before and after participating in the nutrition educational program. There is no risk to your child. The information gathered from these evaluations will help to determine the effectiveness of the nutrition educational program. The end goal is to improve the health of the schoolchildren by not only offering healthy foods for breakfast and snacks at school, but also through teaching the schoolchildren the reasons why healthy eating is important.

The nutrition educational program is part of the school's breakfast/snack initiative and will:

- require a half-an-hour, 1-2 times a week
- take place within the classroom
- involve a number of fun activities, such as, games and drawings
- teach students about the nutrients from healthy foods and why these foods are considered a healthy choice
- give the students an opportunity to try new healthy foods.

The nutrition educational program will only include students from K to grade 8. If you have any questions or would like further information please contact any of the following team members listed below.

Thank you for your time.

Contact Information

Dr. Len Tsuji
Professor of Environment and Health
University of Waterloo
519-888-4567 x32762
ltsuji@uwaterloo.ca

Andrea Isogai
Nutrition Educational Program Coordinator
278-3393 or 278-3340
University of Waterloo
adisogai@uwaterloo.ca

Dr. Rhona Hanning
Associate Professor of Nutrition
Population Health Research Group
University of Waterloo
519-888-4567 x35685
rhanning@uwaterloo.ca

Dear Parent or Guardian,

Professors Rhona Hanning and Len Tsuji of the University of Waterloo are working with Ruby Edwards-Wheesk (Attawapiskat Health Services), the Attawapiskat First Nation Education Authority, and J.R. Nakogee Elementary School in partnership to understand children's food behaviour and physical activity patterns, and different aspects of the school snack program. We would like to provide you with some information about the school survey we are conducting.

An internet survey from the University of Waterloo has been developed for grade 6 to 8 students through ongoing consultation with members of your community. The children would use the computer at J.R. Nakogee Elementary School and complete a 45-minute survey about their eating and physical activity habits, and school snack program. This internet computer survey is CONFIDENTIAL. Your child is given a number and not identified by name on the survey. Your child will have the opportunity to have their height and weight measured by a research team member. Height and weight measurements will be taken in privacy, and only the student will be told their height and weight. No records of height and weight measurements will be kept, other than that recorded on the anonymous web-survey. Once the surveys are completed, the information goes to the University of Waterloo where the data are summarized. Dr. Len Tsuji (or another member of the research team) will then bring a report to Attawapiskat Health Services, Attawapiskat First Nation Education Authority, and J.R. Nakogee Elementary School and give a presentation. The results will help your school and community to identify issues and seek additional funding to enhance community programs for healthy eating and activity.

This survey has been used with students across the Mushkegowuk Territory (Moose Factory, Fort Albany, Kashechewan, Peawanuck, and once before in Attawapiskat).

The survey will:

- Take one class period to complete; The survey will be completed at a time deemed appropriate for the teacher
- Ask the student participant to recall what s/he ate on the previous day; the student may omit questions or withdraw from participation at any time during the survey
- Provide immediate feedback on the student's diet when s/he finishes the survey

The survey is confidential

- The survey is completely confidential and poses no risk to your child
- Each student will have a unique ID and password and is not identified by name; only the university researchers will have access to individual surveys
- Results are published in group format; no individual results are shared
- Information will be stored in locked computer files
- These computers are located in locked offices at the Population Health Research Group, University of Waterloo.
- The data will be permanently stored on CD in electronic form.

What if you change your mind about your child's participation?

- The final decision to participate in this survey must be made by the student and the parent(s) or guardian(s). Your cooperation in permitting your child to take part in this is greatly appreciated. However, participation is voluntary and there is no penalty if your child does not participate.
- **If you and your child agree now to participate, but either of you change your minds later, your child can be withdrawn from the survey at any time, before submitting responses.**

- A student will not be included in the study if a parent or guardian indicates that he or she does not want the student to participate, or if the student does not agree to take part. Students not participating will remain in their classroom with their teacher and participate in normal classroom activities.
- If you do NOT want your son or daughter to participate, please contact Ruby Edwards-Wheesk, Supervisor, Attawapiskat Health Centre at 997-2149.
- If we have not been contacted we will assume that you are permitting your son or daughter to participate.

The survey is only for children Grade 6, 7, and 8, so it will not involve children in JK to Grade 5.

Along with health services approval, this project has also been reviewed by and received ethics clearance through the Office of Research Ethics at the University of Waterloo. If you have any questions or concerns about your child's participation in this study, please contact Dr. Susan Sykes in the Office of Research Ethics at 519-888-4567 ext. 36005.

Should you have any further questions, please do not hesitate to contact one of the team members below.

Thank you very much for your time.

Ruby Edwards-Wheesk
Supervisor
Attawapiskat Health Centre
997-2149

Dr. Rhona Hanning
Associate Professor of Nutrition
University of Waterloo
519-888-4567 x35685
rhanning@uwaterloo.ca

Dr. Len Tsuji
Professor of Environment and Health
University of Waterloo
519-888-4567 x32762
ltsuji@uwaterloo.ca

Michelle Gates & Allison Gates
MSc Candidates
University of Waterloo
519-772-8686
m2gates@uwaterloo.ca, agates@uwaterloo.ca

Appendix D: Program Nutrition Policy and Shopping Guidelines

Snack Program Guidelines for a Healthy School Environment

A Few Simple Rules:

- The **healthiest choices** should be served at least 80% of the time (4 days out of 5).
- **Less healthy choices** should be limited to being served once a week.
- Use **Nutrition Fact labels** on foods along with these guidelines to help you make healthy choices.

Food Group	Healthiest (at least 80%)	Less Healthy (at most 20%)	DO NOT SERVE
Vegetables & Fruit (1 item per day)			
Vegetables & Fruit	<ul style="list-style-type: none"> • Fresh vegetables & fruit • Canned fruit packed in its own juice or light syrup, unsweetened • Unsweetened applesauce • 100% unsweetened fruit juice • Dried fruits (raisins, apricots, etc.) or fruit leather <p>**On the package/label</p> <ul style="list-style-type: none"> • Vegetables or fruit should be the first ingredient and • Fat $\leq 3g$ and sodium ≤ 360 mg 	<ul style="list-style-type: none"> • Canned fruit in syrup • Low sodium vegetable/tomato juice • Salsa <p>**On the package/label</p> <ul style="list-style-type: none"> • Vegetables or fruit should be the first ingredient and • Fat $\leq 5g$ and saturated fat $\leq 2g$ and sodium ≤ 480 mg 	<ul style="list-style-type: none"> • Fruit drinks, cocktails, punches, "ades", or powders • Sweetened applesauce • Fruit roll-ups, fruit by the foot, fruit flavored gummies • Fruit or vegetable chips <p>**On the package/label</p> <ul style="list-style-type: none"> • Vegetables or fruit are not the first ingredient or • Sugar is one of the first ingredients or

			Fat $>5g$ or saturated fat $>2g$ or sodium >480 mg
Grain Products (optional)			
Breads	<ul style="list-style-type: none"> • Whole grain bread, buns, bagels, English muffins, pitas, or bannock <p>**On the package/label</p> <ul style="list-style-type: none"> • Whole grain is the first item on the ingredient list and • Saturated fat $\leq 2g$ and sodium ≤ 240 mg and fibre $\geq 2g$ 	<ul style="list-style-type: none"> • Enriched white bread, buns, bagels, English muffins, pitas, or bannock <p>**On the package/label</p> <ul style="list-style-type: none"> • Saturated fat $\leq 2g$ and sodium ≤ 480 mg 	<ul style="list-style-type: none"> • White breads that are higher in fat or sodium – cheese breads, scones, biscuits <p>**On the package/label</p> <ul style="list-style-type: none"> • Saturated fat $>2g$ or sodium >480 mg
Baked Goods	<ul style="list-style-type: none"> • Whole grain muffins (bran or oat or whole wheat or cornmeal), high-fibre cereal bars or snacks <p>**On the package/label</p> <ul style="list-style-type: none"> • Fat $\leq 5g$ and saturated fat $\leq 2g$ and fibre $\geq 2g$ 	<ul style="list-style-type: none"> • Some whole grain muffins or fruit loaves (banana, blueberry etc.) and high-fibre cereal bars or snacks <p>**On the package/label</p> <ul style="list-style-type: none"> • Fat $\leq 10g$ and saturated fat $\leq 2g$ and fibre $\geq 2g$ 	<ul style="list-style-type: none"> • Croissants, danishes, cakes, cupcakes, doughnuts, pies, turnovers, pastries, cookies, squares, tarts, cinnamon rolls, pop tarts, muffins that are not whole grain, etc. <p>**On the package/label</p> <ul style="list-style-type: none"> • Fat $>10g$ or saturated fat $>2g$ or fibre $<2g$
Grain-Based Snacks	<ul style="list-style-type: none"> • Some whole grain crackers, plain unsalted 	<ul style="list-style-type: none"> • Some crackers, popcorn, or pretzels 	<ul style="list-style-type: none"> • High-fat crackers or pretzels, buttered popcorn,

	popcorn or pretzels		or snacks high in sodium, corn chips, snack mixes
	**On the package/label <ul style="list-style-type: none"> Fat $\leq 3g$ and saturated fat $\leq 2g$ and sodium ≤ 240 mg 	**On the package/label <ul style="list-style-type: none"> Fat $\leq 5g$ and saturated fat $\leq 2g$ and sodium ≤ 480 mg 	**On the package/label <ul style="list-style-type: none"> Fat $> 5g$ or saturated fat $> 2g$ or sodium > 480 mg
Cereals	<ul style="list-style-type: none"> Whole grain, high-fibre cereals **On the package/label <ul style="list-style-type: none"> Whole grain is the first item on the ingredient list and Saturated fat $\leq 2g$ and fibre $\geq 2g$ 	<ul style="list-style-type: none"> Some whole grain flake or crisp type cereals (corn flakes, rice krispies etc.), not sugar-coated **On the package/label <ul style="list-style-type: none"> Whole grain is the first item on the ingredient list and Saturated fat $\leq 2g$ 	<ul style="list-style-type: none"> Sugar-coated cereals or granola. **On the package/label <ul style="list-style-type: none"> Whole grain is not the first item on the ingredient list or Saturated fat $> 2g$ or fibre $< 2g$
Milk & Alternatives (1 item per day)			
Milk	<ul style="list-style-type: none"> White, chocolate, or flavored milk with 2% MF or less, fresh or UHT or evaporated 	<ul style="list-style-type: none"> Homogenized (3.25% MF) milk, fresh, UHT, or evaporated 	<ul style="list-style-type: none"> Milkshakes, cream-based beverages
Yogurt, custards, puddings	<ul style="list-style-type: none"> Plain or fruit yogurt, yogurt tubes, yogurt drinks (Yop), Minigo 		<ul style="list-style-type: none"> Custard, pudding, higher fat yogurts (Balkan)

	**On the package/label <ul style="list-style-type: none"> Fat $\leq 3.25\%$ MF or $\leq 3g$ 		**On the package/label <ul style="list-style-type: none"> Sugar is one of the first ingredients or Fat $> 3.25\%$ MF or $> 3g$
Cheese	<ul style="list-style-type: none"> Lower fat and sodium cheeses and cheese strings, including part-skim mozzarella, light cheddar. **On the package/label <ul style="list-style-type: none"> Fat $\leq 20\%$ MF and sodium ≤ 360 mg and calcium $\geq 20\%$ Daily Value 	<ul style="list-style-type: none"> Most hard and soft non-processed cheese and cheese strings, including cheddar, mozzarella, brick, Monterey jack, havarti, gouda etc. **On the package/label <ul style="list-style-type: none"> Fat $> 20\%$ MF Sodium ≤ 480 mg and calcium $\geq 15\%$ Daily Value 	<ul style="list-style-type: none"> Processed cheese slices, cheez whiz, cream cheese **On the package/label <ul style="list-style-type: none"> Fat $> 20\%$ MF Sodium > 480 mg or calcium $< 5\%$ Daily Value
Meat & Alternatives (optional)			
Nuts & Seeds	<ul style="list-style-type: none"> Preferably unsalted peanuts, almonds, walnuts, sunflower seeds, peanut butter, etc. **On the package/label <ul style="list-style-type: none"> Not coated with candy, 		<ul style="list-style-type: none"> Coated with chocolate, candy, sugar, and/or yogurt; Nutella or other chocolate spreads; sesame snaps; nut brittles; oil roasted, salted, or flavored nuts. **On the package/label <ul style="list-style-type: none"> Coated with candy,

	chocolate, sugar, or yogurt and • Sodium ≤480 mg		chocolate, sugar, or yogurt or • Sodium >480 mg
Other Foods (use sparingly)			
Spreads, condiments, miscellaneous food items		• Low fat salad dressings or dips	<ul style="list-style-type: none"> • Butter, jam, jelly, syrup, honey • Soft drinks and diet soft drinks • Sports drinks and energy drinks • Marshmallows or marshmallow spread • Chocolate, candies, or chips • Jell-o • Full fat salad dressings or dips • Coffee, tea

Adapted by Allison & Michelle Gates from:

Ontario Ministry of Education. (2010). *Nutrition Standards for Ontario Schools*. Retrieved January 2010 from <http://www.edu.gov.on.ca/extra/eng/ppm/150.htm>.

Ontario Society of Nutrition Professionals in Public Health School Nutrition Workgroup Steering Committee. (2004). *Call to action: creating a healthy school nutrition environment*. Retrieved June 2009 from http://www.osnpph.on.ca/pdfs/call_to_action.pdf.

Sample Shopping List Using Snack Program Guidelines for a Healthy School Environment

The following are examples of foods that fit into the Snack Program Guidelines for a Healthy School Environment. However, any food that fits the criteria is acceptable.

Food Group	Healthiest (at least 80%)	Less Healthy (at most 20%)	DO NOT SERVE
Vegetables & Fruit (1 item per day)			
Vegetables & Fruit	<ul style="list-style-type: none"> • Small box raisins • Apples • Bananas • Oranges • ½ cup grapes (palm sized) • 4 dried apricot halves • Celery sticks • Baby carrots • Green or red peppers • Any brand of unsweetened applesauce or applesauce blend – check the labels • Sun-Rype Fruitsource bars • Any brand of canned fruits in their own juice or light syrup – check the labels • 100% fruit juice – make sure 	<ul style="list-style-type: none"> • Any salsa • Reduced sodium versions of vegetable or tomato juices – check the labels • Any brand of canned fruit in syrup 	<ul style="list-style-type: none"> • Fruit drinks, cocktails, punches, “ades”, or powders – check the labels for sugar, glucose, fructose, sucrose, or syrups in the ingredient list • Sweetened applesauce – check for no-sugar added versions • Fruit roll-ups, fruit by the foot, fruit flavored gummies – make sure fruits are the first ingredient • Fruit or vegetable chips

	there is no sugar added in the ingredient list		
Grain Products (optional)			
Breads	<ul style="list-style-type: none"> • Whole grain bread, buns, bagels, English muffins, pitas, or bannock 	<ul style="list-style-type: none"> • Enriched white bread, buns, bagels, English muffins, pitas, or bannock 	<ul style="list-style-type: none"> • White breads that are higher in fat or sodium – cheese breads, scones, biscuits
Baked Goods	<ul style="list-style-type: none"> • Small whole grain muffins (bran or oat or whole wheat or cornmeal) • Nature Valley Fibresource bars • All-Bran Chewy Bars (Chewy variety only) 	<ul style="list-style-type: none"> • All-Bran bars (not the chewy) or bites • Nature Valley Crunchy granola bars • Quaker Oatmeal-to-Go squares • Kellogg’s NutriGrain bars 	<ul style="list-style-type: none"> • Croissants, danishes, cakes, cupcakes, doughnuts, pies, turnovers, pastries, cookies, squares, tarts, cinnamon rolls, pop tarts, muffins that are not whole grain, etc. • Any Quaker Chewy or Dipp’s granola bars • Any chocolate coated granola bars • Kellogg’s Special K cereal bars • Fig Newtons
Grain-Based Snacks	<ul style="list-style-type: none"> • Red Oval Farms Stoned Wheat Thins • Premium Plus whole wheat or multigrain crackers • Whole wheat or 12-grain Melba Toast • Plain rice cakes or rice 	<ul style="list-style-type: none"> • Nabisco Wheat Thins • Plain Melba Toast • Triscuit crackers • Honey Maid honey flavoured graham crackers 	<ul style="list-style-type: none"> • Chocolate coated rice snacks • Any Breton crackers • Any Ritz crackers or other butter crackers • Cheese Nips, most cheese crackers

	snacks • Honey Maid low-fat honey flavoured graham crackers		
Cereals	• All-Bran • Fibre-One • Cheerios • Multi-Grain Cheerios • Quaker Corn Bran • Quaker Oatmeal Squares • Quaker Life cereal • Raisin Bran	• Puffed wheat or rice • Rice Krispies • Corn Flakes • Special K • Chispix	• Corn Pops • Lucky Charms • Reese Puffs • Honey Grahams • Cinnamon Toast Crunch • Flavoured Cheerios • Frosted Flakes • Granola • etc...
Milk & Alternatives (1 item per day)			
Milk	• White, chocolate, or flavored milk with 2% MF or less, fresh or UHT or evaporated	• Homogenized (3.25% MF) milk, fresh, UHT, or evaporated	• Milkshakes, cream-based beverages
Yogurt, custards, puddings	• GoGurt tubes • Minigo • Yop • Most 100g yogurts – check the labels for %MF		• Liberte Mediterranean yogurt • Any Balkan-style yogurt • Check labels for %MF
Cheese	• Most low fat, part-skim cheeses – check the labels	• Cheese strings (check labels) • Most Black Diamond and Kraft cheeses – check labels for other brands	• Cheez Whiz • Velveta • Any processed cheese slices/products • Any cream cheese

Meat & Alternatives (optional)			
Nuts & Seeds	• Any nuts, preferably unsalted • Regular peanut butter		• Oil roasted or flavoured nuts • Honey roasted nuts • Chocolate, candy, yogurt or sugar coated nuts • Nutella and other chocolate nut spreads • Sesame snaps • Nut brittles
Other Foods (use sparingly)			
Spreads, condiments, miscellaneous food items		• Low fat salad dressings or dips	• Butter, jam, jelly, syrup, honey • Soft drinks and diet soft drinks • Sports drinks and energy drinks • Marshmallows or marshmallow spread • Chocolate, candies, or chips • Jell-o • Full fat salad dressings or dips • Coffee, tea

Allison & Michelle Gates, 2010

Appendix E: Student Handouts

Handout I: Eating Well with Canada's Food Guide for First Nations, Inuit, and Métis (Week 1)

Health Canada Santé Canada
Your health and safety... our priority. Votre santé et votre sécurité... notre priorité.

Eating Well with Canada's Food Guide First Nations, Inuit and Métis

The diagram is a circular food guide divided into four colored segments: green (vegetables and fruits), yellow (grains), blue (milk and alternatives), and red (protein). Each segment contains illustrations of food items and traditional activities. The center features a circular illustration of people in traditional dress engaged in various activities like hunting, fishing, and preparing food.

Canada

How to use Canada's Food Guide

The Food Guide shows how many servings to choose from each food group every day and how much food makes a serving.

Recommended Number of Food Guide Servings per day			
Children 2-3 years old	Children 4-13 years old	Teens and Adults (Men/Women)	
4	5-6	7-8	7-10

Vegetables and Fruit Fresh, frozen and canned.	4	5-6	7-8	7-10
Grain Products	3	4-6	6-7	7-8
Milk and Alternatives	2	2-4	Teens Adults (16-19 years) 3 Adults (20-64 years) 3	Teens Adults (16-19 years) 3 Adults (20-64 years) 3
Meat and Alternatives	1	1-2	2	3

1. Find your age and sex group in the chart below.
2. Follow down the column to the number of servings you need for each of the four food groups every day.
3. Look at the examples of the amount of food that counts as one serving. For instance, 125 mL (½ cup) of carrots is one serving in the Vegetables and Fruit food group.

What is one Food Guide Serving?
Look at the examples below.

Eating Well Every Day
Canada's Food Guide describes healthy eating for Canadians two years of age or older. Choosing the amount and type of food recommended in Canada's Food Guide will help:

- children and teens grow and thrive
- meet your needs for vitamins, minerals and other nutrients
- lower your risk of obesity, type 2 diabetes, heart disease, certain types of cancer and osteoporosis (weak and brittle bones).

Vegetables and Fruit: Eat at least one dark green and one orange vegetable each day. Choose vegetables and fruit prepared with little or no added fat, sugar or salt. Use vegetables and fruit more often than juices.

Grain Products: Make at least half of your grain products whole grain each day. Choose grain products that are lower in fat, sugar or salt.

Milk and Alternatives: Drink 500 mL (2 cups) of skim, 1% or 2% milk each day. Select lower fat milk alternatives. Drink fortified soy beverages if you do not drink milk.

Meat and Alternatives: Have meat alternatives such as beans, lentils and tofu often. Eat at least two Food Guide servings of fish each week.* Select lean meat and alternatives prepared with little or no added fat or salt.

When cooking or adding fat to food:

- Most of the time, use vegetable oils with unsaturated fats. These include canola, olive and soybean oils.
- Aim for a small amount (2 to 3 tablespoons or about 30-45 mL) each day. This amount includes oil used for cooking, salad dressings, margarine and mayonnaise.
- Traditional fats that are liquid at room temperature, such as seed and whale oil, or oiligen grasses, also contain unsaturated fats. They can be used as all or part of the 2-3 tablespoons of unsaturated fats recommended per day.
- Choose soft margarines that are low in saturated and trans fats.
- Limit butter, hard margarine, lard, shortening and bacon fat.

*Health Canada provides advice for limiting exposure to mercury from certain types of fish. Refer to www.healthcanada.gc.ca for the latest information. Consult local, provincial or territorial governments for information about eating locally caught fish.

Respect your body... Your choices matter

Following Canada's Food Guide and limiting foods and drinks which contain a lot of calories, fat, sugar or salt are important ways to respect your body. Examples of foods and drinks to limit are:

- pop
- fruit flavoured drinks
- sweet drinks made from crystals
- sports and energy drinks
- candy and chocolate
- cakes, pastries, doughnuts and muffins
- granola bars and cookies
- ice cream and frozen desserts
- potato chips
- nachos and other salty snacks
- french fries
- alcohol

People who do not eat or drink milk products must plan carefully to make sure they get enough nutrients.

The traditional foods pictured here are examples of how people get, and continue to get, nutrients found in milk products. Since traditional foods are not eaten as much as in the past, people may not get these nutrients in the amounts needed for health.

People who do not eat or drink milk products need more individual advice from a health care provider.



Women of childbearing age

All women who could become pregnant, and pregnant and breastfeeding women, need a multivitamin with folic acid every day. Pregnant women should make sure that their multivitamin also contains iron. A health care provider can help you find the multivitamin that is right for you.

When pregnant and breastfeeding, women need to eat a little more. They should include an extra 2 to 3 Food Guide Servings from any of the food groups each day.

For example:

- have dry meat or fish and a small piece of bannock for a snack, or
- have an extra slice of toast at breakfast and an extra piece of cheese at lunch.

Women and men over the age of 50

The need for vitamin D increases after the age of 50.

In addition to following Canada's Food Guide, men and women over the age of 50 should take a daily vitamin D supplement of 10 µg (400 IU).

For strong body, mind and spirit, be active every day.



This guide is based on *Eating Well with Canada's Food Guide*.

For more information, interactive tools or additional copies visit Canada's Food Guide at: www.healthcanada.gc.ca/foodguide

or contact: Publications • Health Canada • Ottawa, Ontario K1A 0K7 • E-Mail: publications@hc-sc.gc.ca • Tel.: 1-866-225-0709 • TTY: 1-800-267-3245 • Fax: (613) 941-5265

Également disponible en français sous le titre : *Seu manger avec le Guide alimentaire canadien - Premières Nations, Inuit et Métis*

This publication can be made available on request on diskette, large print, audio-cassette and braille.

© Her Majesty the Queen in Right of Canada, reproduced by the Minister of Health Canada, 2007. This publication may be reproduced without permission, as changes permitted. nC.Pub: 242a. Cat.: n3-03/2007. 026: 0662-4662-7

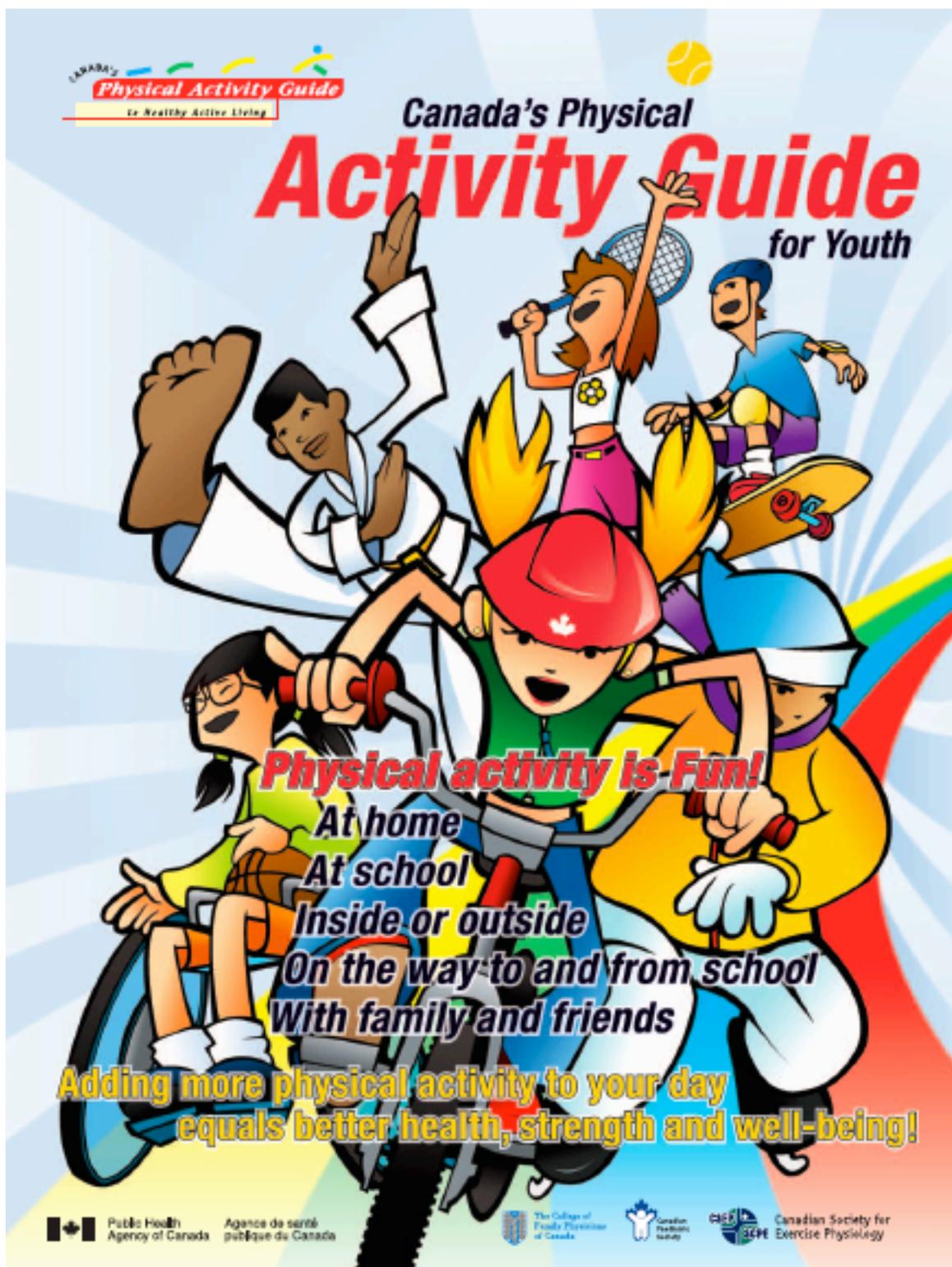
Handout II: Fruit & Vegetable Tasting Handout (Week 2)

Name: _____
Date: _____

Fruit & Vegetable Tasting

Which fruit and vegetables did you taste today? Did you like them? What did they taste like? Fruit and vegetables come in different colours, and each colour provides its own nutritional benefits. Eating a variety of fruit and vegetables helps you get all of the vitamins and minerals that you need to grow and be healthy. Write down the fruit and vegetables you tasted in the first column, and record your observations in the remaining four columns.

Colour	Appearance	Taste	Texture	Opinion
Red				
Orange/Yellow				
Green				
Blue/Purple				
White				





Dare to be **Active!**

Tune into physical activity to:

- Meet new friends
- Improve physical self-esteem
- Achieve a healthy weight
- Build strong bones and strengthen muscles
- Maintain flexibility
- Promote good posture and balance
- Improve fitness
- Strengthen the heart
- Increase relaxation
- Promote healthy growth and development

Let's Get **ACTIVE!**

Canada's Guidelines for **INCREASING** Physical Activity in Youth

This Guide will help you:

1. **INCREASE** time **CURRENTLY** spent on physical activity, starting with 30 minutes **MORE** per day (See **CHART BELOW**)
2. **REDUCE** "non active" time spent on TV, video, computer games and surfing the Internet, starting with 30 minutes **LESS** per day (See **CHART BELOW**)

Build up physical activity throughout the day in periods of at least 5 to 10 minutes

MONTH	Daily INCREASE in moderate* activity (Minutes)		Daily INCREASE in vigorous** activity (Minutes)		Total Daily INCREASE in physical activity (Minutes)	Daily DECREASE in non-active time (Minutes)
Month 1	at least 20	+	10	=	30	30
Month 2	at least 30	+	15	=	45	45
Month 3	at least 40	+	20	=	60	60
Month 4	at least 50	+	25	=	75	75
Month 5	at least 60	+	30	=	90	90



Congratulations!

Daily active time is part of a healthy lifestyle.

*Moderate physical activity examples
• Brisk walking, skating, bike riding

**Vigorous physical activity examples
• Running, supervised weight training, basketball, soccer



Here's the scoop!

– Combine three types of physical activity for best results:

1. **Endurance** activities that make you breathe deeper, your heart beat faster, and make you feel warm.
2. **Flexibility** activities like bending, stretching and reaching that keep your joints moving.
3. **Strength** activities that build your muscles and bones.



Here are some ideas to get you started

Decide to take the first step – It's all up to you – And YOU can DO it!

- Walk more – to school, to the mall, to the park, to your friend's house
- Walk, run or bike instead of getting a drive with mom or dad
- Take the dog for a walk
- Run, jump, skateboard, snow-board, ski, skate or toboggan
- Play sports
- Go skating, swimming, bike riding or bowling
- Rake the leaves, shovel snow or carry the groceries
- Take a class like yoga, hip hop, aerobics or gymnastics
- Check out some activities at the community centre
- Be active with your friends
- Put on some music and move
- Stretch your muscles every day
- Try something new like wall climbing or dance classes

Choose activities you like or think you might like.





Active bodies need energy

Follow *Canada's Food Guide to Healthy Eating* to make wise food choices



Healthy activity is safe activity



© Her Majesty the Queen in Right of Canada, 2002
Cat. H39-611/2002-1E • ISBN 0-662-31931-1

Please use this Guide with additional support resources.

For more information: Call **1 888 334-9769**

or visit **www.pguide.com**

Activity: Energy Balance

Answer these questions:

1. How does following Canada's Food Guide to Healthy Eating contribute to energy balance?

2. What factors influence a healthy weight?

3. Besides achieving and maintaining a healthy body weight, what other benefits do you get from eating healthy, being physically active and feeling good about yourself?

4. Why are vegetables and fruit important?

5. How do vegetables and fruit contribute to health?



Paint Your Plate! Create a Masterpiece
Vegetable and Fruit Action Guide for Schools
HS-GP ©2006

Activity: Food/Beverage Intake & Physical Activity Record

Please record your food and beverage intake including portion sizes for one day. Also record physical activities performed on the same day including time spent and whether they were moderate (m) or vigorous (v).

Name: _____ Date: _____

Food/Beverage Intake	Physical Activity	M/V	Time
Breakfast	Morning		
Snack			
Lunch	Afternoon		
Snack			
Supper	Evening		
Snack			



Paint Your Plate! Create a Masterpiece
Vegetable and Fruit Action Guide for Schools
HS-EP ©2006

Analysis: Food/Beverage Intake & Physical Activity Record

Please complete the following charts based on your one-day Food/Beverage Intake and Physical Activity Record.

Food Group	Recommended Serving Range	Actual Number of Servings Consumed
Grain Products		
Vegetables & Fruit		
Milk Products		
Meats & Alternatives		

Physical Activity Intensity	Recommended Time Spent	Actual Time Spent
Moderate		
Vigorous		



Paint Your Plate! Create a Masterpiece
Vegetable and Fruit Action Guide for Schools
NHFP ©2006

Analysis: Food/Beverage Intake & Physical Activity Record (cont'd)

Questions:

1. How does your one-day food record compare to Canada's Food Guide to Healthy Eating guidelines? _____

2. How does your one-day physical activity record compare to Canada's Physical Activity Guide for Youth guidelines? _____

3. How did you feel (physically and emotionally) throughout the day? _____

4. Is there a connection between what you ate and how physically active you were? _____

5. Record three personal goals to improve your intake of vegetables and fruit and increase your level of physical activity. _____

6. How are you going to achieve those goals? _____

76



Paint Your Plate! Create a Masterpiece
Vegetable and Fruit Action Guide for Schools
HS-67 ©2006

Handout VI: Beverage Tutorial (Week 4)

Name: _____

Date: _____

Beverage Tutorial

People drink all kinds of beverages to keep hydrated and quench their thirst throughout the day. Some beverages are healthier than others. Look at the labels you have in front of you and answer the following questions, they will help you identify the healthiest choice.

1. What is the serving size?

Cola: _____

Apple juice: _____

Fruit punch: _____

Kool-Aid Jammers: _____

Sunny Delight: _____

Gatorade: _____

2. How much sugar does each beverage provide per serving?

Cola: _____

Apple juice: _____

Fruit punch: _____

Kool-Aid Jammers: _____

Sunny Delight: _____

Gatorade: _____

3. Name the first three (3) ingredients on the labels.

Cola: _____

Apple juice: _____

Fruit punch: _____

Kool-Aid Jammers: _____

Sunny Delight: _____

Gatorade: _____

4. From the information above, which beverage do you think is the healthiest choice? WHY?

5. Which of the beverages provides a serving from the vegetable & fruit group of Canada's Food Guide?

Paint Your Plate! Seven-Day Challenge: Student Record Sheet

Use this chart to track the number of vegetables and fruit you eat over the next seven days. Can you meet the five to 10 a day goal? Each time you eat one serving, check it off. Add up the number you eat each day in the right-hand column. Double your fun by challenging others in your family to track their vegetables and fruit intake, too!

What's a serving?

- 1 medium vegetable or fruit,
- 250 mL (1 cup) salad,
- 125 mL (½ cup) raw, cooked, frozen or canned vegetable or fruit,
- 60 mL (¼ cup) dried fruit, or
- 125 mL (½ cup) 100 per cent unsweetened vegetable or fruit juice.

What's my goal?

- 5 to 10 servings per day!

Date	Vegetables ✓ (eg, carrots, broccoli, salad, tomato juice, potatoes...)	Fruit ✓ (eg, grapes, oranges, melons 100 % unsweetened juice, bananas...)	Daily Total
			
			
			
			
			
			
			

Name: _____

Class: _____

How did you score?
 0-2 servings a day – Keep Trying
 3-4 servings a day – Good Start
 5-10 servings a day – Awesome



Paint Your Plate! Create a Masterpiece
 Vegetable and Fruit Action Guide for Schools
 NHEP ©2006

Paint Your Plate! One-Day Challenge: Student Record Sheet

Learn about the colour groups in the chart below.

What Are the Five Colour Groups?	
Vegetables & Fruit Colour Groups	Vegetables & Fruit Examples by Colour
Red	Cherries, red apples, red cabbage, cranberries, red grapes, red onions, pink/red grapefruit, watermelons, red peppers, beets, red tomatoes, raspberries, radishes, rhubarb
Yellow/Orange	Apricots, oranges, papayas, sweet potatoes, cantaloupes, peaches, lemons, yellow peppers, yellow squashes, carrots, mangoes, nectarines
Green	Avocados, limes, cucumbers, artichokes, green beans, green apples, asparagus, green cabbage, green grapes, broccoli, green peppers, brussels sprouts, peas, kiwis, spinach
Blue/Purple	Blackberries, plums, prunes, blackcurrants, blueberries, eggplants, figs, raisins, purple grapes, purple endive
White/Tan/Brown	Bananas, garlic, onion, brown pears, parsnips, turnips, ginger, mushrooms, cauliflower

Use this chart to track your vegetables and fruit intake by colour for one day of the challenge. See if you can reach the goal of eating at least five servings, one from each colour group!

Number	Colour	Name of the Vegetable or Fruit
1	Red	
2	Yellow/Orange	
3	Green	
4	Blue/Purple	
5	White/Tan/Brown	
Bonus	Any Colour	

Did you reach the goal of eating at least five servings, one from each colour group? Which colour group did you miss? Check the colour chart above and try a vegetable or fruit in that colour group.

Name: _____ Classroom: _____

[Return to Your Teacher](#)



Paint Your Plate! Create a Masterpiece
Vegetable and Fruit Action Guide for Schools
N-HEP ©2005

Paint Your Plate! Challenge Certificate

Congratulations!

_____ (name)

You have successfully completed the Paint Your Plate! Challenge.

For great health throughout your life, continue to eat 5 to 10 servings of colourful vegetables and fruit every day.



_____ (date)

_____ (signature)



Appendix F: Parent Resources

Resource I: Eating Well with Canada’s Food Guide for First Nations, Inuit, and Métis (see Appendix D) (Week 1)

Resource II: Three Simple Steps (Week 2)

Three simple steps to eating more fruits and vegetables.

Eating a variety of fruits and vegetables every day is healthy for you. They have vitamins and minerals that can help protect your health. Most are also lower in calories and higher in fiber than other foods. As part of a healthy diet, eating fruits and vegetables instead of high-fat foods may make it easier to control your weight.

1 Find out how many fruits and vegetables you need to eat every day.

Women

AGE	FRUITS	VEGETABLES
19-30	2 cups	2½ cups
31-50	1½ cups	2½ cups
51+	1½ cups	2 cups



Men

AGE	FRUITS	VEGETABLES
19-50	2 cups	3 cups
51+	2 cups	2½ cups



Girls

AGE	FRUITS	VEGETABLES
2-3	1 cup	1 cup
4-8	1 cup	1½ cups
9-13	1½ cups	2 cups
14-18	1½ cups	2½ cups



Boys

AGE	FRUITS	VEGETABLES
2-3	1 cup	1 cup
4-8	1½ cups	1½ cups
9-13	1½ cups	2½ cups
14-18	2 cups	3 cups



These amounts are for less active people. Visit www.fruitsandveggiesmatter.gov to see the amounts needed by more active people.

2 Learn what 1 cup and ½ a cup look like.

EACH COUNTS AS 1 CUP	EACH COUNTS AS ½ CUP
 <p>1 large orange</p>  <p>1 large ear of corn</p>  <p>1 large sweet potato</p>	 <p>16 grapes</p>  <p>6 baby carrots</p>  <p>4 large strawberries</p>

Visit www.fruitsandveggiesmatter.gov for more examples.



3 See how you can add fruits and vegetables into your day as part of a healthy diet.

BREAKFAST	Add some fruit to your cereal.	
SNACK	Grab a piece of fruit.	
LUNCH	Eat a big salad.	
SNACK	Choose raw vegetables as an afternoon snack.	
DINNER	Have two vegetables with dinner and eat fruit for dessert.	

TIPS Enjoy a colorful variety of fruits and vegetables (including beans). Fresh, frozen, canned, and dried all count.

For breakfast:

- Stir low-fat or fat-free granola into a bowl of low-fat or fat-free yogurt. Top with sliced apples or frozen berries.
- Top toasted whole wheat bread with peanut butter and sliced bananas.
- Add vegetables, such as diced tomatoes and onions, to your egg or egg white omelet.



For snacks:

- Eat a piece of fruit like an apple, banana, or plum.
- Place a box of raisins in your child's backpack and pack one for yourself, too.
- Put grapes and banana slices on wooden skewers and freeze for "fruit on a stick."



For lunch and dinner:

- Ask for less cheese and more vegetable toppings on your pizza. Try onions, mushrooms, and bell peppers.
- Spread low-fat cheese and low-fat or fat-free refried beans between two whole wheat tortillas. Brown on both sides in a pan until cheese melts. Top with salsa.
- Eat at least two vegetables with dinner.
- Add frozen vegetables like peas and broccoli to a casserole or pasta.



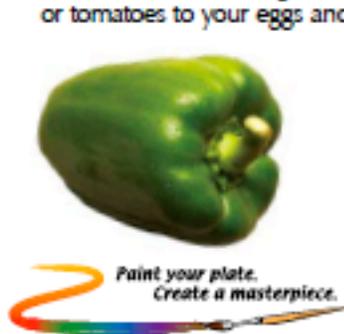
Resource III: Canada's Physical Activity Guide for Youth (see Appendix D) (Week 3)

Resource IV: Paint Your Plate At Breakfast (Week 3)

Paint Your Plate!... at Breakfast

You can help your children eat five to 10 servings of vegetables and fruit daily when you keep these foods in sight and easy to eat. Try the following tips to include veggies and fruit in the all-important breakfast meal:

- Serve a variety of 100 per cent unsweetened fruit juice or 100 per cent fruit juice blends, eg, apple, grapefruit, cranberry, orange, berry or prune. Limit serving sizes to 125 to 250 mL ($\frac{1}{2}$ to 1 cup) portions. Try to include a serving of whole fruit as well as juice.
- Offer colourful fresh fruit in season – chopped the night before to save time.
- Top whole grain cereal with sliced bananas, kiwi or fresh berries. Toss dried fruit like raisins and apricots on hot oatmeal.
- Top fresh cut-up fruit or canned fruit (packed in its own juice or water) with French vanilla yogurt.
- Have washed fresh fruit such as apples, peaches and plums in a bowl near the door for children to grab on the way out.
- Add 250 mL (1 cup) of fresh or frozen berries or mashed bananas to pancake batter or top pancakes and waffles with sliced peaches or fresh berries.
- Top half a whole grain bagel with apple slices, a sprinkle of cinnamon and a slice of low-fat cheese. Broil until the cheese melts.
- Spread peanut butter on a slice of whole wheat toast. Heat half a banana in the microwave for 30 seconds. Mash the banana with a fork and spread on top.
- Shake up the morning with a breakfast fruit smoothie. Mix 250 mL (1 cup) of fresh, frozen or canned fruit with 125 mL ($\frac{1}{2}$ cup) low-fat yogurt and 125 mL ($\frac{1}{2}$ cup) 100 per cent unsweetened fruit juice in a blender. Drink up and smile.
- Add frozen or fresh vegetables such as bell peppers, broccoli, spinach, mushrooms or tomatoes to your eggs and omelettes.



151

A serving of vegetables or fruit is equal to:

- 1 medium vegetable or fruit,
- 250 mL (1 cup) salad,
- 125 mL (½ cup) raw, cooked, frozen or canned vegetable or fruit,
- 60 mL (¼ cup) dried fruit, or
- 125 mL (½ cup) 100 per cent unsweetened vegetable or fruit juice.

References

Cancer Care Ontario, Canadian Cancer Society, Heart and Stroke Foundation. 2003. [Take Five: 5-10 a day – your way!](#) Leader's Guide, Cancer Care Ontario, Toronto, Ontario.

Canadian Produce Marketing Association. Available at: www.cpm.ca/en_home.asp

Adapted from materials produced by City of Hamilton Public Health and Community Services Department, Toronto Public Health and Regional Niagara Public Health Department



Resource V: Understanding Food Labels (Week 4)

Understanding Food Labels

This fact sheet provides 5 easy steps to help with understanding a food label. By referring to the information found on a food label, it can help make choosing healthy food easier.

Step 1	<p>Look at the Serving Size</p> <p>If you eat the same amount as the serving size shown on the nutrition fact table, you will be getting the amount of nutrients and calories that are listed. Compare what you eat to the serving size on the package to see how much nutrients you are getting.</p>
Step 2	<p>Look at the Calories</p> <p>Number of calories on the food label tells you how much energy you will be getting from one serving of the packaged food.</p>
Step 3	<p>Look at the Percent Daily Value (% DV)</p> <p>% DV tells you how much of the nutrient you are getting compare to the recommended amount you need each day. In general, a nutrient with % DV < 5 means the food does not have a lot of the nutrient and % DV > 20 means the food has a lot of the nutrient.</p>
Step 4	<p>Look at these nutrients and get less of them</p> <p>Choose packaged foods that have a low % Daily Value (% DV) for fat, cholesterol, and salt, as too much of these nutrients can affect our health. Sugar has no % DV but too much sugar isn't good for your health either.</p>
Step 5	<p>Look at these nutrients and get more of them</p> <p>Choose packaged foods that have a high % Daily Value (% DV) for fibre, vitamin c, calcium and iron. These nutrients are important for overall good health.</p>

Nutrition Facts	
Per 7 crackers (20 g)	
Amount	% Daily Value
Calories 120	
Fat 2.5 g	4 %
Saturated Fat 0.4 g + Trans Fat 1 g	7 %
Cholesterol 1 mg	
Sodium 135 mg	6 %
Carbohydrate 21 g	7 %
Fibre 3 g	12 %
Sugars 3 g	
Protein 3 g	
Vitamin A 0 %	Vitamin C 0 %
Calcium 2 %	Iron 6 %

Paint Your Plate!... at Lunch

Parents, do not let your children leave home without them! Veggies and fruit, that is. Pack lunches that include at least two servings of vegetables and fruit for lunch and another two servings of vegetables and fruit for snacks. Use the following ideas to help your children get their five to 10 servings of vegetables and fruit at school:

- Keep the fridge and cupboards stocked with easy-to-pack choices such as apples, pears, bananas, clementines, canned fruit cups, baby carrots, cherry tomatoes, dried fruit, grapes and 100 per cent unsweetened juice boxes.
- Send assorted veggies (eg. carrot sticks, red or green pepper strips, florets of broccoli or cauliflower, mushroom caps) with a tasty dip such as a low-fat creamy salad dressing.
- Apples, pears and berries are also great for dipping. For a fast and tasty dip use a low-fat fruit-flavoured yogurt or milk pudding.
- Make a nutritious snack with pretzels, nuts, whole grain cereal and dried fruit such as raisins, apricots, figs or prunes. Check if your school has a nut allergy policy before sending.
- Send a container of tomato-packed salsa with baked tortilla chips for tasty snacking.
- Send a frozen fruit smoothie. Blend whole fruit, yogurt, skim milk and ice cubes. Freeze overnight and pack in lunches the next morning. Send vegetable, tomato or minestrone soup if your child's school has a microwave. Include a whole grain roll and add grated cheese for a tasty garnish.
- Keep a fridge shelf stocked with ready-to-go choices that are easy for a child to pack. Train your children to always add vegetables (eg. carrot, cucumber, celery or zucchini sticks) and fruit (eg. grapes, a banana or a canned fruit cup) for dessert.



Paint Your Plate! Create a Masterpiece
Vegetable and Fruit Action Guide for Schools
NH-IEP ©2006



- Pack sliced tomatoes, cucumbers and dark leafy greens in a separate container to keep sandwiches from getting soggy.
- Stuff a whole wheat pita pocket with apple slices, low-fat shredded cheese and romaine lettuce.
- If having lunch at home, fill a whole wheat pita pocket with peanut butter, banana slices and a handful of broccoli sprouts. For a change of pace, enjoy a peanut butter and banana sandwich on raisin bread.

A serving of vegetables or fruit is equal to:

- 1 medium vegetable or fruit,
- 250 mL (1 cup) salad,
- 125 mL (½ cup) raw, cooked, frozen or canned vegetable or fruit,
- 60 mL (¼ cup) dried fruit, or
- 125 mL (½ cup) 100 per cent unsweetened vegetable or fruit juice.

References

Cancer Care Ontario, Canadian Cancer Society, Heart and Stroke Foundation. 2002. [Take Five: 5-10 a day... your way!](#) Leader's Guide. Cancer Care Ontario, Toronto, Ontario.

Canadian Produce Marketing Association. Available at: www.cpmna.ca/en_home.asp

Adapted from materials produced by City of Hamilton Public Health and Community Services Department, Toronto Public Health and Regional Niagara Public Health Department



Paint Your Plate!... at Dinner

You know that veggies and fruit are good for you. For good health, it's recommended you eat five to 10 servings of veggies and fruit every day.

Here are some ways you can get an extra serving at dinner:

- Aim to have at least half of the dinner plate covered with vegetables.
- Serve soup - tomato, vegetable, minestrone.
- Save time with salad-in-a-bag. Remember to wash it before serving.
- Instead of serving fries, dip slices of sweet potatoes in a mixture of egg whites and nutmeg and bake on a lightly greased pan in a 425° oven for 20 minutes for tasty sweet potato fries.
- Add salad sides - bean, coleslaw or leafy green are all great.
- Offer jazzy juice cubes for a fun snack or easy dessert. Freeze colourful 100 per cent unsweetened fruit juice or 100 per cent fruit juice blends in an ice cube tray and pop out as needed.
- Stir fry peppers, sugar snap peas, broccoli and cauliflower and serve with brown rice, whole grain bulgur or couscous. Add fruits such as raisins, pineapple, mango or kiwi for a tasty twist.
- Get grilling! Use firm, ripe produce such as eggplant, leeks, green and red peppers, mushrooms, squash or corn on the cob. To prevent sticking, lightly baste with vegetable oil or a non-stick spray.
- Top your homemade pizza with zucchini or squash slices, mushrooms, onions, green or red pepper strips, marinated artichoke hearts, broccoli florets, shredded carrots, fresh tomato slices, chopped spinach, or even fruit, like pineapple.
- Add extra fresh or frozen veggies to your favourite spaghetti sauce, chili, lasagna, casserole or stew.



Paint Your Plate! Create a Masterpiece
Vegetable and Fruit Action Guide for Schools
NH-FIP ©2016



nhcp
Northern
New Jersey
Project

- Extend lean ground beef in meatloaf or shepherd's pie by adding finely chopped veggies such as carrots, peppers, onion, celery and mushrooms.
- Go Mexican! Serve lots of shredded carrots, cabbage, lettuce, chopped tomatoes and green and red pepper strips with tacos, burritos or fajitas.
- Add chopped broccoli, carrots or frozen mixed veggies to cooked rice or pasta, including macaroni and cheese. Serve hot or cold.
- Microwave vegetables for an easy side dish.
- Try a black bean, corn and bell pepper salad seasoned with cilantro and balsamic vinegar.
- Toss a handful of beans on your salad or, if you have a sweet tooth, add chopped apples, raisins or dried cranberries.
- Try vegetable instead of meat lasagna or add vegetables to your meat sauce.

A serving of vegetables or fruit is equal to:

- 1 medium vegetable or fruit,
- 250 mL (1 cup) salad,
- 125 mL (½ cup) raw, cooked, frozen or canned vegetable or fruit,
- 60 mL (¼ cup) dried fruit, or
- 125 mL (½ cup) 100 per cent unsweetened vegetable or fruit juice.

References

Cancer Care Ontario, Canadian Cancer Society, Heart and Stroke Foundation. 2003. [Take Five: 5-10 a day... your way!](#) Leader's Guide. Cancer Care Ontario. Toronto, Ontario.

Canadian Produce Marketing Association. Available at: www.cpm.ca/en_home.asp.

Adapted from materials produced by City of Hamilton Public Health and Community Service Department, Toronto Public Health and Regional Niagara Public Health Department



Paint Your Plate! Challenge



Attention All Parents and Guardians!

Paint Your Plate! Vegetables and Fruit Challenge is coming to your child's school and we invite you to participate in your home as well!

Be a great role model...enjoy eating veggies and fruit with your children!

The *Paint Your Plate!* program will teach your children about nutrition and provide them with skills to eat 5 to 10 servings a day of vegetables and fruit now and for the rest of their lives.

Teachers will lead healthy eating lessons in the classroom for one month prior to the *Paint Your Plate!* Challenge.

Join the fun. Make it a family event!

Paint Your Plate! with brightly coloured vegetables and fruit to create a masterpiece and achieve good health.

Watch for the parent resources coming home with your children.



Paint Your Plate! Create a Masterpiece
Vegetable and Fruit Action Guide for Schools
NAEP ©2006



87

Paint Your Plate! Challenge

Dear Parent/Guardian:

Your child's class/school has been invited to take part in a vegetables and fruit challenge supported by your local public health unit. The *Paint Your Plate!* Challenge aims to have students, teachers and their families eat five to 10 servings of vegetables and fruit every day for one week and, hopefully, for a lifetime!

How does *Paint Your Plate!* work?

- Next week, your child will receive a form to record the number of servings of vegetables and fruit he or she eats each day for one week.
- Students will be encouraged to eat one or more servings of vegetables and fruit at every meal and snack.
- Students will be asked to record the total number of servings of vegetables and fruit eaten at all meals and snacks for each day of the challenge week using the *Paint Your Plate!* Student Record Sheets.

Students will be learning about healthy eating and vegetables and fruit in the classroom. You can support your child by reviewing the information brought home on vegetables and fruit and taking the challenge together. Please help your child complete the Student Record Sheets and record his or her vegetables and fruit intake together.

For participating in the challenge, all students will receive a certificate and the class will be eligible to participate in a draw for a vegetables and fruit celebration.

An evaluation form will be sent home with your child at the end of the challenge. Please complete it and send it back with your child the following day.

Thanks for helping with this important nutrition education!

Please alert the school if your child has a food allergy!



Paint Your Plate! Create a Masterpiece
Vegetable and Fruit Action Guide for Schools
NH-FP ©2006



89

Appendix G: Knowledge, Self-Efficacy, and Intentions Questionnaire

Name: _____
Date: _____

Vegetable & Fruit Knowledge, Self-Efficacy, and Intention Questionnaire Pre-Program

Please answer the following questions about vegetables and fruit to the best of your abilities. Circle the answer that you think is most correct. Your answers will be completely anonymous; no one at your school will be able to see your answers. Thank you for your help!

Knowledge Questions

1. How many servings of vegetables and fruit should you eat every day to stay healthy?

- (a) 2 to 3 servings
- (b) 3 to 4 servings
- (c) 5 to 6 servings
- (d) 6 to 7 servings

2. What size is one serving from the vegetables and fruit group of Canada's Food Guide?

- (a) About the size of one fist
- (b) About the size of your palm and the thickness of your little finger
- (c) About the size of the tip of your thumb
- (d) About the size of two fists

3. What food group does Orange Crush pop fit into?

- (a) Fruit
- (b) Orange vegetables
- (c) Grain products
- (d) Vegetables and fruit
- (e) None of the above

4. Which food group does peanut butter fit into?

- (a) Vegetables and fruit
- (b) Meat and alternatives
- (c) Milk and alternatives
- (d) Grains products
- (e) Oils

5. Which of the following statements is true of 100% fruit juice?

- (a) It counts as a serving in the vegetables and fruit group of Canada's Food Guide
- (b) It has a lot of sugar added
- (c) It comes under the brand names of Tang and KoolAid
- (d) It does not contain many valuable vitamins or minerals

Name: _____
Date: _____

Questions about what you usually eat

6. How often do you usually eat fresh vegetables or fruit?

- (a) Rarely or never
- (b) 2-4 times a month
- (c) 2-4 times a week
- (d) 5-6 times a week
- (e) Once a day
- (f) At least twice a day

7. How often do you usually eat cooked vegetables or fruit?

- (a) Rarely or never
- (b) 2-4 times a month
- (c) 2-4 times a week
- (d) 5-6 times a week
- (e) Once a day
- (f) At least twice a day

8. How often do you usually drink 100% fruit juice?

- (a) Rarely or never
- (b) 2-4 times a month
- (c) 2-4 times a week
- (d) 5-6 times a week
- (e) Once a day
- (f) At least twice a day

9. Do you think that you eat a lot of vegetables and fruit?

- (a) Yes, I eat a lot of vegetables and fruit
- (b) I eat a good amount, not too little, not too much
- (c) No, I do not eat a lot of vegetables and fruit

10. Do you think that you eat more or less fruit than most boys and girls of your age?

- (a) Much more
- (b) A bit more
- (c) The same
- (d) A bit less
- (e) Much less

How much do you agree or disagree with the following statements?

11. Eating vegetables and fruit every day makes me feel good.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

Name: _____
Date: _____

12. Eating vegetables and fruit every day gives me more energy.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

13. Eating vegetables and fruit every day could prevent obesity (weighing too much) and diabetes.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

14. I like to eat vegetables and fruit every day.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

15. Vegetables and fruit taste good.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

16. It is difficult for me to eat vegetables and fruit every day.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

17. If I decide to eat vegetables and fruit every day, I can do it.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

18. I want to eat vegetables and fruit every day.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

Name: _____
Date: _____

19. I am willing to try a vegetable or fruit that I have never tried before.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

20. Eating vegetables and fruit every day is a habit for me.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

21. I usually ask my parents to buy vegetables and fruit.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

22. My best friends eat vegetables and fruit.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

23. My parents eat vegetables and fruit.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

24. I do not eat vegetables and fruit because it takes too long to eat.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

25. I do not eat vegetables and fruit because it usually doesn't look fresh.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

Name: _____

Date: _____

26. I do not eat vegetables and fruit because we do not have them in our house often.

- (a) Strongly agree
- (b) Agree
- (c) Not sure
- (d) Disagree
- (e) Strongly disagree

Please answer the following question about which vegetables and fruit you like.

27. Which of the following vegetables and fruit have you tried? (Please circles all the ones you have tried)

- (1) Apples
- (2) Apple sauce
- (3) Bananas
- (4) Berries
- (5) Pears
- (6) Oranges
- (7) Plums
- (8) Peaches
- (9) Cantaloupe
- (10) Musk melon
- (11) Other melon
- (12) Strawberries
- (13) Grapes
- (14) Raisins
- (15) Dried apricots
- (16) Kiwis
- (17) Tomatoes
- (18) Cucumbers
- (19) Green beans
- (20) Corn
- (21) Carrots
- (22) Broccoli
- (23) Cauliflower
- (24) Peas
- (25) Celery
- (26) Fruit cocktail or canned fruit
- (27) Red peppers
- (28) Green peppers
- (29) Squash
- (30) Potatoes
- (31) Sweet potatoes
- (33) Turnips
- (34) Spinach
- (35) Lettuce / salad
- (36) 100% fruit juice
- (37) Beets
- (38) Eggplant
- (39) Radishes
- (40) Mushrooms

Name: _____
Date: _____

28. Which of the following vegetables and fruit do you like? (Please circle all the ones that you like)

- (1) Apples
- (2) Apple sauce
- (3) Bananas
- (4) Berries
- (5) Pears
- (6) Oranges
- (7) Plums
- (8) Peaches
- (9) Cantaloupe
- (10) Musk melon
- (11) Other melon
- (12) Strawberries
- (13) Grapes
- (14) Raisins
- (15) Dried apricots
- (16) Kiwis
- (17) Tomatoes
- (18) Cucumbers
- (19) Green beans
- (20) Corn
- (21) Carrots
- (22) Broccoli
- (23) Cauliflower
- (24) Peas
- (25) Celery
- (26) Fruit cocktail or canned fruit
- (27) Red peppers
- (28) Green peppers
- (29) Squash
- (30) Potatoes
- (31) Sweet potatoes
- (32) Turnips
- (33) Spinach
- (34) Lettuce / salad
- (35) 100% fruit juice
- (36) Beets
- (37) Eggplant
- (38) Radishes
- (39) Mushrooms

THANK YOU!

Appendix H: Parent/Guardian Impressions Questionnaire

Pilot Fruit & Vegetable Education Program Questionnaire and Raffle Ticket

Dear Parent or Guardian,

Please let us know what you thought about the fruit & vegetable education program that was piloted in your child's school this winter/spring. Please include your name on the questionnaire so that you can be entered into the raffle. We value your comments, as they will be useful in future program implementation endeavors. Thank you!

1. Did you think that the resources that your child brought home were culturally appropriate?

- Yes
 No

2. Which resource did you think was the most valuable?

- Canada's Food Guide
 Three Simple Steps
 Canada's Physical Activity Guide
 Paint Your Plate at Breakfast
 Paint Your Plate at Lunch
 Paint Your Plate at Dinner
 Understanding Food Labels
 The health fair (today)

3. What type of information did you hope to receive but did not?

4. What information did you find was not very useful?

5. Did your child tell you about or ask you to purchase any of the vegetables or fruit they tried at school?

- Yes
 No

6. Can you suggest what would help you serve more vegetables and fruit in the home?

7. Do you think the program should run again next year? Why or why not?

8. Please provide any additional comments and/or suggestions. Your opinion is valuable!

Thank you! Do not forget to return this questionnaire to be entered into the RAFFLE!

NAME: _____