The Diets of On-reserve First Nations Youth: An Exploration of the Factors Associated with Healthy Food Choices and the Impact of School and Community Programs

by

Allison Gates

A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Doctor of Philosophy
in
Health Studies and Gerontology

Waterloo, Ontario, Canada, 2015

© Allison Gates 2015

Author's Declaration

This thesis consists of material all of which I authored or co-authored: see **Statement of Contributions** included in the 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.

Statement of Contributions

The studies contained within this thesis have all been published, submitted for publication, or prepared for publication in peer-reviewed academic journals. To acknowledge the efforts and contributions of my academic and community-based colleagues who have been integral to the completion of this work, they have been included as co-authors on the resultant manuscripts. The authorship for each thesis chapter (and the corresponding manuscripts) is shown below. The chapters that were not intended for publication were authored by Allison Gates, under the supervision or Drs. Rhona Hanning and Len Tsuji.

Chapter	Description	Reference	Status
3.0	Study one	Gates, A., Skinner, K., & Gates, M. (2015). The diets of Aboriginal youths in Canada: a systematic review of the literature. *Journal of Human Nutrition and Dietetics, 28*(3), 246-261.	Published[a]
4.0	Study two	Gates, A., Gates, M., Hanning, R.M., & Tsuji, L.J.S. An exploration of the socioeconomic and sociocultural influences on traditional food consumption among 12-17 year-old First Nations youth living on reserves in Canada.	Prepared
5.0	Study three	Gates, A., Gates, M., Tsuji, L.J.S., & Hanning, R.M. The individual, behavioural and socioeconomic factors associated with healthy store-bought food choices for 12-17 year-old First Nations youth living on reserves in Canada.	Prepared
6.0	Study four	Gates, A., Hanning, R.M., Gates, M., & Tsuji, L.J.S. (Submitted, September 2015). The food and nutrient intakes of First Nations youth living in northern Ontario, Canada: evaluation of a harvest sharing program.	Submitted
7.0	Study five	Gates, A., Hanning, R.M., Gates, M., Stephen, J., & Tsuji, L.J.S. (Accepted, September 2015). Four-year evaluation of a healthy school snack program in a remote First Nations community. *Health Behavior and Policy Review*.	In press[b]

[a]Please refer to the copyright agreement from John Wiley and Sons for permission to reproduce this publication, included following the Closing Remarks within this thesis.
[b]Please refer to the e-mail correspondence from Paris Scholar Publishing Ltd. for permission to reproduce this publication, included following the Closing Remarks within this thesis.

The contributions of the authors to the development of each chapter were as follows.

1.0 Allison Gates was responsible for the content of the background. Drs. Rhona Hanning and Len Tsuji provided intellectual guidance, input and revisions.

2.0 Allison Gates was responsible for the original concept for the purpose and rationale. Drs. Rhona Hanning and Len Tsuji provided intellectual guidance, input and revisions.

3.0 Allison Gates, Kelly Skinner and Michelle Gates were mutually responsible for developing the original concept of the study and for designing the search strategy. Allison Gates carried out the search strategy, performed the data extraction, synthesized the findings, wrote the thesis chapter, and prepared the manuscript for publication. Kelly Skinner provided intellectual input and revisions. Michelle Gates duplicated the search and data extraction, and provided intellectual input and revisions.

4.0 Allison Gates was responsible for the original concept of the study, performed the data analysis, synthesized the results and prepared the manuscript for publication. Michelle Gates aided in the development of the original concept, assisted in the data analysis and synthesis of the results, and edited the resultant manuscript. Drs. Rhona Hanning and Len Tsuji supervised the work, and provided intellectual input and revisions. The First Nations Information Governance Centre (FNIGC) provided the data and coordinated the data collection. Dr. Ian Martin provided statistical advice. Maria Santos suggested revisions to the manuscript.

5.0 Allison Gates was responsible for the original concept of the study, performed the data analysis, synthesized the results and prepared the manuscript for publication. Michelle Gates aided in the development of the original concept, assisted in the data analysis and synthesis of the results, and edited the resultant manuscript. Drs. Rhona Hanning and Len Tsuji supervised the work, and provided intellectual input and revisions. The FNIGC provided the data and coordinated the data collection. Dr. Ian Martin provided statistical advice. Maria Santos suggested revisions to the manuscript.

6.0 Allison Gates was responsible for the data collection, performed the data analysis and interpretation, synthesized the results, and prepared the manuscript for publication. Michelle Gates aided in the data collection, analysis and interpretation. Drs. Rhona Hanning and Len Tsuji were responsible for the original concept of the study, provided grant funding for the project and supervised the work. They also provided intellectual input for the manuscript and recommended revisions.

7.0 Allison Gates was responsible for the original concept of the study, collected and analysed the data, synthesized the results and prepared the manuscript for publication. Michelle Gates aided in the data collection and analysis, repeated the qualitative analysis and provided revisions. Drs. Rhona Hanning and Len Tsuji provided grant funding for the project and supervised the work. They also provided intellectual input for the manuscript and suggested revisions. Judy Stephen was the community-based collaborator who helped to coordinate the work.

8.0 Allison Gates was responsible for the content of the discussion. Drs. Rhona Hanning and Len Tsuji provided intellectual input and revisions.

9.0 Allison Gates was responsible for the content of the future directions. Drs. Rhona Hanning and Len Tsuji provided intellectual input and revisions.

10.0 Allison Gates was responsible for the content of the closing remarks. Drs. Rhona Hanning and Len Tsuji provided intellectual input and revisions.

Abstract

Background. In Canada, First Nations (FN) people experience poorer health outcomes and shorter life expectancies than non-Aboriginal people. Of particular concern are the high and rising prevalence rates of overweight and obesity. This is especially true of on-reserve populations, who may be lacking in the opportunities and resources necessary to facilitate healthy lifestyles (e.g., reasonably priced healthy foods, access to organized sports or recreation facilities). The development of obesity for FN people is exceptionally complex and not well understood, although energy intake is a known contributor. The contributors to the food choices of young people are also numerous, interacting and complex. This is compounded by the severe and lasting effects of colonialism and marginalization, which have left much of the Canadian FN population disadvantaged with respect to many of the social determinants of health and distanced them from their culture. First Nations Canadians have, as a result, undergone a relatively rapid and recent transition towards a more 'Western' way of life that is increasingly reliant on store-bought foods and more sedentary in nature. The reduction in traditional, land-based food procurement and consumption among this population, given the known nutritional benefits of these foods and their importance to the holistic health of FN people, is of particular interest. Because of the high prevalence of food insecurity within on-reserve FN populations and the relative lack of economic opportunities in isolated and remote locations, these nutrient-rich traditional foods may sometimes be replaced with energy dense, nutrient poor store-bought

alternatives. The food environment in many FN communities does not support or facilitate healthy choices. Healthy food may cost in excess of two times what it does in larger cities, and in remote and isolated locations, such foods may be inconsistently available and of unacceptable quality when they are. Access to traditional foods may be limited by high economic costs associated with their procurement, changes in the migratory patterns of traditional species, losses of traditional knowledge and fears of environmental contamination. If obesity and chronic disease are to be prevented in remote FN communities, children and adolescents are a logical target for population health interventions. In order to plan, initiate and evaluate program or policy initiatives, knowledge of the factors influencing the food intake of youth is necessary.

Objectives. This thesis aimed to (a) review the current literature on the diets of Aboriginal youth in Canada, (b) explore the socioeconomic and sociocultural predictors of traditional food intake among a large nationwide sample of Canadian on-reserve FN youth, (c) explore the individual, behavioural and socioeconomic predictors of healthy store-bought food choices among a large nationwide sample of Canadian on-reserve FN youth, (d) assess the nutritional significance of traditional food consumption for youth in two remote, isolated FN communities in northern Ontario before and after a harvest sharing program, and (e) investigate the barriers and facilitators to the sustainability of a school-based healthy snack program for FN youth in a remote, isolated northern Ontario community and the impact of the program on diet.

Methods. This thesis is presented as five individual studies. **Study 1** presents a systematic literature review of refereed publications on the diets of school-aged Aboriginal youth residing in Canada, published between January 2004 and 2014. Using a predetermined search strategy, Medline (PubMed), Scopus, Education Resources Information Center, Web of Science and Google Scholar databases were scanned to identify the articles included. Each of the included articles was summarized for purpose, design, year, sample population, setting, dietary assessment method and main findings. **Studies 2** and **3** utilized First Nations Regional Health Survey 2008/10 data, collected by the First Nations Information Governance Centre, to explore the individual, behavioural, socioeconomic and sociocultural predictors of traditional and store-bought food intake among 12-17 year-old youth living on reserves in Canada. Traditional and store-bought food intakes were elucidated via two separate food frequency questionnaires. The individual (i.e., age, sex, body mass index), behavioural (i.e., school attendance, physical activity, smoking, alcohol use), socioeconomic (i.e., number of children in the household, living with ones biological parents, parent education level) and sociocultural (i.e., use of a FN language, attending community cultural events, number of people helping to understand culture, food sharing) predictors of traditional food, milk and milk products, and vegetable intake were assessed via binary logistic regression modelling for four different age and sex subgroups. **Studies 4** and **5** originated from longstanding research collaborations with the remote and isolated subarctic FN communities of the Mushkegowuk Territory on the western coast of James

Bay in northern Ontario, Canada. **Study 4** focused on two separate communities in which a harvest sharing program was initiated in May 2011 to support local access to lesser snow geese. Dietary data from grades 6-8 youth in both communities were collected via a validated web-based 24-hour dietary recall and food frequency questionnaire. The significance of snow goose consumption to food group and nutrient intake and the likelihood of achieving current dietary standards were assessed via Analysis of Variance and Pearson chi-square tests, where appropriate. Potential changes in diet from baseline to the post-pilot phase of the program were assessed via independent samples t-tests and Pearson chi-square tests. **Study 5** focused on a healthy school snack program in one community, which was originally implemented in 2009 and previously evaluated for process and outcomes in 2010. The diets of grades 6-8 youth at baseline and at the four-year time point were assessed via a web-based 24-hour dietary recall, while qualitative information on the challenges and facilitators to the program's sustainability were gathered via a focus group with the principal and coordinating committee. Possible changes in the food group and nutrient intakes of youth, as well as the proportion meeting current dietary standards were assessed via independent samples t-tests and Pearson chi-square tests. All quantitative analyses were conducted using Statistical Package for the Social Sciences (SPSS, *v*. 20 Complex Samples (**Study 2** and **Study 3**) or *v*. 21 (**Study 4** and **Study 5**), IBM Corporation, Armonk, New York) with a significance level of $p \leq 0.05$. Qualitative data were managed and analyzed inductively for themes by hand. The qualitative themes were substantiated by a second, independent researcher.

Results. In **Study 1**, 24 studies were reviewed, all of which were cross sectional in design. The majority of studies (n=16, 67%) were from Ontario or Quebec, focused on FN youth (n=21, 88%) and took place in remote and/or isolated settings (n=18, 75%). Nearly all studies utilized the 24-hour recall approach to measure diet (n=19, 79%). On average, the diets of Aboriginal youth fall short of a number of important food groups and nutrients, with specific concerns for vegetables and fruit, milk and alternatives, fibre, folate, vitamin A, vitamin C, calcium and vitamin D across many studies, along with excess fast food and sugar sweetened beverage consumption. In **Study 2**, 31% of youth reported consuming traditional foods often (n=3587, representing a weighted population of 39 232, 50% 12-14 years old, 52% male). Frequent traditional food consumption was significantly associated with having a parent with a high school education (p=0.014), frequent participation in community cultural events (p<0.001), and often having traditional food shared with one's household (p<0.001). For 12-14 year-old girls (n=834, weighted population of 9 451), the odds of consuming traditional foods often were increased for those who always or almost always participated in community cultural events as compared to those who rarely or never did (OR=2.43, CI=1.43-4.12, p<0.001), and those who often had traditional foods shared with their household as compared to those who had traditional foods shared with their household less often (OR=4.08, CI=2.26-7.34, p<0.001). For 15-17 year-old girls (n=960, weighted population of 9 376) there were increased odds of frequently consuming traditional foods for those who often had traditional foods shared with their household as compared to those who had foods shared with them less often (OR=4.61, CI=3.08-6.88, p<0.001). For 12-14 year-old boys (n=893, weighted population of 10 331), there were increased odds of frequently consuming traditional foods amongst those who spoke a FN language as compared to those who did not (OR=1.41, CI=1.01-1.96, p=0.024), those who always or almost always participated in community cultural events as compared to those who participated rarely or never (OR=1.76, CI=1.16-2.68, p=0.013), and those who often had traditional foods shared with their household as compared to those who had traditional foods shared with them less often (OR=5.13, CI=3.42-7.72, p<0.001). For boys aged 15-17 years (n=900, weighted population of 10 075), there were increased odds of often consuming traditional foods for those whose parents had a high school education as compared to those whose parents had not completed high school (OR=1.86, CI=1.17-2.95, p=0.024), those who always or almost always participated in community cultural events as compared to those who rarely or never did (OR=2.82, CI=1.63-4.88, p=0.001), and those who often had traditional food shared with their household as compared to those who had traditional food shared with them less often (OR=3.67, CI=2.54-5.30, p<0.001). With the exception of participation in community cultural events for 12-14 year-old boys, all of these relationships persisted following adjustment for other socioeconomic and sociocultural variables included in the multivariate models. In **Study 3**, more than two-thirds (68%) of participants reported eating vegetables at least daily (n=3721, representing a weighted population of 41 499, 52% male, 50% 12-14 years old) and over half (57%) reported consuming milk and milk products at least once per day (n=3717, representing a weighted population of 41 368, 52% male, 51% 12-14 years old). Daily vegetable consumption was associated with being younger ($p<0.001$), being physically active ($p<0.001$), being a non-smoker ($p<0.001$), abstaining from alcohol ($p<0.001$) and having at least one parent with a post-secondary education ($p=0.026$). For 12-14 year-old girls (n=891, weighted population of 9 968), the odds of eating vegetables at least daily were increased amongst those who were physically active as compared to those who were not (OR=1.80, CI=1.18-2.75, $p=0.006$) and those who did not use alcohol as compared to those who did (OR=1.70, CI=1.16-2.50, $p=0.006$). For 15-17 year-old girls (n=995, weighted population of 10 076), the odds of consuming vegetables daily were increased amongst those who did not smoke as compared to daily or occasional smokers (OR=1.61, CI=1.14-1.07, $p=0.006$). These relationships all persisted in the multivariate models. For 12-14 year-old boys (n=921, weighted population of 10 971), the odds of eating vegetables daily were increased amongst those whose parents had a post-secondary education as compared to those whose parents had not completed high school (OR=1.51, CI=1.00-2.28, $p=0.050$) and decreased amongst those who did not attend school as compared to those who did (OR=0.50, CI=0.26-0.95, $p=0.031$). For 15-17 year-old boys (n=914, weighted population of 10 484), the odds of eating vegetables daily were increased amongst those whose parents had a post-secondary education as compared to those who had not attended high school (OR=1.87, CI=1.16-3.01, $p=0.033$). These relationships did not persist when adjusted for other factors in the multivariate models. In this same study, milk and milk products consumption was associated with being female ($p=0.025$), attending school ($p<0.001$) and being a non-smoker ($p<0.001$). For 12-14 year-old girls (n=893, weighted population of 9 989), there were increased odds of consuming milk and milk products daily amongst those who did not smoke as compared to daily and occasional smokers (OR=1.93, CI=1.27-2.93, $p=0.002$) as well as amongst those who did not drink alcohol as compared to those who did (OR=1.67, CI=1.10-2.54, $p=0.014$). For 15-17 year-old girls (n=996, weighted population of 10 070), the odds of consuming milk and milk products daily were increased amongst those who were physically active as compared to those who were not (OR=1.64, CI=1.18-2.28, $p=0.003$), amongst those who were non-smokers as compared to those who smoked daily or occasionally (OR=1.56, CI=1.12-2.14, $p=0.007$) and amongst those who lived with one biological parent as compared to those who lived with neither biological parent (OR=1.91, CI=1.25-2.93, $p=0.007$). With the exception of the association between milk product intake and alcohol use amongst the younger sub-group of girls, all of these relationships persisted when controlled for the other variables included in the multivariate models. For 12-14 year-old boys (n=917, weighted population of 10 947), the odds of consuming milk and milk products daily were increased amongst those who were physically active as compared to those who were not (OR=1.51, CI=1.09-2.11, p=0.013) and decreased amongst those who lived with less than three children in their household as compared to those with greater than three children in their household (OR=0.68, CI=0.48-0.97, p=0.029) as well as those who did not attend school as compared to those who did (OR=0.20, CI=0.11-0.37, p<0.001). For 15-17 year-old boys (n=911, weighted population of 10 362), the odds of consuming milk and milk products daily were increased amongst non-smokers as compared to daily and occasional smokers (OR=1.81, CI=1.23-2.69, p=0.003) and decreased amongst those who did not attend school as compared to those who did (OR=0.40, CI=0.25-0.66, p=<0.001). All of these relationships persisted when adjusted for other variables included in the multivariate models. In **Study 4** (n=84, 12.38±1.07 years old, 49% male, 67% overweight or obese), 39% of youth were found to consume snow goose weekly, and girls less so than boys (p=0.006). Although snow goose consumption was not associated with body mass index, the frequency of its consumption was associated with intake of meat and alternatives (p=0.019), protein (p=0.004), vitamin B_{12} (p=0.004), iron (p=0.011) and zinc (p=0.006), where nutrient intakes were highest among those who consumed snow goose moderately (2-6 times per week). Nutrient intake by goose consumption level interacted with sex for protein (p=0.018), thiamine (p=0.008), riboflavin (p=0.042) and iron (p=0.030). Although no changes in mean food group or nutrient intake intakes were observed following the harvest sharing program (n=73, 12.34±0.99 years old, 44% male), it appeared that a greater proportion of youth reported consuming snow goose at this time (63% vs. 48%), and girls were significantly more likely to report consuming the food (61% vs. 33%, p=0.015). In **Study 5**, youth had higher intakes of vegetables and fruit (p=0.048), milk and alternatives (p=0.017), 'other' foods (p=0.030), carbohydrates (p=0.025), fibre (p=0.019), thiamine (p=0.040), riboflavin (p=0.008), folate (p=0.006), calcium (p=0.015), iron (p=0.046), potassium (p=0.007), zinc (p=0.042) and kilocalories (p=0.021) following four years of the program (n=49, 12.7±1.0 years old, 59% male) as compared to baseline (n=43, 13.1±0.9 years old, 60% male). Although numerous challenges were encountered over the first four years of the program, many supporting strategies were noted by the principal and coordinating committee (n=3). Advocacy and community ownership of the program emerged as strong supports to the program's expansion and sustainability. Acquiring reliable personnel and sustained funding, building new facilities and receiving donations of equipment, and moving away from local food purchasing were helpful approaches.

Conclusions. The diets of Aboriginal Canadian youth of school age are typically energy dense and nutrient poor. Explorations of the individual, behavioural, socioeconomic and sociocultural predictors of traditional and healthy store-bought food intakes in a nationwide sample of on-reserve FN youth found a range of significant associations. Traditional food intake was strongly predicted by food sharing and closeness to one's culture (i.e., participation in community cultural events and speaking a FN language), while the intake of healthy store-bought alternatives (i.e., vegetables, and milk and milk products) was predicted by school attendance, other health-related behaviours (i.e., not smoking, abstaining from alcohol, being physically active), and indicators of socioeconomic status (i.e., higher parent education level, fewer children residing in the household, living with both biological parents). These associations varied by age and sex and were not always in the expected direction. In three remote, isolated communities on the western coast of James Bay, school and community programs had a positive impact on the traditional food, healthy food and nutrient intakes of youth, but in all cases these programs were not sufficient to bring the micronutrient and food group intakes of these youth to recommended levels. Nevertheless, these investigations underscore the positive outcomes that can be achieved when the necessary resources are applied in communities that strongly value the good health of their young people.

Acknowledgements

Making it to the end of this very long road was not something that I could have accomplished independently and for that reason I would like to acknowledge the contributions of all of those who have made this possible. First, thank you to the University of Waterloo for providing me with a supportive environment in which to work. I am of course grateful to my supervisors, Drs. Rhona Hanning and Len Tsuji. Thanks to Rhona for first accepting me as a Masters student, for helping me work on my weaknesses, and for the many opportunities to develop my skills and gain confidence in myself. Thank you to Len for the many trips to the north where you introduced me to our community-based partners, thus making this thesis work possible, and for the memorable once-in-a-lifetime experiences that these travels provided. To my committee members, Drs. Marty Cooke and Dan McCarthy, thank you for your valued inputs into this work by providing new perspectives and for pushing me to work outside of my comfort zone. Thank you as well to Dr. Kathi Wilson, my external examiner, for the time, energy and interest that you have put into reviewing my thesis work at the final defence stage. I am also grateful Dr. Ian Martin who patiently took the time to tutor me on statistics and to Maria Santos who made my time at the First Nations Data Centre a comfortable and efficient one.

Beyond my academic supporters I would like to thank my family, especially my parents, for their enduring belief in me throughout this process. Thank you for instilling in me the values of hard work, perseverance and determination, and for having the confidence in me that I find difficulty in finding in myself. Beyond supporting my academic aspirations, thank you for encouraging my passion for endurance sports which taught me that anything is possible through hard work and dedication. Although seemingly irrelevant to academia, my training was a welcome reprieve from my thesis work and also a key factor in maintaining my focus, sanity and health through all of these years. Of course, I cannot forget Michelle who was always close by to provide a thoughtful second opinion. Neither of us could have gone at this alone. Thanks for being the ever-reliable voice of reason and source of entertainment. You were also a very dependable research assistant and editor. Christopher and Shaio, thank you for believing in me from a distance, it is nice that we are finally not so far apart. My little schnauzer and constant companion, Frankincense, came into my life at just the right time. Thank you to Diane Ykelenstam for making that possible. To my fellow graduate students, thank you for being there along the way, it has been fantastic working with you all and I am really going to miss it.

This thesis work was made possible by the First Nations Information Governance Centre's First Nations Research Data Centre, which provided data for two of the studies. I am also grateful to the First Nations communities in northern Ontario who welcomed and collaborated with my colleagues and I on two of the studies, and to the participants who gave their time. The research was funded by Canadian Institutes of Health Research grants. I am extremely lucky to have received training and funding via the Heart and Stroke Foundation of Ontario Masters Studentship Award (2010-2011), the Population Intervention for Chronic Disease Prevention (Canadian Institutes of Health Research and Cancer Care Ontario) training grant (2011-2013), and the Canadian Institutes of Health Research Frederick Banting and Charles Best Canada Graduate Scholarships Doctoral Award (2012-2015) which made my time as a doctoral student infinitely more manageable. Additional funding from the University of Waterloo's President's Graduate Scholarship, Doctoral Entrance Award for Women and numerous teaching and research assistantships were highly appreciated.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

A. **AANDC** Aboriginal Affairs and Northern Development Canada

ACS Aboriginal Children's Survey

AI Adequate Intake

AMDR Acceptable Macronutrient Distribution Range

ANOVA Analysis of Variance

APS Aboriginal Peoples Survey

AS!BC Action Schools! British Columbia

ATFE Akwesasne Task Force on the Environment

B. **BMI** Body Mass Index

C. **CA** Central Adiposity

CCHS Canadian Community Health Survey

CDC United States Centers for Disease Control and Prevention

CFG Eating Well with Canada's Food Guide

CHMS Canadian Health Measures Survey

CHO Carbohydrate

CI Confidence Interval

CIHI Canadian Institute of Health Informatics

CIHR Canadian Institutes of Health Research

CINE Centre for Indigenous Peoples' Nutrition and Environment

CORE Course on Research Ethics

D. **DC** Dietitians of Canada

DFE Dietary Folate Equivalents

DRI Dietary Reference Intake

E. **E** Energy

EAR Estimated Average Requirement

ERIC Education Resources Information Center

F. **FFQ** Food Frequency Questionnaire
FN First Nations
FNIGC First Nations Information Governance Centre

G. **GP** Grain Products

H. **HEI-C** Healthy Eating Index-Canada

I. **ICHS** Inuit Child Health Survey
IHS Inuit Health Survey
IOTF International Obesity Task Force

K. **KSDPP** Kahnawake Schools Diabetes Prevention Project

L. **LFS** Labour Force Survey

M. **MA** Meat and Alternatives
MMA Milk and Alternatives
MSE Mean Standard Error

N. **NHS** National Household Survey

O. **OCAP®** Ownership, Control, Access and Possession®
OR Odds Ratio

P. **PHAC** Public Health Association of Canada
PRISMA Preferred Reporting Items for Systematic Reviews and Meta-Analyses

R. **RAE** Retinol Activity Equivalents
RDA Recommended Dietary Allowance
RHS First Nations Regional Health Survey

S. SBF Store Bought Foods

SD Standard Deviation

SLHDP Sandy Lake Health and Diabetes Project

SLSDPP Sioux Lookout Schools Diabetes Prevention Project

SPSS Statistical Package for the Social Sciences

T. TCPS2 Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans

TF Traditional Foods

U. UL Tolerable Upper Intake Level

USA United States of America

USDA United States Department of Agriculture

UW University of Waterloo

V. VF Vegetables and Fruit

W. WEB-Q Waterloo Web-based Eating Behaviour Questionnaire

WHO World Health Organization

Y. y Years

1.0 Background

1.1 Aboriginal People in Canada

Aboriginal peoples are the descendants of the first inhabitants of North America (Aboriginal Affairs and Northern Development Canada [AANDC], 2012). Canada's Aboriginal population includes First Nations (FN), Métis and Inuit people according to the Constitution (AANDC, 2012). With the exception of the literature review, the studies contained within this thesis have focused exclusively on FN people living on reserves.

Internationally, the proportion of Canada's population that identifies as Indigenous ranks second only to New Zealand (Statistics Canada, 2012). In 2011, 4.3% of Canadians identified as Aboriginal, a proportion that has been rising steadily (up from 3.6% in 2006, 3.3% in 2001 and 2.8% in 1996) (Statistics Canada, 2012, 2013a). The rate of growth of Canada's Aboriginal population has been relatively rapid. From 2006 to 2011, the population grew by 20% to a total of 1 400 685 people, compared to the 5% growth rate for the general population (Statistics Canada, 2013a). This rapid population growth has been attributed mainly to a high birth rate, more people identifying themselves as Aboriginal, and the more complete enumeration of FN reserve populations in the last 20 years (Statistics Canada, 2012). Of Aboriginal Canadians, the majority identify as FN (60.8% or 851 560 people) or Métis (32.3% or 451 795 people) (Statistics Canada, 2013a). Only 4.2% of Canadian Aboriginal people identify as Inuit (59 445 people) (Statistics Canada, 2013a).

By total population size, the largest numbers of Aboriginal people reside in Ontario, Manitoba, Alberta and British Columbia (Statistics Canada, 2013a). As of 2011, 79.1% of Aboriginal

Canadians lived in Ontario (21.5%) or the four western provinces (16.6% for British Columbia, 15.8% for Alberta, 14.0% for Manitoba and 11.3% for Saskatchewan) (Statistics Canada, 2013a). Another 10.1% lived in Quebec and 6.7% lived in the Atlantic provinces (Statistics Canada, 2013a). Still, Aboriginal people made up the largest proportion of the population in Nunavut and the territories. In Nunavut, 86.3% of the population identified as Aboriginal (Statistics Canada, 2013a). The figures for the Northwest Territories and Yukon Territories were 51.9% and 23.1%, respectively (Statistics Canada, 2013a).

1.2 History of Canada's Aboriginal Peoples

Canada's Indigenous peoples occupied North America long before European explorers arrived on the continent in the 11th century (Lackenbauer, Moses, Sheffield, & Gohier, 2004; AANDC, 2013). By the 17th century, the French and British had become dominant powers in North America, creating alliances with FN people to support their commercial interests, including trading European goods for furs (Lackenbauer et al., 2004; AANDC, 2013). Until the late 1700s, alliances between the British and the FNs continued, with their relationship being based largely on commercial and military interests (Lackenbauer et al., 2004; AANDC, 2013).

Beginning in 1820, a new perspective of FN people emerged throughout the British Empire based on the misguided belief that British society and culture were superior, and that it was the duty of the British to bring Christianity and agriculture to FN people in order to 'civilize' them (AANDC, 2013). Thus, they encouraged FN people to abandon their traditional ways of life for an agrarian, sedentary regime (AANDC, 2013). This 'civilization program' remained in place for the next 150 years (AANDC, 2013).

Beginning in 1883, residential schools became the primary means for the 'assimilation' and 'civilization' of FN peoples (Regan, 2010; Truth and Reconciliation Commission of Canada, 2012; AANDC, 2013). First Nations children were forced to abandon their cultural values and traditions and become educated in the same way and on the same subjects as non-Aboriginal children (Regan, 2010; AANDC, 2013). They were punished for practicing their own traditional cultural beliefs and forbidden to speak their own language (Regan, 2010; Truth and Reconciliation Commission of Canada, 2012). Moreover, residential school attendees endured years of emotional and physical abuse, substandard living conditions and complete isolation (even being removed from their parents) for 10 months of the year (Regan, 2010). Aboriginal Elders were prevented from teaching the important spiritual and cultural values of their people to the younger generations (Truth and Reconciliation Commission of Canada, 2012).

More than 150 000 FN children were forced to attend the 132 residential schools across Canada until the closure of the last school in Saskatchewan in 1996 (Regan, 2010; AANDC, 2013). Many of these children did not survive their stay at the schools (Truth and Reconciliation Commission of Canada, 2012). For the survivors, their experiences left permanent psychological and cultural scars, and the traumas that they endured have continued to negatively impact successive generations of FN people (Söchting, Corrado, Cohen, Ley, & Brasfield, 2007; Regan, 2010; Truth and Reconciliation Commission of Canada, 2014). As of 2010, there remained approximately 80 000 residential school survivors living in Canada (Regan, 2010).

1.3 Inequities in the Broader Social Determinants of Health

Misguided attempts at assimilation and a long history of abuse have left Canada's Aboriginal people as one of the most marginalized populations in the country (Regan, 2010). Relevant in the context of this thesis, Aboriginal people face poorer health outcomes as compared to the general population, including a greater burden of some chronic diseases and a shorter life expectancy (Tremblay, Pérez, Ardern, Bryan, & Katzmarzyk, 2005; King, Smith, & Gracey, 2009; Statistics Canada, 2012; Gionet & Roshanafshar, 2013; Statistics Canada, 2013a). These health disparities are largely explained by inequities in many of the broader social determinants of health, including but not limited to: poorer educational attainment and access to education, lesser employment and lower income (poverty), and inferior living conditions (and greater homelessness) (Statistics Canada, 2009a; Leach, 2010; Regan, 2010; Wilson & McDonald, 2010; Zietsma, 2011; Statistics Canada, 2012).

1.3.1 Educational Attainment

Generally, Aboriginal people in Canada attain lower levels of education compared to non-Aboriginal people. National Household Survey (NHS) data (2011) indicated that nearly one third (28.9%) of Aboriginal Canadians had not completed high school, about half (48.4%) had some post-secondary education and 9.8% had a university degree (Statistics Canada, 2013a). By contrast, in the non-Aboriginal population, only 12.1% had not completed high school, 64.7% had some post-secondary education and 26.5% had a university degree (Statistics Canada, 20013a). For FN people, those living off-reserve tended to achieve higher levels of education; 10.9% had a university degree compared to 4.7% of those living on-reserve (Statistics Canada, 2013a). This may be a reflection of the disparity in educational opportunities available to those living on-reserve as compared to off-reserve. Especially tor those living in remote, isolated locations or in the far north, opportunities for higher education may exist only if one is willing to leave their home community.

1.3.2 Income and Employment

Income and employment opportunities, especially for on-reserve FN people living in remote or isolated locations, are often limited (First Nations Information Governance Centre [FNIGC], 2012). According to the Labour Force Survey (LFS) (2008-2009), the employment rate for Aboriginal people lags behind that of the non-Aboriginal population. In 2007, 2008 and 2009, respectively, employment rates in Canada were 59.0%, 60.2% and 57.0% for Aboriginal people compared to 63.6%, 63.7% and 61.8% for non-Aboriginal people (Zietsma, 2011). Similar disparities were observed in rates of unemployment. In 2007, 2008 and 2009, respectively, 10.6%, 10.4% and 13.9% of Aboriginal people were unemployed as compared to 5.9%, 6.0% and 8.1% of non-Aboriginal people (Zietsma, 2011).

Accordingly, Aboriginal people are disproportionately ranked amongst the poorest of all Canadians (Wilson & Macdonald, 2010). Median total income for the Aboriginal population (aged 25-54 years) in 2005 was inferior that of the non-Aboriginal population at $22 000 compared to $33 000 per year (Statistics Canada, 2012). Although the gap in total income between Aboriginal and non-Aboriginal Canadians narrowed slightly between 1996 and 2006, at the current pace it is estimated that it will be another 63 years before income equality is reached (Wilson & Macdonald, 2010).

1.3.3 Living Conditions and Homelessness

Living conditions for Canada's Aboriginal people are often substandard. Aboriginal people are three or more times more likely than non-Aboriginal people to be living in a dwelling considered to be 'crowded' (i.e., more than one person per room, 11% vs. 3% for non-Aboriginal people), or to be living in a home that requires repairs (25% vs. 7% for non-Aboriginal people) (Statistics Canada, 2012). Further, Aboriginal people are overrepresented amongst the homeless in all of Canada's major cities (Leach, 2010). Although they represented only 4% of the total population in 2006, Aboriginal people represented more than 10% of the homeless population, and in some cities, more than 70% of the homeless people were Aboriginal (Leach, 2010). Homelessness in the Aboriginal population may be linked to numerous systemic barriers, including: lower levels of education, a higher unemployment rate, a shortage of affordable housing, discrimination when trying to find a home, and higher rates of substance abuse and addictions, among others (Leach, 2010).

1.3.4 Overall Health and Life Expectancy

As mentioned, Aboriginal Canadians face poorer health outcomes as compared to the non-Aboriginal population, attributable largely to differences in socioeconomic (i.e., employment, living conditions, access to health services), cultural (i.e., racism, loss of cultural identity) and historical (i.e., loss of language and traditional lifestyles) factors unique to their population group (King, Smith, & Gacey, 2009; World Health Organization [WHO], 2013a).

Today, the life expectancy of Canada's Aboriginal people lags behind that of the non-Aboriginal population (73, 74 and 64 years for FN, Métis and Inuit men and 78, 80 and 73 years for FN, Métis and Inuit women compared to 79 years and 80 years for non-Aboriginal men and women, respectively) (Statistics Canada, 2012). This gap in life expectancy can be explained in part by the fact that Aboriginal people are at a higher risk for injuries and suicides, which are causes of death that are more likely to occur in younger people (Health Canada, 2005). Canadian Community Health Survey (CCHS) data (2007-10) indicated that only 54% of Métis, 50% of off-reserve FN and 55% of Inuit people ≥12 years-old would rate their health as 'excellent' or 'very good', compared to 63% of non-Aboriginal Canadians (Gionet & Roshanafshar, 2013). Further, 56% of off-reserve FN and 55% of Métis reported being diagnosed with one or more chronic health condition compared to 43% of non-Aboriginal people (Gionet & Roshanafshar, 2013).

1.4 A Focus on the Health of School-aged First Nations Youth Living On-reserve

1.4.1 A Need for Information on the Health of On-reserve First Nations Youth

The work contained within this thesis has focused mainly on the nutritional health of young FN people living on reserves. Although Canadian Aboriginal people are becoming increasingly urban (i.e., living in large cities or smaller urban centres), a large proportion of FN people reside on reserves (Statistics Canada, 2013a). Reserves are areas of land to be used solely by FN people (The Canadian Encyclopedia, 2012). Though the health of the urban Aboriginal population has been understudied (Wilson & Young, 2008; Ning & Wilson, 2012), one could also argue that FN people living on reserves face unique challenges with relation to access to culturally competent health care and likely differ with respect to many of the social determinants of health. Thus, research specific to this population group is equally important.

Though there exist numerous sources of health and demographic data for Aboriginal Canadians (the Census of the Population, the Aboriginal Peoples Survey (APS), the Aboriginal Children's Survey (ACS), the CCHS, the Canadian Health Measures Survey (CHMS), the Inuit Health Survey (IHS), the Inuit Child Health Survey (ICHS), the LFS, and the NHS) many of these leave on-reserve FN people either underrepresented or completely excluded. Further, there has been a general lack of research on the health of young Aboriginal people, in general; between the years 2000 and 2010, only 43 articles were published on the topic (compared to 83 for non-Aboriginal youth) (Ning & Wilson, 2012). Specifically, data on important social determinants of health (e.g., socioeconomic status) are inadequate (Ning & Wilson, 2012). There is thus a need for data specifically on the health of on-reserve FN people, and those residing in remote and isolated areas or the far north, as well as the many factors that affect their health behaviours and outcomes. The First Nations Regional Health Survey (RHS) was the first national survey administered by FN people to investigate, specifically, the health and wellbeing of FN adults, youth and children living on reserves and in Canada's north. The data from the most recent survey (2008/10) have mainly been reported descriptively (FNIGC, 2012), thus there is much room for more thorough investigations into the many factors that affect the health of this understudied population.

The FN population is young, with a median age of only 26 years as compared to 41 years in the general population (Statistics Canada, 2013a). It is therefore logical that initiatives targeting the health behaviours of FN people be focused on youth, and this has been the recommendation of scholars in the field of Aboriginal health (Willows, Hanley, & Delormier, 2012). The traumas historically experienced by FN people as a result of misguided assimilation policies and the residential school system have continued to affect the subsequent generations. Furthermore, disparities in the social determinants of health affect not only individuals, but also families, communities, and children. Thus, despite the youthfulness of the population, young FN people have not been spared of some of the same health outcomes that also disproportionately affect FN adults, namely obesity and type 2 diabetes.

1.4.2 Overweight, Obesity and Related Health Consequences

As context to the prevalence rates presented herein, it is important to touch on the measurement and classification of weight status for children and youth. The body mass index (BMI), a simple measure of weight-for-height defined as a person's mass (i.e., weight) in kilograms divided by their squared height in metres (kg/m^2), is a commonly used tool for defining weight status (World Health Organization [WHO], 2013b). For children and youth, the recently updated International Obesity Task Force (IOTF) cut points for thinness, healthy weight, overweight and obesity may be used (Cole & Lobstein, 2012). Although not tailored to Aboriginal people, these cut points are based on BMI data from six regions (the United Kingdom, United States of America, the Netherlands, Brazil, Singapore and Hong Kong) collected over 30 years and are considered to be internationally relevant for individuals between the ages of 2 and 18 years (Cole & Lobstein, 2012).

Alternatively, WHO Growth Charts may be used to classify the weight status of 5 to 19 year-old children and youth based on age and sex-specific percentile curves (de Onis, Onyango, Borghi, Siyam, Nishida, & Siekmann, 2007). These curves have been specifically adapted for use in Canada and are considered the gold standard for monitoring the growth children and youth

(Dietitians of Canada [DC], Canadian Paediatric Society, The College of Family Physicians of Canada, Community Health Nurses of Canada, & Secker, 2010). As compared to the WHO cut points, those developed by the IOTF lack sensitivity and may therefore lead to an underestimation of overweight and obesity within a population sample (Reilly, Kelly, & Wilson, 2010).

According to data from the 2004 CCHS, 21% and 20% of Aboriginal youth aged 2 to 17 years were either overweight or obese, respectively (combined total of 41%), compared to only 8% and 18% of non-Aboriginal youth (Shields, 2006). More recently, self-reported data from the RHS (2008/10) showed that a respective 20% and 42% of on-reserve FN youth aged 2 to 11 years were overweight or obese (combined total of 62.5%) (FNIGC, 2012). These figures declined with age; youth aged 12 to 17 years experienced overweight and obesity rates of 30% and 13%, respectively. Although not collected within the same time period, the data from the RHS and CCHS are comparable in that the height and weight data were self-reported and the IOTF cut points for BMI were used on both surveys. The figures from both studies were likely underestimates of true prevalence rates based on the tendency for individuals to overestimate their height and underestimate their weight (Sherry, Jefferds, & Grummer-Strawn, 2007). It is, nevertheless, without a doubt that Aboriginal youth are more severely affected by overweight and obesity as compared to their non-Aboriginal peers (Shields, 2006).

Overweight and obesity in young people is concerning because of the negative impact that carrying excess weight can have on their health, both in the present time and in their future lives as adults. Overweight and obese youth are at an increased risk for a number of comorbidities including chronic health conditions, premature death (prior to age 55 years) and reduced quality of life, not to mention the social stigma and psychological consequences often associated with being overweight (e.g., low self-esteem, poorer social functioning) (Wang, Wild, Kipp, Kuhle, & Veugelers, 2009; Tsiros, Olds, Buckley, Grimshaw, Brennan, & Walkely et al., 2009; Franks, Hanson, Knowler, Sievers, Bennett, & Looker, 2010; Willows, Ridley, Raine, & Maximova, 2013). There is evidence to show that youth who carry excess weight are at an increased risk of continuing to be overweight or obese in adulthood (Singh, Mulder, Twisk, van Mechelen, & Chinapaw, 2008; Herman, Craig, Gauvin, & Katzmarzyk, 2009). This may be attributed to a number of different factors; adipose cells increase most rapidly in number during the growing years and childhood and adolescence are also times when health habits, including food behaviours, are being formed. These habits have a tendency to persist with age, in that an adolescent who does not follow a healthy diet pattern is less likely to do so as an adult (Lake, Mathers, Rugg-Gunn, & Adamson, 2006; Lake, Adamson, Craigie, Rugg-Gunn, & Mathers, 2009). Overweight and obese youth are also at an increased risk of health complications during their future lives as adults. *Reilly and Kelly* (2011) published a systematic review of 28 studies that examined the association between excess body weight in youth and physical morbidity and risk of premature death as adults. The authors found consistent evidence to indicate that measured overweight and obesity were associated with an increased risk of morbidity and premature mortality, particularly cardiometabolic mortality, in adulthood (Reilly, & Kelly, 2011).

The etiology of overweight and obesity in Aboriginal youth is complicated and affected by factors at multiple levels of influence, including: historical factors (e.g., colonization), societal factors (e.g., health policies, norms portrayed in the media), the built environment (e.g., types and concentration of food outlets, community safety), community, home and sociocultural environments (e.g., income, food security), interpersonal factors (e.g., feeding practices, family support) and individual factors (e.g., beliefs, motivations, genetics) (Willows, Hanley, & Delormier, 2012). Despite these multiple influences, the current thesis work focused on food intake, a potentially modifiable contributor to overweight and obesity. Food choices and the ability and desire of a young person to make healthy choices can be influenced by factors at all levels of the social ecological model of health behaviour (Willows, Hanley, & Delormier, 2012).

1.4.3 Food Behaviours and the Nutrition Transition

Since colonization, Aboriginal peoples, in general, have experienced a decline in diet quality, concomitant with a lifestyle shift characterized by an increase in sedentary behaviours and a decrease in physical activity (Kuhnlein, Receveur, Souieda, & Egeland, 2004). Prior to colonization, Aboriginal people met all of their energy requirements through traditional food sources via hunting, trapping, fishing and gathering (Kuhnlein et al., 2004; Willows, 2005; Haman, Fontaine-Bisson, Batal, Imbeault, Blais, & Robidoux, 2010). The replacement of these nutrient-rich and culturally important foods with the store-bought choices of lesser nutritional quality has meant that the diets of Aboriginal people to are now, in general, more energy-dense and nutrient-poor than in the past (Kuhnlein et al., 2004).

For FN youth, nutrient-rich traditional foods and healthy store-bought food choices are both important in setting the foundation of a nutritious diet. Typically, diets that contain traditional foods are more nutrient rich, being higher in a number of vitamins and minerals (e.g., vitamin D, vitamin E, riboflavin, vitamin B_6, iron, zinc, copper, magnesium, manganese, phosphorus, potassium and selenium) even when only small amounts of these foods are consumed (Kuhnlein et al., 2004). In fact, a comprehensive review of the research found that the substitution of traditional foods with nutrient-poor store-bought foods was partly to blame for the often low intakes of iron, folate, calcium, vitamin D, vitamin A, fibre and vegetables, and high intakes of sugar and fat for Aboriginal people (Willows, 2005).

Typically, children and youth consume less traditional foods than their parents and Elders; the diets of Aboriginal youth today are composed mainly of store-bought foods of poorer nutritional quality (Kuhnlein et al., 2004; Willows, 2005; Pigford & Willows, 2010). In a study investigating the dietary patterns of three cultural groups living in the Canadian Arctic (Yukon FN, Dene/Métis and Inuit), it was estimated that only 10-36% of total energy intake came from traditional food sources (Kuhnlein et al., 2004). It has been suggested that young Aboriginal people may be losing the taste preference for traditional food and the knowledge necessary for the harvesting and preparation of them (Willows, 2005).

With relation to store-bought foods, research in a number of discrete on-reserve FN populations has revealed that many youth are not consuming adequate healthy choices to meet their nutrient requirements, nor to promote their optimal health. In a population of Cree children residing in subarctic regions of Quebec for example, only 19% of youth consumed adequate milk and alternatives based on Canada's Food Guide (CFG) recommendations (Health Canada, 2007a) and 99% consumed less than five servings of vegetables and fruit per day (Downs, Arnold, Marshall, McCargar, Raine, & Willows, 2009). The majority (77%) of the participating youth ate at a restaurant or had a take-out meal on one of the three days of recall (Downs et al., 2009). Similarly, research in on-reserve FN communities in Ontario found that the vast majority of youth had inadequate intakes of milk and alternatives (73-85%), calcium (86%) and vitamin D (96%) (Gates, Hanning, Gates, Martin, & Tsuji, 2012a). Mean intakes of vegetables and fruit also fell below currently recommended levels (Gates, Hanning, Gates, Skinner, Martin, & Tsuji, 2012b).

Amongst a representative sample of on-reserve FN youth aged 12-17 years, the RHS reported that only 35% consumed milk or milk products daily, and a respective 32% and 29% consumed vegetables and fruit (excluding juice) with this same frequency (FNIGC, 2012). Conversely, 26% consumed soda several times daily, while another 27% consumed soda once per day (combined total of 53%) (FNIGC, 2012). More than one-tenth (11%) of youth consumed 'fast foods' (e.g., hamburgers, hot dogs) daily, while 17% of youth consumed sweets (e.g., candy, cookies, cake) with this same frequency (FNIGC, 2012). Only 24% of youth reported always or almost always consuming a healthy, balanced diet, and the proportion of youth reporting this declined with increasing age (FNIGC, 2012). Indeed, a recent review of the diets of school-aged Aboriginal youth (Gates, Skinner, & Gates, 2015 [**Study One** herein]) concluded that the diets of these youth, on the whole, fell short of a number of important nutrients, while concomitantly being high in nutrient-poor 'other' foods.

1.4.4 Food Insecurity and Considerations for Northern, Isolated and/or Remote Reserves

First Nations people living on reserves may face some unique challenges and barriers to making healthy food choices. Food insecurity is prevalent amongst FN families (Gionet & Roshanafshar, 2013), and even more so amongst some discrete FN communities (Skinner, Hanning, & Tsuji, 2014). As defined by The World Food Summit (1996), food security exists "*when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy, active life*" (WHO, 2014). Food security is dependent on both the physical and economic access to food that meets not only people's dietary requirements but also their food preferences (WHO, 2014). In the absence of these conditions, food *in*security exists. For FN people living on reserves, the RHS (2008/10) found that more than half of households (54.2%) were either moderately or severely food insecure (FNIGC, 2012), far in excess of the 7% prevalence rate in the non-Aboriginal population as measured by the CCHS (2007-10) (Gionet & Roshanafshar, 2013). In some communities, the prevalence may be even higher. In a subarctic community in northern Ontario, *Skinner, Hanning, & Tsuji* (2014) identified a household food insecurity rate of 70%, and 76% for households with children.

Especially in some communities, the high cost of food in the north contributes to food insecurity and the quality of food choices (FNIGC, 2012; Gionet & Roshanafshar, 2013). It is estimated that it can cost $360-450 per week to feed a family of four a nutritious diet in northern regions, as compared to only $200-250 in more southern areas of the country (Gionet & Roshanafshar, 2013). Especially in some remote, isolated areas, this may be compounded by the lack of adequate employment opportunities for FN people. Analyses of Canadian Community Health Survey data indicated that 17.9% of Aboriginal households relied on social assistance, and that these households were far more likely to be food insecure (Willows, Veugelers, Raine & Kuhle, 2009; Health Canada, 2007b). Specifically in First Nations communities, the RHS found that 57.6% of adults had an annual income of less than $20 000 (FNIGC, 2012), an amount insufficient to support an adequate standard of living in the north. Approximately one-third of on-reserve First Nations adults (33.9%) relied on social assistant as their main source of income (FNIGC, 2012).

For FN people, sufficient access to the traditional foods that are an integral part of their culture is particularly important. Beyond the nutritional benefits of traditional food intake, the literature consistently reports that FN people place high value on locally harvested and prepared food in terms of health and cultural benefits; these benefits are being increasingly undermined by Western food habits (Haman et al., 2010). Although traditional foods may seem like an economical alternative to store-bought ones, in some locations, the costs associated with hunting and harvesting (e.g., travel, equipment) are high, such that only those with substantial economic resources can take part (Haman et al., 2010; Gaudin, Receveur, Girard, & Potvin, 2015). Beyond the economic costs of procuring traditional foods, some FN people may be concerned that these foods have been contaminated (Haman et al., 2010). Whether or not this fear is warranted, such concerns must be weighed against the known cultural and nutritional benefits of traditional food consumption (Haman et al., 2010). The destruction of traditional lands and limits on the areas that can be used for hunting and harvesting are additional barriers to the procurement and consumption of traditional foods for FN families (Gaudin et al., 2015).

In many communities (especially northern, remote and/or isolated ones), when traditional foods are not available or not desired, families must rely on only one store at which to purchase alternatives foods, where prices can be exorbitant (Haman et al., 2010; Gates, Hanning, Gates, Isogai, Metatawabin, & Tsuji, 2011, 2013a, 2013b). Purchasing healthy substitutes for traditional foods may not be an option for many people, as they may be too costly, not available at local food outlets, or not of acceptable quality when they are available (Gates et al., 2011, 2013a, 2013b).

1.4.5 Supporting the Nutritional Health of On-reserve First Nations Youth

Built on knowledge of the factors that can influence the food choices of FN people, and recognizing the value of targeting youth in health promoting initiatives, local solutions aimed at improving the diet quality of these vulnerable young people will be necessary. Although the cultural and nutritional value of traditional foods cannot be understated, the promotion of both traditional and more mainstream, healthy food choices will be important, given that a return to entirely traditional diets is not likely. By involving youth, healthy habits could be instilled at a young age, before excess weight gain becomes a problem. From the author's experience working in some FN communities, the health and wellness of youth is something that is highly valued, as young FN people are the future of the community. Though potentially impeded by many challenges, strategies built on existing community strengths and engaging particularly keen community members may hold promise.

The school is a promising locale for promoting the nutritional health of FN youth, as at school these youth are generally easily accessible most days of the week. School-based initiatives could have the ability to reach a large proportion of the population at an age when they are most receptive to behaviour change and establishing lifelong habits. Schools are also a source of skilled personnel and potential role models for positive health habits. From the author's personal experience, at least in some FN communities, schools may act as a hub where community members convene for social and other events. In this case, schools may also provide for an opportune locale for fostering family and community involvement in supporting the good health of youth, thus reinforcing the lessons and messages delivered at school. The provision of healthy foods at school could also expose youth to foods that may not otherwise be available for them to try at home. Given the known value of engaging youth in health promoting initiatives, and the broad reach that school-level programs provide, the work within this thesis has focused on the determinants of healthy food choices for school-aged FN people, and the evaluation of school and community programs.

2.0 Opening Remarks

2.1 Rationale

As described in section **1.0 Background**, Canada's Aboriginal population remains one of the most disadvantaged of all ethnic groups in the country (Statistics Canada, 2009a; Leach, 2010; Wilson & McDonald, 2010; Zietsma, 2011; Statistics Canada, 2012). Of particular concern in the context of this thesis is the disproportionate burden of overweight and obesity experienced by this population, and in particular, the FN population living on-reserve (Tremblay et al., 2005; Gionet & Roshanafshar, 2013). Overweight and obesity are the root cause of a number of adverse health conditions, both physical and psychological, for FN adults, children and youth alike (Tjepkema, 2006; Guh, Zhang, Bansback, Amarsi, Laird Birmingham, & Anis, 2009; Wang et al., 2009; Tsiros et al., 2009; Franks et al., 2010; Willows et al., 2013). Because the FN population is young and weight and health behaviours like food choices tend to persist from childhood and adolescence into adulthood, focusing health-promoting initiatives on youth is an approach that holds much promise (Singh et al., 2008; Herman et al., 2009; Lake et al., 2009; Willows, Hanley, & Delormier, 2012; Statistics Canada, 2013a).

The determinants of overweight and obesity for Aboriginal peoples are numerous, however, diet is a significant contributor that has the possibility of being modified by many means. These may include promoting positive perceptions, attitudes and self-efficacy, enhancing knowledge, environmental changes that improve the access to healthy foods and policy changes that facilitate making healthy choices. There has been some research to indicate that the diets of Aboriginal Canadians have changed; a move away from traditional foods procured off the land toward store-bought foods has led to a diet that is less nutrient-rich and more energy dense than before

(Kuhnlein et al., 2004). Nevertheless, there is a need for more information on the food habits of FN youths who live on reserves in Canada, and the many factors that play a part in choosing healthy foods, whether these are traditional foods or healthier store-bought alternatives. Such information will equip FN communities with the knowledge necessary to begin to design and deliver tailored programs aimed at providing their youth the best possible chance of living long, healthy lives. The overall aim of this thesis was to begin to explore some of the factors that may influence the food choices of on-reserve FN youth, and to plan and evaluate the impact of programs supporting the nutritional health of this population.

2.2 Thesis Organization

This thesis work is divided into five distinct studies. **Figure 2.1** succinctly illustrates the questions that these five studies addressed, and how each study built upon the previous work. Background information on the demographics, history and health of FN Canadians is presented in **Section 1.0** and helps to provide a foundation for the work that follows. **Study One** presents a systematic review of refereed literature on the dietary intakes of Aboriginal youth in Canada, published between January 2004 and January 2014 (Gates, Skinner, & Gates, 2015). Although the review focused on research in which any Aboriginal youth were participants, the remainder of the thesis focused specifically on FN youth living on reserves.

Study Two utilized nationwide data from the RHS 2008/10 to explore the socioeconomic and sociocultural predictors of frequent traditional food intake for on-reserve FN youth (12-17 years old). **Study Three** utilized the same set of data, this time to explore the individual, behavioural and socioeconomic predictors of healthy store-bought food choices. **Study Four** and **Study Five**

moved on from the previous work to provide in-depth prospective accounts of health-promoting programs that were implemented and evaluated among three small, remote and isolated FN communities located on the western James Bay coast in northern Ontario. **Study Four** documented a harvest sharing program that aimed to improve the access to lesser snow geese amongst the members of two communities during the Spring 2011 season. **Study Five** described process and outcome evaluations of a healthy school snack program in one community, four years following its initial implementation.

Chapter 8.0 discusses the key contributions to the academic literature that have resulted from this thesis work. **Chapter 9.0** provides a summary of some possible future directions that this work may inform, and **Chapter 10.0** includes the author's concluding remarks.

2.3 Overarching Objectives

Although each study included in this thesis had its own distinct objectives, the purpose of the totality of the research herein was to, more generally:

A. Review the current literature on the diets of Aboriginal youth in Canada (**Study One**).

B. Explore the socioeconomic and sociocultural predictors of frequent traditional food intake amongst a large, nationwide sample of Canadian on-reserve FN youth (**Study Two**).

C. Explore the individual, behavioural and socioeconomic predictors of healthy store-bought food choices amongst a large, nationwide sample of Canadian on-reserve FN youth (**Study Three**).

D. Assess the nutritional significance of lesser snow goose (a traditional food) consumption for youth in two remote, isolated FN communities in northern Ontario, and the dietary impact of a harvest sharing program (**Study Four**).

E. Investigate the barriers and facilitators to the sustainability of a school-based healthy snack program for FN youth in a remote, isolated northern Ontario community and the impact of the program on diet (**Study Five**).

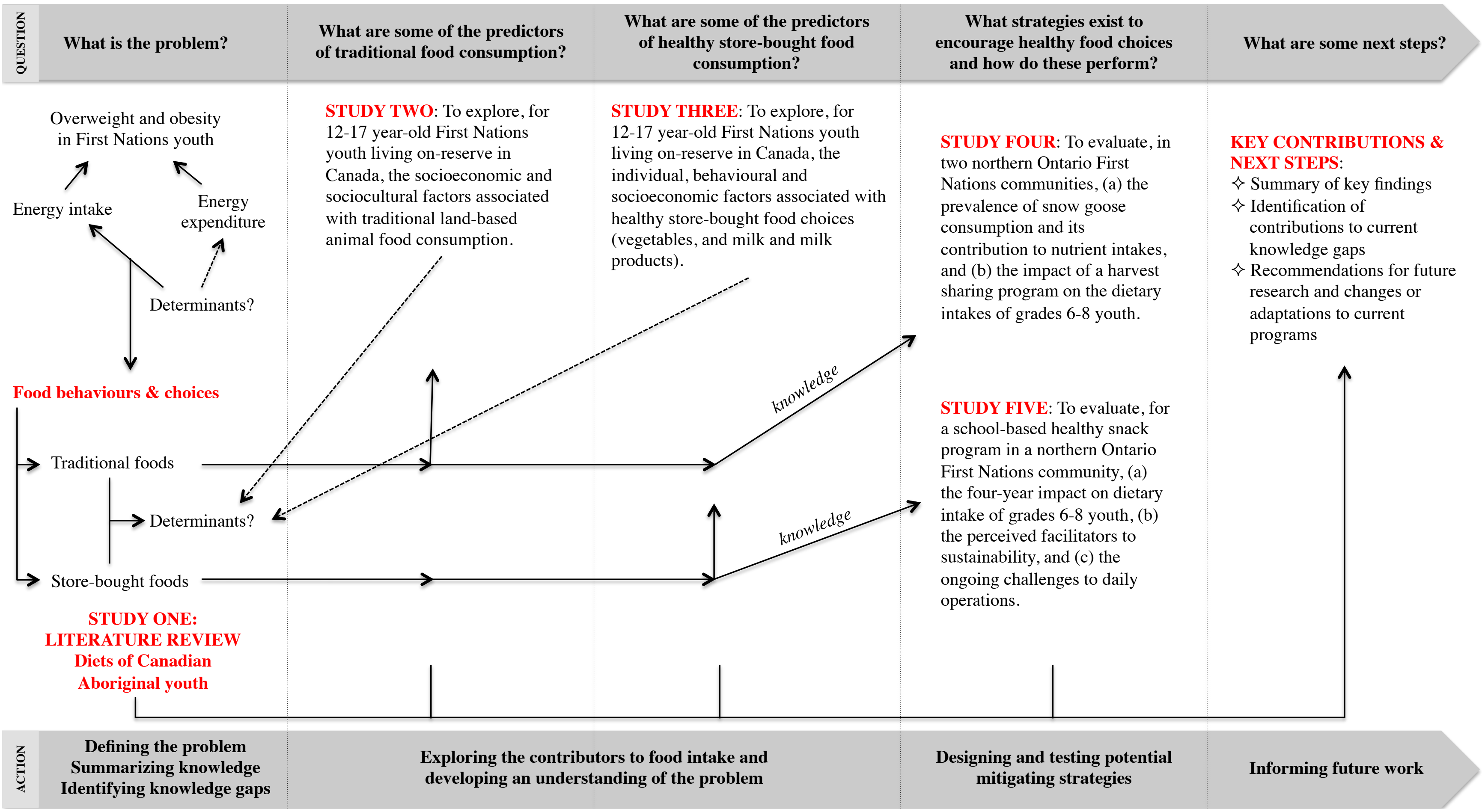

Figure 2.1. Visual representation of the organization of the dissertation

2.4 Theoretical Framework

The social ecological model stipulates that health behaviours, including food choices, are affected by multiple levels of interacting influences, not only within an individual but also within the environment in which they live (Sallis, Owen, & Fisher, 2008). Typically, these multiple levels include intrapersonal, interpersonal, organizational, community and public policy influences (Sallis, Owen, & Fisher, 2008). Although many ecological models exist (Sallis, Owen, & Fisher), in 2012 *Willows, Hanley, & Delormier* suggested a more culturally relevant framework to explain the development of obesity among Canadian Aboriginal youth (Willows, Hanley, & Delormier, 2012). Similar to other models, this adapted framework suggests that the health choices and behaviours of this population of youth are the result of the interaction between individual factors, interpersonal factors, community, home and sociocultural environmental factors, the built environment and societal factors (Willows, Hanley, & Delormier, 2012). The model is, nevertheless, unique in its emphasis on the historical and cultural factors that influence the choices made by Aboriginal youth, including colonization, oppression and the lasting effects of the residential school system, which interact with all of the other levels of influence (Willows, Hanley, & Delormier, 2012). At each level of the model, specific factors related to the health of Aboriginal people are included (e.g., traditional food sharing, having a hunter in the household, cultural knowledge, participation in community cultural events) (Willows, Hanley, & Delormier, 2012).

The social ecological model, and specifically the culturally adapted framework described by *Willows, Hanley, & Delormier* (2012), has guided the research within this thesis. As a whole, this thesis work addresses some of the knowledge gaps in the current literature and evaluates school and community-level initiatives that show promise for positively influencing food choices. As described by *Sallis, Owen, & Fisher* (2008), two core principles of ecological models are that they should be behaviour specific and that multi-level interventions will be the most beneficial in modifying health behaviours, such as diet. Therefore, in order to understand food choices and eating behaviours among FN youth, it is first important explore what may be the most significant contributors at each level of influence specific to these behaviours. Because relatively little information with regard to the factors that modulate food choices and preferences for this population existed prior to this thesis, **Study Two** and **Study Three** aimed to provide preliminary explorations into some of the potential factors amongst a nationwide sample of on-reserve youth.

As mentioned, programs targeting health behaviours like food choices, if they are to be effective, will likely be complex, as they will need to target multiple of the interacting factors that result in the behaviour (Sallis, Owen, & Fisher, 2008). Naturally, these will include not only motivating personal-level changes but also modifying the environments in which people make the choices that affect their health (Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008). Nevertheless, in small communities where resources are often gravely limited, initiatives targeting even discrete aspects of food choices still have the potential to make a positive impact. **Study Four** and **Study Five** investigated how community and school-based programming aimed at enhancing access to traditional or healthy store-bought foods influenced individual behaviours and other factors associated with food choices.

2.5 Research Ethics, Trust and Collaboration

Historically, research involving Canada's Aboriginal populations has been investigator-driven and conducted primarily by researchers who were not Aboriginal themselves (Wilson, 2008; Government of Canada, 2013). This top-down approach often meant that little to no input from the communities was sought and inappropriate research methods, which did not take into account Indigenous ways of knowing, were used; this resulted in investigations where the researchers were the sole beneficiaries of the findings (Cochran, Marshall, Garcia-Downing, Kendall, Cook, & McCubbin et al., 2008; Government of Canada, 2013; Maar, Lightfoot, Sutherland, Strasser, Wilson, & Lidstone-Jones et al., 2011; Simonds & Christopher, 2013). Moreover, the findings of the research may not have been adequately communicated to the communities or may have been communicated in a fashion that was not culturally appropriate or relevant (Cochran et al., 2008; Maar et al., 2011; Simonds & Christopher, 2013). Consequently, the research likely provided little to no benefit to the communities themselves (Cochran et al., 2008; Maar et al., 2011; Simonds & Christopher, 2013). Non-Aboriginal researchers became the 'experts' on Aboriginal people, while the voices of Aboriginal people themselves played little, if any, part in the knowledge that resulted from the research (Wilson, 2008). This history has left many Aboriginal people feeling overwhelmed, over-studied and apprehensive of further research in their communities (Cochran et al., 2008; Wilson, 2008; Maar et al., 2011; Simonds & Christopher, 2013).

In order to move toward more ethical research practices when working with Aboriginal communities, the Canadian Institutes of Health Research (CIHR) has laid out specific ethical guidelines for research involving FN, Inuit and Métis people and a move toward community-based participatory research practices is encouraged (Cochran et al., 2008; Maar et al., 2011; Government of Canada, 2013; Simonds & Christopher, 2013). The First Nations Principles of OCAP® (**o**wnership, **c**ontrol, **a**ccess and **p**ossession) provide guidelines for ethical research with FN peoples and communities with the goal of ensuring that they own, protect and control how their information is collected and used (FNIGC, 2013). Besides basic ethical procedures, there has been a move away from research *on* Aboriginal people toward research *by* Aboriginal people where Aboriginal scholars speak their own truths and conduct research in line with the worldviews, knowledge, culture and experiences of their peoples (Wilson, 2008). Still, many non-Aboriginal Canadian university-based research teams continue to collaborate with Aboriginal people to gain expertise on their health from a predominantly non-Aboriginal perspective (Wilson, 2008). Although not Aboriginal, the author of this thesis and the research team that took part in the work acknowledge the need for a move toward Aboriginal ways of knowing. With a relatively long history of collaboration with the FN communities in which they work, a balance has been established between the needs and desires of the communities for information on their own people and the role of the university research team in supporting these objectives.

The research within this thesis was conducted with respect for the interests of the communities or people from whom the data were collected. **Study Two** and **Study Three** utilized RHS (2008/10) data; the planning and data collection for this survey had been undertaken with respect for the First Nations Principles of OCAP® (FNIGC, 2012, 2013). The participating communities were involved at all stages of the research to ensure that the work was relevant to their needs and interests (FNIGC, 2012). Prior to the current secondary analyses, all plans passed the methodological, technical, and Data Review Access Subcommittee (which consists of a Board member and analysts from the regions) reviews for appropriateness. The data outputs were vetted at the FNIGC's First Nations Data Centre, and the resulting findings, thesis chapters and manuscripts benefitted from review by the FNIGC for relevance and sensitivity to the culture. It is the mandate of the FNIGC to "*make the most of research and information that will truly benefit the health and well-being of First Nations*" (FNIGC, 2012); this mandate was upheld throughout the work. Though the interpretations of the findings are the author's own, the results of the work are owned by the FNIGC.

The community-based work (**Study Four** and **Study Five**) resulted from years of collaboration between the participating FN communities and the university-based research team. Spending time building trusting and equitable relationships in the communities where this thesis work was undertaken, and allowing for the communities to get to know the researchers was an important step from the outset of the work (Maar et al., 2011). The principal author of this thesis spent a number of years visiting the participating communities ahead of undertaking the work found within. Furthermore, the main research team spent many years traveling to the communities and collaborating on a variety of mutually beneficial projects. Learning about the experiences and needs of the communities firsthand helped to guide the directions that the research within this thesis has taken.

For the programs evaluated in **Study Four** and **Study Five**, the original concept for the work and corresponding research questions were developed in partnership with the communities. This helped to ensure that the results would be relevant to their needs and priorities. The directions that the programs ultimately took were the decisions of the communities and not imposed by the researchers. The data collection methods were reviewed by the community-based collaborators for relevance and acceptability, and whenever possible, local research assistants were sought to help with data collection to enhance their involvement and local research capacity (Cochran et al., 2008; Maar et al., 2011; Government of Canada, 2013; Simonds & Christopher, 2013). The programs continued under the direction of community members and the role of the university research team was to guide program development via grant-writing support, the provision of start-up funding, and ongoing evaluation. These roles were discussed and agreed upon prior to the start of the work, and evolved throughout the process.

All members of the university research team received integrity and ethics training for research involving human participants via the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2) Course on Research Ethics (CORE) online at the University of Waterloo. All procedures were carried out in accordance with TCPS2 guidelines. Where applicable, research processes were reviewed and accepted by the Office of Research Ethics at the University of Waterloo. At no time was any research that could knowingly cause harm to any participant or population undertaken.

2.6 Declaration of Biases and Conflict of Interest Statement

Despite attempts to maintain objectivity, it must be acknowledged that every scholar brings to the research their own set of biases (MacCoun, 1998; Finlay, 2002; Kaptchuk, 2003; Wilson, 2008). The notion of subjectivity is typically applied to qualitative research processes, however, even in quantitative studies the data cannot speak for themselves (Kaptchuk, 2003). The majority of the research within this thesis is quantitative in design. Care needed to be taken to interpret these data with as little personal bias as possible, as unbiased interpretations of data are as important in a study as the rigour of the chosen methods (Kaptchuk, 2003). It is, nevertheless, impossible for the interpretation of research data, even in quantitative studies, to remain completely untainted by one's prior knowledge, experiences, emotions and beliefs (MacCoun, 1998; Kaptchuk, 2003).

The latter two studies in this thesis (**Study Four** and **Study Five**) included qualitative components, where equal attention was paid to maintaining objectivity and minimizing personal biases. One's behaviour can impact participants' responses to research questions and during data analysis, being preoccupied with one's own experiences and expectations can distort the findings such that the researcher's viewpoint comes to the forefront, overshadowing the voices of the participants themselves (Finlay, 2002). Throughout this work, participating in a reflexive dialogue with community stakeholders during data analysis and interpretation, allowing for the co-construction of knowledge, helped to minimize biases and even challenge the author's own preconceptions about the outcomes of the studies (Finlay, 2002).

Being completely honest about one's own prior experiences and ideas and how these may affect the research findings, while striving to maintain objectivity, may add credence to research findings (Kaptchuk, 2003). On that note, I would like to provide a brief account of my prior experiences that may have informed and influenced the choice of research topic, the main research questions and objectives, the analyses and the interpretation of the findings within this thesis.

My time in university began in 2004, and in 2008 I completed my undergraduate degree in Human Nutrition and Dietetics at McGill University. Since that time, I have been a registered dietitian. Dietetics is a field based strongly on scientific rigour with an emphasis on evidence-based practice. My undergraduate training was heavily focused on quantitative methods, including one research methods course. For eight months in 2008, I worked as a research assistant at the Food Habits of Canadians research centre and the Centre for Indigenous Peoples Nutrition and Environment (CINE) at McGill University, which was my first exposure to nutrition research with FN people. During my time at CINE I entered and analysed 24-hour recall and food frequency data from the International Polar Year project and from Cree communities on the eastern coast of James Bay in Quebec.

From 2008 to 2010, I completed a Masters degree at the University of Waterloo, and my research was primarily quantitative, however, I did employ some qualitative data collection and analysis to triangulate the quantitative findings. I had the opportunity to work in three remote, isolated communities on the western coast of James Bay, Ontario and began to expand my knowledge of the food habits and influences of food intake for FN youth living on reserves in northern locations that are accessible only by plane for the majority of the year. In 2010 I began my doctoral studies, where I continued to work within the same communities to build upon the relationships and work that I had begun during my Masters. I also had the opportunity to expand my knowledge through a qualitative methods course and courses in program evaluation.

It is without a doubt that these prior experiences have influenced my chosen topic of research, as well as my hypotheses, objectives, methods, and interpretations of the findings. Strategies have been employed throughout this work to attempt to mitigate and somewhat diminish these personal biases. Without my early experiences as a research assistant and my prior work in the communities participating in **Study Four** and **Study Five**, it is unlikely that I would have had the interest or the opportunity to continue to partner with these communities on the current work. Nevertheless, as I have had no personal experience in on-reserve communities that are readily accessible by land, located in southern regions of the country, or in provinces other than Ontario or Quebec, my expectations for **Study Two** and **Study Three** may have been influenced by my prior experiences. The interpretations of the findings could have been biased from my knowledge of the challenges that face remote and isolated northern communities.

The objectives and hypotheses for each of the studies within this thesis were determined prior to the analysis of any data, and were maintained as originally written following the analysis and interpretation stages of the research. In the case of the RHS analyses (**Study Two** and **Study Three**), it is likely that the hypotheses were influenced by prior experiences, which may not in fact be reflective of the situation in other reserve communities in Canada. However, the current body of literature on the topics investigated was used to substantiate the hypotheses, thus somewhat mitigating this bias. For the community based studies, (**Study Four** and **Study Five**) it is without a doubt that previous time spent in the communities influenced the objectives and hypotheses, however, these were again substantiated by current literature on the topics studied and co-constructed with the community collaborators. My personal connections to the communities may have created a vested interest in positive findings, as is widely described in the literature (Boutron, Dutton, Ravaud, & Altman, 2010; Fanelli, 2010).

The research process for each study, including the data analysis and interpretation of the findings, were co-constructed with the participants. For the RHS studies, the data were collected by the FNIGC and the nature of the available data may have influenced the design of these studies. The FNIGC, which represents the participants, approved the analyses and reviewed the statistical outputs and interpretation of the findings at the completion of the studies. For the community-based studies, prior relationships with the communities spurred the ideas for the programs and the directions that these programs ended up taking. Throughout the research, close contact was maintained with community stakeholders and these keen individuals were invited to review and inform the findings based on the data analyses. All qualitative data were analysed by a second independent researcher for objectivity, and any disagreements were reconciled via discussion.

The author has no conflicts of interest to declare. The research within this thesis was funded by Canadian Institutes of Health Research (CIHR) research grants (**Study Four** and **Study Five**) and the primary author was personally funded throughout the research via the Heart and Stroke Foundation of Ontario Master's Studentship Award (2010-2011), the University of Waterloo Doctoral Entrance Award for Women (2010), the CIHR Training Grant in Population Intervention for Chronic Disease Prevention (CIHR and Cancer Care Ontario) (2011-2013), the Frederick Banting and Charles Best CIHR Doctoral Research Award (2012-2015) and the University of Waterloo President's Graduate Scholarship (2012-2015). The data for **Study Two** and **Study Three** were made available via the FNIGC and data collection was planned and carried out by this institution. The funding agencies and the FNIGC had no influence in the design of the studies, nor in the analysis and interpretation of the results.

3.0 Study One: The Diets of School-aged Aboriginal Youth in Canada: A Systematic Review of the Literature[*]

3.1 Overview

Background. Most national surveys examining diet leave large segments of the Aboriginal population underrepresented.

Objectives. To (a) review primary research studies that investigated the dietary intakes of Canadian school-aged Aboriginal youth, (b) summarize the tools and methodologies currently used to measure diet in this population and (c) identify knowledge gaps and suggest areas of future research.

Methods. A systematic review of research published online between January 2004 and January 2014 related to the diets of Canadian school-aged (6-18 years) Aboriginal youth was undertaken, including Medline, Scopus, Education Resources Information Center (ERIC), Web of Science and Google Scholar databases. Studies were summarized based on purpose, design, year, sample population, setting, dietary assessment method and main findings.

Results. Twenty-four studies were reviewed, all of which were cross-sectional in design. Most (n=16, 67%) were from Ontario or Quebec, investigated the diets of FN (n=21, 88%) youth and took place in remote or isolated settings (n=18, 75%). Nearly all studies used the 24-hour recall to assess intake (n=19, 79%), of which 89% used a single recall. The findings suggest that the diets of Aboriginal youth could be improved; of particular concern are inadequate intakes of vegetables and fruit, milk and alternatives, fibre, folate, vitamin A, vitamin C, calcium and

[*]This review was published in April 2014 (online) and will hereafter be cited as: Gates, Skinner, & Gates, 2015. The full citation is as follows: Gates, A., Skinner, K., & Gates, M. (2015). The diets of school-aged Aboriginal youths in Canada: a systematic review of the literature. *Journal of Human Nutrition and Dietetics, 28*(3), 246-261.

vitamin D, concomitant with excess consumption of sugar sweetened beverages, snack and fast foods. Traditional foods remain important but tend to be consumed infrequently.

Conclusions. The diets of Canadian Aboriginal youth are energy-dense and nutrient-poor. The diets of Inuit and Métis youth, in particular, and perceptions of a balanced diet warrant further investigation.

3.2 Introduction

The term 'Aboriginal peoples' encompasses all of the original peoples of North America and their descendants (AANDC, 2012). According to the 2011 NHS, 1 400 685 Canadians identified as Aboriginal, comprising 4.3% of the total population (Statistics Canada, 2013a). For Canadian Aboriginal people, a history of colonialism and the residential school system left indelible scars on the >150 000 who were forced to attend and continues to negatively affect the following generations (Truth and Reconciliation Commission of Canada, 2014). To this day, Aboriginal people, in general, suffer poorer health outcomes and live shorter lives as compared to the non-Aboriginal population (King, Smith, & Gracey, 2009; Statistics Canada, 2012; Gionet & Roshanafshar, 2013).

Of particular concern are the high and rising prevalence rates of overweight and obesity among Aboriginal youth. As Canada's Aboriginal population is young, targeting youth in initiatives promoting healthy weights is a promising approach that has been supported by experts in Aboriginal health (Statistics Canada, 2013a; Willows, Hanley, & Delormier, 2012). Not only does it provide the opportunity to reach a substantial percentage of the population (e.g., through schools), but given the fact that overweight and obese youth are more likely than their healthy-weight peers to become overweight adults, engaging youth in initiatives to promote healthy weights will, if successful, decelerate the further escalation of the issue (Singh et al., 2008).

The etiology of overweight and obesity in Canadian Aboriginal youth is complex and multifactorial. Beyond the very simple view that the accretion of excess body fat is the result of a positive energy balance, it is acknowledged that what and how much a person chooses to eat and the types and amounts of activities they choose to partake in are affected by myriad factors (Story, Neumark-Sztainer, & French, 2002; Van Der Horst, Paw, Twisk, & Van Mechelen, 2007a; Willows, Hanley, & Delormier, 2012). Nevertheless, diet is a known contributor to energy balance, and one that may potentially be receptive to modification via public health programs and policies.

National surveys (e.g., CCHS) examining the health of Canadians provide some insight into the diets of Aboriginal people, however, such surveys often exclude large proportions of the Aboriginal population (e.g., those living on reserves or in northern, remote regions) (Garriguet, 2008a). Also, they may not always report on the diets of youth in specific. This gap has somewhat been filled by the RHS, APS and ACS which include child and youth data (Statistics Canada, 2008; FNIGC, 2012; Statistics Canada, 2013b). However, these surveys were not designed to comprehensively examine diet and were limited to relatively short FFQs (Statistics Canada, 2008; FNIGC, 2012; Statistics Canada, 2013b). At this time, there exists no comprehensive data on the diets of Aboriginal Canadian youth as a whole (including on- and off-reserve populations) that are comparable to data from the general population.

To the authors' knowledge, there currently exists no review of studies investigating the dietary intakes of school-aged Aboriginal youth residing in Canada. A review of the current research will compliment current survey data and will allow for the identification of knowledge gaps to inform where future research should be focused. It will also allow for the refinement of health promoting initiatives that will be more relevant to the needs of the populations that they are targeting. The purpose of this review is to (a) summarize primary research studies that investigated the dietary intakes of school-aged Aboriginal youth residing in Canada, (b) summarize the tools and methodologies currently used to measure diet in this population, and (c) identify knowledge gaps and suggest areas of future research.

3.3 Methods

A systematic review of online, published literature was undertaken in January 2014 in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Liberati, Altman, Tetzlaff, Mulrow, Gøtzsche, & Ionnidis et al., 2009; Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009). Prior to the start of the study, the authors decided on the review protocol, as described herein. The online search strategy including sources, search terms, inclusion and exclusion criteria and a sample search have been outlined in **Table 3.1**. For all databases, studies were first screened by title and abstract. Those selected were then further screened by full text for relevance. To ensure transparency and to identify any articles that had been overlooked, the search was repeated in March 2014 by a second, independent researcher. Any disagreements between the two researchers as to which studies should be included were resolved via discussion until agreement was reached.

Data were extracted from each of the studies identified by two independent researchers to ensure accuracy. If any disagreement was experienced between the findings of the researchers, data were independently extracted again until agreement was reached. Each study was summarized in terms of the following: purpose, study design, study year, sample population (FN, Inuit or Métis; age; sample size; % female) and setting, dietary assessment method used and main findings related to the intake of micro- and macronutrients, foods and/or food groups. Descriptive statistics including mean and median nutrient or food group consumption and proportions of youth with intake levels falling below or above current dietary standards were the main outcomes of interest. Results regarding associations between dietary intakes and different associated factors (e.g., BMI, meals away from home, central adiposity) are beyond the scope of the current review and were therefore not reported. In the case of studies reporting the results of school or community-level nutrition interventions, only baseline dietary intake data are reported, as these are reflective of 'natural' intakes without intervention. The setting of each study was described as it was listed in each respective article (e.g., rural, isolated). Due to the nature of the outcomes of interest, the main source of bias within each individual study was the method used to measure dietary intake among participants (e.g., self-reported methods may be susceptible to social desirability and recall biases). The measure used was reported as described in the study and verified by the second researcher. Other potential sources of bias were not considered in the context of this study. Based on the conglomerate findings of the studies reviewed, key research gaps were identified and recommendations for future research were provided.

Table 3.1. Online search strategy including sources, search terms, inclusion criteria and exclusion criteria

Sources[a]	**Inclusion Criteria**
PubMed (Medline)[b]	a. Studies reporting quantitative results with respect to dietary intake (food groups, specific foods and/or nutrients)
Scopus	
ERIC	b. Studies reported results based on non-invasive measurement(s) of food consumption behaviour (e.g., 24-hour recall, food diaries)
Web of Science	
Google Scholar	c. The population of interest included First Nation, Inuit or Métis youth of school age (6-18 years old)
Reference lists	
	d. The population of interest resided in Canada
Search Terms	e. The study was published in the English language
Nutrition	f. The study was published between January 2004 to January 2014[b]
Diet	g. The study was peer reviewed
Food	
Aboriginal	**Exclusion Criteria**
First Nation	a. The study reported only qualitative findings
Indigenous	b. The study reported only invasive measures of diet quality or dietary adequacy (e.g., laboratory values)
Native	
Inuit	c. The population of interest was <6 years or >18 years of age
Métis	d. The population of interest did not reside in Canada or was not defined as being Aboriginal
Arctic	
Child	e. The study was published in a language other than English
Adolescent	f. The study was published before January 2004 or after January 2014[c]
Youth	g. The study was not peer reviewed
Teen	

[a]Includes life, health and biomedical sciences databases. ERIC, an education database, was included for possible results of nutrition education programs. Google Scholar was searched for articles that were not indexed. Reference lists were searched for any studies not elucidated in the original search.

[b]PubMed (Medline) search: "Canad* and (nutrition* or diet* or food*) and (Aboriginal or First Nation* or indigenous or native or Inuit or Metis or Métis or arctic) and (child* or youth or adolescent* or teen*)", limited to articles published since January 2004.

[c]Studies published earlier than January 2004 may no longer be relevant due to historical bias. The last date searched was March 4, 2014. All searches were limited to the last 10 years (since January 2004).

3.4 Results

The literature search revealed 24 studies investigating the dietary intakes of school-aged Canadian Aboriginal youth that met the inclusion criteria (**Figure 3.1**). A summary of the main findings from each study is shown in **Table 3.2**. All of the studies reviewed were cross-sectional in design, and reported on the results from data collected from 1994 to 2010. The vast majority of the studies were from either Quebec (n=6, 25%) or Ontario (n=10, 42%). Research from British Columbia (n=2, 8%), Prince Edward Island (n=1, 4%) and Yukon and Northwest Territories (n=3, 13%) were lesser, while two studies (8%) reported on the results of national surveys. Most studies (n=21, 88%) reported on the diets of FN youth, while only five studies reported on the diets of Métis (n=4, 17%) or Inuit (n=1, 4%) youth. Most research took place in either isolated or remote communities (n=18, 75%). The most commonly used dietary assessment method was the 24-hour recall (n=19, 79%); of the studies using this method, 89% used a single recall, while the remaining 11% (2 studies) used three recalls. The remaining studies used FFQs (with some using both FFQs and 24-hour recalls) (n=7, 29%).

Of the 14 studies reporting on vegetable and fruit intakes, all found that intakes fell within the 'needs improvement' range (52-100% youth falling below CFG recommendation) (Health Canada, 2007a). Similarly, of the 13 studies reporting on dairy, milk or milk and alternatives intakes, all revealed that intakes could be improved (51-95% youth falling below CFG recommendation) (Health Canada, 2007a). Furthermore, data from the CCHS showed that the intakes of vegetables, fruit and dairy products were lower for Aboriginal youth as compared to their non-Aboriginal peers (Ng, Young, & Corey, 2010). Beyond food group data, the general trend was for diets that were energy-dense and nutrient poor; sugar sweetened beverage, snack and fast-food consumption was high while intakes of fibre (n=7), folate (n=3), vitamin A (n=6), vitamin C (n=2), calcium (n=6) and vitamin D (n=6) were of particular concern across multiple studies.

Few studies (n=7, 29%) reported on traditional food consumption. Of those that did, it was clear that traditional foods still played an important role in the diets of Aboriginal youth, at least in some communities. Traditional foods were found to contribute significantly to intakes of iron, zinc, copper, magnesium, phosphorus, potassium, vitamin E, riboflavin and vitamin B_6. That being said, in most studies, although traditional foods may still be consumed on occasion by the majority of youth, intake levels were typically quite low in terms of frequency per month or contribution by percent energy.

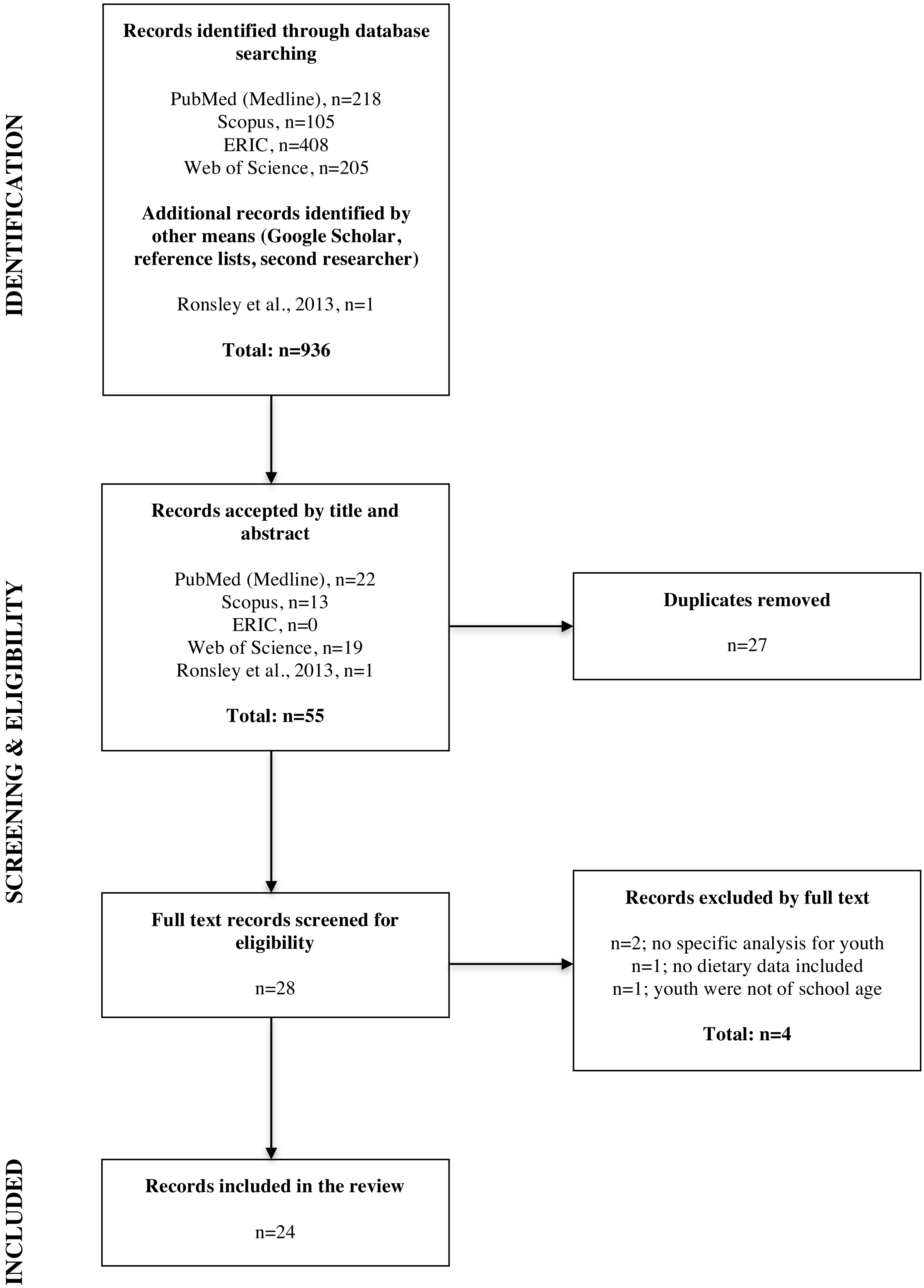

Figure 3.1. Flow diagram of study selection

Table 3.2. Summary of primary research studies on the diets of Canadian Aboriginal youth of school age, published from January 2004 to January 2014[a]

Reference	Purpose	Design & Year	Sample & Setting	Dietary Assessment Method	Main Findings
Adams, Receveur, Mundt, Paradis, & Macaulay, 2005	▪ To assess the relationships among healthy lifestyle indicators for Kahnawake Schools Diabetes Prevention Project participants.	▪ Cross-sectional ▪ 1994	▪ Grade 4-6 Mohawk (FN) youth from two schools in Kahnawake, Quebec ▪ Urban ▪ n=150, 53% female, mean age 9.9 y (range 8-12 y)	▪ Single 24-hour recall ▪ Probing to maximize recall ▪ Food models and household measures to aid in portion size estimation	▪ 52% <CFG recommendation for VF ▪ Sugared beverages were a major source of daily E and sucrose intake ▪ As daily intake from sucrose increased, milk consumption decreased and soft drink intake increased ($p<0.001$)
Downs, Arnold, Marshall, McCargar, Raine, & Willows, 2009	▪ To explore the relationship between diet quality, weight status and food environment.	▪ Cross-sectional ▪ 2004 & 2005	▪ Grade 4-6 Cree (FN) youth from two schools in northern Quebec ▪ Isolated ▪ n=201	▪ Three 24-hour recalls on non-consecutive days, including one weekend day ▪ Multiple-pass interview method ▪ Food models, probes, pictures and packaging of locally sold products	▪ 80.9% and 98.5% < CFG recommendation for MMA and VF, respectively ▪ Traditional game meats contributed to 16.7% Fe and 16.8% Zn intake (but only 3% total E) ▪ Sweetened beverages contributed the highest amount to total E intake (8.9%) ▪ Snack foods contributed the most to E from fat (11.7%) ▪ Youth were at risk of Zn inadequacy (42.8% < EAR); mean intake of vitamin D and Ca <AI ▪ 77.6% consumed ≥1 restaurant/take-out meal
Downs, Marshall, & Willows, 2008	▪ To determine if behavioural lifestyle factors were associated with central adiposity (CA).	▪ Cross-sectional ▪ 2004 & 2005	▪ Grade 4-6 Cree (FN) youth from two communities in northern Quebec ▪ Isolated ▪ n=178 ▪ No CA: n=85, 49.4% female, mean age 10.5±1.1 y ▪ CA: n=93, 60.2% female, mean age 10.9±1.0 y	▪ Three 24-hour recalls on non-consecutive days, including one weekend day ▪ Multiple-pass interview method ▪ Food models, probes, pictures and packaging of locally sold products	▪ 83.7% <3 servings of VF per day ▪ Children with CA consumed fewer VF ($p=0.012$) ▪ No CA: VF (#): 1.7±1.3; Milk (mL): 360±279; Sweetened beverages (mL): 495±344 ▪ CA**:** Kcal: 2202±601; VF (#): 1.3±1.1; Milk (mL): 295±201; Sweetened beverages (mL): 473±340

Reference	Purpose	Design & Year	Sample & Setting	Dietary Assessment Method	Main Findings
First Nations Information Governance Centre, 2012	▪ To assess the health of FN youth living on reserves in Canada.	▪ Cross-sectional ▪ 2008-2010	▪ 12-17 year-old on-reserve FN youth from 216 communities across Canada ▪ Varied locations (FN reserves) ▪ n=4837	▪ Two FFQs (one for SBF and one for TF)	▪ 23.7% reported 'always' or 'almost always' consuming a nutritious balanced diet ▪ 67.6%, 56.0% and 67.3% consumed MMA, vegetables, and fruit, respectively, ≥daily ▪ 5.1%, 8.3% and 2.1% never or hardly ever consumed MMA, vegetables, and fruit, respectively ▪ 79.5% and 53.3% consumed juice and soft drinks/pop, respectively, ≥daily ▪ 56.5% and 63.2 % consumed fast food and sweets, respectively, ≥a few times/week ▪ 23.0%, 15.4%, 19.5% and 40.2% 'often' consumed land based animals, freshwater fish, berries or other wild vegetation and bannock, respectively
Gates, Hanning, Gates, Martin, & Tsuji, 2012a	▪ To describe the intakes of MMA, Ca and vitamin D compared to recommended intakes and intakes of the general population.	▪ Cross-sectional ▪ 2003-2010	▪ 9-18 year-old FN youth from 7 communities in northern and southern Ontario ▪ Isolated and/or remote ▪ n=443; 52% female	▪ Single web-based school day 24-hour recall ▪ Multiple-pass methodology ▪ Adapted for use in FN youth ▪ Validated against dietitian-administered interviews	▪ 79.9% boys 9-13 y and 72.6% boys 14-18 y <CFG recommendation for MMA ▪ 83.8% girls 9-13 y and 84.7% girls 14-18 y <CFG recommendation for MMA ▪ 86.3% boys 9-13 y and 75.3% boys 14-18 y <RDA for Ca ▪ 86.7% of girls 9-13 y and 98.3% of girls 14-18 y <RDA for Ca ▪ 98.6% boys 9-13 y and 90.4% boys 14-18 y <RDA for vitamin D ▪ 96.5% of girls 9-13 y and 98.3% of girls 14-18 y <RDA for vitamin D
Gates, Hanning, Gates, Martin, & Tsuji, 2012b	▪ To describe the intakes of VF, 'other foods' and relevant nutrients compared to recommended intakes and intakes of the general population.	▪ Cross-sectional ▪ 2004-2009	▪ 9-18 year-old FN youth from 7 communities in northern and southern Ontario ▪ Isolated and/or remote ▪ n=443, 52% female, mean age 13.0±1.6 y	▪ Single school-day web-based 24-hour recall ▪ Multiple pass methodology ▪ Adapted for use in FN youth ▪ Validated against dietitian-administered interviews	▪ In all age and gender sub-groups, mean intakes of VF, fibre and folate were less than recommended (<CFG, EAR or AI) ▪ In all age and gender sub-groups, mean servings of 'other foods' was greater than servings of VF ▪ Mean intake of vitamin A was less than recommended for girls 14-18 y

Reference	Purpose	Design & Year	Sample & Setting	Dietary Assessment Method	Main Findings
Gates, Hanning, Gates, McCarthy, & Tsuji, 2012c	▪ To establish baseline nutrient intakes and feasibility of a pilot school snack program	▪ Cross-sectional ▪ 2009	▪ Grade 6-8 FN youth attending St. Andrew's School in Kashechewan, Ontario ▪ Isolated, remote ▪ n=43, 40% female, mean age 13.1±0.9 y	▪ Single web-based school day 24-hour recall ▪ Adapted for use in First Nations youth ▪ Validated against dietitian-administered interviews	▪ 95.3% <CFG recommendation for VF ▪ 100% <AI for fibre ▪ 55.8%, 76.7% and 48.8% <EAR for folate, vitamin A and vitamin C, respectively
Gates, Hanning, Gates, Isogai, Tsuji, & Metatawabin, 2013a	▪ To evaluate the impact of a 5-week comprehensive school nutrition program on MMA intake, knowledge, self-efficacy and intentions	▪ Cross-sectional ▪ 2009	▪ Grade 6-8 FN youth attending Peetabeck Academy in Fort Albany, Ontario ▪ Isolated, remote ▪ n=30, 67% female, median age 13 y (range 11-15 y)	▪ Single web-based school day 24-hour recall ▪ Adapted for use in FN youth ▪ Validated against dietitian-administered interviews	▪ 86.7% <CFG recommendation for MMA ▪ Mean MMA: 1.8±1.1 servings ▪ Mean Ca intake <EAR (785.4±423.5 mg) ▪ Mean vitamin D intake <EAR (2.7±2.4 μg)
Gates, Hanning, Gates, McCarthy & Tsuji, 2013b	▪ To assess the 1-month and 1-year impact of school food provision programs on MMA intakes.	▪ Cross-sectional ▪ 2009	▪ Grade 6-8 FN youth from Kashechewan and Attawapiskat, Ontario ▪ Isolated, remote ▪ Kashechewan: n=43, 40% female; median age13 y (range 11-14 y) ▪ Attawapiskat: n=70, 64% female, median age 12 y (range 11-14 y)	▪ Single web-based school day 24-hour recall ▪ Adapted for use in FN youth ▪ Validated against dietitian-administered interviews	▪ 74.4% and 82.9% <CFG recommendation for MMA in Kashechewan and Attawapiskat, respectively ▪ Ca and vitamin D intakes were low; >80% youth did not meet the AI for each nutrient ▪

Reference	Purpose	Design & Year	Sample & Setting	Dietary Assessment Method	Main Findings
Hlimi, Skinner, Hanning, Martin, & Tsuji, 2012	▪ To investigate the factors influencing TF consumption and concerns about environmental contaminants.	▪ Cross-sectional ▪ 2004-2009	▪ Grades 6-12 Cree (FN) youth from 5 subarctic communities of the Mushkegowuk Territory, Ontario ▪ Isolated, remote ▪ n=262, 50% female	▪ Web-based FFQ ▪ Adapted for use in FN youth	▪ 90% of schoolchildren reported eating game meats
Kakekagumick, Hayward, Harris, Saksvig, Gittelsohn, Monokeesic, Goodman, & Hanley, 2013	▪ To evaluate the impact of the Sandy Lake Health and Diabetes Project on dietary intakes.	▪ Cross-sectional ▪ 1998 & 2005	▪ Ojibway-Cree (FN) youth from Sandy Lake First Nation, Ontario ▪ Isolated, remote ▪ n=122 (1998)	▪ Single 24-hour recall ▪ One-on-one interviews	▪ Mean fibre intake: 11.6±8.0 g ▪ Mean fat intake: 86.4±51.4 g ▪ Mean milk intake: 0.3±0.1 servings ▪ Mean grains intake: 1.2±0.2 servings ▪ 30% E intake was from sugar
Khalil, Johnson-Down, & Egeland, 2010	▪ To describe the dietary habits of youth in three communities.	▪ Cross-sectional ▪ 2005 & 2007	▪ 9-18 year-old Cree (FN) youth from 3 communities in northern Quebec (Mistissini, Wemindji and Eastmain) ▪ Isolated, remote ▪ n=125, 51% female, mean age 13.2±2.8 y	▪ Two qualitative SBF and TF FFQs ▪ Single 24-hour recall, with repeat recalls on 20% participants ▪ Five-step data collection technique (quick list, forgotten foods, details and probing, review and vitamin and mineral supplements) with food and portion models	▪ 98.1% consumed saturated fat >10% total E ▪ 92.8% consumed high-sugar foods (12.8% daily E intake) ▪ 96.8% consumed high-fat foods (39.3% daily E intake) ▪ HEI-C scores were low (mean 64.7±9.3); 95% <recommended score of ≥80 ▪ 'baked goods and cereals' (20%), 'high-sugar drinks' (15%) and 'snack foods' (12%) contributed most to daily E intake ▪ 63%, 95%, 81% and 32% <CFG recommendation for VF, MMA, GP and MA, respectively ▪ TF consumption as days/month was low ▪ 83.2% consumed fish <0.5 times/week, 65.6% consumed traditional meat <0.5 times/week ▪ Nearly 50% consumed at least one type of TF weekly

Reference	Purpose	Design & Year	Sample & Setting	Dietary Assessment Method	Main Findings
Kuhnlein & Receveur, 2007	▪ To identify dietary food sources in Yukon and Northwest Territories (NWT).	▪ Cross-sectional ▪ 2000-2001	▪ 10-12 year-old Dene/Métis and15-19 year-old Inuit youth from Yukon and NWT ▪ Remote ▪ Dene/Métis: n=409 ▪ Inuit: n=34	▪ Single 24-hour recalls in two seasons (November-January, August-October) ▪ Frequency interviews of TF species	▪ Dene/Métis youth consumed 4.5% E from TF ▪ Inuit youth consumed 15% E from TF ▪ Younger generations consumed less TF than older ones ▪ Grains and 'other foods' usually > 90% daily E intake; MA from SBF was 10% total E and MMA 8% of total E ▪ About 55% of E derived from foods identified as fat (21%), sweet (20%) and mixed savoury dishes (14%) ▪ Diets containing TF had more protein, Fe, Zn, Cu, Mg, P, K, vitamin E, riboflavin, vitamin B_6
Nakano, Fediuk, Kassi, & Kuhnlein, 2005a	▪ To describe food use of Dene/Métis and Yukon youth.	▪ Cross-sectional ▪ 2000-2001	▪ 10-12 year-old Dene/Métis youth from 5 Yukon and NWT communities ▪ Remote ▪ n=222, 58% female	▪ Single 24-hour recalls in two seasons (November-January, August-October) ▪ n=187 (84%) provided repeat recalls (consecutive or non-consecutive days) ▪ Standardized protocol using food portion models and photos of traditional food species	▪ TF contributed to 4.5% of total E intake; more TF consumed in the north ▪ TF use was 86% land animals, 11% fish, 2% birds and 1% berries ▪ 46% E intake from SBF fit into CFG food groups (20% GP, 10% MA, 8% MMA, 8% VF) ▪ 55% E intake from SBF was 'other foods' ▪ Children who ate TF and lived in the north region ate significantly more protein ▪ Children with TF consumed significantly more Fe, Zn, Cu, Mg, P, vitamin E, riboflavin and vitamin B_6 ▪ North and central regions had significantly higher TF consumption and Fe, Cu and vitamin B_6 intakes, and lower Na intakes ▪ Intakes of store-bought MMA and GP were higher for children without TF ▪ Children in the south region ate less TF land animal foods and more SBF fat
Nakano, Fediuk, Kassi, Egeland, & Kuhnlein, 2005b	▪ To describe the nutrient intakes and anthropometry of Dene/Métis and Yukon youth in the Arctic.	▪ Cross-sectional ▪ 2000-2001	▪ 10-12 year-old Dene/Métis youth from 5 Yukon and NWT communities ▪ Remote ▪ n=222, 58% female	▪ Single 24-hour recalls in two seasons (November-January, August-October) ▪ Standardized protocol using food portion models and photos of traditional food species	▪ >50% children had intakes of Mg, P, vitamin A and vitamin E <EAR ▪ Mean values of Ca, vitamin D, fibre, omega-6 fatty acids and omega-3 fatty acids were <AI ▪ <10% children had intakes of CHO, protein, Fe, Cu, vitamin C, riboflavin, vitamin B_6, Se and Zn <EAR ▪ Mean Mn intake >AI ▪ >20% and >30% were not within AMDR for CHO and fat, respectively

Reference	Purpose	Design & Year	Sample & Setting	Dietary Assessment Method	Main Findings
Ng, Young, & Corey, 2010	▪ To determine associations of diet, physical activity and television viewing time with obesity, in conjunction with socioeconomic variables.	▪ Cross-sectional ▪ 2004	▪ A representative sample of 12-17 year-old Aboriginal (off-reserve FN, Métis or Inuit) youth from the 2004 CCHS (2.2) ▪ Varied settings ▪ n=198, 49% female, mean age 14.0 y (95% CI 13.6-14.3 y)	▪ Single 24-hour recall by a trained interviewer ▪ Used the computer-based automated multiple-pass method	▪ Except for consuming less dairy products and vegetables, Aboriginal youth did not differ from non-Aboriginal youth in terms of any nutrient or food group intakes, nor E intake ▪ Mean %E from saturated fat: 9.7 ▪ Mean sugar intake: 143.4 g (95% CI 137.1-149.6 g) ▪ Mean fibre intake: 14.9 g (95% CI 14.1-15.8 g) ▪ Mean Na intake: 3393.9 mg (95% CI 3139.1-3648.6 mg) ▪ Mean Ca intake: 926.0 mg (95% CI 870.7-981.3 mg)
Paradis, Lévesque, Macaulay, Cargo, McComber, Kirby, Receveur, Kishchuk, & Potvin, 2005	▪ To assess the impact of the Kahnawake Schools Diabetes Prevention Project on dietary intakes.	▪ Cross-sectional ▪ 1994	▪ Grade 1-6 Mohawk (FN) youth from Kahnawake, Quebec ▪ Urban ▪ n=458	▪ 7-day, 51-food FFQ ▪ Adapted for use in Kahnawake ▪ Completed by parents or children ▪ 3-item subscales used to create indicators of consumption of key foods; scored from 0 (did not eat) to 7 (every day)	▪ Sugar consumption index: 2.22±0.07, fat consumption index: 1.28±0.05, fruit and vegetable consumption index: 2.91±0.07
Receveur, Morou, Gray-Donald, & Macaulay, 2008	▪ To identify differences between selected dimensions of diet quality and quantity across BMI categories.	▪ Cross-sectional ▪ 1994, 1998 & 2002	▪ Grade 4-6 Mohawk (FN) youth from Kahnawake, Quebec ▪ Urban ▪ n=444, 50% female	▪ Single 24-hour recalls in 3 years (all in October) by trained nutritional professionals	▪ Mean intakes of common foods did not differ across weight categories except for French fries (116±69 g for at risk of overweight, 132±92 g for overweight, p=0.027) after adjustment for age ▪ Frequency of consumption of common foods did not differ across weight categories except for crackers (16% for normal weight, 4% for at risk of overweight, 13% for overweight, p=0.015) and potato chips (13% for normal weight, 24% for at risk of overweight, 6% for overweight, p=0.001)

Reference	Purpose	Design & Year	Sample & Setting	Dietary Assessment Method	Main Findings
Ronsley, Lee, Kuzeljevic, & Panagiotopoulos, 2013	▪ To evaluate the impact of the Health Buddies™ program on body mass index, waist circumference, blood pressure, health behaviour and knowledge.	▪ Cross-sectional ▪ 2009-2010	▪ Kindergarten to grade 12 FN youth from Tsimshian FN on the northern Pacific Coast of British Columbia ▪ Remote ▪ n=118, 39% female, mean age 10.9±3.5 y	▪ FFQ for intake of sugar sweetened beverages, milk, fruits, vegetables and 'fruits+vegetables' ▪ Adapted from the US National Cancer Institute's National Institutes of Health: Eating at America's Table Study Quick Food Scan ▪ Validated for youth 9-18 years-old	▪ Mean soda pop intake: 1526.5±2044.9 mL/week ▪ Mean sugar sweetened beverage intake: 6497.4±6906.6 mL/week
Saksvig, Gittlesohn, Harris, Hanley, Valente, & Zinman, 2005	▪ To evaluate the impact of the Sandy Lake school-based diabetes prevention program on dietary intakes, knowledge and psychosocial factors.	▪ Cross-sectional ▪ 1998	▪ Grade 3-5 FN youth attending Thomas Fiddler Memorial School in Sandy Lake First Nation, Ontario ▪ Isolated, remote ▪ n=122, 45% female, age range 7-14 y	▪ Single, weekday 24-hour recalls over 3 weeks ▪ 1-day non-quantitative food diary to assist recall ▪ Probing for details and use of food and 2-dimensional models	▪ Mean macronutrient intakes fell within AMDR ▪ 32% ate ≤30% of E from fat ▪ Mean fibre intake: 11.6±8.0 g
Skinner, Hanning, Metatawabin, Martin, & Tsuji, 2012a	▪ To evaluate the impact of a school nutrition program on dietary intakes.	▪ Cross-sectional ▪ 2004	▪ Grade 6-10 FN youth attending Peetabeck Academy in Fort Albany, Ontario ▪ Isolated, remote ▪ n=63, 55.6% female, mean age 13.5±1.6 y	▪ Single web-based school day 24-hour recalls ▪ Adapted for use in FN youth ▪ Validated against dietitian-administered 24-hour recalls	▪ 78%, 53%, 90% and 28% <CFG recommendation for VF, GP, MMA and MA, respectively ▪ 13% <DRI for CHO ▪ 45%, 60%, 33%, 88%, 88% and 15% <EAR for vitamin A, folate, vitamin C, calcium, vitamin D and Fe, respectively

Reference	Purpose	Design & Year	Sample & Setting	Dietary Assessment Method	Main Findings
Skinner, Hanning, Sutherland, Edwards-Wheesk, & Tsuji, 2012b	▪ To plan community-driven health promotion strategies for healthy eating and physical activity.	▪ Cross-sectional ▪ 2004-2005	▪ Grade 6-11 FN youth attending Peetabeck Academy in Fort Albany, Ontario ▪ Isolated, remote ▪ n=66, 58% female, mean age 14.1 y (boys), 13.0 y (girls)	▪ Single web-based school day 24-hour recalls and FFQ ▪ Adapted for use in FN youth ▪ Validated against dietitian-administered 24-hour recalls	▪ Median intake of VF, GP and MMA <CFG recommendation ▪ Median Ca, vitamin D and fibre intakes <AI ▪ Mean game intake: 2.6 (girls) and 4.0 (boys) servings/week ▪ Youth consumed a mean of 6.6-7.0 servings of cola-type pop, 5.0 servings of French fries, 5.9-6.1 servings of salty snacks, 3.4-3.7 servings of pizza, and 5.8-6.5 servings of candy/chocolate bars per week
Taylor, Timmons, Larsen, Walton, Bryanton, Critchley, & McCarthy, 2007	▪ To assess food consumption among on-reserve youth in Prince Edward Island.	▪ Cross-sectional ▪ 2002	▪ 8-18 year-old Mi'kmaq (FN) youth from Abegweit or Lennox Island, Prince Edward Island (reserves) ▪ Rural ▪ n=55, 60% female	▪ A 27-item FFQ and Eating Behaviour Survey ▪ Validated and pilot tested in Mi'kmaq youth	▪ 51% and 100% <CFG recommendation for MMA and VF, respectively ▪ 48% ate ≥3 snack foods/day ▪ 71% consumed milk daily ▪ >50% had fruit or juice daily ▪ 14% had no vegetables other than salad in past 7 days ▪ 61% did not have salad in past 7 days
Tomlin, Naylor, McKay, Zorzi, Mitchell, & Panagiotopoulos, 2012	▪ To evaluate the impact of a 7-month school health program (Action Schools! BC) on diet	▪ Cross-sectional ▪ 2007	▪ Grade 4-12 FN youth from 3 northwestern British Columbia communities ▪ Rural, remote ▪ n=133, 47% female, mean age 12.4±2.2 y	▪ Single 24-hour recall ▪ Validated	▪ Macronutrient intakes fell within AMDRs ▪ Mean VF servings <CFG recommendation (2.75±2.45) ▪ Mean sugar sweetened beverage intake was high (835.4±725.5 mL/day)

[a]AI: adequate intake (Health Canada, 2013); AMDR: acceptable macronutrient distribution range (Health Canada, 2013); CFG: Canada's Food Guide (Health Canada, 2007a); CHO: carbohydrate; E: energy; EAR: estimated average requirement (Health Canada, 2013); FN: First Nation; FFQ: food frequency questionnaire; GP: grain products (Health Canada, 2007a); MA: meat and alternatives (Health Canada, 2007a); MMA: milk and milk alternatives (Health Canada, 2007a); SBF: store-bought foods; RDA: recommended dietary allowance (Health Canada, 2013); TF: traditional foods; VF: vegetables and fruit (Health Canada, 2007a); y: years.

3.5 Discussion

This study reviewed 24 peer-reviewed journal articles published between January 2004 and January 2014, reporting on the dietary intakes of FN, Inuit and/or Métis youth of school age residing in Canada. Overall, the research revealed diets that were nutrient-poor and high in 'other foods' (e.g., sugar-sweetened beverages, snack foods, fast foods); intakes of important micronutrients, most notably fibre, folate, vitamin A, vitamin C, calcium and vitamin D, were of concern, not surprising given a general trend toward intakes of vegetables and fruit and milk and alternatives below the recommendations of CFG (Adams et al., 2005; Nakano et al., 2005a, 2005b; Paradis et al., 2005; Saksvig et al., 2005; Taylor et al., 2007; Downs et al., 2008, 2009; Khalil, Johnson-Down, & Egeland, 2010; Ng, Young, & Corey, 2010; FNIGC, 2012; Gates et al., 2012a, 2012b, 2012c; Skinner et al., 2012a, 2012b; Tomlin et al., 2012; Gates et al., 2013a, 2013b; Kakekagumick et al., 2013; Ronsley et al., 2013). Nutrient-dense traditional foods, contributing significantly to intakes of iron, zinc, copper, magnesium, phosphorus, potassium, vitamin E, riboflavin and vitamin B_6, did not tend to be consumed with great frequency (Nakano et al., 2005a; Kuhnlein & Receveur, 2007; Downs et al., 2009; Khalil, Johnson-Down, & Egeland, 2010). Traditional foods do, however, remain important as most youth still consume them; that being said, the majority of energy intake tended to be consumed via store-bought foods (Nakano et al., 2005a; Kuhnlein & Receveur, 2007; Khalil, Johnson-Down, & Egeland, 2010; Hlimi et al., 2012). As compared to youth in the general population, Aboriginal youth face similar concerns in terms of nutrient inadequacy (Ng, Young, & Corey, 2010; Health Canada, 2012). Still, results from the 2004 CCHS showed that Aboriginal youth consumed significantly less dairy products and vegetables compared to their non-Aboriginal peers (although the data excluded on-reserve FN youth), but did not differ significantly for other nutrients or food groups

(Ng, Young, & Corey, 2010). It remains clear that in specific sub-populations of Aboriginal youth, specifically those living in rural, remote, isolated and/or northern regions where adequate, consistent access to affordable healthy foods is uncertain (Haman et al., 2010; Gates et al., 2011), adequacy in food groups and nutrients is a concern.

3.5.1 Comparison to Other Indigenous Populations

It is recognized that the historical and present-day factors affecting the food behaviours of each Aboriginal community are unique. That being said, the findings of this review warrant comparison to other Indigenous populations worldwide, which may share some of the same challenges and barriers to healthy eating as Canadian Aboriginal ones. Although each Indigenous community has a distinct past, the transition to more Western lifestyles and the inclusion of an increasing proportion of energy-dense, nutrient poor store-bought foods in the diet, has affected many native communities. A study of the school lunches and breakfasts of American Indian schoolchildren found high energy intakes from fat and saturated fat for both meals, along with inadequate intakes of folate (Story, Snyder, Anliker, Cunningham-Sabo, Weber, & Platero et al., 2002). A study of Mohawk (Native American) youth of school age found that the diets included few naturally occurring sources iron, zinc and folate (Ravenscroft, Schell, & Akwesasne Task Force on the Environment [ATFE], 2014). Further, sugar sweetened beverages were the second highest contributors to vitamin C intakes (Ravenscroft, Schell, & ATFE, 2014). Similar to the Canadian context, the diets American Indian people as a group have been characterized by increased intakes of high-energy, low-nutrient-density foods and described as obesogenic (Compher, 2006). In Australia, research with 5-17 year-old Indigenous youth from the Torres Strait found that 52% and 49% of participants, respectively, consumed one or less servings of fruits and vegetables daily (Valery, Ibiebele, Harris, Green, Cotterill, & Moloney et al., 2012). Takeaway foods (i.e., fast foods) were consumed with great frequency, with one quarter of youth consuming them two or more times per week (Valery et al., 2012). Nearly all (97%) youth reported consuming energy dense foods and beverages at least daily (Valery et al., 2012). It is clear that the food behaviours of Canadian Aboriginal youth are not entirely unique and share many characteristics with the diets of Indigenous youth in other industrialized nations. With that said, the findings of this review should not be generalized to all Indigenous populations, as there exist Indigenous groups worldwide where stunting and underweight (as opposed to overweight and obese) remain the dominant concern in terms of dietary adequacy (Horta, Santos, Welch, Cardoso, dos Santos, & Assis et al., 2013).

3.5.2 Findings in the Context of Disease Risk

The quality of the diets revealed through this review are concerning given the relationship between dietary intake and disease risk. There is convincing evidence for an association between increasing vegetable and fruit consumption and decreased risk for hypertension, coronary heart disease and stroke in adults (Boeing, Bechthold, Bub, Ellinger, Haller, & Kroke et al., 2012). Further, dairy food intake, calcium and vitamin D are important for bone growth and development, particularly at northern latitudes where endogenous vitamin D production via sun exposure is inadequate to meet needs for at least six months of the year (Zhang & Naughton, 2010). Vegetable and fruit intake patterns in the formative years are also likely to persist through to adulthood, while milk and dairy food intakes tend to decrease with age (Lake et al., 2006), meaning that the promotion of healthy habits is especially important during childhood. Similar to youth, investigations into the food behaviours of Aboriginal adults have noted inadequate consumption of vegetables and fruit, milk and alternatives, fibre, folate, calcium, vitamin A, vitamin D and vitamin D, concomitant with the excess consumption of nutrient-poor, store-bought 'other' foods (Hopping, Mead, Erber, Sheehy, Roache, & Sharma, 2010; Bruner & Chad, 2014). Furthermore, diet quality has been found to be independently associated with body fat and waist circumference in school-aged youth (Jennings, Welch, van Sluijs, Griffin, & Cassidy, 2011). This is especially relevant given that Aboriginal youth are disproportionately affected by overweight and obesity, and FN youth, in particular, are at a heightened risk for the development of type 2 diabetes (Young, Dean, Flett, & Wood-Steiman, 2000; Shields, 2006; Public Health Agency of Canada [PHAC], 2011). Given that childhood weight tends to persist into adulthood (Singh et al., 2008) and that the Aboriginal population is young compared to the non-Aboriginal one (Statistics Canada, 2013a), targeting the diets of youth (e.g., via school programs) is a popular approach to address obesity. Such an approach provides the opportunity to not only improve child and youth health, but also to reduce the burden of adult morbidity and premature mortality in the future.

3.5.3 Health Promoting Initiatives

Given the diet quality of many Aboriginal youth, a number of studies have reported on the impact of community and school-based initiatives aiming to improve diet quality in this population. Most notably, the Kahnawake Schools Diabetes Prevention Project (KSDPP), Sandy Lake School-based Diabetes Prevention Program (SLSDPP), Healthy Buddies™ and Action Schools! BC (AS!BC) are initiatives promoting healthier diets, physical activity and diabetes prevention for FN youth that have been met with limited success in terms of improved diet quality (Adams et al., 2005; Paradis et al., 2005; Saksvig et al., 2005; Tomlin et al., 2012, Kakekamugic et al., 2013). Some smaller food provision programs, namely providing healthier store-bought foods to youth during school hours, have also been marginally successful. Research by *Gates et al*. (2012c, 2013b) investigated the impact of school food provision programs in two remote FN communities and noted moderate improvements in diet over the short term, however longer-term success was impeded by multiple community-level barriers. Nevertheless, four years after implementation, the dedication of community members facilitated significant increases in vegetables and fruit and milk and alternatives consumption (Gates, Gates, Hanning, Stephen, & Tsuji, 2014; **Study Five**, herein). Similarly, *Skinner et al*. (2012a) investigated the diets of youth participating in a longstanding (>15 years) school breakfast and snack program in a northern, remote FN community in Ontario. Program attendees reported higher intakes of vegetables and fruit, milk and alternatives, folate, fibre, vitamin C, vitamin A, calcium, vitamin D and iron and lower intakes of energy-dense, nutrient-poor 'other foods' (Skinner et al., 2012a). These case studies show that, at least over the long term (i.e., multiple years), school food provision programs may be able to improve diet quality.

3.5.4 Methodological Considerations

Methodologically, *Burrows, Martin, & Collins* (2010) identified the most accurate technique for measuring self-reported diet in youth as the 3-day, multiple-pass 24-hour recall, including both weekdays and weekend days and using parents as proxy-reporters. In the current review, a minority of studies employed this method, which may have led to inaccuracies in results. Ideally, future research would employ the most accurate technique for measuring self-reported diet, however, the challenges of doing so must be taken into consideration (Campbell, Diamant, Grunau, & Halladay, 1994). Data collection and travel to remote communities may be time- and resource-intensive, and must be scheduled as to not overly impede on school learning hours. When technological resources allow, web-based recalls may provide for a time- and cost-effective solution (Illner, Freisling, Boeing, Huybrechts, Crispim, & Slimani, 2012). Community members can be trained to administer the recalls, thereby contributing to community-based research capacity. Furthermore, the cultural relevance of the data collection method needs to be considered, such that accurate data are available for the traditional foods typically consumed in each community. It cannot be ignored, as well, that much of the research into the diets of Aboriginal youth have employed relatively small sample sizes; six studies had sample sizes of $n \leq 100$ (Taylor et al., 2007; Gates et al., 2012c; Skinner et al., 2012a, 2012b; Gates et al., 2013a, 2013b), while another six had samples sizes of $n \leq 150$ (Adams et al., 2005; Saksvig et al., 2005; Khalil, Johnson-Down, & Egeland, 2010; Tomlin et al., 2012; Kakekagumick et al., 2013; Ronsley et al., 2013). This is a reality of research with Aboriginal communities, and although the validity and generalizability of the results are therefore compromised, it is possible that even if a sample is small, it may represent nearly all youth residing in a community (i.e., close to 100% response rate) (Gates et al., 2012c). In planning for locally relevant health-promoting initiatives, these small samples may be adequate.

3.5.5 Knowledge Gaps and Areas of Future Research

Much of the published research reporting on the food and nutrient consumption of Aboriginal youth has focused on FN youth and those residing in remote, isolated communities in Ontario and Quebec. For this reason, little is specifically known about the diets of Métis and Inuit youth, FN youth living off-reserve or in urban areas, as well as Aboriginal youth living in the remaining provinces and territories. Although data on the diets of very young Inuit and Métis children are available through the ICHS (3-5 year-old Inuit children) (Egeland, Qanuippitali Steering Committee members, Pacey, Johnson-Down, & Cao, 2009) and ACS (<6 year-old Inuit, Métis and off-reserve FN children) (Statistics Canada, 2008), the diets of school-aged Inuit and Métis youth, in particular, remain largely indeterminate. As each Aboriginal community is unique, more detailed information about a wider range of communities is necessary, especially if programs and policies aiming to improve diet quality are to be established. The diets of youth in Aboriginal communities may be affected by a number of factors that are unique to each community, including but not limited to, degree of remoteness and/or isolation, geographic location (e.g., latitude), availability of grocery stores and the cost and availability of healthy foods, accessibility of traditional hunting, trapping and harvesting practices, the lasting impact of acculturation as well as the presence (or lack of) local programming promoting or discouraging healthy eating (Skinner, Hanning, & Tsuji, 2006; Haman et al., 2010; Gates et al., 2011; Willows, Hanley, Delormier, 2012). The current review only located one study specifically investigating the diets of Inuit youth and three for Métis (Nakano et al., 2005a, 2005b; Kuhnlein & Receveur, 2007). For that reason, the findings cannot be generalized to those populations. Nevertheless, it remains clear that as a whole, the food and nutrient consumption of the population could stand to be improved in order to meet current Canadian dietary guidelines as defined by CFG for food groups and Dietary Reference Intakes (DRIs) for nutrients.

Clearly, many of the current initiatives attempting to improve the diet quality of Aboriginal youth in Canada have not been optimal. School food provision may provide for some improvement over the long term, but such programs are insufficient to bring the majority of youth into the range of adequacy for food groups and nutrients (Gates et al., 2012c, 2013b, Skinner et al., 2012a). Furthermore, many communities do not have access to programming aimed at improving the diet quality of their youth. In some communities, especially northern ones, making healthy choices may not even be an option; nutrient-dense foods like vegetables and fruit, low fat dairy products, whole grains and lean meats may be available only sporadically, be exorbitantly expensive or of poor quality upon their arrival within communities (Gates et al., 2011; Socha, Chambers, Zahaf, Abraham, & Fiddler, 2011). Consequently, although education initiatives may improve knowledge and intentions for healthier eating, numerous barriers must be overcome before youth would be able to put this knowledge into action (Saksvig et al., 2005; Gates et al., 2011, 2013a). In order to provide for lasting improvements in diet quality and to ensure dietary adequacy for a larger proportion of Aboriginal youth, multi-level approaches and a greater understanding of why they eat what they do is required. Up-and-coming methods, like photovoice, may provide an effective way to help elucidate the food-related experiences of Aboriginal youth (Martin, Garcia, & Liepert, 2010; Young, Wabano, Burke, Ritchie, Mishibinijima, & Corbiere, 2013).

Relatively little is known about the perceptions of health and nutritious diets, and the importance of traditional foods for Aboriginal youth. Research has shown that some Aboriginal youth may have body weight perceptions that differ from the traditional Western ideal and that some populations may not view obesity as being problematic (Davis, Northington, & Kolar, 2000). Given the more holistic view of health in many Aboriginal cultures, and more specifically the spiritual and cultural importance of traditional foods, Aboriginal youth likely also differ in terms of their perceptions of what would constitute a nutritious diet. To the authors' knowledge, these perceptions largely remain to be elucidated at this time. A greater understanding of the meanings of different foods and conceptions of a healthy diet would allow for culturally relevant initiatives to promote dietary adequacy. Given relatively recent declines in traditional food consumption, and knowing the cultural and dietary importance of traditional foods (Kuhnlein et al., 2004; Nakano et al., 2005a, 2005b; Kuhnlein & Receveur, 2007) programs supporting harvesting, hunting, gathering and harvest sharing, with a focus on passing these skills on through the generations, may hold promise. Similar to youth, it has been reported that Aboriginal adults also consume diets that are simultaneously high in 'other' foods and below recommended levels of vegetables and fruit, and milk and alternatives, yet higher in traditional foods (Bruner & Chad, 2014). Adult nutrient intakes in arctic regions have also been described as being inadequate in fibre, calcium, folate, vitamin A, vitamin D and vitamin E (Hopping et al., 2010). Parental influences, and the influences of other adult role models on the diets of youth warrant further investigation, and it is likely that whole-community and whole-family approaches to dietary improvement will be more successful than those targeting youth only.

3.6 Conclusions

The diets of school-aged Aboriginal Canadians are in need of improvement; many are inadequate in important food groups and micronutrients, while being higher in energy-dense, nutrient-poor store-bought foods. School-based nutrition programs have only been met with marginal success. Looking toward the future, research is required to elucidate the dietary habits and dietary adequacy of school-aged Inuit and Métis youth in particular. Furthermore, balancing methodological rigor and cultural appropriateness, while taking the opportunity to promote community-based research capacity, is important when conducting research in this vulnerable population. Future investigations should also focus on the health perceptions of Aboriginal youth, and their perceptions of a nutritious diet, in particular, as these may differ from typical Western norms. The knowledge gained may be used to target initiatives to improve diet quality. Given the known benefits of traditional food consumption, both nutritional and cultural, initiatives promoting harvest sharing and skill development for the hunting and gathering of such foods may be effective in conjunction with programs promoting healthier store-bought options.

3.7 Limitations

As little data on the diets of Inuit and Métis youth exist, it is likely that the findings of this review are not generalizable to those populations. Many of the studies reviewed utilized relatively small sample sizes, which may have impacted the generalizability of the findings. It should be noted that all of the studies reviewed utilized self-reported methods of measuring dietary intake, which are susceptible to social desirability and recall biases. Only one study used three 24-hour recalls, the most accurate method of measuring self-reported intake (Burrows, Martin, & Collins, 2010). Furthermore, this study did not report on associations between dietary intake and demographic factors, health behaviours or weight status. Further study to review published data on such associations is recommended and would fill a gap in current knowledge specifically for Aboriginal youth. It is possible that relevant studies were missed during the literature search, however, duplication of the search and data extraction by a second, independent researcher has minimized the likelihood that relevant studies would have been excluded.

3.8 Acknowledgements

Thank you to Michelle Gates and Dr. Kelly Skinner for their help in designing the search strategy, duplicating the data extraction and reviewing the manuscript.

3.9 Addendum to Study One

A repeated literature search in November 2015, using the same search strategy, inclusion criteria and exclusion criteria, did not yield any new studies that were relevant to this review.

4.0 Study Two:
An Exploration of the Socioeconomic and Sociocultural Predictors of Traditional Food Consumption Among 12-17 Year-old First Nations Youth Living On Reserves in Canada[*]

4.1 Overview

Background. Youth who consume traditional foods have higher intakes of key nutrients. Knowledge of the predictors of frequent traditional food intake would help to design strategies to improve their consumption amongst youth.

Objectives. Amongst a large sample of 12-17 year-old FN youth residing on reserves across Canada, to explore potential relationships between frequent traditional food intake and each of: individual, socioeconomic and sociocultural factors.

Methods. This study utilized data from the 2008/10 RHS. Traditional food intake was elucidated via an 11-item FFQ. For the purposes of this study, only land- and water-based animals were investigated (i.e., plants and homemade foods were not included), reducing the FFQ to seven categories of foods. Selected potential predictors of traditional food consumption included individual (i.e., age, sex), socioeconomic (i.e., number of children in the household, living with both biological parents, parent education level) and sociocultural (i.e., use of FN language, participation in community cultural events, number of people helping to understand culture, traditional food sharing) factors. Logistic regression modeling was used to test the bivariate and multivariate relationships between frequent traditional food consumption and each of the individual, socioeconomic and sociocultural variables amongst four age and sex sub-groups (12-14 year old boys, 15-17 year-old boys, 12-14 year-old girls and 15-17 year-old girls).

---

[*] This chapter was prepared for submission to a peer-reviewed academic journal as the following: Gates, A., Gates, M., Hanning, R.M., & Tsuji, L.J.S. An exploration of the sociocultural and socioeconomic predictors of traditional food intake among 12-17 year-old First Nations youth living on reserves in Canada.

Results. A total of 3587 participants (52% boys, 50.4% 12-14 years-old), representing a weighted population of 39 232 FN youth, were included in the analyses, of whom 31.2% consumed at least one traditional food often. Frequent traditional food consumption was significantly associated with having a parent with a high school education (p=0.014), almost or almost always participating in community cultural events (p<0.001), and often having traditional food shared with one's household (p<0.001). Bivariate associations were apparent by age and sex category. For 12-14 year-old girls (n=834, weighted population of 9 451), the odds of frequently consuming traditional foods were increased amongst those who always or almost always participated in community cultural events as compared to those who rarely or never did (OR=2.43, CI=1.43-4.12, p<0.001) and those who often had traditional foods shared with their household as compared to less often (OR=4.08, CI=2.26-7.34, p<0.001). For 15-17 year-old girls (n=960, weighted population of 9 376), the odds of consuming traditional foods were increased for those who often had traditional foods shared with their household as compared to less often (OR=4.61, CI=3.08-6.88, p<0.001). For 12-14 year-old boys (n=893, weighted population of 10 331), the odds of consuming traditional foods were increased for those who spoke a FN language as compared to those who did not (OR=1.41, CI=1.01-1.96, p=0.041), those who always or almost always participated in community cultural events as compared to those who participated rarely or never (OR=1.76, CI=1.16-2.68, p=0.013) and those who often had traditional foods shared with their household as compared to those who had food shared with them less often (OR=5.13, CI=3.42-7.72, p<0.001). For boys aged 15-17 years (n=900, weighted population of 10 075), there were increased odds of frequently consuming traditional foods amongst those whose parents had a high school education as compared to those whose parents had not graduated high school (OR=1.86, CI=1.17-2.95, p=0.024), those who always or almost always participated in community cultural events as compared to those who participated less often (OR=2.82, CI=1.63-4.88, p=0.001) and those who had traditional foods shared with their household often as compared to less often (OR=3.67, CI=2.54-5.30, p<0.001). All of these relationships persisted following the adjustment for socioeconomic and sociocultural variables in the multivariate models, with the exception of participation in cultural events for 12-14 year-old boys.

Conclusions. For 12-17 year-old FN youth residing on reserves in Canada, food sharing was consistently an important predictor of traditional food consumption, while participation in community cultural events was also influential for most subgroups of youth. This suggests merit in examining food sharing initiatives and programming as a means to improve traditional food exposure and knowledge amongst youth.

DISCLAIMER: This study contains the findings of the author's analyses of data from the 2008/10 First Nations Regional Health Survey. Please note that the analyses contained herein do not necessarily reflect the views of the First Nations Information Governance Centre. Statistics reproduced from this document must be accompanied by a citation of this document, including a reference to the page on which the statistic in question appears.

4.2 Background

Aboriginal Canadians once relied heavily on traditional land-based food procurement to meet their energy and nutrient requirements (Kuhnlein et al., 2004; Willows, 2005; Haman et al., 2010; AANDC, 2013). This practice, aside from being extremely physically demanding (Young & Katzmarzyk, 2007; Pal, Haman, & Robidoux, 2013), promoted good health in that the resulting diets were both energy balanced and nutrient-rich (Willows, 2005). In more recent decades, the procurement and consumption of traditional foods by Canada's Aboriginal groups have become increasingly threatened by multiple contributing factors; environments and migration patterns are changing, important traditional species are declining in number or becoming extinct, and hunting has become increasingly expensive (i.e., fuel, ammunition, other equipment). Furthermore, lifestyles are evolving and changing priorities leave less time for traditional activities, traditional knowledge is gradually being lost and taste preferences for culturally important foods are changing (Chan, Fediuk, Hamilton, Rostas, Caughey, & Kuhnlein et al., 2006; Guyot, Dickson, Paci, Furgal, & Chan, 2006; Power, 2008; Robidoux, Haman, & Sethna, 2009; Thompson, Kamal, Alam, & Wiebe, 2012; Ford, Lardeau, Blackett, Charwood, & Kurszewski, 2013; Pal, Haman, & Robidoux, 2013; Skinner, Hanning, Desjardins, & Tsuji, 2013; Tam, Gough, Edwards, & Tsuji, 2013).

The resultant decline in traditional food consumption has meant that many FN individuals now rely more heavily on store-bought foods to meet their dietary requirements. In many locales, the store-bought choices that are available and accessible result in a diet that is nutritionally inferior as compared to years past when traditional foods were at the forefront (Kuhnlein et al., 2004; Willows, 2005; Haman et al., 2010; Egeland, Johnson-Down, Cao, Sheikh, & Weiler, 2011). Declining rates of traditional food consumption are especially concerning amongst children and youth, who typically eat less of these foods compared to past generations (Kuhnlein et al., 2004; Willows, 2005; Power, 2008). Given declining rates of exposure, it is plausible that the taste preferences of young FN people are changing, favouring store-bought choices over the culturally important foods on which they once subsisted (Power, 2008; Willows, 2005).

Aboriginal youth now face substantially higher prevalence rates of obesity as compared to their non-Aboriginal peers (Shields, 2006; FNIGC, 2012). The forces that come together to lead to the accretion of excess body fat for FN youth are numerous, complex and strongly mediated by lasting social inequities secondary to a history of marginalization and cultural oppression (Willows, Hanley, & Delormier, 2012). The well-documented transition from traditional to store-bought foods that has occurred for much of this population (Kuhnlein et al., 2004; Willows, 2005; Haman et al., 2010; AANDC, 2013) is undoubtedly a strong contributor warranting further investigation. A robust understanding of the many forces that affect the food behaviours of FN youth is necessary if desirable and realistic modifications to the environments in which they make choices about what they eat are to be fruitful (Willows, Hanley, & Delormier, 2012).

The challenges and barriers to accessing and consuming traditional foods for Aboriginal people have been previously elucidated in at least some depth in a number of distinct settings (Chan et al., 2006; Guyot et al., 2006; Power, 2008; Robidoux, Haman, & Sethna, 2009; Thompson et al., 2012; Ford et al., 2013; Pal, Haman, & Robidoux, 2013; Skinner et al., 2013; Tam et al., 2013). Further investigations into these barriers have informed strategies to support the nutritional and cultural needs of FN people by enhancing the harvest, sharing and consumption of these foods (Chan et al., 2006; Thompson et al., 2012; Ford et al., 2013; Skinner et al., 2013; **Study Four** herein). Nevertheless, the majority of the research investigating the factors that affect food choices and traditional food intake in particular has focused on adults. The factors influencing youth's intake of traditional foods have been investigated with lesser frequency, and have been identified as a knowledge gap warranting further investigation (Willows, 2005).

4.3 Impetus for this Research

There exists relatively little published literature on the many contributors to the decline in traditional food consumption for FN people. Work by *Gaudin et al*. (2014), elucidated some of the determinants of traditional food intake for three Cree communities in northern Quebec using a mixed methods approach. The authors found that those who consumed traditional foods more often were more likely to be older, more active, have less formal education and to be a hunter (Gaudin, Receveur, Walz, Girard, & Potvin, 2014). No associations were found between traditional food consumption and sex, BMI, smoking status, employment status, health perceptions, concerns about pollution, number of people in the household, nor speaking English at home (Gaudin et al., 2014). This research provides valuable insights into some of the individual, sociocultural and socioeconomic factors that may influence the food choices of this population. However, an in-depth exploration into the socioeconomic and sociocultural influences on traditional food consumption for a nationwide sample of FN youth does not currently exist. Further work is necessary to substantiate *Gaudin et al.*'s (2014) findings among Canadian youth, who may be affected by entirely different influences as compared to adults.

The 2008/10 RHS collected demographic, health and wellness information on a representative sample of FN youth living on reserves across Canada (FNIGC, 2008, 2012). As part of the survey, participants were asked to report on their traditional food intake as well as possible influential factors such as age, sex, living with both biological parents, parent education level, use of a FN language, participation in community cultural events, number of people helping to understand one's culture, and having traditional food shared with one's household (FNIGC, 2008, 2012). These data provide the opportunity to fill a knowledge gap (Willows, 2005) by exploring some of the individual, sociocultural and socioeconomic influences on the traditional food use of on-reserve FN youth residing in Canada.

4.4 Objective and Hypotheses

4.4.1 Objective

Using data from a Canada-wide sample of 12-17 year-old FN youth living on reserves, the objective of the present study is as follows:

A. To explore potential bivariate and multivariate relationships of each of: individual, sociocultural and socioeconomic characteristics with traditional land- and water-based animal food consumption (i.e., traditional foods).

4.4.2 Hypotheses

All of the independent variables were chosen as they were hypothesized to be significant predictors of frequent traditional food consumption for 12-17 year-old FN youth living on reserves. The specific hypotheses for each independent variable, developed *a priori*, are presented in **Table 4.1**. The directions of these relationships and the knowledge used to inform them follow the table.

Table 4.1. Hypotheses for study two

Independent Variable	Hypothesis
Age	Older youth will consume traditional foods less frequently than younger ones.
Sex	Boys will consume traditional foods more frequently than girls.
# of children in the household	The odds of frequent traditional food consumption will be increased amongst those who reside in households with three or more children as compared to those who reside in households with less than three children.
Living with biological parents	The odds of frequent traditional food consumption will be increased amongst those youth who live with only one or neither of their biological parents as compared to those who live with both biological parents.
Parent education	The odds of frequent traditional food intake will be increased amongst those youth whose parents have less than a high school education as compared to those whose parents have more formal education.
Use of a First Nations language	The odds of frequent traditional food intake will be increased amongst those youth who can speak a First Nations language as compared to those who do not speak a First Nations language.
Community cultural events	The odds of frequent traditional food consumption will be increased amongst those youth who always or almost always participate in community cultural events as compared to those who participate less often.
# people helping to understand culture	The odds of frequent traditional food consumption will be increased amongst those youth who have greater than four individuals who help them to understand their culture as compared to those who have less than two people who help them to understand their culture.
Food sharing	The odds of frequent traditional food intake will be increased amongst those youth who often have foods shared with their household as compared to those who have foods shared less often.

Age. Based on previous reports of declining traditional food use with age (Willows, 2005; Power, 2008), it is expected that older youth (15-17 year-olds vs. 12-14 year-olds) will consume traditional foods less frequently than younger ones. Older youth tend to consume more food as compared to younger ones based simply on differences in body size and energy expenditure (in general) (Rodríguez, Moreno, Sarría, Fleta, & Bueno, 2000). The association between age and traditional food consumption frequency, however, is less clear.

Sex. Although few reports have compared the traditional food consumption of FN youth by sex, of those that exist girls and boys have been either found to consume traditional foods with similar frequency (Hlimi et al., 2012) or boys have been found to be more frequent consumers (Berti, Hamilton, Receveur, & Kuhnlein, 1999; **Study Four** herein). It has also been noted that males may consume more traditional foods simply based on differences in body size and energy expenditure (Willows, 2005). Based on this work, it is expected that boys will consume traditional food more frequently than girls, however, the paucity of previous research impedes the development of a strong hypothesis.

Number of children in the household. First Nations people living on reserves face higher prevalence rates of food insecurity compared to non-Aboriginal people (FNIGC, 2012; Skinner, Hanning, & Tsuji, 2014; Health Canada, 2007b). Households with three or more children have been identified as being at an increased risk for food insecurity as compared to those with fewer children (Che & Chen, 2001; Willows et al., 2009). Contrary to the general population, FN children living in food insecure households are just as likely as adults in the same household to be food insecure (Indigenous and Northern Affairs Canada [INAC], 2003, 2004a, 2004b; DC, 2005). How this may relate to traditional food intake has not been explicitly investigated, however, it has been demonstrated that traditional food procurement is in fact no more economical for FN families compared to choosing store-bought foods (Pal, Haman, & Robidoux, 2013). Nevertheless, traditional food sharing is a common way that FN families may cope with food insecurity (Willows, 2005; Thompson et al., 2012; Skinner et al., 2013; Kerpan, Humbert, & Henry, 2015). It is thus hypothesized that the odds of frequent traditional food consumption will be increased amongst those youth who reside in households with three or more children as compared to those who reside in households with less than three children.

Living with biological parents. Living in a lone parent household is a risk factor for food insecurity (Willows et al., 2009), given its relationship to low income, which is the most important determinant of food insecurity (Nord & Brent, 2002; Power, 2005). Thus, youth living without both of their biological parents would be expected to experience higher rates of food insecurity as compared to those living with both parents. How families may cope with food insecurity and how this could impact youth’s traditional food intake, as previously mentioned, is uncertain. Nevertheless, given that traditional food sharing is a common coping mechanism against food insecurity (Willows, 2005; Thompson et al., 2012; Skinner et al., 2013; Kerpan, Humbert, & Henry, 2015), it is hypothesized that the odds of frequent traditional food consumption will be increased amongst those youth who live with only one or neither of their biological parents as compared to those who live with both biological parents.

Parent education. Lower adult educational achievement is a risk factor for food insecurity for Aboriginal households (Willows et al., 2009). Again, this could affect overall food intake, however, the direction and strength of this relationship cannot be predicted with much certainty. *Gaudin et al*. (2014) found, in a Cree population in Quebec, that lower educational attainment was associated with greater intakes of traditional foods. Whether or not this holds true for youth whose parents have achieved lower levels of formal education has not been previously investigated. Nevertheless, it is hypothesized that the odds of frequent traditional food intake will be increased amongst those youth whose parents have less than a high school education as compared to those whose parents have more formal education.

Use of a FN language. Having the ability to speak a FN language may be indicative of how connected a youth is to their culture. Food selection is, at least in part, influenced by culture (Kittler & Sucher, 2004) and for FN people the consumption of traditional foods is integral to holistic health (Power, 2008; Kerpan, Humbert, & Henry, 2014). Because of the hypothesized relationship between speaking a FN language and the importance of FN culture in a youth's life, it is hypothesized that the odds of frequent traditional food intake will be increased amongst those youth who can speak a FN language as compared to those who do not speak a FN language.

Community cultural events. Community cultural events have been described as a time for feasting and traditional food sharing amongst community members (Pal, Haman, & Robidoux, 2013; Kerpan, Humbert, & Henry, 2014). Beyond food sharing, these events may also serve as educational experiences for youth, allowing them to gain a greater appreciation for their culture and, potentially, stronger preferences for traditional foods. For this reason, it is expected that the odds of frequent traditional food consumption will be increased amongst those youth who participate in community cultural events more often (always or almost always) as compared to those who participate less often.

Number of people helping to understand culture. For FN youth, traditional foods may be associated with family and culture (Kerpan, Humbert, & Henry, 2014). It has been said that traditional food procurement and preparation practices are best learned by experience and that this is typically taught to youth via older generations (Pal, Haman, & Robidoux, 2013). Given that a person's culture determines, at least in part, the types of foods that are desirable to them and that they chose to eat (Kittler & Sucher, 2004), it is expected that the odds of frequent traditional food consumption will be increased amongst those youth who have greater than four individuals who help them to understand their culture as compared to those who have less than two people who help them to understand their culture.

Traditional food sharing. The sharing of traditional foods is a common practice in many FN communities (Pal, Haman, & Robidoux, 2013; Kerpan, Humbert, & Henry, 2014) and is a mitigating strategy against food insecurity (Willows, 2005; Thompson et al., 2012; Skinner et al., 2013; Kerpan, Humbert, & Henry, 2014). Although having traditional foods shared with ones family could certainly increase ones intake of these foods, the necessity of having these foods shared could also mean that they are more scarcely available within ones household. Nevertheless, for the purposes of this study, it is hypothesized that the odds of frequent traditional food intake will be increased amongst those youth who often have traditional foods shared with their household as compared to those who have these foods shared less often.

4.5 Methods

4.5.1 First Nations Cultural Framework

The First Nations Cultural Framework, originally developed by the FNIGC for the 2002/03 RHS data collection period, informed the RHS 2008/10 data collection and is meant to guide the interpretation of the data such that the findings are presented in a way that is usable to the participants and reinforces their worldviews and holistic health beliefs (FNIGC, 2012). The model is circular, with the FN person at the center, action (behaviours) to the north, vision (ways of being) to the east, relationships (ways of relating to time) to the south and reason (analysis) to the west (FNIGC, 2012). The questions on the survey were informed by the need for balance between these directions (FNIGC, 2012). The current study focused on the action (i.e., health behaviours and food security), reason (i.e., demographics, employment, income and education) and relationships (i.e., community wellness, language, residential schools, and culture) quadrants of the model, with the knowledge that these are all closely tied to the fourth quadrant, vision (i.e., physical health).

4.5.2 Survey Method and Participants

The RHS collects data on the health and wellness of FN adults, youth and children living on-reserve and in northern regions of Canada (FNIGC, 2013). First piloted in 1997, it was the first and remains the only First Nations-governed national health survey in the country (FNIGC, 2013). The data collected through the RHS have filled a knowledge gap on the health of on-reserve FN people, given that in most national surveys (e.g., CCHS, CHMS), those living in northern regions or on reserves are either excluded or underrepresented (FNIGC, 2013). The survey, data collection, analysis and interpretation were designed such that the findings are relevant and useful to the FN people and communities that participated (FNIGC, 2012). The first phase of the RHS began in the Fall of 2002 and was completed in mid-2003. It collected data on 22 602 on-reserve FN people from 238 communities across Canada (FNIGC, 2013). The second phase was completed in Fall 2010 and collected data on 21 757 FN people from 216 communities (FNIGC, 2012). The response rate was relatively high, at 72.5% (FNIGC, 2012). The food and nutrition-related findings from the second phase (2008/10), to this point, have been reported mainly descriptively (National Report on Adults, Youth and Children living in First Nations Communities (FNIGC, 2012)). Although surveys have been collected for the third phase, these data are not yet available.

Youth (12-17 year-old) data from the 2008/10 RHS were collected using a 30-minute self-administered survey, completed on laptop computers using Computer Assisted Personal Interviewing software (Creative Research Systems, Petaluma, California) (FNIGC, 2012). Written parental consent was obtained prior to data collection. A two-stage sampling strategy was used, where first the participating communities were selected, stratified by region, sub-region and community size (communities with a population of <75 people were excluded). Participants were sampled from most provinces and territories, with the exception of Nunavut (**Table 4.2**) (FNIGC, 2012). The second stage involved the random selection of individuals within each age and gender group using locally updated Band membership lists (FNIGC, 2012).

Table 4.2. Number of sub-regions and communities, and percentage of the total population from each participating province and territory completing the 2008/10 First Nations Regional Health Survey (FNIGC, 2012)

Province or Territory	# of sub-regions	# of communities	% of population
Yukon	6	14	41.5
Northwest Territories	5	16	13.7
British Columbia	4	36	4.8
Alberta	3	16	2.3
Saskatchewan	11	35	5.0
Manitoba	8	30	4.2
Ontario	5	24	3.6
Quebec	9	22	7.4
Newfoundland	1	1	44.5
Nova Scotia/Prince Edward Island	2	14	15.1
New Brunswick	1	7	11.7
Canada (total)	**55**	**216**	**5.3**

4.5.3 Traditional Food Intake

Two separate FFQs were used to collect data on the food intake patterns of youth – one for store-bought foods and another for traditional foods (FNIGC, 2008, 2012). The participants were asked to recall the frequency of their consumption of a variety of foods for each questionnaire (over the previous 12 months for traditional foods; the store-bought food questionnaire asked for 'usual' intake) (FNIGC, 2008, 2012). For the purposes of this study, only the FFQ for traditional foods was investigated. This questionnaire included a variety of land- and water-based traditional animal and plant foods as well as select homemade food items that may be consumed in different regions of the country (FNIGC, 2008, 2012). The specific foods included on the questionnaire, and corresponding response options, are shown in **Table 4.3**.

Table 4.3. Foods included and response options on the food frequency questionnaire used to assess the traditional food consumption patterns of 12-17 year-old First Nations youth participating in the 2008/10 First Nations Regional Health Survey (FNIGC, 2008, 2012)

Food item	Response options
▪ Land-based animals (moose, caribou, bear, deer, bison, etc.)	▪ Often
▪ Fresh water fish	▪ A few times
▪ Salt water fish	▪ Not at all
▪ Other water-based foods (shellfish, eels, clams, seaweed, etc.)	
▪ Sea-based animals (whale, seal, etc.)	
▪ Game birds (goose, duck, etc.)	
▪ Small game (rabbit, muskrat)	
▪ Berries or other wild vegetation	
▪ Bannock/fry bread	
▪ Wild rice	
▪ Corn soup	

For the purposes of this study, only land- and water-based animal foods were investigated (i.e., homemade foods and plant foods were not included). To account for the fact that different types of traditional animal foods may be consumed in different regions, as well as to simplify the analysis, traditional food intake was dichotomized as 'frequently consumes traditional foods' and 'rarely or never consumes traditional foods'. Frequent consumption of traditional foods was defined as: consuming *any one of* land-based animals, fresh water fish, salt water fish, other water-based animal foods, sea-based animals, game birds or small game, 'often'. All other participants were categorized as rarely or never consuming traditional foods. In other words, rarely or never consuming traditional foods was defined as: reporting 'not at all' or 'a few times' consuming *all of* these foods (i.e., did not consume *any* of the available foods 'often').

4.5.4 Selected Independent Variables

A number of variables were selected from the survey as potential predictors of frequent traditional food consumption among youth, based on the previously presented hypotheses. These were grouped into three main categories of variables, including individual factors, socioeconomic factors and sociocultural factors. **Table 4.4** shows the chosen independent variables and the corresponding questions as they were presented on the survey, with response options. Responses were oftentimes re-coded to be meaningful for the analyses and to reduce the total number of categories used to maintain appropriate cell sizes. Age and sex were included as they are non-modifiable, known contributors to dietary intake. Number of children in the household, residing with both biological parents and parent education level were selected as they are typically closely tied to socioeconomic status and food security, and thus may have an impact on food intake. Knowledge of a FN language, participation in community cultural events, number of people helping to understand FN culture and traditional food sharing were chosen as they may be indicative of a participant's connectedness to their FN culture, thus could influence food choices.

Table 4.4. Independent variables included in the logistic regression analyses to explore frequent traditional food intake among 12-17 year-old First Nations youth from the 2008/10 First Nations Regional Health Survey (FNIGC 2008, 2012)

Variable	Question	Responses	Categories
Individual factors			
Age	What is your date of birth?	Day, Month, Year	1 = 12-14 years* 0 = 15-17 years
Sex	Are you male or female?	Male, Female	1 = male* 0 = female
Socioeconomic factors			
# of children in household	Including yourself, how many children and youth are living in this [your] household?	# 0-5 years, # 6-11 years, # 12-18 years	1 = >3 children* 0 = 1-3 children
Living with biological parents	Who do you live with most of the time?	Biological mother, biological father, brother(s)/sister(s), aunt/uncle/cousins, grandparent(s), my stepmother, my stepfather, step-brother(s)/step-sister(s), the mother that adopted me, the father that adopted me, my boyfriend/girlfriend/spouse, my child(ren), unrelated children, a woman I am not related to, a man I am not related to, don't know, refused, other	3 = neither biological parents* 2 = one biological parent (mother or father) 1 = both biological parents (mother or father)
Parent education	What is the highest level of formal schooling that your parents or guardians have completed?	Some elementary school, elementary school, some high school, diploma/certificate from trade or vocational school, diploma/certificate from community college or CEGEP, university degree, Masters degree, Doctorate, not applicable	3 = neither mother nor father achieved high school* 2 = mother or father achieved high school 1 = mother or father achieved some post-secondary education
Sociocultural factors			
Use of First Nations language	Can you understand or speak a First Nations language?	Yes, no, don't know, refused	1 = no* 0 = yes
Community cultural events	Do you take part in your local community's cultural events?	Always/almost always, sometimes, rarely, never, don't know, refused	3 = rarely or never* 2 = sometimes 1 = always/almost always
# of people helping to understand culture	Who helps you understand culture?	Yes, no, refused (grandparents, parents, aunts and uncles, other relatives, friends, school teachers, community elders, other community members, no one, don't know, refused, other)	3 = >4 people* 2 = 2-4 people 1 = <2 people
Traditional food sharing	In the past 12 months, how often did someone share traditional food with your household?	Often, sometimes, never, don't know, refused	1 = sometimes or never* 0 = often

*Reference category

4.5.5 Data Use and Ethical Approval

Access to the 2008/10 RHS youth data was requested from the FNIGC, who approved the project and vetted the outputs from the analyses. Statistical guidance from consultant Dr. Ian Martin from the University of Toronto Scarborough was sought in the planning of the analyses. All analyses took place at the First Nations Data Centre in Ottawa, Ontario, in accordance with the ethical protocols set out by the FNIGC.

4.6 Data Analysis and Interpretation

All analyses were carried out using the Statistical Package for the Social Sciences (SPSS, Complex Samples, *v*. 20, IBM Corporation, Armonk, New York) with a level of statistical significance decided *a priori* at $p \leq 0.05$. To take into account the two-stage stratified sampling design of the RHS and in order to achieve more statistically valid estimates for the population sample, information about the sampling design was incorporated into the analyses (FNIGC, 2015). Thus, all analyses were performed on the weighted population. Participants with missing data (i.e., responded with 'don't know' or 'refused') for any of the independent variables or for traditional food intake were excluded from the analyses.

The sample was described using descriptive statistics (i.e., means±SD, frequencies) and differences within the sample were investigated initially via Pearson Chi-square statistics. Subsequently, binary logistic regression models were used to test the bivariate (crude) and multivariate (including all independent variables) relationships between the independent variables and frequent traditional food intake. Exploratory analyses revealed that, for traditional food intake, there were significant interaction effects by age and sex for a number of the independent variables. Specifically, age interacted with participation in community cultural events ($p<0.001$) and traditional food sharing ($p<0.001$). Sex interacted with parent education level ($p=0.018$), participation in community cultural events ($p<0.001$) and traditional food sharing ($p<0.001$). To account for these known interactions, four separate sets of models were tested (i.e., one for each age and sex sub-group).

4.7 Results

4.7.1 Characteristics of the Sample Population

A total of 3587 youth, representing a population of 39 232 FN youth in the weighted sample, were included in the analyses following the removal of participants with missing values (n=1250). For the chosen variables, rates of missing data ranged from zero to 9.3% (**Table 4.5**). There was a nearly equal representation of both sexes within the final sample, with only slightly fewer girls (48.0%) than boys (52.0%). Both age groups were also nearly equally represented; 50.4% of the youth fell into the 12-14 year-old age category, while the remaining 49.6% were aged 15-17 years. Characteristics of the sample population with respect to the chosen independent variables are shown in **Table 4.5**, including differences by traditional food intake frequency.

Of the participating youth, 31.2% reported consuming at least one traditional food often, while the remaining 68.6% reported consuming such foods either only a few times or not at all. No differences in traditional food consumption frequency were observed by sex, age group, number of children in the household, whether or not the youth was living with both of their parents, nor the use of a FN language. Frequent traditional food consumption was associated with having a parent with a high school education (as opposed to a post-secondary education or less than a high school education) ($p=0.014$), more frequent participation in community cultural events ($p<0.001$) and often having traditional food shared with one's household ($p<0.001$).

Table 4.5. Characteristics of the subset of youth participants from the 2008/10 First Nations Regional Health Survey included in the analysis (n=3587)[a]

Variable	Data missing (%)	Proportion of sample (%)	Consumes Traditional Foods (%)[b]	p-value[c]
Traditional animal foods	4.5			
Often		31.2		
A few times or not at all		68.8		
Age	0.1			0.515
12-14 years		50.4	30.4	
15-17 years		49.6	31.9	
Sex	0.0			0.124
Male		52.0	32.7	
Female		48.0	29.5	
# of children in household	1.9			0.600
1-3 children		63.6	31.6	
>3 children		36.4	30.4	
Living with biological parents	n/a[d]			0.906
Both biological parents		40.1	30.9	
One biological parent		44.9	31.1	
Neither biological parent		15.0	32.1	
Parent education	7.9			**0.014**
Some post-secondary		33.0	29.3	
High school		25.2	36.7	
<High school		41.8	29.2	
Use of FN language	4.9			0.142
Yes		57.5	32.6	
No		42.5	29.2	
Community cultural events	2.0			**<0.001**
Always or almost always		23.1	42.1	
Sometimes		51.7	29.0	
Rarely or never		25.2	25.6	
# of people helping to understand culture	2.9			0.078
<2 people		41.4	28.5	
2-4 people		42.5	32.0	
>4 people		16.2	35.7	
Traditional food sharing	9.3			**<0.001**
Often		27.9	55.0	
Sometimes or less		72.1	21.9	

[a]Representing a population of 39 232 youth in the weighted sample.
[b]Defined as answering 'often' to at least one of the traditional foods on the food frequency questionnaire.
[c]As assessed via the Pearson Chi-square statistic. Variables where significant differences in responses by traditional food intake (often vs. a few times or never) were observed are shown in bold.
[d]Statistic has been suppressed due to low cell count (n<5).
Source: The First Nations Information Governance Centre, microdata abstract: 2015-GATA-001, July 9, 2015.

4.7.2 Logistic Regression Analyses for Girls

In total, 834 girls aged 12-14 years (weighted population of 9 451) and 960 girls aged 15-17 years (weighted population of 9 376) were included in the logistic regression analyses, following the removal of participants with missing data. For 12-14 year-olds, participating in community cultural events and food sharing predicted the odds of frequent traditional food consumption (**Table 4.6**). For 12-14 year-old girls, the odds of frequent traditional food consumption were increased amongst those who reported always or almost always participating in community cultural events as compared to those who never did (OR=2.43, CI=1.43-4.12, $p<0.001$), and amongst those who reported often having traditional food shared with their household as compared to those who sometimes or never did (OR=4.08, CI=2.26-7.34, $p<0.001$). Following adjustment for measures of socioeconomic status and other sociocultural variables in the multivariate model, the relationships for both participation in community cultural events (OR=1.66, CI=0.96-2.90, $p=0.021$) and traditional food sharing (OR=4.44, CI=2.69-7.34, $p<0.001$) persisted.

For 15-17 year-old girls, of all the variables investigated, only traditional food sharing predicted the odds of frequent traditional food consumption (**Table 4.6**). There were increased odds of frequent traditional food consumption amongst those who reported often having traditional food shared with their household as compared to those who had food shared less often (OR=4.61 CI=3.08-6.88, $p<0.001$). This relationship persisted following adjustment for socioeconomic and other sociocultural variables in the multivariate model (OR=4.65, CI=3.11-6.95, $p<0.001$).

Table 4.6. Logistic regression models to explore traditional food consumption among 12-17 year old First Nations girls from the 2008/10 First Nations Regional Health Survey[a]

Independent Variable	**12-14 Year-old Girls (n=834)[b]**					**15-17 Year-old Girls (n=960)[b]**				
	Consumes Traditional Foods (%)[c]	**Crude OR**	**95% CI**	**Adj-ust OR[d]**	**95% CI**	**Consumes Traditional Foods (%)[c]**	**Crude OR**	**95% CI**	**Adj-ust OR[d]**	**95% CI**
# of children in household										
1-3 children	29.2	1.17	0.76-1.79	1.44	0.89-2.31	32.1	1.14	0.77-1.69	1.25	0.81-1.93
>3 children	26.1	1.00		1.00		29.3	1.00		1.00	
Living with biological parents										
Both biological parents	29.9	1.07	0.66-1.73	1.40	0.83-2.35	26.2	0.78	0.50-1.23	0.94	0.55-1.60
One biological parent	25.7	0.86	0.49-1.51	0.96	0.54-1.71	35.8	1.23	0.78-1.94	1.37	0.82-2.26
Neither biological parent	28.6	1.00		1.00		31.2	1.00		1.00	
Parent education										
Some post-secondary	26.7	1.05	0.63-1.75	0.97	0.57-1.62	27.5	0.78	0.54-1.12	0.66	0.43-1.02
High school	32.8	1.40	0.84-2.34	1.32	0.76-2.27	33.5	1.03	0.65-1.64	1.04	0.63-1.69
<High school	25.8	1.00		1.00		32.8	1.00		1.00	
Use of FN language										
Yes	28.4	1.06	0.69-1.64	0.87	0.57-1.34	32.8	1.20	0.83-1.75	0.98	0.62-1.53
No	27.2	1.00		1.00		28.9	1.00		1.00	
Community cultural events										
Always or almost always	42.4	**2.43**	**1.43-4.12**	**1.66**	**0.96-2.90**	37.5	1.69	0.97-2.96	1.62	0.86-3.05
Sometimes	24.0	1.04	0.63-1.72	0.84	0.51-1.39	30.9	1.27	0.80-2.00	1.27	0.78-2.07
Rarely or never	23.3	1.00				26.2	1.00		1.00	
# of people helping to understand culture										
<2 people	24.9	1.00		1.00		29.5	1.00		1.00	
2-4 people	28.4	1.19	0.75-1.90	1.15	0.72-1.85	30.4	1.05	0.70-1.56	0.90	0.59-1.36
>4 people	34.9	1.61	0.89-2.92	1.24	0.61-2.52	36.9	1.40	0.83-2.36	1.06	0.56-2.02
Traditional food sharing										
Often	49.9	**4.08**	**2.26-7.34**	**4.44**	**2.69-7.34**	54.6	**4.61**	**3.08-6.88**	**4.65**	**3.11-6.95**
Sometimes or less	19.6	1.00		1.00		20.7	1.00		1.00	

[a]Statistically significant odds ratios for variables in the bivariate and multivariate models are shown in bold ($p \leq 0.05$).
[b]Representing a weighted population of 9 451 girls aged 12-14 years and 9 376 girls aged 15-17 years.
[c]Defined as answering 'often' to at least one of the traditional foods on the food frequency questionnaire.
[d]Including all variables in the model.
Source: The First Nations Information Governance Centre, microdata abstract: 2015-GATA-001, July 9, 2015.

4.7.2 Logistic Regression Analyses for Boys

A total of 893 boys aged 12-14 years (weighted population of 10 331) and 900 boys aged 15-17 years (weighted population of 10 075) were included in the logistic regression analyses following the removal of participants with missing data. For 12-14 year-olds, the use of a FN language, participating in community cultural events and traditional food sharing were predictive of frequent traditional food consumption (**Table 4.7**). The odds of frequent traditional food consumption were increased for those who spoke a FN language as compared to those who did not (OR=1.41, CI=1.01-1.96, p=0.041), for those who always or almost always participated in community cultural events as compared to those who rarely or never did (OR=1.76, CI=1.16-2.68, p=0.013), and for those who often had traditional food shared with their household as compared to those who had food shared less often (OR=5.13, CI=3.42-7.72, p<0.001). When adjusted for socioeconomic and other sociocultural variables in the multivariate model, the relationships between frequent traditional food consumption and the use of a FN language (OR=1.59, CI=1.11-2.28, p=0.010) and traditional food sharing (OR=5.61, CI=3.69-8.54, p<0.001) persisted, while the relationship with participation in community cultural events did not.

For 15-17 year-old boys, the odds of frequent traditional food consumption were predicted by parent education level, participation in community cultural events and traditional food sharing (**Table 4.7**). The odds of frequent traditional food consumption were increased for those whose parents had completed high school as compared to those whose parents had less than a high school education (OR=1.86, CI=1.17-2.95, p=0.024), for those who always or almost always participated in community cultural events as compared to those who rarely or never did

(OR=2.82, CI=1.63-4.88, p=0.001), and a for those who often had traditional food shared with their household as compared to those who had foods shared less often (OR=3.81, CI=2.55-5.69, p<0.001). The relationships between frequent traditional food consumption and parent education level (OR=1.94, CI=1.17-3.20, p=0.033), participation in community cultural events (OR=2.23, CI=1.26-3.95, p=0.019) and traditional food sharing (OR=3.67, CI=2.54-5.30, p<0.001) persisted following adjustment for other socioeconomic and sociocultural variables in the multivariate model.

Table 4.7. Logistic regression models to explore traditional food consumption among 12-17 year old First Nations boys from the 2008/10 First Nations Regional Health Survey[a]

Independent Variable	12-14 Year-old Boys (n=893)[b]					15-17 Year-old Boys (n=900)[b]				
	Consumes Traditional Foods (%)[c]	Crude OR	95% CI	Adjust OR[d]	95% CI	Consumes Traditional Foods (%)[c]	Crude OR	95% CI	Adjust OR[d]	95% CI
# of children in household										
1-3 children	32.7	0.99	0.69-1.44	1.04	0.68-1.58	32.0	0.91	0.64-1.31	0.89	0.62-1.29
>3 children	32.8	1.00		1.00		34.0	1.00		1.00	
Living with biological parents										
Both biological parents	32.6	0.68	0.40-1.14	0.77	0.47-1.27	34.6	1.32	0.77-2.27	1.35	0.76-2.39
One biological parent	30.5	0.62	0.37-1.04	0.61	0.37-1.02	32.4	1.20	0.68-2.13	1.16	0.64-2.11
Neither biological parent	41.6	1.00		1.00		28.6[e]	1.00		1.00	
Parent education										
Some post-secondary	29.5	0.91	0.59-1.38	0.93	0.57-1.52	33.3	1.34	0.91-1.97	1.24	0.82-1.88
High school	39.1	1.39	0.88-2.21	**1.81**	**1.14-2.88**	41.1	**1.86**	**1.17-2.95**	**1.94**	**1.17-3.20**
<High school	31.6	1.00		1.00		27.3	1.00		1.00	
Use of FN language										
Yes	36.0	**1.41**	**1.01-1.96**	**1.59**	**1.11-2.28**	33.1	1.05	0.72-1.54	0.99	0.63-1.54
No	28.5	1.00		1.00		31.9	1.00		1.00	
Community cultural events										
Always or almost always	42.0	**1.76**	**1.16-2.68**	1.61	0.95-2.72	46.1	**2.82**	**1.63-4.88**	**2.23**	**1.26-3.95**
Sometimes	29.6	1.02	0.67-1.55	1.00	0.64-1.57	31.5	1.51	0.97-2.37	1.31	0.85-2.00
Rarely or never	29.2	1.00		1.00		23.3	1.00			
# of people helping to understand culture										
<2 people	31.7	1.00		1.00		28.1	1.00		1.00	
2-4 people	34.0	1.11	0.76-1.61	0.84	0.55-1.27	34.7	1.36	0.93-1.98	1.06	0.70-1.61
>4 people	32.2	1.02	0.61-1.71	0.63	0.37-1.05	39.4	1.66	0.94-2.95	1.21	0.60-2.44
Traditional food sharing										
Often	59.4	**5.13**	**3.42-7.72**	**5.61**	**3.69-8.54**	55.6	**3.81**	**2.55-5.69**	**3.67**	**2.54-5.30**
Sometimes or less	22.2	1.00		1.00		24.7	1.00		1.00	

[a]Statistically significant odds ratios in the bivariate and multivariate models are shown in bold ($p \leq 0.05$).
[b]Representing a weighted population of 10 331 boys aged 12-14 years and 10 075 boys aged 15-17 years.
[c]Defined as answering 'often' to at least one of the traditional foods on the food frequency questionnaire.
[d]Including all variables in the model.
[e]Estimate is associated with high sampling variability and should be interpreted with caution.
Source: The First Nations Information Governance Centre, microdata abstract: 2015-GATA-001, July 9, 2015.

4.8 Discussion

Traditional foods provide important nutrients for FN youth and are typically nutritionally superior to the store-bought food choices that often replace them (Kuhnlein et al., 2004; Willows, 2005; Haman et al., 2010; Egeland et al., 2011). This exploratory study amongst a nationwide sample of young FN people living on reserves suggests that the frequency of consumption of traditional foods by this population could benefit from improvement. Also, traditional food sharing and cultural connectedness, as defined by participation in community cultural events and knowledge of a FN language, were identified as particularly important predictors of the regular intake of traditional foods.

4.8.1 Traditional Food Intake and Comparisons to Previous Work

Fewer than one-third (31%) of youth in this study reported often consuming at least one traditional animal food, which is consistent with previous reports of declining intakes and preferences for such foods for young Aboriginal people as compared to their parents and Elders (Kuhnlein, Souieda, & Receveur, 1996; Willows, 2005; Kuhnlein & Receveur, 2007; Power, 2008). One important consideration here, however, is the nature of the data and the way that the traditional food variable was created. Participants who reported 'a few times' consuming a large variety of different traditional foods may have been classified as infrequent consumers. Nevertheless, given the one year time span for recall on the FFQ, those who reported only consuming a traditional food 'a few times' are unlikely to be frequent consumers of these foods.

According to data from the 2006 ACS, of young FN children living off-reserve only 33% consumed game meats at least once per month and less than one-tenth (8%) ate game birds with the same frequency (Langlois, Findlay, & Kohen, 2013). Although the figures are not directly comparable, the current data suggest that it is possible that youth living on reserves are experiencing similar rates of consumption of traditional foods as compared to their Aboriginal peers living off-reserve and in urban settings. Still, research in some distinct FN populations has identified a relatively high prevalence of traditional food consumption among youth. For example, *Hlimi et al*. (2012) found that, for Cree youth residing in reserve communities on the western coast of James and Hudson Bays, 84-100% of youth reported eating game meats depending on the community in which they lived. The bulk of the research, nevertheless, suggests that for most youth living on reserves in Canada, high frequencies of traditional food consumption are no longer the norm. Even in the study by *Hlimi et al*. (2012), despite a high prevalence of intake, 25-73% of youth consumed game meats infrequently (i.e., 'rarely or never'), depending on the community. In Alexander FN in Alberta, Kindergarten to grade 12 youth took photos of the foods that they consumed throughout the day and not a single photo of traditional foods was captured (Genuis, Willows, Alexander First Nation, & Jardine, 2014).

The appreciable difference in food consumption patterns between communities is an interesting phenomenon, and one that warrants further investigation. Although not possible in the context of the present study, it is likely that a youth's access and exposure to traditional foods is highly dependent on the geographic region in which they reside. The geographic setting may affect families' access to resources like food sharing programs and/or community freezers, as well as their proximity to land on which to practice traditional food procurement. For example, although it may require extensive travel and resources (Robidoux, Haman, & Sethna, 2009; Thompson et al., 2012; Pal, Haman, & Robidoux, 2013; Skinner et al., 2013), FN families living in northern regions of the country may be able to partake in traditional food procurement within the their local environment. By contrast, FN people residing on reserves near urban centres may not have this option and would therefore need to rely on other methods of procuring these foods (e.g., food sharing networks) (Power, 2008; Kerpan, Humbert, & Henry, 2014). In future investigations, the role of geographic location, community size and existing supportive programs and resources on the amount and type of traditional foods that youth consume would be of particular interest. The knowledge gained would inform feasible policy and program initiatives, and identify areas of greatest need.

Although not extensively investigated in on-reserve FN populations, it has previously been postulated that differences in traditional food consumption may exist by sex, but that this may be due at least in part to differences in body size and energy expenditure, thus energy intake (i.e., boys would consume more than girls based on comparatively larger body sizes and energy needs) (Willows, 2005). Furthermore, research in adult Aboriginal people has found that men consumed more traditional foods as compared to women (Kuhnlein et al., 2004). By age, some research has reported differences in consumption of traditional foods as youth get older; a study of Inuit youth found that younger (7-15 year-old) boys had higher traditional food intakes compared to older (16-18 year-old) ones, whereas the opposite was observed in girls (Berti et al., 1999). By contrast, the present study identified no differences in the frequency of traditional food consumption between boys and girls, nor between younger (12-14 year-old) and older (15-17 year-old) youth. That said, the nature of the data meant that portion sizes and absolute quantities of traditional foods consumed could not be elucidated. In the future, studies investigating traditional food consumption with greater depth, including information like preparation method and portion sizes, would provide for a greater understanding of the consumption patterns of this subgroup of the FN population.

4.8.2 Traditional Food Sharing Strongly and Positively Predicts Food Choices

Amongst all of the sub-samples of youth investigated in this study, traditional food sharing emerged as a consistent and powerful predictor of frequent traditional food consumption, and one that remained important even following adjustment for potential markers of socioeconomic status (i.e., parent education level, household size, living with both parents) and other sociocultural factors (i.e., knowledge of a FN language, participation in community cultural events, number of people helping to understand culture). This is not a surprising finding, as food access is a known contributor to food choices and dietary intake (Larson & Story, 2009). In fact, *Hlimi et al.* (2012) found that, for a sample of FN youth in northern Ontario, 34% would eat more game meats if these foods were more available in their homes. Food sharing is undoubtedly correlated with food availability. Nevertheless, less than one third (28%) of youth reported that their household had partaken in the practice. Formal food sharing programming (e.g., paid hunters, community freezers) in some communities may be a promising approach to improving traditional food access and consumption for youth who may not otherwise have these available to them.

Food sharing as a means to improve traditional food access is not a novel concept. Historically, traditional foods were procured not only for one's own family, but to be shared with the community (Willows, 2005; Kerpan, Humbert, & Henry, 2014). Even for urban-dwelling FN youth, traditional foods have been associated with family and culture (Kerpan, Humbert, &

Henry, 2014). Harvest sharing may occur via large community feasts, where the sharing of traditional knowledge is part of the experience itself along with the preparation and consumption of these foods. Otherwise, simple networks between and within families are commonplace in some communities (Pal, Haman, & Robidoux, 2013). Not having a hunter in one's household has been identified as a barrier to consuming traditional foods (Chan et al., 2006; Power, 2008). Thus, youth who reside in such households may never acquire the skills necessary to procure and prepare these foods. Secondary to a lack of exposure, they also may not develop a taste for these foods (Willows, 2005; Power, 2008), instead acquiring a preference for the store-bought alternatives that they are more familiar with. In this way, food sharing networks not only increase a family's access to traditional foods. They also provide for an opportunity for youth to learn about their culture and for this knowledge to be maintained throughout the generations.

Aboriginal Canadians experience social inequities and are more likely to depend on social assistance as their sole income source, to live in poverty and to be experience food insecurity as compared to non-Aboriginal people (Willows et al., 2009). Research has indicated that the most important barrier to consuming a healthy diet is in fact inadequate income (Nord & Brent, 2002; Power, 2005). Especially in some communities, where few employment opportunities exist, this may limit the variety, quantity and quality of food that is made available to youth. Although traditional foods may provide for an alternative source of dietary energy when the resources for purchasing store-bought foods are not available, as recently documented by *Pal, Haman, & Robidoux*'s (2013) work in a sub-arctic Ontario community, the average cost of procuring land-based animal meat is greater than the price of meats that are available in local stores. In fact, the cost of procuring traditional foods, which typically includes extensive travel and the cost of fuel, transportation, and other necessary materials, has been described as a serious obstacle to their consumption in multiple communities (Lambden, Receveur, Marshall, & Kuhnlein, 2006; Robidoux, Haman, & Sethna, 2009; Thompson et al., 2012; Ford et al., 2013; Pal, Haman, & Robidoux, 2013; Skinner et al., 2013). In northern Ontario, it was estimated that it would cost $25 000 per year to partake in hunting and fishing given the equipment and travel required (Pal, Haman, & Robidoux, 2013). For families residing in Canada's arctic, it is estimated that up to 50% may not have the means to partake in traditional food procurement (Lambden et al., 2006).

Given the economic challenges faced by many FN families, food sharing has been described in a number of studies as an important strategy for addressing food insecurity and assuring that all community members have enough food to eat (Willows, 2005; Chan et al., 2006; Ford et al., 2013; Skinner et al., 2013; Kerpan, Humbert, & Henry, 2014). Equally important for youth, it has been suggested that more formal food sharing initiatives may play a role in fostering positive perceptions toward traditional diets (Haman et al., 2010), and when combined with learning opportunities, may mitigate the documented decline in traditional knowledge and traditional food preferences from generation to generation (Willows, 2005; Power, 2008). Diets that include traditional foods are not only more nutritious (Berti et al., 2009; Nakano et al., 2005; Kuhnlein & Receveur, 2007; Johnson-Down & Egeland, 2010; Khalil, Johnson-Down, & Egeland, 2010; Gagné, Blanchet, Lauzière, Vaissière, Vézina, & Ayotte et al., 2012); these foods are also integral to the health and cultural identity of FN people (Power, 2008). The findings of the current study support the idea that food sharing networks may be a viable tool, at least in some communities, for promoting the health of youth by encouraging traditional food intake.

Few studies exist explicitly investigating the impact of harvest sharing on the nutrient intakes and diet quality of FN youth, however, suggested approaches have included the employment of salaried hunters (Chan et al., 2006; Skinner et al., 2013), support programs to help fund harvesters' equipment and supplies, community freezers and hunting skills development programs for youth (Chan et al., 2006). Schools may also provide a convenient site for intervention, as the vast majority of youth attend and shared foods could be used to supplement existing nutrition education and food provision programming. Schools have been described as a positive milieu for cultural lessons and being a social hub in many communities, could serve as a venue for cultural events where knowledge is shared and foods are prepared and served (Kerpan, Humbert, & Henry, 2014). As there currently exists little evidence of the effectiveness of more formal food sharing programs on improving the diet quality of young FN people living on reserves, studies documenting and evaluating such programs would provide for useful case studies for communities looking to support the nutritional health of their youth.

4.8.3 The Importance of Cultural Connectedness

Cultural connectedness, which is related to but also distinct from traditional food sharing, also emerged as a significant predictor of traditional food intake for FN youth. More specifically, participation in community cultural events predicted a higher frequency of traditional food intake for all but the older (15-17 year-old) sub-sample of girls, and knowledge of a FN language was a predictor of frequent traditional food consumption for the younger (12-14 year-old) sub-sample of boys. These finding are not unexpected, given that an individual's culture influences, at least in part, the types of foods that are acceptable to them, the amounts and combinations of foods that they choose to eat, and the types of foods that they consider to be ideal and nutritious

(Kittler & Sucher, 2004; Willows, 2005). Thus, those youth who are more detached from their culture may be more likely to lack adequate exposure to traditional foods, to possess less knowledge of how to prepare them in a way that would be desirable, or to prefer store-bought foods based on their familiarity as compared to traditional ones.

Participating in community cultural events (e.g., scheduled hunts and community feasts) may encourage traditional food consumption, as these represent opportunities for families to convene and share harvested foods, and for Elders to transmit cultural knowledge to the younger generations (Pal, Haman, & Robidoux, 2013). It has been said that traditional food procurement and preparation (i.e., catching/killing, gutting, cleaning and cooking) are skills that are best taught via hands-on experience (Pal, Haman, & Robidoux). Moreover, the diminished transmission of traditional knowledge from Elders to young people has been described as a threat to traditional food access and cultural identity (Power, 2008). Even amongst FN youth residing in urban areas, traditional foods have been associated with family, culture, celebrations and feasts (Kerpan, Humbert, & Henry, 2014). Those who were regularly exposed to traditional foods enjoyed them more, consumed them with greater frequency and tended to assist in their preparation, acquiring skills vital to their cultural identity and survival (Power, 2008; Kerpan, Humbert, & Henry, 2014).

Despite the value of community cultural events in supporting traditional food intake amongst FN youth, less than one-quarter of youth reported ‘always or almost always’ participating in such occasions, and another quarter reported ‘rarely or never’ participating. Given relatively low participation in such events, concomitant with declining rates of traditional food consumption, opportunities for youth to gain exposure to traditional foods and acquire practical knowledge may be of benefit. It has been estimated that a child may need to try a food at least 20 times before their preferences are changed (Cooke, 2007). Cultural events such as feasts could provide opportunities for youth to taste traditional foods that they may not otherwise have access to, while also providing them with knowledge that they can then pass on to their own prospective children. Again, school-based interventions would provide for a broad reach, and multicomponent initiatives, including family involvement, food exposure, classroom lessons and hands-on learning opportunities, policies and role modeling opportunities may hold promise (Taylor, Evers, & McKenna, 2005). Documentation of culturally relevant knowledge transmission strategies and existing programming would help to inform future initiatives at the school and community level.

4.8.4 Other Potential Influences

None of the indicators of socioeconomic status investigated were significantly associated with traditional food intake frequency, with the exception of parent education level. Specifically, amongst both subgroups of boys, the odds of frequent traditional food consumption were increased if their parents had attended high school as compared to those whose parents were less educated. What was interesting was that this relationship did not hold true for girls, and those whose parents had a post-secondary education were at no advantage as compared to those whose parents had not completed high school.

Typically, lower parental education status has been associated with poorer diet quality in children (Taylor, Evers, & McKenna, 2005), and lower educational attainment amongst

Aboriginal people is one contributor to food insecurity risk (Che & Chen, 2001; Willows et al., 2009). Nevertheless, there is a lack of a good understanding of the relationship between education and traditional food intake for FN people; what is clear is that a formal schooling and the acquisition and development of traditional knowledge are not interchangeable. One who has a higher degree of formal education may be more likely to be employed and have the financial means to procure and prepare traditional foods. Nevertheless, the skills necessary to become a capable and proficient hunter require years of practice, guidance and experience alongside older, more experienced hunters (Pal, Haman, & Robidoux, 2013). In a sample of Cree adults from Quebec, *Gaudin et al*. (2014) found that those who consumed traditional foods at least three times per week were more likely to have not completed any schooling as compared to those who ate these foods less frequently. Participants suggested that those who were more formally educated were in fact more detached from their culture, thus more likely to rely on store-bought foods instead of culturally meaningful choices (Gaudin et al., 2014). Moreover, full time employment would leave less time for hunting or fishing trips (Gaudin et al., 2014). Further study is required to better understand the relationship between education and traditional food intake; it is likely that both a formal education and the acquisition of traditional knowledge need to be balanced such that families can have both the economic means and practical experience necessary to partake in traditional food procurement activities.

4.9 Results Dissemination

The results of this study will be relevant and of interest to FN people in Canada, as well as to academics and health professionals working with FN youth, or interested in FN health. The manuscript resulting from this work has been submitted to a peer-reviewed academic journal.

The findings have been shared with the FNIGC, who administer the RHS, as a means of communicating the results to those most closely involved in the research (e.g., community advisors).

4.10 Strengths and Limitations

The findings of this study act as a starting point for more detailed investigations of the determinants of traditional food use for youth, and could inform relevant initiatives aimed at creating environments that encourage positive food choices. This study is strengthened by the fact that it utilized data from a large nationwide sample of on-reserve FN youth. For this reason, it is possible that the findings are relevant and generalizable to Canadian on-reserve FN youth of school age. Of note, the relatively large amount of missing data may have rendered the final sample non-representative of the young FN people living on reserves. The participants who were excluded due to missing data may have differed from those whose data were complete.

Methodological limitations to this research also exist. Due to the limited accessibility to regional data, the identification of differences or cluster effects based on geographical location, community size or degree of remoteness was not possible. Further, the nature of the tool used to collect the dietary data meant that information on preparation methods and portion sizes were not available. The frequency options included (i.e., ‘often’, ‘a few times’, or ‘not at all’) were highly subjective and could have been interpreted differently from person to person. Nevertheless, the FFQ allowed for the efficient collection of data from a relatively large sample of youth, which would not have been possible if more detailed approaches (e.g., diet records or 24-hour recalls) had been used. Because the time frame for recall was one year, recall error is a strong possibility.

It is difficult for participants to remember foods that they have eaten, especially when the time period is very lengthy and spans a number of seasons. The nature of the data did not allow for investigations by season, which could significantly impact the types and amounts of foods consumed (Kuhnlein, Souieda, & Receveur, 1995). A recency effect may have occurred, as youth may have been more likely to recall the foods that they had consumed in the more recent past.

4.11 Conclusions

The current study investigated the individual, sociocultural and socioeconomic factors predicting the odds of frequent traditional food consumption amongst a large sample of 12-17 year-old FN youth residing on reserves across Canada. This exploratory work identified relationships between traditional food sharing, participation at community cultural events, knowledge of a FN language and parent education level and traditional food intake frequency. This knowledge provides impetus for more in-depth exploration of these factors and how they influence food choices and preferences among this population of youth. Qualitative research (e.g., photovoice, talking circles) is necessary to add credence to the quantitative findings herein and to elaborate on the reasons behind the relationships identified from the point-of-view of FN youth, their families and communities.

The inclusion of traditional foods in the diet not only improves nutrient intakes for youth; it is also integral to their cultural identities (Willows, 2005; Power, 2008). A greater understanding of the determinants of food intake, including both store-bought and traditional foods, is necessary in order to develop strategies to modify these determinants and promote diet quality (Willows, 2005). The current study sheds light on only a few of these potential determinants, however, the assessment of other factors (e.g., the built environment, regional influences) was beyond the capacity of this research and should be a priority for future study.

4.12 Acknowledgements

The author would like to thank Maria Santos, First Nations Data Centre Coordinator at the FNIGC for her assistance throughout the data request and statistical analysis process, and Dr. Ian Martin (University of Toronto Scarborough) for providing statistical guidance. The author is grateful to the participants for their time, and to the FNIGC for providing the opportunity to carry out the analyses.

5.0 Study Three:
An Exploration of the Individual, Behavioural and Socioeconomic Factors Predicting Healthy Store-bought Food Choices for 12-17 Year-old First Nations Youth Living On Reserves in Canada[*]

5.1 Overview

Background. Given the transition to store-bought foods for Aboriginal youth, measures are required to promote the intake of healthy choices like vegetables and lower fat milk and milk products. Knowledge of the predictors of the intake of these nutrient dense foods would facilitate the development of strategies to promote their consumption in this population.

Objectives. Amongst a large sample of 12-17 year-old FN youth living on reserves in Canada, to explore potential relationships between vegetables and milk and milk products intakes and each of: individual, behavioural and socioeconomic factors.

Methods. Data from the 2008/10 RHS were used in this study. Vegetables and milk and milk products intakes were collected via a 10-item FFQ with five response options. For the purpose of this study, these response categories were collapsed into 'at least daily' and 'less than daily'. Selected predictors of vegetables and milk and milk products intakes included individual (i.e., age, sex, BMI), behavioural (i.e., school attendance, physical activity level, smoking status, alcohol use) and socioeconomic (i.e., number of children in the household, living with both biological parents, parent education level) factors. Binary logistic regression modeling was used to test the bivariate and multivariate relationships between the dependent variables (i.e., vegetables, and milk and milk products) and each of the individual, behavioural and socioeconomic factors amongst four age and sex sub-groups (boys and girls aged 12-14 and 15-17 years).

[*] This chapter was prepared to be submitted to a peer-reviewed academic journal as the following: Gates, A., Gates, M., Tsuji, L.J.S., & Hanning, R.M. The individual, behavioural and socioeconomic predictors of healthy store-bought food choices for First Nations youth living on reserves in Canada: a cross-sectional study.

Results. For vegetables, 3721 participants (51.7% boys, 49.5% 12-14 years old), representing a weighted population of 41 499 FN youth, were included in the analyses following the removal of those with incomplete data. Nearly one-third (31.6%) of the population reported less than daily vegetable consumption. Daily vegetable intake was associated with being younger ($p<0.001$), being physically active ($p<0.001$), being a non-smoker ($p<0.001$), abstaining from alcohol ($p<0.001$) and having at least one parent who had completed some post-secondary education ($p=0.026$). Bivariate associations emerged for each age and sex sub-group. For 12-14 year-old girls (n=891, weighted population of 9 968), the odds of daily vegetable intake were increased amongst those who were physically active (OR=1.80, CI=1.18-2.75, $p=0.006$) as compared to those who were not and those who did not use alcohol (OR=1.70, CI=1.16-2.50, $p=0.006$) as compared to those who did. For 15-17 year-old girls (n=995, weighted population of 10 076), the odds of daily vegetable consumption were increased amongst non-smokers (OR=1.61, CI=1.14-1.07, $p=0.006$) as compared to smokers. These relationships persisted in the multivariate models. For 12-14 year-old boys (n=921, weighted population of 10 971), the odds of daily vegetable intake were decreased amongst those who did not attend school (OR=0.50, CI=0.26-0.95, $p=0.031$) as compared to those who did, and increased amongst those whose parents had a post-secondary education (OR=1.51, CI=1.00-2.28, $p=0.050$) as compared to those whose parents were less educated. For 15-17 years-old boys (n=914, weighted population of 10 484), the odds of daily vegetable intake were increased amongst those whose parents had a post-secondary education (OR=1.87, CI=1.16-3.01, $p=0.033$) as compared to those whose parents were less educated. These relationships did not persist when adjusted for the other independent variables in the model. For milk and milk products, 3717 participants (representing a weighted population of 41 368 FN youth) were included in the analyses following the removal of those with incomplete data (51.5% boys, 50.6% 12-14 years old), of whom 43.1% did not consume milk and milk products daily. Daily milk and milk products intake was associated with being a girl ($p=0.025$), attending school ($p<0.001$), being physically active ($p=0.050$) and being a non-smoker ($p<0.001$). Bivariate relationships were apparent by age and sex sub-group. For 12-14 year-old girls (n=893, weighted population of 9 989), there were increased odds of daily milk and milk product intake amongst non-smokers (OR=1.93, CI=1.27-2.93, $p=0.002$) as compared to smokers, and those who did not use alcohol (OR=1.67, CI=1.10-2.54, $p=0.014$) as compared to those who did. For 15-17 year-old girls (n=996, weighted population of 10 070), the odds of daily milk and milk product intake were increased amongst those who were physically active (CI=1.64, OR=1.18-2.28, $p=0.003$) as compared to those who were not, those who did not smoke (OR=1.56, CI=1.12-2.14, $p=0.007$) as compared to those who did, and those who lived with one of their biological parents (OR=1.91, CI=1.25-2.93, $p=0.007$) as compared to those who lived with neither biological parent. All of these relationships persisted in the multivariate models, with the exception of the relationship between milk and milk product intake and alcohol use for the younger sub-group. For 12-14 year-old boys (n=917, weighted population of 10 947), the odds of daily milk and milk product intake were decreased amongst those who did not attend school (OR=0.20, CI=0.11-0.37, $p<0.001$) as compared to those who did, and those who lived with less than three children in their household (OR=0.68, CI=0.48-0.97, $p=0.029$) as compared to those whose households had more than three children, and increased amongst those who were physically active (OR=1.51, CI=1.09-2.11, $p=0.013$) as compared to those who were not. For 15-17 year-old boys (n=911, weighted population of 10 362), the odds of daily milk and milk products intake were increased amongst non-smokers (OR=1.81, CI=1.23-2.69, $p=0.003$) as compared to smokers, and decreased amongst those who did not attend school (OR=0.40, CI=0.25-0.66, $p<0.001$) as compared to those who did. All of these relationships persisted following adjustment for other independent variables in the multivariate models.

Conclusions. Vegetable, and milk and milk product intake frequency was low for a large proportion of on-reserve FN youth, and the daily consumption of these foods was predicted by a number of behavioural factors and indicators of socioeconomic status. The strength and presence of these relationships differed considerably by age and sex category. More work is required to substantiate these findings and to gain FN perspectives on the relationships that were identified. Multi-component initiatives, targeting many related health behaviours are recommended, as these may help to synergistically promote the improved nutrition and health of youth.

DISCLAIMER: This study contains the findings of the author's analyses of data from the 2008/10 First Nations Regional Health Survey. Please note that the analyses contained herein do not necessarily reflect the views of the First Nations Information Governance Centre. Statistics reproduced from this document must be accompanied by a citation of this document, including a reference to the page on which the statistic in question appears.

5.2 Background

The prevalence of obesity is a growing cause for concern in Canada, and children and adolescents are becoming increasingly affected (Shields, 2006; Roberts, Shields, de Groh, Aziz, & Gilbert, 2012). Compared to their non-Aboriginal peers, Aboriginal youth are far more likely to be overweight or obese (prevalence rate of 41%) (Shields, 2006). First Nations youth residing on reserves may be faced with unique challenges to making healthy lifestyle choices (Skinner, Hanning, & Tsuji, 2006; Gates et al., 2011, 2013a) and, consequently, experience even higher rates of overweight and obesity (FNIGC, 2012).

Although the accretion of excess body weight in children and adolescents is complex and multifactorial, it has been suggested that increasing intakes of 'other' foods or 'junk' foods (i.e., those that do not supply substantial amounts of micronutrients, yet are energy dense), an increase in eating away from home, and declining vegetable and fruit intakes, among other environmental trends are likely contributors to the current obesity epidemic (French, Story, & Jeffrey, 2001). For FN youth, the story is much more complex; Aboriginal people have experienced a recent and relatively rapid transition toward more Western lifestyles, characterized by increased sedentary time, a reduction in physical activity and an increasing reliance on store-bought foods which are nutritionally inferior to the foods to which they were traditionally accustomed (Kuhnlein et al., 2004; Willows, 2005).

Even more so than their peers in the general population (Garriguet, 2007; Ng, Young, & Corey, 2010), the diets of Canadian Aboriginal youth, in general, are characterized by intakes of important nutrients (e.g., calcium, vitamin D, fibre), vegetables and fruit, and milk and alternatives that fall below recommended levels, while their intakes of 'other' foods are high (Ng, Young, & Corey, 2010; Gates, Skinner, & Gates, 2015). Vegetable and fruit intake is associated with total diet quality (Garriguet, 2009), and this food group is an important source of folate, vitamin C, beta carotene, potassium and fibre (Whitney, Rolfes, Hammond, & Piché, 2013). Furthermore, adequate vegetable and fruit intake has been associated with reduced risk for a number of diseases, including cardiovascular diseases and certain cancers (World Cancer Research Fund & the American Institute for Cancer Research, 2007; Wang, Ouyang, Liu, Zhu, Zhao, & Bao et al., 2014). Because there exist few natural sources of vitamin D in the Canadian food supply, fortified milk products provide an important source of this vital nutrient, as well as providing calcium, phosphorus, potassium, magnesium, zinc, vitamins B_2, B_{12}, and A (Vatanparast, Calvo, Green, & Whiting, 2004). Although conclusive evidence does not exist at this time, epidemiologic research has suggested that there may be a role for inadequate calcium and vitamin D status and the development of obesity (Song & Sergeev, 2012).

5.3 Impetus for this Research

Health behaviours are the result of environmental influences at multiple levels, and social ecological models of health have been developed to explain these influences for the general population (McLeroy, Bibeau, Steckler, & Glanz, 1988; Glanz & Bishop, 2010) and an adapted model has been produced for Aboriginal youth (Willows, Hanley, & Delormier, 2012). There has been a relative wealth of research investigating the potential influences on the dietary intakes of youth, including socioeconomic (e.g., parental income, household food security), demographic (e.g., age, sex, BMI) and lifestyle factors (e.g., physical activity, smoking, alcohol use). Specific focus in the research on the vegetables and fruit (e.g., vegetables, fruit, juices), and milk and alternatives (e.g., milk, yogurt, cheese) food groups of CFG is reflective of the importance of the adequate intake of these food groups to the nutrient intakes of youth. Moreover, the majority of youth in Canada fail to reach the recommended intake levels for these food groups (Garriguet, 2007).

Although the intakes of vegetables and fruit, and milk and alternatives among Aboriginal youth have been reported to be lower compared to their peers in the general population (Ng, Young, & Corey, 2010), there has been less research to elucidate the factors that affect the decisions that FN youth make about their store-bought food intake (Willows, 2005). First Nations youth living on reserves may face unique challenges to accessing healthy store-bought foods, including but not limited to economic factors (e.g., higher rates of food insecurity, high cost of foods in some northern or isolated locations) and environmental factors (e.g., inadequate availability of healthy foods at the store) (Skinner, Hanning, & Tsuji, 2006; Haman et al., 2010; Gates et al., 2011, 2013a). Differences in cultural norms about health and body weight may also impact youths' food choices (Kittler & Sucher, 2004; Gates, Hanning, Martin, Gates & Tsuji, 2014a). Greater knowledge of the many factors that may influence FN youth's intake of healthy store-bought food is necessary in order to inform environmental changes to facilitate making positive choices (Willows, 2005).

As part of the 2008/10 RHS, on-reserve FN youth were asked to report their usual intake of vegetables, and milk and milk products, along with other individual, behavioural and socioeconomic factors that may influence their dietary intake (FNIGC, 2008, 2012). These data allow for an exploration of the influence of these factors on healthy store-bought food intake amongst a large nationwide sample of youth.

5.4 Objectives and Hypotheses

5.4.1 Objectives

Using data from a sample of 12-17 year-old FN youth living on reserves across Canada, the objectives of the present study are as follows:

A. To explore potential bivariate and multivariate relationships of each of: individual, behavioural and socioeconomic characteristics with vegetable intake frequency.
B. To explore potential bivariate and multivariate relationships of each of: individual, behavioural and socioeconomic characteristics with milk and milk product intake frequency.

5.4.2 Hypotheses

All of the independent variables were chosen as they were hypothesized to significantly predict daily vegetable and milk and milk product intake for 12-17 year-old FN youth living on reserves. The specific hypotheses for each independent variable, developed *a priori,* are shown in **Table 5.1**. The directions of these relationships and the knowledge used to inform them follow the table.

Table 5.1. Hypotheses for study three

Independent Variable	Hypothesis
Age	Older youth will be less likely to consume vegetables, and milk and milk products daily as compared to younger youth.
Sex	Boys will be more likely to consume milk and milk products daily, and less likely to consume vegetables daily as compared to girls.
Body mass index	The odds of consuming vegetables, and milk and milk products daily will be increased amongst normal weight youth as compared to those who are overweight or obese.
School attendance	The odds of daily vegetable and milk and milk products intake will be increased amongst those youth who attend school as compared to those who do not.
Physical activity level	The odds of daily vegetable and milk and milk products intake will be increased amongst those youth who are physically active as compared to those who are not.
Smoking status	The odds of daily vegetable and milk and milk products intake will be decreased amongst youth who smoke as compared to non-smokers.
Alcohol use	The odds of daily vegetable and milk and milk products intake will be decreased amongst youth who used alcohol in the last year as compared to those who did not.
# of children in the household	The odds of daily vegetable and milk and milk products intake will be decreased amongst youth who have three or more children in their household as compared to those with less than three children in their household.
Living with biological parents	The odds of daily vegetable, and milk and milk products intake will be decreased amongst youth who live with one or neither of their biological parents as compared to those who live with both of their biological parents.
Parent education	The odds of daily vegetable and milk and milk products intake will be increased amongst youth whose parents have completed high school or have a post-secondary education as compared to those whose parents are less educated.

Age. Diet quality has been shown to diminish with age (Taylor, Evers, & McKenna, 2005; Garriguet, 2009), and much of the research investigating dietary intake in children and adolescents has found that both the intake of vegetables, and milk and milk products tend to decline from childhood through to adolescence (Berkey, Rockett, Willett, & Colditz, 2005; Rasmussen, Krølner, Klepp, Lytle, Brug, & Bere et al., 2006; Garriguet, 2008b; Larson, Neumark-Sztainer, Harnack, Wall, Story, & Eisenberg, 2009; Lorson, Melgar-Quinonez, &

Taylor, 2009). It is therefore hypothesized that older youth (15-17 years) will be less likely to consume vegetables, and milk and milk products daily as compared to younger youth (12-14 years).

Sex. The research investigating vegetable intake by sex is not entirely conclusive, however, the majority of the findings have pointed to the notion that girls consume more vegetables and fruit than boys during adolescence (Rasmussen et al., 2006; Lorson, Melgar-Quinonez, & Taylor, 2009). Meanwhile, data from the CCHS (Garriguet, 2007, 2008b) and the US Project-EAT (Larson, Story, Wall, & Neumark-Sztainer, 2006) study found that boys tend to drink more milk as compared to girls. Based on this knowledge, it is expected that boys will be more likely to consume milk and milk products daily, and less likely to consume vegetables daily as compared to girls.

Body mass index. The relationship between BMI and vegetable, and milk and milk product intake is currently unclear. In a large international study of overweight, obesity, physical activity and diet patterns of 10-16 year-old youth, no association was found between vegetable intake and body weight (Janssen, Katzmarzyk, Boyce, Vereecken, Mulvihill, & Roberts et al., 2005). Similarly, a large study of American youth found no difference in weight status across mean total vegetable intakes (Lorson, Melgar-Quinonez, & Taylor, 2009). For milk and milk products, although some research has found that higher intakes are associated with greater BMI gains (Berkey et al., 2005), other studies have found that lower milk and dairy intakes are associated with being overweight (Larson et al., 2006) and that higher intakes are associated with lesser risk abdominal obesity (Bradlee, Singer, Qureshi, & Moore, 2010; Abreu, Santos, Moreira, Santos, Vale, & Soares-Miranda et al., 2012). Nevertheless, it has been suggested that declining intakes of healthy foods such as vegetables and milk, concomitant with increasing frequency of eating outside of the home and the consumption of 'other' foods are important contributors to obesity (French, Story, & Jeffrey, 2001). It is thus hypothesized that the odds of consuming vegetables, and milk and milk products daily will be increased for normal weight youth as compared to those who are overweight or obese.

School attendance. The school environment can have a positive effect on the food choices of youth and has been described as an ideal setting for nutrition interventions (Taylor, Evers, & McKenna, 2005). School food provision and education programs for FN youth have been seldomly reported in the literature (Assembly of First Nations, 2008) and have been met with limited results. The school snack program reported on herein (**Study Five)** and a similar program in Fort Albany, Ontario (Skinner et al., 2012a) demonstrated the potential positive impact of food provision in the school milieu. Although not substantiated in on-reserve FN populations, educational status (Rasmussen et al., 2006) has been associated with greater vegetable intake, and a study by *Ferrar & Golley* (2015) found that academic activities clustered with dairy food intake in boys, and with vegetable intake in girls. It is thus hypothesized that the odds of daily vegetable and milk and milk products intake will be increased for those youth who attend school as compared to those who do not.

Physical activity level. *Ferrar & Golley* (2015) investigated the clustering of health behaviours in a large sample of Australian youth, and found that for boys, dairy food intake clustered with team sports and that low vegetable and fruit intake clustered with screen time. In the same study, non-team sports clustered with vegetable intake for girls (Ferrar & Golley, 2015). Similarly, a review of the clustering of diet, physical activity and sedentary behaviours in young people found that low diet quality/high sedentary behaviour, high diet quality/high physical activity and low diet quality/low physical activity patterns had been identified in a number of studies (Leech, McNaughton, & Timperio, 2014). Other studies, however, have reported no association between physical activity and diet for youth (Berkey et al., 2005; Moreno-Gómez, Romaguera-Bosch, Tauler-Riera, Bannasa-Veny, Pericas-Beltran, & Martinez-Andreu et al., 2012). Furthermore, Aboriginal Canadian youth consume less vegetables and dairy products compared to their non-Aboriginal peers, while also being more physically active (Ng, Young, & Corey, 2010), so the findings for the general population may not generalizable to FN people. Nevertheless, for the purposes of this study it is hypothesized that the odds of daily vegetable, and milk and milk products intake will be increased amongst those youth who are physically active as compared to those who are not.

Smoking status and alcohol use. Data from the CCHS found that both smoking and alcohol use were associated with lower diet quality scores (Garriguet, 2009). A review of the research investigating socioeconomic indicators and health behaviours in adolescents found that lower socioeconomic status was associated with cigarette smoking, however, that alcohol use and socioeconomic status are likely unrelated (Hanson & Chen, 2007). Aboriginal people are more likely than those in the general population to be reliant on social assistance, a contributing factor to food insecurity and lesser diet quality (Willows et al., 2009). Although research on the associations between risk behaviours and diet quality is limited, based on the CCHS findings, it is hypothesized that the odds of daily vegetable and milk and milk product intake will be decreased amongst youth who smoked or used alcohol in the last year as compared to non-smokers and youth who did not drink alcohol.

Number children in the household. Compared to those households with less children, those with three children or more are at greater risk for food insecurity (Che & Chen, 2001; Willows et al., 2009) and food insecurity rates are higher for on-reserve FN families as compared to non-Aboriginal ones (FNIGC, 2012; Skinner, Hanning, & Tsuji, 2014; Health Canada, 2007b). Research has indicated that children who live in food insecure households typically consume less vegetables and fruit (Kirkpatrick & Tarasuk, 2008; Lorson et al., 2009) and milk and milk products (Kirkpatrick & Tarasuk, 2008; Mark, Lambert, O'Loughlin, & Gray-Donald, 2012), have less healthy foods available in their homes and perceive greater barriers to healthy eating (Widome, Neumark-Sztainer, Hannan, Haines, & Story, 2009). For this reason, it is hypothesized that the odds of consuming vegetables and milk and milk products daily will be decreased amongst youth who have three or more children in their household as compared to those with less than three children in their household.

Living with biological parents. A review of research from 34 countries investigating the correlates of vegetable and fruit intake among children and youth found that those living in single-parent families had lower intakes as compared to those living in two-parent families (Rasmussen et al., 2006). This is consistent with the research indicating that youth residing in households with a higher socioeconomic status (or higher incomes) were more likely to consume more vegetables and fruit (Rasmussen et al., 2006; Riediger, Shooshtari, & Moghadsian, 2007; Hanson & Chen, 2007; St. John, Durant, Campagna, Rehman, Thompson, Wadsworth, &

Murphy, 2008; Cutler et al., 2011) and milk (Larson et al., 2006; St. John et al., 2008; Mark et al., 2012) as compared to their peers in lower income families, and typically single parent families are at greater risk for food insecurity (Willows et al., 2009). It is therefore hypothesized that the odds of consuming vegetables, and milk and milk products daily will be decreased amongst youth who live with one or neither of their biological parents as compared to those who live with both of their biological parents.

Parent education. In the general population of youth, lower levels of parent education have relatively consistently been associated with lower intakes of vegetables (Rasmussen et al., 2006; Riedeger, Shooshtari, & Moghadasian, 2007; van der Horst, Oenema, Ferreira, Wendel-Vos, Giskes, & van Lenthe et al., 2007b), and milk and milk products (Abreu et al., 2012), and lower diet quality (Taylor, Evers, & McKenna, 2005; Garriguet, 2009). Some research, however, has not found this association (Pearson, Biddle, & Gorely, 2008). Given the findings of the bulk of the research on the topic, it is hypothesized that the odds of daily vegetable and milk and milk products intake will be increased amongst youth whose parents have completed high school or have a post-secondary education as compared to those whose parents are less educated.

5.5 Methods

5.5.1 First Nations Cultural Framework

As described in **Study Two**, the First Nations Cultural Framework guided the data collection for the RHS and is meant to inform the interpretation of the data so that the findings will be relevant to the participants. A full description of the framework can be found in **Study Two** (*4.5.1 First Nations Cultural Framework)*.

5.5.2 Survey Method and Participants

The current study utilized data collected from FN youth living on reserves across Canada as part of the 2008/10 RHS. The survey method and participants have been described in detail in **Study Two** (*4.5.2 Survey Method and Participants*). Briefly, the 2008/10 RHS collected data on a representative sample of FN youth aged 12-17 years residing in reserve communities across the country. The participants were sampled from most provinces and territories; communities of different size categories were selected within each 'sub-region' to ensure representative samples at the regional and national level (please refer to **Table 4.2** in **Study Two**) (FNIGC, 2012).

5.5.3 Vegetable and Milk and Milk Product Intake

To gain insight into the eating habits of participants, two separate FFQs were used – one for store-bought foods and another for traditional, land-based foods (FNIGC, 2008, 2012). For the purposes of this study, only the store-bought foods questionnaire was used, with a focus on vegetables, and milk and milk products. On this questionnaire, participants were asked to recall their 'usual' intake of a variety of foods, including more and less healthy store-bought options (FNIGC, 2008, 2012). A list of the specific foods included on the questionnaire and the corresponding response options provided are shown in **Table 5.2**.

Table 5.2. Foods included and response options on the food frequency questionnaire used to assess the store-bought food consumption patterns of 12-17 year-old First Nations youth participating in the 2008-10 First Nations Regional Health Survey (FNIGC, 2008, 2012)

Food item	Response options
▪ Milk and milk products (e.g., yogurt, cheese)	▪ Several times a day
▪ Protein (beef, chicken, pork, fish, eggs, beans, tofu)	▪ Once a day
▪ Vegetables	▪ A few times a week
▪ Fruit (excluding fruit juice)	▪ About once a week
▪ Bread, pasta, rice and other grains	▪ Never/hardly ever
▪ Water	
▪ Juice	
▪ Soft drinks/pop	
▪ Fast food (e.g., burgers, pizza, hotdogs, French fries)	
▪ Sweets (e.g., candy, cookies, cake)	

In order to provide for a simplified and more meaningful analysis, reported intakes of milk and milk products, and vegetables were dichotomized into 'consumes milk and milk products/vegetables at least daily' and 'does not consume milk and milk products/vegetables daily'. As such, youth who reported consuming vegetables, and milk and milk products either 'several times a day' or 'once a day' were classified as consuming these foods at least daily. Those who reported consuming vegetables, and milk and milk products 'a few times a week', 'about once a week', or 'never/hardly' ever were classified as not consuming these foods daily.

5.5.4. Selected Independent Variables

As described previously, a number of independent variables were selected as they were hypothesized to predict daily healthy store-bought food intake for on-reserve FN youth. These factors were grouped into three main categories of variables, including individual factors, behavioural factors and socioeconomic factors. The survey questions associated with each variable and corresponding response options are shown in **Table 5.3**. When applicable, the responses options were categorized to provide for a meaningful analysis based on current knowledge and recommendations, and to maintain adequate cell sizes. The individual factors, including age, sex and BMI were chosen as they are known to be associated with dietary intake and food choices. The behavioural factors, including school attendance, health risk behaviours (smoking and alcohol use) and physical activity level have been shown to cluster with diet in some studies of the general population of youth (Hanson & Chen, 2007; Garriguet, 2009), however, the ways that these cluster are not always well understood and the associations between these different health behaviours and diet have not been studied extensively in FN populations. Finally, indicators of socioeconomic status, including the number of children in the household, living with one's biological parents, and parent education level were selected as they are closely tied to household income and food security (Che & Chen, 2001; Willows et al., 2009), and therefore could influence food availability and eating behaviours.

Table 5.3. Independent variables included in the logistic regression models investigating daily vegetable, and milk and milk product intake among 12-17 year-old First Nations youth from the 2008/10 First Nations Regional Health Survey (FNIGC 2008, 2012)

Variable	Question	Responses	Categories
Individual factors			
Age	What is your date of birth?	Day, Month, Year	1 = 12-14 years* 0 = 15-17 years
Sex	Are you male or female?	Male, Female	1 = male* 0 = female
Body mass index[a]	How tall are you without shoes on? How much do you weight (lbs)?	Numeric; body mass index calculated as [(kg of body mass) / (m of height)^2]	1 = normal or underweight* 0 = overweight or obese
Behavioural factors			
School attendance	Are you currently attending school?	Yes, no, don't know, refused	1 = yes* 0 = no
Physical activity level[b]	In the past 12 months, which of the following have you participated in? In the past 12 months, how many times did you participate in the activity? How much time (in minutes) do you generally spend doing the activity in the average session?	Numeric; physical activity index calculated	1=inactive or moderately active* 0 = active
Smoking status	At the present time, do you smoke cigarettes?	Not at all, daily, occasionally, refused	1 = daily or occasionally* 0 = not at all
Alcohol use	During the past 12 months, have you had a drink of beer, wine, liquor or any other alcoholic beverage?	Yes, no, don't know, refused	1 = yes* 0 = no
Socioeconomic factors			
# of children in household	Including yourself, how many children and youth are living in this [your] household?	# 0-5 years, # 6-11 years, # 12-18 years	1= >3 children* 0 = 1-3 children
Living with biological parents	Who do you live with most of the time?	Biological mother, biological father, brother(s)/sister(s), aunt/uncle/cousins, grandparent(s), my stepmother, my stepfather, step-brother(s)/step-sister(s), the mother that adopted me, the father that adopted me, my boyfriend/girlfriend/spouse, my child(ren), unrelated children, a woman I am not related to, a man I am not related to, don't know, refused, other	3 = neither biological parents* 2 = one biological parent (mother or father) 1 = both biological parents (mother or father)
Parent education	What is the highest level of formal schooling that your parents or guardians have completed?	Some elementary school, elementary school, some high school, diploma/certificate from trade or vocational school, diploma/certificate from community college or CEGEP, university degree, Masters degree, Doctorate, not applicable	3 = neither mother nor father achieved high school* 2 = mother or father achieved high school 1 = mother or father achieved some post-secondary education

*Reference category; [a]Calculated using self-reported height and weight data and categorized using International Obesity Task Force cut points (Cole & Lobstein, 2012).
[b]Categorized based on calculated metabolic equivalent values as follows: inactive (1.5 kcal/kg/day), moderately active (1.51-2.99 kcal/kg/day), active (≥3 kcal/kg/day) (FNIGC, 2012).

5.5.5 Data Use and Ethical Approval

Data from the 2008/10 RHS were requested from the FNIGC, whom approved the work and vetted the data outputs. Dr. Ian Martin, a consultant from the University of Toronto Scarborough, helped to inform the statistical methods. All analyses were undertaken by the principal author of this thesis at the First Nations Research Data Centre in Ottawa, Ontario following the FNIGC's ethical protocols.

5.6 Data Analysis and Interpretation

All data were analyzed using SPSS Complex Samples (*v*. 20, IBM Corporation, Armonk, New York) with a level of statistical significance set *a priori* at $p \leq 0.05$. As described in **Study Two**, the two-stage stratified sampling design information of the RHS (FNIGC, 2015) was incorporated into the analyses and participants with missing data (i.e., 'refused' or 'don't know' responses) for any of the independent variables or for vegetable, or milk and milk products intake were excluded. All analyses were performed on the weighted population of youth.

Descriptive statistics (i.e., means±SD, frequencies) were first employed to describe the participants, and differences within the population sample were identified using Pearson Chi-square statistics. To test the bivariate (crude) and multivariate (including all independent variables) relationships between the independent variables and daily vegetable, and milk and milk product intake, respectively, binary logistic regression models were employed. Exploratory analyses revealed that, for daily vegetables intake, there were significant interaction effects for age and sex with a number of the independent variables. Specifically, interactions were observed between age and BMI ($p<0.001$), school attendance ($p<0.001$), physical activity level ($p<0.001$), smoking status (p<0.001), alcohol use (p<0.001), number of children in the household (p<0.001), living with biological parents (p<0.001), and parent education level (p<0.001). Sex interacted with school attendance (p=0.043), physical activity level (p<0.001), smoking status (p<0.001) and alcohol use (p<0.001). Similarly for daily milk and milk products intake, there were significant interaction effects of age and sex and a number of the independent variables. Specifically, age interacted with school attendance (p<0.001), smoking status (p=0.001), and number of children in the household (p=0.016), while sex interacted with BMI (p=0.031), school attendance (p<0.001), physical activity level (p=0.006), smoking status (p<0.001) and parent education level (p=0.031). To account for these known interactions, four separate models were tested for each vegetable, and milk and milk product intake (i.e., one for each age and sex group).

5.7 Results

5.7.1 Characteristics of the Sample Population for Vegetables Intake

Of the 4837 youth surveyed, 3721 (representing a weighted population of 41 499 FN youth) were included in the analyses investigating vegetable intake following the exclusion of those with incomplete data. For the variables included, rates of missing data ranged from zero to 7.9% (**Table 5.4**). The sample was nearly perfectly balanced by age and sex; 50.5% fell into the 12-14 year-old age category and 51.7% were boys. **Table 5.4** shows the characteristics of the weighted sample with respect to the independent variables, including differences by vegetable intake frequency. Over two-thirds (68.4%) of youth consumed vegetables daily. At least daily vegetable consumption was associated with being younger (12-14 years old) (p<0.001), being physically active ($p<0.001$), being a non-smoker ($p<0.001$), abstaining from alcohol ($p=0.001$) and having at least one parent who has completed a post-secondary education ($p=0.026$).

Table 5.4. Characteristics of the subset of youth participants from the 2008/10 First Nations Regional Health Survey included in the analysis for vegetables intake (n=3721)[a]

Variable	Data missing (%)	Proportion of sample (%)	Vegetables daily[b] (%)	p-value[c]
Vegetables	1.1			
At least daily		68.4		
Less than daily		31.6		
Age	0.1[d]			**<0.001**
12-14 years		50.5	73.2	
15-17 years		49.5	63.6	
Sex	0.0			0.791
Male		51.7	68.7	
Female		48.3	68.2	
Body mass index	6.9			0.326
Normal or underweight		56.9	69.4	
Overweight or obese		43.1	67.3	
School attendance	0.9[d]			0.058
Yes		87.5	69.4	
No		12.5	61.4	
Physical activity level	5.7			**<0.001**
Inactive or moderately active		48.8	64.0	
Active		51.2	72.7	
Smoking status	3.8			**<0.001**
Daily or occasionally		31.7	62.0	
Not at all		68.3	71.4	
Alcohol use	3.5			**0.001**
Yes		38.2	63.7	
No		61.8	71.3	
# of children in household	1.9			
1-3 children		62.9	67.8	0.436
>3 children		37.1	69.6	
Living with biological parents	n/a[e]			0.404
Both biological parents		39.3	70.1	
One biological parent		45.2	67.8	
Neither biological parent		15.5	66.2	
Parent education	7.9			**0.026**
Some post-secondary		33.1	72.4	
High school		25.0	68.4	
<High school		41.9	65.3	

[a]Representing a weighted population of 41 499 FN youth.
[b]Defined as answering 'several times a day' or 'once a day' on the vegetables question on the food frequency questionnaire.
[c]As assessed via the Pearson Chi-square statistic. Variables where significant differences in responses by vegetable frequency (daily vs. less often) are shown in bold.
[d]Statistic has been suppressed due to low cell count (n<5) or high sampling variability (CV>33.3%).
[e]Estimate is associated with high sampling variability and should be interpreted with caution.
Source: The First Nations Information Governance Centre, microdata abstract: 2015-GATA-001, July 9, 2015.

5.7.2 Logistic Regression Analyses for Vegetables Intake for Girls

In total, 891 girls aged 12-14 years (weighted population of 9 968) and 995 girls age 15-17 years (weighted population of 10 076) were included in the analyses following the removal of those with incomplete data. For the younger sub-group of girls, the odds of daily vegetable intake were predicted by physical activity level and alcohol use (**Table 5.5**). For these girls, the odds of daily vegetable intake were increased amongst those who were physically active as compared to those who were not (OR=1.80, CI=1.18-2.75, p=0.006) and amongst those who abstained from alcohol as compared to those who did not (OR=1.70, CI=1.16-2.50, p=0.006). Adjusted for other individual, behavioural and socioeconomic factors in the multivariate model, the relationships between daily vegetable intake and physical activity level (OR=1.91, CI=1.29-2.84, p=0.001) and alcohol use (OR=1.88, CI=1.16-3.06, p=0.010) persisted.

For 15-17 year-old girls, the odds of daily vegetable intake were predicted only by smoking status (**Table 5.5**). Those who were non-smokers had increased odds of consuming vegetables daily as compared to those who smoked occasionally or daily (OR=1.61, CI=1.14-2.27, p=0.006). This relationship remained following adjustment for other individual, behavioural and socioeconomic factors in the multivariate model (OR=1.54, CI=1.03-2.30, p=0.032).

Table 5.5. Logistic regression models to explore daily vegetable consumption among 12-17 year old First Nations girls from the 2008/10 First Nations Regional Health Survey[a]

Independent Variable	12-14 Year-old Girls (n=891)[b]					15-17 Year-old Girls (n=995)[b]				
	Vegetables daily (%)[c]	Crude OR	95% CI	Adjust OR[d]	95% CI	Vegetables daily (%)[c]	Crude OR	95% CI	Adjust OR[d]	95% CI
Body mass index										
Normal or underweight	75.2	1.00		1.00		65.0	1.00		1.00	
Overweight or obese	73.0	0.90	0.62-1.30	0.88	0.61-1.27	58.2	0.75	0.53-1.07	0.77	0.55-1.07
School attendance										
Yes	73.7	1.00		1.00		62.2	1.00		1.00	
No	81.0	1.52	0.56-4.14	1.85	0.68-5.05	61.7	0.98	0.66-1.44	1.20	0.77-1.85
Physical activity level										
Inactive or moderately active	69.2	1.00		1.00		59.4	1.00		1.00	
Active	80.2	**1.80**	**1.18-2.75**	**1.91**	**1.29-2.84**	66.5	1.35	0.94-1.94	1.28	0.89-1.85
Smoking status										
Daily or occasionally	71.0	1.00		1.00		56.6	1.00		1.00	
Not at all	75.2	1.23	0.79-1.93	0.86	0.50-1.49	67.7	**1.61**	**1.14-2.27**	**1.54**	**1.03-2.30**
Alcohol use										
Yes	66.0	1.00		1.00		60.1	1.00		1.00	
No	76.7	**1.70**	**1.16-2.50**	**1.88**	**1.16-3.06**	65.3	1.25	0.88-1.78	1.09	0.74-1.59
# of children in household										
1-3 children	72.9	0.85	0.57-1.27	0.88	0.60-1.28	61.3	0.91	0.64-1.29	0.85	0.60-1.21
>3 children	76.0	1.00		1.00		63.5	1.00		1.00	
Living with biological parents										
Both biological parents	72.5	0.74	0.39-1.40	0.72	0.36-1.44	60.9	0.87	0.56-1.34	0.72	0.46-1.14
One biological parent	74.7	0.83	0.44-1.56	0.80	0.41-1.54	62.4	0.93	0.61-1.42	0.82	0.53-1.25
Neither biological parent	78.1	1.00		1.00		64.2	1.00		1.00	
Parent education										
Some post-secondary	72.2	0.88	0.53-1.48	0.94	0.56-1.57	66.6	1.49	0.96-2.30	1.44	0.93-2.23
High school	76.0	1.08	0.66-1.76	1.14	0.72-1.80	63.9	1.32	0.85-2.04	1.22	0.78-1.92
<High school	74.6	1.00		1.00		57.3	1.00		1.00	

[a]Variables that were statistically significant in the multivariate model are shown in bold.
[b]Representing a weighted population of 9 968 girls aged 12-14 years and 10 076 girls aged 15-17 years.
[c]Defined as answering 'several times a day' or 'once a day' to vegetable consumption on the food frequency questionnaire.
[d]Including all variables in the model.
Source: The First Nations Information Governance Centre, microdata abstract: 2015-GATA-001, July 9, 2015.

5.7.3 Logistic Regression Analyses for Vegetables Intake for Boys

Following the removal of youth with incomplete data, 921 boys aged 12-14 years (weighted population of 10 971) and 914 boys aged 15-17 years (weighted population of 10 484) were included in the analyses. Amongst 12-14 year-old boys, the odds of daily vegetable intake were predicted by school attendance and parent education level (**Table 5.6**). Specifically, those youth who did not attend school had decreased odds of consuming vegetables daily as compared to those who did attend (OR=0.50, CI=0.26-0.95, p=0.031), and those who had a parent with some post-secondary education had increased odds of consuming vegetables daily as compared to those whose parents had not completed high school (OR=1.51, CI=1.00-2.28, p=0.050). Neither of these relationships persisted following the adjustment for other individual, behavioural and socioeconomic factors in the multivariate model.

For the older sub-group of boys, the odds of daily vegetable consumption were predicted by parent education and physical activity level (**Table 5.6**). Similar to the younger sub-group of boys, 15-17 year-olds had increased odds of consuming vegetables daily if at least one of their parents had some post-secondary education as compared to those whose parents had not completed high school (OR=1.87, CI=1.16-3.01, p=0.033). This relationship did not persist following the adjustment for other individual, behavioural and socioeconomic factors in the multivariate model. Boys aged 15-17 years also had increased odds of consuming vegetables daily if they were physically active as compared to those who were not (OR=1.46, CI=1.03-2.08, p=0.034). Following adjustment for other individual, behavioural and socioeconomic factors in the multivariate model, this relationship persisted (OR=1.44, CI=1.02-2.03, p=0.038).

Table 5.6. Logistic regression models to explore daily vegetable consumption among 12-17 year old First Nations boys from the 2008/10 First Nations Regional Health Survey[a]

Independent Variable	12-14 Year-old Boys (n=921)[b]					15-17 Year-old Boys (n=914)[b]				
	Vegetables daily (%)[c]	Crude OR	95% CI	Adjust OR[d]	95% CI	Vegetables daily (%)[c]	Crude OR	95% CI	Adjust OR[d]	95% CI
Body mass index										
Normal or underweight	73.1	1.00		1.00		64.7	1.00		1.00	
Overweight or obese	71.4	0.92	0.68-1.23	0.92	0.69-1.23	65.2	1.02	0.70-1.50	1.02	0.70-1.51
School attendance										
Yes	73.2	1.00		1.00		67.2	1.00		1.00	
No	57.6	**0.50**	**0.26-0.95**	0.62	0.30-1.28	54.4	0.58	0.32-1.06	0.67	0.39-1.13
Physical activity level										
Inactive or moderately active	68.3	1.00		1.00		59.9	1.00		1.00	
Active	74.8	1.38	0.99-1.94	1.33	0.95-1.88	68.6	**1.46**	**1.03-2.08**	**1.44**	**1.02-2.03**
Smoking status										
Daily or occasionally	64.1	1.00		1.00		63.1	1.00		1.00	
Not at all	73.7	1.57	0.98-2.50	1.64	0.99-2.71	66.2	1.15	0.78-1.70	0.86	0.55-1.35
Alcohol use										
Yes	73.8	1.00		1.00		63.6	1.00		1.00	
No	71.9	0.91	0.57-1.46	0.74	0.43-1.25	66.6	1.14	0.79-1.65	1.13	0.72-1.78
# of children in household										
1-3 children	70.9	0.85	0.59-1.21	0.84	0.60-1.17	66.6	1.28	0.85-1.93	1.22	0.79-1.88
>3 children	74.2	1.00		1.00		60.8	1.00		1.00	
Living with biological parents										
Both biological parents	77.0	1.60	0.96-2.67	1.35	0.78-2.33	68.3	1.61	0.87-2.99	1.47	0.83-2.59
One biological parent	69.0	1.07	0.65-1.76	0.95	0.55-1.66	65.1	1.40	0.74-2.64	1.24	0.70-2.21
Neither biological parent	67.7	1.00		1.00		57.2	1.00		1.00	
Parent education										
Some post-secondary	78.1	**1.51**	**1.00-2.28**	1.45	0.95-2.20	72.5	**1.87**	**1.16-3.01**	1.70	1.07-2.72
High school	67.8	0.89	0.59-1.35	0.91	0.60-1.39	65.4	1.34	0.81-2.23	1.24	0.75-2.06
<High school	70.3	1.00		1.00		58.4	1.00		1.00	

[a]Variables that were statistically significant in the multivariate model are shown in bold.
[b]Representing a weighted population of 10 971 boys aged 12-14 years and 10 484 boys aged 15-17 years.
[c]Defined as answering ‘several times a day’ or ‘once a day’ to vegetable consumption on the food frequency questionnaire.
[d]Including all variables in the model.
Source: The First Nations Information Governance Centre, microdata abstract: 2015-GATA-001, July 9, 2015.

5.7.4 Characteristics of the Study Population for Milk and Milk Products Intake

For the investigation of milk and milk products intake, at total of 3717 youth (representing a weighted population of 41 368 youth) were included in the analyses following the exclusion of 1120 participants for whom full data were not available. For the variables included, rates of missing data ranged from zero to 8.0% (**Table 5.7**). Of the population sample, approximately one half (51.5%) were boys, and 50.6% fell into the 12-14 year-old age category. **Table 5.7** shows the characteristics of the sample with respect to the independent variables, including differences by milk and milk product consumption frequency. Nearly two-thirds (56.9%) of youth reported consuming milk and milk products daily. Daily reported consumption of milk and milk products was associated with being a girl ($p=0.025$), attending school ($p<0.001$), being physically active ($p=0.050$) and being a non-smoker ($p<0.001$).

Table 5.7. Characteristics of the subset of youth participants from the 2008/10 First Nations Regional Health Survey included in the analysis for milk and milk products intake (n=3717)[a]

Variable	Data missing (%)	Proportion of sample (%)	Milk and milk products daily (%)[b]	p-value[c]
Milk and milk products	1.2[d]			
At least daily		56.9		
Less than daily		43.1		
Age	0.1[d]			0.148
12-14 years		50.6	58.6	
15-17 years		49.4	55.2	
Sex	0.0			**0.025**
Male		51.5	54.4	
Female		48.5	59.6	
Body mass index				0.328
Normal or underweight	6.9	56.8	58.0	
Overweight or obese		43.2	55.6	
School attendance	0.9[d]			**<0.001**
Yes		87.8	58.8	
No		12.2	44.0	
Physical activity level	5.7			**0.050**
Inactive or moderately active		48.6	54.4	
Active		51.4	59.3	
Smoking status	3.8			**<0.001**
Daily or occasionally		31.5	49.7	
Not at all		68.5	60.3	
Alcohol use	3.5			0.365
Yes		38.1	55.7	
No		61.9	57.7	
# of children in household	1.9			0.784
1-3 children		62.7	56.7	
>3 children		37.3	57.4	
Living with biological parents	n/a[e]			0.466
Both biological parents		39.5	57.2	
One biological parent		45.3	55.8	
Neither biological parent		15.2	59.6	
Parent education	7.9			0.133
Some post-secondary		33.3	59.9	
High school		25.0	58.0	
<High school		41.7	53.9	

[a]Representing a weighted population of 41 368 youth.
[a]Defined as answering ‘several times a day’ or ‘once a day’ on the milk and milk products question on the food frequency questionnaire.
[c]As assessed via the Pearson Chi-square statistic. Variables where significant differences in responses by milk and milk products frequency (daily vs. less often) are shown in bold.
[d]Estimate is associated with high sample variability and should be interpreted with caution.
[e]Statistic has been suppressed due to low cell count (n<5) or high sampling variability (CV>33.3%).
Source: The First Nations Information Governance Centre, microdata abstract: 2015-GATA-001, July 9, 2015.

5.7.5 Logistic Regression Analyses for Milk and Milk Products Intake for Girls

Following the exclusion of participants with missing data, a total of 893 girls aged 12-14 years (weighted population of 9 989) and 996 girls aged 15-17 years (weighted population of 10 070) were included in the analyses. For 12-14 year-old girls, the odds of daily milk and milk product consumption were predicted by smoking status and alcohol use (**Table 5.8**). Specifically, 12-14 year-old girls had increased odds of consuming milk and milk products daily if they did not smoke as compared to daily or occasional smokers (OR=1.93, CI=1.27, p=0.002). Those who did not consume alcohol had increased odds of consuming milk and milk products daily as compared to those who did report consuming alcohol (OR=1.67, CI=1.10-2.54, p=0.014). Although the relationship between daily milk and milk product intake and smoking status (OR=1.75, CI=1.03-3.00, p=0.038) persisted following the adjustment for other individual, behavioural and socioeconomic factors in the multivariate models, the relationship with alcohol use did not.

For the older sub-group of girls, the odds of daily milk and milk product intake were predicted by physical activity level, smoking status, and living with one's biological parents (**Table 5.8**). Specifically, for 15-17 year-old girls the odds of consuming milk and milk products daily were increased amongst those who were physically active as compared to those who were not (OR=1.64, CI=1.18-2.28, p=0.003), amongst those who did not smoke as compared to those who smoked daily or occasionally (OR=1.55, CI=1.12-2.14, p=0.007) and amongst those who lived with one biological parent as compared to those who lived with neither biological parent (OR=1.91, CI=1.25-2.93, p=0.007). The significant relationships between daily milk and milk product intake and physical activity level (OR=1.49, CI=1.08-2.06, p=0.014), smoking status (OR=1.68, CI=1.15-2.46, p=0.007) and living with one's biological parents (OR=1.79, CI=1.16-

2.78, p=0.019) all persisted following the adjustment for other individual, behavioural and socioeconomic variables in the multivariate model.

Table 5.8. Logistic regression models to explore daily milk and milk product consumption among 12-17 year old First Nations girls from the 2008/10 First Nations Regional Health Survey[a]

Independent Variable	**12-14 Year-old Girls (n=893)[b]**					**15-17 Year-old Girls (n=996)[b]**				
	Milk and milk products daily (%)[c]	**Crude OR**	**95% CI**	**Adjust OR[d]**	**95% CI**	**Milk and milk products daily (%)[c]**	**Crude OR**	**95% CI**	**Adjust OR[d]**	**95% CI**
Body mass index										
Normal or underweight	62.0	1.00		1.00		61.7	1.00		1.00	
Overweight or obese	58.4	0.86	0.59-1.26	0.87	0.61-1.23	54.6	0.75	0.54-1.03	0.76	0.55-1.06
School attendance										
Yes	59.6	1.00		1.00		60.6	1.00		1.00	
No	70.7[e]	1.64	0.48-5.56	1.82	0.61-5.42	50.7	0.67	0.44-1.02	0.81	0.53-1.23
Physical activity level										
Inactive or moderately active	59.7	1.00		1.00		54.2	1.00		1.00	
Active	61.4	1.07	0.74-1.57	1.11	0.79-1.57	66.0	**1.64**	**1.18-2.28**	**1.49**	**1.08-2.06**
Smoking status										
Daily or occasionally	47.9	1.00		1.00		53.4	1.00		1.00	
Not at all	64.0	**1.93**	**1.27-2.93**	**1.75**	**1.03-3.00**	64.0	**1.55**	**1.12-2.14**	**1.68**	**1.15-2.46**
Alcohol use										
Yes	50.8	1.00		1.00		60.0	1.00		1.00	
No	63.4	**1.67**	**1.10-2.54**	1.31	0.77-2.23	56.8	0.88	0.64-1.20	**0.70**	**0.49-1.00**
# of children in household										
1-3 children	58.2	0.80	0.55-1.18	0.84	0.60-1.18	61.2	1.33	0.95-1.87	1.23	0.86-1.75
>3 children	63.2	1.00		1.00		54.3	1.00		1.00	
Living with biological parents										
Both biological parents	59.2	0.66	0.40-1.07	0.60	0.37-0.99	56.4	1.33	0.87-2.04	1.26	0.80-2.00
One biological parent	59.0	0.65	0.40-1.07	0.60	0.38-0.95	64.9	**1.91**	**1.25-2.93**	**1.79**	**1.16-2.78**
Neither biological parent	68.9	1.00		1.00		49.2	1.00		1.00	
Parent education										
Some post-secondary	57.8	0.90	0.57-1.43	1.01	0.64-1.59	62.6	1.25	0.86-1.81	0.98	0.65-1.49
High school	63.8	1.16	0.73-1.84	1.22	0.79-1.89	55.7	0.94	0.63-1.40	0.77	0.52-1.15
<High school	60.3	1.00		1.00		57.3	1.00		1.00	

[a]Variables that were statistically significant in the multivariate model are shown in bold.
[b]Representing a weighted population of 9 989 girls aged 12-14 years and 10 070 girls aged 15-17 years.
[c]Defined as answering 'several times a day' or 'once a day' to milk and milk product consumption on the food frequency questionnaire.
[d]Including all variables in the model.
[e]Estimate is associated with high sampling variability and should be interpreted with caution.
Source: The First Nations Information Governance Centre, microdata abstract: 2015-GATA-001, July 9, 2015.

5.7.6 Logistic Regression Analyses for Milk and Milk Products Intake for Boys

In total, 917 boys aged 12-14 years (weighted population of 10 947) and 911 boys aged 15-17 years (weighted population of 10 362) were included in the analyses following the exclusion of those without complete data. For 12-14 year-old boys, the odds of daily milk and milk product intake were predicted by school attendance, physical activity level and the number of children residing in their household (**Table 5.9**). For this younger sub-group of boys, the odds of consuming milk and milk products daily were decreased amongst those who did not attend school as compared to those who did (OR=0.20, CI=0.11-0.37, $p<0.001$) and amongst those who lived in a household with three children as compared to those who lived in households with greater than three children (OR=0.68, CI=0.48-0.97, $p=0.029$). Those who were physically active had increased odds of consuming milk and milk products daily as compared to those who were inactive or only moderately active (OR=1.51, CI=1.09-2.11, $p=0.013$). The relationships for school attendance (OR=0.21, CI=0.12-0.37, $p<0.001$), physical activity level (OR=1.43, CI=1.05-1.94, $p=0.022$) and the number of children residing in the household (OR=0.64, CI=0.46-0.90, $p=0.010$) all persisted following the adjustment for other individual, behavioural and socioeconomic factors in the multivariate model.

For the older sub-group of boys, the odds of daily milk and milk product intake were predicted by school attendance and smoking status (**Table 5.9**). Specifically, 15-17 year-old boys had decreased odds of consuming milk and milk products daily if they did not attend school as compared to those who did attend (OR=0.40, CI=0.25-0.66, $p<0.001$), and increased odds if they did not smoke as compared to daily and occasional smokers (OR=1.81, CI=1.23-2.69, $p=0.003$). Both the relationship for school attendance (OR=0.47, CI=0.30-0.74, $p=0.001$) and smoking status (OR=1.61, CI=1.07-2.43, p=0.021) persisted following the adjustment for other individual, behavioural and socioeconomic variables in the multivariate model.

Table 5.9. Logistic regression models to explore daily milk and milk product consumption among 12-17 year old First Nations boys from the 2008/10 First Nations Regional Health Survey[a]

Independent Variable	12-14 Year-old Boys (n=917)[b]					15-17 Year-old Boys (n=911)[b]				
	Milk and milk products daily (%)[c]	Crude OR	95% CI	Adjust OR[d]	95% CI	Milk and milk products daily (%)[c]	Crude OR	95% CI	Adjust OR[d]	95% CI
Body mass index										
Normal or underweight	58.6	1.00		1.00		50.2	1.00		1.00	
Overweight or obese	55.2	0.87	0.58-1.31	0.89	0.62-1.28	54.4	1.18	0.84-1.67	1.21	0.85-1.72
School attendance										
Yes	59.2	1.00		1.00		55.5	1.00		1.00	
No	22.4[e]	**0.20**	**0.11-0.37**	**0.21**	**0.12-0.37**	33.3	**0.40**	**0.25-0.66**	**0.47**	**0.30-0.74**
Physical activity level										
Inactive or moderately active	50.7	1.00		1.00		51.8	1.00		1.00	
Active	60.9	**1.51**	**1.09-2.11**	**1.43**	**1.05-1.94**	51.9	1.00	0.72-1.40	1.00	0.71-1.39
Smoking status										
Daily or occasionally	57.1	1.00		1.00		42.9	1.00		1.00	
Not at all	56.9	0.99	0.61-1.61	0.93	0.58-1.49	57.7	**1.82**	**1.23-2.69**	**1.61**	**1.07-2.43**
Alcohol use										
Yes	61.9	1.00		1.00		51.0	1.00		1.00	
No	56.0	0.78	0.49-1.27	0.90	0.55-1.46	52.8	1.08	0.75-1.55	0.95	0.64-1.41
# of children in household										
1-3 children	53.2	**0.68**	**0.48-0.97**	**0.64**	**0.46-0.90**	54.8	1.50	0.98-2.28	1.20	0.80-1.80
>3 children	62.6	1.00		1.00		44.7	1.00		1.00	
Living with biological parents										
Both biological parents	61.5	1.02	0.60-1.73	0.92	0.58-1.47	50.0	0.61	0.36-1.05	**0.52**	**0.31-0.85**
One biological parent	51.1	0.67	0.38-1.17	0.62	0.37-1.04	49.9	0.61	0.34-1.08	**0.56**	**0.33-0.95**
Neither biological parent	61.2	1.00		1.00		62.1	1.00		1.00	
Parent education										
Some post-secondary	62.2	1.50	0.90-2.50	1.61	1.00-2.59	56.9	1.56	1.03-2.35	1.35	0.89-2.03
High school	57.4	1.23	0.79-1.90	1.38	0.89-2.12	54.8	1.43	0.91-2.26	1.25	0.79-1.99
<High school	52.2	1.00		1.00		45.9	1.00		1.00	

[a]Variables that were statistically significant in the multivariate model are shown in bold.
[b]Representing a weighted population of 10 947 boys aged 12-14 years and 10 362 boys aged 15-17 years.
[c]Defined as answering 'several times a day' or 'once a day' to milk and milk product consumption on the food frequency questionnaire.
[d]Including all variables in the model.
[e]Estimate is associated with high sampling variability and should be interpreted with caution.
Source: The First Nations Information Governance Centre, microdata abstract: 2015-GATA-001, July 9, 2015.

5.8 Discussion

Despite the emphasis on the importance of traditional food consumption for FN youth, the move toward more Western lifestyles and the increasing reliance on store-bought foods is not likely to be reversed. For this reason, strategies to promote healthy store-bought food choices will be necessary to complement initiatives to reduce the current rate of decline in traditional food intake and cultural knowledge amongst youth. To inform such strategies, a comprehensive understanding of the predictors of eating behaviours and food choices will be needed. The current study provided for an exploration of some of the potential individual, behavioural and socioeconomic predictors of healthy store-bought food intake, revealing relationships between daily vegetable, and milk and milk product intake and markers of socioeconomic status, health behaviours such as physical activity, alcohol intake and smoking, and non-modifiable individual factors such as age and sex. This work adds to an area of research where relatively little was previously known (Willows, 2005), and may be used to inform future work to understand the identified relationships in greater depth.

5.8.1 Store-bought Food Intake and Associations with Individual Factors

Congruent with previous research in regional samples of Aboriginal youth (Gates, Skinner, & Gates, 2015), the present study found that many on-reserve FN youth had relatively low intakes of nutrient-rich store-bought foods. Canada's Food Guide for FN, Inuit and Métis currently recommends a minimum of five servings of vegetables and fruit for children aged 4-13 years, and a minimum of seven servings for teens and adults (Health Canada, 2007a). Within these recommendations, it is advised that a minimum of one dark green and one orange vegetable be consumed daily (Health Canada, 2007a). Despite these guidelines, nearly one third of participants (32%) did not consume at least one vegetable per day. Although information on the quality of vegetable choices (e.g., juice as compared to whole vegetables) and on portion size were not available, it remains concerning that there exists a substantial proportion of youth who fail to meet even minimum recommended levels of intake.

The concern was similar for the intake of milk and milk products. Canada's Food Guide for FN, Inuit and Métis recommends that 4-13 year-old children consume a minimum of two servings of milk and milk alternatives daily, and a minimum of one additional serving for teenagers (i.e., three servings) (Health Canada, 2007a). Despite these recommendations, 43% of youth did not consume a milk or milk product daily. It is acknowledged that milk and milk products were not part of the traditional diets of FN people, and thus may not be a popular choice for youth. Some studies have also reported higher prevalence rates of lactose sensitivity among the Indigenous populations (Bell, Draper, & Bergan, 1973; Ellestad-Sayed, Haworth, & Hildes, 1978), which would prevent the consumption of these foods. Nevertheless, CFG warns that because individuals are typically consuming less of the traditional foods that once supplied the nutrients found in milk (e.g., wild plants, seaweed, bannock, fish with bones, bone soup), it is likely that these foods alone will not provide sufficient amounts of calcium and vitamin D required for good health (Health Canada, 2007a). Daily intake of milk and milk alternatives thus remains important for this population.

Research in the general population has found that overall diet quality tends to decline with age (Taylor, Evers, & McKenna, 2005; Garriguet, 2009), including a reduction in vegetable and milk and alternatives intakes as youth grow through their adolescent years (Berkey et al., 2005;

Ramussen et al., 2006; Garriguet, 2008b; Larson et al., 2009; Lorson, Melgar-Quinonez, & Taylor, 2009). By sex, a number of studies have found that girls consume more vegetables as compared to boys (Rasmussen et al., 2006; Lorson, Melgar-Quinonez, & Taylor, 2009), but that boys in fact consume more milk as compared to girls during adolescence (Larson et al., 2006; Garriguet, 2007, 2008b). For the FN youth in the present study, vegetable intake frequency was associated with age, where older youth were less likely to consume them daily, while there was no association between age group and milk and milk product intake. Although there was no association between sex and vegetable intake, girls were more likely to consume milk and milk products daily as compared to boys. These findings are not in complete agreement with what has been observed in the general population, but provide some insight into subgroups of the population at which health initiatives should be targeted.

5.8.2 Relationships with Other Health and Risk Behaviours

Amongst the general population of youth, there has been some evidence to indicate a clustering of health and health risk behaviours, with better diet quality being associated with higher physical activity levels (Leech, McNaughton, & Timperio, 2014; Ferrar & Golley, 2015), and smoking and alcohol intake being associated with lower odds of consuming vegetables and milk or milk products (Garriguet, 2009). Congruent with work in non-Aboriginal populations, the current study identified significant relationships between physical activity level, smoking status and alcohol use and the frequency of vegetable, and milk and milk product intake. It is, however, notable that there existed considerable variation in the existence and strength of these associations when each of the age and sex sub-groups was investigated separately.

As compared to those who were either inactive or only moderately active, active 12-14 year-old girls had increased odds of consuming vegetables daily; the odds of daily vegetable intake were also increased amongst active 15-17 year-old boys as compared to their less active peers. Conversely, the older (15-17 year-old) sub-group of girls and younger (12-14 year-old) sub-group of boys were more likely to consume milk and milk products daily if they were physically active. The identification of these associations amongst a representative sample of youth is practically significant, as interventions that target correlated health behaviours (i.e., physical activity and diet) simultaneously may result in greater health benefits as compared to the sum of interventions targeting each of these behaviours separately (Gillman, Pinto, Tennstedt, Glanz, Marcus, & Friedman, 2001).

For girls, there were increased odds of consuming vegetables and milk and milk products daily amongst those who did not smoke as compared to those who did (except for the vegetables intake among the younger sub-group of girls, where no relationship existed). Similarly, amongst the younger sub-group of girls, those who abstained from alcohol were at increased odds of consuming vegetables, and milk and milk products daily as compared to those who drank alcohol. For boys, only the older sub-group had increased odds of consuming milk and milk products daily if they were non-smokers as compared to those who smoked daily or occasionally. These findings suggest, that for at least some sub-groups of the young FN population, participation in risky health behaviours such as smoking and drinking and lower intake frequencies of healthy store-bought foods are somehow linked.

There exist myriad contributors to health and risk behaviours for youth, including a deeply rooted historical context that is particularly pertinent for the FN population. Nevertheless, the behavioural findings herein support the idea that comprehensive programming encouraging healthy lifestyles, including the promotion of positive habits and deterrence of ones associated with health risk, may provide for synergistic health benefits and thus may be desirable in this population with a relatively high prevalence of reported risk behaviours. Although the physical activity level of Aboriginal youth in Canada, on average, exceeds that of non-Aboriginal youth (Ng, Young, & Corey, 2010), there is still a large proportion that are not active enough to reap the health benefits associated with moderate-to-vigorous physical activity (Foulds, Warburton, & Bredin, 2013). Within the present study, only half (51%) of youth were active. Furthermore, relatively large proportions of the participants took part in risk behaviours; nearly one-third (32%) reported smoking and 38% reported drinking alcohol. It is acknowledged that the high prevalence of risk behaviours amongst FN youth will not be resolved without addressing more deeply seated issues. Nevertheless, the documentation and evaluation of multi-component health promotion interventions, including their impact on different facets of physical and mental health, would be helpful to inform larger scale programs and policies that encourage healthy lifestyles.

5.8.3 Relationships with Markers of Socioeconomic Status

Amongst participating youth, daily vegetable, and milk and milk product intake was predicted by a number of indicators of socioeconomic status. For both sub-groups of boys, there were increased odds of consuming vegetables at least daily amongst those who had at least one parent with a post-secondary education as compared to those whose parents had not completed high school. This relationship did not hold true for girls, nor for the intake of milk and milk products.

These findings differ somewhat from the general population, where lower parent education has typically been associated with lower intakes of vegetables (Rasmussen et al., 2006; Riediger, Shooshtari, & Moghadasian, 2007; van der Horst et al., 2007b), and milk and milk products (Abreu et al., 2012).

Parents who have a post-secondary education are more likely to be employed and to be earning higher incomes as compared to those who have not completed high school (Statistics Canada, 2009b). Healthy diets can be expensive (Drewnowski & Specter, 2004; Drewnowski & Darmon, 2005), and even more so in remote and isolated or northern locations (Government of Canada, 2009), such that energy-dense and nutrient-poor foods may be the only option for low-income households. It is not surprising, then, that lower socioeconomic status has been associated with eating fewer vegetables and poorer diet quality (Rasmussen et al., 2006; Hanson & Chen, 2007) and poverty and lower levels of education are among the sociodemographic risk factors for food insecurity for Aboriginal families (Che & Chen, 2001; Willows et al., 2009). Universal food provision programs, allowing access to healthy foods for all sub-groups of youth regardless of income, could potentially improve the intakes of nutrient-dense foods while not stigmatizing those youth whose families do not have the means to procure them.

Finally, there existed relationships between youths' living situation and their dietary intakes. Specifically, the elder (15-17 year-old) girls who lived with one biological parent were at increased odds of consuming milk or milk products daily as compared to those living with neither biological parent, while living with both biological parents offered no advantage. For the older (15-17 year-old) boys, those who lived with either one or both biological parents seemed to be at a disadvantage – these youth were at significantly reduced odds of consuming milk and milk products daily as compared to those who lived with neither biological parent. These relationships are difficult to explain; typically, living with both parents would be advantageous, given that lone-parent households often have lower incomes and are more prone to food insecurity (Che & Chen, 2001; Willows et al., 2009). Compared to non-Aboriginal children, FN children are more likely to be living with a lone-parent, a grandparent or other relatives, and these families experience higher rates of food insecurity (Willows et al., 2009). What is nevertheless clear from these findings is that the association between diet quality and living situation may not be quite so straightforward. Because the nature of the relationships identified herein cannot be easily explained given the current body of knowledge, this is likely an area that warrants further investigation.

5.8.4 Future Directions

Despite age and sex differences in intake, the consumption frequency of healthy store-bought foods could stand to be improved, on average, for all subgroups of the population. Healthy eating initiatives should thus follow a population health approach, where all youth within a community are included. Although the present study found no association between vegetable and milk and milk product intake frequency and BMI, there exist numerous health benefits to consuming the recommended amounts of these foods beyond the maintenance of a healthy body mass (i.e., weight). The intake of vegetables and fruit has been associated with diet quality (Garriguet, 2009) and reduced risk of cardiovascular diseases and certain cancers later in life (World Cancer Research Fund & the American Institute for Cancer Research, 2007; Wang et al., 2014). Fortified milk products provide an important source of vitamin D (Vatanprast et al., 2010), a nutrient scarcely naturally available in the food supply, which plays a role in the attainment of peak bone mass (Heaney, Abrams, Dawson-Hughes, Looker, Marcus, Markovic et al., 2000). Schools may provide for an opportune venue for healthy eating programming, given the potential for a broad reach; schools also typically bring together a wealth of skilled personnel and positive role models.

Many schools employ universal food provision programs for youth. These have been documented and evaluated in a number of FN schools and have been met with moderate success at moving food group and nutrient intakes toward recommended levels (Saksvig et al., 2005; Skinner et al., 2012a, **Study Five** herein). Simply exposing youth to healthy foods by making them universally available, regardless of need, may be sufficient to enhance their desirability (Cooke, 2007). This may be especially true in remote and/or northern locations where affordable healthy foods of acceptable quality are oftentimes unavailable (Skinner, Hanning, & Tsuji, 2006; Gates et al., 2011, 2013a). Still, although many school-based programs exist in FN communities, these are infrequently evaluated, thus their impact rarely documented (Assembly of First Nations, 2008). Knowledge of what types of initiatives exist and what strategies have been met with success would help to inform healthy eating programming in communities where this does not yet exist.

5.9 Results Dissemination

Please refer to *4.9 Results Dissemination* in **Study Two**.

5.10 Strengths and Limitations

Akin to **Study Two**, the findings of this study may be generalizable to Canadian FN youth living on-reserve and have provided insight into some predictors of healthy food intake. Nevertheless, the relatively large amount of missing data may have resulted in a study sample that was no longer representative of the Canadian on-reserve population of FN youth. Cluster effects by community or region could not be detected, as these data were not available for the present study.

The self-reported nature of the survey data is prone to social desirability bias and recall error. The self-report of height and body mass (i.e., weight) is notoriously less accurate and more prone to bias as compared to using measured values (Sherry, Jefferds & Grummer-Strawn, 2007), leading to the likelihood of lower than actual BMIs. Furthermore, the IOTF cut points used to classify youth into BMI categories are known to underestimate overweight and obesity relative to WHO values (Reilly, Kelly, & Wilson, 2010). These were the cut points chosen for the RHS, and were relevant at the time of data collection, which now dates back nearly six years. Neither the IOTF, nor the WHO cut points have been validated amongst Aboriginal youth. The study design also precluded any inferences of cause and effect.

The FFQ provided for a more efficient assessment of usual intake as compared to more time-consuming methods (e.g., 24-hour recalls, food records), however, the questionnaire had no specified recall period and details on the quality and quantity of food consumed were not included; one could consume large or negligible amounts at a single time period. A recency effect is possible, where participants may have been more likely to report their ‘usual’ intake from the current season as opposed to more distant ones. The dietary intakes of youth are known to vary significantly by season (Kuhnlein, Souieda, & Receveur, 1995), however, this factor could not be investigated.

5.11 Conclusions

This study explored the vegetables and milk and milk products intakes of a large sample of FN youth residing on reserves across Canada. Predictors of the daily intake of these foods included behavioural and socioeconomic factors, with notable variation in the existence and significance of associations between age and sex categories. Further work is necessary to provide for a more in-depth understanding of the relationships between the factors investigated and food behaviours. Qualitative investigations may allow for a greater understanding of the findings, preferably from from the perspectives of FN youth and their families. Given the associations between various health and health risk behaviours and dietary intake identified in this study, programs targeting multiple facets of healthy lifestyles are recommended as they may promote the good health of youth synergistically.

5.12 Acknowledgements

This work would not have been possible without the contributions of the participants who gave their time. The author would like to thank Maria Santos, First Nations Data Centre co-ordinator at the FNIGC, for supporting the data analyses; the FNIGC for collecting the data and for making them available for analysis; and consultant Dr. Ian Martin (University of Toronto Scarborough) for informing the statistical analyses.

6.0 Study Four:
The Diets of First Nations Youth Living in Northern Ontario: Contribution of Lesser Snow Geese in the Spring Season and Evaluation of a Harvest Sharing Program*

6.1 Overview

Background. Despite known health and cultural benefits, the consumption of locally harvested foods is declining among Canadian FN people, especially youth.

Objectives. To investigate, among grades 6-8 youth in two remote, isolated FN communities in northern Ontario, (a) the frequency of lesser snow goose (*Chen caerulescens caerulescens*) intake, (b) the contribution of snow goose intake to each of: the intake of common store-bought foods, CFG food groups and nutrients in the Spring season, and (c) the association of snow goose intake with BMI. Also, to (d) evaluate the impact of a local harvest sharing program on the frequency of lesser snow goose consumption and overall dietary intake after two months.

Methods. A harvest sharing program supporting access to locally procured lesser snow geese was initiated in two focal FN communities. Dietary intakes of school-attending youth, and the prevalence and frequency of snow goose consumption were assessed at baseline (April 2011) and after two months (June 2011) using a 24-hour dietary recall and FFQ. Food group and nutrient intakes were compared to CFG recommendations and Dietary Reference Intake standards, respectively. Body mass index category was tabulated for each participant using self-reported height and weight data and WHO growth curves. Associations between diet and snow goose consumption frequency were assessed via Analysis of Variance (ANOVA) or Pearson Chi-square tests, where appropriate. Differences between the diets of those who consumed snow goose on the day recalled as compared to those who did not were tested using independent samples t-tests. Associations between BMI category and snow goose consumption were assessed

*This chapter was submitted in September 2015 to a peer-reviewed academic journal as the following: Gates, A., Hanning, R.M., Gates, M., & Tsuji, L.J.S. The food and nutrient intakes of First Nations youth living in northern Ontario, Canada: evaluation of a harvest sharing program.

via Pearson Chi-square tests. Changes in diet (baseline to post-pilot) were assessed via independent samples t-tests and Pearson Chi-square tests.

Results. At baseline (n=84, 12.38±1.07 years old, 49% male, 67% overweight or obese) less than half of participants (48%) reported consuming snow goose, and girls less so than boys (p=0.006). Thirty-nine percent of youth reported consuming snow goose at least weekly, while the remainder consumed it less often (or never), a frequency that did not differ by sex. Neither snow goose consumption (yes vs. no), nor the frequency of its consumption, was associated with BMI. Snow goose consumption frequency was associated with intakes of meat and alternatives (p=0.019), protein (p=0.004), vitamin B_{12} (p=0.004), iron (p=0.011) and zinc (p=0.006), where nutrient intakes were highest among those who consumed snow goose moderately (2-6 times per week). These youth were also more likely to meet dietary recommendations for vitamin C (p=0.033). Nutrient intake by goose consumption level interacted with sex for protein (p=0.018), thiamine (p=0.008), riboflavin (p=0.042) and iron (p=0.030). Following the pilot phase of the program, a greater proportion of youth (n=73, 12.34±0.99 years old, 44% male) reported eating snow goose (63% vs. 48%), although the change only reached significance for girls (61% vs. 33%, p=0.015). This increase in snow goose consumption was insufficient to yield measurable changes in dietary intake.

Conclusions. Spring snow goose consumption imparts nutritional benefits for FN youth living in two isolated, remote FN communities, however, more than half of youth do not consume this locally available traditional food. A local harvest sharing program increased the prevalence of snow goose consumption, significantly among girls, but did not result in statistically significant changes in nutrient and food group intakes following the pilot phase.

6.2 Background

Due in part to the lasting effects of their history, FN Canadians face poorer health and shorter lifespans as compared to non-Aboriginal people (Gionet & Roshanafshar, 2013). Prior to colonial contact in the 17th century, many FN people were either nomadic or semi-nomadic and relied on hunting, trapping, fishing, foraging, gathering and other land-based food procurement methods to feed themselves and their families (Kuhnlein et al., 2004; Willows, 2005; Haman et al., 2010; AANDC, 2013). By the 19th century, misguided attempts by British settlers to 'civilize' FN people meant that much of the population was negatively impacted by assimilation policies and many children were required to attend residential schools that deprived them of their culture (AANDC, 2013; Kaspar, 2014). Many FN Canadians were involuntarily pushed away from their traditional lifestyles, including the diets and food procurement methods to which they were accustomed (AANDC, 2013; Kaspar, 2014).

The relatively rapid transition experienced by Canadian FN people, typified by the adoption of more Western lifestyles, has contributed to a decline in diet quality and physical activity and a simultaneous rise in sedentary behaviours (Kuhnlein et al., 2004; Young & Katzmarzyk, 2007; Haman et al., 2010). The disproportionately high rates of overweight and obesity within this population (Tremblay et al., 2005; Public Health Agency of Canada [PHAC] & Canadian Institutes for Health Information [CIHI], 2011; FNIGC, 2012; Gionet & Roshanafshar, 2013) can be attributed, in part, to this transition along with myriad other contributing factors (Haman et al., 2010). Strategies aimed at lessening the continued rise in the prevalence of overweight and obesity are urgently warranted for this population, especially given the fact that FN people are at a two-to-three fold risk for developing metabolic consequences of carrying excess weight, such as type 2 diabetes, compared to the general population (PHAC, 2011).

Canada's Aboriginal population is young; thus, it has been suggested that interventions promoting healthy weights for this population be aimed at children and youth (Willows, Hanley, & Delormier, 2012; Healthy Kids Panel, 2013), and the rationale for this is clear. An overwhelming 43% of on-reserve FN youth aged 12-17 years are overweight or obese (using self-reported height and weight data) (FNIGC, 2012), a figure far in excess of the 26% prevalence rate observed in their peers in the general population (using measured height and weight data) (Shields, 2006). In some communities, prevalence rates of overweight and obesity for youth have been reported at 70% or greater (Gates, Hanning, Gates, Stephen, Fehst, & Tsuji, 2015; Eskicioglu, Halas, Sénéchal, Wood, McKay, & Villeneuve et al., 2014). Overweight and obese FN youth are at risk for developing type 2 diabetes at younger ages than those in the general population (PHAC, 2011) and, like all youth, are more likely to grow up to be overweight and obese adults compared to their normal-weight peers (Singh et al., 2008; Herman et al., 2009).

The forces that come together to result in overweight and obesity in youth are so many that they cannot be easily enumerated nor understood (Lau, Douketis, Morrison, Hramiak, Sharma, & Ur, 2007; Finegood, Merth, & Rutter, 2010). For FN youth, the problem is increasingly complex, being impacted at all levels by historical and cultural influences that are specific to their population group (Willows, Hanley, & Delormier, 2012). One factor that is beginning to be understood with greater depth and is a known contributor to energy balance is dietary intake; it is also potentially amenable to change via community-based healthy eating programming (Lau et al., 2007).

With a transition to more Western lifestyles, diet quality has diminished for many FN people (Kuhnlein et al., 2004). Specifically, traditional foods are being used with lesser frequency, typically replaced by store-bought alternatives of poorer nutritional value (Kuhnlein et al., 2004; Willows, 2005; Haman et al., 2010; Egeland et al., 2011). Currently available research on the nutritional benefits of traditional food consumption for Aboriginal youth has consistently linked diets containing these foods with increased intakes of important nutrients (e.g., protein, omega-3 fatty acids, iron, zinc, copper, magnesium, selenium, phosphorus, riboflavin, niacin, and vitamins A, C, D, E, B_6 and B_{12}), along with lower intakes of sodium (Berti et al., 1999; Kuhnlein et al., 2004; Nakano et al., 2005a; Willows, 2005; Kuhnlein & Receveur, 2007; Johnson-Down & Egeland, 2010; Egeland et al., 2011; Gagné, Blanchet, Lauzière, Vaissière, Vézina, & Ayotte et al., 2012). Besides their nutritional value, these foods are vital to holistic health for FN people (Willows, 2005; Power, 2008; Haman et al., 2010).

Despite the known nutritional advantages of diets based on traditional foods, the use of these foods by Aboriginal people has declined; youth tend to have the lowest intakes as compared to older generations (i.e., parents and Elders) (Kuhnlein et al., 2004; Willows, 2005). Store-bought foods are becoming an increasingly important component of the diets of FN youth, however, the choices made available to them and those that they therefore often consume are generally of poor nutritional quality (Kuhnlein et al., 2004; Willows, 2005; Haman et al., 2010; Egeland et al., 2011; Gates, Skinner, & Gates, 2015). A number of community- and school-based initiatives have, accordingly, focused on improving the availability and consumption of high-quality store-bought alternatives among this vulnerable population with varying levels of short-term success (Saksvig et al., 2005; Gates et al., 2012c, 2013b; Skinner et al., 2012a). An alternative or complementary approach would be to improve youth's access to traditional foods.

6.3 Impetus for this Research

The University of Waterloo (UW) research team, led by Drs. Rhona Hanning and Len Tsuji (now at the University of Toronto Scarborough), has been collaborating with the northern, remote, isolated FN communities of the western coast of James and Hudson Bays for >10 years to evaluate the food and physical activity behaviours of youth. These data have been used to plan health promoting initiatives at the school and community level. Specifically, baseline data were used to inform initiatives to supplement previously existing school health programs in two separate communities. In one community (Community A), a well established school breakfast and snack program (Skinner et al., 2012a) was enhanced with a nutrition curriculum targeting exposure to healthy foods and vegetable and fruit, and milk and alternatives knowledge (Gates et al., 2011, 2013a). A school greenhouse and gardening project was also started (Skinner, Hanning, Metatawabin, & Tsuji, 2014). In another community (Community B), a pre-existing breakfast program was supplemented with milk and alternatives (e.g., milk, yogurt, cheese) after baseline data identified inadequate calcium and vitamin D intakes as an issue of concern amongst schoolchildren (Gates et al., 2013b). Both initiatives were marginally successful over the short term (Gates et al., 2011, 2013a, 2013b).

The school curriculum resulted in increased vegetable and fruit, and milk and alternatives knowledge, greater intentions to consume milk and alternatives, and increased exposure to a wide variety of healthy foods that youth had not yet had the opportunity to try (Gates et al., 2011, 2013a). Dietary improvements, however, were inhibited by community-level barriers to the procurement of healthy foods (Gates et al., 2011, 2013a). Although increases in vitamin D and milk and alternatives intakes were observed as a result of the school food provision program in Community B, the majority of youth continued to have intakes that fell below currently recommended optimal levels (Gates et al., 2013a).

The two aforementioned programs focused on improving the quality of store-bought foods consumed by youth (Gates et al., 2011, 2013a, 2013b). Although some positive results were observed, the programs were clearly insufficient, alone, to bring the dietary intakes of important food groups and nutrients to adequate levels (Gates et al., 2011, 2013a, 2013b). With this in mind, and at the request of the participating communities, the importance of the inclusion of traditional foods in ongoing initiatives to support the health of youth was brought to the forefront. Previous research by *Hlimi et al*. (2012) with grades 6-12 FN youth from communities on the western coast of James and Hudson Bays revealed that 34% of youth would increase their game meat consumption if it were more available in their homes and 33% would increase their consumption if their parents ate it more often. Building from these results, a traditional harvest sharing program was proposed for Spring 2011 in both communities with the specific goal of enhancing the harvest and sharing of lesser snow geese (*Chen caerulescens caerulescens*).

6.4 Objectives and Hypotheses

6.4.1 Objectives

For grades 6-8 FN youth from two remote, isolated communities on the western coast of James Bay, Ontario, the objectives of this study were as follows:

A. To investigate the prevalence and frequency of lesser snow goose intake.

B. To investigate the contribution of the consumption of this food to each of: the intake of common store-bought foods, food groups and nutrients.

C. To investigate the association between lesser snow goose intake and BMI.

D. To investigate the impact of a harvest sharing program on the prevalence and frequency of lesser snow goose consumption and food group and nutrient intake following the Spring 2011 harvest.

6.4.2 Hypotheses

The hypotheses, decided *a priori* for each of the objectives, are shown in **Table 6.1**. The hypothesis for each objective is elaborated upon in more detail following the table.

Table 6.1. Hypotheses for study four

Objective	Hypothesis
A	The majority (85% or more) of youth will consume lesser snow goose, and boys and girls will consume snow goose with equal frequency.
B	Youth who consumed snow goose on the day recalled will have significantly higher intakes of protein, iron, zinc, riboflavin, niacin, and vitamins A, C, D, B_6 and B_{12} and lower intakes of sodium. Youth who report a greater frequency of snow goose consumption will, similarly, have superior nutrient intakes as compared to those who consume it less frequently, and will consume less nutrient-poor store-bought alternatives
C	No strong hypothesis based on currently available literature.
D	The harvest sharing program will result in a significant increase in the prevalence and frequency of lesser snow goose consumption among participating youth. Significantly improved intakes of micronutrients will therefore result.

Objective A. The majority of participating youth (85% or more) will consume lesser snow goose, and boys and girls will consume this food with similar frequency. Previous research by *Hlimi et al.* (2012) in the same region found that nearly all youth consumed game meats (84-100% depending on the community) and that there was no significant difference in the frequency or prevalence of game consumption between boys and girls. It is not expected that the findings for the focal communities will be substantially different.

Objective B. Those youth who consumed snow goose on the day recalled will have significantly higher intakes of protein, iron, zinc, riboflavin, niacin, and vitamins A, C, D, B_6 and B_{12} and lower intakes of sodium as compared to those who did not. Those who reported a greater frequency of snow goose consumption will have similarly improved nutrient intakes as compared to those who consume it less frequently, and will consume less nutrient-poor store-bought alternatives. Such would be expected based on the current body of knowledge (Berti et al., 1999; Kuhnlein et al., 2004; Nakano et al., 2005a; Willows, 2005; Kuhnlein & Receveur, 2007; Johnson-Down & Egeland, 2010; Egeland et al., 2011; Gagné et al., 2012), however, it is acknowledged that the impact of traditional food consumption (and snow goose consumption specifically) has not often been investigated in populations of young FN people living in remote, isolated reserve communities. For this reason, predictions regarding the role of snow goose consumption in overall diet and nutrient intake are difficult to make.

Objective C. Body mass index is affected by multiple levels of influence, and traditional food intake is only one potential factor, which in itself may be mediated by multiple contributing forces. For this reason, it is difficult to predict whether or not a relationship between Spring snow goose intake prevalence or frequency and BMI will be observed. Although traditional food intake has been associated with higher quality diets (Berti et al., 1999; Kuhnlein et al., 2004; Nakano et al., 2005a; Willows, 2005; Kuhnlein & Receveur, 2007; Johnson-Down & Egeland, 2010; Egeland et al., 2011; Gagné et al., 2012) and traditional food procurement itself is labour intensive (Young & Katzmarzyk, 2007; Pal, Haman, & Robidoux, 2013), only limited reports have investigated the association between BMI and traditional food consumption, and even less so in youth (Khalil, Johnson-Down, & Egeland, 2010; Gaudin et al., 2014). The results of these studies have been mixed, and the dearth of current evidence precludes any strong predictions at this time.

Objective D. The harvest sharing program will result in a significant increase in the prevalence and frequency of lesser snow goose consumption among participating youth. Because the program will help to overcome some of the common barriers to traditional food consumption (i.e., economic costs of equipment and travel), it is reasonable to expect such a change. Furthermore, previous research within the same region found that a large proportion of youth (34%) would eat more game meat if it were more available in their home (Hlimi et al., 2012). Given the small sample size, these changes may not reach statistical significance. With an increase in the frequency of snow goose intake, it is expected that the harvest sharing program will result in greater intakes of the nutrients that have previously been associated with traditional food consumption (i.e., protein, omega-3 fatty acids, iron, zinc, copper, magnesium, selenium, phosphorus, riboflavin, niacin, and vitamins A, C, D, E, B_6 and B_{12}) and lower intakes of sodium (Berti et al., 1999; Kuhnlein et al., 2004; Nakano et al., 2005a; Willows, 2005; Kuhnlein & Receveur, 2007; Johnson-Down & Egeland, 2010; Egeland et al., 2011; Gagné et al., 2012).

6.5 Methods

6.5.1 Community-based Research Approach

A community-based approach guided this study, such that the values, needs and wishes of the participating communities were respected throughout the research process (Cochran et al., 2008). More than 10 years ago, the UW research team began partnering with the participating FN Education Authorities (equivalent to municipal school boards) and since that time a relationship of mutual trust has been established. Through the collection of youth food behaviour and physical activity data and following an assessment of the existing barriers and supports to healthy living in the communities (Skinner, Hanning, & Tsuji, 2006), school health promotion activities have been tested and continued by the communities, with the support of UW researchers (Gates et al., 2011, 2012c, 2013a, 2013b, 2014a, 2015; Skinner et al., 2014; **Study Five** herein).

Consultation with relevant stakeholders (i.e., FN Health Services, Education Authorities) and experienced local hunters was a first step to program planning. Through communication with key stakeholders regarding what types of health promoting initiatives would be useful and relevant in their communities, the original concept for the program was developed. Throughout, all aspects of the project were carried out collaboratively (e.g., original concept, data collection, interpretation and dissemination) and ultimately, the direction that the program took was based on the needs expressed by the focal communities. Beyond its academic value, the findings of this study were expected to be of benefit to community members by informing decision-making, program development and policies.

6.5.2 Participants and Setting

The two focal communities are located in northern Ontario, on the western coast of James Bay. Both are isolated communities, being accessible only by airplane for the majority of the year and by winter road for two-to-three months of the year when the sustained temperature is cold enough. Transport between the communities can also be achieved by boat once the ice has melted. They are also geographically remote in that they are located at a great distance from any major city; ~400-500 km from Timmins, Ontario, the closest urban centre and ~950-1100 km from the metropolitan city of Toronto, Ontario.

In both of these communities as well as in neighbouring ones, traditional foods remain important for youth. In a sample of 194 grades 6-12 schoolchildren from five communities in the region, 90% answered 'yes' when asked if they consume game meat (Hlimi et al., 2012). Still, 55% reported being concerned about the possibility of environmental contamination of the traditional foods that they consumed (Hlimi et al., 2012). Because limited economic opportunities exist in these communities and many families rely on social assistance, affording healthy store-bought foods (which may be more than twice as costly as in southern locations) may be prohibitive for some people (Power & DC, 2005; Mulvale, 2008; Gionet & Roshanafshar, 2013). Although traditional foods remain important, the procurement and preparation of these foods may also be limited for economic reasons for many families (Chan et al., 2006; Power, 2008; Robidoux, Haman, & Sethna, 2009; Haman et al., 2010; Thompson et al., 2012; Ford et al., 2013; Skinner et al., 2013).

All school-attending youth in grades 6-8 in both communities were eligible to participate in the study. At this age, it was presumed that youth would have the ability to read, understand and respond to questions related to their dietary intake. As is typical for this type of data collection in the participating communities, passive parental consent procedures were used (**Appendix A**). At least one week prior to data collection, information letters were sent home with potential participants to inform parents/guardians of the nature of the study and the upcoming data collection period. In an effort to ensure the comprehensibility and readability of the letters by parents/guardians, the letters were written at a grade 7 reading level. Full contact information was supplied within the letters and parents/guardians were asked to contact (by phone, e-mail or in person) the primary investigators at UW or school-based collaborators in their home community should they have any concerns about their child's participation in the study, or should they wish that their child not participate. On the days of data collection, students were given a brief oral explanation of the study and asked to agree to their own participation. Students were allowed to decline participation or withdraw from the study at any time without consequence. Prior to data collection, the study received ethical clearance from the Office of Research Ethics at UW (#16534) and was reviewed by the local Health Services organizations.

6.5.3 Harvest Sharing Program

Following the initial planning period, the harvest sharing program was initiated in Spring (mid-May) 2011 in an attempt to enhance the harvesting and sharing of lesser snow geese, specifically supporting those families who could not afford to procure traditional foods themselves (Tsuji, 2015). Previous research has shown that the levels of environmental contaminants (i.e., organochlorines) in this species of bird harvested during the Spring season would pose no threat to humans (Tsuji, Martin, Martin, LeBlanc, & Dumas, 2007). Further, these birds were chosen because they are overabundant due to anthropogenic reasons, and are destroying the northern wetland ecosystem (Ankney, 1996). The program itself consisted of three main components: (1) transporting adult harvesters to Cape Henrietta Maria, Ontario, (2) supplying the harvesters with materials to construct temporary harvesting camps and other necessary supplies (e.g., steel shotshells, as to not lead contaminate the harvested birds, or those ingesting them), and (3) the sharing of the harvested geese amongst their community (Tsuji, 2015). Harvesters were invited to participate based on economic need (as identified by the Band, i.e., the locally elected FN governing body), and had to possess a valid Possession and Acquisition Licence (Gardner & Tsuji, 2014). Harvesters shared half of their harvest with their home community. In 2011, through the harvest sharing program, 3684 lesser snow geese (i.e., 22 104 lbs or 10 026 kg) were harvested and shared (Tsuji, 2015).

6.5.4 Dietary Intake

At baseline (April 7-12, 2011) and following the pilot phase of the program (June 2-7, 2011), the dietary intakes of grades 6-8 youth in both participating communities were measured via the Waterloo Web-Based Eating Behaviour Questionnaire (WEB-Q; Hanning, Royall, Toews, Blashill, Wegener, & Driezen, 2009), a self-administered 24-hour dietary recall and FFQ. The 24-hour recall portion of the WEB-Q mimics a multiple pass methodology (Blanton, Moshfegh, Baer, & Kretsch, 2006; Hanning et al., 2009). This methodology entails a systematic, five step process whereby dietitians (typically) will ask respondents to recount their previous day's intake in increasing levels of detail in order to minimize recall error (Blanton et al., 2006; Hanning et al., 2009). Within the WEB-Q, participants were prompted to choose from a list of >900 foods (including locally available foods, e.g., snow goose, caribou, moose meat, bannock, Labrador tea) by searching by name or by food category. These foods then appeared on a 'plate'; portion size estimation was supported by two-dimensional photographs, many of which were taken in the region and were representative of the types of foods that the participants typically consume. Prompts for commonly forgotten foods (e.g., condiments, toppings, beverages) occurred throughout the questionnaire.

The 24-hour recall portion of the WEB-Q is valid relative to recalls completed by a dietitian (Pearson's correlation coefficients in excess of 0.5 for energy and macronutrients) and has also been validated in a small sample of youth (n=25) residing in one of the focal communities (Hanning et al., 2009). The food frequency portion asked youth to recall how commonly they consumed a variety of foods and provide responses via radio buttons. The frequency questions used at baseline and corresponding response options are shown in **Table 6.2.**

Table 6.2. Frequency questions included on the questionnaire with response options

Foods	**Response options**
How often to you eat/drink…	
Milk	At least twice a day
Salty snacks	Once a day
French fries or other fried potatoes	5-6 times a week
Cola-type pop	2-4 times a week
Non-cola type pop	2-4 times a month
Pizza	Rarely or never
Candy or chocolate bars	
Spring snow goose (wavie/wavey)	
Do you eat…	
Spring snow goose (wavie/wavey)	Yes
	No

All students present at school on the day of the data collection completed the survey unless they were not permitted to do so by their parents/guardian. For consistency and because dietary intake can vary by day of the week (e.g., weekday as compared to a weekend day) (Hart, Raynor, Osterholt, Jelalian, & Wing, 2011), questionnaires were only completed on school days from Tuesday through to Friday, to collect data on normal weekday food consumption patterns only.

Each student was provided with a unique, computer-generated login name and password to enter the questionnaire such that they would not be identifiable. Taking 30-45 minutes from start to finish, the questionnaires were completed on school computers in groups of 10 to 30 at a time with the supervision of UW research assistants and at least one local teacher or teaching assistant. Students were provided with reading and comprehension assistance when necessary, but an attempt was made to not influence responses. In order to maximize response rates, students who were absent on the original dates of data collection were accommodated on alternate days, when possible.

6.5.5 Demographic and Anthropometric Measures

Demographic and anthropometric information about the participants were collected via the WEB-Q. Following the opening page and prior to starting the 24-hour recall, participants were prompted to report their age, sex, school grade, height and body mass (i.e., weight). In order to improve the correctness of self-reported height and weight data, youth were provided with the necessary tools to measure these anthropometric variables if desired. Height was measured by a UW or community-based research assistant following WHO protocols using a measuring tape affixed to a vertical surface to the nearest 0.5 centimetre (WHO, 2008). In order to ensure confidentiality, participants measured their own weight in an adjacent room or quiet hallway using a standard analog scale to the closest 0.5 kilogram. Students were provided with guidance for the measurements if necessary and were asked to be as honest as possible. Shoes and heavy outerwear or sweaters were removed prior to the measurements, while socks were kept on. Immediately following the measurements, participants entered their data into the appropriate section of the WEB-Q before moving on to the 24-hour recall and food frequency portions.

6.6 Data Analysis and Interpretation

All dietary data were analyzed using SPSS (*v*. 21, IBM Corporation, Armonk, New York) with a level of statistical significance decided *a priori* at $p \leq 0.05$. The aid of statistical consultant Dr. Ian Martin (University of Toronto Scarborough) was sought to ensure the appropriateness of the statistical tests used. For all relevant analyses, tests of normality and equality of variances were performed; where variances were not equal, logarithmic transformations were used to achieve equality.

6.6.1 Demographics and Anthropometry

Data on age and sex were presented descriptively using means±SDs or frequencies, as appropriate. For each participant, self-reported height and weight data were used to calculate BMI to the nearest 0.1 kg/m^2. Participants were classified into BMI categories based on the WHO age and sex-specific growth curves (severe thinness (<-3 SD), thinness (<-2 SD), healthy, overweight (>+1 SD) or obese (>+2 SD)), the gold standard for monitoring the growth of youth in Canada (DC et al., 2010).

6.6.2 Twenty-four Hour Recall Data

The foods and beverages reported in the 24-hour recalls were categorized into food groups as per the 2007 CFG (Health Canada, 2007a). Subsequently, these were translated into daily energy, macro- and micronutrient intakes based on the 2010 Canadian Nutrient File (Health Canada, 2010). Students who reported a reason to have strayed from their usual intake (e.g., illness, special occasion) on the day recorded or those who reported unrealistic energy intakes (<500 kcal or >6000 kcal, which may occur if participants misjudge portion sizes, forget many foods or report an unusual day) were excluded from the dietary analyses (Berkey, Rockett, Field, Gillman, Frazier, & Camargo et al., 2000; Ludwig, Peterson, & Gortmaker, 2001).

The dietary intakes (macronutrients, micronutrients and food groups) of participants were reported descriptively (means±SDs). Dietary adequacy with regard to food group consumption was assessed by comparing mean intakes to the 2007 CFG minimum recommended intakes for boys and girls 9-13 years old and teens and adults (14-18 years) (Health Canada, 2007a) (**Table 6.3**).

Table 6.3. Canada's Food Guide recommendations used for comparison (Health Canada, 2007a)

Food Group	Dietary Recommendation			
	9-13 years		14-18 years	
	Boys	Girls	Boys	Girls
Vegetables and fruit (servings)	5	5	7	7
Milk and alternatives (servings)	2	2	3	3
Meat and alternatives (servings)	1	1	3	2
Grain products (servings)	4	4	7	6

Likewise, adequacy with regard to micronutrient intakes was assessed using the Dietary Reference Intake (DRI) recommendations for boys and girls aged 9-13 and 14-18 years (Health Canada, 2013) (**Table 6.4**). These reference values are commonly used to assess the macro- and micronutrient adequacy of the diets of healthy people (Health Canada, 2013). The proportion of participants with intakes above and below the Estimated Average Requirement (EAR), the intake of a nutrient that will meet the requirements of 50% of a healthy population, was assessed. The

EAR was chosen rather than the Recommended Dietary Allowance (RDA) (the intake of a nutrient deemed adequate for 98% of a healthy population) (Health Canada, 2013) because the level of the RDA would be in excess of the needs of nearly half of the participants and thus would provide for a less realistic comparison. For those nutrients where an EAR was not available (which is the case when there is insufficient scientific evidence on which to base the establishment of an RDA) the Adequate Intake (AI) was used as a means for comparison (Health Canada, 2013). Set at the mean intake of a healthy population (Health Canada, 2013), the AI cannot be used as a measurement of adequacy, but for the purposes of this study it provided a standard against which the intakes of the participants could be compared. For the macronutrients, the Acceptable Macronutrient Distribution Ranges (AMDRs) (the proportion of energy intake recommended from each macronutrient) were used as a measure of comparison (Health Canada, 2013).

6.6.3 Food Frequency Data

Results of the food frequency questions at baseline were presented descriptively (i.e., frequencies). In order to provide for more meaningful and simplified results and to maintain adequate cell sizes for the analyses the response categories for the question 'how often do you eat…?' were reduced as shown in **Table 6.5**. For the question 'Do you eat Spring snow goose?', the proportions of participants answering 'yes' or 'no' at each time point were presented. Differences in the frequencies of consumption of the various foods by sex and BMI category at baseline were assessed using Pearson Chi-squares.

Table 6.4. Dietary Reference Intake values for selected nutrients used for comparison (Health Canada, 2013)[a]

Nutrient	9-13 years				14-18 years			
	RDA		EAR		RDA		EAR	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Vitamin A (µg RAE)	600	600	445	420	900	700	630	485
Vitamin D (µg)	15	15	10	10	15	15	10	10
Thiamine (mg)	0.9	0.9	0.7	0.7	1.2	1.0	1.0	0.9
Riboflavin (mg)	0.9	0.9	0.8	0.8	1.3	1.0	1.1	0.9
Niacin (mg)	12	12	9	9	16	14	12	11
Vitamin B_6 (mg)	1.0	1.0	0.8	0.8	1.3	1.2	1.1	1.0
Vitamin B_{12} (µg)	1.8	1.8	1.5	1.5	2.4	2.4	2.0	2.0
Folate (µg DFE)	300	300	250	250	400	400	330	330
Vitamin C (mg)	45	45	39	39	75	65	63	56
Calcium (mg)	1300	1300	1100	1100	1300	1300	1100	1100
Iron (mg)	8.0	8.0	5.9	5.7	11.0	15.0	7.7	7.9
Potassium (mg)[b]	4500	4500	-	-	4700	4700	-	-
Sodium (mg)[b, c]	1500	1500	-	-	1500	1500	-	-
Zing (mg)	8.0	8.0	7.0	7.0	11.0	9.0	8.5	7.3
Carbohydrate (g)[d]	130	130	100	100	130	130	100	100
Protein (g)[d]	34	34	0.76	0.76	52	46	0.73	0.71
Fat (g)[d]	-	-	-	-	-	-	-	-
Fibre (g)[b]	31	26	-	-	38	26	-	-

[a]AI: Adequate Intake; DFE: Dietary Folate Equivalents; EAR: Estimated Average Requirement; RAE: Retinoic Acid Equivalents; RDA: Recommended Dietary Allowance; UL: Tolerable Upper Intake Level

[b]Values presented for fibre, potassium, sodium are Adequate Intakes (AIs), and not Recommended Dietary Allowances. Although not a measure of adequacy, the AI was used as a means of comparison for the purposes of this study.

[c]For sodium, the Tolerable Upper Intake Level (UL) of 2200 mg/day and 2300 mg/day for youth aged 9-13 and 14-18 years, respectively, was used for comparison.

[d]Acceptable Macronutrient Distribution Ranges (AMDRs) for carbohydrate, protein and fat are 45-65%, 10-30% and 25-35% of total energy, respectively, for all age and sex subgroups.

Table 6.5. Recoded response options for the questions, 'how often do you eat…?'

How often do you eat: spring snow goose (wavie/wavey) and store-bought foods	
Original Response Options	**Recoded Response Options**
At least twice a day Once a day	At least daily
5-6 times a week 2-4 times a week	At least twice weekly
2-4 times a month Rarely or never	Monthly or less

6.6.4 Snow Goose Consumption Frequency and Association with Diet and Body Mass Index

To inform the need for the harvest sharing program, baseline intakes of snow geese and the contribution of snow goose consumption to overall dietary intake (i.e., food groups and nutrients) were investigated. Frequencies of snow goose consumption were presented descriptively and differences by sex and BMI were assessed using Pearson Chi-square tests. Using the baseline data, the potential association between the frequency of snow goose consumption and the intake of food groups, macro- and micronutrients by sex were assessed using MANOVA. Subsequently, the potential associations between the frequency of snow goose consumption on the likelihood of meeting recommended dietary intake levels of food groups and nutrients (as defined by CFG and the DRIs) were assessed using Pearson Chi-square tests. The possible associations between the frequency of intake of common store-bought foods and the frequency of snow goose consumption were assessed via Pearson Chi-square tests.

To further elucidate the role of Spring snow goose consumption on overall dietary intake, the group at baseline was dichotomized as those who consumed snow goose on the day recalled versus those who did not. Independent samples t-tests were used to investigate the potential differences in food group, macro- and micronutrient intakes by group. To investigate the potential difference in the likelihood of meeting recommended levels of dietary intake, Pearson Chi-square tests were used.

6.6.5 Comparison of Snow Goose Consumption and Dietary Intakes from Baseline to the Post-pilot Phase

The possible changes in snow goose consumption prevalence and frequency following the pilot phase of the program were tested using Pearson Chi-square tests. Accordingly, potential changes in the intakes of food groups and nutrients from baseline to the post-pilot phase were tested via independent samples t-tests. Potential changes in the proportions of participants meeting minimum recommended levels of dietary intake were assessed via Pearson Chi-square tests.

6.7 Results

The demographic characteristics of the participating youth at baseline and following the pilot phase of the harvest sharing program are shown in **Table 6.6**. Eighty-four FN youth from the two communities participated in the baseline dietary and anthropometric measures (49.4% male, 12.38±1.07 years old, 30.6% overweight, 36.1% obese). Seventy-three youth participated in the post-pilot follow-up measures (43.8% male, 12.34±0.99 years old, 27.1% overweight, 35.7% obese). At neither time point did the boys differ significantly from the girls by age, nor by prevalence of overweight or obesity. As expected, there were no significant differences in the demographic characteristics of the participants over time.

Table 6.6. Characteristics of the participants at baseline and following the pilot phase of the harvest sharing program

Characteristic	Baseline (May 2011)			Post-pilot (June 2011)		
	Total	Boys	Girls	Total	Boys	Girls
N[a]	84	40	41	73	32	41
Mean age ±SD (years)	12.38±1.07	12.45±1.20	12.32±0.96	12.34±0.99	12.44±1.08	12.27±0.92
% overweight[b]	30.6	25.0	29.3	27.1	25.0	26.8
% obese[b]	36.1	32.5	31.7	35.7	34.4	34.1

[a]At baseline, three participants did not report their sex. One youth did not report their snow goose intake. [b]World Health Organization cut points were used.

6.7.1 Snow Goose Consumption, Dietary Intakes and Body Mass Index

Snow goose consumption and the dietary intakes of participating youth were assessed at baseline in order to ascertain the nutritional significance of this food during the Spring season (**Table 6.7**). At this time point, less than half of participants (47.6%) answered 'yes' to the question 'do you eat spring snow goose?'. Girls answered 'yes' with significantly lesser frequency than boys (33.3% vs. 64.1%, p=0.006) (**Figure 6.1**). When asked to report how frequently they consume snow goose, 38.7% reported eating the food at least on a weekly basis, while the remainder consumed it either a few times per month or less (**Figure 6.2**). Although boys appeared to more often report consuming snow goose at least weekly as compared to girls (48.8% vs. 27.3%), this difference did not reach statistical significance (p=0.077). Neither snow goose consumption ('yes' or 'no') (p=0.581) nor snow goose consumption frequency (p=0.808) were significantly associated with BMI category.

The majority of participants had intakes of vegetables and fruit (83.3%), milk and alternatives (55.4%), fibre (100%), vitamin A (78.3%), vitamin D (97.6%), folate (53.0%), calcium (81.9%) and potassium (96.4%) that fell below the reference standards used (i.e., CFG, EAR or AI) at this time point (**Table 6.7**). Furthermore, only 38.6% of youth had intakes of fat that fell within the AMDR (44.6% fell above and 16.9% fell below) and 55.4% had intakes of sodium that exceeded the Tolerable Upper Intake Level (UL). The diets of boys and girls were analogous, except that girls consumed significantly more servings of vegetables and fruit (3.8 vs. 2.1 servings/day, p=0.005) and accordingly more vitamin C (141.1 mg vs. 83.1 mg, p=0.013).

The food group, macro- and micronutrient intakes of the participating youth were significantly associated with frequency of snow goose consumption (**Tables 6.8 and 6.9**). Specifically, snow goose consumption frequency was significantly associated with intakes of meat and alternatives (p=0.019), protein (p=0.004), vitamin B_{12} (p=0.004), iron (p=0.011) and zinc (p=0.006), where nutrient intakes were highest among those who consumed snow goose moderately (2-6 times per week) (**Table 6.7**). Meat and alternatives intakes were highest amongst those who consumed snow goose at least daily. There was an interaction between sex and the frequency of snow goose intake for each of protein (p=0.018), thiamine (p=0.008), riboflavin (p=0.042) and iron (p=0.030). The intake of these nutrients increased along with increasing snow goose consumption frequency in girls, whereas in boys the highest intakes of these nutrients were observed with moderate (2-6 times per week) snow goose consumption levels. Snow goose consumption frequency was also associated with meeting the reference standards for vitamin C (p=0.033) (**Table 6.8**). When stratified by sex, snow goose consumption frequency was not associated with meeting any of the dietary standards for boys, whereas girls were more likely to meet the recommendations for meat and alternatives (p=0.048) and potassium (p=0.005) if they consumed snow goose at least daily (data not shown). From the FFQ, the highest levels of snow goose consumption frequency (i.e., at least daily) were also associated with the highest levels of intake of cola (p=0.026), non-cola soft drinks (p=0.018) and pizza (p=0.040) (**Table 6.9**). This association did not persist when girls and boys were investigated separately.

There were apparent differences in dietary intake among those youths who consumed snow goose on the day recalled as compared to those who did not. At baseline, nine youth (10.8%) consumed snow goose (78% male); these youth consumed significantly greater servings of meat and alternatives (2.5±1.1 vs. 1.4±1.6 servings, p=0.009), greater proportions of energy from protein (19.1±9.9 vs. 13.7±5.1%, p=0.009) and more iron (19.0±7.1 vs. 12.7±5.9 mg, p=0.004) compared to those who did not (**Table 6.10**). They were, however, no more likely to meet the recommended dietary standards (tested statistically, data not shown).

Table 6.7. Dietary intakes (24-hour) of participants at baseline by frequency of snow goose consumption[a]

Food group or nutrient[b]	How often do you eat spring snow goose?				p-value[c]
	Total (n=83)	Once or more per day (n=17)	2-6 times per week (n=16)	Monthly or less (n=50)	
Mean intake ±SD					
Canada's Food Guide Food Group Servings[b]					
Vegetables and fruit	3.0±2.7	3.0±3.4	3.5±2.8	2.7±2.4	0.434
Milk and alternatives	2.0±1.6	1.9±1.7	2.4±1.7	1.9±1.5	0.358
Meat and alternatives	1.5±1.3	2.2±1.7	1.8±1.3	1.1±1.0	**0.010**
Grain products	6.4±3.4	6.4±3.2	7.0±4.6	6.2±3.0	0.568
'Other' foods	5.5±3.3	6.3±2.9	6.1±3.3	5.0±3.3	0.217
Energy and Energy Yielding Nutrients					
Energy (kcal)	1864.4±871.4	2042.3±1079.8	2149.1±1051.9	1692.9±692.4	0.083
Carbohydrate (g)	248.3±127.4	264.6±144.2	278.2±164.5	231.4±107.5	0.271
Carbohydrate (% kcal)	53.2±10.1	51.8±8.3	50.8±9.0	54.6±10.9	0.472
Protein (g)	65.0±33.7	75.3±45.3	82.4±35.9	55.6±25.0	**0.007**
Protein (% kcal)	14.3±6.0	14.8±4.6	16.7±8.8	13.4±5.2	0.548
Fat (g)	69.6±37.4	77.9±46.9	80.1±40.6	62.2±30.8	0.098
Fat (% kcal)	33.2±8.8	34.2±7.8	33.0±9.1	32.8±9.2	0.857
Saturated fat (g)	26.0±15.0	27.8±17.1	29.7±16.7	23.7±13.2	0.226
Saturated fat (% kcal)	12.4±4.2	12.4±3.6	12.3±4.7	12.3±4.3	0.952
Fibre (g)	10.5±6.1	10.3±7.3	11.9±6.8	9.9±5.3	0.369
Micronutrients					
Vitamin A (µg RAE)	327.0±216.8	359.2±217.4	331.2±179.8	319.5±229.6	0.832
Vitamin D (µg)	2.7±2.8	2.5±2.1	2.4±2.3	3.0±3.1	0.733
Thiamine (mg)	1.4±0.7	1.3±0.9	1.6±0.7	1.3±0.6	0.174
Riboflavin (mg)	1.7±0.8	1.8±0.9	2.0±0.9	1.6±0.8	0.139
Niacin (mg)	27.5±15.5	32.1±24.0	32.2±15.0	24.2±11.2	0.275
Vitamin B_6 (mg)	1.05±0.6	1.2±1.0	1.1±0.5	1.0±0.5	0.595
Vitamin B_{12} (µg)	3.8±2.7	4.0±2.4	5.7±4.0	3.2±2.0	**0.012**
Folate (µg DFE)	275.5±152.3	251.1±195.7	323.8±171.7	267.7±129.3	0.228
Vitamin C (mg)	113.2±106.1	117.8±129.1	165.6±123.9	94.7±87.5	**0.042**
Calcium (mg)	748.2±474.7	702.7±499.5	884.0±529.5	715.9±453.5	0.312
Iron (mg)	13.4±6.3	13.0±6.9	17.3±8.1	12.2±5.0	**0.011**
Potassium (mg)	1935.1±1025.2	2078.7±1281.8	2182.9±825.7	1784.3±979.1	0.263
Sodium (mg)	2768.1±1546.4	2943.8±1979.3	3336.8±1765.9	2488.9±1244.7	0.093
Zinc (mg)	8.7±4.4	9.3±4.8	11.2±5.5	7.6±3.5	**0.016**

[a]There was a sex by snow goose frequency interaction for protein (p=0.018), thiamine (p=0.008), riboflavin (p=0.042) and iron (p=0.030). Intakes of these nutrients increased with increasing snow goose consumption frequency for girls, whereas the highest intakes for these nutrients in boys were observed at the moderate (2-6 times per week) snow goose intake frequency level. At baseline, one youth did not report their snow goose intake.

[b]Canada's Food Guide data are presented in servings.

[c]As assessed via ANOVA. Bolded values represent statistically significant associations (p≤0.05).

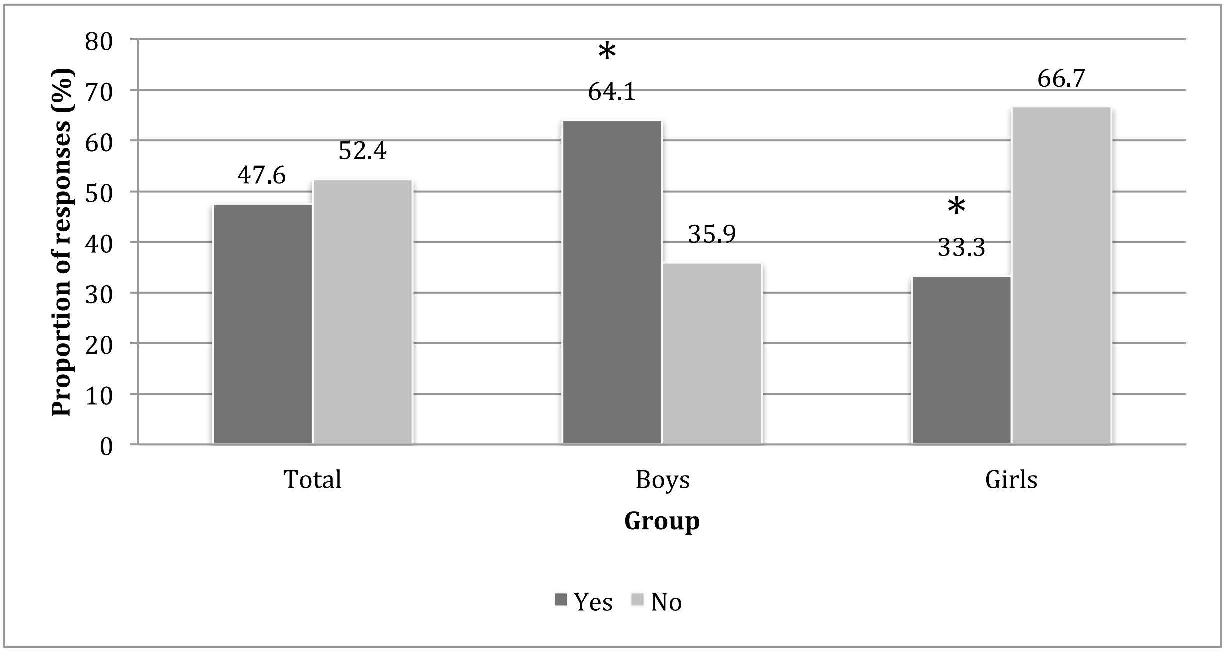

Figure 6.1. Self-reported prevalence of snow goose consumption among participants at baseline (n=83) *p=0.006

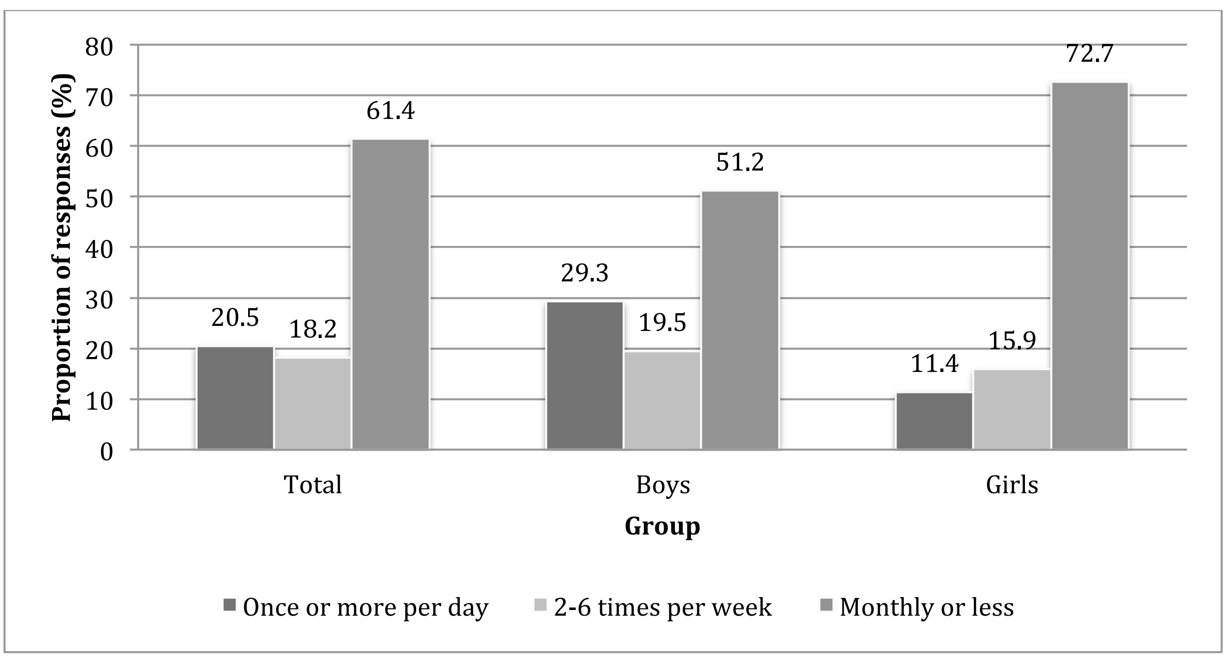

Figure 6.2. Self-reported frequency of snow goose consumption among participants at baseline (n=83)

Table 6.8. Proportions of participants who met the recommended dietary standards, by frequency of snow goose consumption

Food group or nutrient	Standard used[a]	How often do you eat spring snow goose?				p-value[b]
		Total (n=83)	Once or more per day (n=17)	2-6 times per week (n=16)	Monthly or less (n=50)	
Proportion of participants who met the standard[c]						
Canada's Food Guide Food Groups[d]						
Vegetables and fruit	≥CFG	16.9	11.8	25.0	16.0	0.578
Milk and alternatives	≥CFG	44.6	41.2	56.3	42.0	0.578
Meat and alternatives	≥CFG	57.8	76.5	62.5	50.0	0.148
Grain products	≥CFG	69.9	58.8	62.5	76.0	0.318
Energy and Energy Yielding Nutrients						
Carbohydrate (% kcal)	AMDR	72.3	76.5	81.3	68.0	0.440
Protein (% kcal)	AMDR	91.6	100.0	87.5	90.0	0.567
Fat (% kcal)	AMDR	38.6	41.2	18.8	44.0	0.298
Fibre (g)	≥AI	0.0	0.0	0.0	0.0	n/a[e]
Micronutrients						
Vitamin A (µg RAE)	≥EAR	21.7	11.8	25.0	24.0	0.536
Vitamin D (µg)	≥EAR	2.4	0.0	0.0	4.0	0.502
Thiamine (mg)	≥EAR	79.5	70.6	100.0	76.0	0.069
Riboflavin (mg)	≥EAR	89.2	88.2	100.0	86.0	0.290
Niacin (mg)	≥EAR	91.6	88.2	100.0	90.0	0.391
Vitamin B_6 (mg)	≥EAR	61.4	47.1	68.8	64.0	0.371
Vitamin B_{12} (µg)	≥EAR	83.1	88.2	100.0	76.0	0.068
Folate (µg DFE)	≥EAR	47.0	35.3	56.3	48.0	0.471
Vitamin C (mg)	≥EAR	68.7	52.9	**93.8**	66.0	**0.033**
Calcium (mg)	≥EAR	18.1	17.6	25.0	16.0	0.717
Iron (mg)	≥EAR	85.5	76.5	100.0	84.0	0.140
Potassium (mg)	≥AI	3.6	11.8	6.3	0.0	0.066
Sodium (mg)	≥UL	44.6	41.2	31.3	50.0	0.402
Zinc (mg)	≥EAR	56.6	52.9	68.8	54.0	0.551

[a]AMDR: Acceptable Macronutrient Distribution Range; AI: Adequate Intake; CFG: Canada's Food Guide; EAR: Estimated Average Requirement; UL: Upper Tolerable Intake Level

[b]As assessed via Pearson Chi-square tests. Bolded values represent statistically significant associations (p≤0.05).

[c]Bolded values represent statistically significant adjusted standardized residuals (>1.96 or <-1.96)

[d]Canada's Food Guide data are presented in servings.

[e]No statistics were computed because fibre intake was constant across categories of snow goose consumption.

Table 6.9. Frequency of consumption of common store-bought foods by participants at baseline, by snow goose consumption frequency

Food category	How often do you eat spring snow goose? Total (n=83)	Once or more per day (n=17)	2-6 times per week (n=16)	Monthly or less (n=50)	p-value[a]
	Proportion of participants reporting different levels of intake[b]				
Milk					0.826
Once or more per day	57.6	64.7	50.0	57.7	
2-6 times per week	21.2	17.6	31.3	19.2	
Monthly or less	21.2	17.6	18.8	23.1	
Salty snacks					0.106
Once or more per day	37.6	50.0	31.3	35.8	
2-6 times per week	44.7	37.5	62.5	41.5	
Monthly or less	17.6	12.5	6.3	22.6	
French fries/fried potatoes					0.107
Once or more per day	29.9	41.2	43.8	**22.2**	
2-6 times per week	33.3	29.4	43.8	31.5	
Monthly or less	36.8	29.4	**12.5**	**46.3**	
Cola					**0.026**
Once or more per day	42.5	**70.6**	31.3	37.0	
2-6 times per week	40.5	23.5	**62.5**	38.9	
Monthly or less	17.2	5.9	6.3	**24.1**	
Non-cola pop					**0.018**
Once or more per day	36.0	**58.8**	37.5	28.3	
2-6 times per week	41.9	**17.6**	62.5	43.4	
Monthly or less	22.1	23.5	**0.0**	28.3	
Pizza					**0.040**
Once or more per day	27.9	**50.0**	25.0	21.2	
2-6 times per week	29.1	16.7	**50.0**	26.9	
Monthly or less	43.0	33.3	25.0	**51.9**	
Candy/Chocolate bars					0.244
Once or more per day	27.3	33.3	31.3	24.1	
2-6 times per week	25.0	11.1	37.5	25.9	
Monthly or less	47.7	55.6	31.3	50.0	

[a]As assessed via Pearson Chi-square tests. Bolded values represent statistically significant associations ($p \leq 0.05$).

[b]Bolded values represent cells with statistically significant (>1.96 or <-1.96) adjusted standardized residuals.

Table 6.10. Nutrient intakes among those who consumed snow goose on the day recalled compared to those who did not

Food group or nutrient	Snow goose consumed on day recalled		p-value[a]
	Yes (n=9)	No (n=75)	
Mean intake ±SD			
Canada's Food Guide Food Groups[b]			
Vegetables and fruit	3.5±2.8	2.9±2.7	0.488
Milk and alternatives	1.6±1.1	2.1±1.6	0.364
Meat and alternatives	2.5±1.1	1.4±1.3	**0.009**
Grain products	5.0±1.6	6.6±3.5	0.175
'Other' foods	4.4±2.3	5.7±3.4	0.287
Energy and Energy Yielding Nutrients			
Energy (kcal)	1861.6±584.1	1864.7±584.1	0.992
Carbohydrate (g)	221.1±75.9	251.6±132.2	0.501
Carbohydrate (% kcal)	47.6±8.7	53.9±10.1	0.644
Protein (g)	83.2±29.1	62.7±33.7	0.085
Protein (% kcal)	19.1±9.9	13.7±5.1	**0.009**
Fat (g)	72.0±32.8	69.4±38.1	0.091
Fat (% kcal)	33.4±8.2	33.1±9.0	0.937
Saturated fat (g)	22.1±10.2	26.5±15.4	0.150
Saturated fat (% kcal)	10.4±3.1	12.6±4.3	0.141
Fibre (g)	8.8±3.3	10.7±6.3	0.172
Micronutrients			
Vitamin A (µg RAE)	273.7±150.6	333.4±223.3	0.138
Vitamin D (µg)	1.6±1.4	2.9±2.9	0.170
Thiamine (mg)	1.1±0.5	1.4±0.7	0.215
Riboflavin (mg)	1.7±0.7	1.7±0.8	0.471
Niacin (mg)	28.6±12.9	27.3±15.9	0.836
Vitamin B_6 (mg)	0.9±0.3	1.1±0.7	0.242
Vitamin B_{12} (µg)	4.4±4.8	3.8±2.4	0.091
Folate (µg DFE)	228.3±126.5	281.2±154.9	0.479
Vitamin C (mg)	150.6±127.7	108.7±103.3	0.266
Calcium (mg)	602.5±310.0	765.6±489.4	0.333
Iron (mg)	19.0±7.1	12.7±5.9	**0.004**
Potassium (mg)	1882.1±606.6	1941.4±1067.1	0.871
Sodium (mg)	2692.9±912.3	2777.1±1609.8	0.878
Zinc (mg)	10.2±5.8	8.5±4.2	0.279

[a]As assessed via independent samples t-tests. Bolded values represent statistically significant associations (p≤0.05).

[b]Canada's Food Guide data are presented in servings.

6.7.2 Assessment of Post-pilot Changes in Diet and Snow Goose Consumption

At the 1-month follow-up, 12 youths (16%) reported consuming snow goose on the day recalled (50% male). There was a trend toward a greater proportion of youths answering 'yes' when asked if they consume snow goose (62.7% vs. 47.6%), however, this did not reach statistical significance (p=0.065). Upon closer inspection, however, girls were significantly more likely to respond 'yes' following the pilot program (60.5% vs. 33.3%, p=0.015), while the frequency of this response for boys remained virtually unchanged (65.5% vs. 64.1%, p=0.904) (**Figure 6.3**). There appeared to be a trend toward a lesser proportion of youth consuming snow goose 'monthly or less often' following the pilot program. This, however, did not translate into significant differences between the frequencies of snow goose consumption reported at the post-pilot time point and those at baseline for the total sample (p=0.323), nor for boys (p=0.227) or for girls (p=0.742) (**Figure 6.4**). There were no significant changes in the mean intakes of food groups, macronutrients or micronutrients, nor in the proportion of youth reaching recommended levels of intake over the period of the study for either the entire sample, for boys or for girls (data not shown).

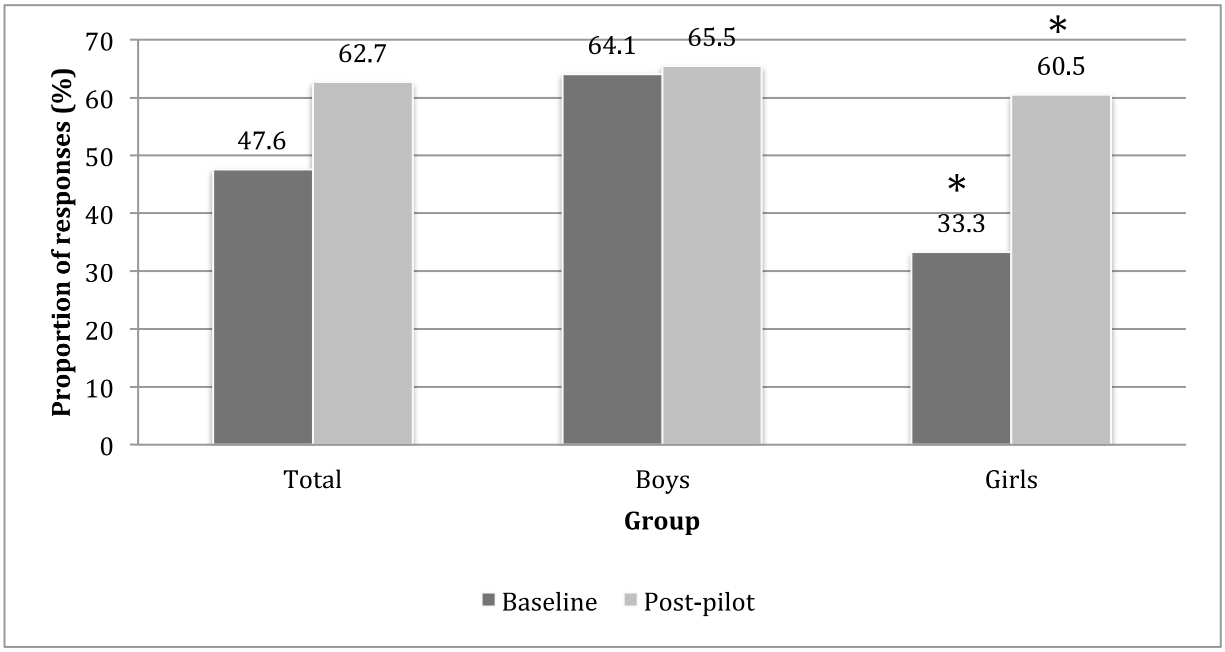

Figure 6.3. Proportions of participants answering 'yes' to the question 'do you eat spring snow goose' at baseline (n=83) as compared to following the pilot harvest sharing program (n=73); *p=0.015

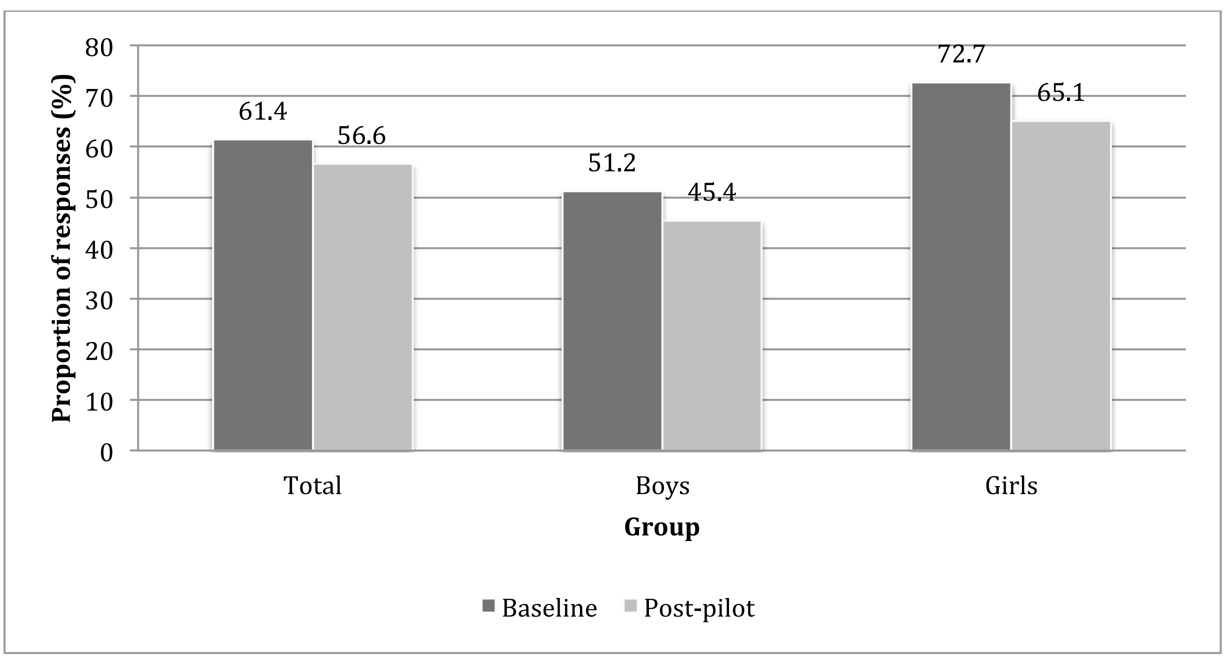

Figure 6.4. Proportions of youth who reported consuming snow goose 'monthly or less' at baseline (n=83) as compared to following the pilot harvest sharing program (n=73)

6.8 Discussion

Although the nutritional merits of traditional food consumption have been widely studied in Canada's north (e.g., Northwest Territories, Yukon Territory, Nunavut) and mainly in adult Aboriginal populations (Kuhnlein, Soueida, & Receveur, 1996; Berti et al., 1999; Kuhnlein et al., 2004; Nakano et al., 2005a, 2005b; Kuhnlein & Receveur, 2007; Johnson-Down & Egeland, 2010; Egeland et al., 2011; Gagné et al., 2012; Jamieson, Weiler, Kuhnlein, & Egeland, 2012) fewer studies have investigated the prevalence of traditional food consumption and the nutritional merits of these foods for FN youth (as opposed to Inuit or Métis) (Khalil, Johnson-Down, & Egeland, 2010). The current study adds to the dearth of data on the prevalence of traditional food intake for FN youth residing in reserve communities in northern Ontario, Canada, and supports the importance of these foods to the nutrient intakes of a population particularly prone to food insecurity (FNIGC, 2012), poor diet quality (Gates, Skinner, & Gates, 2015) and excess weight (FNIGC, 2012). Although exclusively limited to snow goose consumption, the current study begins to explain the nutritional importance of this common traditional food in the Spring season and the potential value of a program facilitating the harvesting and sharing of this food amongst community members.

6.8.1 Prevalence of Snow Goose Consumption and Nutritional Merits

A number of studies have reported that, in Aboriginal communities where traditional foods are consumed, children tend to consume them in lesser amounts and with lesser frequency as compared to adults or their Elders (Kuhnlein, Soueida, & Receveur, 1996; Kuhnlein et al., 2004; Kuhnlein & Receveur, 2007). Nevertheless, research in an on-reserve Cree population in Canada found that fourth and fifth grade schoolchildren associated cultural foods with good health and described eating them in everyday life (Pigford, Willows, Holt, Newton, & Ball, 2012). Studies of other distinct on-reserve Canadian Aboriginal populations have also indicated that although these foods may not contribute to large proportions of dietary energy intake, they continue to be important for youth (Berti et al., 1999; Nakano et al., 2005a; Kuhnlein & Receveur, 2007; Johnson-Down & Egeland, 2010; Khalil, Johnson-Down, & Egeland, 2010; Gagné et al., 2012; Langlois, Findlay, & Kohen, 2013). Nevertheless, one study in Alexander FN, a remote reserve community in Alberta, found that when youths were asked to identify of the types of foods that they ate most often and liked by taking pictures of them, no pictures of traditional foods were captured (Genuis et al., 2014). Although the reasoning behind these findings could not be determined with certainty (Genuis et al., 2014), this dichotomy between the known cultural importance of these foods and the relative scarcity of their consumption underscores the need for programming to make these nutritious and culturally valuable foods more available and desirable.

Previous research in the communities on the western James Bay and Hudson Bay coasts found that all or nearly all youths continued to consume game meat, depending on the community (Hlimi et al., 2012). Of particular interest in the current investigation was the intake of Spring snow goose. Less than half of youth reported consuming this food, a figure that could stand to be improved given the relative abundance of this migratory species during the Fall season in the areas surrounding the communities of interest (Tsuji & Nieboer, 1999). Nevertheless, this figure can be seen as highly encouraging given that only 8% of off-reserve FN youth who participated in the 2006 ACS reported consuming game birds at least monthly (Langlois, Findlay, & Kohen, 2013). Although not investigated as part of the present study, previous research by *Skinner et al.*

(2013) in one of the participating communities found that many barriers to consuming traditional foods existed, including the high cost of hunting (e.g., fuel for travel, cost of equipment like guns and ammunition), changes in the environment that affect people's ability to hunt in specific areas at specific times, and the uncertainty of how successful a hunting trip would be considering the associated costs. Similar barriers have been commonly reported in other studies examining the traditional food availability and food security of Aboriginal people (Chan et al., 2006; Robidoux, Haman, & Sethna, 2009; Power, 2008; Haman et al., 2010; Thompson et al, 2012; Ford et al., 2013; Tam et al., 2013).

An interesting finding of this study was the significant difference in the prevalence of snow goose consumption between boys and girls. This novel finding has not been previously reported for other young on-reserve FN populations and cannot necessarily be easily explained without qualitative data to substantiate it. *Hlimi et al*. (2012)'s research found that boys and girls consumed game with similar frequency, implying that boys did not necessarily have a greater preference for these cultural foods as compared to girls. In a study of Baffin Inuit children and adolescents, traditional food intake remained constant before dropping off in the 16-18 year-old age category for girls (Berti et al., 1999). Conversely, the intake of these foods increased with age among boys (Berti et al., 1999). In a population of Inuit, Dene/Métis and Yukon adults, men were found to consume more traditional foods than women (Kuhnlein et al., 2004). Although these populations cannot be directly compared given differences in the availability and use of different species of traditional foods, these findings highlight the importance of encouraging traditional food consumption among young FN people and especially girls. It has been demonstrated that some dietary habits acquired in childhood and adolescence may persist into adulthood (Craigie, Lake, Kelly, Adamson, & Mathers, 2011); a similar trend may also exist for traditional food consumption (Genuis et al., 2014).

Most studies of the traditional food intakes of Aboriginal youth do not include comparisons between boys and girls (Kuhnlein, Soueida, & Receveur, 1996; Nakano et al., 2005a, 2005b; Kuhnlein & Receveur, 2007; Johnson-Down & Egeland, 2010; Khalil, Johnson-Down, & Egeland, 2010; Gagné et al., 2012; Langlois et al., 2013) and to the knowledge of the author, although there have been comparisons of the traditional food intakes of adults and youth (Kunnlein, Soueida, & Receveur, 1996; Kuhnlein & Receveur, 2007), longitudinal cohort studies investigating the intakes of traditional foods of FN people from childhood into adolescence and adulthood do not exist. Nevertheless, research in the region has found that males are more likely to participate in traditional hunting and fishing activities as compared to females (Kirby, Lévesque, & Wabano, 2007). Further study is needed to corroborate the findings of the present research, and to elucidate possible reasons for why boys and girls may have different preferences for some traditional foods and how this could be mitigated. Qualitative investigations into the perceived importance of traditional foods in girls as compared to boys would help to design initiatives specifically tailored to this portion of the population. Furthermore, knowledge of how the importance of and preferences for traditional foods evolve over the course of childhood and adolescence and into young adulthood would further help to customize relevant initiatives to encourage traditional food intake.

Unsurprising, based on previous research on the contribution of traditional food consumption to the nutrient intakes of youths (Nakano et al., 2005a; Kuhnlein & Receveur, 2007; Johnson-Down

& Egeland, 2010; Khalil, Johnson-Down, & Egeland, 2010; Gagné et al., 2012), the frequency of snow goose consumption for the participants of the present study was associated with higher intakes of meat and alternatives, protein, vitamin B_{12}, iron and zinc. These nutrients, inherent in snow goose meat (Health Canada, 2007c) and other traditional meats, are especially important in a population where food insecurity is a significant issue (FNIGC, 2012) and the nutrient density of youths' diets is of concern (Gates, Skinner, & Gates, 2015). These findings underscore the nutritional importance of this food source for the FN youths of these two communities during the Spring season. In combination with the fact that approximately half of youth do not consume this food, and more than seven out of ten girls, the need for initiatives supporting the intake of this food either via enhancing access or influencing preferences is clear.

Previous, complementary research in the same region found that approximately one-third of youth would consume more game meat if their parents ate it more often, and that the same proportion (34%) would consume it more if their parents ate it more (Hlimi et al., 2012). Nearly one quarter (23%) of youth thought that they would eat more game meat if their parents knew how to prepare it better (Hlimi et al., 2012). Concomitantly, more than half (55%) of youths were worried about the environmental contamination of the game meat that they consumed (Hlimi et al., 2012). Little other research exists that has begun to elucidate the factors that influence youth to choose traditional foods over store-bought ones (Willows, 2005), or vice versa, although clearly these choices are the result of a combination of forces that come together in ways that are difficult to isolate (Willows, Hanley, & Delormier, 2012). Food security research makes it clear that accessing traditional foods may be impeded by economic factors (i.e., the cost of equipment and travel), the loss of traditional knowledge, changing migration patterns, fears of environmental contamination, the destruction of traditional lands, and a reduction in the time for hunting, among others (Chan et al., 2006; Power, 2008; Robidoux et al., 2009; Thompson et al., 2012; Haman et al., 2010; Ford et al., 2013; Skinner et al., 2013; Gaudin et al., 2015). These investigations, however, are relevant mainly for adults. Given the well-known nutritional benefits of consuming traditional meats, along with the declining frequency of their consumption especially among youth, mixed-methods investigations into the reasons why youths do not eat these foods with greater frequency would be of great interest and value.

Contrary to what would naturally be expected, for those nutrients associated with snow goose consumption frequency, it was not in fact the highest level of consumption (once per day or more) that was associated with the highest intakes, but instead a more moderate (but still generous) consumption level (2-6 times per week). The Canadian Nutrient File indicates that one CFG serving of goose (75g, roasted) provides 23 g protein, 0.4 μg vitamin B_{12}, 7.4 mg iron, and 2.4 mg zinc (Health Canada, 2007c). To the knowledge of the author, relatively few studies have investigated the intake of game meats, nor specific traditional foods and their associations with total diet quality (beyond absolute nutrient intakes), or how traditional food intake may mitigate the consumption of other foods in the diet, including store-bought foods of greater and lesser nutritional quality.

Research by *Khalil, Johnson-Down, & Egeland* (2010), who investigated the diets of Cree FN youths residing on reserves in northern Quebec, found that those youths who consumed traditional foods on a weekly basis had higher intakes of vegetables and fruit, but also consumed more fatty snack foods. Similarly, in the present study those youths who consumed snow goose with the highest frequency were also most likely to consume cola, non-cola pop and pizza with high frequency (daily). Although it is generally accepted that the diets of youth who consume traditional foods are more nutrient dense, more research is necessary in a variety of on-reserve FN populations who face similar hindrances to food availability, to elucidate the differences in actual food consumption patterns (as opposed to nutrients) that moderate these differences in diet quality amongst youth who consume more traditional foods. In a number of FN communities, the sharing of traditional foods has been described as a common method for enhancing food security by ensuring that everyone has enough food (Chan et al., 2006; Thompson et al., 2012; Skinner et al., 2013). It is therefore reasonable to hypothesize that those youths who consume traditional game meats most frequently may also be those whose families face more severe food insecurity; low-quality store-bought foods may thus be the most viable source of dietary energy once nutrient-rich traditional foods have run out. Healthy alternatives like vegetables and fruit and lower fat milk products are often very expensive at local stores in the communities in this region and thus unattainable for lower income families (Gates et al., 2011, 2013a).

The current study found no association between the prevalence of snow goose consumption in the Spring season, nor frequency of snow goose consumption and BMI. Of note, snow goose consumption in the present study was infrequent (one time per month or less) for most youth, and thus highly unlikely to impact body weight. Further, energy intake was not associated with the frequency of the consumption of this food. To date, investigations into the association between game meat or traditional food intake and body size or body fatness have been met with mixed results (Khalil, Johnson-Down, & Egeland, 2010; Gaudin et al., 2014). The study by *Khalil, Johnson-Down, & Egeland* (2010) found that those youths who consumed traditional foods at least weekly had a significantly lower mean BMI as compared to those who consumed these foods infrequently. Conversely, a study of Cree adults from northern Quebec found no association between traditional food intake and BMI (Gaudin et al., 2014). Despite supplying ample micronutrients, traditional foods also of course supply energy (kilocalories), and there has not been a substantial body of research identifying a difference in total energy intake by prevalence or frequency of traditional food consumption. Nevertheless, the procurement of traditional foods requires considerable physical energy and can be a significant contributor to purposeful physical activity for those who partake in it (Young & Katzmarzyk, 2007). If youths were to be included in the procurement of traditional foods (e.g., wild game, fish) that they were consuming, this could possibly impact one half of the energy balance equation.

6.8.2 Need for Programming and Impact of the Harvest Sharing Program

Food insecurity is an unfortunate reality for many FN families, far more so than in the general population. Estimates from the RHS (2008/10) indicated that 54% of on-reserve FN households were food insecure (FNIGC, 2012). In the general population, the figure from the 2007-10 CCHS was a comparatively low 2.5% (Gionet & Roshanafshar, 2013). For FN people food security encompasses not only market foods but traditional ones as well, and 'cultural food security' (a term coined by *Power, E.M.* (2008)) and the barriers and facilitators to having sufficient, safe traditional foods have been studied in more detail in recent years. The many barriers to the procurement and consumption of traditional foods amongst Aboriginal people have already been discussed. Conversely, research in a number of Aboriginal populations has begun to elucidate some supporting strategies that have been useful in mitigating these challenges (Chan et al., 2006; Thompson et al., 2012; Ford et al., 2013; Skinner et al., 2013).

Strategies that have consistently been thought to improve cultural food security for Aboriginal communities include greater support for local hunters and harvesters (i.e., funding for equipment and supplies), additional community hunts, programs to enhance the hunting skills and traditional knowledge of youths, salaries for hunters, and community freezers where game meats could be preserved and shared amongst those in the greatest need (Chan et al., 2006; Haman et al., 2010; Thompson et al., 2012; Ford et al., 2013; Skinner et al., 2013). In a relatively large study of Aboriginal communities in northern Manitoba, a traditional food program was associated with greater food security, but also with improved human capital (it employed hunters and provided training) and social capital in that foods were distributed at community events (Thompson et al., 2012). Such programs clearly have great potential but have been rarely evaluated. Indeed, within this thesis **Study Two** found that traditional food sharing between families living on reserves was strongly predictive of frequent traditional food consumption amongst youth.

It was the aim of the harvest sharing program evaluated herein to build upon this foundation of knowledge and to work with the participating communities to make snow geese more available to the families in the greatest need during the Spring harvest. Previous work by *Skinner et al.* (2013) in one of the participating communities found that food sharing was a common means of ensuring that community members had enough food; 63% of community members took part in this practice. One strategy identified by the participants to help overcome food insecurity and improve traditional food availability was to employ salaried hunters who had the knowledge and means to procure traditional foods during the harvesting season (Skinner et al., 2013). These foods could then be stored in community freezers and distributed such that those who did not have the economic means to hunt could also benefit (Skinner et al., 2013). On this premise, the harvest sharing program was piloted.

The harvest sharing program was as successful as one could expect based on the two-month timeline between baseline and post-pilot measures of dietary intake among youths. Baseline data helped to substantiate the need for the program, as it revealed that a considerable proportion of the participating youth did not consume snow goose. This need was especially true for girls; for this reason, the early results of the pilot phase are encouraging in that it appears that girls saw the greatest improvement in snow goose consumption.

The early findings of this program add to the relative lack of quantitative data on the direct impact of formal harvest sharing on the nutrient intakes of FN youths. For Aboriginal people, including the Cree, taking part in the procurement and sharing of traditional foods is an integral part of their culture that helps not only to enhance food security but also to sustain social relationships (Willows, 2005). It has been suggested that initiatives supporting the sharing of land-based foods may have a role to play in encouraging more traditional diets, changing perceptions toward traditional foods and improving the likelihood that community members would participate in traditional food procurement and consumption (Haman et al., 2010). This may be especially important for youth, for whom traditional knowledge and preferences for such foods is suggested to be declining (Willows, 2005). Qualitative investigations into the impact of harvest sharing on the beliefs and perceptions surrounding traditional food for youths would be of interest, though were beyond the scope and aims of the current study.

Though insufficient to significantly affect the nutrient intakes of this small sample of youth, this study exemplifies the changes in food patterns that may result from resource intensive and logistically challenging programming. Data on food group and nutrient intakes show that in spite of better snow goose access, and long-standing school nutrition programs that benefit vegetable and fruit, and milk and alternatives intakes, the diets of most youth still fall short of the recommended intakes of these food groups and the associated micronutrients (Gates et al., 2012a, 2012b; Skinner et al., 2012a). These communities are strongly committed to helping youth be healthier and it is likely the conglomerate of multiple complementary initiatives that will help these particularly vulnerable youth to achieve comparable nutrient intakes to those observed in the general population. Future directions that members of the community advisory committees have suggested include cultural food procurement skill development and the inclusion of traditional foods in the current school food provision initiatives to help to continue to build upon the early success of the current program. Expanding the program to include harvest sharing across all hunting seasons, and to include more species of traditional game meats, would likely help to amplify its impact.

6.9 Results Dissemination

Youth received immediate feedback about their dietary intake via a screen at the end of the WEB-Q, which compared their dietary intake on the previous day to current CFG recommendations. Study results are shared with the participating communities via reports and additional presentations will be given upon request. Continued correspondence with the communities may occur via members of the UW research team either in person or remotely (e.g., via e-mail and telephone).

Beyond dissemination to the communities, the results of this research may be of benefit to researchers and policymakers interested in Aboriginal health, food security, diet and obesity. The results research have been shared amongst colleagues via a presentation at an academic conference (2015 Canadian Obesity Summit, Toronto, Ontario). The resultant manuscript has been submitted for publication in a peer-reviewed academic journal.

6.10 Strengths and Limitations

It is known that diets that include traditional food are typically more nutrient-dense than those that do not (Berti et al., 1999; Kuhnlein et al., 2004; Nakano et al., 2005a; Willows, 2005; Kuhnlein & Receveur, 2007; Johnson-Down & Egeland, 2010; Egeland et al., 2011; Gagné et al., 2012), however, few studies have examined the impact of traditional food consumption, and specifically the effect of a harvest sharing program, on the diets of FN youth living on-reserve in northern, remote regions. This study begins to fill that research gap and provides impetus and direction for future research. Depending on the desires of the participating communities, the harvest sharing program could be scaled up to include sharing between other nearby communities, or could be used as a model on which similar programs could be based in other remote, isolated FN communities who are facing issues of cultural food security.

Although it would be preferable to use three non-consecutive 24-hour dietary recalls to assess the usual dietary intakes of youth (Burrows, Martin, & Collins, 2010), only one recall was used at both time periods for this study. This limits the ability to capture the intake of snow geese, since the data represent a snapshot of a single day (i.e., an individual may not have eaten snow goose on the day recalled even though they typically consume it nearly every day). For the context of this study, methodological rigour needed to be balanced with feasibility (i.e., the end of the school year in June), and it was decided that one recall would be the most practical while still providing for a relatively accurate representation of weekday dietary intake without imposing a significant burden on participants, nor unreasonably intruding on productive school hours. Further, the fact that participants with unusually high or low energy intakes, as well as those who reported not consuming their usual diet the day prior to the data collection were excluded from the analyses helped to ensure that the data were representative of what participants consumed on a 'usual' weekday. Also, the 24-hour recall data were supplemented with food frequency questions to ensure that the usual intake of specific food items of interest (including snow goose) were not missed simply because a participant did not consume that food on the day before the recall.

It is also acknowledged that self-reported dietary intake is subject to numerous sources of error and bias, including recall error, social desirability bias and the accidental misinterpretation of portion sizes. That being said, the multiple pass technique, as mimicked by the WEB-Q, including prompts for forgotten foods and two-dimensional photos of portion sizes, helped to minimize recall error and errors in portion size estimation that may occur due to lack of portion size knowledge (Blanton et al., 2006). The anonymous, confidential online nature of the WEB-Q, as compared to face-to-face interviews, likely increased the chance that participants responded as honestly as possible.

Because this study did not utilize a control group, any changes in dietary intake cannot be attributed to the effect of the pilot program with absolute confidence. However, the participating communities were too small to have a control group, and withholding a pilot program hypothesized to positively impact the health of youth, especially in communities where poverty and food insecurity prevalence rates are high, would not be ethical. Furthermore, the fact that all FN communities are unique, even if they are located in close geographic proximity to one another, means that a neighbouring community would not have provided for a suitable control.

The small sample sizes (n=84 in April and n=73 in June) likely reduced the power to observe statistically significant findings and also limits the generalizability of the results. That being said, efforts were made to recruit as many grades 6-8 youth as possible in both communities by offering the questionnaire on various school days. No students who were eligible to participate refused, and the results remain relevant to the participating communities themselves and may be of interest to neighbouring communities facing similar challenges.

Of note, the benefits of any harvest sharing program will be reliant on the success of the seasonal hunt, which can vary year-to-year and is not predictable (Skinner et al., 2013). For this reason, the findings of this study cannot be generalized to different years, other seasons, or different species of traditional game meats. To confirm the findings of this study and to ascertain the benefits observed in the pilot phase, repeated investigations across different years and seasons would be necessary.

6.11 Conclusions

The current study identified a 48% prevalence of snow goose consumption amongst a sample of youth residing in two small reserve communities in northern Ontario, and a much lower prevalence amongst girls as compared to boys. Although not associated with BMI, snow goose consumption imparted nutritional benefits for those who consumed it. Following a harvest sharing program, snow goose consumption rates were augmented (significantly only amongst girls), although this change was not sufficient to simultaneously affect nutrient intakes. Nevertheless, the impact of the program, particularly among those youths with the greatest need, exemplifies how facilitating access to traditional foods has the potential to improve their intake. Ultimately, this is one step towards greater holistic health for youth.

6.12 Acknowledgements

The author would like to thank the communities for their involvement in this research and the participants for taking part in the study. Thank you to Dr. Dan McCarthy and Zachariah General (University of Waterloo) for their help in data collection, and to Dr. Ian Martin (University of Toronto Scarborough) for his statistical expertise. This research was supported by a CIHR (Institute of Aboriginal Peoples' Health, and Institute of Nutrition, Metabolism and Diabetes) grant (AHI-105525).

7.0 Study Five:
School Food Provision for First Nations Youth: Process and Outcome Evaluations of a Healthy Snack Program in a Northern Ontario Community After Four Years*

7.1 Overview

Background. A healthy school snack program, initiated in May 2009 in a remote, isolated FN community on the western coast of James Bay, was received with enthusiasm. Despite disappointing outcomes after one year, morale for the program remained high.

Objectives. To undertake process and outcome evaluations of the healthy school snack program four years following its implementation to (a) describe the facilitators to its sustainability, (b) describe the ongoing challenges its everyday operations, and (c) assess its impact on the food group and nutrient intakes of grades 6-8 youth.

Methods. A utilization-focused participatory approach to evaluation was employed. A focus group with the school principal and snack program committee (n=3) in June 2013 was used to elucidate strategies for sustainability and ongoing challenges. To assess outcomes, school-attending youth completed a web-based 24-hour dietary recall at baseline (May 2009, grades 6-8) and after four years (June 2013, grades 6-7). Food group and nutrient intakes were compared to CFG recommendations and DRI standards, respectively. In June 2013, youth also completed online questionnaires about their impressions of the program (multiple choice and open-ended questions). Four-year changes were assessed via independent samples t-tests (continuous variables) and Pearson's Chi square statistics (categorical variables). Qualitative data were analysed inductively and summarized.

*This chapter was accepted for publication in September 2015 in the journal *Health Behavior and Policy Review* as the following: Gates, A., Hanning, R.M., Gates, M., Stephen, J., & Tsuji, L.J.S. Four-year evaluation of a healthy school snack program in a remote First Nations community. (in press).

Results. Facilitators to the sustainability of the program included: changes in procurement and transport of food, securing more sustained funding, mobilising reliable and motivated personnel, and acquiring facilities and equipment. These were supported by advocacy and the local government. After four years (n=49, 12.7±1.0 years old, 59% male), youth had significantly higher intakes of vegetables and fruit (p=0.048), milk and alternatives (p=0.017), 'other' foods (p=0.030), carbohydrates (p=0.025), fibre (p=0.019), thiamine (p=0.040), riboflavin (p=0.008), folate (p=0.006), calcium (p=0.015), iron (p=0.046), potassium (p=0.007), zinc (p=0.042) and kilocalories (p=0.021) compared to baseline (n=43, 13.1±0.9 years old, 60% male). Most youth continued to consume amounts of food groups and nutrients below recommended intake levels.

Conclusions. Given adequate resources and personnel a school food provision program in a remote, isolated FN community in northern Ontario was sustainable and afforded its participants improvements in dietary intake. Supporting programs targeting other influences of dietary intake are required should continued improvements in diet be desired.

7.2 Background

Aboriginal Canadians remain amongst the most vulnerable of all ethnic groups and are disproportionately affected by chronic health conditions (King, Smith, & Gracey, 2009; Statistics Canada, 2012; Gionet & Roshanafshar, 2013). The high and rising prevalence rates of overweight and obesity for Aboriginal Canadians, including Aboriginal youth, is of particular concern (Tremblay et al., 2005; Gionet & Roshanafshar, 2013). Children and youth who are overweight or obese face numerous physical and psychological health consequences; they may be at an increased risk for chronic health conditions, reduced quality of life, discrimination, poorer self-esteem and premature death later in life (Wang et al., 2009; Tsiros et al., 2009; Franks et al., 2010). First Nations people are at particular risk for developing type 2 diabetes, a metabolic disease associated with overweight and obesity (Tjepkema, 2006; Guh et al., 2009; PHAC, 2011), and for developing it at younger ages (PHAC, 2011).

First Nations youth living on reserves may face exceptional community-level obstacles to attaining and maintaining a healthy weight, including poor access to affordable, healthy foods and fewer resources for purposeful physical activity or organized sports (Skinner, Hanning, & Tsuji, 2006; Gates et al., 2011, 2013a). Programs that help FN communities to overcome some of the common community-level barriers to healthy lifestyles are required to begin to curtail the issue, and it has been recommended that children and youth be the focus of such initiatives (Willows, Hanley, & Delormier, 2012). Children and youth who are overweight or obese are significantly more likely to become overweight and obese adults (Singh et al., 2008; Herman et al., 2009), and programs aimed at this demographic could be used to shape the lifestyles of individuals at an age when they are learning habits that may endure throughout their lifetimes.

Given that the Aboriginal population is young (Statistics Canada, 2013a), initiatives focused on youth have the potential for a broad and enduring reach, especially if they involved schools, where nearly all youth spend the majority of their waking hours on weekdays. Schools may also be a rich source of resources, including physical resources, personnel and positive role models.

There are innumerable factors at multiple levels of influence that may impact a person's food choices and physical activity levels; unique cultural and historical factors add an additional layer of complexity to these choices for FN youth (Willows, Hanley, & Delormier, 2012). There is therefore no easy solution to the obesity epidemic in many FN communities. Instead, it is likely that the issue will need to be tackled via multiple, complementary approaches at various levels (e.g., individual, family, school, community, policy). Nevertheless, diet is a modifiable contributor to energy balance. The transition from traditional lifestyles to a more Western way of life has meant that many FN youth now consume diets that are energy-dense and nutrient-poor (Kuhnlein et al., 2004; Willows, 2005); specifically, inadequate consumption of foods from the vegetables and fruit, and milk and alternatives food groups of CFG are a concern, along with the simultaneous overconsumption of foods that provide little nutritional value (Gates, Skinner, & Gates, 2015). Further, the consumption of culturally important traditional foods is becoming increasingly less frequent, especially amongst younger generations of FN people who may lack the skills necessary to obtain and prepare them (Kuhnlein et al., 2004; Willows, 2005).

The fact that diets containing traditional foods are typically healthier compared to those that do not cannot be understated (Kuhnlein et al., 2004). Nevertheless, the increased reliance on store-bought alternatives (Kuhnlein et al., 2004; Willows, 2005) is a reality that is not soon likely to change. The quality of store-bought choices may potentially be improved via initiatives aimed at reducing the barriers to their procurement. Especially in remote and/or isolated communities and those located in northern Canada, healthy foods like vegetables, fruits, low-fat dairy and meat products and whole grains may be extremely expensive, completely unavailable or of inconsistent quality once they arrive on store shelves (Gates et al., 2011, 2013a). Compounded by high rates of food insecurity among the Aboriginal population (Willows, 2008; FNIGC, 2012; Gionet & Roshanafshar, 2013) and the relative lack of economic opportunities in remote locations, healthy choices may be simply inaccessible to many people and the cheaper alternatives are often high in energy, sugar, fat and salt.

Educational initiatives may increase preferences for healthy foods, intentions to eat healthier, or healthy eating knowledge (Saksvig et al., 2005; Gates et al., 2011; Triador, Farmer, Miximova, Willows, & Kootenay, 2014). There may be too many community-level barriers for those living on remote, isolated reserve communities, however, to use these skills to make healthy changes to their diets (Gates et al., 2011, 2013a). The universal provision of healthy meals and snacks in the school environment may be a viable option to help improve the diet quality of this vulnerable population of youth. The positive impact that school breakfast and snack programs can have on the dietary intake of FN youth has been infrequently reported, despite the high prevalence of such programs in Canadian FN schools (Assembly of First Nations, 2008). In a subarctic community in northern Ontario with a well-established universal school snack program, *Skinner et al*. (2012a) found that participants had higher intakes of vegetables and fruit, milk and alternatives, folate, fibre, vitamin C, vitamin A, calcium, vitamin D and iron as compared to those who chose not to partake in the program. They also had lower intakes of ‘other’ foods (e.g., cookies, candy, chips), which should only be consumed occasionally given their poor nutrient content and high energy density (Skinner et al., 2012a). In another northern Ontario FN with a particularly high prevalence of diabetes, *Saksvig et al.* (2005) evaluated the impact of a school diabetes prevention initiative, which included a daily 'breakfast snack' program. Exposure to the program was associated with an increased likelihood of meeting minimum intake recommendations for fibre (Saksvig et al., 2005). More studies of the potential for this type of program to improve the dietary intakes of FN youth would be of value for communities looking to support and promote the good health of young people.

7.3 Impetus for this Research

The desire from community-level stakeholders to learn more about the health and wellness of their youth emerged from a longstanding collaboration between researchers at UW and the remote, isolated FN communities of the western coast of James Bay. Previous research in the region helped to elucidate some of the barriers and opportunities to healthy eating and physical activity (Skinner, Hanning, & Tsuji, 2006). Stemming from this research, discussions with stakeholders in one of the communities helped to identify a school breakfast and snack program as a promising opportunity to improve the access to healthy store-bought foods for youth. The research team, led by researchers Drs. Rhona Hanning and Len Tsuji, provided guidance for the planning of the program and seed funding to get the program started.

The UW research team traveled to the community in May 2009 to collect baseline data on the eating habits of the community's youth to help substantiate the need for the program and guide its development. Baseline 24-hour dietary recall data revealed that a respective 95% and 74% of youth in grades 6-8 had intakes of vegetables and fruit, and milk and alternatives below minimum CFG recommendations (Gates et al., 2012c, 2013b). The consumption of related micronutrients, including fibre (100%), vitamin A (77%), folate (56%), calcium (>80%) and vitamin D (>80%) were below recommended minimum levels of intake for most youth (Gates et al., 2012c, 2013b). The breakfast and snack program was initiated based on these data, initially providing all elementary school youth with at least two servings of vegetables and fruit and two servings of milk and alternatives daily (Gates et al., 2012c, 2013b). After one week, the diets of the youth were measured once again. At this time, improvements in the consumption of fibre, vitamin C and calcium were observed (yet remained largely inadequate) and the program was continued under the direction of a school-based volunteer, following recommended purchasing guidelines (**Appendix B**) (Gates et al., 2012c, 2013b).

The promising improvements in dietary intake initially observed were not maintained at one-year follow-up (Gates et al., 2012c, 2013b). Myriad community-level barriers prevented consistent delivery of the program during its first year, including inconsistent personnel support, inadequate infrastructure, the high cost of foods in the north, the lack of stock of the recommended foods at the local store, an unexpected community health crisis, and a natural disaster (i.e., flooding) requiring temporary closure of the school and evacuation from the community (Gates et al., 2012c, 2013b; Gates et al., 2014). Nevertheless, the need and morale for the program remained high and a local school nutrition committee was assembled to maintain the program. More consistent funding was sought and the program continued under the direction of school-based volunteers with the support of UW researchers (Gates et al., 2014).

In September 2012, the UW research team returned to the community as part of the continuing work to support health-promoting programming for youth at the school level. At this time, changes to enhance the sustainability of the school snack program were observed (Gates A & Gates M, personal observations). The research team worked with the community to undertake further evaluation of the program, and to elucidate strategies for sustainability and ongoing challenges.

7.4 Objectives and Hypotheses

7.4.1 Objectives

A process evaluation was undertaken to determine whether the school-based healthy snack program had been designed and delivered effectively. The process evaluation facilitated the attainment of the following research objectives:

A. To describe the facilitators to the four-year sustainability of a school-based healthy snack program from the perspectives of the principal and coordinating committee.
B. To describe the ongoing challenges to the daily operations and sustainability of the school-based healthy snack program from the perspectives of the principal and coordinating committee.

An outcome evaluation was undertaken to determine the extent to which the school-based healthy snack program's activities contributed to the attainment of its objectives. The outcome evaluation facilitated the attainment of the following research objective:

C. To assess the four-year (i.e., May 2009 to June 2013) impact of a school-based healthy snack program on the food group and nutrient intakes of grades 6-8 youth from a remote, isolated community on the western coast of James Bay, Ontario.

7.4.2 Hypotheses

The hypotheses, decided *a priori* for each of the objectives, are shown in **Table 7.1**. The hypothesis for each objective is elaborated upon in more detail following the table.

Table 7.1. Hypotheses for study five

Objective	Hypothesis
A	The sustainability of the program will have been supported by the elimination or reduction in a number of the previously identified community- and school-level barriers to its continuation.
B	Some of the previously elucidated challenges to the sustainability of the program will have yet to be completely overcome.
C	The consumption of vegetables and fruit, and milk and alternatives will increase significantly from 2009 to 2013, and the consumption of 'other' foods will significantly decrease. Nutrients closely tied to vegetables and fruit, and milk and alternatives consumption (i.e., vitamins A, C, D and K, folate, calcium, potassium and fibre) will increase significantly, while sodium may decrease. Following four years of the program, large proportions of the participating youth will continue to consume amounts of food groups and nutrients below currently recommended levels.

Objective A. The sustainability of the program will have been supported by the elimination or reduction in a number of the previously identified community- and school-level barriers to its continuation. These included inconsistent funding, insufficient personnel support, inadequate infrastructure, the high cost of foods in the north, the lack of stock of healthy foods at the local store and an unexpected health crisis and natural disaster, as previously described (Gates et al., 2012c, 2013b, 2014). At the four year time point, it would be reasonable to hypothesize that consistent and adequate funding will have be established, dedicated and reliable personnel will have been mobilized, facilities for food preparation and distribution will have been acquired or built and food purchasing will have been expanded to include out-of-community bulk suppliers or other more economical means of food procurement.

Objective B. Some of the previously elucidated challenges to the sustainability of the program will have yet to be completely overcome. For example, funding may still not be entirely adequate, or personnel support may remain sparse. There may be other unique challenges that cannot be predicted ahead of time.

Objective C. The consumption of vegetables and fruit, and milk and alternatives will increase significantly from 2009 to 2013, and the consumption of 'other' foods will significantly decrease, because these foods will be displaced by those provided by the program. Further, nutrients closely tied to vegetables and fruit, and milk and alternatives consumption (i.e., vitamins A, C, D and K, folate, calcium, potassium and fibre) will increase significantly, while sodium *may* decrease, but likely not significantly due to the widespread distribution of this nutrient in the food supply. Despite hypothesized improvements in diet, it is expected that large proportions of the participating youth will continue to consume amounts of food groups and nutrients below currently recommended levels, given the previously elucidated community-level barriers to healthy eating (Gates et al., 2011, 2013a).

7.5 Framework for the Evaluation

7.5.1 Community Partnership

Pre-evaluation partnership building (Bharadwaj, 2014) was integral to the development of a relationship of mutual respect and trust between community stakeholders and UW researchers (Government of Canada, 2013). The research team from UW has been collaborating with the communities of the western coast of James and Hudson Bays, Ontario, for more than 10 years with the aim of collecting baseline eating and physical activity data to inform health-promoting initiatives for community-dwelling youth. Initially, collaboration with community advisors helped to elucidate the barriers and supports to healthy eating and physical activity in these remote, coastal communities (Skinner, Hanning, & Tsuji, 2006). This work evolved to include the development, implementation and evaluation of a number of school-based health promotion initiatives, including comprehensive school nutrition programs (Gates et al., 2011, 2013a), healthy school snack programs (Gates et al., 2012c, 2013b, 2014), a school greenhouse project (Skinner et al., 2014) and a school sports initiative (Gates et al., 2015).

Consultation with stakeholders in one FN community revealed the desire for a school-based nutrition program with the general aim of improving the accessibility of healthy store-bought foods for the community's youth (Gates et al., 2012c, 2013b). Moving forward from the initial consultation phase, planning for the program began including achieving consensus on the roles of the research team and community in the evaluation. Ultimately, community members lead the development and delivery of the program to promote community ownership, relevance and sustainability. The university research team were responsible for the evaluation of the program and promoted its longevity through knowledge sharing, seed funding and grant-writing support.

When possible, community stakeholders were included in the evaluation process and reviewed evaluation and knowledge dissemination materials for appropriateness.

7.5.2 Evaluation Context

The healthy school snack program that was evaluated as part of this study underwent two previous evaluations since its implementation in 2009. One week following its initiation, an implementation evaluation (Myers, 1999) was conducted to monitor whether or not the program was operating according to the original plan (Gates et al., 2012c, 2013b). This included the collection of quantitative data on the diets of the participating youth, and a focus group discussion with teachers and the principal (Gates et al., 2012c, 2013b). One year later, in June 2010, the UW researchers facilitated a process evaluation as part of the ongoing monitoring of the program in order to assess how well the program was operating under normal conditions (Myers, 1999; Rossi, Lipsey, & Freeman, 2004; Gates et al., 2012c, 2013b). Again, this included quantitative data collection on the diets of the participating youth and qualitative feedback from both teachers and youth (Gates et al., 2012c, 2013b). The findings of these evaluations helped to provide guidance on how the day-to-day operations of the program could be improved and provided impetus for discussions on how some of the barriers to the continuation of the program could be overcome.

7.5.3 Evaluation Approach and Questions

The present study employed a utilization-focused, participatory approach to complete a process and outcome evaluation of the program, four years after its initial implementation. Utilization-focused evaluation is an approach that emphasizes the usefulness of the evaluation for the intended users of the program (i.e., participants) and its closest stakeholders (Patton, 2012). The aim was to monitor the ongoing operations of the program (i.e., process) and to determine whether or not the program was achieving its intended dietary outcomes (Rossi, Lipsey, & Freeman, 2004).

A logic model for the program as it was designed is shown in **Figure 7.1** and outlines the program's main activities and how these relate to the achievement of its objectives. The multi-coloured circle at the left hand side of the model represents the four food groups of CFG (Health Canada, 2007a), with one coloured band for each food group. At the center of the circle lies the main activity of the program, healthy school food provision. The apple and milk carton represent the program's emphasis on the provision of vegetables and fruit, and milk and alternatives based on the suggested buying list provided at the beginning of the program (**Appendix B**). Surrounding the circle are the primary outputs for the program, including the number of youth participating (i.e., proportion of youth who benefitted), and the number of servings of different types of foods served. From the left-most circle come the short- and long-term objectives for the program. Along the bottom, the ultimate objective of the program is shown. Along the top, the overarching context is depicted, including different factors that could affect the outcomes of the program, based on *Willows, Hanley, & Delormier*'s (2012) social ecological model. Throughout, the colours of CFG (Health Canada, 2007a) are used to emphasize the focus of the program on diet quality and adequacy.

The main evaluation questions, as they relate to the objectives of this study, are shown in **Table 7.2**. Being a participatory approach, the main stakeholders who would hold interest in the program were identified as a first step prior to any evaluation activities. **Figure 7.2** outlines the main stakeholders for the program; those closest to the program are pictured in the arch most closely surrounding the school, while those more indirectly impacted (i.e., parents, families, the greater community, the local government, and the local health and education authorities) are pictured further away. Other parties holding interest in the program but not necessarily directly involved are pictured outside of the main arches (i.e., researchers, policymakers, health practitioners, local stores, and neighbouring communities). The arches are shown in green and blue, representing the emphasis on the vegetables and fruit, and milk and alternatives food groups of CFG, respectively. For the purposes of this study, only those stakeholders most closely involved in the program (i.e., students, organizing committee and principal) took part in the evaluation.

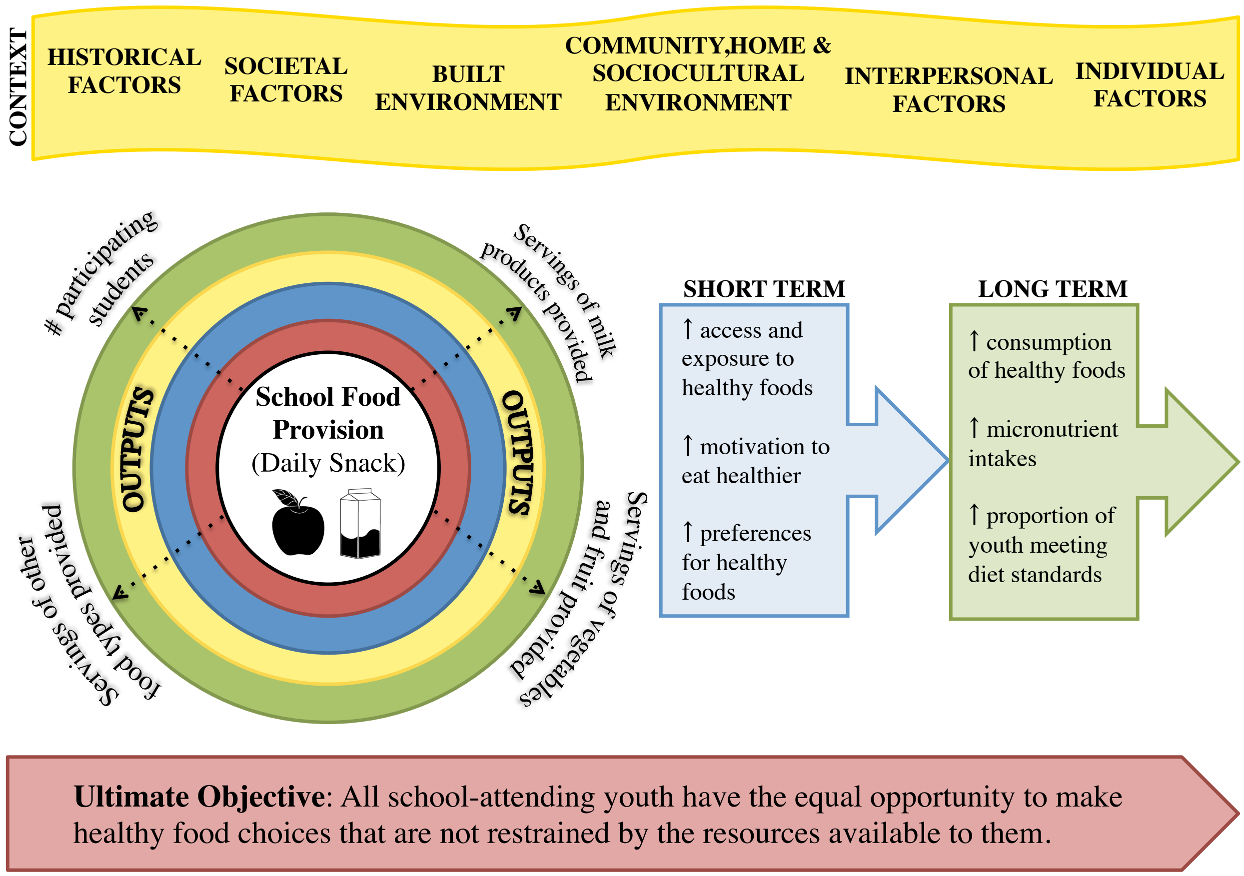

Figure 7.1. Logic model depicting the intended design and outcomes of a school-based healthy snack program in a remote, isolated First Nations community

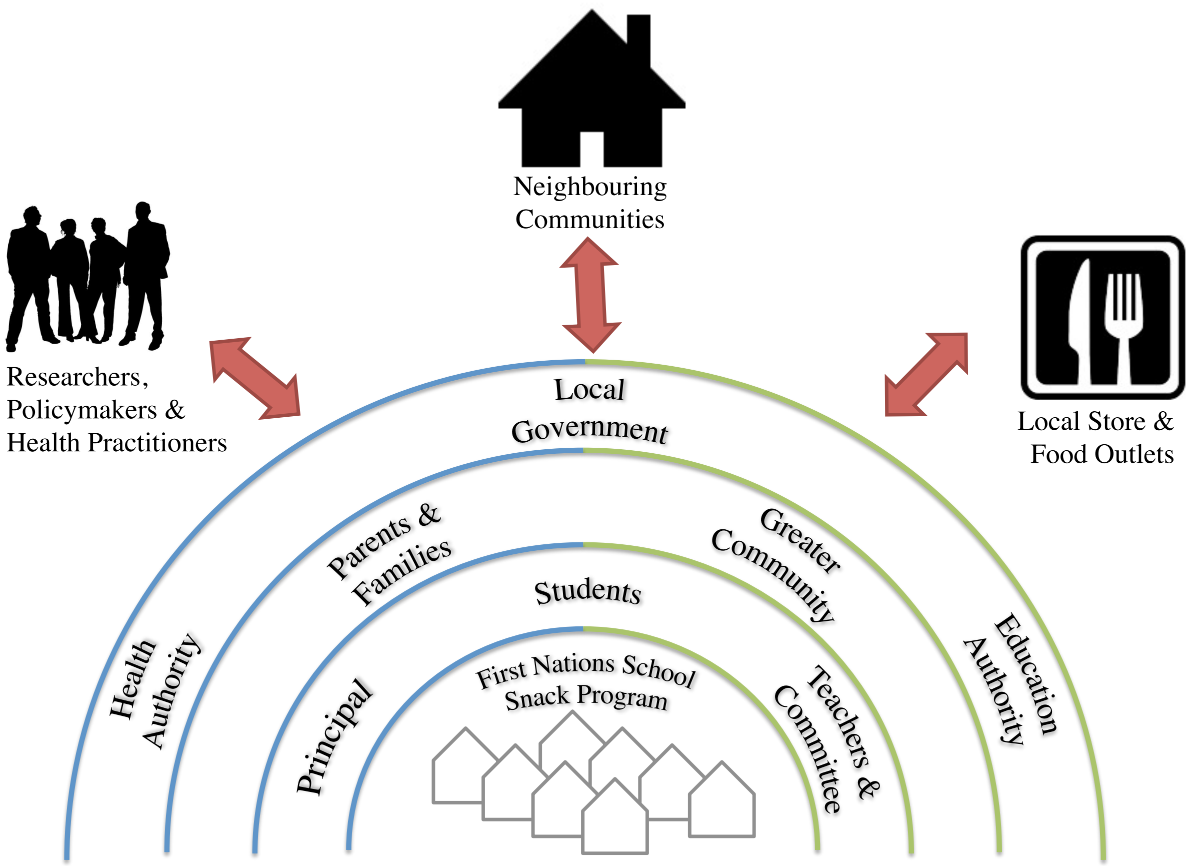

Figure 7.2. Stakeholders for a healthy school snack program in a remote, isolated First Nations community

Table 7.2. Evaluation matrix for a healthy school snack program in a remote, isolated First Nations community[a]

Research Objective	Evaluation			
	Selected Questions	**Indicator(s)**	**Information Source(s)**	**Method(s)**
Process: *Has the healthy school snack program been designed and delivered effectively?*				
A, B	1. Is the program being delivered as intended based on the initial design?	▪ Extent to which the program adheres to its design ▪ Opinions of the principal and committee	▪ Record of daily operations ▪ Principal ▪ Snack program committee	▪ Personal observation ▪ Focus group
A, B	2. Is the program reaching its intended users (school-aged youth)?	▪ Participation rate ▪ Opinions of the principal and committee	▪ Participants ▪ Principal ▪ Snack program committee	▪ Participation survey ▪ Focus group
A, B	3. Are the facilities and resources adequate to deliver the program as intended?	▪ Availability facilities and resources ▪ Opinions of principal and committee	▪ Observations ▪ Principal ▪ Snack program committee	▪ Personal observation ▪ Focus group
A, B	4. Is there adequate personnel support to deliver the program as intended?	▪ Opinions of principal and committee	▪ Principal ▪ Snack program committee	▪ Focus group
A, B	5. Is the program being delivered consistently?	▪ Opinions of principal and committee	▪ Principal ▪ Snack program committee	▪ Focus group
A, B	6. Is the program sustainable?	▪ Opinions of principal and committee	▪ Principal ▪ Snack program committee	▪ Focus group
A, B	7. Do any of the program's activities **not** contribute to the attainment of its objectives?	▪ Number and type of activities that do not contribute to the objectives ▪ Opinions of principal and committee	▪ Participants ▪ Principal ▪ Snack program committee	▪ Focus group
Outcomes (Impact): *To what extent has the program's activities contributed to the attainment of its objectives?*				
C	1. What impact does the program have on the diets of its intended users?	▪ Changes in dietary intake ▪ Opinions of participants ▪ Opinions of principal and committee	▪ Participants ▪ Principal ▪ Snack program committee	▪ 24-hour dietary recall ▪ Participation survey ▪ Focus group
C	2. Are there any unintended positive or negative outcomes from the program?	▪ Changes in dietary intake ▪ Opinions of participants ▪ Opinions of principal and committee	▪ Participants ▪ Principal ▪ Snack program committee	▪ 24-hour dietary recall ▪ Participation survey ▪ Focus group

[a]Adapted from the work of *Langevin* (2001).

7.6 Methods

7.6.1 Participants and Setting

This study took place in a FN community located on the western coast of James Bay, Ontario. The community, located about 10 kilometres upstream from James Bay on the northern shore of the Albany River, is both remote (located approximately 400 km from Timmins, Ontario, the nearest urban centre and 1000 km from Toronto, Ontario, the nearest metropolitan city) and isolated (accessible only by air year-round, by winter road during the colder months and by boat in the warmer months) (Five Nations Energy, 2012). The community has a population of approximately 1700 people who are predominantly Cree (Five Nations Energy, 2012). There is one main local store to buy groceries, clothing and other goods, as well as two convenience stores, mostly selling non-perishable goods and snack foods (Gates A & Gates M, personal observations). Similar to other communities in the north, the cost of foods is high (≥2 times more expensive than in the south) and healthy choices are oftentimes not available (AANDC, 2010; Gionet & Roshanafshar, 2013). Further, limited economic opportunities exist in the community and a high rate of food insecurity mean that affording healthy foods may be a challenge for many families (Willows et al., 2009). Research in a neighbouring community found that the high cost, lack of availability and poor quality of healthy foods at the local store were considered some of the most serious barriers to healthy eating (Skinner, Hanning, & Tsuji, 2006; Gates et al., 2011, 2013a).

The local school, consisting of portable classrooms, opened in 2008 after the previous school was condemned due to toxic mould (Timmins Daily Press, 2007). Approximately 400 students from pre-kindergarten to grade 7 (pre-kindergarten to grade 8 until 2010) attend. All school-attending youth in grades 6-8 (2009; grades 6-7 in 2013) were eligible to participate in the evaluation. Youth of this age were chosen because only older youth have the requisite ability to respond to questions about their dietary intake.

Prior to collecting any data, the evaluation received ethical clearance from the Office of Research Ethics at UW (#15402), and was reviewed by the local Education Authority. Information letters explaining the nature of the evaluation were sent home with potential participants at least one week prior to data collection (**Appendix A**) and included the contact information for the principal investigators based at UW as well as community-based collaborators. Letters were written at a grade 7 reading level, such that they would be readable and comprehensible by most, if not all parents. Culturally appropriate passive parental consent was used; any parent or guardian who did not wish for their child to participate was asked to contact either the university-based researchers or the school by telephone, e-mail or in person, using the contact information provided in the information letter. Youth were also asked to assent to the study, following a brief explanation of the research by a UW or community-based research assistant prior to data collection. In this way, consent to the study was two-fold (both parental and student).

At any time during the study, students could choose to discontinue their participation without consequence. Because the 2013 data collection was part of a complimentary study also examining physical activity and fitness levels of the participating youth (UW Office of Research Ethics #18309), active parental consent was required at this time (as opposed to the passive method used in 2009). Students who did not return signed consent forms were therefore not eligible to participate (**Appendix C**).

In 2013, the school principal and snack program coordinating committee members were also invited to participate in the evaluation by elaborating on their experiences with the program. These qualitative data provided for a more in-depth understanding of the strengths and limitations of the program beyond that which could be assessed via quantitative means. Prior to any discussion, these adult participants were provided with background information about the study, signed a consent form and orally assented (**Appendix D**).

7.6.2 Twenty-four Hour Dietary Recalls

In May 2009 and June 2013, the dietary intakes of school-attending youth (grades 6-8 in 2009 and grades 6-7 in 2013) were collected via a self-administered 24-hour dietary recall, using the WEB-Q (Hanning et al., 2009). The WEB-Q has previously been described in detail in **Study 4** (*6.5.4 Dietary Intake*). Briefly, this validated online tool allows for the efficient collection of 24-hour recall data. It employs multiple-pass methodology, provides two-dimensional food models to guide portion estimation and includes more than 900 foods including locally available traditional foods that would be familiar to and commonly consumed by FN students (Hanning et al., 2009).

All eligible students present at school on the day of data collection participated in the study. Data were collected on weekdays between Tuesday and Friday, such that the recalled information would reflect school-day food consumption only. In an attempt to maximize the participation rate, absent students were offered the option to complete the questionnaire either remotely (i.e., from home) or on another school day. Students completed the 30-45 minute questionnaires on school computers following a brief explanation of the study by a university-based research assistant. Between 10 and 20 students completed the questionnaire at one time, depending on the availability of computers with access to the Internet and class size. Participation was supervised by a minimum of two research assistants and one teacher or teaching assistant who could help students to complete the questionnaire or answer their questions, if needed. The first page of the questionnaire provided a brief written explanation of the research and asked students to assent to the study. To assure anonymity, students were provided with a unique, computer-generated identification number and password to enter the survey.

7.6.3 Participant Surveys

Before completing the 24-hour recall, the WEB-Q prompted students to enter basic demographic information, including their sex, age and school grade. In addition to the usual diet information collected using the survey, in 2013 the WEB-Q was also used as a platform to collect quantitative and qualitative data from the participating youth on their impressions of the program via open-ended and multiple choice questions. The included questions and corresponding response options, as generated in consultation with community advisors, are shown in **Table 7.3**. Participants were encouraged to provide honest answers and were helped with typing and comprehension by the university-based researchers, teachers or teaching assistants if necessary.

Table 7.3. Questions and response options included on the questionnaire to collect participants' impressions of the program

Question	Response Format and Options
1. How often do you participate in the school snack program?	Every school day, more than half the week, less than half the week, rarely or never
2. Because of the school snack program: a. I am motivated to eat healthier b. I make better choices about what I eat c. I eat more vegetables d. I eat more fruits e. I have asked my parents/guardian to buy or serve the vegetables or fruits I tried at school	Strongly agree, agree, disagree, strongly disagree
3. Is there a different food you would like to see included in the school snack program?	Open ended
4. If you could change one thing about the snack program, what would it be?	Open ended

7.6.4 Focus Group

In June 2013, a focus group with the school principal (n=1) and snack program coordinating committee (n=2) was conducted to elucidate strategies for the four-year sustainability of the snack program as well as to better understand any ongoing challenges or barriers to program continuation. The 45-minute discussion took place in a private room after working hours at the community school for convenience and comfort, and refreshments were provided. The focus group was led by a university-based researcher using predetermined open-ended questions and prompts to generate discussion (**Table 7.4**). The researcher made a conscious effort not to influence responses and to maintain neutrality throughout the discussion. A second researcher was present to collect detailed notes. Directly following the focus group, the two researchers debriefed to ensure the accuracy and detail of the information recorded.

Table 7.4. Focus group script and prompts to elucidate the strategies for the four-year sustainability of the snack program and to better understand the ongoing challenges and barriers

1. **For those who have been involved in the snack program from the beginning, can you describe the history of the program? How has the program been running since 2009?**
    - What types of foods are offered?
    - How often does the program run?
    - From where is the food purchased? How does it get here?
    - Who prepares and distributes the food?
    - How many people are involved? Are they all volunteers?
    - What proportion of students participate?

2. **What were the main challenges to starting and continuing the program?**
    - Funding?
    - Volunteers?
    - Space and infrastructure?
    - Food safety?...

3. **How did you go about overcoming these challenges?**
    - Consistent funding?
    - Adequate personnel?
    - Adequate volunteers?…

4. **What do you think are the most important contributors to the sustainability of the program?**

5. **From your observation, how has the program benefitted the students?**
    - Diet
    - Behaviour
    - Attendance
    - Attention…

6. **Have you had any feedback from parents or students? What do they say?**

7. **What role do students play in the program? Parents?**
    - Food preparation, distribution, organization, clean-up…

8. **What are the main reasons the program needs to continue; what makes it valuable?**

9. **Ideally, what do you see for the future of the snack program? How will you get there? What is stopping you from achieving this right now?**

10. **If you were to provide recommendations to another community trying to start a similar program, what would you say to them? What are the lessons learned?**

11. **Do you think that the snack program is sufficient? What do you think are the next steps?**

12. **Any additional comments?**

7.7 Data Analysis and Interpretation

7.7.1 Quantitative 24-hour Recall and Survey Data

All quantitative data were analyzed using SPSS (*v*. 21, IBM Corporation, Armonk, New York) with a level of statistical significance decided *a priori* at $p \leq 0.05$. The aid of statistical consultant Dr. Ian Martin (University of Toronto, Scarborough) was sought to ensure the appropriateness and correctness of all statistical procedures. Demographic data were summarized descriptively (i.e., mean ±SD) for the sample as a whole as well as separately for boys and girls. Quantitative responses to the WEB-Q questions regarding students' impressions of the snack program were summarized descriptively (i.e., frequencies). As in **Study 4** (*6.6.2 Twenty-four Hour Recall Data*), measures were taken to ensure that the 24-hour recall data were consistent with the usual school-day food consumption patterns of the participating youth, including the exclusion of students who reported an unusual day (Berkey et al., 2000; Ludwig, Peterson, & Gortmaker, 2001).

Food-based data from the 24-hour recalls were categorized into food groups in accordance with the 2007 CFG (Health Canada, 2007a) and analyzed for energy, and macro- and micronutrient content in accordance with the 2007 or 2010 Canadian Nutrient File, depending on the time of data collection (Health Canada, 2007c, 2010). Baseline and four-year dietary intakes, specifically the number of servings consumed from the vegetables and fruit, milk and alternatives, meat and alternatives, and grain products groups of CFG were compared to CFG recommendations for males and females aged 9-13 years and teens and adults (14-18 years) (Health Canada, 2007a) (as shown in **Study Four, Table 6.3**).

Similarly, participants' consumption of relevant macro- and micronutrients at each time point were compared to current DRI recommendations for 9-13 and 14-18 year-old youth (Health Canada, 2013). At the individual level, micronutrient intakes were compared to the EAR. For nutrients without an established EAR, the AI was used (as shown in **Study Four, Table 6.4**). The AMDRs were used to determine the appropriateness of macronutrient intakes at the individual and group level (Health Canada, 2013). For further details and definitions with regard to the use of the DRIs to estimate dietary adequacy, please refer to **Study 4** (*6.6.2 Twenty-four Hour Recall Data*).

Beyond the aforementioned descriptive statistics, group-level changes in the consumption of relevant food groups and nutrients were assessed via independent samples t-tests. Because youth consumed significantly more energy (i.e., kilocalories) in 2013 as compared to 2009 and absolute nutrient intakes can be influenced by total energy intake (i.e., those who eat more energy also consume, on average, a greater amount of most nutrients) the t-tests were also performed on variables that were adjusted for energy intake using the nutrient-density method (Willet, Howe, & Lawrence, 1997). The nutrient-density method is used to define nutrient consumption as intakes per 1000 kilocalories (Willet, Howe, & Lawrence, 1997). To assess changes in the proportions of youth meeting current dietary recommendations (i.e., CFG, EAR, AI, AMDR or UL) for food groups and nutrients, Pearson Chi-square tests were used. For all analyses, tests of normality were performed and variables that did not follow a normal distribution were transformed as appropriate.

7.7.2 Qualitative Survey and Focus Group Data

Qualitative notes from the focus group with the principal and snack program committee members were analyzed inductively (Glaser & Strauss, 1967; Strauss & Corbin, 1990; Charmaz, 2006). Given the relatively small amount of data, the analysis was performed by hand without the aid of data organization software. Each line of text was initially coded using gerunds (Charmaz, 2006). These codes, each on individual pieces of paper, were spread on a table and grouped into categories. These categories were then used to form overarching themes (Charmaz, 2006). An attempt was made by the author to maintain neutrality and not to impose pre-conceived notions or ideas onto the data. Instead, an effort was made to allow the themes to emerge from the data themselves (Charmaz, 2006). Following the initial analysis, the analytical process was repeated by a second independent researcher to reduce the likelihood of bias (Shenton, 2004). Any differences were discussed until consensus was reached. Qualitative responses from students to the open-ended questions on the WEB-Q were summarized descriptively.

7.8 Results

7.8.1 Characteristics of the Participants

The characteristics of the participants in May 2009 and June 2013 are shown in **Table 7.5**. No significant differences were observed in the proportion of boys and girls (p=0.964) nor in age (p=0.053) between time periods.

Table 7.5. Characteristics of school snack program participants in May 2009 and June 2013[a]

Characteristic	May 2009			June 2013		
	Total	Boys	Girls	Total	Boys	Girls
N	43	26	17	49	29	20
Participation in the evaluation (%)	71.6	-	-	67.1	-	-
Mean age ±SD (years)	13.1±0.9	13.3±0.9	12.7±0.8	12.7±1.0	12.8±1.1	12.4±0.8

[a]Baseline data have been reported in previous evaluations (Gates et al., 2012c, 2013a), however, 2013 values are novel.

7.8.2 Results of the Process Evaluation

7.8.2.1 Perspectives of Students

When asked what types of foods they would like to see added to the snack program, 16 youth indicated that they would like to see either more fruit, or different types of vegetables and fruit. Fruits of interest included kiwifruit, apples, bananas, carrots, mangoes, oranges, watermelon and juice. Other types of foods requested included traditional foods (moose meat and tea), pork chops, granola, cheese with crackers, yogurt, cereal and muffins. Some youth reported desiring energy-dense, nutrient-poor foods ('other' foods), including cookies, candy, pizza, cake, ice cream and chips.

Youth reported desiring changes to the program that mirrored the types of foods that they wanted more of. A number of youth reported wanting more fruits or vegetables to be included in the program; they also requested being allowed to have as many fruits or vegetables as they desired (e.g., two bananas instead of just one). Conversely, some youth reported wanting the program to serve more 'junk foods' or 'more sugar'.

7.8.2.2 Perspectives of Coordinating Committee and Principal

The five dominant themes related to the initial challenges and facilitators to the sustainability of the program included *procurement and transport*, *funding*, *food quality and safety*, *facilities and equipment* and *personnel support*. **Figure 7.3** depicts these five main themes and how they relate to the initial barriers to the program's continuation (2009) as well as to its later sustainability (2013). The first and last columns depict the program, as it existed in 2009 and 2013, respectively. The two middle columns show the initial challenges to the continuation of the program (in red) and the facilitators to its four-year sustainability (in green). Despite the main themes being presented separately, they tended to be interrelated and were influenced in some way by one another. One additional overarching theme, *local champion, advocacy and local government support*, emerged as an important factor helping to mitigate the challenges. Throughout the figure, the arrows show the progression of the program over its first four years, as it moves toward sustainability and the achievement of its objectives.

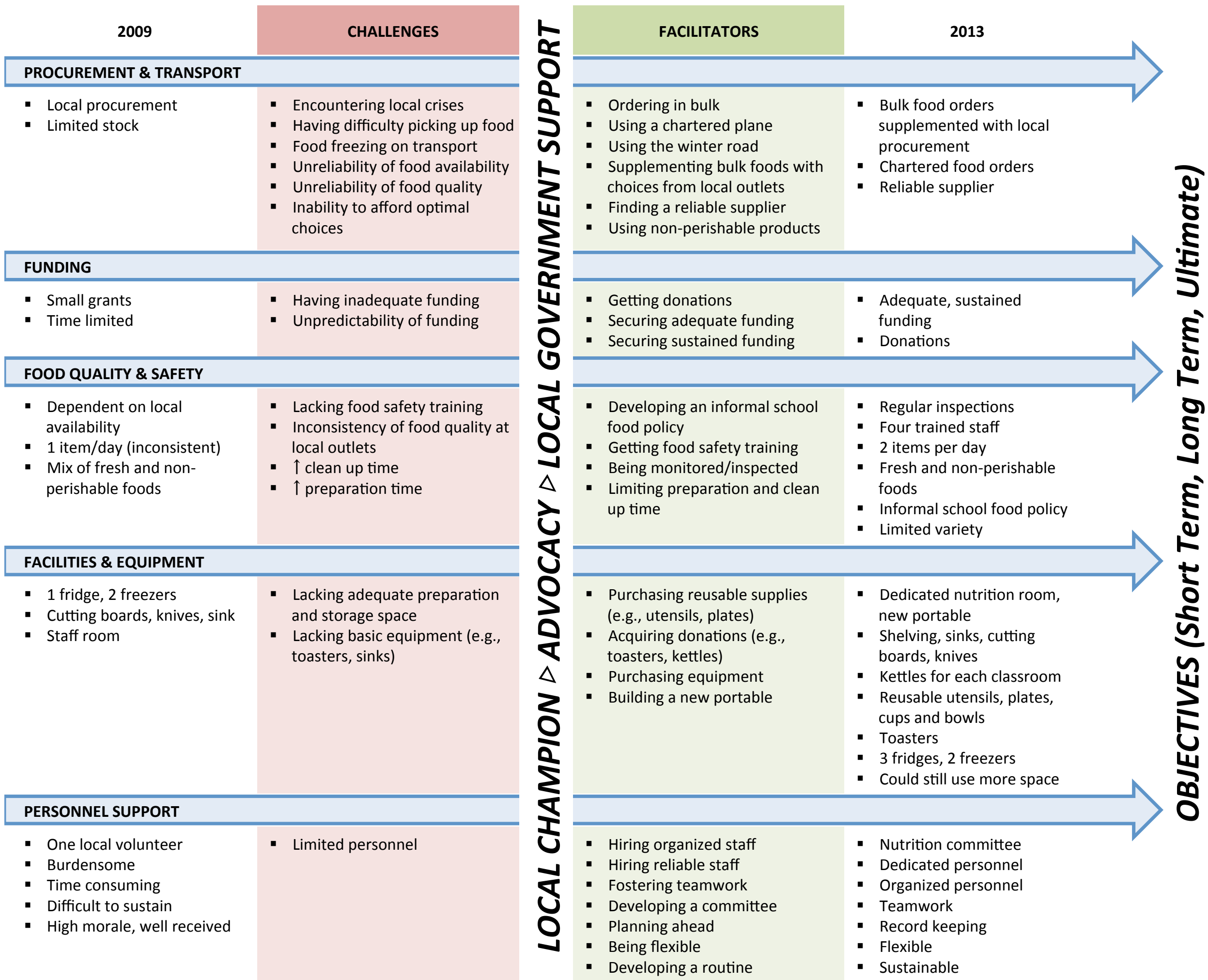

Figure 7.3. Themes related to barriers and facilitators to the continuation of a school-based healthy snack program in a remote First Nations community

Procurement and transport. At its inception, food for the snack program was procured daily from the local store, located approximately one kilometre from the school. The program was run by a single volunteer who had to travel to the store daily to pick up the foods for the program. The types of food that could be offered were limited by those that were in stock at the store each day. On many occasions, the planned foods (e.g., fresh fruit) had to be replaced with the next reasonable alternative (e.g., fruit juice); these alternatives were not always of equal nutritional value (e.g., whole wheat English muffins vs. NutriGrain bars). Even when foods were ordered well in advance, local weather conditions could delay their arrival at the store meaning that a suitable alternative would need to be sought on short notice. Because bulk food prices could not be offered by the store and given the very high cost of foods in the north, consistent provision of the program was very expensive.

Moving on from these challenges, bulk ordering and the use of a chartered plane to fly foods in to the community was a feasible solution that allowed food provision not only to be more consistent and reliable, but also more economical. Finding a reliable supplier that could send good quality, fresh foods in a timely fashion was key to the long-term sustainability of the program. These fresh foods are supplemented by non-perishable offerings as well as occasional purchases at the local store when snacks run out between bulk orders. During the colder months the winter road is also utilized, but can sometimes be problematic as fresh foods can freeze during transport. This is a challenge that has been difficult to overcome and continues to limit the types of foods that can be served; the variety of the snacks provided is limited to those foods that are robust enough to survive the harsh weather conditions that may be experienced during their transport to the north.

Funding. The program began thanks to seed funding from the research group at UW and, beginning in 2010, a Breakfast for Learning grant. This grant was insufficient to fund a daily program and was also set to last only for one year without a guarantee for renewal. Due to the insufficiency and uncertainty of the funding, the program operated only intermittently in its first couple of years and was limited to only one food item (e.g., an apple), once or twice per week.

Discussion with neighbouring community advocates (i.e., school staff in communities where longstanding food provision programs existed) and grant writing support from UW researchers later led to more substantial funding via a grant from OnexOne, a non-profit organization that funds school nutrition programs in Canadian FN communities (OnexOne, 2014). Although considerably greater than the Breakfast for Learning grant, the OnexOne funding was still not sufficient for the program to reach its full potential and was also limited in its longevity.

Approximately three years into the program, persistent advocacy via a local champion (i.e., the school principal) led to additional funding for school-based health initiatives via the local government. This additional funding is not only sufficient for the program to run daily, but is also consistent and sustained (i.e., does not expire). Trust and local government support allows for cash advances to be provided to the school which can be paid back at a later date, allowing for large bulk food orders which may not have been possible had the program been running only on small, time-bound grants. Periodic donations from a variety of organizations (e.g., Canadian Tire) have also been helpful in allowing the program to run consistently.

Food quality and safety. In its early stages, the program served one food item per day, once or twice per week, on an inconsistent basis. The quality of the food provided was limited by what was available at the local store, what was affordable and what could be served with minimal clean-up and preparation time. The snacks also had to be easily transportable between the portable classrooms. The types of foods that could be served were limited by a lack of food safety training, as well as by the lack of equipment for preparing food and the facilities needed to store it. Also, given that there was a sole volunteer to provide the program, the types of foods served had to be quick and easy to pick up, prepare and distribute.

Since the 2011-2012 school year, the program has been monitored by certified food inspectors, and food safety training has been provided to four staff members who work for the program. This has enhanced the school-based nutrition capacity and has allowed for a greater variety of perishable foods to be served (including potentially 'hazardous' foods, e.g., dairy requiring refrigeration). By 2013, the program was serving at least two food items per student per day, typically a mix of perishable and non-perishable food items (e.g., yogurt, cheese and crackers, peanut butter and English muffins, fresh fruit, fruit juices, cereal with milk). By this time, some classes had developed an informal nutrition policy, where energy-dense 'junk' foods were not allowed in the classroom (e.g., soda, chips, candy). Although a mix of healthy foods is served, some limiters to the variety of items provided have included preparation time (few staff), clean-up time (teachers prefer foods that are quick and easy to clean), available storage space and food preparation equipment. For this reason, vegetables continue to be served less often than would be desired.

Facilities and equipment. For the first couple of years, the school snack program was delivered out of the staff room, where limited food preparation equipment and storage areas were located. Storage for perishable items was limited to one small refrigerator and two freezers, and preparation equipment was limited to one sink and a couple of cutting boards and knives. Thanks to continued advocacy for the program by the principal and increased funding support via the local government, two years into the program a new portable was built at the school which housed a locked room dedicated to the school nutrition program. The room has multiple sinks and funds were allocated for new fridges and freezers, of which there now exist three and two, respectively. Donations of kettles and toasters also helped to expand upon the types of foods that could be served. As of 2013, ample shelving was available for non-perishable food items, and the increased storage room facilitated bulk food ordering, which helped to cut down on operational costs.

The purchase of a set of reusable utensils, plates, bowls and cups and drying racks for each classroom also helped to expand upon the variety of foods that could be served, and helped to reduce overall operating costs; instead of ordering individually packaged items, bulk foods could be portioned in the classroom. Although more resources are always welcomed (e.g., equipment to prepare and serve hot breakfasts), as of 2013 the program had adequate facilities and equipment to operate as originally intended.

Personnel support. In its first couple of years, the program was very burdensome to operate; with only one dedicated volunteer to run the program, snacks could only be served intermittently and running the program proved to be a time consuming and labour intensive endeavour. That said, there was great enthusiasm and morale for the program, the students seemed to benefit from it, and it was, overall, well received. From this enthusiasm and thanks to the support of the school's principal, a nutrition committee was mobilized consisting of four staff members who were dedicated to running the program.

Finding reliable, organized staff was originally a challenge; for one year (2011-2012) the program was run by students, but this was later deemed not to be feasible nor sustainable. The acquisition of organized, reliable staff who were later trained in food safety meant that snacks could be provided every school day. Teamwork was described as a very important aspect to the ongoing sustainability of the program; each committee member has his or her own responsibilities, and by working together, the program has been able to run relatively smoothly and without interruption.

Recordkeeping has become another foundation of the program, such that the funds allocated to different activities and the types and amounts of foods that are being purchased and distributed is continuously recorded. This recordkeeping practice enhances the sustainability of the program, such that if the school administration were to change, records of how the program was provided will be available.

Local champion, advocacy and local government support. One overarching mitigating factor that emerged from the analysis was the undeniable importance of having a local champion who advocated for the continuation and further development of the program following its first years in operation. The work of the local champion and later support of the local government was the main impetus for overcoming the early challenges that the program faced.

During the 2011-2012 school year, the school hired a new principal who saw great promise in the snack program and became a powerful advocate for its continued growth. Through discussions with the local government, additional and sustained funding was awarded for the program. This local government support and associated additional funding was key in allowing for bulk purchasing as well as for providing the program with the monetary resources required to operate consistently.

Through continued advocacy, the school's principal has facilitated the acquisition of donations and the organization of a school snack program committee. Reliable food suppliers were sought and tireless work was undertaken to ensure that the program was being run as originally intended to meet its objectives.

7.8.3 Results of the Outcome Evaluation

7.8.3.1 Comparison of Food Group and Nutrient Intakes from 2009 to 2013

From May 2009 to June 2013, intakes of vegetables and fruit (p=0.048), milk and alternatives (p=0.017), 'other' foods (p=0.030), carbohydrates (p=0.025), fibre (p=0.019), thiamine (p=0.040), riboflavin (p=0.008), folate (p=0.006), calcium (p=0.015), iron (p=0.046), potassium (p=0.007), zinc (p=0.042) and total kilocalories (p=0.021) all increased significantly. When investigated by sex, boys consumed significantly more milk and alternatives (p=0.010), 'other' foods (p=0.028), thiamine (p=0.040), riboflavin (p=0.080) and calcium (p=0.007), while girls had significantly higher intakes of folate (p=0.035) and potassium (p=0.040) in 2013 as compared to baseline. The absolute nutrient and food group intakes of the participants in May 2009 in contrast to those in June 2013 are shown in **Table 7.6**.

Notably, the significant increases in micronutrient, carbohydrate and food group intakes observed from baseline to the four year time point were accompanied by an unintended statistically significant increase in total energy intake (p=0.021). For this reason, macronutrient, micronutrient and food group intakes were adjusted for energy (Willet, Howe, & Lawrence, 1997) to investigate differences in nutrient density from baseline to four years. Comparing the nutrient density of the diets of participating youth from May 2009 to June 2013, no significant differences were observed. However, investigating by sex, boys experienced a significant increase in mean intake of milk and alternatives (p=0.035) and calcium (p=0.013) per 1 000 kcal after four years as compared to baseline. There were no significant changes in energy-adjusted nutrient and food group intakes for girls. The nutrient densities of the participants' diets in May 2009 as compared to June 2013 are shown in **Table 7.7.**

7.8.3.2 Proportions of Youth Meeting Dietary Standards

As compared to 2009, there were significant improvements in the proportions of youth who met current dietary standards for a number of food groups and nutrients following the first four years of the snack program (**Table 7.8**). As compared to 2009, significantly more youth met CFG recommendations for vegetables and fruit (p=0.016) and milk and alternatives (p=0.026). For micronutrients, significantly more youth met the EAR for riboflavin (p=0.040), niacin (p=0.008), vitamin B_6 (p=0.002), vitamin B_{12} (p=0.047), calcium (p=0.026) and zinc (p=0.006). Specifically for boys, a greater proportion met the recommendations for milk and alternatives (p=0.025) and calcium (p=0.015) after four years of the program. In 2013, more girls met the recommendations for vegetables and fruit (p=0.050), niacin (p=0.014), vitamin B_6 (p=0.006) and zinc (p=0.036) as compared to in 2009.

Despite these improvements in food group and nutrient intakes over the first four years of the snack program, the majority of participating youth continued to fall short of current dietary standards (**Table 7.8**). Notably, 80% of boys did not meet the CFG recommended intake for vegetables and fruit and 43% did not meet the recommended intake for milk and alternatives. Only one third of boys met the AMDR for fat, while 57% had intakes of this macronutrient above the recommended range (data not shown). The majority of boys also fell short of the EAR for a number of micronutrients, most notably vitamin A (67%), vitamin D (97%), vitamin C (50%) and potassium (97%). The diets of the participating boys were concomitantly excessively high in sodium; an overwhelming 83% of boys had intakes of this nutrient that exceeded the UL.

Similarly for girls, the majority had intakes of vegetables and fruit (75%) and milk and alternatives (65%) that fell below the recommendations of CFG. Only 35% had a fat intake that fell within the AMDR for this nutrient, and 55% had intakes that exceeded this range (data not shown). Akin to boys, the majority of girls had intakes of a number of micronutrients that fell below the EAR, including vitamin A (75%), vitamin D (95%), calcium (75%) and potassium (90%). Nearly two thirds (60%) of girls had intakes of sodium that were in excess of the UL.

7.8.3.3 Subjective Feedback on Program Participation from Students

Data collected via the WEB-Q indicated a very good participation rate for the program in 2013, where 81% of youth reported participating in the program every school day. An additional 6% of youth reported participating in the program more than half the week. Daily participation in the program was associated with greater intakes of fibre (p=0.030), iron (p=0.030), and carbohydrates (p=0.049) (data not shown). Compared to those who participated less frequently, girls who participated daily had greater intakes of vegetables and fruit (p=0.042) and vitamin C (p=0.050). There was no difference in dietary intake by participation level for boys.

The program was well received by the participating youth. The vast majority (82%) reported feeling motivated to eat healthier and 80% reported making healthier food choices as a result of the program. Most youth believed that they consumed more vegetables (62%) and fruit (86%) as a result of the program, and 70% reported asking their parents/guardian to buy or serve some of the foods that they had the opportunity to try at school.

Table 7.6. Comparison of absolute food group and nutrient intakes of participants from 2009 to 2013

Variable	Mean Dietary Intake ±SD						Change from 2009 to 2013 (p-value)[a]		
	May 2009			June 2013					
	Total n=43	Boys n=26	Girls n=17	Total n=49	Boys n=29	Girls n=20	Total	Boys	Girls
Canada's Food Guide Food Groups[b]									
Vegetables and fruit	2.3±2.0	2.3±2.2	2.3±1.7	3.5±3.0	3.4±3.2	3.7±2.9	**0.048**	0.141	0.162
Milk and alternatives	2.2±1.9	2.0±1.7	2.4±2.1	3.3±2.4	3.6±2.4	2.9±2.5	**0.017**	**0.010**	0.534
Meat and alternatives	1.9±1.7	2.4±1.8	1.3±1.3	2.0±1.7	2.0±1.7	2.1±1.6	0.835	0.346	0.095
Grain products	6.9±4.3	7.6±4.5	5.9±3.9	8.0±4.3	8.6±4.7	7.1±3.5	0.230	0.425	0.323
'Other' foods	5.5±3.2	5.5±3.1	5.5±3.4	7.7±4.6	7.7±4.0	7.7±5.5	**0.030**	**0.028**	0.228
Energy and Energy Yielding Nutrients									
Energy (kcal)	2079.6±1031.5	2170.7±995.9	1940.2±1099.7	2619.9±1165.6	2640.0±1170.3	2589.9±1188.3	**0.021**	0.115	0.095
Carbohydrate (g)	258.2±111.5	251.4±92.4	268.5±138.2	335.0±148.0	335.5±146.6	334.4±153.9	**0.025**	0.092	0.182
Carbohydrate (% kcal)	52.9±13.6	50.1±4.3	57.3±11.3	51.7±9.9	51.2±10.0	52.4±10.1	0.615	0.728	0.175
Protein (g)	74.5±47.0	82.3±46.6	62.5±46.3	88.3±39.4	91.4±39.1	83.6±40.3	0.126	0.429	0.147
Protein (% kcal)	13.6±4.3	14.3±4.6	12.6±3.8	14.0±4.3	14.6±5.2	13.0±2.1	0.681	0.776	0.437
Fat (g)	84.5±54.2	94.3±57.6	69.5±46.2	105.5±60.3	105.9±62.5	104.9±58.3	0.083	0.476	0.051
Fat (% kcal)	34.0±9.8	36.3±10.1	30.5±8.4	35.2±8.6	35.0±8.4	35.7±9.0	0.530	0.580	0.084
Saturated fat (g)	32.0±22.2	35.9±23.5	25.9±19.1	38.3±21.9	40.1±22.8	35.7±20.8	0.169	0.503	0.150
Saturated fat (% kcal)	12.9±4.5	13.8±4.8	11.5±3.7	12.9±4.1	13.4±4.2	12.2±4.1	0.934	0.769	0.570
Fibre (g)	11.0±6.4	11.3±6.7	10.4±5.4	14.2±7.0	14.0±6.3	14.6±8.0	**0.019**	0.128	0.076
Micronutrients									
Vitamin A (µg RAE)	319.6±275.7	319.2±257.6	320.2±309.5	413.7±304.3	446.8±295.5	364.2±318.2	0.124	0.093	0.674
Vitamin D (µg)	2.4±2.4	2.2±2.0	2.7±3.0	3.1±2.9	3.5±3.0	2.6±2.7	0.198	0.078	0.947
Thiamine (mg)	1.5±0.8	1.5±0.8	1.5±0.8	1.8±0.9	2.0±1.0	1.6±0.8	**0.040**	**0.040**	0.523
Riboflavin (mg)	1.7±1.1	1.7±1.0	1.7±1.2	2.3±1.2	2.5±1.1	2.1±1.3	**0.008**	**0.006**	0.338
Niacin (mg)	15.8±11.4	17.9±12.7	12.4±8.4	18.4±8.5	19.3±8.9	17.1±7.8	0.209	0.652	0.090
Vitamin B_6 (mg)	1.1±0.7	1.1±0.7	1.1±0.8	1.3±0.6	1.4±0.7	1.2±0.5	0.126	0.172	0.481
Vitamin B_{12} (µg)	4.1±3.4	4.5±3.5	3.5±3.2	5.2±3.3	5.5±3.6	4.6±2.7	0.116	0.266	0.244
Folate (µg DFE)	259.6±156.3	268.9±178.5	245.4±118.3	369.2±211.1	360.9±200.0	381.8±231.6	**0.006**	0.077	**0.035**
Vitamin C (mg)	75.3±80.6	87.3±93.9	57.1±51.8	126.2±139.5	109.3±141.9	151.5±135.2	0.249	0.504	0.083
Calcium (mg)	812.9±577.5	797.2±536.9	836.9±651.2	1145.0±693.9	1261.0±676.0	971.0±701.0	**0.015**	**0.007**	0.553
Iron (mg)	15.1±8.0	16.1±7.6	13.7±8.6	18.4±7.4	18.8±6.3	17.8±8.9	**0.046**	0.152	0.171
Potassium (mg)	1888.7±1111.5	2004.2±1125.2	1712.1±1100.0	2568.4±1933.7	2582.4±1233.5	2547.5±1253.4	**0.007**	0.074	**0.040**
Sodium (mg)	3501.2±2234.7	3855.6±2414.5	2959.2±1866.4	3863.2±1228.8	4077.8±1768.0	3541.3±2165.8	0.404	0.693	0.392
Zinc (mg)	9.3±6.8	10.3±7.2	7.8±6.0	11.9±5.2	12.6±5.6	10.8±4.5	**0.042**	0.179	0.095

[a]As assesed via independent samples t-tests. Bolded values represent statistically significant changes ($p \leq 0.05$).

[b]Mean intake amounts for Canada's Food Guide food groups are presented in servings.

Table 7.7. Comparison of energy adjusted food group and nutrient intakes of from 2009 to 2013

Variable	Mean Dietary Intake per 1000 kcal ±SD						Change from 2009 to 2013 (p-value)[a]		
	May 2009			June 2013					
	Total n=43	Boys n=26	Girls n=17	Total n=49	Boys n=29	Girls n=20	Total	Boys	Girls
Canada's Food Guide Food Groups[b]									
Vegetables and fruit	1.2±1.1	1.0±1.0	1.4±1.2	1.4±1.1	1.3±1.1	1.5±1.2	0.337	0.316	0.757
Milk and alternatives	1.0±0.8	0.9±0.7	1.3±0.7	1.2±0.6	1.3±0.6	1.1±0.6	0.267	**0.035**	0.381
Meat and alternatives	0.8±0.6	1.0±0.7	0.5±0.4	0.8±0.6	0.8±0.6	0.8±0.5	0.973	0.240	0.063
Grain products	3.3±1.1	3.4±1.2	3.1±1.0	3.1±1.4	3.3±1.5	2.9±1.2	0.616	0.783	0.638
'Other' foods	2.9±1.7	2.8±1.5	3.0±2.0	3.2±1.8	3.4±2.0	2.8±1.5	0.360	0.183	0.829
Energy and Energy Yielding Nutrients									
Carbohydrate (g)	132.3±33.9	125.2±35.8	143.3±28.3	129.2±24.9	128.0±25.0	131.1±25.3	0.615	0.728	0.175
Protein (g)	34.0±10.8	35.7±11.4	31.6±9.6	35.0±10.7	36.6±13.0	32.5±5.2	0.673	0.771	0.432
Fat (g)	37.9±10.9	40.4±11.2	33.9±9.4	39.2±9.5	38.9±9.4	39.7±10.0	0.530	0.579	0.083
Saturated fat (g)	14.3±5.0	15.3±5.3	12.7±4.1	14.4±4.6	14.9±4.6	13.6±4.6	0.932	0.775	0.577
Fibre (g)	5.2±1.9	5.0±2.1	5.5±1.6	5.8±2.5	5.7±2.4	6.0±2.8	0.189	0.257	0.507
Micronutrients									
Vitamin A (µg RAE)	163.7±138.8	151.2±140.1	182.7±138.8	158.1±97.7	175.0±106.4	132.8±78.9	0.233	0.475	0.469
Vitamin D (µg)	1.4±1.7	1.1±1.5	1.7±2.0	1.3±1.2	1.5±1.4	1.0±0.8	0.861	0.322	0.396
Thiamine (mg)	0.8±0.5	0.7±0.4	0.9±0.7	0.7±0.2	0.8±0.3	0.6±0.2	0.775	0.577	0.252
Riboflavin (mg)	0.8±0.4	0.8±3.5	0.9±0.5	0.9±0.5	1.1±0.6	0.8±0.3	0.272	0.053	0.271
Niacin (mg)	7.3±3.3	7.6±3.5	6.8±2.9	7.4±2.2	7.6±2.0	7.1±2.4	0.382	0.934	0.790
Vitamin B_6 (mg)	0.5±0.3	0.5±0.3	0.6±0.3	0.5±0.2	0.5±0.2	0.5±0.1	0.985	0.724	0.670
Vitamin B_{12} (µg)	1.9±1.1	1.9±1.1	1.8±1.0	1.9±0.9	2.0±1.0	1.8±0.8	0.670	0.673	0.893
Folate (µg DFE)	142.3±91.0	129.0±79.4	162.6±105.7	141.6±53.6	136.4±47.6	149.4±61.9	0.302	0.316	0.767
Vitamin C (mg)	38.6±46.2	38.3±39.8	39.0±55.8	45.5±49.0	35.1±36.7	61.0±60.9	0.488	0.759	0.263
Calcium (mg)	394.1±208.8	359.0±192.5	447.8±226.9	432.0±160.5	477.8±153.8	363.3±148.3	0.325	**0.013**	0.183
Iron (mg)	7.6±3.1	7.5±3.0	7.8±3.4	7.6±3.0	8.0±3.5	6.9±1.7	0.933	0.596	0.928
Potassium (mg)	933.5±395.4	897.1±356.9	989.3±453.7	1019.2±370.5	1024.6±413.1	1011.1±305.6	0.284	0.225	0.863
Sodium (mg)	1631.7±575.3	1676.5±558.7	1563.2±610.7	1531.9±580.6	1670.3±628.5	1324.2±436.6	0.408	0.969	0.175
Zinc (mg)	4.3±1.9	4.4±2.2	4.1±1.4	4.8±1.6	5.0±1.8	4.4±1.1	0.181	0.265	0.443

[a]As assesed via independent samples t-tests. Bolded values represent statistically significant changes (p≤0.05).

[b]Mean intake amounts for Canada's Food Guide food groups are presented in servings per 1000 kcal.

Table 7.8. Proportions of participating youth who met dietary standards in 2009and 2013

Variable	Standard Used[a]	% Meeting Minimum Dietary Standard						Change from 2009 to 2013 (p-value)[b]		
		May 2009			June 2013					
		Total n=43	Boys n=26	Girls n=17	Total n=49	Boys n=29	Girls n=20	Total	Boys	Girls
Canada's Food Guide Food Groups										
Vegetables and fruit	≥CFG	4.7	7.7	0.0	22.0	20.0	25.0	**0.016**	0.263	**0.050**
Milk and alternatives	≥CFG	25.6	26.9	23.5	48.0	56.7	35.0	**0.026**	**0.025**	0.495
Meat and alternatives	≥CFG	58.1	61.5	52.9	62.0	55.2	75.0	0.615	0.633	0.188
Grain products	≥CFG	67.4	73.1	58.8	82.0	80.0	85.0	0.105	0.541	0.136
Energy and Energy Yielding Nutrients										
Carbohydrate (% kcal)	AMDR	62.8	46.2	88.2	60.0	56.7	65.0	0.883	0.731	0.085
Protein (% kcal)	AMDR	81.4	84.6	76.5	96.0	96.7	95.0	**0.018**	0.058	0.159
Fat (% kcal)	AMDR	37.2	26.9	52.9	34.0	33.3	35.0	0.555	0.773	0.290
Fibre (g)	≥AI	0.0	0.0	0.0	4.0	0.0	10.5	0.180	n/a[c]	0.487
Micronutrients										
Vitamin A (µg RAE)	≥EAR	25.6	26.9	23.5	30.0	33.3	25.0	0.636	0.603	1.000
Vitamin D (µg)	≥EAR	2.3	0.0	5.9	4.0	3.3	5.0	1.000	1.000	1.000
Thiamine (mg)	≥EAR	83.7	80.8	88.2	88.0	86.7	90.0	0.553	0.719	1.000
Riboflavin (mg)	≥EAR	76.7	76.9	76.5	92.0	93.3	90.0	**0.040**	0.127	0.383
Niacin (mg)	≥EAR	65.1	69.2	58.8	88.0	83.3	95.0	**0.008**	0.213	**0.014**
Vitamin B_6 (mg)	≥EAR	51.2	57.7	41.2	82.0	80.0	85.0	**0.002**	0.070	**0.006**
Vitamin B_{12} (µg)	≥EAR	74.4	76.9	70.6	90.0	90.0	90.0	**0.047**	0.277	0.212
Folate (µg DFE)	≥EAR	46.5	46.2	47.1	64.0	60.0	70.0	0.090	0.300	0.157
Vitamin C (mg)	≥EAR	51.2	53.8	47.1	58.0	50.0	70.0	0.509	0.774	0.157
Calcium (mg)	≥EAR	25.6	30.8	17.6	48.0	63.3	25.0	**0.026**	**0.015**	0.701
Iron (mg)	≥EAR	88.4	88.5	88.2	98.0	96.7	100.0	0.092	0.328	0.204
Potassium (mg)	≥AI	4.7	3.8	5.9	6.0	3.3	10.0	1.000	1.000	1.000
Sodium (mg)	≥UL	65.1	73.1	52.9	74.0	83.3	60.0	0.352	0.351	0.666
Zinc (mg)	≥EAR	55.8	61.5	47.1	82.0	83.3	80.0	**0.006**	0.066	**0.036**

[a]AI: Adequate Intake; AMDR: Acceptable Macronutrient Distribution Range; CFG: Canada's Food Guide recommended intake; EAR: Estimated Average Requirement; UL: Tolerable Upper Intake Level. Although it is acknowledged that the Adequate Intake is not a suitable measure to indicate the adequacy of an individual's dietary intake, it was used as a measure of comparison in the absence of an Estimated Average Requirement.

[b]As assesed via Pearson Chi-square tests. Fisher's Exact tests were used for cells with expected counts <5. Bolded values represent statistically significant changes (p≤0.05).

[c]No statistics were computed because the May 2009 and June 2013 values were constant (i.e., 0.0 at each assessment).

7.9 Discussion

It is generally expected that any program that aims to provide school-attending youth with a daily healthy snack would lead to an increase in the intake of the food groups provided and the nutrients associated with these food groups. Despite the great potential and positive morale for the healthy school snack program, the expected improvements in the dietary intakes of participating youth were not achieved within the first year following its implementation (Gates et al., 2012c, 2013b). During the following three years, multiple positive changes to daily operations eventually led to a program that was more efficient, sustainable and effective in achieving its intended outcomes.

7.9.1 Positive Impact on Diet

At baseline, the vegetables and fruit, and milk and alternatives food groups of CFG were identified as targets for improvement, given the important nutrients that these food groups provide as well as the relatively low mean participant intake of these food groups as compared to current recommendations (Gates et al., 2012c, 2013b). Nutrient-dense choices from these food groups are important for growing youth as they are rich sources of calcium, vitamin D (milk and alternatives), folate, vitamin C, beta carotene, potassium and fibre (vegetables and fruit) (Whitney et al., 2013). Following four years of the program, promising improvements in the mean intakes of vegetables and fruit, and milk and alternatives were observed among participating youth, concomitant with increases in the mean intakes of carbohydrates, fibre, thiamine, riboflavin, folate, calcium, iron, potassium and zinc. A significantly greater proportion of youth met the CFG recommendations for vegetables and fruit, and milk and alternatives, the AMDR for protein and the EAR for riboflavin, niacin, vitamin B_{12}, vitamin B_6, calcium and zinc.

Particularly encouraging were the improvements observed in milk and alternatives intakes, calcium and vitamin D. Milk and alternatives are sources of the calcium (DC, 2014) and vitamin D (Vatanparast et al., 2010) in the Canadian diet. These nutrients are important for their role in the growth and maintenance of healthy bones and teeth, and in the achievement of peak bone mass (Heaney et al., 2000). The adequate intake of vitamin D, in particular, is especially important for those living at northern latitudes, where endogenous synthesis of the nutrient via sunlight (the main source of vitamin D) is inadequate for many months of the year (Ward, Gaboury, Ladhani, & Zlotkin, 2007), and people spend more time inside or heavily clothed due to the harsh, cold weather conditions.

Although there currently exist no conclusive data on the roles of adequate calcium and vitamin D status on body weight or body composition, epidemiologic studies have shown that low calcium and vitamin D status may be implicated in the development of obesity (Song & Sergeev, 2012). Although the current state of knowledge does not allow for the provision of recommendations for the intake of these nutrients based on their potential role in body fat accretion, it does provide a certain added impetus for the adequate intake of these nutrients for FN youth, whom are affected by overweight and obesity disproportionately (Shields, 2006). The rate of overweight and obesity in the participants of this study was measured at 70% in 2013 (using WHO cut points), which exceeds the national rate for youth of the same age by 38.5% (Roberts et al., 2012; Gates et al., 2015).

Substandard intakes of milk and alternatives, and calcium and vitamin D are relatively common among FN youth (Gates, Skinner, & Gates, 2015) as well was youth across Canada (Ward et al., 2007; Vatanprast et al., 2010; Health Canada, 2012). In many northern communities, the consumption of these foods is limited by local availability and economic access (Haman et al., 2010; Gates et al., 2011, 2013a). The current study demonstrates that providing milk products free of cost to students for whom these may otherwise not be accessible may be a feasible way of improving their intake, although cause-and-effect cannot be ascertained. Following four years of the program, the mean intake of milk and alternatives increased by 1.1 servings per day (55% of the CFG recommendation for 9-13 year-olds and 37% of the recommendation for 14-18 year-olds).

The significant increase in the mean vegetables and fruit intake was also notable, and likely linked to the simultaneous increases in mean intakes of fibre, folate and potassium. Like milk and alternatives, research on the relationship between adequate vegetable and fruit intake in childhood and adulthood and weight status is inconclusive (Ledoux, Hingle, & Baranowski, 2011). Nevertheless, there is evidence that adequate vegetable and fruit intake is associated with a lesser risk for heart disease and several cancers later in life (World Cancer Research Fund & the American Institute for Cancer Research, 2007; Wang et al., 2014). Dietary fibre, supplied in modest amounts by vegetables and fruit, has been suggested to reduce obesity risk in adults, although the evidence for children and youth is less convincing (Kranz, Brauchia, Slavin, & Miller, 2012). Given that there is insufficient data for the development of a RDA for fibre, the adequacy of the intake of this nutrient for Canadian youth is difficult to ascertain (Health Canada, 2012). Nevertheless, the median fibre intakes of both adolescent males and females in Canada fall below the AI, and research to date suggests an urgent need to continue to support and encourage adequate fibre intake for youth (Health Canada, 2012; Kranz et al., 2012).

Similar to milk and alternatives, the consumption of fresh vegetables and fruit is challenged in many northern communities due to the high cost of these foods, their limited availability and often poor quality once they arrive on store shelves (Skinner, Hanning, & Tsuji, 2006; Gates et al., 2011, 2013a). Even canned and frozen alternatives are very expensive and inaccessible for many people. Programs such as the one described herein help to overcome many of these challenges. The 1.2 serving increase in mean intake demonstrates the utility of such programs, and is also practically significant because inadequate vegetable and fruit consumption in childhood has been suggested to track into adolescence (Ambrosini, Emmett, Northstone, & Jebb, 2013). Moreover, youth who consume the recommended servings of vegetables and fruit when they are young are two to six times more likely to continue to do so as adults (te Velde, Twisk, & Brug, 2007). Optimizing the vegetable and fruit intakes of children via food provision may therefore be of benefit not only for their childhood health but also for their future diets and health as adults (te Velde, Twisk, & Brug, 2007). Although the majority of participants did not reach the CFG recommendations for vegetables and fruit, the proportion meeting this standard increased by 17.3% over the first four years of the program.

7.9.2 Comparison to Other Similar Programs

Although there are very few comparable studies of school food provision programs in other FN communities, those that do exist have noted similar positive findings. A 2012 study by *Skinner et al*. found that the participants of a well-established school snack program in a neighbouring James Bay community had higher intakes of milk and alternatives, calcium and vitamin D as compared to non-participants. Those who took part also consumed more vegetables and fruit, folate, fibre, vitamin C, vitamin A and iron (Skinner et al., 2012). Similarly, *Saksvig et al*. (2005)

investigated a school breakfast/snack program as part of the SLHDP providing Ojibway-Cree schoolchildren with a glass of 1% milk, a piece of fruit, a piece of cheese and a rice cake daily. Increased exposure to the program was associated with a significantly greater likelihood of meeting recommended minimum intake levels of dietary fibre (i.e., age (years) +5 g/day for 7-14 year olds) (Saksvig et al., 2005). The current study, in combination with these limited data, shows that school food provision may be a powerful tool to help enhance the intake of healthy foods in this vulnerable, young population. Further studies in other FN communities, with control groups where possible, are required in order to confirm these findings.

Conversely, other styles of school or community-based programs for Aboriginal youth have been met with mixed success at improving the intakes of food groups or nutrients (Towns, Cooke, Rysdale, & Wilk, 2014). A review by *Towns et al.* (2014) identified four unique school-based initiatives in Canada (the KSDPP and AS!BC) and the United States of America (USA) (Pathways and a Minneapolis after school program) aimed at reducing obesity and/or diabetes for FN youth that did not include a food provision component. Neither the Minneapolis program nor AS!BC resulted in any significant improvements in dietary intake (Rinderknecht & Smith, 2004; Tomlin et al., 2012; Towns et al., 2014).

The KSDPP, a multicomponent school and community initiative aimed at promoting healthy weights and reducing obesity for Mohawk schoolchildren (Paradis et al., 2005), included a school nutrition policy and curriculum component to promote healthy choices of both store-bought and traditional foods (Paradis et al., 2005). Over the first two years of the program, there were no changes in any of the dietary variables tested (vegetables and fruit, fat, and sugar); in the following six years, although scores on the fat and sugar consumption indices decreased, so did vegetable and fruit consumption (Paradis et al., 2005). The Pathways initiative in the USA was also a multicomponent school program, including a healthy eating curriculum and foodservice changes to promote healthy food choices aimed at reducing body fat for American Indian schoolchildren (Cabellero, Clay, Davis, Ethelbah, Rock, & Lohman et al., 2003). The program was successful in reducing the total percentage of energy intake from fat in participating students as compared to controls (Caballero et al., 2003). In neither of these two programs were the intakes of other food groups or nutrients assessed.

The current study adds to the paucity of research investigating the change in food group and nutrient intakes of FN youth over the course of a school food provision program. It also demonstrates that food availability and exposure can influence the dietary choices of youth. Research in a neighbouring James Bay community found that school nutrition curricula were associated with improved nutrition knowledge, exposure to and preferences for healthy foods and intentions to consume more milk and milk alternatives. However, partaking in the curricula was not sufficient to change food consumption patterns (Gates et al., 2011, 2013a). The desire and ability of individuals to prepare healthy foods was not seen as a hindrance to consumption; instead, the high cost, inadequate stock and poor quality of selections at the community store were identified as serious obstacles to choosing a healthy diet (Gates et al., 2011, 2013a). Similarly, in Alexander FN, a program including seven months of school gardening and four months of healthy snacks was able to improve youths' preferences for a variety of vegetables, but had no impact on participants' vegetable and fruit intakes at home (Triador et al., 2014). Social cognitive theory explains that a person's self-efficacy (i.e., belief in ones own ability to make a change) is vital to regulating health behaviour change; health improvement may thus be hindered by personal and physical impediments to self-efficacy (Bandura, 1998). School-based health initiatives may therefore have the ability to improve nutrition knowledge and intentions to consume a healthy diet or preferences for healthy foods, all while not significantly impacting dietary intake itself. In many FN communities, physical access to healthy choices may impair behaviour change despite the desire and intention of individuals to do so (Haman et al., 2010; Gates et al., 2011, 2013a).

Ideally, school nutrition initiatives in remote, isolated and/or northern Canadian FN communities should include a food provision component since healthy food availability is unreliable and exposure is uncertain. Research has indicated that youth's exposure to healthy foods and ample opportunity to taste new foods are highly predictive of food preferences (Cooke, 2007). In fact, it has been suggested that one half of the variability in youth's food preferences is accounted for by familiarity with a given food (Cooke, 2007). Conversely, foods that are unfamiliar are often disliked (Cooke, 2007). School food provision may be an effective health improvement strategy, especially in communities where healthy food availability is limited, by allowing for repeated exposure to healthy foods like fresh vegetables and fruit or milk and alternatives that may not normally be available to youth in their homes.

Youth who are exposed to a variety of healthy foods from a young age are known to have healthier diets throughout childhood (Cooke, 2007). Although not tested directly in the current study, the majority of students did report asking their parents to buy or serve the healthy foods that they tried at school, and making healthier choices because of their involvement in the program. Future research on the impact of school food provision on the variety of healthy foods consumed and the preferences for these foods would be of interest. Building on simple food provision, initiatives such as school gardening or cultural trips to procure local traditional foods may hold promise by simultaneously providing nutrition education, skill development and cultural connectedness all while improving healthy food access.

7.9.3 Continued Dietary Inadequacies and Unexpected Outcomes

Despite the numerous positive changes in diet that occurred, the school snack program described herein also demonstrates the potential for unexpected outcomes resulting from school food provision, and the limitations of this type of approach. Regardless of significant improvements in the mean intake of vegetables and fruit, and milk and alternatives and the associated micronutrients, the vast majority of youth still did not meet current recommendations for most food groups and nutrients. In fact, even after four years of the program, nearly all youth did not meet the AI for potassium or fibre, nor the EAR for vitamin D. The findings of *Skinner et al.* (2013) were similar; despite the longstanding, stable nature of the program that they investigated and the positive impact that it imparted on the diets of participants, the nutrient intakes of the majority of participating youth still failed to meet current dietary standards. Of note, because the EAR is the amount of a nutrient predicted to meet the needs of only 50% of a healthy population, if the RDA had been used even greater proportions of youth would have been categorized as having insufficient intakes.

Although the school snack program positively impacted the food group and nutrient intakes of participating youth, in reality it only helped to improve upon one eating occasion out of the typical three meals and multiple snacks that youth consume on a daily basis. There were no components aimed at modifying the availability of healthy options at home or at the community store, nor were there any components aimed at improving parental knowledge or food skill development. Building on school food provision and guided by the social ecological model developed by *Willows, Hanley & Delormier* (2012), expansion of the program to include family and community-level components (e.g., community gardening projects, food purchasing cooperatives, food skill development and education for families) would likely help to provide for continued improvement in the diets of youth. Realistically, diets cannot be expected to further improve should significant changes to food availability within the community not occur via policies and programs that may require substantial resources; these resources may not be available at this time.

The program, as it was designed, provides only store-bought foods and not traditional foods, which are known to provide numerous vital nutrients as well as cultural benefits for FN youth (Kuhnlein et al., 2004; Haman et al., 2010). Expansion of the program to include traditional food procurement and preparation would help to develop these food skills among FN youth, for whom traditional food consumption is on the decline (Kuhnlein et al., 2004; Willows, 2005). A review of the research suggested that the substitution of traditional foods, which once made up the vast majority of FN peoples' diets (Kuhnlein et al., 2004), with nutrient-poor store-bought alternatives was at least partly to blame for the often poor micronutrient intakes within this population (Willows, 2005). Although ensuring the access of high quality, nutrient-dense store-bought choices for youth is a positive first step, the incorporation of traditional foods would improve upon the cultural relevance of the program and is something that the community has expressed a desire for. A number of participating youth also requested more traditional foods when asked about the types of changes they would like to see to the program.

One unexpected outcome of the program was a significant increase in mean total energy intake after four years as compared to baseline. Given the very high rates of overweight and obesity in the participating youth, this apparent increase in total food intake is clearly not desirable. That said, it is entirely possible that mean energy expenditure also increased over the same time period, thus increasing total energy requirements and accounting for the increase in intake, although this variable was not explored as part of the current study. Of note, the school implemented an after-school sports program in October 2012. Between October 2012 and June 2013, participating youth increased their time spent in moderate-to-vigorous physical activity by 48 minutes per day (p=0.016) (objectively measured via accelerometry over three school days) and BMI z-score did not change (Gates, Hanning, Gates, Stephen, Fehst, & Tsuji, in press). The after-school sports program was not available at the advent of the school snack program in 2009, thus it is likely that 2009 activity levels were similar to those observed prior to the start of the sports program in the Fall of 2012.

Unfortunately, the cause of the increased energy intakes observed as part of this study cannot be isolated, nor can it be determined with any certainty whether or not it was in fact warranted based on energy expenditure. When investigated per 1000 kcal, there were in fact no significant changes in the mean nutrient density of the diets over the first four years of the program, with the exception of milk and alternatives, and calcium which both increased significantly in boys. This does not negate the fact that following four years of the program, participating youth were significantly more likely to meet dietary recommendations for vegetables and fruit, milk and alternatives, riboflavin, niacin, vitamin B_6, vitamin B_{12}, calcium and zinc. In this way, diet quality can be thought to have improved.

It can also not be ignored that following four years of the program, youth had significantly higher intakes of 'other' foods (+2.2 servings), which contribute to energy intake without necessarily providing substantial amounts of any other nutrients. Although this did occur simultaneously with the progression of the program, records indicate that this outcome is not in fact a reflection of the types of food served as part of the program itself. On the days studied, youth had access to English muffins, peanut butter, bananas, apples and yogurt through the program, none of which are considered 'other' foods. It is possible that with the increase in energy intake, youth were also consuming more of the foods that were readily available to them at the local food outlets. Although it would require substantial resources, one solution to this problem would be to establish a universal breakfast and lunch program for FN youth residing in isolated, remote and/or northern communities. It is plausible that such an initiative would substantially increase the likelihood of making healthy food choices and reduce the necessity of youth to consume cheap, energy-dense, nutrient-poor alternatives to meet their energy needs.

7.9.4 Sustainability, Challenges and Future Directions

As exemplified by the challenges encountered during its first year, the sustainability and feasibility of school food provision in this remote, isolated community was uncertain in the early stages. Although not confirmed by this study, it is expected that comparably remote and isolated communities may face similar challenges to the start-up and continuation of school food provision initiatives. The present study serves as a case study and provides 'lessons learned' which may help to guide such communities to overcome some of the barriers to the development and maintenance of their own programs.

The most significant challenges to the development and continuation of the healthy snack program were securing adequate and sustained funding, and reliable and dedicated personnel. Some small grants are available to FN communities wishing to start food provision programs at their schools, but the funds provided by these are typically not sufficient as they do not account for the high cost of food in many northern locations. They also do not account for the added start-up costs for communities that have no facilities or equipment for food preparation or storage, or the fact that it is not reasonable to expect schools to fundraise in areas where few economic opportunities are available. Oftentimes, grant programs do not account for personnel salaries and therefore volunteers must be relied upon to operate the program without monetary compensation. Without a team of dedicated and reliable personnel in its first year, the program could only run sporadically as all of the responsibilities of running the program fell on one person.

The most significant impetus for the ongoing sustainability of the program was the advocacy of local champions which led to the formation of a school snack program committee and eventually, local government support for the program. Support and sustained funding from the local government meant that the program could really take off in its third year; facilities were built to support the development of the program (additional portable classroom), food safety training was acquired for the committee members, supplies were purchased (e.g., refrigerators, bowls), and bulk food purchasing was initiated, which helped to reduce costs and increased the variety and quality of food that could be served. Ideally, similar communities looking to implement school food provision programs should seek local champions for the program and assemble a local team of personnel with a common interest in the program as early as possible to improve the probability that the program will be successful in achieving its intended outcomes.

Despite sizeable improvements in the program over its first four years of operation, certain challenges have yet to be overcome. The variety of foods that can be served is still restricted to those that are either available at the local store, or that can survive the harsh weather conditions experienced during transport to the north. Because of limited time and preparation space, the large number of students who take part in the program and the fact that the snacks must be transported to the portable classrooms, the foods given must be easy to prepare and transport, therefore few vegetables are included. Despite students' morale for the program, food provision itself cannot be relied upon for changing intentions or attitudes; at four years, a number of youth desired that 'junk' foods be added to the program. School food provision, nevertheless, is a positive first step in communities with little to no existing nutrition programming, and one that will likely have the greatest impact on diet as compared to education or other initiatives.
Since the 2013 evaluation, the program has continued and has expanded to include fresh fruits and vegetables twice weekly via the nearby Health Unit for two months of the year. The Health Unit also donated a refrigerator to increase the school's storage capacity of fresh foods, plastic food models and other resources for classroom lessons (e.g., seeds). The school's health programming now also includes cultural foods (e.g., wild meats and fish) and cultural food procurement experiences for youth (J Stephen, personal communication, 15 June 2015). The

school still consists of portables, yet the ongoing success and expansion of the program despite early challenges is a demonstration of the community's ongoing dedication to the health of their youth.

7.10 Results Dissemination

Preliminary descriptive results from the 2009 and 2013 data collections have been transmitted to the community via reports (for teachers, the principal and the local health authority), summary sheets (for parents/guardians) and presentations (for teachers and the principal). Students received instantaneous feedback regarding their food group intakes as compared to CFG recommendations via a summary page at the end of the WEB-Q, which they were encouraged to print if they so desired. Additional presentations and reports related to the findings of this study will be made upon request of the community. It is also anticipated that continued discussion between the UW research team and community stakeholders will occur remotely (i.e., via e-mail, Skype or telephone) given the cost of travel.

The findings of this research have been presented at a number of academic conferences, including the Canadian Obesity Summit (Vancouver, British Columbia, 2013), the Canadian Nutrition Society Annual Meeting (St. John's, Newfoundland, 2014) and the International Society for Behavioral Nutrition and Physical Activity Conference (Edinburgh, Scotland, 2015). The resultant manuscript has been accepted for publication in the journal *Health Behaviour and Policy Review*.

7.11 Strengths and Limitations

Very few studies have reported on the impact of simple food provision programs in remote, isolated FN communities, their feasibility, long-term sustainability and strategies to overcome common challenges. This research will be of utility for communities facing comparable circumstances who are looking to start similar programs. It also adds to the paucity of data on the ability of school food provision to improve food group and nutrient intakes in this population of youth.

It should be noted that although the use of three non-consecutive 24-hour recalls is recommended to accurately estimate the dietary intakes of youth (Burrows, Martin, & Collins, 2010), only one recall was used at both time points in this study. As thoroughly described in **Study 4** (*6.10 Strengths and Limitations*), measures were taken to ensure that the foods reported were representative of normal school-day intakes, participants reporting unusual days of intake were excluded from the analyses, and the chosen methodology was a compromise between scientific rigour, participant burden and the complexity of data collection in remote and isolated locations.

The accuracy of the self-reported method of dietary intake assessment used in this study may have been hampered by recall error and social desirability bias, but as previously described (**Study 4**, *6.10 Strengths and Limitations*), the tool utilizes the multiple pass methodology, reducing this possibility. The self-administered, anonymous quality of the WEB-Q reduced the risk of social desirability bias compared to face-to-face interviews.

Because this study did not follow a randomized controlled design, any changes in diet over the four-year study period cannot be conclusively attributed to the snack program; thus, the results should be interpreted with this in mind. It should be noted that the Nutrition North Canada program (Government of Canada, 2014), which subsidizes the cost of some perishable foods in northern Canada, came into effect during the four-year study period and could have impacted the dietary intakes of youth. The current study could not account for this potential confounder. That being said, the participating community was not large enough to accommodate a comparison group; providing a program that is expected to be immediately beneficial, for only a select proportion of community youth, would have been unethical. Because not all FN communities are directly comparable (even those that are located in close proximity geographically), neighbouring communities would not have provided suitable controls for the purposes of this study. The study is strengthened by the fact that both data collections occurred during the same season.

The small sample sizes for the quantitative analyses (n=43, 71.6% participation rate in 2009; n=53, 67.1% participation rate in 2013) may have reduced the power to detect significant differences in diet from baseline to four years. That being said, 100% of the students at school on the days that the questionnaires were administered completed the study. Although the results may not be generalizable to other communities, they still remain important for similar communities along the western coast of James and Hudson Bays. The sample size for the qualitative component was too small to reach saturation or to provide generalizable findings (Sandelowski, 1995), however, participants were chosen purposively based on their depth of understanding of a very specific experience, and were the only local individuals with a comprehensive understanding of the program.

7.12 Conclusions

With sustained funding and adequate resources, a dedicated team of personnel, unrelenting advocacy, and local government support, a healthy school snack program in a remote, isolated FN community in northern Ontario was feasible and sustainable and had the power to improve the dietary intakes of participating youth after four years. Despite significant improvements in vegetables and fruit, and milk and alternatives intakes, and the nutrients that these food groups impart, the dietary intakes of the majority of youth still fell short of recommended intake levels. The program remains limited in the type and variety of snacks that can be served, which are restricted by the harsh traveling conditions that the foods must endure on their way to the north. Additional components of comprehensive school health, including education, policy and community engagement, may work synergistically with food provision to enhance the diets of FN youth.

7.13 Acknowledgements

The author would like to thank the community for their contribution to this research and the participants for taking part in this study. Thank you to Judy Stephen for her help in planning the project and continued support of the research partnership; to Dr. Ian Martin (University of Toronto Scarborough) for his statistical advice; and to Alex Stephen for field transportation. This research was funded by a CIHR research grant.

8.0 Discussion and Key Contributions

8.1 General Discussion

Youth living in FN communities in Canada are vulnerable to poor nutrition and risk of chronic disease. Collectively, this work has taken advantage of multiple approaches to begin to provide for a general understanding of some of the factors that may influence the food choices of on-reserve FN youth, and to evaluate strategies that may be used to support the health of these young people. The social ecological model (Sallis, Owen, & Fisher, 2008; Willows, Hanley, & Delormier, 2012) proved to be useful to frame the many influences on the food choices of youth; triangulation of multiple approaches (a systematic literature review, the analysis of national survey data, and evaluations of school and community programs) provided a rich explanation of the phenomenon. This thesis adds to the academic literature on the strategies to support the nutrition and health of FN youth, their families and communities.

The systematic review undertaken at the outset of this thesis provided a foundation of knowledge on the dietary intakes of school-aged Aboriginal youth. This comprehensive review guided the development of research questions, and the generation of ideas for potential programming initiatives that had the potential to be well received and lead to positive dietary outcomes for youth in three communities. A strengths-based approach (McCaskey, 2008) is important when working with FN populations, to avoid exacerbating negative stereotypes or stigmatizing a population that already faces many systematic social inequities. The review brought to light some disappointing realities; namely, that the diets of Aboriginal youth, on average, are far from established standards for health and longevity (Gates, Skinner, & Gates, 2015). Nevertheless, the knowledge gained set the stage for a positive, optimistic approach to the exploration of some of the determinants of healthy diet patterns.

Data from the 2008/10 RHS allowed for a focus on two separate facets of food behaviours, those being nutritious store-bought food and traditional food intake, which are both integral to a healthy diet pattern for FN youth. A strengths-based research approach frames ‘problems’ as being external to the individual (McCaskey, 2008), and this is supported by social ecological models (Sallis, Owen, & Fisher, 2008; Willows, Hanley, & Delormier, 2012) which attempt to explicate the many influences on health behaviours, such as food choices, of which the individual level (e.g., personal beliefs, attitudes, knowledge) is only one component. Rather than exploring negative food behaviours (e.g., high intakes of ‘other’ foods), and the factors that result in these, the author chose to focus here on positive behaviours (i.e., *daily* vegetable and milk and milk products intake, and *frequent* traditional food intake). The findings, thus, inform potential supports of healthy food choices for FN youth.

The RHS analyses were strengthened by the fact that the data were collected by FN people, in collaboration with the participating communities. The data themselves are unique in that no other survey has comprehensively reported on the health and wellbeing of on-reserve FN people, who face challenges and circumstances with relation to food choices and health outcomes that differ from off-reserve populations and the general population of youth. The survey provided data on a relatively large sample of youth, which strengthened the analyses, especially given that the bulk of the studies on the diets of these young people have employed very small sample sizes and have been carried out at the community level (Gates, Skinner, & Gates, 2015). The broad range of data also allowed for the investigation of a wide range of potential influences.

This thesis was designed so that the comprehensive picture provided by the analysis of RHS data was complemented by prospective studies at the community level that allowed for in-depth examinations of specific determinants and the interpretation of findings from the perspectives of FN community members. The research was strengthened by collaborative processes in which community stakeholder perspectives were integral to the development of the ideas and strategies used. As a researcher, it is only second nature to rely on theories and scholarly knowledge as the basis of program development. Community stakeholders, on the other hand, hold a keen interest in the health of their youth, and have specialized knowledge of the challenges that their communities face. Perhaps even more important, they are acutely aware of the community-level strengths that can be capitalized upon to design promising school and community interventions.

Systems-level approaches (Wilk & Cooke, 2015) make it clear that there is no single program or intervention that will be sufficient to change the diets of FN youth. Drastic changes in the environments in which FN youth and their families make choices about what they eat, including policy and program interventions, will be necessary to support positive change. Nevertheless, it is important to take context into consideration (Wilk & Cooke, 2015), and it is here where the community collaborators played a crucial role in designing and delivering realistic and sustainable initiatives. The work herein demonstrates that in communities with few pre-existing resources for programming, even initiatives that may seem relatively simple and uni-faceted can be logistically challenging to implement.

The community level studies exemplify the potential to change behaviour through addressing barriers and embracing opportunities. Based on the author's experience from working with the communities, there was never a shortage of ambitious ideas on behalf of the collaborators for new initiatives to optimize the health of their youth. It was, instead, a shortage of resources to bring these ideas to fruition that, more often, limited program implementation, development, sustainability and evaluation. The studies herein are examples of what can be achieved when community members with a similar vision rally together and gain local support for their work. It is exceptionally important that programs such as those within this thesis are evaluated and documented, to inform promising practices and broader policy changes. The losses to methodological rigour from small samples sizes and logistic constraints are balanced by relevance.

This thesis demonstrates how multiple study designs, each with their respective strengths and weaknesses, can support the generation of different types of knowledge to further the current understanding of food choices for FN youth, and to promote healthy choices. Though in no way comprehensive, this work has contributed new information to a growing body of literature on the determinants of on-reserve FN youth's food choices, filling gaps where previous research was relatively scarce.

8.2 Contributions

Each of the five studies contained within this thesis contributes to current knowledge on the food habits of FN youths, the factors that influence their food choices, and the potential of community-level programming to influence patterns of food intake. The key contributions for each of the studies are described in this section to bring the conglomerate of the findings together in a more succinct fashion.

Study One provided a foundation for the work that followed it by reviewing and summarizing the current state of knowledge about the dietary intakes of Aboriginal youth living in Canada. The study was novel in that it is the first review of its kind in the field. Further, by comprehensively examining what was already known, important areas for future research emerged. These included specific populations that require further attention (e.g., school-aged Inuit and Métis youth), the need for a greater understanding of the many factors that influence the food choices of Aboriginal youth, and for examples of successful programs that support healthy diets. Work in subsequent chapters addressed some of the research gaps identified.

Study Two provided an exploration of the predictors of frequent traditional food intake in a relatively large, nationwide sample of FN youth living on reserves across the country. Prior to this study, no investigations of this nature existed in this young population, and particularly not in a nationwide sample. Although the nutritional and cultural merits of traditional food intake have been reported for Inuit and Métis adults and youth, little research had explored the traditional food intake of FN youth. The findings support strengthening youth's ties to their FN culture as a promising approach to promoting their holistic health through the consumption of traditional foods.

Study Three built on the previous study by exploring the potential predictors of daily healthy store-bought food consumption (i.e., vegetables, and milk and milk products) in a relatively large sample of FN youth from reserve communities across Canada. Studies using a nationwide sample of on-reserve youth had not been previously published. Akin to the previous study, the knowledge gained throughout this exploratory work helped to develop a preliminary understanding of some of the predictors of healthy store-bought food intake for this population, thus identifying specific behaviours or conditions that may warrant more in-depth investigation. The findings support the potential for multi-component initiatives, targeting multiple health behaviours, to promote the health and nutrition of youth.

Study Four was an example of a community level intervention that built on food sharing as an opportunity to enhance traditional food intake identified in chapter two. It investigated the prevalence and frequency of snow goose consumption and its contribution to food group and nutrient intakes for FN youth in two remote, isolated subarctic communities. Traditional food intake had been scarcely investigated in FN youth living on reserves (as compared to Inuit or Métis youth living in Canada's north). This study adds to the scant body of literature and elaborates on what was currently known by investigating differences by sex. Although harvest sharing is common in FN communities, the impact of more formal harvest sharing programs was also understudied. This research demonstrated the modest benefits that can result from resource-intensive harvest sharing programming.

Study Five addressed the poor diet quality identified in **Study Three** and built on the opportunity of school-level programming identified in **Study One**. It provided a unique look into the barriers and facilitators to the sustainability of a school snack program in a remote, isolated FN community, as well as its impact on the diets of participating youth. Although it is believed that such programs are quite common in FN communities, they have not often been evaluated or reported on. This study substantiated the need for such programs in communities where food insecurity prevalence rates are high and access to healthy foods is limited. It demonstrated how programs that are community-owned and have the support of local champions can be sustainable, and support the nutritional health of at-risk populations. It is, nevertheless, likely that broader policy and environmental changes will be required to address the nutrition-related health disparities experienced by this population.

8.3 Potential Shortcomings

Notwithstanding the contributions that this thesis work has provided, it is important to acknowledge the known shortcomings of the research. First, the nearly entirely quantitative nature of this work has resulted in findings that are relatively uni-dimensional; the voices of the FN youth themselves have not had the opportunity to come to the forefront through this research. This is largely the result of the exploratory nature of the studies using the RHS data (**Study Two** and **Study Three**). These were only a small contribution to what needs to be learned about the food choices of this young and vulnerable population. Ideally, the results of this work could be returned to each participating community; qualitative investigations (e.g., sharing circles, photovoice) in a sample of focal communities would help to add a FN perspective to the identified relationships, and help develop an understanding of their meaning. Unfortunately, this was not a possibility within the scope, timeline and budget of the current thesis work.

In hindsight, the programming and methods for the two community-level studies (**Study Four** and **Study Five**) could have been more culturally relevant or sensitive. Also, the greater involvement of community members in the evaluation processes would have promoted community-based research and evaluation capacity, empowering the communities to continue data collection and evaluation on their own terms. More careful advance planning may have also helped to play a role in enhancing sustainability. Despite these weaknesses, these programming efforts were ultimately well received by the participating communities. Important to acknowledge here is that when the available resources are time-bound (as are most research grants) and motivated personnel are on board, it is not necessarily ethical to withhold or delay a project that has the potential to benefit a population of youth who are particularly vulnerable. The more than decade-long collaboration of the UW research team and participating communities has allowed for extensive discussion and study of the barriers and supports to healthy lifestyles and the types of programs that may help to enrich the lives of youth (Skinner, Hanning, & Tsuji, 2006).

The community-based work was limited by lack of a control group and small sample sizes. However, FN communities are unique and comparable controls unlikely. The fact that school food provision programs in FN communities are rarely evaluated or reported on means that there are few examples to draw on and limited evidence for 'best practices'. Should evaluations of these programs not be undertaken or published based on potential weaknesses that are, oftentimes, out of the control of the researcher, this trend will only continue. Despite the compromises to rigour that constrain research in remote communities, the data collected were of great value to the participating communities who are motivated to learn about the health of their youth.

9.0 Future Directions

Beyond representing relatively novel contributions to the current body of research on the diets and food habits of FN youths, the studies described within this thesis also lend themselves to a brief discussion of future research directions that may follow from the findings described in each chapter.

As evidenced in **Study One**, more research is needed to explore the diets of Inuit and Métis youth of school age, a population that has been relatively underserved in this respect. Although much knowledge exists of the diets of younger (six years or less) children belonging to these distinct cultural groups, as well as adults, school-aged youth have rarely been studied. Information about school-aged youth is especially important because this is a critical age when many lifetime habits are being acquired. Moreover, such data would inform programming that could be put in place at the school level, providing for a broad reach and potentially greater impact.

The findings from the exploratory work in **Study Two** provide for only a very limited understanding of some of the factors that may predict frequent traditional food intake for on-reserve FN youth. Why and how these different factors (i.e., namely food sharing and connectedness to one's culture) affect food intake in this population deserves further attention, and qualitative methods that would allow for youth to explicate the meaning of these findings would be of great value. This is especially true given that most of the research investigating traditional foods for Aboriginal people have either focused on adults or on young populations living in the arctic or of Inuit or Métis descent.

A more thorough understanding of how different cultural and community factors influence traditional food consumption would allow for the identification of specific target areas for programming, as well as pertinent areas where policy changes could be applied. These may vary significantly across different communities. Regional analyses could not be performed due to the limited availability of these data in the context of this thesis work. In the future, however, further investigations of differences by geographic remoteness, latitude, region and community size would be a positive step toward a greater understanding of how these may affect food choices. Investigations of seasonal differences would also be of interest, given that variation in food intake by season has been identified in at least some reserve communities (Kuhnlein, Souieda, & Receveur, 1995).

Similarly, **Study Three** provided for a preliminary exploration of the predictors of healthy store-bought food choices for this population, however, much room remains for developing a comprehensive understanding of these influences from a FN perspective. Akin to **Study Two**, the findings of this study need to be triangulated with qualitative information collected from youth. Regional and seasonal analyses would also be of interest.

The findings of the community-based research (**Study Four** and **Study Five**) helped to substantiate the need for programming to support healthy diets, especially in communities where food insecurity is prevalent and access to healthy foods (both store-bought and traditional) is limited. Despite the modest successes of the programs described in **Study Four** and **Study Five**, there remains great potential for future study. The initial findings of the harvest sharing initiative during the pilot phase may be used to enhance the currently existing program such that the benefits initially observed could be amplified. Qualitative investigations and ongoing discussion and collaboration with the participating communities as to how they would like to go about this, if they are interested, would be of value. Some potential areas for exploration would include expanding the program to include multiple seasons and the harvest of a greater variety of species. Children could also be more involved in the program; some of the harvest procured could go directly to the school food provision programs in the respective communities. This would not only to strengthen the cultural relevance of these previously existing programs, but also provide for unique learning experiences and improved cultural knowledge should youth be involved in the procurement and/or preparation of the harvested foods.

Akin to **Study Four**, the findings of the evaluation of the healthy school snack program in **Study Five** may be used to begin conversations with the community-based collaborators on possible next steps for their existing school-based health programming. Already, continued collaboration with the community has led to the inception and evaluation of an after school sports program for youth (Gates et al., 2015). The addition of more traditional foods to the daily snack program, and cultural learning experiences within the classroom have been identified as possible areas for development.

10.0 Closing Remarks

Throughout the past seven years, I have had the good fortune of working with knowledgeable, skilled mentors and collaborators. Beginning as a recent graduate of dietetics, I had no clear vision of what lay ahead for me but I certainly had no idea that, nearly three quarters of a decade down the road, I would end up here.

The health disparities experienced by Canada's FN people are cause for concern and deserve attention. I am in a sense lucky to have been provided with the opportunity to travel to northern Ontario to see the unfortunate living conditions experienced by some of Canada's first people firsthand. It is without a doubt that substantial changes in programming and policies are required to ensure the good health of this vulnerable population. To inform such programs and policies, first a greater understanding of the many contributors to the health choices of this population is necessary. My own interests and expertise in nutrition and my clinical background led me to focus, mainly quantitatively, on the diets and food choices of youth within this work.

This thesis has built on what was currently known about the diets and food habits of FN youth living on reserves, and has provided some examples of relatively successful community programs that have encouraged the good health of schoolchildren. Although only a small contribution to the current body of research, it can only be my hope that this work will provide one more piece of a very complex puzzle and perhaps inspire more in-depth inquiries into the contributors to the health of this population in great need.

Thank you for reading.

11.0 Letters of Copyright Agreement

11.1 Copyright Agreement from John Wiley and Sons for Study One

RightsLink - Your Account https://s100.copyright.com/MyAccount/viewPrintableLicenseDe...

JOHN WILEY AND SONS LICENSE
TERMS AND CONDITIONS

Oct 27, 2015

This Agreement between Allison Gates ("You") and John Wiley and Sons ("John Wiley and Sons") consists of your license details and the terms and conditions provided by John Wiley and Sons and Copyright Clearance Center.

License Number	3737150374223
License date	Oct 27, 2015
Licensed Content Publisher	John Wiley and Sons
Licensed Content Publication	Journal of Human Nutrition and Dietetics
Licensed Content Title	The diets of school-aged Aboriginal youths in Canada: a systematic review of the literature
Licensed Content Author	A. Gates,K. Skinner,M. Gates
Licensed Content Date	May 22, 2014
Pages	16
Type of Use	Dissertation/Thesis
Requestor type	Author of this Wiley article
Format	Electronic
Portion	Full article
Will you be translating?	No
Title of your thesis / dissertation	The diets of on-reserve First Nations youth: an exploration of the factors associated with healthy food choices and the impact of school and community programs
Expected completion date	Dec 2015
Expected size (number of pages)	340
Requestor Location	Allison Gates [redacted] None None [redacted] Canada Attn: Allison Gates
Billing Type	Invoice
Billing Address	Allison Gates [redacted] None None [redacted] Canada Attn: Allison Gates
Total	**0.00 CAD**
Terms and Conditions	

TERMS AND CONDITIONS

This copyrighted material is owned by or exclusively licensed to John Wiley & Sons, Inc. or one of its group companies (each a"Wiley Company") or handled on behalf of a society with which a Wiley Company has exclusive publishing rights

of 4 15-10-27 4:15 PM

in relation to a particular work (collectively "WILEY"). By clicking "accept" in connection with completing this licensing transaction, you agree that the following terms and conditions apply to this transaction (along with the billing and payment terms and conditions established by the Copyright Clearance Center Inc., ("CCC's Billing and Payment terms and conditions"), at the time that you opened your RightsLink account (these are available at any time at http://myaccount.copyright.com).

Terms and Conditions

- The materials you have requested permission to reproduce or reuse (the "Wiley Materials") are protected by copyright.

- You are hereby granted a personal, non-exclusive, non-sub licensable (on a stand-alone basis), non-transferable, worldwide, limited license to reproduce the Wiley Materials for the purpose specified in the licensing process. This license, **and any CONTENT (PDF or image file) purchased as part of your order,** is for a one-time use only and limited to any maximum distribution number specified in the license. The first instance of republication or reuse granted by this license must be completed within two years of the date of the grant of this license (although copies prepared before the end date may be distributed thereafter). The Wiley Materials shall not be used in any other manner or for any other purpose, beyond what is granted in the license. Permission is granted subject to an appropriate acknowledgement given to the author, title of the material/book /journal and the publisher. You shall also duplicate the copyright notice that appears in the Wiley publication in your use of the Wiley Material. Permission is also granted on the understanding that nowhere in the text is a previously published source acknowledged for all or part of this Wiley Material. Any third party content is expressly excluded from this permission.

- With respect to the Wiley Materials, all rights are reserved. Except as expressly granted by the terms of the license, no part of the Wiley Materials may be copied, modified, adapted (except for minor reformatting required by the new Publication), translated, reproduced, transferred or distributed, in any form or by any means, and no derivative works may be made based on the Wiley Materials without the prior permission of the respective copyright owner.**For STM Signatory Publishers clearing permission under the terms of the STM Permissions Guidelines only, the terms of the license are extended to include subsequent editions and for editions in other languages, provided such editions are for the work as a whole in situ and does not involve the separate exploitation of the permitted figures or extracts,** You may not alter, remove or suppress in any manner any copyright, trademark or other notices displayed by the Wiley Materials. You may not license, rent, sell, loan, lease, pledge, offer as security, transfer or assign the Wiley Materials on a stand-alone basis, or any of the rights granted to you hereunder to any other person.

- The Wiley Materials and all of the intellectual property rights therein shall at all times remain the exclusive property of John Wiley & Sons Inc, the Wiley Companies, or their respective licensors, and your interest therein is only that of having possession of and the right to reproduce the Wiley Materials pursuant to Section 2 herein during the continuance of this Agreement. You agree that you own no right, title or interest in or to the Wiley Materials or any of the intellectual property rights therein. You shall have no rights hereunder other than the license as provided for above in Section 2. No right, license or interest to any trademark, trade name, service mark or other branding ("Marks") of WILEY or its licensors is granted hereunder, and you agree that you shall not assert any such right, license or interest with respect thereto

- NEITHER WILEY NOR ITS LICENSORS MAKES ANY WARRANTY OR REPRESENTATION OF ANY KIND TO YOU OR ANY THIRD PARTY, EXPRESS, IMPLIED OR STATUTORY, WITH RESPECT TO THE MATERIALS OR THE ACCURACY OF ANY INFORMATION CONTAINED IN THE MATERIALS, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY, ACCURACY, SATISFACTORY QUALITY, FITNESS FOR A PARTICULAR PURPOSE, USABILITY, INTEGRATION OR NON-INFRINGEMENT AND ALL SUCH WARRANTIES ARE HEREBY EXCLUDED BY WILEY AND ITS LICENSORS AND WAIVED BY YOU.

- WILEY shall have the right to terminate this Agreement immediately upon breach of this Agreement by you.

- You shall indemnify, defend and hold harmless WILEY, its Licensors and their respective directors, officers, agents and employees, from and against any actual or threatened claims, demands, causes of action or proceedings arising from any breach of this Agreement by you.

- IN NO EVENT SHALL WILEY OR ITS LICENSORS BE LIABLE TO YOU OR ANY OTHER PARTY OR ANY OTHER PERSON OR ENTITY FOR ANY SPECIAL, CONSEQUENTIAL, INCIDENTAL, INDIRECT, EXEMPLARY OR PUNITIVE DAMAGES, HOWEVER CAUSED, ARISING OUT OF OR IN CONNECTION WITH THE DOWNLOADING, PROVISIONING, VIEWING OR USE OF THE MATERIALS REGARDLESS OF THE FORM OF ACTION, WHETHER FOR BREACH OF CONTRACT, BREACH OF WARRANTY, TORT, NEGLIGENCE, INFRINGEMENT OR OTHERWISE (INCLUDING, WITHOUT LIMITATION, DAMAGES BASED ON LOSS OF PROFITS, DATA, FILES, USE, BUSINESS OPPORTUNITY OR CLAIMS OF THIRD PARTIES), AND WHETHER OR NOT THE PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. THIS LIMITATION SHALL APPLY NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY PROVIDED HEREIN.

- Should any provision of this Agreement be held by a court of competent jurisdiction to be illegal, invalid, or unenforceable, that provision shall be deemed amended to achieve as nearly as possible the same economic effect as the original provision, and the legality, validity and enforceability of the remaining provisions of this Agreement shall not be affected or impaired thereby.

- The failure of either party to enforce any term or condition of this Agreement shall not constitute a waiver of either party's right to enforce each and every term and condition of this Agreement. No breach under this agreement shall be deemed waived or excused by either party unless such waiver or consent is in writing signed by the party granting such waiver or consent. The waiver by or consent of a party to a breach of any provision of this Agreement shall not operate or be construed as a waiver of or consent to any other or subsequent breach by such other party.

- This Agreement may not be assigned (including by operation of law or otherwise) by you without WILEY's prior written consent.

- Any fee required for this permission shall be non-refundable after thirty (30) days from receipt by the CCC.

- These terms and conditions together with CCC's Billing and Payment terms and conditions (which are incorporated herein) form the entire agreement between you and WILEY concerning this licensing transaction and (in the absence of fraud) supersedes all prior agreements and representations of the parties, oral or written. This Agreement may not be amended except in writing signed by both parties. This Agreement shall be binding upon and inure to the benefit of the parties' successors, legal representatives, and authorized assigns.

- In the event of any conflict between your obligations established by these terms and conditions and those established by CCC's Billing and Payment terms and conditions, these terms and conditions shall prevail.

- WILEY expressly reserves all rights not specifically granted in the combination of (i) the license details provided by you and accepted in the course of this licensing transaction, (ii) these terms and conditions and (iii) CCC's Billing and Payment terms and conditions.

- This Agreement will be void if the Type of Use, Format, Circulation, or Requestor Type was misrepresented during the licensing process.

- This Agreement shall be governed by and construed in accordance with the laws of the State of New York, USA, without regards to such state's conflict of law rules. Any legal action, suit or proceeding arising out of or relating to these Terms and Conditions or the breach thereof shall be instituted in a court of competent jurisdiction in New York County in the State of New York in the United States of America and each party hereby consents and submits to the personal jurisdiction of such court, waives any objection to venue in such court and consents to service of process by registered or certified mail, return receipt requested, at the last known address of such party.

WILEY OPEN ACCESS TERMS AND CONDITIONS
Wiley Publishes Open Access Articles in fully Open Access Journals and in Subscription journals offering Online Open. Although most of the fully Open Access journals publish open access articles under the terms of the Creative Commons Attribution (CC BY) License only, the subscription journals and a few of the Open Access Journals offer a choice of Creative Commons Licenses. The license type is clearly identified on the article.
The Creative Commons Attribution License
The Creative Commons Attribution License (CC-BY) allows users to copy, distribute and transmit an article, adapt the article and make commercial use of the article. The CC-BY license permits commercial and non-
Creative Commons Attribution Non-Commercial License
The Creative Commons Attribution Non-Commercial (CC-BY-NC)License permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.(see below)

Creative Commons Attribution-Non-Commercial-NoDerivs License
The Creative Commons Attribution Non-Commercial-NoDerivs License (CC-BY-NC-ND) permits use, distribution and reproduction in any medium, provided the original work is properly cited, is not used for commercial purposes and no modifications or adaptations are made. (see below)
Use by commercial "for-profit" organizations
Use of Wiley Open Access articles for commercial, promotional, or marketing purposes requires further explicit permission from Wiley and will be subject to a fee.
Further details can be found on Wiley Online Library http://olabout.wiley.com/WileyCDA/Section/id-410895.html

Other Terms and Conditions:

v1.10 Last updated September 2015

Questions? customercare@copyright.com **or +1-855-239-3415 (toll free in the US) or +1-978-646-2777.**

11.2 Email Correspondence Indicating Permission to Reproduce Study Five from Paris Scholar Publishing Ltd.

Question re: manuscript HBPR-2015-48/R1-(107) Inbox x

Allison Gates [redacted] Nov 9 (2 days ago)

to rjmcdermott

Hello Dr. McDermott,

Thank you for your recent e-mail correspondence regarding the acceptance of our manuscript for the journal Health Behaviour and Policy and Review (HBPR=2015-48/R1-(107)). Myself and the co-authors have completed the requested stylistic changes and have resubmitted the manuscript.

I am writing for confirmation that the publication of a version of this manuscript in my doctoral thesis, which will be publicly available online in January 2016, does not violate the eventual copyright agreement of the manuscript in the journal.

Thank you,

Allison Gates RD, MSc
PhD candidate
School of Public Health and Health Systems
University of Waterloo
Waterloo, Ontario, Canada

rjmcdermott@parisscholarpublishing.org 11:31 PM (12 hours ago)

to Allison

It is not viewed by us as a violation or a conflict.

Robert J. McDermott, PhD
Senior Consulting Editor
Health Behavior and Policy Review
Paris Scholar Publishing Ltd
rjmcdermott@parisscholarpublishing.org

...

12.0 References

Aboriginal Affairs and Northern Development Canada [AANDC]. (2010). Regional results of price surveys. Available at: http://www.aadnc-aandc.gc.ca/eng/1100100035986/1100100035987#ont (accessed 21 July 2015).

Aboriginal Affairs and Northern Development Canada [AANDC]. (2012). Aboriginal Peoples and Communities: Terminology. Available at: http://www.aadnc-aandc.gc.ca/eng/1100100014642/1100100014643 (accessed 21 July 2015).

Aboriginal Affairs and Northern Development Canada [AANDC]. (2013). First Nations in Canada. Available at: http://www.aadnc-aandc.gc.ca/eng/1307460755710/1307460872523 (accessed 21 July 2015).

Abreu, S., Santos, R., Moreira, C., Santos, P.C., Vale, S., Soares-Miranda, L., Autran, R., Mota, J., & Moreira, P. (2012). Relationship of milk intake and physical activity to abdominal obesity among adolescents. *Pediatric Obesity, 9*(1), 71-80.

Adams, A., Receveur, O., Mundt, M., Paradis, G., & Macaulay, A. (2005). Healthy lifestyle indicators in children (grades 4 to 6) from the Kahnawake Schools Diabetes Prevention Project. *Canadian Journal of Diabetes, 29*(4), 403-409.

Ambrosini, G.L., Emmett, P.M., Northstone, K., & Jebb, S.A. (2013). Tracking a dietary pattern associated with increased adiposity in childhood and adolescence. *Obesity*, *22*(2), 458-465.

Ankney, C.D. (1996). An embarrassment of riches: too many geese. *The Journal of Wildlife Management*, *60*(2), 217-223.

Assembly of First Nations. (2008). *An environmental scan of nutrition programs and policies in First Nations schools*. Ottawa, Ontario, Canada: Assembly of First Nations.

Bandura, A. (1998). Health promotion from the perspective of social cognitive theory. *Psychology & Health*, *13*(4), 623-649.

Bell, R.R., Draper, H.H., & Bergan, J.G. (1973). Sucrose, lactose, and glucose tolerance in northern Alaskan Eskimos. *American Journal of Clinical Nutrition*, *26*(11), 1185-1190.

Berkey, C., Rockett, H.R.H., Field, A.E., Gillman, M.W. Frazier, A.L., Camargo, C.A., & Colditz, G.A. (2000). Activity, dietary intake, and weight changes in a longitudinal study of preadolescent and adolescent boys and girls. *Pediatrics*, *105*(4), 1–9.

Berkey, C.S., Rockett, H.R.H., Willett, W.C., & Colditz, G.A. (2005). Milk, dairy fat, dietary calcium, and weight gain: a longitudinal study of adolescents. *Archives of Pediatrics & Adolescent Medicine, 159*(6), 543-550.

Berti, P.R., Hamilton, S.E., Receveur, O., & Kuhnlein, H.V. (1999). Food use and nutrient adequacy in Baffin Inuit children and adolescents. *Canadian Journal of Dietetic Practice and Research, 60*(2), 63-70.

Bharadwaj, L. A framework for building research partnerships with First Nations communities. (2014). *Environmental Health Insights, 8*(8), 15-25.

Blanton, C.A., Moshfegh, A.J., Baer, D.J., & Kretsch, M.J. (2006). The USDA automated multiple-pass method accurately estimates group total energy and nutrient intake. *The Journal of Nutrition, 136*(10), 2594-2599.

Boeing, H., Bechthold, A., Bub, A., Ellinger, S., Haller, D., Kroke, A., Leschik-Bonnet, E., Müller, M.J., Oberritter, H., Schulze, M., Stehle, P., & Waltzl, B. (2012). Critical review: vegetables and fruit in the prevention of chronic diseases. *European Journal of Nutrition*, *51*(6), 637-663.

Boutron, I., Dutton, S., Ravaud, P., & Altman, D.G. (2010). Reporting and interpretation of randomized controlled trials with statistically nonsignificant results for primary outcomes. *Journal of the American Medical Association, 303*(20), 2058-2064.

Bradlee, M.L., Singer, M.R., Qureshi, M.M., & Moore, L.L. (2010). Food group intake and central obesity among children and adolescents in the Third National Health and Nutrition Examination Survey (NHANES III). *Public Health Nutrition, 13*(6), 797-805.

Bruner, B.G., & Chad, K.E. (2014). Dietary practices and influences on diet intake among women in a Woodland Cree community. *Journal of Human Nutrition and Dietetics*. *27*(Suppl. 2), 220-229.

Burrows, T.L., Martin, R.J., & Collins, C.E. (2010). A systematic review of the validity of dietary assessment methods in children when compared with the method of doubly labeled water. *Journal of the American Dietetic Association, 110*(10), 1501-1510.

Caballero, B., Clay, T., Davis, S.M., Ethelbah, B., Rock, B.H., Lohman, T., Norman, J., Story, M., Stone, E.J., Stephenson, L., Stevens, J., & Pathways Study Research Group. (2003). Pathways: a school-based, randomized controlled trial for the prevention of obesity in American Indian schoolchildren. *Preventive Medicine,* 37(6 Pt 2), S13-S23.

Campbell, M.L., Diamant, R., Grunau, M., & Halladay, J. (1994). Conducting dietary surveys in Aboriginal communities: methodological considerations. *Canadian Home Economics Journal. 44,* 118-122.

Chan, H.M., Fediuk, K., Hamilton, S., Rostas, L., Caughey, A., Kuhnlein, H., Egeland, G., & Loring, E. (2006). Food security in Nunavut, Canada: barriers and recommendations. *International Journal of Circumpolar Health, 65*(5), 416-431.

Charmaz, K. (2006). Coding in grounded theory research (Pp. 42-71). In *Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis*. London, UK: Sage Publications.

Che, J., & Chen, J. (2001). Food insecurity in Canadian households. *Health Reports, 12*(4), 11-22.

Cochran, P.A.L., Marshall, C.A., Garcia-Downing, C., Kendall, E., Cook, D., McCubbin, L., & Gover, R.M.S. (2008). Indigenous ways of knowing: implications for participatory research and community. *American Journal of Public Health, 98*(1), 22-27.

Cole, T.J., & Lobstein, T. (2012). Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. *Pediatric Obesity, 7*(4), 284-294.

Compher, C. (2006). The nutrition transition in American Indians. *Journal of Transcultural Nursing. 17*(3), 217-223.

Cooke, L. (2007). The importance of exposure for healthy eating in childhood: a review. *Journal of Human Nutrition and Dietetics*, *20*(4), 294-301.

Craigie, A.M., Lake, A.A., Kelly, S.A., Adamson, A.J., & Mathers, J.C. (2011). Tracking of obesity-related behaviours from childhood to adulthood: a systematic review. *Maturitas, 70*(3), 266-284.

Cutler, G.J., Flood, A., Hannan, P., & Neumark-Sztainer, D. (2011). Multiple sociodemographic and socioenvironmental characteristics are correlated with major patterns of dietary intake in adolescents. *Journal of the American Dietetic Association, 111*(2), 230-240.

Davis, S.P., Northington, L., & Kolar, K. (2000). Cultural considerations for treatment of childhood obesity. *Journal of Cultural Diversity, 7*(4), 128-132.

de Onis, M., Onyango, A.W., Borghi, E., Siyam, A., Nishida, C, & Siekmann, J. (2007). Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of the World Health Organization, 85*(9), 660-667.

Dietitians of Canada, Canadian Paediatric Society, The College of Family Physicians of Canada, Community Health Nurses of Canada, & Secker, D. (2010). Promoting optimal monitoring of child growth in Canada: using the new WHO growth charts. *Canadian Journal of Dietetic Practice and Research, 71*(1), e1-3.

Dietitians of Canada. (2005). Individual and household food insecurity in Canada: Position of Dietitians of Canada. Available at: http://www.dietitians.ca/Downloads/Public/householdfoodsec-position-paper.aspx (accessed 21 July 2015).

Dietitians of Canada. (2014). Food sources of calcium. Available at: http://www.dietitians.ca/Nutrition-Resources-A-Z/Factsheets/Osteoporosis/Food-Sources-of-Calcium.aspx (accessed 21 July 2015).

Downs, S.M., Arnold, A., Marshall, D., McCargar, L.J., Raine, K.D., & Willows, N.D. (2009). Associations among the food environment, diet quality and weight status in Cree children in Québec. *Public Health Nutrition, 12*(9), 1504-1511.

Downs, S.M., Marshall, D., & Willows, N.D. (2008). Central adiposity and associated lifestyle factors in Cree children. *Applied Physiology, Nutrition and Metabolism, 33*(3), 476-482.

Drewnowski, A., & Darmon, N. (2005). The economics of obesity: dietary energy density and energy cost. *The American Journal of Clinical Nutrition, 82*(1), 265S-273S.

Drewnowski, A., & Specter, S.E. (2004). Poverty and obesity: the role of energy density and energy costs. *The American Journal of Clinical Nutrition, 79*(1), 6-16.

Egeland, G.M., Johnson-Down, L., Cao, Z.R., Sheikh, N., & Weiler, H. (2011). Food insecurity and nutrition transition combine to affect nutrient intakes in Canadian Arctic communities. *The Journal of Nutrition, 141*(9), 1746-1753.

Egeland, G.M., Qanuippitali Steering Committee members, Pacey, A., Johnson-Down, L., & Cao, Z. (2009). *The International Polar Year Nunavut Inuit Child Health Survey 2007-2008*. Ste-Anne-de-Bellevue, Quebec, Canada: Centre for Indigenous Peoples' Nutrition and Environment.

Ellestad-Sayed, J.J., Haworth, J.C., & Hildes, J.A. (1978). Disaccharide malabsorption and dietary patterns in two Canadian Eskimo communities. *American Journal of Clinical Nutrition*, *31*(8), 1473-1478.

Eskicioglu, P., Halas, J., Sénéchal, M., Wood, L., McKay, E., Villeneuve, S., Shen, G.X., & McGavock, J.M. (2014). Peer mentoring for type 2 diabetes prevention in First Nations children. *Pediatrics, 133*(6), e1624-e1631.

Fanelli, D. (2010). Do pressures to publish increase scientists' bias? An empirical support from US states data. *PLoS One, 5*(4), e10271. doi: 10.1371/journal.pone.0010271.

Ferrar, K., & Golley, R. (2015). Adolescent diet and time use clusters and associations with overweight and obesity and socioeconomic position. *Health Education & Behavior, 9*. doi: 10.1177/1090198114560017.

Finegood, D.T., Merth, T.D.N., & Rutter, H. (2010). Implications of the Foresight Obesity System Maps for solutions to childhood obesity. *Obesity, 18*(S1), S13-S16.

Finlay, L. (2002). "Outing" the researcher: the provenance, process, and practice of reflexivity. *Qualitative Health Research, 12*(4), 531-545.

First Nations Information Governance Centre [FNIGC]. (2008). First Nations Regional Health Survey. Youth. Available at: http://fnigc.ca/sites/default/files/ENpdf/RHS_2008/RHS-Y2.pdf (accessed 21 July 2015).

First Nations Information Governance Centre [FNIGC]. (2012). *First Nations Regional Health Survey (RHS) 2008/10: National Report on Adults, Youth and Children Living in First Nations Communities*. Ottawa, Ontario, Canada: First Nations Information Governance Centre.

First Nations Information Governance Centre [FNIGC]. (2013). The First Nations Principles of OCAP™. Available at: http://fnigc.ca/ocap.html (accessed 21 July 2015).

First Nations Information Governance Centre [FNIGC]. (2015). *The First Nation Data Centre (FNDC) on-site orientation guide*. Ottawa, Ontario, Canada: The First Nations Information Governance Centre.

Five Nations Energy. (2012). Fort Albany and Kashechewan. Available at: http://www.fivenations.ca/index.php/community/fort-albany-and-kashechewan (accessed 21 July 2015).

Ford, J.D., Lardeau, M.-P., Blackett, H., Chatwood, S., & Kurszewski, D. (2013). Community food program use in Inuvik, Northwest Territories. *BMC Public Health, 13,* 970. doi: 10.1186/1471-2458-13-970.

Foulds, H.J.A., Warburton, D.E.R., & Bredin, S.S.D. (2013). A systematic review of physical activity levels in Native American populations in Canada and the United States in the last 50 years. *Obesity Reviews, 14*(1), 593-603.

Franks, P.W., Hanson, R.L., Knowler, W.C., Sievers, M.L., Bennett, P.H., & Looker, H.C. (2010). Childhood obesity, other cardiovascular risk factors, and premature death. *The New England Journal of Medicine, 362*(6), 485-493.

French, S.A., Story, M., & Jeffrey, R.W. (2001). Environmental influences on eating and physical activity. *Annual Review of Public Health, 22*, 309-335.

Gagné, D., Blanchet, R., Lauzière, J., Vaissière, É., Vézina, C., Ayotte, P., Déry, S., & O'Brien, H.T. (2012). Traditional food consumption is associated with higher nutrient intakes in Inuit children attending childcare centres in Nunavik. *International Journal of Circumpolar Health, 71*, 18401, doi: 0.3402/ijch.v71i0.18401.

Gardner, H., & Tsuji, L.J.S. (2014). Exploring the impact of Canadian regulatory requirements on the persistence of the subsistence lifestyle: a food security intervention in remote Aboriginal communities. *The International Journal of Social Sustainability in Economic, Social, and Cultural Context, 11*(1), 1-10.

Garriguet, D. (2007). Overview of Canadians' eating habits. *Health Reports, 18*(2), 17-32.

Garriguet, D. (2008a). Obesity and the eating habits of the Aboriginal population. *Health Reports, 19*(1), 21-35.

Garriguet, D. (2008b). Beverage consumption of children and teens. *Health Reports, 19*(4), 17-22.

Garriguet, D. (2009). Diet quality in Canada. *Health Reports, 20*(3), 41-52.

Gates, A., Gates, M., Hanning, R.M., Stephen, J., & Tsuji, L.J.S. (2014a). Impact of a school food provision program in a remote First Nation community. Proceedings of the Canadian Nutrition Society Annual Meeting. 5-7 June 2014. St. John's, New Brunswick. *Applied Physiology, Nutrition, and Metabolism*.

Gates, A., Hanning, R.M., Gates, M., Isogai, A.D., Metatawabin, J., & Tsuji, L.J.S. (2011). A school nutrition program improves vegetable and fruit knowledge, preferences, and exposure in First Nation youth. *The Open Nutrition Journal, 2011*(5), 1-6.

Gates, A., Hanning, R.M., Gates, M., McCarthy, D., & Tsuji, L.J.S. (2012c). Inadequate nutrient intakes in youth of a remote First Nations community: challenges and the need for sustainable changes in program and policy. *ISRN Public Health, 2012*. doi: 10.5402/2012/504168.

Gates, A., Hanning, R.M., Gates, M., Skinner, K., Martin, I.D., & Tsuji, L.J.S. (2012b). Vegetable and fruit intakes of on-reserve First Nations schoolchildren compared to Canadian averages and current recommendations. *International Journal of Environmental Research and Public Health, 2012*(9), 1379-1397.

Gates, A., Skinner, K., & Gates, M. (2015). The diets of school-aged Aboriginal youths in Canada: a systematic review of the literature. *Journal of Human Nutrition and Dietetics,* 28(3), 246-261.

Gates, M., Hanning, R.M., Gates, A., Isogai, A., Tsuji, L.J.S., & Metatawabin, J. (2013a). A pilot comprehensive school nutrition program improves knowledge and intentions for intake of milk and milk alternatives among youth in a remote First Nation. *Journal of Nutrition Education and Behaviour, 45*(5), 455-459.

Gates, M., Hanning, R.M., Gates, A., Martin, I.D., & Tsuji, L.J.S. (2012a). Intakes of milk and alternatives among on-reserve First Nations youth in northern and southern Ontario, Canada. *Public Health Nutrition, 16*(3), 515-523.

Gates, M., Hanning, R.M., Gates, A., McCarthy, D.D., & Tsuji, L.J.S. (2013b). Assessing the impact of pilot school snack programs on milk and alternatives intake in 2 remote First Nation communities in northern Ontario, Canada. *Journal of School Health, 83*(2), 69-76.

Gates, M., Hanning, R.M., Gates, A., Stephen, J., Fehst, A., & Tsuji, L. (2015). Physical activity and fitness of First Nations youth in a remote and isolated northern Ontario community: a needs assessment. *Journal of Community Health*. Epub ahead of print.

Gates, M., Hanning, R.M., Gates, A., Stephen, J., Fehst, A., & Tsuji, L.J.S. (in press). A pilot sports program in a remote First Nations community: an evaluation of process and outcomes over one school year. *Health Behavior and Policy Review*.

Gaudin, V.L., Receveur, O., Walz, L. Girard, F., & Potvin, L. (2014). A mixed methods inquiry into the determinants of traditional food consumption among three Cree communities of Eeyou Istchee from an ecological perspective. *International Journal of Circumpolar Health, 73,* 24918. doi: 10.3402/ijch.v73.24918.

Gaudin, V.L., Receveur, O., Girard, F., & Potvin, L. (2015). Facilitators and barriers to traditional food consumption in the Cree community of Mistissini, northern Quebec. *Ecology of Food and Nutrition, 54*(6), 663-692.

Genuis, S.K., Willows, N., Alexander First Nation, & Jardine, C. (2014). Through the lens of our cameras: children's lived experience with food security in a Canadian Indigenous community. *Child: Care, Health and Development,* doi: 10.1111/cch.12182.

Gillman, M.W., Pinto, B.M., Tennstedt, S., Glanz, K., Marcus, B., & Friedman, R.H. (2001). Relationships of physical activity with dietary behaviors among adults. *Preventive Medicine, 32*(3), 295-301.

Gionet, L., & Roshanafshar, S. (2013). *Select health indicators of First Nations people living off reserve, Métis and Inuit*. Ottawa, Ontario, Canada: Minister of Industry.

Glanz, K., & Bishop, D. (2010). The role of behavioural science theory in development and implementation of public health interventions. *Annual Review of Public Health*, *31*(1), 399-418.

Glaser, B.G. & Strauss, A.L. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. New York, New York, USA: Aldine De Gruyter.

Government of Canada. (2009). Cost of the revised Northern Food Basket in 2012-2013. Available at: http://www.nutritionnorthcanada.gc.ca/eng/1369313792863/1369313809684 (accessed 27 July 2015).

Government of Canada. (2013). Panel of Research Ethics .TCPS 2 – Chapter 9. Research Involving the First Nations, Inuit and Métis People of Canada. Available at: http://www.pre.ethics.gc.ca/eng/policy-politique/initiatives/tcps2-eptc2/chapter9-chapitre9/ (accessed 21 July 2015).

Government of Canada. (2014). Nutrition North Canada. Available at: http://www.nutritionnorthcanada.gc.ca/eng/1415385762263/1415385790537 (accessed 21 July 2015).

Guh, D.P., Zhang, W., Bansback, N., Amarsi, Z., Laird Birmingham, C.L., & Anis, A.H. (2009). The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis. *BMC Public Health, 9*, 88, doi:10.1186/1471-2458-9-88.

Guyot, M., Dickson, C., Paci, C., Furgal, C., & Chan, H.M. (2006). Local observations of climate change and impacts on traditional food security in two northern Aboriginal communities. *International Journal of Circumpolar Health, 65*(5), 403-415.

Haman, F., Fontaine-Bisson, B., Batal, M., Imbeault, P., Blais, J.M., & Robidoux, M.A. (2010). Obesity and type 2 diabetes in Northern Canada's remote First Nations communities: the dietary dilemma. *International Journal of Obesity, 34(*Suppl 2), S24-S31.

Hanning, R.M., Royall, D., Toews, J.E., Blashill, L., Wegener, J., & Driezen, P. (2009). Web-based food behaviour questionnaire: validation with grades six to eight students. *Canadian Journal of Dietetic Practice and Research, 70*(4), 172-178.

Hanson, M.D., & Chen, E. (2007). Socioeconomic status and health behaviors in adolescence: a review of the literature. *Journal of Behavioral Medicine, 30*(3), 263-285.

Hart, C.N., Raynor, H.A., Osterholt, K.M., Jelalian, E., & Wing, R.R. (2011). Eating and activity habits of overweight children on weekdays and weekends. *Pediatric Obesity*, *6*(5-6), 467-472.

Health Canada. (2005). First Nations comparable health indicators. Available at: http://www.hc-sc.gc.ca/fniah-spnia/diseases-maladies/2005-01_health-sante_indicat-eng.php#life_expect (accessed 21 July 2015).

Health Canada. (2007a). Eating Well with Canada's Food Guide for First Nations, Inuit and Métis. Available at: http://www.hc-sc.gc.ca/fn-an/pubs/fnim-pnim/index-eng.php (accessed 21 July 2015).

Health Canada. (2007b). Canadian Community Health Survey, Cycle 2.2, Nutrition (2004) - Income-related food security in Canada. Available at: http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/surveill/income_food_sec-sec_alim-eng.pdf (accessed 21 July 2015).

Health Canada. (2007c). Canadian Nutrient File. Available at: http://www.hc-sc.gc.ca/fn-an/nutrition/fiche-nutri-data/cnf_aboutus-aproposdenous_fcen-eng.php (accessed 21 July 2015).

Health Canada. (2010). Canadian Nutrient File. Available at: http://www.hc-sc.gc.ca/fn-an/nutrition/fiche-nutri-data/cnf_downloads-telechargement_fcen-eng.php (accessed 21 July 2015).

Health Canada. (2012). Do Canadian Adolescents Meet their Nutrient Requirements through Food Intake Alone? Available at: http://www.hc-sc.gc.ca/fn-an/alt_formats/pdf/surveill/nutrition/commun/art-nutr-adol-eng.pdf (accessed 21 July 2015).

Health Canada. (2013). Dietary Reference Intakes. Available at: http://www.hc-sc.gc.ca/fn-an/nutrition/reference/index-eng.php (accessed 21 July 2015).

Healthy Kids Panel. (2013). No time to wait: the healthy kids strategy. Available at: http://www.health.gov.on.ca/en/common/ministry/publications/reports/healthy_kids/healthy_kids.pdf (accessed 21 July 2015).

Heaney, R.P., Abrams, S., Dawson-Hughes, B., Looker, A., Marcus, R., Matkovic, V., & Weaver, C. (2000). Peak bone mass. *Osteoporosis International*, *11*, 985-1009.

Herman, K.M., Craig, C.L., Gauvin, L., & Katzmarzyk, P.T. (2009). Tracking of obesity and physical activity from childhood to adulthood: the Physical Activity Longitudinal Study. *International Journal of Pediatric Obesity*, *4*(4), 281-288.

Hlimi, T., Skinner, K., Hanning, R.M., Martin, I.D., & Tsuji, L.J.S. (2012). Traditional food consumption behaviour and concern with environmental contaminants among Cree schoolchildren of the Mushkegowuk territory. *International Journal of Circumpolar Health, 71*, 17344. doi: 10.3402/ijch.v71i0.17344.

Hopping, B.N., Mead, E., Erber, E., Sheehy, C., Roache, C., & Sharma, S. (2010). Dietary adequacy of Inuit in the Canadian Arctic. *Journal of Human Nutrition and Dietetics*, *23*(Suppl. 1), 27-34.

Horta, B.L., Santos, R.V., Welch, J.R., Cardoso, A.M., dos Santos, J.V., Assis, A.M.O., Lira, P.C., & Coimbra, C.E. (2013). Nutritional status of indigenous children: findings from the First National Survey of Indigenous People's Health and Nutrition in Brazil. *International Journal for Equity in Healt*h, *12*(1), 23.

Illner, A.-K., Freisling, H., Boeing, H., Huybrechts, I., Crispim, S.P., & Slimani, N. (2012). Review and evaluation of innovative technologies for measuring diet in nutritional epidemiology. *The International Journal of Epidemiology, 41*(4), 1187-1203.

Indian and Northern Affairs Canada [INAC]. (2003). *Nutrition and food security in Kugaaruk, Nunavut*. Ottawa, Ontario, Canada: Minister of Public Works and Government Services Canada.

Indian and Northern Affairs Canada [INAC]. (2004a). *Nutrition and food security in Kangiqsujuaq, Nunavut*. Ottawa, Ontario, Canada: Minister of Public Works and Government Services Canada.

Indian and Northern Affairs Canada [INAC]. (2004b). *Nutrition and food security in Fort Severn, Ontario*. Ottawa, Ontario, Canada: Minister of Public Works and Government Services Canada.

Jamieson, J.A., Weiler, H.A., Kuhnlein, H.V., & Egeland, G.M. (2012). Traditional food intake is correlated with iron stores in Canadian Inuit men. *The Journal of Nutrition, 142*(4), 764-770.

Janssen, I., Katzmarzyk, P.T., Boyce, W.F., Vereecken, C., Mulvihill, C., Roberts, C., Currie, C., Pickett, W., & The Health Behaviour in School Aged Children Obesity Working Group. (2005). Comparison of overweight and obesity prevalence in school-aged youth from 34 countries and their relationships with physical activity and dietary patterns. *Obesity Reviews, 6*(2), 123-132.

Jennings, A., Welch, A., van Sluijs, E.M.F., Griffin, S.J., & Cassidy, A. (2011). Diet quality is independently associated with weight status in children aged 9-10 years. *The Journal of Nutrition, 141*(3), 453-459.

Johnson-Down, L., & Egeland, G.M. (2010). Adequate nutrient intakes are associated with traditional food consumption in Nunavut Inuit children aged 3-5 years. *The Journal of Nutrition, 140*(7), 1311-1316.

Kakekagumick, K.E., Hayward, M.N., Harris, S.B., Saksvig, B., Gittelsohn, J., Manokeesic, G., Goodman, S., & Hanley, A.J. (2013). Sandy Lake Health and Diabetes Project: a community-based intervention targeting type 2 diabetes and its risk factors in a First Nations community. *Frontiers in Endocrinology*, *12*(4), 170. doi: 10.3389/fendo.2013.00170.

Kaptchuk, T.J. (2003). Effect of interpretive bias on research evidence. *British Medical Journal, 326*(7404), 1453-1455.

Kaspar, V. (2014). The lifetime effect of residential school attendance on Indigenous health status. *American Journal of Public Health, 104*(11), 2184-90.

Kerpan, S.T., Humbert, M.L., & Henry, C.J. (2015). Determinants of diet for urban Aboriginal youth: implications for health promotion. *Health Promotion Practice, 16*(3), 392-400.

Khalil, C.B., Johnson-Down, L., & Egeland, G.M. (2010). Emerging obesity and dietary habits among James Bay Cree youth. *Public Health Nutrition, 13*(11), 1829-1837.

King, M., Smith, A., & Gracey, M. (2009). Indigenous health part 2: the underlying causes of the health gap. *Lancet, 374*(9683), 76-85.

Kirby, A.M., Lévesque, L., & Wabano, V. (2007). A qualitative investigation of physical activity challenges and opportunities in a northern-rural, Aboriginal community: voices from within. *Pimatisiwin, 5*(1), 6-24.

Kirkpatrick, S.I., & Tarasuk, V. (2008). Food insecurity is associated with nutrient inadequacies among Canadian adults and adolescents. *The Journal of Nutrition, 138*(3), 604-612.

Kittler, P.G., & Sucher, K.P. (2004). *Food and Culture*. 4th edition. Toronto, Ontario, Canada: Thompson Wadsworth.

Kranz, S., Brauchia, M., Slavin, J.L., & Miller, K.B. (2012). What do we know about dietary fibre intake in children and health? The effects of fibre intake on constipation, obesity, and diabetes in children. *Advances in Nutrition, 3*(1), 47-53.

Kuhnlein, H.V., Souieda, R., & Receveur, O. (1995). Baffin Inuit food use by age, gender and season. *Journal of the Canadian Dietetic Association, 56*(4), 175-183.

Kuhnlein, H.V., & Receveur, O. (2007). Local cultural animal food contributes high levels of nutrients for arctic Canadian indigenous adults and children. *The Journal of Nutrition, 137*(4), 1110-1114.

Kuhnlein, H.V., Receveur, O., Soueida, R., & Egeland, G.M. (2004). Arctic indigenous peoples experience the nutrition transition with changing dietary patterns and obesity. *The Journal of Nutrition, 134*(6), 1447-1453.

Kuhnlein, H.V., Soueida, R., & Receveur, O. (1996). Dietary nutrient profiles of Canadian Baffin Island Inuit differ by food source, season, and age. *Journal of the American Dietetic Association, 96*(2), 155-162.

Lackenbauer, P.W., Moses, J., Sheffield, R.S., & Gohier, M. (2004). *A commemorative history of Aboriginal people in Canadian military*. Ottawa, Ontario, Canada: National Defence Canada.

Lake, A.A., Adamson, A.J., Craigie, A.M., Rugg-Gunn, A.J., & Mathers, J.C. (2009). Tracking of dietary intake and factors associated with dietary change from early adolescence to adulthood: the ASH30 study. *Obesity Facts, 2*(3), 158-165.

Lake, A.A., Mathers, J.C., Rugg-Gunn, A.J., & Adamson, A.J. (2006). Longitudinal change in food habits between adolescence (11-12 years) and adulthood (32-33 years): the ASH30 Study. *Journal of Public Health, 28*(1), 10-16.

Lambden, J., Receveur, O., Marshall, J., & Kuhnlein, H.V. (2006). Traditional and market food access in arctic Canada is affected by economic factors. *International Journal of Circumpolar Health, 65*(4), 332-340.

Langevin, C.M. (2001). An evaluation framework for the Maison Decision House substance abuse treatment program. *The Canadian Journal of Program Evaluation*, *16*(1), 99-129.

Langlois, K.A., Findlay, L.C., & Kohen, D.E. (2013). Dietary habits of Aboriginal children. *Health Reports, 24*(4), 3-7.

Larson, N., & Story, M. (2009). A review of environmental influences on food choices. *Annals of Behavioral Medicine, 38*(1), 56-73.

Larson, N.I., Neumark-Sztainer, D., Harnack, L., Wall, M., Story, M., & Eisenberg, M.E. (2009). Calcium and dairy intake: longitudinal trends during the transition to young adulthood and correlates of calcium intake. *Journal of Nutrition Education and Behavior, 41*(4), 254-260.

Larson, N.I., Story, M., Wall, M., & Neumark-Sztainer, D. (2006). Calcium and dairy intakes of adolescents are associated with their home environment, taste preferences, personal health beliefs, and meal patterns. *Journal of the American Dietetic Association, 106*(11), 1816-1824.

Lau, D.C.W., Douketis, J.D., Morrison, K.M., Hramiak, I.M., Sharma, A.M., & Ur, E. (2007). 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children [summary]. *Canadian Medical Association Journal, 176*(8), S1-S13.

Leach, A. (2010). The roots of Aboriginal homelessness in Canada. *Parity, 23*(9), 12-13.

Ledoux, T.A., Hingle, M.D., & Baranowski, T. (2011). Relationship of fruit and vegetable intake with adiposity: a systematic review. *Obesity Reviews*, *12*(5), e143-e150.

Leech, R.M., McNaughton, S.A., & Timperio, A. (2014). The clustering of diet, physical activity and sedentary behaviour in children and adolescents: a review. *International Journal of Behavioral Nutrition and Physical Activity, 11,* 4. doi: 10.1186/1479-5868-11-4.

Liberati, A., Altman, D.G., Tetzlaff, J., Mulrow, C., Gøtzsche, P.C., Ionnidis, J.P.A., Clark, M., Devereaux, P.J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLoS Medicine*, *6*(7), e1000100, doi:10.1371/journal.pmed.1000100.

Lorson, B.A., Melgar-Quinonez, H.R., & Taylor, C.A. (2009). Correlates of fruit and vegetable intakes in US children. *Journal of the American Dietetic Association, 109*(3), 474-478.

Ludwig, D.S., Peterson, K.E., & Gortmaker, S.L. (2001). Relation between consumption of sugar-sweetened drinks and childhood obesity: A prospective, observational analysis. *The Lancet*, *357*(9255), 505–508.

Maar, M.A., Lightfoot, N.E., Sutherland, M.E., Strasser, R.P., Wilson, K.J., Lidstone-Jones, C.M., Graham, D.G., Beaudin, R., Daybutch, G.A., Dokis, B.R., Lesage, M.T., Raymond, M., & Williamson, P. (2011). Thinking outside the box: Aboriginal people's suggestions for conducting health studies with Aboriginal communities. *Public Health, 125*(11), 747-753.

MacCoun, R.J. (1998). Biases and the interpretation and use of research results. *Annual Review of Psychology, 49*(29), 259-287.

Mark, S., Lambert, M., O'Loughlin, J., & Gray-Donald, K. (2012). Household income, food insecurity and nutrition in Canadian youth. *Canadian Journal of Public Health, 103*(2), 94-99.

Martin, N., Garcia, A.C., & Leipert, B. (2010). Photovoice and its potential use in nutrition and dietetic research. *Canadian Journal of Dietetic Practice and Research, 71*(2), 93-97.

McCaskey, W. (2008). *The strengths approach*. Victoria: Luke's Innovative Resources.

McLeroy, K.R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly, 15*(4), 351-377.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., & The PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Medicine, 6*(7), e1000097. doi:10.1371/journal.pmed.1000097.

Moreno-Gómez, C., Romaguera-Bosch, D., Tauler-Riera, P., Bennasar-Vehy, M., Pericas-Beltran, J., Martinez-Andreu, S., & Aguilo-Pons, A. (2012). Clustering of lifestyle factors in Spanish university students: the relationship between smoking, alcohol consumption, physical activity and diet quality. *Public Health Nutrition, 15*(11), 2131-2139.

Mulvale, J.P. (2008). Basic income and the Canadian welfare state: exploring the realms of possibility. *Basic Income Studies, 3*(1), 1-2.

Myers, A. (1999). *Program evaluation for exercise leaders*. Windsor, Ontario, Canada: Human Kinetics.

Nakano, T., Fediuk, K., Kassi, N., & Kuhnlein, H.V. (2005a). Food use of Dene/Métis and Yukon children. *International Journal of Circumpolar Health, 64*(2), 137-146.

Nakano, T., Fediuk, K., Kassi, N., Egeland, G., & Kuhnlein, H.V. (2005b). Dietary nutrients and anthropometry of Dene/Métis and Yukon children. *International Journal of Circumpolar Health, 64*(4), 147-156.

Ng, C., Young, T.K., & Corey, P.N. (2010). Associations of television viewing, physical activity and dietary behaviours with obesity in Aboriginal and non-Aboriginal Canadian youth. *Public Health Nutrition, 13*(9), 1430-1437.

Ning, A., & Wilson, K. (2012). A research review: exploring the health of Canada's Aboriginal youth. *International Journal of Circumpolar Health, 71*. doi: 10.3402/ijch.v71i0.18497.

Nord, M., & Brent, C.P. (2002). *Food Insecurity in Higher Income Households*. Washington, District of Columbia, USA: USDA Economic Research Service.

OneXOne. (2014). Our mission. Our vision. Available at: http://www.onexone.org/what-we-do/our-mission-vision/ (accessed 21 July 2015).

Ontario Ministry of Education. (2010). Appendix: Nutrition Standards for Ontario Schools. Available at: https://www.edu.gov.on.ca/extra/eng/ppm/Appendix150.pdf (accessed 9 September 2015).

Ontario Society of Nutrition Professionals in Public Health School Nutrition Workgroup Steering Committee. (2004). Call to action: creating a healthy school nutrition environment. Available at: from http://www.osnpph.on.ca/resources/index.php (accessed 9 September 2015).

Pal, S., Haman, F., & Robidoux, M.A. (2013). The costs of local food procurement in two northern Indigenous communities in Canada. *Food and Foodways*, *21*(2), 132-152.

Paradis, G., Lévesque, L., Macaulay, A., Cargo, M., McComber, A., Kirby, R., Receveur, O., Kishchuk, N., & Potvin, L. (2005). Impact of a diabetes prevention program on body size, physical activity, and diet among Kanien'kehá:ka (Mohawk) children 6 to 11 years old: 8-year results from the Kahnawake Schools Diabetes Prevention Project. *Pediatrics, 115(*2), 333-339.

Patton, M.Q. (2012). *Essentials of utilization-focused evaluation*. Thousand Oaks, California, USA: Sage Publications.

Pearson, N., Biddle, S.J.H., & Gorely, T. (2008). Family correlates of fruit and vegetable consumption in children and adolescents: a systematic review. *Public Health Nutrition, 12*(2), 267-283.

Pigford, A.E., & Willows, N.D. (2010). *Promoting optimal weights in aboriginal children in Canada through ecological research*. Chapter 27 in Childhood Obesity Prevention – International Research, Controversies and Interventions. Oxford, United Kingdom: Oxford University Press.

Pigford, A.E., Willows, N.D., Holt, N.L., Newton, A.S., & Ball, B.D.C. (2012). Using First Nations children's perceptions of food and activity to inform an obesity prevention strategy. *Qualitative Health Research*, *22*(27), 986-996.

Power, E., & Dietitians of Canada. (2005). Individual and household food insecurity in Canada: position of Dietitians of Canada. Available at: http://www.dietitians.ca/Downloadable-Content/Public/householdfoodsec-position-paper.aspx (accessed 21 July 2015).

Power, E.M. (2005). Determinants of healthy eating among low-income Canadians. *Canadian Journal of Public Health, 96*(Supplement 3), S37-S42.

Power, E.M. (2008). Conceptualizing food security for Aboriginal people in Canada. *Canadian Journal of Public Health, 99*(2), 95-97.

Public Health Agency of Canada [PHAC] & Canadian Institute for Health Information [CIHI]. (2011). *Obesity in Canada: A Joint Report from the Public Health Agency of Canada and the Canadian Institute for Health Information*. Ottawa, Ontario, Canada: Her Majesty the Queen in Right of Canada.

Public Health Agency of Canada [PHAC]. (2011). Diabetes in Canada: Facts and From a Public Health Perspective. Available at: http://www.phac-aspc.gc.ca/cd-mc/publications/diabetes-diabete/facts-figures-faits-chiffres-2011/highlights-saillants-eng.php#chp6 (accessed 21 July 2015).

Rasmussen, M., Krølner, R., Klepp, K.-I., Lytle, L., Brug, J., Bere, E., & Due, P. (2006). Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part I: quantitative studies. *International Journal of Behavioral Nutrition and Physical Activity, 11*(3), 22. doi: 10.1186/1479-5868-3-22.

Ravenscroft, J., Schell, L.M. & Akwesasne Task Force on the Environment [ATFE]. (2014). Dietary patterns of Akwesasne Mohawk adolescents. *Annals of Human Biology*, *41*(5), 403-414.

Receveur, O, Morou, K., Gray-Donald, K., & Macaulay, A. (2008). Consumption of key food items is associated with excess weight among elementary-school-aged children in a Canadian First Nations community. *Journal of the American Dietetic Association, 108*(2), 362-366.

Regan, P. (2010). *Unsettling the Settler Within. Indian Residential Schools, Truth Telling, and Reconciliation in Canada*. Vancouver, British Columbia, Canada: UBC Press.

Reilly, J.J., & Kelly, J. (2011). Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review. *International Journal of Obesity, 35*(7), 891-898.

Reilly, J.J., Kelly, J., & Wilson, D.C. (2010). Accuracy of simple clinical and epidemiological definitions of childhood obesity: systematic review and evidence appraisal. *Obesity Reviews, 11*(9), 645-655.

Riediger, N.D., Shooshtari, S., & Moghadasian, M.H. (2007). The influence of sociodemographic factors on patterns of fruit and vegetable consumption in Canadian adolescents. *Journal of the American Dietetic Association, 107*(9), 1511-1518.

Rinderknecht, K., & Smith, C. (2004). Social cognitive theory in an after-school nutrition intervention for urban Native American youth. *Journal of Nutrition Education and Behavior*, *36*(6), 298-304.

Roberts, K.C., Shields, M., de Groh, M., Aziz, A., Gilbert, J.-A. (2012). Overweight and obesity in children and adolescents: Results from the 2009 to 2011 Canadian Health Measures Survey. *Health Reports*, *23*(3), 37-41.

Robidoux, M.A., Haman, F., & Sethna, C. (2009). The relationship of the burbot (Lota lota L.) to the reintroduction of off-the-land foods in the Sandy Lake First Nation community. *Biodemography and Social Biology, 55*(1), 12-29.

Rodríguez, G., Moreno, L.A., Sarría, A., Fleta, J., & Bueno, M. (2000). Resting energy expenditure in children and adolescents: agreement between calorimetry and prediction equations. *Clinical Nutrition, 21*(3), 255-260.

Ronsley, R., Lee, A.S., Kuzeljevic, B., & Panagiotopoulos, C. (2013). Healthy Buddies™ reduces body mass index z-score and waist circumference in Aboriginal children living in remote coastal communities. *Journal of School Health, 83(*9), 605-613.

Rossi, P.H., Lipsey, M.W., & Freeman, H.E. (2004). *Evaluation. A systematic approach.* 7th Edition. Thousand Oaks, California, USA: Sage Publications.

Saksvig, B., Gittlesohn, J., Harris, S.B., Hanley, A.J.G., Valente, T.W., & Zinman, B. (2005). A pilot school-based healthy eating and physical activity intervention improves diet, food knowledge, and self-efficacy for Native Canadian children. *Journal of Nutrition, 135*(10), 2392-2398.

Sallis, J.F., Owen, N. & Fisher, E.B. (2008) *Ecological models of health behavior* (ch. 20). In *Health Behavior and Health Education: theory, research and practice*. 4th edition. Glanz K, Timer BK, Viswanath K (eds). San Francisco, California, USA: John Wiley & Sons Inc.

Sandelowski, M. (1995). Sample size in qualitative research. *Research in Nursing & Health*, 18(2), 179-183.

Shenton, A.K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information, 22*(2004), 63-75.

Sherry, B., Jefferds, M.E., & Grummer-Strawn, L.M. (2007). Accuracy of adolescent self-report of height and weight in assessing overweight status: a literature review. *Archives of Pediatrics & Adolescent Medicine*, *161*(12), 1154-1161.

Shields, M. (2006). Overweight and obesity among children and youth. *Health Reports, 17*(3), 27-42.

Simonds, V.W., & Christopher, S. (2013). Adapting Western research methods to Indigenous ways of knowing. *Framing Health Matters, 103*(12), 2185-2192.

Singh, A.S., Mulder, C., Twisk, J.W.R., van Mechelen, W., & Chinapaw, M.J.M. (2008). Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obesity Reviews, 9*(5), 474-488.

Skinner, K., Hanning, R.M., & Tsuji, L.J.S. (2006). Barriers and supports for healthy eating and physical activity for First Nation youths in northern Canada. *International Journal of Circumpolar Health, 65*(2), 148-161.

Skinner, K., Hanning, R.M., & Tsuji, L.J.S. (2014). Prevalence and severity of household food insecurity of First Nations people living in an on-reserve, sub-Arctic community within the Mushkegowuk Territory. *Public Health Nutrition*, *17*(1), 31-39.

Skinner, K., Hanning, R.M., Desjardins, E., & Tsuji, L.J.S. (2013). Giving voice to food security in a remote indigenous community in subarctic Ontario, Canada: traditional ways, ways to cope, ways forward. *BMC Public Health, 13,* 427. doi: 0.1186/1471-2458-13-427.

Skinner, K., Hanning, R.M., Metatawabin, J., Martin, I.D., & Tsuji, L.J.S. (2012a). Impact of a school snack program on the dietary intake of grade six to ten First Nation students living in a remote community in northern Ontario, Canada. *Rural and Remote Health, 12*, 2122.

Skinner, K., Hanning, R.M., Metatawabin, J., Tsuji, L.J.S. (2014). Implementation of a community greenhouse in a remote, sub-arctic First Nations community in Canada: a descriptive case study. *Rural and Remote Health*, *14*(2), 2545.

Skinner, K., Hanning, R.M., Sutherland, C., Edwards-Wheesk, R., & Tsuji, L.J.S. (2012b). Using a SWOT analysis to inform healthy eating and physical activity strategies for a remote First Nations community in Canada. *American Journal of Health Promotion, 26*(6), e159-e170.

Socha, T., Chambers, L., Zahaf, M., Abraham, R., & Fiddler, T. (2011). Food availability, food store management, and food pricing in a northern First Nation community. *International Journal of Humanities and Social Science*, *1*(11), 49-61.

Söchting, I., Corrado, R., Cohen, I.M., & Brasfield, C. (2007). Traumatic pasts in Canadian Aboriginal people: further support for a complex trauma conceptualization? *BC Medical Journal*, *49*(6), 320-326.

Song, Q., & Sergeev, I.N. (2012). Calcium and vitamin D in obesity. *Nutrition Research Reviews, 25*(1), 130-141.

St. John, M., Durant, M., Campagna, P.D., Rehman, L.A., Thompson, A.M., Wadsworth, L.A., & Murphy, R.J.L. (2008). Overweight Nova Scotia children and youth. The roles of household income and adherence to Canada's Food Guide to Healthy Eating. *Canadian Journal of Public Health, 99*(4), 201-306.

Statistics Canada. (2008). Aboriginal Children's Survey. Available at: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5108&Item_Id=22502 (accessed 21 July 2015).

Statistics Canada. (2009a). 2006 Census: educational portrait of Canada, 2006 Census: national picture. Available at: http://www12.statcan.gc.ca/census-recensement/2006/as-sa/97-560/p6-eng.cfm (accessed 21 July 2015).

Statistics Canada. (2009b). Average income by highest level of education attained, school/work status and gender. Available at: http://www.statcan.gc.ca/pub/81-595-m/2009075/tbl/tbl7-eng.htm (accessed 27 July 2015).

Statistics Canada. (2012). 2006 Census: Aboriginal Peoples in Canada in 2006: Inuit, Métis and First Nations, 2006 Census: Findings. Available at: http://www12.statcan.ca/census-recensement/2006/as-sa/97-558/index-eng.cfm (accessed 21 July 2015).

Statistics Canada. (2013a). *Aboriginal Peoples in Canada: First Nations People, Métis and Inuit. National Household Survey, 2011*. Ottawa, Ontario, Canada: Minister of Industry.

Statistics Canada. (2013b). Aboriginal Peoples Survey. Available at: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=3250&lang=en&db=imdb&adm=8&dis=2 (accessed 21 July 2015).

Story, M., Kaphingst, K.M., Robinson-O'Brien, R., & Glanz, K. (2008). Creating healthy food and eating environments: policy and environmental approaches. *Annual Review of Public Health*, *29*, 253-272.

Story, M., Neumark-Sztainer, D., & French, S. (2002). Individual and environmental influences on adolescent eating behaviors. *Journal of the American Dietetic Association, 102*(3 Suppl), S40-S51.

Story, M., Snyder, P., Anliker, J., Cunningham-Sabo, L., Weber, J.L., Platero, H. & Stone, E.J. (2002). Nutrient content of school meals in elementary schools on American Indian reservations. *Journal of the American Dietetic Association, 102*(2), 253-256.

Strauss, A. & Corbin, J. (1990). *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Newbury Park, California, USA: Sage Publications.

Tam, B.Y., Gough, W.A., Edwards, V., & Tsuji, L.J.S. (2013). The impact of climate change on the well-being and lifestyle of a First Nation community in the western James Bay region. *The Canadian Geographer, 57*(4), 441-456.

Taylor, J.P., Evers, S., & McKenna, M. (2005). Determinants of healthy eating in children and youth. *Canadian Journal of Public Health, 96*(Suppl 3), S20-S26.

Taylor, J.P., Timmons, V., Larsen, R., Walton, F., Bryanton, J., Critchley, K., & McCarthy, M.J. (2007). Nutritional concerns in Aboriginal children are similar to those in non-Aboriginal children in Prince Edward Island, Canada. *Journal of the American Dietetic Association, 107*(6), 951-955.

te Velde, S.J., Twisk, J.W., & Brug, J. (2007). Tracking of fruit and vegetable consumption from adolescence into adulthood and its longitudinal association with overweight. *British Journal of Nutrition, 98*(2), 431-438.

The Canadian Encyclopedia. (2012). Reserves. Available at: http://www.thecanadianencyclopedia.ca/en/article/aboriginal-reserves/ (accessed 21 July 2015).

The Healthy Kids Panel. (2013). *No Time to Wait: The Healthy Kids Strategy*. Ottawa, Ontario, Canada: Queen's Printer for Ontario. Online. Available at: http://www.health.gov.on.ca/en/common/ministry/publications/reports/healthy_kids/healthy_kids.pdf (accessed 21 July 2015).

Thompson, S., Kamal, A.G., Alam, M.A., & Wiebe, J. (2012). Community development to feed the family in Northern Manitoba communities: evaluating food activities based on their food sovereignty, food security, and sustainable livelihood outcomes. *Canadian Journal of Nonprofit and Social Economy Research, 3*(2), 43-66.

Timmins Daily Press. (2007). Kashechewan First Nation to get portable classrooms before new school is built. Available at: http://media.knet.ca/node/2919 (accessed 21 July 2015).

Tjepkema, M. (2006). Adult obesity. *Health Reports, 17*(3), 9-25.

Tomlin, D., Naylor, P.J., McKay, H., Zorzi, A., Mitchell, M., & Panagiotopoulos, C. (2012). The impact of Action Schools! BC on the health of Aboriginal children and youth living in rural and remote communities in British Columbia. *International Journal of Circumpolar Health, 71*, 17999. doi: 10.3402/ijch.v71i0.17999.

Towns, C., Cooke, M., Rysdale, L., & Wilk, P. (2014). Healthy weights interventions in Aboriginal children and youth: a review of the literature. *Canadian Journal of Dietetic Practice and Research*, *75*(3), 125-131.

Tremblay, M.S., Pérez, C.E., Ardern, C.I., Bryan, S.N., & Katzmarzyk, P.T. (2005). Obesity, overweight and ethnicity. *Health Reports, 16*(4), 23-34.

Triador, L., Farmer, A., Maximova, K., Willows, N., & Kootenay, J. (2014). A school gardening and healthy snack program increased Aboriginal First Nations children's preferences toward vegetables and fruit. *Journal of Nutrition Education and Behavior*, *47*(2), 176-180.

Truth and Reconciliation Commission of Canada. (2012). *Canada, Aboriginal Peoples, and Residential Schools. They Came for the Children*. Winnipeg, Manitoba, Canada: Truth and Reconciliation Commission of Canada.

Truth and Reconciliation Commission of Canada. (2014). Residential Schools. Available at: http://www.trc.ca/websites/trcinstitution/index.php?p=4 (accessed 21 July 2015).

Tsiros, M.D., Olds, T., Buckley, J.D., Grimshaw, P., Brennan, I., Walkley, J, Hills, A.P., Howe, P.R.C., & Coates, A.M. (2009). Health-related quality of life in obese children and adolescents. *International Journal of Obesity, 33*(4), 387-400.

Tsuji, L.J.S. (2015, ms). Sharing-the-Harvest: addressing food security and sustainability issues in First Nations of Northern Ontario, Canada.

Tsuji, L.J.S., & Nieboer, E. (1999). A question of sustainability in Cree harvesting practices: the seasons, technological and cultural changes in the western James Bay region of northern Ontario, Canada. *The Canadian Journal of Native Studies XIX, 1*(1999), 169-192.

Tsuji, L.J.S., Martin, I.D., Martin, E.S., LeBlanc, A., & Dumas, P. (2007). Spring-harvested game birds from the western James Bay region of northern Ontario, Canada: organochlorine concentrations in breast muscle. *Science of the Total Environment*, *385*(1-3), 160-171.

Valery, P.C., Ibiebele, T., Harris, M., Green, A.C., Cotterill, A., Moloney, A., Sinha, A.K. & Garvey, G. (2012) Diet, physical activity, and obesity in school-aged indigenous youths in northern Australia. *Journal of Obesity*, *2012*. doi: 10.1155/2012/893508.

Van der Horst, K., Oenema, A., Ferreira, I., Wendel-Vos, W., Giskes, K., van Lenthe, F., & Brug, J. (2007b). A systematic review of environmental correlates of obesity-related dietary behaviors in youth. *Health Education Research, 22*(2), 203-226.

Van der Horst, K., Paw, M.J.C.A., Twisk, J.W.R., & Van Mechelen, W. (2007a). A brief review on correlates of physical activity and sedentariness in youth. *Medicine and Science in Sports and Exercise, 39*(8), 1241-1250.

Vatanparast, H., Calvo, M.S., Green, T.J., & Whiting, S.J. (2010). Despite mandatory fortification of staple foods, vitamin D intakes of Canadian children and adults are inadequate. *Journal of Steroid Biochemistry and Molecular Biology*, *121*(1-2), 301-303.

Wang, F., Wild, T.C., Kipp, W., Kuhle, S., & Veugelers, P.J. (2009). The influence of childhood obesity on the development of self-esteem. *Health Reports, 20*(2), 21-27.

Wang, X., Ouyang, Y., Liu, J., Zhu, M., Zhao, G., Bao, W., & Hu, F.B. (2014). Fruit and vegetable consumption and mortality from all causes, cardiovascular disease, and cancer: systematic review and dose-response meta-analysis of prospective cohort studies. *British Medical Journal*, *349*, doi: 10.1136/bmj.g4490.

Ward, L.M., Gaboury, I., Ladhani, M., & Zlotkin, S. (2007). Vitamin D-deficiency rickets among children in Canada. *Canadian Medical Association Journal*, *177*(2), 161-166.

Whitney, E., Rolfes, S.R., Hammond, G., & Piché, L.A. (2013). *Understanding Nutrition*, 1st Canadian Edition. Toronto, Ontario, Canada: Nelson Education Ltd.

Widome, R., Neumark-Sztainer, D., Hannan, P.J., Haines, J., & Story, M. (2009). Eating when there is not enough to eat: eating behaviors and perceptions of food among food-insecure youths. *American Journal of Public Health, 99*(5), 822-828.

Wilk, P., & Cooke, M. (2015). Collaborative public health system interventions for chronic disease prevention among urban Aboriginal peoples. *International Indigenous Policy Journal,* 61(4). doi: 10.18584/iipj.2015.6.4.3

Willett, W.C., Howe, G.R., Lawrence, H.K. (1997). Adjustment for total energy intake in epidemiologic studies. *American Journal of Clinical Nutrition*, *65*(Suppl),1220S-1228S.

Willows N.D., Hanley, A.J.G., & Delormier, T. (2012). A socioecological framework to understand weight-related issues in Aboriginal children in Canada. *Applied Physiology, Nutrition, and Metabolism, 37*(1), 1-13.

Willows, N.D. (2005). Determinants of healthy eating in Aboriginal peoples in Canada. The current state of knowledge and research gaps. *Canadian Journal of Public Health, 96*(Suppl 3), S32-S36.

Willows, N.D., Ridley, D., Raine, K.D., & Maximova, K. (2013). High adiposity is associated cross-sectionally with low self-concept and body size dissatisfaction among indigenous Cree schoolchildren in Canada. *BMC Pediatrics*, *13*, 118, doi:10.1186/1471-2431-13-118.

Willows, N.D., Veugelers, P., Raine, K., & Kuhle, S. (2009). Prevalence and sociodemographic risk factors related to household food security in Aboriginal peoples in Canada. *Public Health Nutrition, 12*(8), 1150-1156.

Wilson, D., & Macdonald, D. (2010). *The income gap between Aboriginal peoples and the rest of Canada*. Ottawa, Ontario, Canada: Canadian Centre for Policy Alternatives.

Wilson, K., & Young, T.K. (2008). An overview of Aboriginal health research in the social sciences: current trends and future directions. *International Journal of Circumpolar Health, 67*(2-3), 179-189.

Wilson, S. (2008). *Research is Ceremony. Indigenous Research Methods*. Halifax, Nova Scotia, Canada: Fernwood Publishing.

World Cancer Research Fund & the American Institute for Cancer Research. (2007). *Food, nutrition, physical activity and the prevention of cancer: a global perspective.* Washington, District of Columbia, USA: American Institute for Cancer Research.

World Health Organization [WHO]. (2008). *Training course on child growth assessment. Measuring a child's growth*. Geneva, Switzerland: World Health Organization.

World Health Organization [WHO]. (2013a). Social determinants of health. Available at: http://www.who.int/social_determinants/en/ (accessed 21 July 2015).

World Health Organization [WHO]. (2013b). BMI classification. Available at: http://apps.who.int/bmi/index.jsp?introPage=intro_3.html (accessed 21 July 2015).

World Health Organization [WHO]. (2014). Trade, foreign policy, diplomacy and health. Food security. Available at: http://www.who.int/trade/glossary/story028/en/ (accessed 21 July 2015).

Young, N.L., Wabano, M.J., Burke, T.A., Ritchie, S.D., Mishibinijima, D., & Corbiere, R.G. (2013). A process for creating the Aboriginal children's health and well-being measure (ACHWM). *Canadian Journal of Public Health*, *104*(2), e136-141.

Young, T.K., & Katzmarzyk, P.T. (2007). Physical activity of Aboriginal people in Canada. *Canadian Journal of Public Health*, *98*(Suppl 2), S148-S160.

Young, T.K., Dean, H.J., Flett, B., & Wood-Steiman, P. (2000). Childhood obesity in a population at high risk for type 2 diabetes. *The Journal of Pediatrics, 136*(3), 365-369.

Zhang, R., & Naughton, D.P. (2010). Vitamin D in health and disease: current perspectives. *Nutrition Journal, 9*, 65. doi:10.1186/1475-2891-9-65.

Zietsma, D. (2011). The Aboriginal Labour Force Analysis Series. Aboriginal people living off-reserve and the labour market: estimates from the Labour Force Survey, 2008-2009. Available at: http://www5.statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=71-588-X&chropg=1&lang=eng (accessed 21 July 2015).

13.0 Appendices

Appendix A. Sample information letter for participation in the web-based survey

INFORMATION LETTER RE: EVALUATION OF STUDENT FOOD BEHAVIOUR

[insert date]

Dear Parent or Guardian,

Professors Rhona Hanning and Len Tsuji of the University of Waterloo are working with the [redacted], and [redacted] in partnership to understand children's food behaviour and physical activity patterns. 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 [redacted] and complete a 45-minute survey about their eating and physical activity habits. 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 [redacted], and [redacted] 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 [redacted] ([redacted]).

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 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 one of the contact persons listed at the bottom of this page.
- 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.

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
ljtsuji@uwaterloo.ca

Michelle Gates & Allison Gates
PhD Candidates
University of Waterloo
[redacted]
m2gates@uwaterloo.ca, agates@uwaterloo.ca

Appendix B. Purchasing guidelines for a school snack program in a remote, isolated community in northern Ontario[a]

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	• 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 there is no sugar added in the ingredient list	• Any salsa • Reduced sodium versions of vegetable or tomato juices – check the labels • Any brand of canned fruit in syrup	• 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
Grain Products (optional)			
Breads	• **Whole grain** bread, buns, bagels, English muffins, pitas, or bannock	• Enriched white bead, buns, bagels, English muffins, pitas, or bannock	• White breads that are higher in fat or sodium – cheese breads, scones, biscuits
Baked Goods	• Small **whole grain** muffins (bran or oat or whole wheat or cornmeal) • Nature Valley Fibresource bars • All-Bran Chewy Bars (Chewy variety only)	• All-Bran bars (not the chewy) or bites • Nature Valley Crunchy granola bars • Quaker Oatmeal-to-Go squares • Kellogg's NutriGrain bars	• 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 Dipps granola bars • Any chocolate coated granola bars • Kellogg's Special K

Food Group	Healthiest (at least 80%)	Less Healthy (at most 20%)	DO NOT SERVE
			cereal bars • Fig Newtons
Grain-Based Snacks	• 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 snacks • Honey Maid low-fat honey flavoured graham crackers	• Nabisco Wheat Thins • Plain Melba Toast • Triscuit crackers • Honey Maid honey flavoured graham crackers	• Chocolate coated rice snacks • Any Breton crackers • Any Ritz crackers or other butter crackers • Cheese Nips, most cheese 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 • Crispix	• 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 • Velvetta • 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 •

Food Group	Healthiest (at least 80%)	Less Healthy (at most 20%)	DO NOT SERVE
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

[a]Allison & Michelle Gates, 2010. Adapted from the Ontario Ministry of Education (2010) and the Ontario Society of Nutrition Professionals in Public Health School Nutrition Workgroup Steering Committee (2004).

Appendix C. Information letter and consent form for the physical activity study

Title of Project: Evaluation of a multi-component initiative to promote physical activity among youth in [redacted]

Organizers: Dr. Rhona Hanning, Dr. Leonard Tsuji, Allison Gates, Michelle Gates, Judy Stephen, Andrew Fehst

<u>INFORMATION LETTER – PHYSICAL ACTIVITY STUDY</u>

September 4, 2012

Dear Parent(s) Or Guardian(s):

I am writing to ask permission for your child to participate in a research project. This project is being lead by Drs. Rhona Hanning and Len Tsuji at the University of Waterloo along with [redacted] and the local Education Authority. During the 2012-2013 school year, Judy Stephen (principal) and Andrew Fehst (Grade 8 teacher) will run a school-based physical activity program. University of Waterloo researchers will support and evaluate the program. The project plans to benefit youth by: 1) increasing physical activity, 2) promoting a healthy lifestyle, and 3) encouraging a healthy body image.

The objectives of the project are to:

1. Learn about the barriers and supports to being physically active for youth
2. Learn about the body image, eating and physical activity habits of youth
3. Work with [redacted] to support a school-based physical activity program
4. Evaluate the impact of the program

The project will include the following. Measurements will be taken at two times. Once at the beginning and once at the end of the 2012-2013 school year:

1. **Web-based survey:** This will occur in class on school computers. It will include questions on diet and body image. Your child will have a unique username and password. This will ensure that their answers are confidential. The survey will take about 45 minutes. Your child will be able to skip any question they don't want to answer.
2. **Routine physical fitness testing**: This will include a four tests during physical education class. 1) 20-m shuttle run, 2) flexibility test, 3) muscular strength test, and 4) muscular endurance test. Results will be collected by Andrew Fehst and given to the research team.
3. **Body composition**: Height, weight, body fat % (using a scale), waist circumference, heart rate and blood pressure (using an electronic blood pressure cuff). This will take less than 30 minutes. Each child will be measured individually (for confidentiality) on school grounds.
4. P**hysical activity level:** Your child will be asked to wear an accelerometer (like a step-counter) around their waist. They will wear it for 3 full days. They will only take it off to take a shower or at other times when it could be damaged. Each day, information will be collected from the accelerometer (at school).

All students in grades 6 and 7 who have received parental permission (signed consent form) and verbally agree to the study will participate. Allison and Michelle Gates, from the University of Waterloo, will perform the measurements along with Andrew Fehst. There will be no remuneration for participating. However, each child will receive a copy of their results to take home. Results for individual children will be kept strictly confidential. They will not be shared with school staff. Reports will include only summary information. It will not be possible to identify any individual child. A written feedback report will be sent to [redacted] and the local Education Authority. If you would like a copy of this report, you can obtain one by contacting the researchers or [redacted]. Additional presentations will be made at the request of the community. All information collected will be kept in locked files on an encrypted laptop. These will be stored indefinitely on a CD in a locked filing cabinet within the School of Public Health and Health Systems at the University of Waterloo.

The physical activity program is planned to benefit youth and the community. It will likely increase physical activity. It may also promote physical fitness and a healthy body image. This study aims to confirm the benefits of this program. There are no known or anticipated risks to participation in this study. However, the decision about your child's participation is yours. By completing the attached consent form and having your child return it to [redacted] within the next 10 days, you agree to have your child participate. Additionally, verbal consent from your child will be obtained prior to data collection. Children or parents may withdraw their permission at any time during the study. This can be done, without penalty, by contacting the researcher, Judy Stevens or Andrew Fehst at [redacted], or the local Education Authority.

I would like to assure you that this study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo. In addition, it has been approved by the local Education Authority. It has the support of Judy Stevens (principal) and Andrew Fehst (physical education teacher) at [redacted]. Should you have any concerns or comments resulting from your child's participation in this study, please contact Dr. Maureen Nummelin, the Director, Office of Research Ethics, at 1-519-888-4567, Ext. 36005 or maureen.nummelin@uwaterloo.ca.

If you have any questions about the study, or if you would like additional information to help you reach a decision, please feel free to call me at the University of Waterloo, 519-888-4567, Ext. 35685. Thank you in advance for your interest and support of this project.

Yours sincerely,

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

Judy Stephen
Principal
[redacted]

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

Andrew Fehst
Physical Education Teacher
[redacted]

Allison Gates & Michelle Gates, PhD Candidates
School of Public Health & Health Systems
[redacted]
University of Waterloo
agates@uwaterloo.ca, m2gates@uwaterloo.ca

Title of Project: Evaluation of a multi-component initiative to promote physical activity among youth in [redacted]

Organizers: Dr. Rhona Hanning, Dr. Leonard Tsuji, Allison Gates, Michelle Gates, Judy Stephen, Andrew Fehst

CONSENT FORM

By completing this consent form and having my child return it to St. Andrew's School by **September 21, 2012**, I agree to have my child participate in the described research project, lead by Drs. Rhona Hanning and Len Tsuji at the University of Waterloo, in partnership with [redacted] and the local Education Authority. I have made this decision based on the information I have received in the information letter. I have had the opportunity to ask questions and request any additional details I wanted about this study.

I understand that as a participant in this study, my child will be involved in two phases of data collection. One phase will be at the beginning and one at the end of the 2012-2013 school year. My child will give verbal consent before participating. Each phase will include: 1) a routine physical fitness test (data given to research team), 2) wearing an accelerometer for three days, 3) testing body composition, and 4) a short web-based survey. I also understand that I may withdraw consent for my child's participation at any time. I may do so, without penalty, by indicating this decision to the researcher, Judy Stephen or Andrew Fehst at [redacted], or the local Education Authority.

I am aware that this study has been reviewed by, and received ethics clearance through, the Office of Research Ethics at the University of Waterloo, and that I may contact the Director at 519-888-4567 ext. 36005 if I have any concerns or comments resulting from my participation in this study.

I agree to have my child participate in this research project.

YES NO (Please circle your choice)

Child's Name: ______________________________(Please print)

Parent or Guardian's Name: _____________________________(Please print)

Parent or Guardian's Signature: _________________________________

Date: ___________________

Appendix D. Information letter and consent form for participation in the focus group

INFORMATION LETTER –STAFF FOCUS GROUPS

[insert date]

Dear Member of School Staff:

A research project is being conducted by Drs. Rhona Hanning and Len Tsuji at the University of Waterloo along with St. Andrew's School and the local Education Authority.

As part of this project, you are invited to take part in a focus group. In this discussion, we will try to find out about the snack program at [redacted]. We will ask you what you liked about it and what you think should change. The discussion will be lead by Allison Gates and Michelle Gates of the University of Waterloo.

Staff who have signed the attached consent form and returned it to the main office at St. Andrew's School will participate. The discussion will take about 30 minutes. It will take place at a time that is convenient to the group (e.g., either directly after school or during the lunch break), in the second week of May. We will discuss your opinion of the physical activity program that took place this school year. There is no remuneration for participating. There are no known or anticipated risks to your participation in this session. The discussion leader will take notes on a computer. These will be kept in a locked file on an encrypted laptop. If there is a question that you do not want to answer, you do not have to. We will make this clear at the beginning of the discussion. All information discussed is considered confidential. In any reports, responses will be grouped with those from other participants. Your name will not be associated with any comments. A written feedback report will be sent to [redacted] and the local Education Authority. If you would like a copy of this report, you can obtain one by contacting the researchers or [redacted]. Additional presentations will be made at the request of the community. The information collected from the discussion will be kept indefinitely on a CD in a locked file cabinet within the School of Public Health and Health Systems at the University of Waterloo. Only study researchers will be able to access it.

Given the group format of the discussion, you will be asked you to keep information that could identify another participant and their comments confidential. If you have any questions about your participation in this discussion, you can contact professor Rhona Hanning at 519-888-4567, Ext. 35685. If you want to withdraw from the study at any time, please contact the researcher, Judy Stephen at [redacted] or the local Education Authority.

I would like to assure you that this study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo. However, the final decision about participation is yours. By completing the attached consent form and returning it to the main office at [redacted] within the next 10 days, you agree to participate. Should you have comments or concerns resulting from your participation in this study, please contact Dr. Maureen Nummelin, the Director, Office of Research Ethics, at 1-519-888-4567, Ext. 36005 or maureen.nummelin@uwaterloo.ca.

If you have any questions about the study, or if you would like additional information to assist you in reaching a decision, please feel free to call Dr. Rhona Hanning at the University of Waterloo, 519-888-4567, Ext. 35685. Thank you in advance for your interest and support of this project.

Yours sincerely,

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

Judy Stephen
Principal
[redacted]

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

Allison Gates & Michelle Gates, PhD Candidates
School of Public Health & Health Systems
[redacted]
University of Waterloo
agates@uwaterloo.ca, m2gates@uwaterloo.ca

<u>CONSENT FORM</u>

By completing this consent form and returning it to the main office at [redacted] within the next 10 days, I agree to participate in the discussion, lead by Allison Gates and Michelle Gates, from the University of Waterloo. I have made this decision based on the information I have received in the information letter. I have had the opportunity to ask questions and request any additional details I wanted about this study.

I understand that as a participant, I will be involved in a group discussion about my thoughts about the school snack program. The discussion will take place at school during the second week of May. I also understand that I may withdraw consent for my participation at any time. I may do so, without penalty, by indicating this decision to the researcher, Judy Stephen at [redacted], or the local Education Authority.

I am aware that this study has been reviewed by, and received ethics clearance through, the Office of Research Ethics at the University of Waterloo, and that I may contact the Director at 519-888-4567 ext. 36005 if I have any concerns or comments resulting from my participation in this study.

I agree to participate in this discussion.

YES NO (Please circle your choice)

Name: _____________________________(Please print)

Signature: ________________________________

Date: ___________________