

# **HOUSEHOLD FOOD INSECURITY AND OBESITY IN FIRST NATIONS COMMUNITIES IN CANADA**

by

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## **Abstract**

**Background:** Food insecurity for Indigenous households across Canada is an ongoing challenge and the associated impacts on health and wellness represent an important public health issue. For Indigenous populations living both on and off-reserve, the diet-related health concerns of food insecurity include obesity, poor dietary quality and chronic disease.

**Objective:** To better understand the factors and processes underlying food insecurity and obesity in First Nations living on-reserve in order to contribute to an evidence-based discussion of strategies for protecting traditional food practices and addressing inequities in health and nutrition.

**Methods:** Secondary data analysis was conducted from the First Nations Food, Nutrition and Environment Study (FNFNES), which applied a cross-sectional study design intended to be representative of First Nations living on-reserve in Canada (south of 60°). Data were analysed from the social, health and lifestyle questionnaire and food security questionnaire components of the FNFNES. Multivariate logistic regression, approached within a holistic framework of First Nations health and wellness, was used to examine the determinants of food insecurity and associations with obesity among individuals living in food insecure households. Analyses were conducted of First Nations communities in British Columbia, Manitoba, Ontario and Alberta.

**Results:** Forty-six percent of First Nations households were food insecure, with 9.5% of households classified as marginally food insecure, 27.9% moderately food insecure and 8.9% severely food insecure. Socio-demographic characteristics significantly associated with food insecurity included age, gender, region, main source of income, years of education, presence or absence of children in the household, road access and household traditional food activity. Rates

of obesity were highest among marginally food insecure households (56%). Compared with food secure households, marginally food insecure households had significantly higher odds of obesity (OR 1.5, 95% confidence interval 1.19, 1.97), after adjustments for socio-demographic variables.

**Conclusions:** The relationship between food insecurity and obesity highlight the need for multifaceted approaches that focus on income and the provision of affordable and accessible healthy foods, with particular consideration for quality and cultural appropriateness. Indigenous food sovereignty provides a promising framework for developing culturally appropriate strategies that enable community capacity to address food insecurity and diet-related health conditions.

## **Preface**

This thesis contains work based on analyses from the First Nations Food, Nutrition and Environment Study (FNFNES) by the candidate, Ashleigh Domingo, under the supervision of Dr. Jerry Spiegel and co-supervision of Dr. Malek Batal, with guidance from Dr. Martin Guhn and Dr. Hannah Wittman. Secondary data analysis of the FNFNES was conducted by the candidate, as well as the writing of the manuscript.

Sections of this thesis will be submitted to peer reviewed journals for publication. Ethical approval has been obtained from the University of British Columbia Behavioural Research Ethics Board (certification number H15-01376).

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## **Dedication**

This thesis is dedicated to my loving family who have always guided and supported me unconditionally.

To my loving and hard-working mother whose strong-will has inspired and motivated me to achieve both personal and academic goals.

To my loving father, who has always supported my decisions, adventures and has guided me throughout my academic career.

To my supportive brother who has always had my back especially when I needed it the most.

## Chapter 1: Introduction

In Canada, food insecurity has been identified as an urgent public health issue for Indigenous populations<sup>1</sup> who have been found to disproportionately bear the burden from a high prevalence rate of food insecurity relative to the general Canadian population (Power, 2005; Council, 2014; Tarasuk et al., 2014). However, current understandings of food security, as defined by the Food and Agriculture Organization of United Nations, have primarily focused on economic constraints to purchasing food in the market (Tarasuk et al., 2014; Power, 2008), and have excluded important elements of a human-rights approach to food, including the social and cultural considerations of food security (Windfuhr & Jonsen, 2005; Gonzalez, 2010). Current conceptualizations of food security have been primarily developed in non-Indigenous contexts, which have not taken into full account traditional and ancestral food practices, nor have they considered the unique food security challenges related to the harvesting, sharing, and consumption of traditional foods (Power, 2008; Elliot et al., 2012). In particular, for Indigenous populations in Canada living on-reserve whose diet consists of both traditional and market based food, it is important to consider challenges to accessing food from both traditional and market food sources (Skinner et al., 2013; Power, 2008).

Recognition of the significance of social circumstances related to the acquisition and consumption of food is particularly supported by the framework of *food sovereignty*, which has

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<sup>1</sup> “Indigenous people,” as defined by Kuhnlein and Chan (2000) refers to a “cultural group in a particular ecologic area that has developed a successful subsistence base by using available natural resources.” (pg.569). The plural form, “Indigenous peoples,” used throughout this study, recognizes the cultural diversity within Indigenous people (Kuhnlein & Receveur, 1996). In Canada, Indigenous peoples, collectively refers to “Aboriginal peoples” that are constitutionally defined as First Nations, Métis and Inuit. Accordingly, throughout this thesis the terms “Indigenous” and “Aboriginal” will both be used to refer to Canada’s First Nations, Métis and Inuit peoples.

been defined as the “*the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems*” (Nyéléni Forum for Food Sovereignty, 2007). Food sovereignty provides a critical alternative to food security by considering culture and human rights, as well as recognizing how power dynamics have determined relations of production and distribution within the food system (Wittman, 2011). Approaches to addressing food insecurity for Indigenous populations must therefore involve a consideration of food sovereignty, including rights over traditional land and land-use practices.

For Indigenous populations living both on and off reserve, diet-related health concerns associated with food insecurity include inadequate nutrition, obesity and obesity-related chronic conditions, such as diabetes, heart disease and high blood pressure (Elliot et al., 2012; Fieldhouse & Thompson, 2012; Kirkpatrick & Tarasuk, 2008; Vozoris & Tarasuk, 2003). The changes in diet and lifestyle observed among Indigenous groups in Canada and globally (Kuhnlein et al., 2004; Haman et al., 2010), characterized by a shift from consumption of traditional foods to more energy dense processed foods, combined with limited access to affordable nutritious food from both traditional and market-based food systems<sup>2</sup>, have been identified as factors underlying the interrelated issues between food insecurity and obesity (Fieldhouse & Thompson, 2012; Foulds et al., 2011; Elliot et al., 2012; Damman et al., 2007; Egeland et al., 2011). This has been described in the literature as the *nutrition transition* (Kuhnlein et al., 2004; Egeland et al., 2011;

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<sup>2</sup>There are two food systems that play an important role in food security for Indigenous peoples in Canada, the traditional and market food systems (Power, 2008). A traditional food system as defined by Kuhnlein and Chan (2000) refers to all “food species that are available to a particular culture from local natural resources and the accepted patterns for their use within that culture” (p.596). A market food system includes agribusiness food products available to global consumers (Elliot et al., 2012).

Rotenburg, 2016) that has been influenced by a range of historical, social, environmental and economic drivers including: colonial laws and residential school policies; the introduction of imported westernized goods; and greater engagement in a wage economy reducing time and energy to engage in traditional food acquisition activities, all of which have been considered to contribute to social change (Sharma, 2010).

In this thesis, I seek to deepen understanding of the social determination of food security and related contributions to health and wellness by examining the relationship between food insecurity and obesity in First Nations communities. To pursue this goal, data from the First Nations Food, Nutrition and Environment Study (FNFNES) were analysed to determine the factors and processes associated with the availability and access to traditional and market-based foods, as well as the association between food insecurity and obesity in First Nations living on reserve. In addition, through a critical review of the literature, the concept and framework of food sovereignty, including Indigenous food sovereignty, are discussed as an important means to restore and enhance access to traditional foods to achieve long-term food security and promote health and wellness. This study draws on a holistic analysis of First Nations health through an examination of the interplay between various factors affecting food security, obesity and Indigenous food sovereignty including the legacy of colonization, environmental dispossession, human rights, environmental change, poverty, nutrition and food safety. The primary objective of the present study is to provide an understanding of the factors and processes underlying the interrelated issues of food insecurity and obesity, as well as to facilitate a discussion on the importance of Indigenous food sovereignty in protecting traditional food practices and addressing inequities in health and nutrition.

The next chapter commences with a review of the literature on Canada's Indigenous populations, household food security and the food security scale, rates of food insecurity in Canada, Indigenous traditional foods and wellness, and the impacts of food insecurity on health and wellness, with specific examples discussed. The concept and framework of food sovereignty is then explored, followed by an overview of factors affecting Indigenous food security and food sovereignty through an examination of the links between the legacy of colonialism and environmental dispossession, environmental change, and poverty related issues. The subsequent chapters in this thesis include an overview of the conceptual model and framing of the research, followed by a description of the methods applied in the study, a summary of the results, discussion of findings, and concludes with a summary of the present thesis, including research questions and objectives addressed and implications for policy.

## Chapter 2: Literature Review

### 2.1 Indigenous Peoples in Canada

#### 2.1.1 Socio-political context

Indigenous peoples in Canada, also commonly referred to as Aboriginal peoples, are a diverse group living across the country and are defined by the Canadian Constitution Act as First Nations, Métis and Inuit (Bartlett, 2003). Data from the 2011 National Household Survey indicate that there are approximately 1.4 million Aboriginal people living across Canada (Statistics Canada, 2011). The largest group of Aboriginal people are First Nations, representing 60.8% of the total Aboriginal population, followed by Métis (32.3%) and Inuit (4.2%) (Statistics Canada, 2013a). First Nations in particular are a diverse and unique group whose presence in numbers is greatest in Ontario (23.6%) followed by British Columbia (18.2%) and Alberta (13.7%), and whose presence as a percentage share of the total jurisdictional population is most prominent in the Northwest Territories, Yukon, Manitoba and Saskatchewan (Statistics Canada, 2013a). Approximately half of First Nations have registered Indian status<sup>3</sup> and of those who report being Registered Indians (637,660), 49.3% live on-reserve<sup>4</sup> (Statistics Canada, 2013a).

The socio-political context of Aboriginal peoples is particularly important to understanding the contemporary health outcomes of colonialism that can be viewed in social, political and economic dimensions of Aboriginal peoples' lives. Historically, through colonial laws and practices, Aboriginal peoples were displaced physically from their traditional territories, and were subject to assimilation policies that sought to undermine the social and cultural fabric of

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<sup>3</sup>Registered Indians refers to a person who is registered under the Canadian *Indian Act* (Statistics Canada, 2013a).

<sup>4</sup>Reserves are Crown lands set aside for the use of registered Indians (First Nations) by the Canadian government (Adelson, 2005).



Aboriginal identity (Bartlett, 2003). Such policies led to the creation of residential schools intended to assimilate Aboriginal people into mainstream European Canadian society. In residential schools, Aboriginal children were separated from their families and communities, and were forbidden to speak their traditional languages or practice any skills gained from their communities (Reading & Wien, 2009). Through a range of colonial policies, Aboriginal peoples were alienated from traditional territories, ways of life, and were forced to abandon their cultural practices, many of which connected Aboriginal people to their natural environment such as water, plants and animals (Richmond & Ross, 2009). Aboriginal people continue to experience disproportionate adverse health effects from the loss of their traditional environments and the erosion of their cultural identity rooted in Canada's historical legacy of colonization (Bartlett, 2003). The intergenerational impacts from public humiliation, punishment and abuse in residential schools are well documented and continue to be felt by Aboriginal peoples today (Reading & Wien, 2009). Although the impacts of colonization are similar among Aboriginal groups, through certain policies such as the Indian Act, the impacts of colonialism on First Nations health and wellness have been regarded to be most deleterious (Reading & Wien, 2009). All Aboriginal groups, however, have endured the adverse effects from the loss of land, language and resources (Reading & Wien, 2009).

### **2.1.2 Indigenous holistic perspective of health**

Among Indigenous groups in Canada and globally, a holistic perspective of health is embraced, comprising the physical, social, spiritual, emotional, and mental dimensions of health (Reading & Wien, 2009; Adelson, 2005). The interrelatedness between such dimensions of health and wellness is widely understood and is emphasized as particularly important to holistic understandings of health. However, the diversity and differences in holistic understandings of

health among Aboriginal groups, as reflected by cultural, social and political differences between First Nations, Métis and Inuit, are important to recognize. As the focus of this study is on First Nations peoples, this thesis acknowledges a First Nations conceptualization of health, according to the First Nations Centre (FNC) as understood to be “a balance between the physical, mental, emotional, and spiritual realms of life. In some First Nations cultures, it is also a life that is lived according to the seven grandfather teaching of wisdom, love, respect, bravery, honesty, humility and truth” (FNC, 2012). In this thesis, it is therefore recognized and understood that conceptualizations of holistic features of health vary by each First Nations community, practice and cultural context.

## **2.2 Household Food Security**

### **2.2.1 Food security defined**

Food security, as defined by the Food and Agriculture Organization (FAO) of the United Nations, has been described as a state that “*exists when all people, at all times, have physical, social, and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*” (FAO, 2002). While such framing has been contested as being narrow in the absence of a full appreciation of what is implied by *food preferences* (Rehber 2012), this definition of food security has been implemented and embraced by Canadian public health policies, which have focused on household levels of food insecurity and have placed an emphasis on access, availability, and utilization dimensions of food security (Power, 2008). However, measurement and monitoring of food security in Canada, as measured in federal government surveys, focus on household *access* to adequate food and is primarily concerned with the household’s economic ability to purchase food from the market (Power,

2008; Tarasuk et al., 2014). Food insecurity has been described as an outcome of inadequate access to a sufficient amount of nutritious food to maintain good health (Tarasuk et al., 2014). Experiences of food insecurity can range from going hungry, missing meals, or running out of food, to being unable to afford a balanced diet.

### **2.2.2 Measuring food insecurity: Household Food Security Survey Module (HFSSM)**

The income-related Household Food Security Survey Module (HFSSM), developed by the United States Department of Agriculture, is internationally recognized and used as a measure of household food insecurity for adults and children within a household (Health Canada, 2007). Since 1995, the HFSSM has been used in the United States (US) to monitor household food security through the Current Population Survey (CPS) (Bickel et al., 2000). The module has also been used in Canada in large-scale national surveys such as the Canadian Community Health Survey (CCHS) to measure experiences of household food insecurity. Since 2004, the HFSSM has been included in the CCHS to measure households' experiences of food insecurity due to financial constraints, over the previous 12 months.

The HFSSM contains a set of 18 questions regarding self-reports of uncertain or insufficient food availability, access and utilization due to financial constraints over a 12-month period prior to being surveyed. Ten of the 18 survey questions are specific to adult experiences of food insecurity, while the remaining eight are specific to children under the age of 18 residing in the household. The sequence in the HFSSM is such that questions increase in the degree of severity of food insecurity a household has experienced. To reduce the burden that may be imposed from the food security questionnaire, respondents are not asked questions of increasing severity if the

respondent has few affirmed items at earlier stages in the module. This process has been identified in the HFSSM as internal “screens” to reduce respondent burden (Bickel et al., 2000).

From the survey module, a single respondent representative of the household is asked whether he/she or any other members of the household have experienced any of the described conditions of food insecurity, which range in severity from: experiences of anxiety of running out of food without money to buy more, to inadequate quantity or quality of foods, to reduced food intake, to the physical sensation of hunger, and going a whole day without eating (Bickel et al., 2000). Each question from the survey specifies a lack of money as the reason households are unable to achieve food security. The module, however, does not determine the food security status of a single individual residing in the household. It therefore cannot be assumed that individuals within a household share the same food security status (Bickel et al., 2000).

### **2.2.3 The household food security scale**

The food security survey questionnaire is combined to form a single overall measure of household food security called the food security scale. The food security scale is a numerical continuous scale that measures the degree of food insecurity experienced by household members (Bickel et al., 2000). A household’s numerical score is dependent on the number of affirmed responses in the survey item questionnaire. A response is considered affirmed when a respondent on behalf of the household indicates (i) ‘yes’; (ii) ‘often’ or ‘sometimes’; or (iii) ‘almost every month’ or ‘some months but not every month’ (Health Canada, 2007).

Based on the ten-item adult food security scale, for example, the degree of severity of food insecurity would be expressed by a range of numerical values from zero to ten. A household that has zero affirmed responses and therefore has not experienced any conditions of food insecurity,

as described by the survey questionnaire, will have a scale value of zero, while a household with seven affirmed responses will have a scale value of seven. As noted earlier in section 2.2.2, food security is measured for adults as a group and children as a group. Thus, the food security scale represents the degree of food insecurity for household members as a group, and does not necessarily reflect the food insecurity status for any particular individual in the household (Bickel et al., 2000).

#### **2.2.4 Household food security status: US and Canada**

The household food security scale is often categorized to provide a more meaningful range of the severity of food insecurity experienced by a household. There are different methods used, however, to determine household food security status specifically in the US and Canada. The U.S standard method simplifies the food security scale into four categories: (i) food secure; (ii) food insecure without hunger; (iii) food insecure with hunger-*moderate*; and (iv) food insecure with hunger-*severe* (Bickel et al., 2000). Moderate and severe food insecurity with hunger is sometimes combined into a single category of “food insecure with hunger.” More recently, however, the categories “food insecure with hunger-*moderate*” and “food insecure with hunger-*severe*” have been replaced by “low food security” and “very low food security” respectively (Health Canada, 2007).

In the US, the food security status of households with children is determined based on the 18-item questionnaire combined (Health Canada, 2007). However, this approach to determining the food security status of households based on a single-scale has been deemed problematic (Health Canada, 2007). This is because the relationship between food security among adults and children is dependent on the age of the children in the household (Nord & Bickel, 2002). There is

evidence that food insecurity among adults does not necessarily indicate that children within the same household are also food insecure, especially among younger children (Nord & Bickel, 2002). Among US households with children, adults have been found to undergo considerably high levels of food insecurity before children are food insecure (Bickel et al., 2000).

In Canada, the approach to determining the food security status of a household differs considerably from the US standard method. In Canada, three categories have been used to describe the level of food insecurity experienced by *adults* and *children* in the *household*: (i) food secure; (ii) moderate food insecurity; and (iii) severe food insecurity (Health Canada, 2007). More recent analyses of food insecurity, by Tarasuk and colleagues, have described experiences of food insecurity into *four* different categories: (i) food secure; (ii) marginal food insecurity; (iii) moderate food insecurity; (iv) and severe food insecurity (Tarasuk et al., 2014). The threshold used to define each category of food security is dependent on the number of affirmed responses (“yes”, “often true”, “sometimes true”) to the questions in the HFSSM. In this study, the thresholds used to determine food security status of individuals are described in table 2.1, and are coincident with the four food security categories as defined by Tarasuk and colleagues (2014) in their analysis of *household* food insecurity in Canada.

In contrast to the US standard method, the food security status of a *household* is determined by considering the food security status of adults and children in the household (Health Canada, 2007). The food security status of adults is determined using the 10-item adult Food Security Scale, while the food security status among children is determined with the 8-item Child Food Security Scale. Among households without children, the adult food security scale is used to determine the status of food security for the household. For households with children, the food

security status for a household is determined by considering the food security scale for both adults and children separately. A household is considered food secure if *both* adults and children in the household are food secure. Households are considered *marginally* food insecure if *either* adults or children within the household were assessed to be marginally food insecure, and *moderately* food insecure if *both* adults and children, or *either* adults or children within the household were assessed to be moderately food insecure (Tarasuk et al., 2014). A household is considered severely food insecure if *either* adults or children in the household are severely food insecure (Tarasuk et al., 2014). This approach to determining the food security status of a household, by considering both adults and children within a household, recognizes that adults may compromise their own food intake before children in the household experience the effects of scarce resources.

<b>Table 2.1 Categorization of Household Food Security Status*</b>			
<b>Status</b>	<b>Description</b>	<b>10 item adult food security scale</b>	<b>8 item child food security scale</b>
<b>Food Secure</b>	No indication of difficulty with income related food access	0 affirmed response	0 affirmed response
<b>Marginally Food Insecure</b>	Indication of worry to adequate and secure access to food	Affirmed no more than 1 item	Affirmed no more than 1 item
<b>Moderately Food Insecure</b>	Indication of compromise in quality and/or quantity of food consumed	2-5 affirmed responses	2-4 affirmed responses
<b>Severely Food Insecure</b>	Indication of reduced food intake and disrupted eating patterns	≥6 affirmed responses	≥5 affirmed responses

\*Adapted and modified from: Canadian Community Health Survey, cycle 2.2, Nutrition (2004): Income Related Household Food Security in Canada; Tarasuk et al., 2013. Table is based on the 18-item food security questionnaire in the HFSSM.

### **2.2.5 Limitations of the HFSSM**

Although the HFSSM questionnaire is most commonly used as a measure of household food insecurity, the module is designed to measure food insecurity as resulting from financial resource constraints. Other factors that may contribute to compromised eating patterns and food consumption such as food safety, dieting or fasting, disordered eating, distance to the nearest shopping market or the availability of food through socially and culturally acceptable sources are not captured by the food security survey questionnaire. Additional factors that may undermine one's ability to obtain financial resources such as illness, disability and reduced mobility among the elderly are not measured in the module. The module is also limited in its generalizability to individuals in the household (Bickel et al., 2000). Although the module has been shown to be reliable in describing the food security status of a population, the food security status of a household is not necessarily reflective of any particular individual residing in a household - as food insecurity does not affect all household members in the same way (Bickel et al., 2000). The time period by which food insecurity is measured may also be viewed as a limitation of the food security module survey. An individual who has experienced food insecurity in the past year may in fact be food secure at the time the respondent is interviewed (Health Canada, 2007). Lastly, inconsistency in defined categories of food security status, limits the degree of comparability between studies and countries using the HFSSM in large-scale population based national surveys.



## 2.3 Studies Assessing the Prevalence of Food Insecurity in Canada

### 2.3.1 Rates of food insecurity in Canada

In 2012, the Canadian Community Health Survey (CCHS) identified that a total of 1.7 million households have experienced food insecurity in Canada, representing one in every eight households (Tarasuk et al., 2014). This number amounts to 4 million Canadians, including 1.15 million children, who have experienced some level of food insecurity and its associated impacts on health and wellbeing during the previous 12 months (Tarasuk et al., 2014). Approximately 4.1% of households were classified as marginally food insecure, reporting some worry of running out of food and/or having limited access to a wide selection of food due to a lack of money. In addition, 6% of households were classified as *moderately* food insecure, indicating a compromise in the quality/or quantity of food, while 2.6% were classified as *severely* food insecure, indicative of a greater level of food deprivation including missed meals, and reduced food intake (Tarasuk et al., 2014).

Between 2008 and 2012, the prevalence of household food insecurity in Canada has increased significantly from 11.3% to 12.5% (Tarasuk et al., 2014). The results from the 2012 CCHS revealed Nunavut to have the highest prevalence of food insecurity, where 45.2% of households reported being food insecure. This is followed by the Northwest Territories, where 20.4% of households reported experiencing some level of food insecurity (Tarasuk et al., 2014). The prevalence of food insecurity was also high in the Maritimes and the Yukon with rates exceeding 15% (Tarasuk et al., 2014). Across the country, approximately 84% of food insecure households were located in Ontario, Quebec, British Columbia and Alberta, the most populated provinces of

Canada. The province with the lowest prevalence of household food insecurity was Alberta with a rate of 11.5% (Tarasuk et al., 2014).

The results from the 2012 CCHS, as reported by Tarasuk et al. (2014), identified 28.2% of Aboriginal households as having a rate of food insecurity that is more than double the rate of all Canadian households (12.6%). Additional socio-demographic characteristics found to be associated with a higher likelihood of food insecurity in Canada include households receiving social assistance as the major source of income (69.5%), households reliant on Employment Insurance or Workers Compensation (38.4%), being a female lone parent (34.3%), earning an income below the Low Income Measure (29.0%), those identified as being black (27.8%), and renting a home (26.1%) (Tarasuk et al., 2014).

### **2.3.2 Rates of food insecurity in Canada's Indigenous populations**

Although the CCHS is designed to be representative of the Canadian population, the survey excludes First Nations living on reserve, and therefore the true prevalence and level of vulnerability to food insecurity among Indigenous populations in Canada is underestimated by the omission of First Nations living on reserve (Tarasuk et al., 2014). Other surveys specific to measuring the health status of Indigenous peoples in Canada have provided further information regarding the state of food insecurity for Aboriginal populations. In Canada, there are three large-scale surveys that provide a comprehensive overview of food security in Aboriginal populations: the First Nations Regional Health Survey (FNRHS), the Nunavik Inuit Health Survey, and the IPY Inuit Health Survey (Council, 2014).

From 2008-2010, the FNRHS collected data from 216 First Nations communities in northern Canada (above the 60<sup>th</sup> parallel) (FNIGC, 2012) to provide information on determinants of health, general health status, and nutrition and food security. However, in contrast to surveys such as the CCHS and FNFNES that use the Household Food Security Survey Module (HFSSM) to measure the food security status of a household, the food security results reported by FNIGC were examined based on nine survey questions pertaining to household food security status. Six of the nine questions are specific to providing information on behaviours and conditions characteristic of households experiencing difficulty to meet their food needs for First Nations adults, while the remaining three provide information regarding the food security status of households with children (FNIGC, 2012). Based on responses to the questions on food security, household food security status is determined using the following classification: food secure, moderately food insecure or severely food insecure.

The results from the FNRHS identified 54.2% of First Nations people in Northern Canada to experience moderate or severe food insecurity, indicating First Nations people living in these regions to be considerably more food insecure than the general Canadian population (FNIGC, 2012). The results from the survey revealed that approximately 33.8% of respondents indicated that they *sometimes* were unable to afford a balanced meal, while 14.1% of respondents reported that they *often* were unable to afford a balanced meal. Additionally, 17.8% of respondents reported experiences of hunger and did not eat due to a lack of money for food (FNIGC, 2011).

The most comprehensive assessment of food insecurity among the Inuit in Canada is the IPY Inuit Health Survey. From the 1,901 Inuit households surveyed, 62.6% were found to be food insecure, while 27.2% experienced severe food insecurity (Huet et al., 2012). In addition, the

results from the Nunavik Inuit Health Survey found the people of Nunavut to have the highest food insecurity rate (68.8%) for any Indigenous population in a developed country (Egeland, 2011). Low income, high food costs and unemployment, combined with concerns for environmental contamination in the traditional food system and climate change have been identified as the underlying factors contributing to the high prevalence of food insecurity across Nunavut (Egeland, 2011; Turner & Clifton, 2009; Ford et al., 2006; Council, 2014). Among Métis populations in Canada, there is a lack of peer-reviewed literature and studies about the state of food insecurity in those communities (Council, 2014). However, available data from these three large-scale surveys, along with the CCHS, indicate food insecurity is a serious public health issue in Canada and particularly among Aboriginal populations. The high prevalence of food insecurity found among Indigenous peoples in Canada has also been reported by community-based studies that have indicated food insecurity to remain a challenge for Indigenous peoples living in remote communities and in urban areas (Skinner et al., 2013; Bhawra et al., 2015). The high rates of food insecurity in Aboriginal populations draws attention to the need to consider the full account of Aboriginal peoples' food practices, including their unique ties to the environment related to the gathering and consumption of traditional food.

## **2.4 Food Insecurity and Impacts on Health and Wellness**

The diet of First Nations living on-reserve consists of traditional and market-based foods which are obtained from both conventional and traditional food systems. These two food systems, conventional and traditional, are fundamental to Indigenous food security and culture (Elliot et al., 2012). The negative health concerns associated with household food insecurity for Indigenous populations have therefore ranged from the erosion of cultural and social wellbeing

to nutrition inadequacy, obesity and chronic diseases. This section commences with a review of the literature on Indigenous traditional foods systems; the benefits of traditional foods; and the negative health consequences associated with food insecurity.

#### **2.4.1 Indigenous traditional food systems**

The diet of Indigenous peoples, particularly among those living in more rural and remote communities, consists of both traditional and market-based foods (Council, 2014). A traditional food system, as described by Kuhnlein and Receveur (1996) refers to “all food within a particular culture available from local natural resources and culturally accepted. It also includes the sociocultural meanings, acquisition/processing techniques, use, composition and nutritional consequences for the people using the food” (p.418). Traditional foods include foods originating from local plant or animal resources obtained through gathering, collecting or harvesting practices (Earle, 2011). Marine mammals (seals, beluga, walrus), fish and seafood (Arctic char, white fish, trout/salmon), land animals (caribou, bear, hare, fox), as well as wild berries have been regarded as common types of traditional foods consumed in Indigenous communities in Canada (Blanchet & Rochette, 2008).

Rates of traditional food consumption vary by community and also by socio-demographic characteristics such as age, gender, education, region, and size of the community (Blanchet & Rochette, 2008). Additional factors that contribute to varying rates of traditional food consumption include the availability of traditional foods in the area, seasonality, environmental variability, and the cost of food at local stores (Guyot et al., 2006; Lambden et al., 2006). A decrease, however, in the consumption of traditional food has been documented along with a shift in diet and lifestyle since the 1950s (Gombay, 2005). This is believed to be coincident with

social and food system changes, which include the loss of traditional territory as a result of colonization, environmental degradation, specifically plant and wildlife, and the transition to a wage-based economy such as the commoditization of traditional food to reduce the costs of hunting (Kuhnlein et al., 2001; Furgal et al., 2012; Beaumier & Ford, 2010). The change in diet and lifestyle observed among Indigenous groups in Canada and globally, has been identified in the literature as the “nutrition transition” characterized by a shift from consumption of traditional foods to more processed market foods high in saturated fats, sodium and sugar (Kuhnlein & Chan, 2000; Damman et al., 2008; Haman et al., 2010). Although the consumption of traditional foods has declined over time (Blanchet & Rochette, 2008), the use of traditional foods is still common among First Nations and Métis communities and remains an important part of Aboriginal diet and lifestyle (Batal et al., 2004; Chan et al. 2016; Chan et al., 2014; Chan et al., 2011; Chan et al., 2012).

#### **2.4.2 The benefits of traditional foods**

##### *Cultural wellbeing*

For Indigenous populations, culture is the foundation for both individual and collective identity, and has been regarded as a key determinant of Indigenous peoples’ overall health and wellness (Reading & Wien, 2009). The traditional food system, as defined above, has been identified as an integral part of Indigenous peoples’ culture, social and economic lives expressed through traditional food practices (Richmond & Ross, 2009; Lambden et al., 2006). As culture and the physical environment have commonly been viewed by Indigenous peoples as intimately connected, traditional food practices such as the gathering and consumption of traditional foods have been considered to be the most direct link between the health of Indigenous populations and

their traditional environments (Richmond & Ross, 2009). The use of the environment for the hunting and gathering of plants and traditional medicines has therefore been perceived to strengthen Indigenous peoples' connectivity to the land, reinforcing identity and spiritual wellbeing (Myers et al., 2004; Fergurson, 2011).

In a study examining First Nations perspectives of the environment, economy, health and wellbeing, respondents described connections between their environment, culture and economic viability as key determinants of a healthy community (Richmond et al., 2005). Participants in the study described their ability to use the environment for traditional activities, such as hunting, fishing, and the gathering of plants and medicines, as central to their way of life (Richmond et al., 2005). Kral and colleagues (2011) found traditional harvesting practices involving the preparation and sharing of food with friends and family to be a key part of Indigenous wellbeing. The exchange of food and hunting equipment with members of the community has been found to reinforce social ties, strengthen personal relationships and facilitate the distribution of food between families, communities and regions for social and economic purposes (Gombay, 2010). Traditional foods have also been regarded to form a basis for non-cash economies (Willows, 2005), and have represented an inexpensive and ideal alternative to store-bought foods (Thompson et al., 2014; Council, 2014).

### *Nutrition, diet and lifestyle*

The nutritional benefits associated with the consumption of traditional foods have also been well documented. Studies examining the nutritional value of Indigenous food systems have identified traditional foods to be a key source of nutrients, rich in vitamins, minerals, and proteins (Chan et al. 2016; Chan et al., 2014; Chan et al., 2011; Chan et al., 2012; Kuhnlein et al., 2002). There is

evidence that the consumption of traditional foods is associated with increased intakes of vitamins B6, B12, D and E, zinc, iron, magnesium and potassium (Kuhnlein et al., 2002; Donaldson et al., 2010). Studies examining the nutritional content of traditional foods have found significantly higher intakes of vitamin A, vitamin E, vitamin D, magnesium, and potassium and lower intakes of saturated fats, carbohydrates and sugar when traditional foods were consumed (Egeland et al., 2011; Kuhnlein et al., 2004). Studies have also found traditional foods to be associated with beneficial fat profiles, with greater amounts of DHA and EPA consumed and lower percentages of saturated fats (Earle, 2011). Traditional foods were found to be a high source of omega-3 and 6 fatty acids (Kuhnlein et al., 2004), which has been identified to decrease the risk of cardiovascular disease (Earle, 2011).

Other studies have indicated benefits from physical activity and increased energy expenditure associated with traditional food acquisition activities (Alder et al., 1996). Samson and Pretty (2006) found that engaging in hunting and trapping activities can expend between 12.5 to 50 megajoules (MJ) of energy per day compared to the 0.8-2.1 MJ energy exerted from not being engaged with traditional activities (Samson & Pretty, 2006). Thus, the acquisition and consumption of traditional foods are associated with a number of benefits related to diet and nutritional health, as well as cultural, social and economic dimensions of Indigenous peoples' health and wellness.

### **2.4.3 Food insecurity and impacts on cultural, social and economic wellbeing**

Given the importance of traditional foods to Indigenous peoples' culture, nutritional health and lifestyle, threats to accessing traditional foods not only have implications for food security, but also for the cultural, social and economic dimensions of Indigenous peoples' health and wellness. Common barriers that have prevented access to traditional foods include: loss of access



to traditional territory; the high costs of equipment and transportation; loss of traditional knowledge; lack of skills related to food preparation; increased cost of living, environmental contaminants; urbanization; industrial activities; and climate change (Elliot et al., 2012; Robidoux et al., 2009; Mead et al., 2010).

Such barriers may prevent households from accessing and consuming more traditional foods leading to compromises in food security and subsequently diet and health. Further, recognizing the social and cultural significance related to food sharing, the gathering and consumption of traditional foods, barriers that limit access to traditional foods may undermine traditional knowledge and ties to the environment with negative impacts on cultural, emotional and spiritual dimensions of Indigenous peoples' health and wellness. Factors affecting Indigenous peoples' ability to use the physical environment to access traditional food may therefore reduce the opportunity to practice aspects of their traditional ways of life. For example, the Ojibway First Nations community of Grassy Narrows details the adverse health and social consequences associated with environmental contamination of the traditional food system (Wheatley & Paradis, 1995).

The community of Grassy Narrows in northwestern Ontario is located 180 km from a chlor-alkali plant, which had pumped more than 20 tons of mercury-laden effluent into the English-Wabigoon river system. High levels of the effluent had bioaccumulated in the aquatic ecosystem of the English-Wabigoon River, where residents of Grassy Narrows had been exposed to elevated levels of methylmercury through the consumption of fish (Wheatley & Paradis, 1995). The results from a 10-year mercury exposure-sampling program had found some of the highest levels of human mercury among the residents of Grassy Narrows (Wheatley & Paradis, 1995).

Community members who relied on the fisheries as a cultural and economic base experienced a disruption of lifestyle and eating patterns from the consumption of contaminated fish (Wheatley, 1997). Additional destructive effects from the contaminated fisheries were the high incidence of deaths from suicide and alcohol/drug induced violence in the community related to lifestyle changes including: the degradation of the physical environment, unemployment, and feelings of powerlessness and dependency (Wheatley, 1997).

The consumption of contaminated fish and its associated impacts on health has also been assessed and documented among Indigenous residents in the coastal areas of British Columbia (Wiseman & Gobas, 2002). The health effects associated with exposure to persistent organic pollutants (POPs), from contaminated food include endocrine disruption, immunotoxicity, and altered development (Jacobson & Jacobson, 1996; Sauer et al., 1994). Negative impacts on health and wellness associated with the transition to store-bought food due to environmental contaminants have also been documented (Wiseman & Gobas, 2002; Richmond & Ross, 2009). The adverse effects on health and wellness from the contamination of a traditional food system, as described above, highlight how a disruption in traditional lifestyle can undermine food security and induce social and cultural stress to a community. In the Aboriginal community of Grassy Narrows mentioned above, exposure to environmental methylmercury through consumption of contaminated fish produced a range of social and cultural impacts, and had led to the closure of a local commercial fishery, a traditional source of food, that not only provided an economic base, but was viewed as an integral part of cultural identity (Wheatley, 1997). With traditional foods contaminated, community members sought alternative foods that are believed to have facilitated a change in diet from the consumption of fish high in protein to high

carbohydrate foods (Wheatley, 1997) with implications for food insecurity and diet-related health concerns including obesity and related chronic conditions.

#### **2.4.4 Food insecurity: nutrition inadequacy, obesity and chronic disease**

A reciprocal association exists between food security and health, in that health can be an outcome of being food secure, as well as a determinant of food security (Council, 2014). Being food insecure is tied to negative physical and mental health outcomes which include malnutrition, poor dietary quality, obesity, child developmental issues, chronic diseases, depression, anxiety low immunity levels and family stress (Young et al., 2000). Obesity and the development of chronic diseases, specifically type 2 diabetes mellitus and coronary heart disease, have emerged as areas of growing concern in Indigenous populations (Young et al., 2000).

Obesity has been described as a condition of excess body fat arising from a chronic imbalance in energy, whereby high intakes of energy exceed energy expenditure (Katzmarzyk, 2002). In Canada, an increasing trend in the prevalence of overweight and obesity has been documented (Katzmarzyk, 2002). Over a 13-year period, prevalence rates of obesity have more than doubled for Canadian adults from 1985 to 1998 at both provincial and national levels (Katzmarzyk, 2002). However, there is evidence that the prevalence of overweight and obesity vary substantially across ethnic groups (Tremblay et al., 2005). Results from the CCHS (2000/01-2003) indicate Southeast Asians have the lowest prevalence of self-reported overweight (22%), while the highest prevalence has been found among off-reserve Indigenous populations in Canada (63%) (Tremblay et al., 2005). Further, compared with 17% of those of European ancestry classified as obese, 28% of Indigenous people were classified as obese (Tremblay et al., 2005). Data from the CCHS (2004) also identified Indigenous people as having the highest prevalence of obesity at a rate of 37.8% relative to the general Canadian population (22.6%)

(Katzmarzyk, 2008). In addition, results from the 2008/10 First Nations Regional Health Survey revealed 34.2% of First Nations adults in Northern Canada to be overweight, while 34.8% were classified as obese and 5.4% were identified to be morbidly obese (FNIGC, 2012). These results have been supported by community-based studies that have also documented high rates of overweight or obesity among Indigenous groups (Hanley et al., 2000; Young et al., 2000; Ng et al., 2006).

Obesity has been identified as a risk factor for a number of chronic conditions of which include increased risks of type 2 diabetes mellitus, coronary heart disease, hypertension and dyslipidemia (Panel, NHLBI, 1998; Navaneelan & Janz, 2014). In a study examining the association between the social determinants of health and health outcomes among First Nations people living off-reserve, Rotenberg (2016) found First Nations classified as obese or overweight to have at least one health condition and to have rated their health as fair or poor compared to those classified as normal weight, after controlling for various socio-demographic variables (Rotenberg, 2016). The extent of obesity-related morbidities among Indigenous populations and the associated impacts on health and wellbeing is of particular concern. Type 2 diabetes and cardiovascular disease, in particular, have been higher for First Nations people compared to non-Aboriginal populations in Canada and is considered to be in part due to obesity, food insecurity, and poor nutritional quality (CIHI, 2013; Earle, 2011). Results from the First Nations Food, Nutrition and Environment Study (FNFNES) indicate a high prevalence of diabetes among First Nation adults in Ontario (30%) and Manitoba (23%) (Chan et al., 2012; Chan et al., 2014) in comparison to a rate of 6.5% for Canadians aged 12 or older in 2012 (Statistics Canada, 2013b).

Although individuals experiencing food insecurity are expected to have reduced food intake, there is a growing body of research, which paradoxically indicate a positive association between

obesity and food insecurity (Olson, 1999; Hanson et al., 2007; Wilde & Peterman, 2005; Townsend et al., 2001; Adams et al., 2003; Lyons et al., 2008). The relationship between food insecurity and obesity was first interpreted by Dietz (1995), who suggested that either “food choices or physiologic adaptations in response to episodic food shortage could cause increased body fat” (p.767). Since then, a number of studies have linked the prevalence of obesity and overweight to be associated with food insecurity as reflective by an increase in the consumption of lower costing, nutrient poor, high fat, energy dense food (Young et al., 2000; Townsend et al., 2001; Lyons et al., 2008, Stuff et al. 2007; Drewnowski, 2004).

Energy dense foods have been described as foods that provide the most dietary energy per unit weight (Drewnowski, 2014). Dry energy dense foods such as potato chips, chocolate, doughnuts and bread often contain contents such as refined grains, starch, fat and added sugar. These kinds of foods have been found to provide the most dietary energy per unit cost (Drewnowski, 2004). Contrastingly, lean meat, fresh vegetables, fruit and fish have been found to provide lower dietary energy at a much higher cost (Drewnowski, 2004). An energy dense diet would therefore consist of foods such as processed meat, soft drinks, deserts and snacks, which are high in added sugars, carbohydrates, sodium and saturated fats. Studies have linked high consumption of such energy dense foods to be associated with increased energy intakes and weight gain. Other plausible mechanisms for the association between food insecurity and obesity include overconsumption when food is made available, fear of food restriction, and preoccupation with food consumption (Stuff et al., 2007).

Townsend and colleagues (2001) have found various socio-demographic variables to be associated with food insecurity and high body mass index (BMI) among females (Townsend et

al., 2001). The results from Townsend (2001) are consistent with other studies that have found an association between food insecurity and obesity, as well as a significant interaction with gender, whereby rates of obesity have been found to be significantly higher for food insecure female respondents (Townsend et al., 2001; Lyons et al., 2008; Stuff et al., 2007; Basiotis et al., 2003). Food insecurity has also been found to be directly linked to lower healthy eating index scores associated with a decrease in the consumption of fruits and vegetables, dairy products, and grains (Huet et al., 2011). Other studies, however, have provided conflicting results indicating either a negative association, or no relationship between obesity and food insufficiency (Vozoris & Tarasuk, 2003).

Current dietary surveys among Indigenous groups in Canada have indicated poor dietary patterns with less traditional food consumed and more market-based food consumed containing high amounts of sodium and saturated fats (Kuhnlein et al., 2004). The *nutrition transition* mentioned above is characterized by the shift from the consumption of nutrient-dense, traditional food to market-based foods high in fat, sodium and carbohydrates, and has been identified to be associated with negative effects on health, diet and nutritional intakes (Kuhnlein et al., 2004; Egeland et al., 2011). The nutrition transition has predominantly been observed among younger Indigenous generations, women, and communities with greater access to market-based foods (Samson and Pretty, 2006; Chan et al., 2006; Receveur et al., 1997). Poverty, food costs, food preferences, and changing harvesting practices have been recognized as factors contributing to the nutrition transition and associated changes in diet and lifestyle (Council, 2014). Food insecurity in conjunction with the nutrition transition has been identified to be partially responsible for the high rates of obesity and chronic diseases in First Nations communities (Egeland et al., 2011; Kuhnlein et al., 2004).

## 2.5 Food Sovereignty: A Critical Perspective of Food Security

### 2.5.1 Food sovereignty

As previously discussed, the impacts of food insecurity go beyond the immediate effects of hunger and nutritional intake, to areas such as social and cultural wellbeing. However, the current definition of food security as indicated by the FAO and embraced by Canadian policy, has overlooked important socio-cultural considerations of food security (Gonzalez, 2010). In fact, the social and cultural elements of food such as the local aspect of the diet, traditions, customs, and religion are overlooked from current approaches and practices that focus on increasing food quantity within an economic framework to supply and demand. In addition, the narrow interpretation of food security fails to recognize the broader structural forces that hinder one's ability to make healthy food choices (Caraher & Coveney, 2003). Many scholars continue to challenge the definition of food security, as provided by the FAO, and the extent to which it is inclusive of a wide range of dietary needs and food preferences, as well as *forms* of access that align with the universal right to food (Elliot et al., 2012; Windfuhr & Jonsen, 2005, Gonzalez, 2010).

The ability for people to make healthy food choices is constrained by various factors which include socioeconomic status, gender, income, ethnicity, and global supply patterns, which may lead to poor diet choices and negative health outcomes (Caraher & Coveney, 2004). The current definition of food security fails to recognize the wider elements of the food system, including corporate power and its control over food supplies, and how this influences food choices of individuals and communities. The global food market is controlled by a small number of corporations that have a tight control over the price of food, research, and the development of

food technologies in the global North and the global South (Dilley & Boudreau, 2001). These corporations have now been regarded to be prominent among the primary drivers of dietary change through their control over production and distribution.

There is a need to consider the conceptualization of food security as the *right* of individuals and communities to a sufficient amount of culturally and socially appropriate foods. Food security approached as a human rights issue, including social, economic and cultural rights, is particularly supported by the framework of *food sovereignty* (Council, 2014). Food sovereignty has been broadly defined as the “the right of nations and peoples to control their own food systems, including their own markets, production modes, food cultures and environments” (Wiebe & Wipf, 2011, pg.4). It has been regarded as more than a paradigm or concept, but rather as a newly emerging framework to addressing the rights and obligations around the production and consumption of food that challenges the political and economic structures within which food systems are determined (Wittman, 2011).

Food sovereignty provides a critical alternative to food security by considering culture and human rights, as well as recognizing how power relations have determined the production and distribution within the food system, which have shaped food access and patterns of consumption (Wittman, 2011). The fundamental principles underlying food sovereignty include providing food for people, localizing food systems, enabling local control over land and food resources, maximizing local knowledge and skills, and promoting environmental sustainability (Patel, 2012). At the core of these principles is the notion that the decisions regarding specific aspects of food systems governance should be made by those who depend on- and are affected by- them the most (Wittman, 2011). Theories regarding how food sovereignty may produce specific pathways



to health equity have been relatively undeveloped, particularly in the English language scholarship, with a recent meta-narrative review of this literature (Weiler et al 2014) noting that attention to this construct has been far more common in Spanish (e.g. Heinish 2013).

### **2.5.2 Indigenous food sovereignty**

Indigenous food sovereignty provides a unique framework within the context of Indigenous peoples' struggles rooted in colonial laws and practices (Grey and Patel, 2014). Indigenous food sovereignty has been described as "present day strategies that enable and support the ability of Indigenous communities to sustain traditional hunting, fishing, gathering, farming and distribution practices" (Morrison, 2011, pg.98). Indigenous food sovereignty recognizes the importance of protecting and honouring traditional food practices against ongoing colonial pressures (Desmarais & Wittman, 2014). The principles underlying Indigenous food sovereignty has been described by Dawn Morrison (2011) to be connected to Indigenous peoples' distinct cultures and their relationships with the environment and food systems embedded within their traditional territories. Morrison (2011) emphasizes four central principles of Indigenous food sovereignty as identified by community members, traditional harvesters and elders of which include: (1) the notion that *food is sacred* including relationships with the land, plants and animals that cannot be constrained by colonial laws or policies; (2) *participation* is needed at the individual, family, community and regional level to maintain Indigenous relationships with the land; (3) food related needs and practices should be *self-determined*, including the ability to freely make decisions concerning harvesting and hunting practices; (4) and that coordinated approaches to *policy and legislative reform* are necessary to mobilize the principles of Indigenous food sovereignty (Morrison, 2011).

Indigenous food sovereignty therefore provides a framework for addressing food insecurity through strategies that enable and support communities to engage in traditional food practices, which respect the social and cultural circumstances related to food. This is particularly relevant to Indigenous populations in Canada given the importance of traditional foods as an integral part of Indigenous peoples social, cultural and economic lives. Strategies and programs to address food insecurity in Indigenous populations in Canada must therefore consider engaging with the principles of Indigenous food sovereignty that considers a broad range of factors affecting both food security and food sovereignty. This includes the impacts of colonization and assimilation policies, which have negatively affected the capacity at which Aboriginal peoples are able to practice self-determination and autonomy over the resources of their traditional environments.

## **2.6 Factors Affecting Food Security and Food Sovereignty**

There are a number of determinants that have been identified to undermine food security and food sovereignty for Indigenous peoples (Council, 2014). These factors and processes consist of proximal, intermediate and distal determinants of Aboriginal health as described by Reading and Wein (2009). Proximal determinants such as health behaviours and environments have been described as those factors that have an immediate or direct impact on health, while intermediate determinants, such as community resources and capacities represent the origin of proximal determinants. Further, distal determinants represent more upstream factors and processes embedded within historical, political, economic and social contexts that have been identified to have a much greater influence on the health of Aboriginal peoples' lives (Reading & Wein 2009; Kant et al., 2009).

### **2.6.1 Proximal determinants: Poverty and low-income households**

In the territories of Canada, two main factors have been identified as contributing to food insecurity: (i) poverty and (ii) declining levels of access to traditional/country food (Council, 2014). Poverty has been identified as a major challenge to obtaining an adequate diet from either traditional food or market-based foods (Huet et al., 2012; Tarasuk et al., 2014). Particularly, in areas of northern Canada with strikingly high food prices and high living costs, challenges to ensuring food security are compounded by low-income and high rates of unemployment. Low-income has been found to be associated with crowded household conditions, public housing, or households headed by a single-adult, which have been identified as variables linked with household food insecurity (Huet et al., 2012).

Socio-demographic characteristics related to income that are associated with a higher likelihood of food insecurity include: social assistance as the major source of income, reliance on employment insurance, being a female lone parent, and renting a home (Tarasuk et al., 2014). In addition, such factors may also be compounded by a lack of education surrounding nutritious foods in the market, poor mental health, addiction, and social exclusion. Although income is an important determinant of food security, the effect of income must also be understood within the broader socio-cultural and historical context of Aboriginal people (Beaumier & Ford, 2010).

At a national level, Aboriginal people living on and off-reserve continue to have a household income that is substantially lower than non-Aboriginal households (Adelson, 2005). Wilson and MacDonald (2010) found non-Aboriginal households to have a median income that is \$7,083 higher than Aboriginal people living in urban settings, and \$4,493 higher than Aboriginal people in rural settings (MacDonald, 2010). The income gap between Indigenous and non-Indigenous

populations in Canada remains high and is even higher within the Territories. Data on 16 communities of the Dene Nation surveyed from the First Nations Regional Health Survey (FNRHS) indicate that 67% of households reported having an annual income of less than \$50,000 and 46% with an annual income of less than \$30,000 (Council, 2014). Having a low income has direct ties to food security by determining the quality and quantity of food an individual is able to access from either the market or traditional food sources.

The high cost of food in the northern regions of Canada has been regarded as a significant contributor to food insecurity, where the average weekly cost of food has been found to be \$380 per week or \$19,760 per year (Rosol et al., 2011). In First Nations communities in Ontario, the cost of a nutritious food basket<sup>5</sup> for a family of four ranged from \$175 to \$344 a week and for First Nations communities in Alberta weekly food costs ranged from \$168 to \$377 (Chan et al., 2014; Chan et al., 2016). The effect of low income on food security has therefore been compounded by the high cost of food in these regions. Studies have also found low income as a barrier to accessing traditional foods, arising from the cost of fuel, and high cost of hunting and fishing equipment, which have prevented Indigenous people from engaging in hunting and harvesting activities (Kuhnlein et al., 2013; Beaumier & Ford, 2010). Additional factors affecting access and consumption of traditional foods include, a lack of a skilled hunter in the family, physical inability to hunt, fish, as well as a decrease in the amount of time available to gather and hunt traditional foods. Such factors have had an impact on food security and food sovereignty in Indigenous populations.

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<sup>5</sup>A “nutritious food basket” is used to document the cost and affordability of a nutritious foods for a healthy diet (Health Canada, 2009).

### **2.6.2 Intermediate determinants: Environmental degradation and climate change**

Concerns regarding the safety and availability of traditional foods, arising from environmental degradation and climate change, have presented challenges to food security. Food insecurity arising from contamination of traditional food systems is not only associated with significant impacts on physical health, but can contribute to a disruption of Indigenous peoples' ways of life, affecting their spiritual and emotional wellbeing, as in the particular case of Grassy Narrows previously discussed in section 2.4.3.

A number of studies have revealed traditional foods to be subject to contamination from local and global sources of industrial development. Environmental contaminants such as organochlorine pesticides (e.g., DDT, lindane), polychlorinated biphenyls (PCBs), and heavy metals (e.g., mercury, lead) have accumulated in the environment as a consequence of agricultural practices, industrial processes and urban development (Stewart et al., 2011). Such contaminants are toxic, are able to persist in the environment and have a strong tendency to bioaccumulate in living organisms (Cullon et al., 2012; Stewart et al., 2011). High concentrations of bioaccumulated metals and organochlorines have been found among various predatory fish species, such as the kokopu, northern pike, lake trout, salmon, and walleye populations (Stewart et al., 2011; Kidd et al., 2012; Evans et al., 2005). In the Strait of Georgia, British Columbia, biomagnification of PCBs have also been measured and found among invertebrates and marine mammals, specifically harbour seals, which accounted for the greatest proportion of accumulated PCBs (Cullon et al., 2012). The bioaccumulation of contaminants in marine and terrestrial ecosystems has affected the availability of traditional foods with impacts on food security and Indigenous health and wellbeing.

Climate change in northern Canada is also of specific concern to traditional food security through its influence on the abundance and availability of wildlife in the North, as well as the extent at which traditional foods can be accessed. Between 1970 and 2004, there has been a significant decrease (26%) in the abundance of vertebrate species in the high arctic regions of Canada (McRae et al., 2010). Other communities have noted changes in water level, species and weather patterns, as well as a decline in duck and goose populations (Berkes et al., 2005). Declines in the Caribou herd of southern Baffin Island have been reported, as well as the Beverly caribou whose range extends over northern Saskatchewan, northern Manitoba, NWT and Nunavut (Jenkins et al., 2013; Campbell et al., 2012). With changing climatic conditions, various communities have expressed concerns regarding the safety of traditional hunting practices. Reports of decreasing ice thickness, sea ice-breakage, and rough wind conditions have created dangerous travel conditions, which have increased the risks associated with hunting and have reduced access to wildlife (Ford et al., 2006). Changing environmental conditions from climate change and environmental contamination have affected the quality and quantity of traditional foods with impacts on food security and the overall health of Indigenous communities.

### **2.6.3 Distal determinants: Environmental dispossession**

The process by which Aboriginal peoples access to traditional resources has been reduced by colonial laws, has been referred to as *environmental dispossession* (Richmond & Ross, 2009). Such policies have forced Aboriginal people to abandon their cultural practices, many of which connected Aboriginal people to their natural environment such as water, plants and animals. In addition, from the establishment of residential schools, which had sought to assimilate

Aboriginal people into mainstream Canadian culture, Aboriginal people were deprived of their traditional knowledge and skills (Reading & Wein, 2009).

The loss of traditional land and knowledge through an erosion of culture and societal values has negatively impacted Aboriginal peoples' ability to use the physical resources of their environment. The effects of colonialism and assimilation practices have had intergenerational effects on Aboriginal wellbeing, which has contributed to on-going social problems in Aboriginal communities (Waldrom et al., 2006; Adelson, 2005). Traditional knowledge has been regarded as a key aspect to developing skills related to harvesting and food processing, which can be viewed as a set of cultural practices necessary for food security. Thus, an erosion of Aboriginal traditional land and knowledge has important implications for food security and food sovereignty (Council, 2014).

Policies and regulations intended to disconnect Indigenous people from their traditional lands, language, knowledge and practices have been regarded as an indirect form of dispossession affecting food security and food sovereignty (Council, 2014). Direct forms of environmental dispossession include processes that have physically disrupted land use (Council, 2014), such as fossil fuel combustion, agricultural pesticides, industrial activities and its associated by-products, which have negatively impact traditional food systems.

## **Chapter 3: Framing the Research**

### **3.1 Importance and Rationale**

Food security is not only an important determinant of health, but is a basic human right, necessary for health and wellbeing (McIntyre & Rondeau, 2009). In Canada, rates of household food insecurity are highest among Indigenous peoples relative to the general Canadian population, and its associated impacts on health and wellness represent a serious public health issue (Tarasuk et al., 2014; Willows et al., 2008; Power, 2008). The unique food security challenges faced by Indigenous peoples whose diets consist of both traditional and market-based foods emphasize the need to understand patterns of food insecurity among Indigenous communities living on-reserve and in remote areas (Huet et al., 2012). This includes a consideration of the challenges associated with the harvesting, sharing and consumption of traditional food, as well as accessing food from the market (Power, 2008).

For First Nations peoples in particular, food is an important part of culture and identity. Food obtained from traditional food sources not only represent an essential source of nutrients, but also link First Nations peoples to the land and resources of the physical environment, a relationship that is central to First Nations holistic health (Richmond & Ross, 2009). As previously described, data available from the FNRHS indicate a high prevalence of food insecurity among First Nations communities in northern Canada (above the 60<sup>th</sup> parallel). However, relatively few studies based on large-scale national survey data have provided information concerning the level of food insecurity for First Nations people living on-reserve in the Sub-Arctic regions of Canada (south of the 60<sup>th</sup> parallel), as First Nations living on-reserve have been excluded from the CCHS. Data analysed in this study, from the First Nations Food,



Nutrition and Environment Study, will therefore provide valuable information regarding the state of food insecurity for First Nations living on reserve, south of the 60<sup>th</sup> parallel in Canada, including the barriers to accessing and consuming traditional and market-based foods.

The impact of food insecurity on First Nations health and wellness also emphasizes the need for the development of programs and policies to reduce the prevalence of food insecurity and its consequences to First Nations health. As described previously, food insecurity is tied to negative physical and mental health outcomes of which include, malnutrition, poor dietary quality, obesity, chronic diseases, and family stress (Young et al., 2000). Obesity in particular has been found to be highest among Aboriginal populations, and the extent of obesity-related morbidities is of growing concern. There have also been a limited number of studies that have examined the relationship between food insecurity and obesity in Aboriginal populations in Canada (Willows et al., 2012). The impacts on health and wellbeing from both food insecurity and obesity highlight the importance of understanding how obesity is related to food insecurity in the context of First Nations peoples.

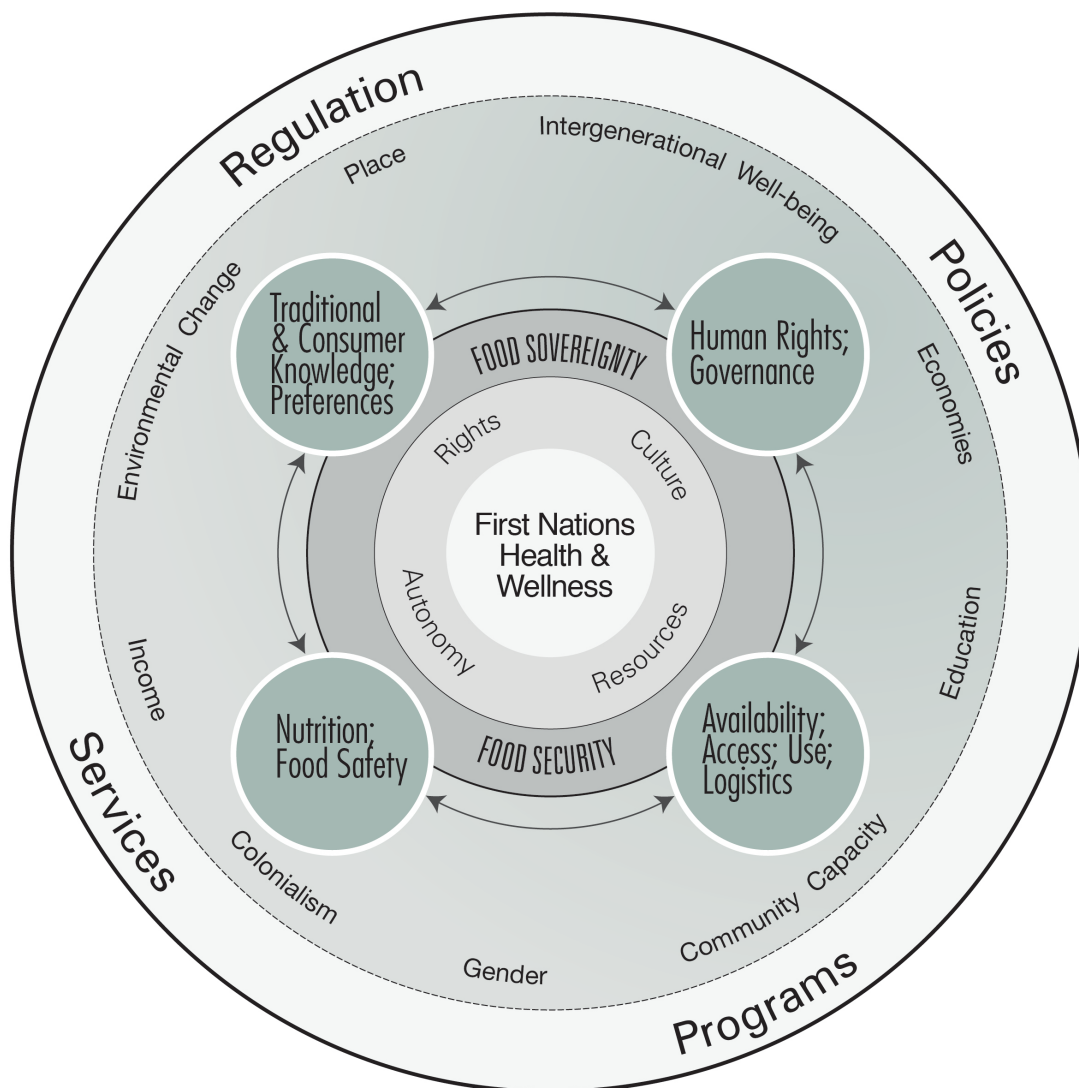
By pursuing research that addresses food-health related issues, this study will bring forward new understandings on the factors and processes associated with food insecurity in First Nations communities to address obesity, access to sustainable food systems, and promote patterns of healthy food consumption. This research is of specific importance to understanding the processes underlying First Nations health within the context of food-health related issues. The knowledge generated from this project will be used to identify promising points of intervention to address food insecurity, nutrition and promote access to Aboriginal traditional foods. Further, this research will serve to promote the health of First Nations by informing policy-makers of the

importance of engaging with the principles of Indigenous food sovereignty to address food insecurity and inequities in health and nutrition.

## **3.2 Conceptual Framework**

### **3.2.1 Holistic approach**

The conceptual model undertaking this study is based on the models put forth by Health Canada's Food Security Reference Group (FSRG) and the Council of Canadian Academics: The Expert Panel on the State of Knowledge of Food Security in Northern Canada (FSRG, 2009; Council, 2014). Both models have been combined to critically review the literature and analyze data related to factors and processes affecting food security, including their links to health and wellbeing, specifically in relation to obesity in First Nations communities. The purpose of integrating both models was to apply and embrace Indigenous peoples' holistic perspective to health, in understanding how food security and food sovereignty have emerged from the interplay of various factors and processes that in turn have an influence over First Nations overall health and wellness. The conceptual model depicted in Figure 3.1 is key to understanding how a consideration of food sovereignty can enhance our current conceptualizations of how food security, health and wellness can be achieved for First Nations communities.



### Figure 3.1 Conceptual Model\*

The conceptual model provides a holistic framework for analysing and understanding food security and food sovereignty in First Nations communities in Canada. The diagram represents the interplay between structural and social factors that affect food security and food sovereignty, which have an influence over the health and wellbeing of First Nations communities. The model is designed to be fluid and therefore no single factor should be interpreted as static, but rather understood as having multiple relationships with other factors in the model. Further, food security and food sovereignty are not be viewed as separate entities affecting First Nations health and wellness.

\*Adapted and reproduced from the FSRG, 2009 & the Council, 2014.

Note: Factors in the outermost wheel (programs, services, regulation and policies) were adapted from the FSRG (2009) conceptual model. Additional factors adapted from the FSRG (2009) conceptual model include: income, community capacity, and education. Revisions made to the model include: the addition of “traditional and consumer knowledge”; “autonomy” was added in replacement of “health”; and “First Nations Health and Wellness” at the centre of the wheel was added in replacement of “Northern Aboriginal Peoples”. All other factors identified in the model originated from the conceptual framework developed by the Council (2014).

### 3.2.2 Inner wheel

At the centre of the wheel is **First Nations people's health and wellness** as to place an emphasis on the various factors and processes that impact the livelihood, equity and wellbeing of First Nations communities. **Culture, rights, autonomy** and **resources** at the centre of wheel, encompass important determinants of First Nations health and wellness, and have implications for both food security and food sovereignty (Council, 2014; Reading & Win, 2009).

**Culture** may be expressed in practices, norms, values, traditional beliefs, and ways of life that is learned and shared from one generation to the next (NCCAF, 2009). Culture has been identified as an important determinant of Indigenous health, as it is the foundation to individual and collective identity, and has a strong influence over perceptions of health and illness (Reading & Wein, 2009). Indigenous peoples' relationships with traditional lands and environments nurture the spiritual, social, economic and political roots of culture (Council, 2014). The erosion of culture and identity can therefore create an imbalance to Indigenous holistic health.

**Aboriginal rights:** A consideration of Aboriginal peoples' rights to health, social services, food, land and harvesting practices is important to understanding and analyzing the health and wellness of Aboriginal communities (Council, 2014). The model recognizes how limited land access and harvesting rights can affect the extent to which Aboriginal people are able to utilize resources of their traditional territories, with implications for food security and food sovereignty. Understanding the importance of Aboriginal rights and its relation to self-determination in the context of food systems is emphasized by the model as essential to the analysis of food security and food sovereignty for First Nations people.

**Autonomy** and self-determination have been identified as a key determinant of Aboriginal health (Reading & Wein, 2009; Richmond et al., 2005). That is, Aboriginal peoples' rights to freely pursue the social, economic and cultural developments of their communities and determine their own political status has been viewed as fundamental to empowering Aboriginal communities efforts for impacting their overall health and wellbeing of Aboriginal populations (Richmond et al., 2005; Adelson, 2005). The conceptual model recognizes how unequal access and control over social and health care services, land, economies and education, as well as participation in political decision-making processes have negatively affected Aboriginal peoples' health by undermining their self-determination and autonomy (Adelson, 2005; Reading & Wein, 2009). Further, the model recognizes how colonial laws and agenda, such as the *Indian Act*, undermine Aboriginal peoples' rights and authority to determine their own lives (Bartlett, 2003). Emphasis is placed on the importance of Aboriginal autonomy to determining and addressing the social and economic conditions of their communities (Adelson, 2005).

**Resources:** Equitable access to both capital and natural resources of the environment is important for improving and maintaining health outcomes (Council, 2014). Through colonization, Aboriginal peoples have been denied access to resources and conditions to maximize their social and economic wellbeing. Access to natural resources is important for achieving food security, particularly among Aboriginal groups who live a traditional lifestyle and whose livelihood is dependent on the resources provided by the natural environment. Capital resources, such as financial, social and economic resources, also play an important role in promoting health and food security. Financial resources are necessary for accessing food from both traditional or market sources. In addition, social resources such as the knowledge and skills to obtain and prepare food have important implications for individual, household and community

food security. Food security and food sovereignty may therefore be undermined by the presence and legacies of colonial policies and agendas that limit control and possession over land, social and health services, economies and education.

### **3.2.3 Mid wheel**

The factors within the four circles overlapping the inner and outer wheel: **nutrition and food safety; traditional and consumer knowledge and preferences; human rights and governance; and availability, access, use and logistics**, represent important elements of food security and food sovereignty. Such factors are inter-related, and have linkages to the other factors on the inner wheel (Council, 2014).

**Nutrition** obtained from food is an integral part of food security that is essential for health and wellbeing. Food that is low in quality and nutrients may therefore be an inhibitor of food security and lead to poor health outcomes, including excess dietary energy and obesity.

Obtaining a nutritious balanced diet is important for promoting and maintaining both a healthy diet and active lifestyle. The model recognizes that nutrition may be affected by other factors in the model, and that solely improving access may not necessarily lead to a nutritious diet without the influence of the other factors listed in the model such as knowledge, food safety, and availability (Council, 2014).

**Food safety** has been included in the model to emphasize the potential risks to First Nations health and wellbeing from either (i) the consumption of traditional food exposed to contaminants or pathogens; (ii) unsafe preparation, processing and storage of food, as well as cooking practices; and (iii) consumption of unhealthy or expired food from the market (Council, 2014).

The consumption of unsafe, contaminated food not only has implications for food security, but is associated with compromises to health and wellbeing.

**Traditional and consumer knowledge** has a strong influence over food **preferences**, cultural practices, and the use of either traditional or market-based foods, all of which have important impacts on both food security and food sovereignty (Council, 2014). Knowledge about traditional food systems can have an influence over hunting and harvesting practices, food choices, preparation and use, as well as potential risks and benefits of traditional food (FSRG, 2009). Similarly, knowledge of food obtained from market-based sources, in terms of production and processing, can influence eating habits, healthy food choices and the degree to which traditional foods are consumed. The model recognizes the importance of knowledge and preferences in examining and understanding food security and food sovereignty for First Nations peoples.

Food security approached as a **human rights** issue, including social, economic and cultural rights, is particularly supported by the framework of *food sovereignty* (Wittman, 2011; Windfuhr & Jonsen, 2005). The model emphasizes a human rights approach, recognizing the degree to which the right to food is implemented and practiced, can influence the extent at which First Nations communities can achieve food security and food sovereignty (Council, 2014). An understanding of how structures of **governance** can limit the extent to which Aboriginal rights and human rights are acknowledged and practiced, is important in the analysis of food security and food sovereignty for First Nations. Further, the right of individuals and communities to a sufficient amount of culturally and socially acceptable food is recognized to be important for promoting and achieving food security (Council, 2014).

**Availability, accessibility, and use** are important components of food security, and also highlight the complexity and differences between food obtained from traditional and market based food systems (Council, 2014). The availability of a sufficient amount of traditional and market-based foods of high quality, and that is made accessible to acquire a nutritious diet, has important implications for both food security and food sovereignty. The **logistics** of accessing traditional and market-based foods in rural and remote communities is also important to be considered, as the costs of transporting, storing, and selling may impact food preferences, as well as how food is obtained and prepared (Council, 2014).

#### **3.2.4 Outer wheel: Influencing factors**

Nine factors have been identified that can either function as an enabler or barrier to food security, food sovereignty, and the wellbeing of First Nations communities. The influencing factors consist of determinants of Aboriginal health using the following categories, as described by Reading and Wien (2009): proximal (health behaviours and environments), intermediate (community resources, systems and capacities) and distal (historic, political, economic and social contexts). The determinants of Aboriginal health identified in the model include: **place, gender, education, economies, income; intergenerational wellbeing, community capacity, environmental change; and colonialism** (Council, 2014, FSRG, 2009), which have been recognized to have direct impacts on physical, emotional, mental and spiritual dimensions of Aboriginal health (Reading & Wein, 2009). Proximal determinants of health are factors that have a direct influence on health; whereas intermediate determinants are thought of to be the origin of proximal determinants (Reading & Wien, 2009). Distal determinants of health have been described as having the most profound influence on health (Reading & Wien, 2009).



### *Proximal determinants*

**Place:** Communities situated in remote and rural areas may be faced with challenges to acquiring traditional and market-based foods. The high costs of transporting market foods, in conjunction with the costs of equipment for hunting can create barriers to accessing food and obtaining a healthy and nutritious diet. Understanding the challenges with accessing food from both traditional and market-based food systems, in the context of where communities and households may be situated geographically, is important to consider in the analysis of food insecurity and food sovereignty.

**Gender:** Results from the CCHS (2012), suggest that Indigenous women are disproportionately affected by food insecurity compared to Indigenous men and non-Indigenous women in Canada (Council, 2014). Although women tend to often be involved in the preparation of food and play an important role in achieving household food security, they are more likely than men to experience food insecurity, the effects of hunger, and poverty (FSRG, 2009). The model recognizes the importance and need of gender-based analyses of food insecurity in future studies.

**Education** including traditional and consumer knowledge and skills are important determinants of health (Reading & Wein, 2009). The ability to acquire knowledge of healthy foods and develop skills for food preparation, storage, and traditional harvesting practices can improve access to food, with implications for food security and food sovereignty (FSRG, 2009).

**Economies:** This factor broadly highlights the combination of market and traditional economies in rural and remote communities, which may function as both an enabler of and barrier to food security (Council, 2014). The high costs associated with the import and distribution of market

food, as well as equipment for obtaining traditional foods is compounded by high rates of poverty. Poverty and low-**income** not only impact households access to market-based foods, but also limit hunting practices and the extent to which food can be obtained from traditional food sources. Poverty and limited access to traditional food sources associated with social, economic, political and cultural changes, has been identified as the driving force behind the shift from nutrient dense traditional food to store bought food, leading to high rates of obesity and diabetes (Council, 2014). Further, the model recognizes that sufficient income is needed for communities, households and individuals to obtain food by either purchasing food in the market or harvesting and hunting traditional foods (FSRG, 2009).

#### *Intermediate determinants*

**Intergenerational wellbeing:** is an important determinant for the overall health and wellness of Aboriginal communities (Council, 2014). It is essential for achieving food security and can also be an outcome of being food secure as supported by access to nutritious traditional and market-based food. The historical traumas of residential schools, the loss of traditional land and colonial laws felt for generations, have had contemporary impacts on health and wellness, and are important in the analysis of food security and food sovereignty for First Nations people (Reading & Wein, 2009). The sharing of knowledge, skills, and traditional food practices from one generation to the next, has been identified as an important enabler of food security.

**Community capacity:** The model recognizes that resource development opportunities and infrastructure are important contributors to the economic and social stability of a community (Reading & Wein, 2009). Inadequate social and economic resources can restrict Aboriginal

communities access to funding and the development of programs to improve access to food, such as food sharing programs, community gardens, and traditional harvesting workshops. Strategies and activities that can enhance community capacity, increase availability and affordability of healthy food, and promote community wellness and intergenerational knowledge sharing are emphasized as important approaches to promoting food security and food sovereignty (FSRG, 2009).

**Environmental change:** Given Indigenous peoples close relationship with the natural environment and the resources it provides, environmental change has serious implications for both food security and food sovereignty. Changes in climate, weather, and ecosystems, all of which support and affect hunting and harvesting activities, can impact the quality and quantity of traditional foods (Council, 2014). Environmental contaminants found in water, wildlife, fish and vegetation present concerns regarding the safety of traditional foods. Such changes to the environment have been identified to place a major role in higher intakes of market-based foods.

#### *Distal determinants*

**Colonialism:** The impact of colonialism on Indigenous peoples' health and wellbeing is considered a fundamental factor to understanding the contemporary health outcomes of Indigenous communities (Reading & Wein, 2009). The physical displacement from and dispossession of traditional lands, which restricted hunting, trapping or fishing practices, disconnected Indigenous peoples' ties to the environment. Such processes prevented the sharing of cultural practices, traditional knowledge, and language from being passed on to next generations. Further, younger generations were unable to learn and acquire the skills of

traditional approaches to gathering, harvesting and preparation practices of food, all of which have implications for food security and food sovereignty (Council, 2014).

### **3.2.5 Outer wheel: Context**

The four contextual factors listed in the most outer wheel- **programs, services, regulation and policies**- represent factors and processes at the community, regional, national, or international level that can have an influence over community food security (FSRG, 2009). Such factors can have an impact over the influencing factors affecting food security and food sovereignty, and subsequently the overall health and wellness of First Nations peoples. The contextual factors provide a basis for promoting food security and food sovereignty in First Nations communities (FSRG, 2009).

**Programs:** The development of programs to address issues within various points of the traditional and market food system is important for promoting food security and food sovereignty. However, given that experiences of food insecurity vary at the individual, household, community, and regional level, diverse approaches must also be implemented to mitigate food insecurity. It is recognized that the lack of food security programs, as well as programs that provide short-term or temporary solutions to food insecurity may be limited in their scope and effectiveness to address food security at various levels (Council, 2014). Programs that focus on building capacity and skills development within a community may go further to providing the conditions that support food security and food sovereignty (Council, 2014).

**Services:** To enhance the effectiveness of services targeted at improving food insecurity, coordination and collaboration across government, public health officials, non-government sectors and community organizations are needed to increase the availability and accessibility of

food security services (Council, 2014). Further, intersectoral partnerships across various parts of the food system, such as social, economic and environmental sectors, have been viewed as important to enhancing the effectiveness and sustainability of food security services (Council, 2014).

**Regulation:** Institutional structures and rules of governance can have an influence over access and control of resources, which can impact various factors affecting food security and food sovereignty (FSRG, 2009; Council, 2014). Rules of governance that hinder Aboriginal peoples' control and access to resources disempower Aboriginal peoples' abilities to improve their social and economic conditions through making decisions and taking control of their own food systems. Providing the conditions to promote Aboriginal food sovereignty can therefore be seen as an important means to achieving food security.

**Policies:** Plans of action aimed at reducing poverty and vulnerability by promoting self-reliance, community economic development, and efficient labour markets are needed to enhance food security and promote food sovereignty (Council, 2014). The development of food and nutrition policies aimed at promoting healthy consumption of nutritious, safe and sustainable food, are vital for reducing the burden of chronic diseases associated with the consumption of high fat, energy-dense food, and food-related diseases from unsafe and contaminated food.

### 3.3 Research Questions Addressed by the Study

This study aims to form a comprehensive understanding of the factors and processes that have an association with food insecurity and related contributions to health and wellness, including attention to obesity, which provides a window to a particular health concern that has been noted to have social determinants.

The *primary research questions* this study seeks to address include:

1. What factors and processes are associated with the availability and accessibility of traditional and market based foods (food security) for First Nations communities?
2. Is household food insecurity associated with obesity in First Nations communities?
3. How can the framework of Indigenous food sovereignty enhance our understanding of how food security can be achieved?

Specific objectives of this study are to:

- Describe the prevalence of food insecurity for First Nations communities in Ontario, British Columbia, Manitoba, and Alberta.
- Examine the association between socio-demographic characteristics and food insecurity for First Nations.
- Describe the prevalence of obesity among food insecure households for First Nations communities in Ontario, British Columbia, Manitoba, and Alberta.
- Describe the relationship between food insecurity and obesity for First Nations living on-reserve.
- *Explore* how food sovereignty can be understood to affect household food security and obesity in First Nations communities (in an effort to facilitate discussion).

By addressing the above objectives, this thesis research aims to provide knowledge of the current state of food insecurity and its association with obesity for First Nations living on reserve in Canada. The knowledge generated from this study is intended to inform policy-makers of both current conditions and actions required to improve First Nations food security, which includes a consideration of First Nations food sovereignty and access to traditional food systems.

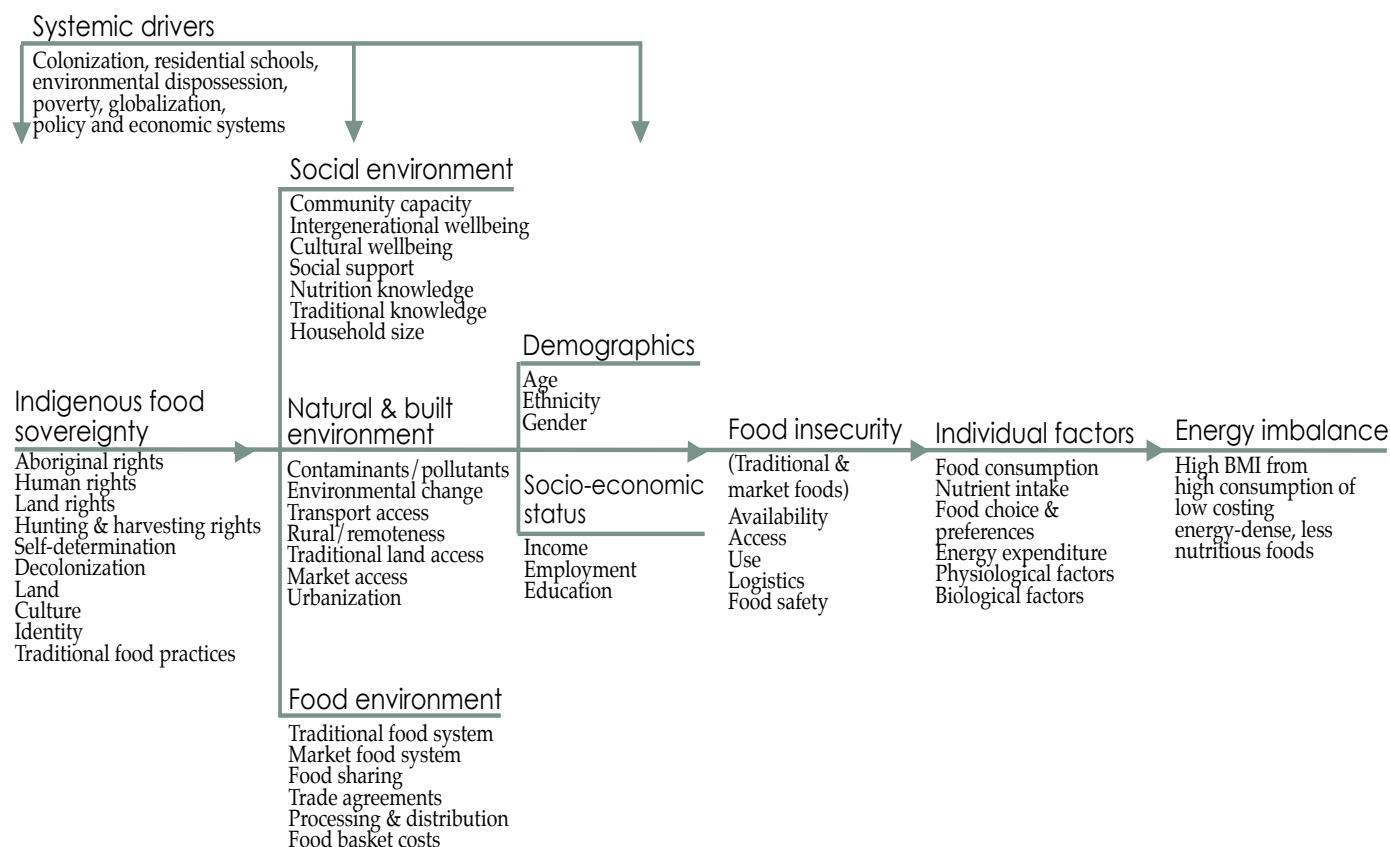
The hypothesized mechanisms underlying the relationship between household food insecurity and obesity are depicted in Figure 3.2. The model includes various factors hypothesized to be associated with household food insecurity and obesity (Friel et al., 2007; Townsend et al., 2001; Willows et al, 2012; Fieldhouse & Thompson, 2012). Elements of Indigenous food sovereignty have also been included to highlight the factors viewed as essential to protecting traditional food practices and addressing the on-going challenges of colonization (Grey & Patel, 2014; Desmarais & Wittman, 2014). Illustrated in the model are systemic drivers that can hinder Indigenous food sovereignty and use of various points of the traditional and market-based food systems, which may lead to differential exposure and vulnerability to food insecurity and obesity.

Specific hypotheses tested in the present study include:

1. The prevalence of food insecurity is high among First Nations living on-reserve and there are multiple factors associated with the prevalence of food insecurity, including barriers to accessing traditional foods.
2. Food insecurity is associated with greater body mass index.

While the first two primary research questions of the study test specific hypotheses (as described above), the third research question is primarily hypothesis generating. Recognizing that the “food sovereignty” construct was not incorporated in the development of the FNFNES and its survey

tools, this study sets out the more modest goal of *considering* how food sovereignty can affect household food insecurity and obesity in First Nations communities. This includes recognizing the potential and limitations of examining “household engagement with traditional food activity”.



**Figure 3.2 Conceptual framework for analysis of food insecurity and its relationship to obesity in First Nations communities**

Illustrated in the model are the factors and processes related to food insecurity, and the hypothesized mechanisms underlying the relationship between food insecurity and obesity. The framework shows how systemic drivers have a large influence over Indigenous food sovereignty, and environmental and socio-economic factors of food insecurity and obesity. Note: BMI, body mass index.



## **Chapter 4: Methods**

The quantitative methods employed in this study consisted of a set of multivariate logistic regression and multi-level analyses approached within a holistic framework of First Nations health and wellness. Data were derived from the First Nations Food, Nutrition and Environment Study (FNFNES), which provides information on current traditional and store bought food use, household food insecurity status, environmental health and nutrition from up to 100 First Nations communities across Canada. Multivariate logistic regression was applied to address the first two research questions that considered associations among variables with food insecurity and obesity. In addition, a multi-level analysis was conducted to examine community-wide levels of household engagement with traditional food activity as a way to consider the implications of food sovereignty.

### **4.1 Survey Design and Sampling Frame**

#### **4.1.1 First Nations Food, Nutrition and Environment Study (FNFNES)**

The FNFNES, a cross sectional study design, is intended to be representative of First Nations living on-reserve in Canada south of the 60<sup>th</sup> parallel. As First Nations living on-reserve have been excluded from nation-wide surveys such as the Canadian Community Health Survey (CCHS) which gathers information related to health status and determinants of health for the Canadian population, the FNFNES was developed to address this gap and provide national and regional information on First Nations diet and food-health related concerns. The data collected from the FNFNES is intended to serve as a valuable platform to addressing knowledge gaps on diet, food security, traditional food use and exposure to environmental hazards.

The FNFNES collects information regionally across Canada over a 10-year period (2008-2018), and provides a characterization of the health and diet of First Nations peoples living on reserve. The FNFNES is collectively led by investigating partners from the Assembly of First Nations (AFN)<sup>6</sup>, the Université de Montréal, the University of Ottawa, the University of Northern British Columbia (2008-2013), and the Environmental Public Health Division of the First Nations and Inuit Health Branch, Health Canada. The FNFNES was initiated by a resolution that was passed at the AFN Annual General Assembly by the Chiefs-in-Assembly in 2007. All aspects of the project including the design of the questionnaire, research objectives, methodology, and implementation directly involved First Nations leadership at the community, regional, and national levels. The First Nations and Inuit Health Branch, Health Canada, has provided funding for the FNFNES.

The first set of data collection began in 2008-2009 in 21 on-reserve First Nations communities in British Columbia (BC), and has subsequently been collected in 9 First Nations communities in Manitoba (MB) in 2010, 18 First Nations communities in Ontario (ON) in 2011-2012, and 10 First Nations communities in Alberta (AB) in 2013. In this study, data is reported from 58 First Nations communities living on reserve in BC, MB, ON and AB, as data has yet to be collected and analysed from First Nations communities in Saskatchewan, Quebec and the Maritime provinces.

There are multiple components to the FNFNES survey of which include: household interviews; the collection of surface water for contamination analysis, particularly of pharmaceuticals; samples of drinking water for traces of metals; traditional food samples for analyses of

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<sup>6</sup>The Assembly of First Nations (AFN) is a national advocacy organization representative of First Nations peoples across Canada.

environmental contaminants; and hair samples for mercury. The household interviews conducted include questionnaires on traditional food frequency; 24-hour diet recall; social, health and lifestyle (SHL); and household food security status using the income related Household Food Security Survey Module (HFSSM) described in Chapter 2, section 2.2.2. In this study, data were analysed from the SHL questionnaire and food security questionnaire of the FNFNES used in household interviews (Appendix A & B). These questionnaires are intended to provide information on dietary patterns, lifestyle, general health status, environmental concerns and food security. In addition, the SHL questionnaire in conjunction with the food security questionnaire provides information on experiences of food insecurity, as well as barriers to traditional and market-based foods.

#### **4.1.2 FNFNES sampling frame**

The FNFNES uses a systematic random sampling method within an ecozone/culture area framework to randomly select communities to participate in the study. This method of sampling aims to ensure equal representation of diversity in culture from each community. The systematic random sampling method applied in the study is based on a probability that is proportional to the size of each community. This ensures that highly populated communities are more likely to be sampled. The primary sampling unit of the FNFNES are communities, while households and individuals selected from each household make up the secondary and tertiary random sampling units, respectively. Communities invited to participate within the eight AFN regions that are south of the 60<sup>th</sup> parallel in Canada were contacted by the AFN.

The FNFNES 10-year project timeline (2008-2018) aims to gather information from up to 100 First Nations communities across Canada. Within each randomly selected community, up to 100

First Nations households are randomly selected to participate. To account for potential non-response bias, oversampling is carried out to obtain a systematic random sample of 125 households with a target of 100 households to be surveyed. In communities that had less than 100 households, all households in the community were surveyed. From each household selected, a randomly selected adult, representative of the household, is invited to participate in the study. Data were collected from a single adult per household, nineteen years and older, who self-identified as a First Nations person living on-reserve. Each participant of the FNFNES study is asked a series of questions concerning their traditional and market-based food use, food security status, as well as their health and socioeconomic status. The methodology used to collect data from each community is the same across all regions to ensure comparability of results. Participation was voluntary, and the participant could refuse to complete different components of the survey or withdraw from the study at any point in time.

## **4.2 Data Access and Ethics**

The FNFNES and this study has been guided by the Tri-Council Policy Statement: Ethical Conduct for Research and specifically Chapter 9 of the Tri-Council Policy Statement “Research Involving the First Nations, Inuit and Métis People of Canada (TCPS2, 2010).” The FNFNES and this study were also guided by the First Nations principles of Ownership, Control, Access and Possession (OCAP) of data.

The Assembly of First Nations has an important role in the development of the FNFNES and is considered equal partners in the project. In addition, the FNFNES ensures that each First Nations participant has equal participation in the research process and is offered opportunities to contribute to the study including refinement of reports, communication of results and data

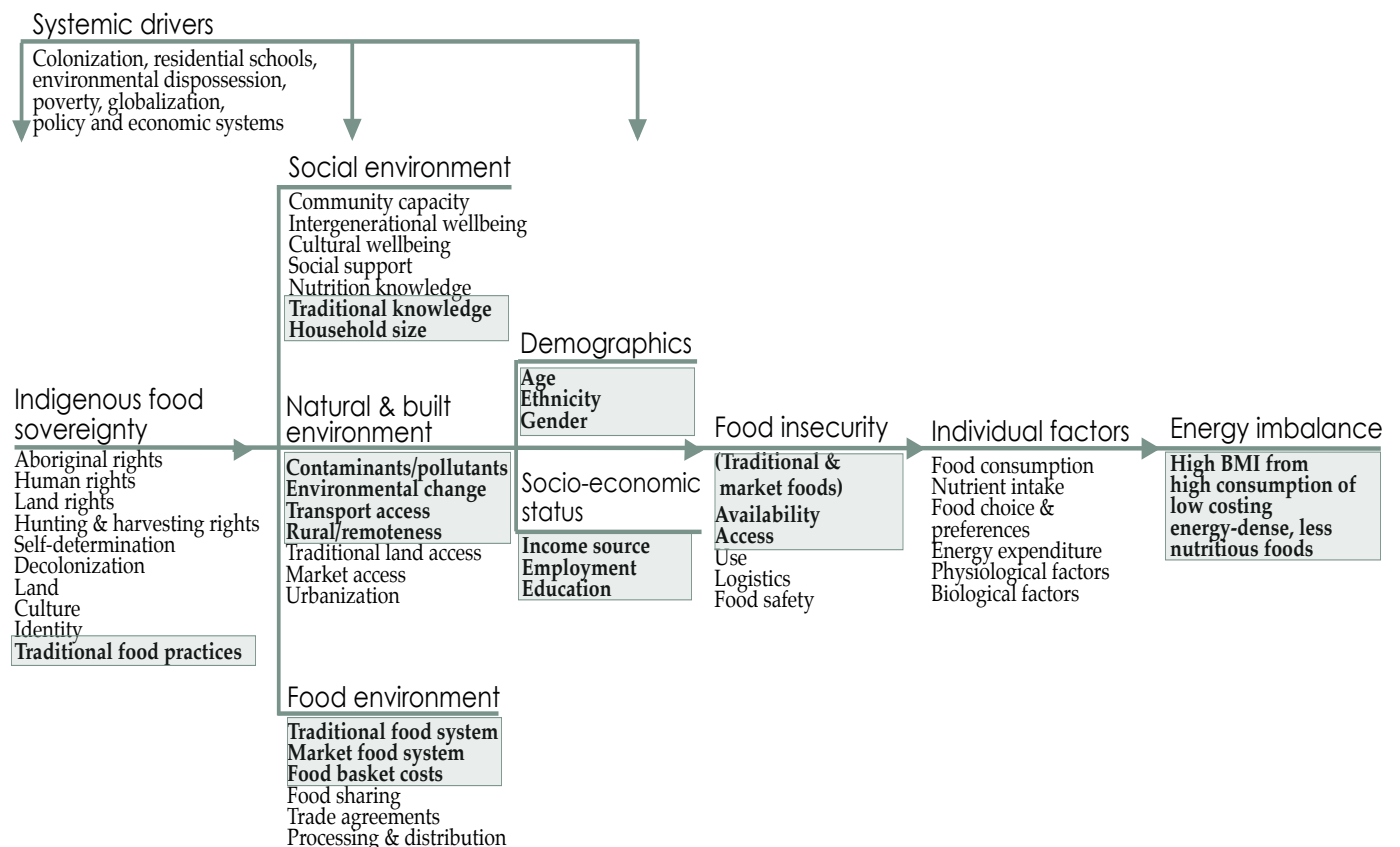
collection materials. First Nations participants are provided the opportunity to review regional reports and request any revisions.

Before sampling is initiated, a representative designated by each randomly selected community is invited to attend a two-day preparatory workshop at the beginning of each sampling year to contribute to finalizing survey questionnaires, methodology and research objectives. Following the methodology workshop, the principle investigators of the FNFNES visit each participating community to discuss the project with the Chief and Council and sign a community research agreement outlining the details of the research partnership. Once the community research agreement has been signed, community members responsible for data collection are hired and trained by the FNFNES. Nutrition Research Coordinators, dietitians and professional nutritionists hired by the FNFNES provide support and training to hired community members throughout data collection.

Individual participation in the study is based on informed written consent after a thorough explanation of the project components have been explained to the community and individual participants. Surveys were not conducted without the written informed consent of the participant. In line with the OCAP principles and the Tri-Council Policy Statement, all community results are only shared directly with each participating First Nations community and for the community's results only both in raw and descriptive analyzed format. Ethical approval for conducting the FNFNES was provided from the Ethics Review Board at Health Canada, the Université de Montréal, University of Northern British Columbia and the University of Ottawa. Ethics approval for the present study has been obtained from the Ethics Review Board at the University of British Columbia.

## 4.3 Variables

In this thesis, the variables that were considered for analysis to address the primary research questions of the study using variables available from both the social, health and lifestyle questionnaire (Appendix A) and the food security questionnaire (Appendix B) are illustrated in figure 4.1.



**Figure 4.1 Operationalizing the conceptual framework for analysis of food insecurity and its relationship to obesity in First Nations communities**

Illustrated in the model are variables considered for analysis to address the primary research questions of the study using the variables available from the social, health and lifestyle questionnaire (Appendix A) and food security questionnaire (Appendix B) used in household interviews of the First Nations Food, Nutrition and Environment Study (FNFNES). Variables operationalized in the study are in bold and highlighted.

### 4.3.1 Household food security status

The first set of analyses considered the social determinants of food insecurity for First Nations people living on-reserve using multivariate logistic regression modelling. The primary outcome variable of interest was household food security status dichotomized as food secure and food insecure (marginal, moderate or severe). Household food security status was measured based on the number of affirmed (positive) responses (“yes”, “often true” or “sometimes true”) to the 18-item questionnaire used in the FNFNES household interviews, adapted from the household food security survey module (HFSSM) (Table 2.1, Chapter 2).

Households were classified as *marginally* food insecure if the respondent indicated some worry to adequate and secure access to food (1 affirmed response); *moderately* food insecure if the respondent reported experiencing a compromise in the quantity and/or quality of food consumed (2-5 affirmed responses); and *severely* food insecure if the respondent had experienced a reduction in food intake and disrupted eating patterns (at least 6 affirmed responses).

Additionally, households were classified as food secure (0 affirmed responses) if the participant provided no indication of having difficulties with food access. For further information on how categories of household food security were defined based on the household food security scale refer to chapter 2, sections 2.2.3 and 2.2.4. Variables that were explored as potential predictors of food insecurity in bivariate and multivariate analyses are described in Table 4.1.

**Table 4.1 Variables explored as potential predictors of food insecurity among First Nations respondents**

	<b>Predictor*</b>	<b>Description</b>	<b>Type</b>
<b>Individual level</b>	<b>Sex</b>	Whether the respondent of the household was female or male	Categorical
	<b>Age group</b>	Age of the respondent categorized as: 19-30; 31-50; 51-70; 71+	Categorical
	<b>Income</b>	Main source of income categorized as: Workers compensation/ employment insurance; Wages; Social Assistance; Pension; Other	Categorical
	<b>Years Education</b>	Number of years of education of the respondent	Continuous
	<b>Region</b>	Province where the respondent resides categorized as British Columbia (BC), Manitoba (MB), Ontario (ON), Alberta (AB)	Categorical
<b>Household level</b>	<b>Presence of children in the household</b>	Whether the respondent indicated yes or no to children being present in the household	Dichotomous/ Categorical
	<b>Household traditional food activity<sup>‡</sup></b>	Whether the respondent indicated any member of the household to be engaged in traditional food acquisition activities in the past year (hunt or set snares for food; fish; collect wild plant food; collect seafood; plant a garden)	Dichotomous/ Categorical
	<b>Total people in household</b>	Number of people in the household	Continuous
	<b>Climate<sup>§</sup></b>	Less availability of and accessibility to traditional food due to climate change as indicated by the respondent.	Dichotomous/ Categorical
	<b>Contaminants<sup>†</sup></b>	Less availability of and accessibility to traditional food due to environmental contaminants (pollution, pesticides, industrial effluents)	Dichotomous/ Categorical
<b>Community level</b>	<b>Type of road access into a community</b>	Whether the community is accessible by year-round, fly in only, or winter road	Categorical
	<b>Food basket costs</b>	Cost and affordability of healthy eating within each community.	Continuous
	<b>Service centre (km)</b>	Distance to service centre from each community	Continuous

Note: Refer to the social, health and lifestyle questionnaire in Appendix A for further information on how variables were constructed.

<sup>‡</sup>Obtained from question 5 and 6 of the social, health and lifestyle questionnaire.

<sup>§</sup>Based on question 9a and 9b of the social, health and lifestyle questionnaire in Appendix A.

<sup>†</sup>This variable was obtained from question 8b of the social, health and lifestyle questionnaire.

### 4.3.2 Obesity and food insecurity

The second set of analyses comprised of a multivariate logistic regression model to examine the association between household food insecurity and obesity. The primary outcome variable of interest was body mass index (BMI) used in calculating obesity, weight in kilograms (kg)



divided by height in meters squared ( $m^2$ ). Data on height and weight were based on measured and self-reports from household interviews. In the case where only reported heights and weights were available, adjustments were made to account for response bias through the addition of the estimated bias. This estimated bias was based on the average difference between measured and reported values of BMI by gender using a paired t-test.<sup>7</sup> Based on the World Health Organization and Health Canada's Guidelines for Body Weight Classification for adults (aged 18 years or older), the following weight categories used in this analysis included: underweight (BMI <18.5), normal weight (BMI 18.5-24.9), overweight (BMI 25.0-29.9), and obese (BMI  $\geq$ 30.0) (Health Canada, 2003). For multivariate logistic regression analysis of household food insecurity and associations with obesity, BMI was dichotomized to consider the presence or absence of obesity, adjusting for age, sex, region, main source of income, and the number of years of education. The primary explanatory variable of interest, household food insecurity status, was categorized as food secure, marginally food insecure, moderately food insecure and severely food insecure.

#### **4.3.3 Socio-demographic and household characteristics**

Socio-demographic variables obtained from household interviews that were used in regression analyses include: region (province), sex, age group, years of education, main source of income, children in the household, household traditional food activity, the type of road access into a community and community traditional food activity. The variables used in this analysis were

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<sup>7</sup>No significant differences were found in BMI values using reported and measured height and weight in BC and Manitoba. However, there were significant differences found for data from Ontario and Alberta. The estimated bias were added to each self-reported BMI to adjust for significant differences found in BMI. For Ontario, 414 respondents provided both measured height and weight, while 869 individuals had reported weight and height values. The estimated bias values for Ontario were 0.328 for females and 0.623 for males. For Alberta, 512 individuals provided both measured height and weight, while 48 individuals provided self-reported height and/or weight. The estimated bias values for Alberta were 0.557 for females and 0.400 for males.

categorized as the following. Region was categorized as British Columbia (BC), Manitoba (MB), Ontario (ON), and Alberta (AB). Participant age consisted of 4 categories: 19 to 30, 31 to 50, 51 to 70, and 71 and over. Sex was categorized as female or male. The variable education was continuous and measured in years. The income variable was defined as household main source of income and consisted of 5 categories: wages, pension, social assistance, and workers compensation/employment insurance (workers comp/EI) and other (student loans, trust fund, none, disability benefits). Children in the household were either present (yes) or absent (no). The type of road access into a community was categorized as all year round road access, fly in, and winter road only. Household traditional food activity was dichotomized as yes or no, and defined as anyone in the household who engaged in either hunting, fishing, collecting wild plant food or seafood, or planting a garden in the past year (Appendix A, question 5 and 6). Community traditional food activity represented an aggregate of household traditional food activity; the variable was calculated based on the percentage of households engaged in traditional food activities within each community. Additional variables that were examined in regression analyses with food insecurity are described in Table 4.1.

## **4.4 Statistical Analysis**

### **4.4.1 Descriptive statistics**

All statistical analyses were conducted using SAS Version 9.4 (SAS Institute). Prevalence estimates of food insecurity were derived from total households experiencing food insecurity, as well as households of marginal, moderate and severe food insecurity. The prevalence of food insecurity was examined by region, socio-demographic characteristics and household composition. Gender-specific prevalence rates were also obtained for female and male

respondents living in marginally, moderately and severely food insecure households, as well as food secure households. Prevalence estimates of obesity were obtained for respondents living in food secure households, as well as marginally, moderately and severely food insecure households. Rates of obesity by household food security status were obtained for female and male respondents separately, as well as the total sample. Descriptive statistics of socio-demographic characteristics of participants were also obtained, as well as concerns for traditional food security and barriers to using traditional foods as identified by participants in the social, health and lifestyle questionnaire used in household interviews (Appendix A). The frequency procedure in SAS was used to obtain prevalence rates of household food insecurity and obesity, as well as counts and percentages of socio-demographic characteristics, traditional food insecurity and the number of households reporting barriers to using more traditional foods. In addition, analysis of variance was used to examine the variation in the average percentage of community traditional food activity by province.

#### **4.4.2 Multivariate logistic regression**

In this study, pooled analyses from BC, MB, ON and AB were conducted and outcomes were compared for women and men in stratified analyses. All statistical analyses excluded observations with missing values. Univariate and bivariate analyses were first undertaken to examine associations between household food insecurity, BMI, and each socio-demographic and health-related variable. This consisted of contingency tables, graphical summaries, and bivariate regression models to examine the association between variables. Multivariate logistic regression modelling was approached in two ways to: (1) explore the determinants of food insecurity; (2) and examine the association between obesity and household food security status.

In the first analysis, multivariate logistic regression was conducted to determine the strongest predictors of food insecurity using the logistic procedure in SAS. Bivariate logistic regression analysis was undertaken in conjunction with the backward stepwise selection method to examine the association between household food insecurity and various socio-demographic characteristics identified in a review of the literature on risk factors of food insecurity. In bivariate analyses, the association between food insecurity status and socio-demographic characteristics were assessed using logistic regression modelling and the chi-square test. In the backward stepwise selection method, all predictors are entered into the model and the least significant variable is removed in a stepwise process at a preliminary significance level of 0.1.

Collinearity in the model was assessed, and variables that were strongly associated with each other were removed from the model. Among significant predictors contained in the model, two-way interaction terms were assessed and non-significant interactions were removed from the model. The Akaike Information Criterion and the Hosmer and Lemeshow goodness of fit test was used to assess the models fit during the backward stepwise procedure. The final model contained predictive variables that contributed to the models fit, and that met practical and statistical significance based on the type III sum of squares and significance level of 0.05.

In the second analysis, multivariate logistic regression analyses were conducted to determine the odds of being obese for individuals living in food insecure households, while adjusting for socio-demographic variables. Unadjusted associations for each variable included in the model were assessed with the main predictor of interest, household food security status, as well as the outcome variable, obesity. In this model, the statistical effect sizes of household food insecurity were assessed using the three levels of food insecurity (marginal, moderate, and severe food

insecurity). This was done using the logistic procedure in SAS. Gender-specific analyses were also conducted to examine the association between household food insecurity and obesity for female and male respondents separately. Both unadjusted and adjusted odds ratios were obtained, as well as the 95% confidence interval for each. In both approaches to multivariate logistic regression modelling, interactions were assessed among significant variables in the model, and were removed depending on their statistical significance and contribution to the models fit.

#### **4.4.3 Multi-level analysis of food insecurity and food sovereignty**

A multilevel logistic regression analysis was conducted to explore the concept of food sovereignty and compare estimates obtained from the multivariate logistic regression of predictors of food insecurity as described above (4.4.2).

A multilevel analysis was also carried out in an effort to explore the concept of food sovereignty and its relationship to food security by examining traditional food activity at a collective community level as a proxy indicator of food sovereignty, as this construct is generally understood as a communal attribute. However, this was done recognizing that this construct had not been incorporated in the survey used in the FNFNES, and that the development of appropriate metrics to quantify and describe food sovereignty is still needed.

The variable “community traditional food activity” was created by aggregating household level responses in each community that indicated engagement with traditional food activity. This community level value was then used as a proxy indicator of food sovereignty in a multilevel analysis. A two-level model was run using the generalized linear mixed model procedure in SAS. Variables entered as fixed effects at level-1 (individual level) in the model include: sex, age group, region, household main source of income, years of education, the presence or absence

of children in the household and household traditional food activity. Variables entered at level-2 (community level) included: type of road access into a community and community traditional food activity, with 'community' serving as the level-2 grouping factor. Variables entered as random effects in the model included the intercept and household traditional food activity. The variable household traditional food activity was entered in the model as a random effect to examine whether the association between household traditional food activity and food insecurity varied significantly by each community.

## **Chapter 5: Results**

### **5.1 Participant Characteristics**

Table 5.1 provides a detailed description of the socio-economic and demographic characteristics of participants of the study. There were a total of 3847 adults who participated in the household interviews (social, health and lifestyle questionnaire) from British Columbia, Manitoba, Ontario and Alberta, of which 2465 (64.1%) were females and 1382 (35.9%) were males. For female respondents the average age was 44 years old, and for male respondents the average age was 46 years old. In the sample as a whole participants age ranged from 19 to 96 years of age, with 20.4% of the sample within the age of 19 to 40, 46.1% within age range of 31 to 50, 27.7% of sample were between the ages 51 to 70, and 5.7% were age 71 and over. The highest number of participants surveyed was from Ontario making up 37.2% of the sample, followed by British Columbia (28.7%), Manitoba (18.4%) and Alberta (15.8%).

**Table 5.1. Socio-demographic and Household Characteristics of  
First Nations living on-reserve in Alberta, British Columbia, Manitoba and Ontario**

	Overall n=3847 (%)	Women n=2465 (%)	Men n=1382 (%)
<b>Age Group</b>	n= 3847 (100)	n= 2451 (63.7)	n= 1375 (35.7)
19-30	782 (20.4)	527 (21.5)	255 (18.6)
31-50	1767 (46.2)	1163 (47.5)	604 (43.9)
51-70	1059 (27.7)	627 (25.6)	432 (31.4)
71+	218 (5.7)	134 (5.5)	84 (6.1)
<b>Region</b>	n=3847 (100)	n= 2465 (64.1)	n= 1382 (35.9)
Alberta	609 (15.8)	387 (15.7)	222 (16.1)
British Columbia	1103 (28.7)	705 (28.6)	398 (28.8)
Manitoba	706 (18.4)	477 (19.4)	229 (16.6)
Ontario	1429 (37.2)	896 (36.4)	533 (38.6)
<b>Income Source</b>	n=3806 (100)	n=2439 (64.1)	n=1367 (35.9)
Wages	1916 (50.3)	1269 (52)	647 (47.3)
Social Assistance	1053 (27.7)	650 (26.7)	403 (29.5)
Pension	507 (13.3)	316 (13)	191 (14)
Workers compensation/ employment insurance	230 (6.0)	134 (5.5)	96 (7.1)
Other	100 (2.6)	70 (2.9)	42 (44.2)
<b>Average years of education</b>	10.68	10.93	10.3
<b>Presence of children in the household</b>	n=3847 (100)	n=2465 (64.1)	n=1382 (35.9)
Yes	2277 (59.2)	1636 (66.4)	641 (46.4)
No	1570 (40.8)	829 (33.6)	741 (53.6)
<b>Household traditional food activity</b>	n=3847 (100)	n=2465 (64.1)	n=1382 (35.9)
Yes	2614 (68)	1622 (65.8)	992 (71.8)
No	1233 (32.1)	843 (34.2)	390 (28.2)

Note: Totals may vary due to the exclusion of missing values. Percentages may not add up to 100% due to rounding.



## 5.2 Prevalence and Predictors of Household Food Insecurity

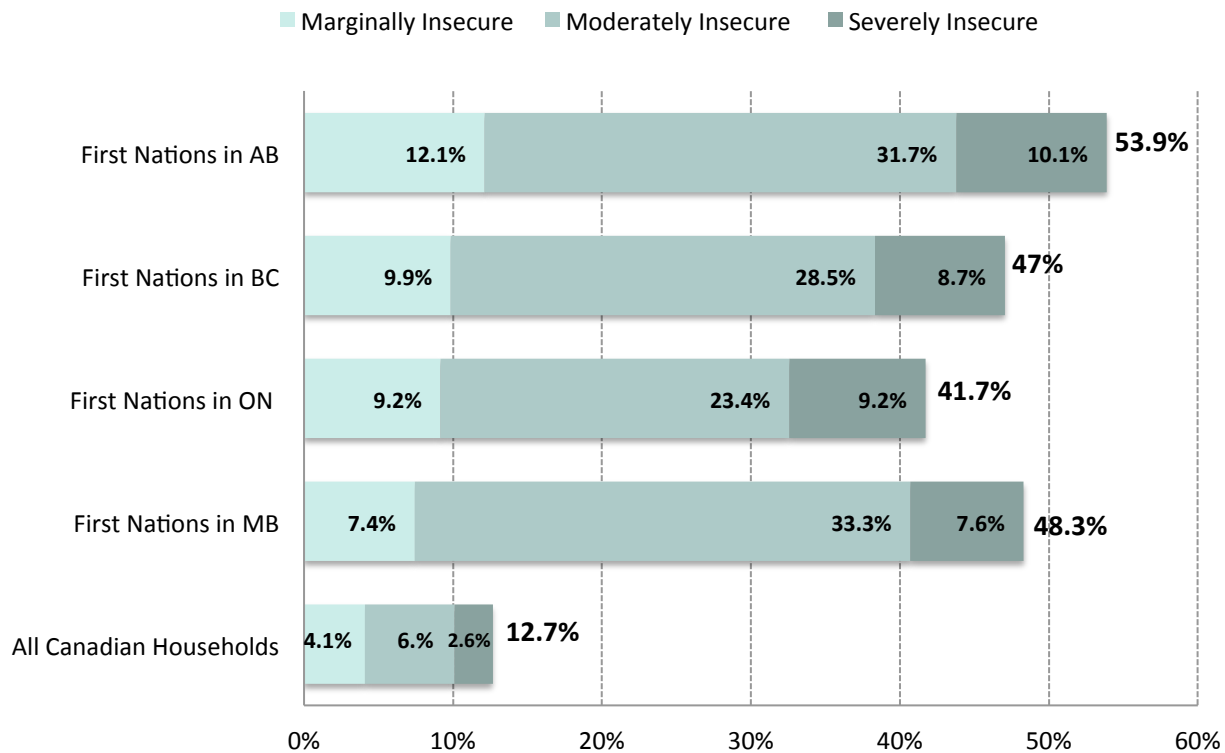
### 5.2.1 Prevalence of food insecurity

Among those who participated in the social health and lifestyle questionnaire (3847), 3681 responded to the household food security questionnaire. Of those who responded to the household food security questionnaire, 46.4% of households (1707 First Nations households on-reserve) experienced some level of food insecurity (Table 5.2). The level of food insecurity experienced by households varied, with 9.5% of households (351 households) categorized as *marginally* food insecure, indicating concerns about adequate and secure access to food, while 27.9% of households (1028 households) were classified as *moderately* food insecure, reporting compromises in the quality and/or quantity of food consumed. Further, 8.9% of households (328 households) were *severely* food insecure providing an indication of a reduction in food intake and a disruption in eating patterns. Figure 5.1 provides a breakdown of the prevalence of food insecurity for First Nations by region. Households in Alberta had the highest prevalence of food insecurity (53.9%), followed by households in Manitoba (48.3%), British Columbia (47%), and Ontario (41.7%) (Figure 5.1). Prevalence rates of food insecurity not only varied by region, but by socio-demographic and economic characteristics of participants.

**Table 5.2. Household Food Security Status for Women and Men**

	N	Food Secure (%)	Food Insecure (marginal, moderate, severe combined) (%)	Marginally Food Insecure (%)	Moderately Food Insecure (%)	Severely Food Insecure (%)
<b>Overall</b>	3681	1974 (53.63)	1707 (46.37)	351 (9.54)	1028 (27.93)	328 (8.91)
<b>Women</b>	2370	1213 (51.18)	1157 (48.82)	250 (10.55)	701 (29.58)	206 (8.69)
<b>Men</b>	1311	761 (58.05)	550 (41.95)	101 (7.70)	327 (24.94)	122 (9.31)

## Household Food Insecurity in First Nations Communities & Canada



**Figure 5.1** The prevalence of household food insecurity for First Nations living on reserve in Ontario (ON), Manitoba (MB), British Columbia (BC) and Alberta (AB).

Note: Data for all Canadian households were derived from Statistics Canada, Canadian Community Health Survey, 2012 reported by Tarasuk et al., 2014 (data excludes First Nations living on-reserve).

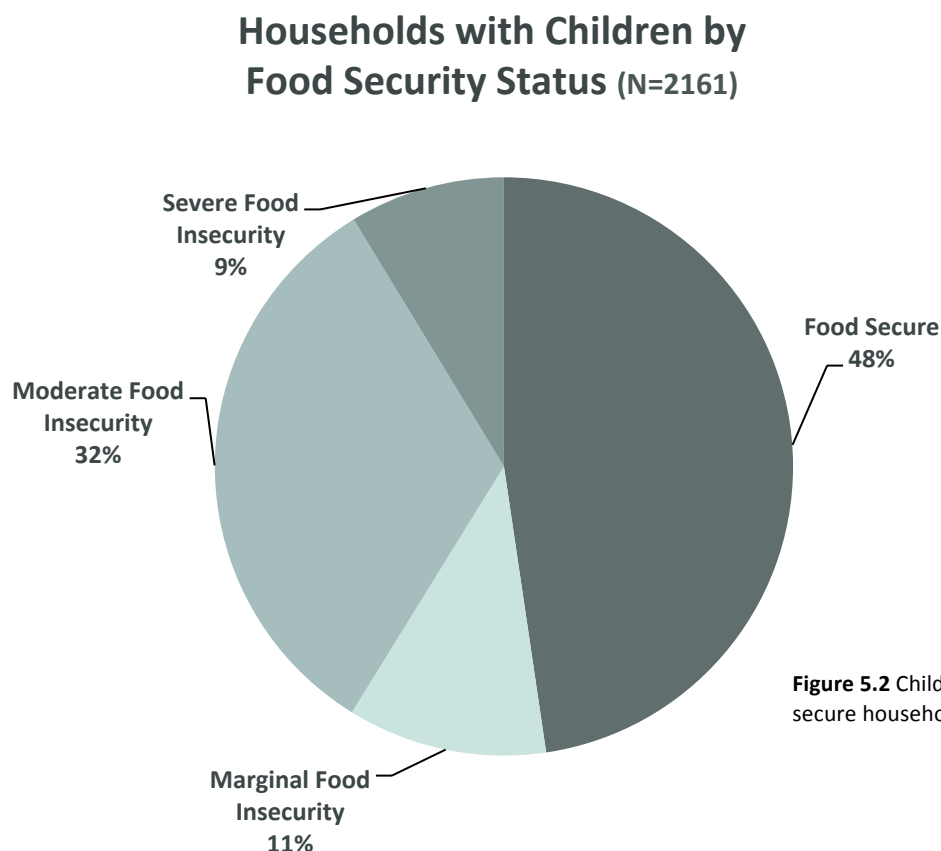
### **5.2.2 Bivariate analysis of food insecurity by socio-demographic and household characteristics**

For respondents living in food insecure households, prevalence rates of food insecurity were found to be significantly higher for females than males ( $p<0.001$ ). Among female respondents, 48.8% lived in food insecure households, while 51.1% lived in food secure households. Conversely, for male respondents, 42% lived in food insecure households, while 58.1% lived in food secure. Gender-specific analyses using the three levels of food insecurity revealed prevalence rates of moderate food insecurity to be highest for both female and male respondents. Among female respondents, 10.6% were marginally food insecure, while 29.6% were moderately food insecure, and 8.7% lived in severe food insecure households. For male respondents, 7.7% were marginally food insecure, while 24.9% were moderately food insecure and 9.3% were severely food insecure.

The prevalence of food insecurity also varied significantly with age group ( $p<0.001$ ). Younger to middle age groups were found to have the highest rates of food insecurity, while older age groups had comparatively lower rates of food insecurity. Among respondents aged 19-30 years old, the prevalence of food insecurity was 53.2%, while for respondents within the age range of 31-50 years old, rates of food insecurity were 49.7%. Contrastingly, for respondents aged 51-70 the prevalence of food insecurity was 38.9%, and 30.6% for respondents aged 71 and over.

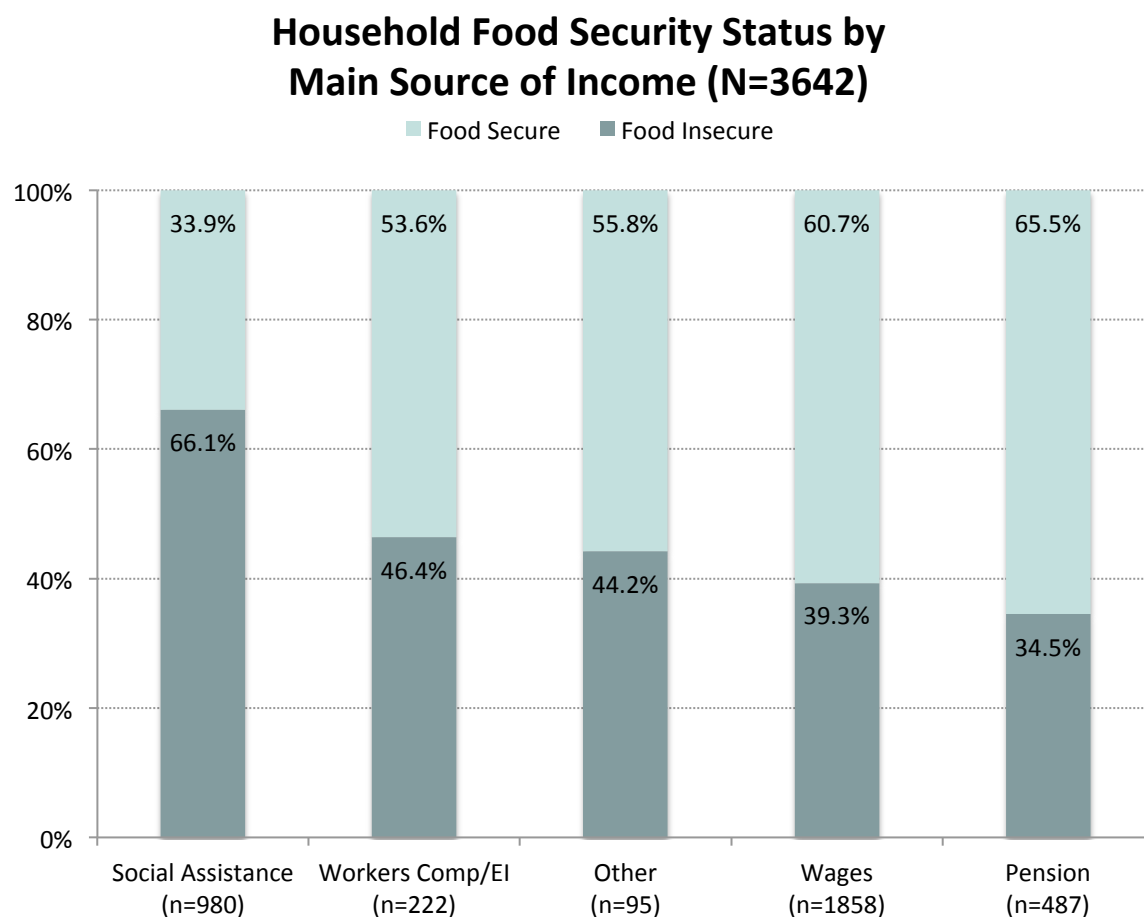
Food insecurity rates had also varied by household composition. Among households with children, the prevalence of food insecurity was 52.4%. This rate also varied significantly by the level of food insecurity for households with children ( $p<0.001$ ). For households with children, the prevalence of food insecurity was highest among moderately food insecure households

(32.5%), followed by marginal (11.1%) and severe (8.7%) food insecurity (Figure 5.2). In contrast, for households without children present, the prevalence of food insecurity was 37.8%. The prevalence of food insecurity also varied significantly by the total number of people in the household ( $p<0.001$ ). Among households with less than five people, the prevalence of food insecurity was 43.6%. Contrastingly, for households with 6 or more people, the prevalence of food insecurity was 58%. More specifically, households that comprised of 6 to 10 people had a rate of food insecurity of 57.8%, while households with 11-19 people had a rate of food insecurity of 59.6%. Further, compared with food *secure* households with children, food *insecure* households with children had, on average, a greater number of people living in the household (5.2 compared with 4.8), and a greater ratio of children (<15 years of age) to adults ( $\geq 15$  years of age) in the household (1.1 compared with 0.97).



**Figure 5.2** Children in food insecure and food secure households

Household main source of income has commonly been found to be strongly associated with rates of food insecurity. Among households receiving social assistance as a main source of income, 66.1% were food insecure (Figure 5.3). Conversely, households whose main source of income was pensions had the lowest rate of food insecurity (34.5%). However, households whose main source of income was wages, 39.3% were food insecure.



**Figure 5.3** Percentage of food secure and food insecure households by household main source of income.

**Table 5.3. Prevalence and Bivariate Analysis of Predictors of Food Insecurity**

<b>Predictor</b>	<b>Sample Size</b>	<b>Food Secure (%)</b>	<b>Food Insecure (%)</b>	<b>P-value*</b>
<b>Sex</b>	3681	1974 (53.6)	1707 (46.4)	<0.001
Female	2370	1213 (51.2)	1157 (48.8)	
Male	1311	761 (58.1)	550 (42)	
<b>Age Group</b>	3663	1966 (53.7)	1697 (46.3)	<0.001
19-30	747	350 (46.9)	397 (53.2)	
31-50	1687	848 (50.3)	839 (49.7)	
51-70	1023	625 (61.1)	398 (38.9)	
71+	206	143 (69.4)	63 (30.6)	
<b>Region</b>	3681	1974 (53.6)	1707 (46.4)	<0.001
Alberta	594	274 (46.1)	320 (53.9)	
British Columbia	1065	564 (53)	501 (47)	
Manitoba	646	334 (51.8)	312 (48.3)	
Ontario	1376	802 (58.3)	574 (41.7)	
<b>Income Source</b>	3642	1950 (53.5)	1692 (46.5)	<0.001
Wages	1858	1127 (60.9)	731 (39.3)	
Social Assistance	980	332 (33.9)	648 (66.1)	
Pension	487	319 (65.5)	168 (34.5)	
Workers compensation/ employment insurance	222	119 (53.6)	103 (46.4)	
Other	95	53 (55.8)	42 (44.2)	
<b>Years of education</b>	3608	1946 (53.9)	1662 (46.1)	<0.001
<b>Presence of children in the household</b>	3681	1974 (53.6)	1707 (46.4)	<0.001
Yes	2161	1030 (47.7)	1131 (52.3)	
No	1520	944 (62.1)	576 (37.9)	

<b>Type of Access into a community</b>	3681	1974 (53.6)	1707 (46.4)	<0.001
Year round road access	3023	1732 (57.3)	1291 (42.7)	
Fly in	234	86 (36.8)	148 (63.3)	
Winter road only	424	156 (36.8)	268 (63.2)	
<b>Household traditional food activity</b>	3681	1974 (53.6)	1707 (46.4)	0.002
Yes	2518	1306 (51.9)	1212 (48.1)	
No	1163	668 (57.4)	495 (42.6)	

\*P-value corresponds to bivariate analysis of food security status and predictor.

### 5.2.3 Multivariate analysis of predictors of food insecurity

Food insecurity was significantly associated with a number of socio-demographic variables in both bivariate (Table 5.3) and multivariate analysis (Table 5.4). In the multivariate logistic regression model, food insecurity was associated with whether the respondent was female or male. Female respondents were found to be associated with higher odds of food insecurity than male respondents (adjusted OR 1.34, 95% CI: 1.15±1.58). Compared with respondents age 71 and older, younger participants age 19 to 30 (adjusted OR 2.15, 95% CI: 1.34±3.45) and middle age participants age 31 to 50 (adjusted OR 2.08, 95% CI: 1.32±3.27), had significantly higher odds of food insecurity. The odds of food insecurity also varied significantly by region ( $p<0.001$ ); compared with households in Manitoba, significant higher odds of food insecurity were found for households residing in British Columbia (adjusted OR 1.69, 95% CI: 1.32±2.15) and Alberta (adjusted OR 1.62, 95% CI: 1.27±2.07).

**Table 5.4. Multivariate Logistic Regression Analysis Results: Predictors of Food Insecurity (n=3224)**

Table 3.11. Multivariate Logistic Regression Analysis Result: Predictors of Food Insecurity (N = 522)				
Predictor	Adjusted Odds Ratio	95% Wald Confidence Limits		P-value
Sex				
Male	Ref	-		
Female	1.34	1.15	1.58	<0.001
Age group				
71+	Ref	-		
19-30	2.15	1.34	3.45	0.002
31-50	2.08	1.32	3.27	0.002
51-70	1.47	0.97	2.23	0.069
Region				
Manitoba	Ref	-		
Alberta	1.62	1.27	2.07	<0.001
British Columbia	1.69	1.32	2.15	<0.001
Ontario	0.99	0.78	1.27	0.939
Income Source				
Wages	Ref	-		
Workers compensation/ employment insurance	1.8	1.3	2.49	<0.001
Social Assistance	3.16	2.61	3.83	<0.001
Pension	1.32	0.96	1.8	0.084
Other	1.2	0.77	1.85	0.421
Years Education	0.96	0.94	0.99	0.01
Presence of children in the household				
No	Ref	-		
Yes	1.5	1.26	1.77	<0.001



<b>Type of access into a community</b>				
Year round road access	Ref		-	
Fly in	2.51	1.77	3.57	<0.001
Winter road only	2.81	2.15	3.69	<0.001
<b>Household traditional food activity</b>				
No	Ref		-	
Yes	1.4	1.18	1.65	<0.001

Household main source of income was found to be a strong predictor of food insecurity ( $p<0.001$ ), specifically among households receiving social assistance as a main source of income. Households receiving social assistance as a main source of income were associated with significantly higher odds of food insecurity (adjusted OR 3.16, 95% CI: 2.61±3.83) compared to households with wages as a main source of income. In addition, compared with households with wages as a main source of income, households receiving workers compensation or employment insurance as a main source of income had significantly higher odds of food insecurity (adjusted OR 1.8, 95% CI: 1.3±2.49). The number of years of education was also found to be associated with lower odds of food insecurity (adjusted OR 0.96, 95% CI: 0.94±0.99). In addition, the presence of children in the household in multivariate analyses was significantly associated with higher odds of food insecurity compared with households with no children (adjusted OR 1.5, 95% CI: 1.26±1.77).

#### **5.2.4 Effect of specific on-reserve community characteristics on food insecurity**

There were two additional variables that were included in the multivariate analysis that were found to be significantly associated with food insecurity: the type of road access into the community and household traditional food activity. These variables are characteristics unique to First Nations communities living on-reserve and are therefore further explored in this chapter.

##### **5.2.4.1 Type of road access into a community**

In the multivariable analysis of predictors of food insecurity, the type of road access into the community was found to be strongly associated with rates of food insecurity (Table 5.4).

Households residing within communities that could only be accessed through fly in had higher odds of food insecurity compared with households in communities with year round road access ( $p < 0.001$ ). In this sample of First Nations communities, there were five communities that were accessible by plane. Within these communities, 61% of households were, on average, food insecure. Similarly, communities only accessible by winter road only were significantly associated with higher odds of food insecurity compared with communities with year round road access ( $p < 0.001$ ). There were seven communities that were only accessibly by winter road. Within these communities that could only be accessed by winter road, 62.8% of households were, on average, food insecure.

##### **5.2.4.2 Household traditional food activity**

Household traditional food activity was significantly associated with food insecurity in both bivariate and multivariate analyses (Table 5.3, 5.4). Households engaged in traditional food activities were found to have higher odds of food insecurity compared with households not engaged in traditional food activities (Table 5.4), suggesting that pursuing traditional food

activity itself might be influenced by food insecurity, a dimension not addressed in the survey questionnaires used in the FNFNES.

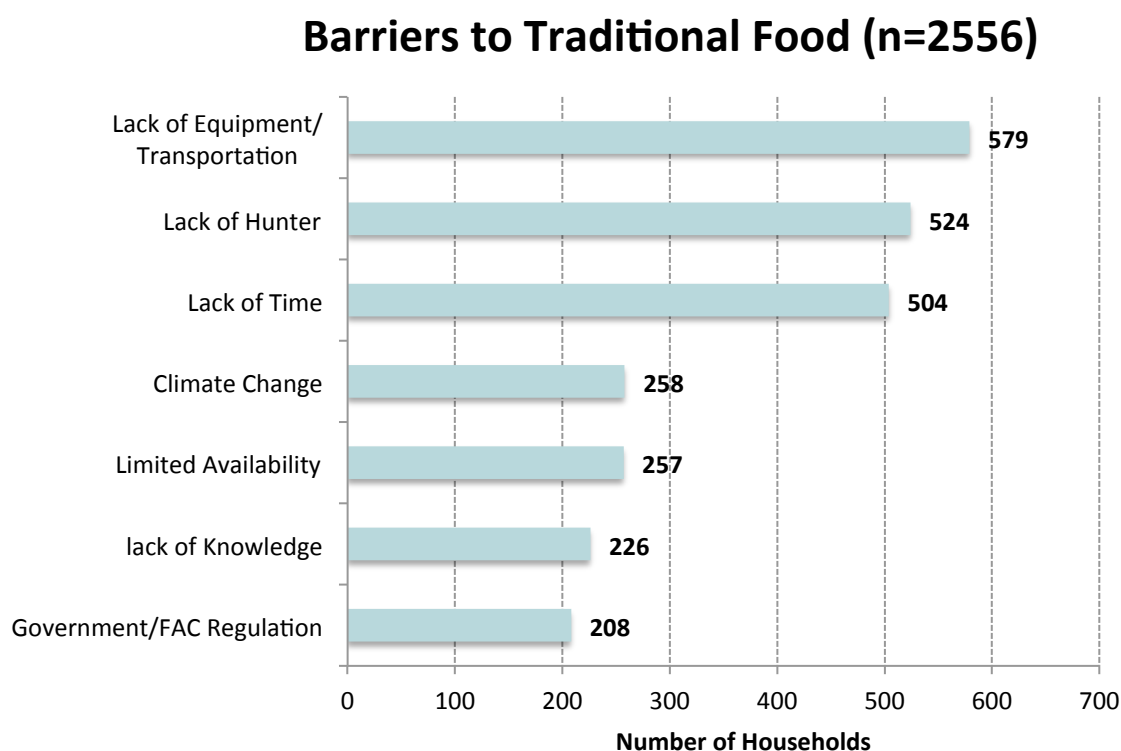
In communities accessible by plane, where the odds of food insecurity were observed to be greater in multivariate analysis (Table 5.4), 65.1% of households that reported using traditional food activities were food insecure. Within these communities accessible by plane, households receiving social assistance, the income group observed to have a high prevalence of food insecurity, 88% of households engaged in traditional food activities were food insecure. While among communities accessible by winter road only, 63.8% of households engaged in traditional food activities, were food insecure. Within these communities, 82.3% of households receiving social assistance as a main source of income and who reported using traditional food activities were food insecure.

As the association found between household traditional food activity and food insecurity could be suggestive of additional challenges related to household food security, questions from the social, health and lifestyle (SHL) questionnaire regarding household traditional food security were therefore examined (Appendix A, question 8c & 8d).

Analyses regarding traditional food use and household traditional food activity revealed that among households engaged in traditional food activities, 50.8% of respondents to the SHL questionnaire conducted in household interviews indicated that in the last 12 months “we worried our *traditional food* would run out before we could get more.” In addition, among households engaged in traditional food activity, 52% of respondents indicated that “the *traditional food* we got just didn’t last, and we couldn’t get any more.” Although 68% of households reported being actively engaged in traditional food activities, approximately half of

those households have expressed concerns regarding their traditional food running out.

Participants of household interviews who responded to the SHL questionnaire in the study (Appendix A, question 8b) identified barriers that prevented their household from using more traditional food (Figure 5.4). Barriers to using traditional foods that were commonly identified by participants include: the lack of equipment and or transportation to hunt; the lack of a hunter in the household; lack of time; lack of traditional foods available; the lack of knowledge to obtain traditional foods; and government policies and regulations. In addition, many participants had indicated that climate change had affected the availability of and accessibility to traditional foods.



**Figure 5.4** Barriers to using more traditional foods as identified by survey respondents to the social, health and lifestyle questionnaire (Appendix A, Question 8b).

## 5.3 Household Food Insecurity and Obesity

### 5.3.1 Pooled analyses: Alberta, British Columbia, Manitoba, Ontario

Among the 3364 with calculated BMI in the sample 46.1% were classified as obese, while 33.7% were classified as overweight, 19.2% were categorized as normal weight and 1.1% were categorized as underweight. Prevalence rates of obesity were found to be higher among female respondents in the sample with 48.9% classified as obese, while for male respondents 41.5% were classified as obese.

In bivariate comparisons of obesity with the three levels of food insecurity (marginal, moderate, severe), prevalence rates of obesity were significantly associated with food security status ( $p < 0.001$ ). Rates of obesity were highest among marginally food insecure households, where 56% of individuals living in marginally food insecure households were obese (Table 5.5). Individuals living in marginally food insecure households had an average BMI of 31.3 kg/m<sup>2</sup>. Conversely, rates of obesity were lowest among individuals living in severely food insecure households (37.2%), and in moderately food insecure households the prevalence of obesity was 44.3%. Individuals living in severe food insecure households had a mean BMI of 28.8 kg/m<sup>2</sup>, while those residing in moderately food insecure households had a mean BMI of 29.9 kg/m<sup>2</sup>.

**Table 5.5. Prevalence of Obesity by Food Security Status for Women and Men**

	<b>Overall (%)</b>	<b>Women (%)</b>	<b>Men (%)</b>
<b>Food Secure</b>	811 (46.6)	488 (48)	323 (44.6)
<b>Food Insecure</b>	672 (45.3)	473 (49.5)	199 (37.8)
<b>Marginally Food Insecure</b>	169 (56)	116 (56.6)	53 (54.6)
<b>Moderately Food Insecure</b>	397 (44.3)	286 (49.1)	111 (35.5)
<b>Severely Food Insecure</b>	106 (37.2)	71 (42.3)	35 (29.9)

The results of both bivariate and multivariate logistic regression analyses are summarized in Table 5.6. In bivariate logistic regression analyses, for both female and male respondents, those living in marginally food insecure households had higher odds of obesity compared to respondents living in food secure households (OR 1.5, CI: 1.17±1.92,  $p=0.002$ ). However, individuals living in severe food insecure households had lower odds of obesity compared to food secure households (OR 0.68, CI: 0.52±0.88,  $p=0.003$ ). No significant association was found between obesity and moderately food insecure households.

Similarly, in the multivariate regression analysis, the relationship observed in bivariate analyses, persisted after adjusting for sex, age, region, main source of income and number of years of education. In the multivariate model, individuals living in marginally food insecure households had significantly higher odds of obesity than those living in food secure households (OR 1.53, CI: 1.19±1.97,  $p=0.001$ ). Conversely, those living in severe food insecure households had lower

odds of obesity than individuals living in food secure households (OR 0.74 CI: 0.56±0.97,  $p=0.030$ ). No significant association was found among individuals living in moderately food insecure households and obesity. Although no significant interactions were found in the multivariate analyses with food insecurity, gender-specific analyses were conducted due to the high number of female respondents in the study.

**Table 5.6. Logistic Regression Analysis of Obesity Associated with 3 Different Levels of Household Food Insecurity**

	Overall n=3126		Women n=1905		Men n=1221	
	Unadjusted OR	Adjusted OR <sup>§</sup>	Unadjusted OR	Adjusted OR <sup>‡</sup>	Unadjusted OR	Adjusted OR <sup>‡</sup>
<b>Food Secure<sup>†</sup></b>	-	-	-	-	-	-
<b>Marginally Food Insecure</b>	1.5** (1.17, 1.92)	1.53** (1.19, 1.97)	1.46* (1.08, 1.98)	1.57** (1.15, 2.15)	1.51 (0.98, 2.32)	1.57* (1.01, 2.43)
<b>Moderately Food Insecure</b>	0.91 (0.77, 1.07)	0.97 (0.82, 1.15)	1.04 (0.84, 1.28)	1.12 (0.9, 1.39)	0.69** (0.52, 0.91)	0.77 (0.58, 1.03)
<b>Severely Food Insecure</b>	0.68** (0.52, 0.88)	0.74* (0.56, 0.97)	0.8 (0.57, 1.11)	0.89 (0.63, 1.27)	0.52** (0.34, 0.79)	0.56* (0.36, 0.87)

(95% Confidence Interval); OR, Odds Ratio.

<sup>†</sup>Reference category.

<sup>§</sup>Odds ratio from multivariate logistic regression adjusting for age, gender, income, years of education, region.

<sup>‡</sup>Odds ratio from multivariate logistic regression adjusting for age, income, years of education, region.

\* (P<0.05) \*\* (P<0.01) Significantly different from food security.

Note: Refer to Appendix C for adjusted odds ratios and confidence intervals of variables adjusted for in the models.

### 5.3.2 Gender-specific analyses

In bivariate comparisons, among female respondents only, household food insecurity was significantly associated with obesity ( $p=0.043$ ). Obesity rates were highest among females living in marginally food insecure households (56.6%) and lowest among female respondents in severe food insecure households (42.3%). The average BMI for female respondents living in marginally food insecure households was 31.8 kg/m<sup>2</sup>, while for female respondents living in moderate and severe food insecure households, the average BMI was 30.4 kg/m<sup>2</sup> and 29.3 kg/m<sup>2</sup> respectively.

In the unadjusted logistic regression model, females living in marginally food insecure households had significantly higher odds of obesity compared to food secure households (OR=1.46, CI: 1.08±1.98,  $p=0.015$ ). However, no significant association was found between moderate and severe food insecurity with obesity. This relationship persisted in multivariate logistic regression analysis. In the multivariate analysis, among female respondents, marginally food insecure households had higher odds of obesity compared to food secure households (OR 1.57, CI: 1.15±2.14,  $p=0.005$ ), adjusting for confounding effects by age, region, household main source of income and years of education. No significant association was found between obesity and those living in moderate or severe food insecure households in the multivariate analysis.

For male respondents, in bivariate comparisons, obesity was significantly associated with food security status ( $p<0.001$ ). Similar to female respondents, prevalence rates of obesity were highest among male respondents living in marginally food insecure households (54.6%) and lowest among males living in severe food insecure households (29.9%). The average BMI for male respondents living in marginally food insecure households was 30.2 kg/m<sup>2</sup>, while in



moderate and severe food insecure households the average BMI was 28.9 kg/m<sup>2</sup> and 28.2 kg/m<sup>2</sup> respectively.

In the simple bivariate analysis, among male respondents, those living in moderate food insecure households had lower odds of obesity (OR=0.69, CI: 0.52±0.91,  $p=0.009$ ), as well as for males living in severe food insecure households (OR=0.52, CI: 0.34±0.79,  $p=0.003$ ). No significant association was found between marginal food insecurity and obesity. However, in multivariate analyses, the odds of obesity were significantly higher for male respondents living in marginally food insecure households than food secure households, after adjusting for age, region, income and years of education (OR 1.57, CI: 1.01±2.42,  $p=0.044$ ). In addition, male respondents living in severe food insecure households had significantly lower odds of obesity compared with food secure households (OR 0.56, CI: 0.36±0.87,  $p=0.011$ ), while adjusting for socio-demographic variables. No significant association was found between male respondents living in moderately food insecure households and obesity.

### **5.3.3 Food insecurity as a potential mediator**

As the conceptual model presented in section 3.3.3, outlining the hypothesized mechanisms for the relationship between food insecurity and obesity, may suggest potential mediation by food insecurity, a mediation analysis of food insecurity on the association between household main source of income and obesity was therefore explored. Given the binary nature of the outcome variable obesity, the categorical nature of the mediator variable food insecurity and predictor variable “main source of income”, and the non-linear association between food insecurity and obesity, a formal mediation analysis (such as the one developed by Hayes et al., 2014) could not

be applied. Therefore, the mediation analysis carried out followed the traditional recommendations by Baron and Kenny (1986)<sup>8</sup>. The analyses showed that when the variables food insecurity and income were modelled to predict the odds of obesity, both variables remained statistically significant (Appendix D, Table D.4). In addition, in a multivariate logistic regression analysis of food insecurity and obesity adjusting for age, sex, region, and years of education, the variable main source of income dropped in its statistical significance and increased in its effect size (Appendix C, Table C.1). This suggests that the variables in the model share a common variance in their relationship with obesity and is in line with the hypothesis that the effect of income on obesity may partially be mediated by the variable food insecurity.

## **5.4 Exploring Food Sovereignty**

While the association between food insecurity and various socio-demographic characteristics (section 5.2.2 & 5.2.3) identified as proximal determinants (section 3.2), was analyzed to address the first research question of the present study by directly applying data produced by FNFNES survey, the concept of food sovereignty was explored indirectly. As food sovereignty is generally understood to be a communal attribute, an effort was made to construct a community value that could be associated with the concept of food sovereignty by examining “household engagement with traditional food activity” as captured by the social, health and lifestyle questionnaire used in household interviews of the FNFNES (Appendix A, question 5 & 6).

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<sup>8</sup>Results from mediation analysis following the recommendation by Kenny Barron (1986) are shown in Appendix D Tables D.1 to D.4.

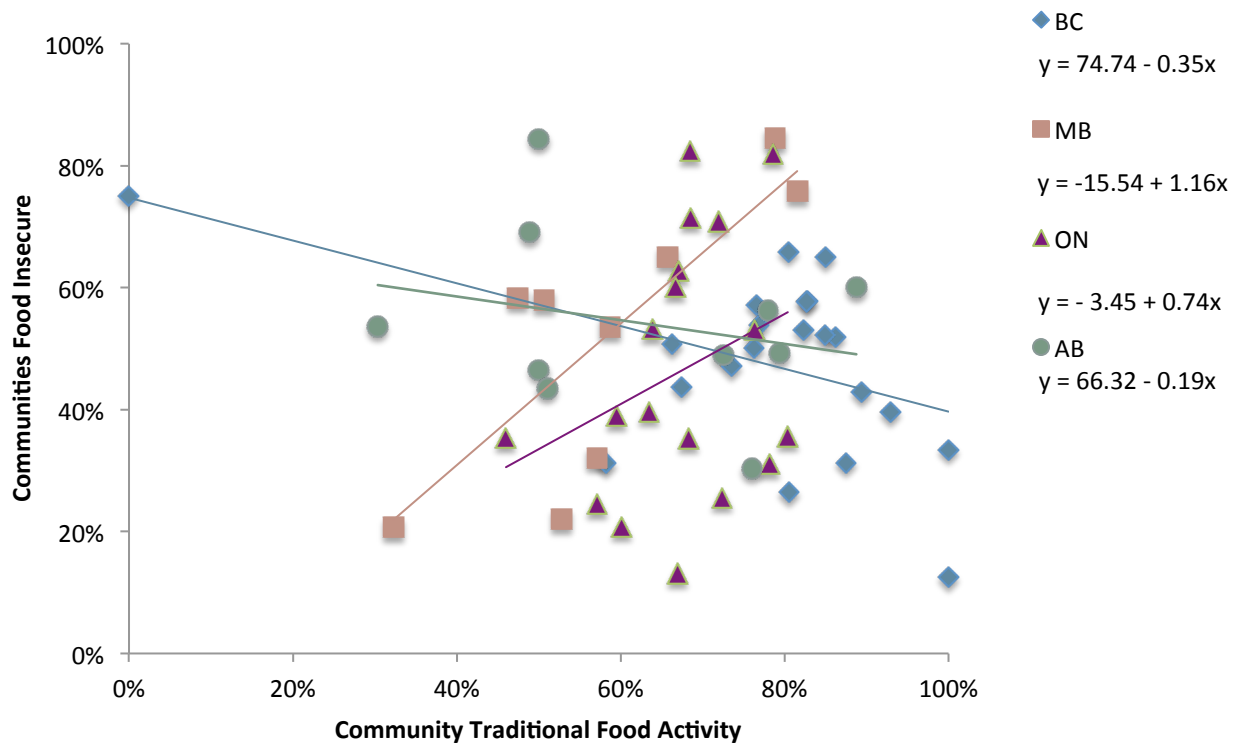
Household traditional food activity was explored at a community level by considering whether the presence of those engaged in such activities in a community could be considered as an influence on outcomes such as food security. As discussed in the methods section (4.4.3) community traditional food activity was constructed as an aggregate of the percentage of households that reported being engaged in traditional food activities within each community.

Community traditional food activity significantly varied by region ( $p=0.016$ ) and was found to be highest in British Columbia where an average of 77.6% of communities engaged in traditional food activities, followed by Ontario (67.4%), Alberta (62.5%), and Manitoba (58.4%). In British Columbia, Figure 5.5 indicated that an association might exist between the level of community traditional food activity and the presence of food insecurity, with analysis of the 21 communities suggesting that a statistically significant relationship existed with greater community traditional food activity being associated with a lower percentage of food insecure communities ( $p=0.025$ ). Further, when all provinces were considered in a multilevel analysis<sup>9</sup>, community traditional food activity was not found to be significantly associated with food insecurity. Further, although household traditional food activity was found to be significantly associated with food insecurity (Table 5.3), in the multi-level analysis the effect of household traditional food activity on food insecurity did not significantly vary from one community to the next.

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<sup>9</sup>Results from the multi-level analysis summarized in Appendix E in Tables E.1 and E.2.

## Food Insecurity & Community Traditional Food Activity by Province



**Figure 5.5** The association between community traditional food activity and communities food insecure by province

## **Chapter 6: Discussion**

### **6.1 Food Insecurity as a Public Health Concern for First Nations living on-reserve**

#### **6.1.1 Prevalence of food insecurity**

The results from the present study indicate that food insecurity remains an ongoing challenge for Indigenous households and in particular, First Nations on-reserve, and its associated impacts on health and wellness represent an important public health issue. Studies examining food insecurity have consistently revealed Indigenous households in Canada to be disproportionately affected by food insecurity compared to non-Indigenous households in Canada (Power, 2008; Tarasuk et al., 2014; Guo et al., 2015; Willows et al., 2008; Council, 2014). In this study, the prevalence of food insecurity in this sample of First Nations households on-reserve was high, with 46.4% of First Nations households experiencing some degree of food insecurity. Among food insecure households, 9.5% of households were classified as marginally food insecure, 28% were moderately food insecure and 8.9% were severely food insecure. This is also consistent with data provided by the First Nations Regional Health Survey that have revealed 54.2% of First Nations households in northern on-reserve communities to be more food insecure, a rate that is far greater than that of the general Canadian population (FNIGC, 2012).

The present study also revealed a number of variations in the prevalence of food insecurity by region, socio-demographic characteristics, and household composition. Food insecurity was highest in the province of Alberta (53.9%), followed by Manitoba (48.3%), British Columbia (47%) and Ontario (41.7%). Rates of food insecurity were highest among female respondents;

households with children; as well as households receiving social assistance as a main source of income. These results are consistent with other studies that have reported a number of groups vulnerable to food insecurity, including low income households; those with lower education levels; females and single female headed families; and households with children (Tarasuk et al., 2014; Guyot et al., 2015; Willows et al., 2008).

### **6.1.2 Predictors of food insecurity**

In this study, the socio-demographic variables observed to be significantly associated with food insecurity in bivariate analyses reached statistical significance in the multivariate analysis.

Significant predictors of food insecurity included sex, age group, region, main source of income, years of education, the presence or absence of children in the household, type of road access into the community and household traditional food activity. Predictors found to be significantly associated with higher odds of food insecurity included, being female, the presence of children in the household, receiving social assistance as a main source of income, receiving workers compensation/employment insurance as a main source of income, lower education, young to middle age groups (19-30 and 31-50), residing in BC and AB, household traditional food activity, and communities without year-round road access. Such factors are consistent with other studies that have also found being female, receiving social assistance, the presence of children in the household, lower education, not having all-year road access, and younger age groups to be significant predictors of food insecurity among Indigenous households in Canada (Willows et al., 2008; Thompson et al., 2011; Gionet & Roshanafshar, 2013; Guo et al., 2015).

Although reasons for the observed differences in the prevalence of food insecurity by socio-demographic and household characteristics for First Nations living on-reserve, were not

explicitly examined in the present study, a number of possible explanations have been offered by the literature. The high prevalence of food insecurity among female respondents has been identified to be associated with females more inclined to sacrifice their own food security to provide food for their family and ensure that children within the household are food secure (McIntyre et al., 2003; Beaumier & Ford, 2010; Martin & Lippert, 2012). It has consistently been shown that households with children often have a higher prevalence of food insecurity than households without children. This observation is likely associated with the presence of a greater number of people in household. In this study, food insecure households with children had, on average, a greater number of people living in the household compared with food secure households with children. This is consistent with findings from the Nunavut Inuit Child Health Survey (2001-2008) that found child food insecure homes, on average, had a greater number of persons living in the household and also had a greater ratio of children to adults (1.7 compared with 1.5) compared with child food secure homes (Council, 2014).

Factors such as reliance on income support and lower education, found to be significantly associated with food insecurity, are also indicative of a socio-economic gradient with food security status, where households of lower socio-economic status are faced with challenges that reduce access to nutritious foods (Huet et al., 2012). Households receiving social assistance as a primary source of income or reliant on employment insurance/workers compensation must not only allocate those funds for food, but towards additional essentials such as shelter and household utilities (Power, 2005). Households reliant on income support may therefore still lack the purchasing power to ensure adequate access to healthy and nutritious food. In this study, older age groups (51-70 and 71+) had a lower prevalence of food insecurity compared to

younger and middle age groups (19-30 and 31-50). Similar findings of older age being significantly associated with food security suggest that the association may be reflective of better budgeting skills (Guo et al., 2015; Chan et al., 2006) or other forms of social support.

Households residing in British Columbia and Alberta were found to have significantly higher odds of food insecurity when compared with Manitoba. Although a provincial comparative analysis was not conducted in this study, differences in the level of vulnerability to food insecurity by province could be tied to differences in the implementation of federal and provincial policies and programs providing income support or that address food security within each province. Provincial differences in minimum wage, welfare benefits, and employment insurance policies, although not examined in the present study, may have an influence over household food access. Additional factors such as community remoteness, distance to nearest service centre and differences in weather and climate may also play a role in the level of vulnerability to food insecurity by province.

Although having an active hunter in the family has been observed to provide a protective effect against food insecurity (Huet et al., 2012), the inverse relationship found in the present study between household traditional food activity and food security, could be indicative of additional challenges that prevent households from regularly using traditional foods in support of the *nutrition transition* that will be further discussed in the subsequent section. In this study, approximately half of the number of households that indicated being engaged in traditional food activities had expressed concerns regarding their traditional food running out (Chapter 5, section 5.2.4). However, it is recognized that the measure of household traditional food activity used in this study does not provide an indication as to how *frequently* individuals in the household



engaged with traditional food activities, as barriers do exist that can prevent regular access to traditional food acquisition activities (Elliot et al., 2012; Robidoux et al., 2009; Mead et al., 2010). The present study revealed a number of financial, local and regulatory barriers identified by participants that prevented their household from using more traditional foods.

The lack of hunting equipment and transportation; the lack of a hunter in the family or help to hunt; and a lack of time were common barriers identified by participants that prevented their household from using more traditional foods. Other barriers, although less frequently reported by households, included limited availability of traditional foods; loss of traditional knowledge; government policies and regulations; and climate change as factors that have impacted the use of traditional foods. The barriers identified in the present study, are consistent with other studies that have examined factors that can either enable or hinder access to traditional foods of which include: loss of knowledge; lack of time; availability/sustainability; land access; economics; lack of equipment; environmental degradation; and resource depletion (Elliot et al., 2012; Robidoux et al., 2009; Mead et al., 2010; Richmond et al., 2005). These factors may limit opportunities for households to regularly engage in hunting, harvesting and gathering practices, as well as develop the necessary skills to harvest and prepare traditional foods with implications for food insecurity and nutrition. The barriers identified to using more traditional foods not only have implications for compromises in food security, but also the nutrition transition and subsequently nutritional health and diet-related conditions such as obesity. The inverse association found between household engagement with traditional food activities and food security, may therefore suggest that households have been faced with challenges that are preventing frequent engagement with traditional food practices, as indicated by barriers identified from participants that have prevented their household from using more traditional foods.

### 6.1.3 The social *determination* of First Nations food insecurity

The predictors of food insecurity found in the present study emphasize the importance of understanding the social and political processes that have shaped the unequal distribution of health determinants. This is particularly important in the context of understanding inequities in First Nations health and wellness and in recognizing the historical underpinnings of food insecurity that are deeply rooted in colonial policies and practices. This orientation to examining the pathways and processes that affect population health, distinguished in the literature as the *social determination of health*, has been embraced as a useful approach to providing critical insights on actions necessary to contribute to health equity in populations faced with differing levels of marginalization (Spiegel et al., 2015). It is therefore imperative that results from the present study are tied to a discussion on the processes underlying such determinants.

Through colonial laws and practices, Aboriginal peoples were displaced physically from their traditional territories, which prevented use and access to resources of their traditional environments. This process of environmental dispossession, characterized by the loss of traditional land and knowledge, has contributed to the erosion of culture and societal values (Bartlett, 2003; Richmond & Ross, 2008; Reading & Wein, 2009) and has prevented the development of skills related to harvesting and food processing (Council, 2014). Further, through the establishment of residential schools that enforced cultural assimilation of Aboriginal peoples into mainstream Canadian culture (Richmond & Ross, 2008), the sharing of cultural practices and traditional ways of life related to the environment and traditional food acquisition practices to younger generations was severely compromised. The historical factors tied to colonial laws and practices that sought to undermine the social and cultural fabric of Aboriginal identity, have

been identified as the most fundamental process underlying contemporary stresses (Richmond & Ross, 2008; Reading & Wein, 2009). This can be viewed in the present study of challenges associated with food insecurity and concerns for obesity and related chronic diseases. Further, the inverse association found between household traditional food activity and food security may emphasize the need for greater attention to be given to understanding and measuring the social, cultural and land-use determinants of Indigenous health, as emphasized by Kant et al., (2013). In a study examining the social, cultural and land use determinants of Indigenous health and wellbeing, Kant and colleagues (2013) found the impact of government regulations on land-use activities and the percentage of home cooked meals from traditional diets, to have profound impacts on First Nations social and cultural wellbeing (Kant et al., 2013). As Kant and colleagues found the percentage of meals from traditional diets as the most important contributor to the social, cultural and land use determinants having the greatest impact on First Nations health and wellness (Kant et al., 2013), consideration for the development of strategies that support greater land-use and traditional food activities are therefore needed. Recognition of the socio-political context of Indigenous peoples is essential to discussing the challenges of food insecurity and the diet-related health concerns of obesity, in an attempt to identify promising points of action to achieve Indigenous food sovereignty.

## **6.2 The Relationship between Obesity and Food Insecurity**

### **6.2.1 Food insecurity-obesity paradox**

Food insecurity and obesity are serious public health issues for First Nations living on-reserve. Although the relationship between poor health, nutritional intakes and food insecurity have been extensively studied, an evolving body of literature on the relationship between food insecurity and obesity has emerged since William Dietz initially hypothesized the relationship in a case-study in 1995 (Dietz, 1995). Since then, a number of studies have confirmed the paradoxical relationship between food insecurity and obesity (Olson, 1999; Hanson et al., 2007; Wilde & Peterman, 2005; Townsend et al., 2001; Adams et al., 2003; Lyons et al., 2008).

In this study, a significant non-linear association was found between household food insecurity and obesity. Marginally food insecure households had significantly higher odds of obesity compared to food secure households. Contrastingly, those living in severe food insecure households had significantly lower odds of obesity compared with food secure households. When gender-specific analyses were conducted, women living in marginally food insecure households had significantly higher odds of obesity compared to food secure households. Women living in severe food insecure households were also found to have lower odds of obesity, however, this observation did not reach statistical significance. For men, marginal food insecurity was significantly associated with higher odds of obesity compared with men living in food secure households. While male respondents living in severe food insecure households had significantly lower odds of obesity compared to males living in food secure households.

The results from the present study are consistent with other studies that observed a non-linear association between food insecurity and obesity. Studies that have found an association between

food insecurity and obesity have reported higher levels of overweight or obesity at low and intermediate levels of food insecurity, while more severe levels of food insecurity were found to be associated with lower BMI compared to food secure households in non-Indigenous populations (Hanson et al., 2007; Wilde & Peterman, 2005; Townsend et al., 2001; Adams et al., 2003). In a study by Hanson and colleagues (2007), women experiencing low food insecurity were significantly more likely to be obese, while marginal food secure women were significantly associated with overweight compared to fully food secure women, after adjustments for age, ethnicity, marital status, income and education (Hanson et al., 2007). Conversely, men experiencing low food security were significantly less likely to be obese compared to fully food secure men (Hanson et al., 2007).

Similarly, Wilde and Peterman (2005) found that among women living in households that were marginally food secure and food insecure without hunger, significantly higher odds of obesity were found compared with fully food secure households, after controlling for ethnicity, income, education and health status (Wilde & Peterman, 2005). Further, among male respondents only, those living in marginally food secure households had significantly higher odds of obesity compared to fully food secure households, when adjusting for ethnicity, income, education and health status (Wilde & Peterman, 2005). An additional study by Townsend and colleagues (2001) also found a positive association with overweight or obesity with food insecurity among female respondents. Townsend had categorized food insecurity as mild, moderate or severe, and had found that among women living in mildly food insecure households, 30% were more likely to be overweight than those who were food secure, after adjustments were made for ethnicity, age, education, food stamp usage, exercise and hours spent watching television per day (Townsend et al., 2001).

Overall, studies have provided mixed findings on the relationship between food insecurity and obesity, emphasizing the need to consider the gradations of food insecurity in examining this relationship. Contradictory findings have been found across studies examining the association between food insecurity and obesity or overweight across women and men and different levels of food insecurity measured in Canada, the United States and internationally. Studies have revealed a non-linear or an inverted U-shaped pattern, as in the present study and other studies described above. While others have shown a linear or dose-response relationship between food insecurity and obesity (Holben et al., 2007; Laraia et al., 2010). Discrepancies between studies are likely attributable to differences in the way food insecurity and obesity have been measured, different definitions of food insecurity and obesity used, and differences in the choice of confounding variables used in the analysis of food insecurity and obesity.

### **6.2.2 Exploring mechanisms of food insecurity and obesity**

There are many possible mechanisms for the relationship between food insecurity and obesity that have been offered by the literature. The first hypothesis that has commonly been discussed as a mechanism for the relationship between obesity and intermediate levels of food insecurity is the overconsumption of energy dense, less nutritious foods (Dietz, 1995; Franklin et al., 2012; Scheier, 2005). Drewnowski (2004) provides an economic perspective on the observed association between obesity and the food environment within an energy-cost framework. In his analysis, he describes how energy dense foods that are high in fat and poor nutrient quality are often purchased at the lowest cost and consumed by households faced with limited economic resources (Drewnowski, 2004). Increased intakes of energy dense foods have been thought to occur during periods of a lack of money and have been identified to be a response to budgetary or financial constraints. In a study assessing the impact of changing food environments on

dietary practices among Inuit communities, community leaders commonly described that people on income support were particularly more vulnerable to purchasing unhealthy processed foods due to the lower costs associated with those foods (Mead et al., 2010). Similarly, in a study examining community perspectives on the relationship between food insecurity and obesity among First Nations and Métis parents, families identified low income as an underlying factor of food insecurity and reported being reliant on energy-dense foods as they tended to be more affordable compared to nutritious foods (Bhawra et al., 2015).

A second hypothesized explanation for the association between food insecurity and obesity that has been discussed is inconsistent access to food that may lead to overconsumption when food is made available (Dietz, 1995; Scheier, 2005). This has been considered to be associated with fluctuations in the households' economic cycle that may lead to alternating periods between overconsumption or food binging when food is most abundant in the household, followed by periods of food scarcity and under-consumption. This alternating cycle between food binging and food restriction has been identified to lead to a gradual gain in weight overtime (Townsend et al., 2001; Wilde & Peterman, 2006; Polivy, 1996; Polivy et al., 1994).

A third mechanism offered by the literature, more specific to Indigenous populations in Canada and globally, is the nutrition transition. The nutrition transition observed, from changes in traditional diets towards increased use of market-based foods has been identified to be associated with the rise in obesity, chronic diseases and a decrease in dietary adequacy (Mead et al., 2010; Kuhnlein et al., 2004). In Indigenous populations in Canada, increases in the prevalence of obesity and chronic diseases such as cardiovascular disease and type-2 diabetes mellitus, have been described to be indicative of a dietary and lifestyle transformation (Haman et al., 2010).

The combined effect of food insecurity and the nutrition transition has been examined to be associated with a shift in nutritional health with implications for increased risk of obesity and related chronic diseases (Egeland et al., 2011).

### **6.2.3 The nutrition transition**

First Nations peoples have undergone a nutrition transition characterized by a decrease in physical activity and a shift in the consumption of traditional foods to more energy dense, less nutritious market-based foods containing high amounts of saturated fats and simple sugars (Haman et al., 2010). The nutrition transition has been measured and observed through changing patterns in the use of traditional foods overtime, as well as differences in the use of traditional foods between younger and older generations. A decreasing trend in the consumption of traditional foods has been observed across Indigenous groups; and younger age groups have been found to consume less traditional foods than older age groups (Sheikh et al., 2011; Kuhnlein et al., 2004).

The profound shift in diet and lifestyle corresponding to increased intakes of processed foods high in saturated fats, refined carbohydrates and sugar, has been tied with the increase in the prevalence of obesity and related chronic diseases in Indigenous populations (Sheikh et al., 2011; Haman et al., 2010; Batal et al., 2005; Young et al., 2000; Gittelsohn et al., 1998). Traditional foods have been found to be an essential source of nutrients, omega 3 and omega 6 fatty acids and be lower in saturated fats compared with market-based foods (Kuhnlein et al., 2004). Kuhnlein and colleagues (2004) examined the nutrition transition among Indigenous communities in the Arctic and found that on days without traditional foods consumed, there were significantly higher intakes of sucrose, carbohydrates, sodium and saturated fats examined for



First Nations, Inuit and Dene/Métis. Contrastingly, when traditional foods were consumed, significantly higher intakes of vitamin A, vitamin E, vitamin D, vitamin B-6, zinc, magnesium, potassium, riboflavin, and less fat, carbohydrates and sugar were found in the diet (Kuhnlein et al., 2004).

Egeland and colleagues (2011) examined food insecurity and the nutrition transition in Inuit communities in the Arctic and found that among food insecure women, there were significantly higher intakes of carbohydrates and lower intakes vitamin C, vitamin D, iron, magnesium, and calcium (Egeland et al., 2011). Further, it was found that among those who were food insecure and who had not consumed traditional foods in the past day, reported having the lowest nutrient intakes (Egeland et al., 2011). In addition to the nutritional benefits of traditional foods, the physical activity associated with the hunting and gathering of traditional foods has been found to be associated with an increase in energy expenditure (Alder et al., 1996). Thus, the combined health impacts of food insecurity and the nutrition transition present serious implications for dietary quality, obesity and obesity-related chronic diseases.

There are a number of factors believed to be involved with nutrition transition including the barriers identified in the present study, such as the lack of hunting equipment and transportation and lack of a hunter in the family or help to hunt. Broader determinants related to environmental dispossession, colonialism, cultural assimilation, and environmental change should also be considered as involved in the nutrition transition and the contemporary ill-health outcomes observed with the association between food insecurity and obesity. The observed association found between marginal food insecurity and the higher odds obesity among First Nations households may therefore be tied to greater consumption of low-costing energy dense foods, in

support of the nutrition transition, with barriers identified in the present study as potentially mediating a shift from nutritious traditional foods to store-bought foods. In this light, the observed association found between severely food insecure First Nations households and the lower odds of obesity may be tied to *decreased* energy intakes from a disruption of eating patterns and low consumption of food that could be contributing to weight loss.

## **6.3 Policy Implications: Approaches to Addressing Food Insecurity and Obesity**

### **6.3.1 Strategies addressing food insecurity and obesity**

The rapid changes in diet, culture and lifestyle among Indigenous populations in Canada has been influenced by a range of factors including: greater engagement in a wage economy reducing both time and energy to engage in hunting and gathering practices (Sharma, 2010); the introduction of new food sources with a variety of imported goods (Sharma, 2010); as well as historical influences including colonial policies and practices that have facilitated the physical displacement of Indigenous peoples from their traditional territories, and assimilated Indigenous peoples through the enforcement of residential schools that sought to undermine Indigenous identity (Richmond & Ross, 2009). These key influences centred on historical, environmental, economic, and individual factors, have had an influence on the nutrition transition that has brought about changes in diet, culture and lifestyle, with implications for First Nations health and wellness (Figure 3.1, Chapter 3). Approaches to addressing food insecurity for Indigenous populations must therefore involve a consideration of a range of factors, as well as the social and cultural circumstances of food that are related to customs and traditions.

Research aimed at informing policy on approaches to addressing the prevalence of obesity and obesity-related chronic diseases have pointed to improving the quality of diet and promoting increased levels of physical activity (Haman et al., 2010; Sharma, 2010). Approaches to addressing food insecurity have mainly focused on food and food-related behaviours, with food charities, such as food banks, as the dominant response (Tarasuk, 2005). Such an approach has been identified to provide only short-term or temporary solutions to food insecurity. Additional responses to food insecurity for Indigenous populations in Canada have involved, hunter support subsidies and community-based education programs to enhance the development of healthy food preparation skills, nutrition knowledge and promote healthy food choices (Fergusson, 2011; Mead et al., 2010). Although such strategies are necessary, the approaches to addressing food insecurity as described above, offer only short and medium-term solutions (Council, 2014), and when implemented independently they present limitations in their scope to addressing the combined issues of food insecurity and obesity. Further, current approaches to addressing food insecurity, as described above, frame food insecurity as an issue in need of a food solution (Rudolph & McLachlan, 2013; Tarasuk, 2005), nevertheless while observing that it is an issue that is rooted in income inadequacy and poverty shaped by political, social and economic influences that limit access to and ownership of resources.

Current food subsidies in place have frequently been critiqued for providing temporary relief of food insecurity and do not directly address income inadequacy (Tarasuk, 2005). Strategies such as food banks, have accordingly been considered as an ineffective response to food insecurity, and have even been viewed as a potential factor exacerbating the problem of overweight and obesity in First Nations children (Bhawra et al., 2015). In addition, many of the educational programs have lacked government support, and programs such as Healthy Foods North, aimed at

encouraging healthier eating patterns, have been discontinued due to a lack of government funding (Fergusson, 2011). These programs are often developed as small-scale community initiatives and have not been established under a provincial or national food security strategy (Tarasuk, 2005). Further, although the skills gained from these programs are of high importance to enhance skills for healthy food preparation, the application of such skills is greatly dependent on the availability and accessibility of nutritious foods. Such health education programs do not always directly address the barriers to accessing food that are influenced by a number of social, political, environmental, historical and economic factors. More interventionist ways of creating alternative food distribution systems (e.g. Dwyer 2010) have received limited attention, but nevertheless offer an additional strategy and process for addressing a chronic challenge.

### **6.3.2 Indigenous food sovereignty**

In the context of Aboriginal populations and in particular, on-reserve First Nations communities, strategies for addressing both food insecurity and obesity must directly integrate First Nations knowledge and perspectives. This is particularly important in the development of multi-faceted approaches that are culturally appropriate in targeting income inadequacy and that promote physical activity, as well as healthier food environments within a holistic perspective of First Nations health and wellness. Approaches that enable community capacity, empowerment over resources, access to traditional land, and renewal of traditional knowledge, not only present opportunities for increasing access to traditional food sources, with implications for food security and nutritional health to address obesity, but also address holistic dimensions of First Nations health and wellness. Recognition of the cultural and social significance related to the role of food has been supported by the framework of food sovereignty.

In this study, food sovereignty was explored in a multilevel analysis of food insecurity, using the variable “community traditional food activity” as a proxy indicator of food sovereignty that was based on an aggregate of household level engagement with traditional food activity for each community. However, traditional food activity at the community level was not observed to present any statistically significant associations with food insecurity in the multi-level analysis. Given that community traditional food activity was based on a sample size of 58 communities, this could have limited the power of the multi-level model to reach statistical significance. Although community traditional food activity was not found to be a statistically significant predictor of food security, the principles underlying the framework of Indigenous food sovereignty can arguably still provide useful insights on culturally appropriate strategies to address food insecurity and associated health concerns, and have therefore been considered in this discussion.

Food sovereignty recognizes the power relations involved in the production and distribution of food and how they are determined within the dominant food system (Wittman, 2011; Wiebe & Wipf, 2011). At the core of food sovereignty, a framework for food system change, are goals aimed at strengthening communities and environmental sustainability in the production, distribution and consumption of food deemed as socially and culturally appropriate (Desmarais & Wittman, 2014). These goals are informed by strategies centred on transforming society as a whole through food and agriculture to address unequal power relations between foods providers and consumers and inequities in the distribution of resources (Demarais & Wittman, 2014).

Indigenous food sovereignty, however, encompasses important elements that are supported by food sovereignty, such as shifting the control of food systems to local and community-based

producers, but recognizes the importance of traditional knowledge, protection of land-use practices and decolonization (Rudolph & McLachlan, 2013; Patel, 2012; Grey & Patel, 2015; Wiebe & Wipf, 2011). An Indigenous food sovereignty framework encompasses and recognizes relations between health provided by traditional foods with the health of the land, as well as the historical influences that are rooted in colonial policies and practices that have undermined those relationships (PEPP, 2010; Rudolph & McLachlan, 2013). Within this framework, the interrelated issues of food insecurity and obesity can therefore be viewed as symptoms of colonial laws and practices that have undermined food sovereignty in Indigenous communities.

Industrial activities such as mining, forestry and agriculture that have extracted resources from Indigenous traditional territories and displaced traditional food systems, have played a role in the erosion of food sovereignty (Rudolph & McLachlan, 2013; Grey & Patel, 2015). Approaches to addressing food security, should therefore consider the principles of Indigenous food sovereignty centred on decolonization, as well as the protection of Aboriginal rights, land rights, traditional foods, culture and identity. As engagement with the principles of Indigenous food sovereignty are needed to develop culturally appropriate strategies that enable community capacity to engage with traditional food practices to achieve long-term food security, this has important implications for nutritional health and obtaining a healthier diet with important considerations for addressing obesity, a diet-related health concern associated with food insecurity found in the present study.

Many scholars have emphasized the need for government initiatives to tackle the issue of poverty by increasing income and social assistance funding for families in financial need (Willows, 2008; Tarasuk, 2005). However, approaches that involve a consideration of Aboriginal peoples' knowledge, values and practices to inform action and strategies aimed at reducing poverty, and

that also focus on the development of localized community-based food production are necessary to address the combined issues of food insecurity and obesity. A number of multi-level approaches with collaboration among First Nations communities, government health departments, academia, and community-based local organizations to develop culturally appropriate interventions, will likely be most effective in facilitating an equitable food system and addressing the interrelated issues of food insecurity and obesity.

## **6.4 Limitations of the Study**

While the FNFNES is designed to be regionally representative of First Nations communities in Canada, the cross-sectional study design limits the degree at which inferences can be made in regards to cause and effect. In addition, the use of secondary data creates limitations on the kind of questions that could be addressed from the variables available in the study. Variables such as household income in relation to Low Income Measure (LIM); marital status (couples, female lone parent, male lone parent); number of children in the household under the age of 18; family medical history; community remoteness; physical activity, and disordered eating patterns were not available from the data set. Additional measures of a household's economic circumstance would have provided further insight on the factors that contribute to vulnerability to food insecurity. Further, the results presented in this study were conducted based on an unweighted sample. Therefore, the prevalence rates of food insecurity and obesity presented, as well as associations observed are only representative of the 58 communities sampled from British Columbia, Manitoba, Ontario and Alberta, and cannot be generalized to other First Nations communities across Canada.

There is an on-going debate whether the criteria for overweight and obesity using BMI is appropriate for non-European populations. Although BMI is the most commonly used measure of excess body weight, cut-points have been developed and validated among individuals of European descent, and therefore classifications of BMI may not be applicable to non-European populations (Razak et al., 2007). Despite best efforts to use measured height and weight data, the use of self-reported height and weight raises concerns of social desirability/response bias. Studies have found self-reports of weight to be underestimated and even more so among individuals who are overweight and obese (Boström & Diderichsen, 1997).

The household food security survey module (HFSSM), used in the food security questionnaire of the FNFNES, also presented limitations in measuring food insecurity due to additional reasons aside from financial constraints. Although the HFSSM is a validated multi-item measure of food insecurity (Bickel et al., 2000), reasons such as food safety, disordered eating patterns, and the lack of socially and culturally appropriate foods available that may contribute to compromises in food security are not captured by the survey. Additional factors that may undermine household food security such as disability or illness are not measured in the survey. In addition, the HFSSM is also limited in its generalizability of individual's experiences of food insecurity in the household. The survey measures food insecurity at a household level, is therefore not necessarily reflective of a particular individual in the household, as food insecurity may not necessarily affect members of the household in the same way.

The variable 'household traditional food activity' used in the analysis of predictors of food insecurity and as a proxy (at a community scale) indicator of food sovereignty also presented several limitations. Household traditional food activity was captured in the social, health and



lifestyle (SHL) questionnaire used in household interviews (Appendix A, question 5 & 6), and was defined as anyone in the household who engaged in either of the following traditional food activities in the past year: hunt or set snares for food; fish; collect wild plant food; collect seafood; and/or plant a garden. Based on respondent's answers to questions five and six of the SHL questionnaire, household engagement with traditional food activities was dichotomized as yes or no. Household engagement with traditional food activity (as captured in the FNFNES), however, does not provide a measure of how frequent members of the household engaged in traditional food activities. That is, the measure used for household traditional food activity is insensitive to the intensity of traditional food activity taking place in a household. Further, the measure used for documenting household traditional food activity does not capture reasons for household engagement with traditional food activities that could be related to either food security or personal interests and hobbies.

Although the limitations of this construct was acknowledged, an effort was made to consider the implications of food sovereignty by examining household engagement with traditional food activity at a community level. This however, did not yield a significant association with food security, but was considered as the concept and framework of food sovereignty presents a potentially important discourse to exploring how the issues of food insecurity and obesity, as presented in the current study, can be addressed. Analyses using household traditional food activity should nevertheless be interpreted carefully, recognizing the limitations with how this variable was constructed, as the development of a survey instrument to better capture traditional food activity and food sovereignty are still needed. A survey tool that incorporates questions that consider access to traditional land, how traditional food is obtained (members in the household, community freezer, food sharing program), and how often households engage with traditional

food acquisition activities would provide a better understanding of traditional food activity. Further, when results from the FNFNES are reported back to participating communities, community leaders and investigators of the FNFNES can facilitate a discussion on strategies that community members deem necessary and culturally appropriate to address the issues raised from the results of the FNFNES.

A regional comparative analysis of food insecurity and obesity was not conducted in the present study, however, this would have been informative in examining and explaining the variation in the prevalence of food insecurity by province, as well as the relationship between food insecurity and obesity. As the present study only conducted analyses for communities in British Columbia, Manitoba, Ontario, and Alberta as a whole, data soon to be collected from the other regions of Canada in the upcoming years of the FNFNES project timeline (2008-2018) will present opportunities for regional comparisons on the prevalence and distribution of food insecurity and associations with obesity across Canada, which can be conducted on a much larger sample size.

In addition to the quantitative methods employed in this study, qualitative work is needed to better understand the conditions underlying food insecurity and obesity, as well as to develop culturally appropriate approaches to addressing food-health related concerns. Qualitative research in Indigenous communities using methods such as interviews (e.g. Skinner et al., 2013), focus groups (e.g. Chan et al., 2006; Bhawra et al., 2015) or the Story/Dialogue method (e.g. Elliot et al., 2012) that can better capture Indigenous peoples experiences and perspectives, can provide further insights on constructs difficult to measure in surveys such as household and community traditional food acquisition practices and Indigenous food sovereignty from the knowledge of First Nations people. Further, qualitative studies assessing the effectiveness of

community-based food and nutrition interventions from the perceptions of First Nations communities are needed to effectively evaluate their impact. In this regard, a focus on successful outliers could be especially informative to suggest relationships that merit further attention and policy consideration.

## **Chapter 7: Conclusion**

### **7.1 Summary**

The overarching objective of the present study was to provide a comprehensive understanding of the factors and processes underlying the interrelated issues of food insecurity and obesity, as well as to facilitate a discussion on the importance of strategies that enable Indigenous food sovereignty as a means to protecting traditional food practices and addressing inequities in health and nutrition. This main objective was approached in the present study by answering a number of primary research questions using quantitative methods applied within a holistic framework of First Nations health and wellness.

The first research question this study sought to address was the factors and processes affecting the availability and accessibility of traditional and market-based foods for First Nations communities. This question was addressed using multivariate logistic regression to examine the strongest predictors of food insecurity. This question was also addressed through an examination of the barriers identified by respondents that prevented their household from using more traditional foods. Socio-demographic characteristics significantly associated with food insecurity included age, sex, region, main source of income, years of education, presence or absence of children in the household, type of road access into a community and household traditional food activity. This constellation of circumstances suggests that the processes whereby First Nations communities are coping with food insecurity call for more than tinkering with existing relationships. Specific barriers to using more traditional foods as identified by participants included: the lack of hunting equipment and transportation; the lack of a hunter in the family or help to hunt; a lack of time; limited availability; loss of traditional knowledge; government

policies and regulations; and climate change. As food insecurity is as prevalent as this study confirms, development of new approaches to addressing both market and traditional foods is clearly still needed.

The second question this thesis sought to address was the relationship between household food insecurity and obesity. This question was also examined using multivariate logistic regression to examine the odds of obesity among individuals living in food insecure households, while adjusting for confounding effects of age, sex, main source of income, years of education and region. Gender-specific analyses were conducted to account for the larger number of female respondents in the sample. In this analysis, a significant non-linear association was found between household food insecurity and obesity. Marginally food insecure households had significantly higher odds of obesity compared to food secure households for both female and male respondents. In addition, respondents living in severe food insecure households had significantly lower odds of obesity compared with food secure households. This association was also found among male respondents only, but not female respondents when gender-specific analyses were conducted. As the high prevalence of obesity (and its association with diabetes, a disease of great concern which has not been addressed in this study) prompts further attention on its association with food insecurity, this study indicates that policy measures that just increase access to existing food options among more food insecure populations could actually aggravate obesity, which is observed to be higher among “marginally” food insecure populations. Attention then must be given to the quality of food that is to be made more accessible.

The last question addressed in this study, was exploratory, and sought to operationalize the framework of Indigenous food sovereignty to provide insights on how food security, nutrition

and health can be achieved for First Nations living on-reserve. This question was examined in a multi-level analysis of individual, household and community level predictors of food insecurity. Specifically, household traditional food activity and community traditional food activity were examined as proxies of food sovereignty. However, community traditional food activity as a predictor of food security did not reach statistical significance in the multi-level analysis of food insecurity. Despite the lack of association found, the principles underlying the framework of Indigenous food sovereignty provided an insightful discussion on strategies for addressing food insecurity and obesity – but point to a need for developing more precise indicators that can serve as the basis for empirical studies that can contribute to a deepening of knowledge in this area. Nevertheless, the framework of Indigenous food sovereignty facilitated a meaningful discussion that emphasized the need for current interventions to consider the principles of Indigenous food sovereignty that are centred on decolonization, the protection of Indigenous harvesting and land rights, and renewal of traditional knowledge. In this regard, attention to processes for improving quality of food with particular attention to its cultural appropriateness can provide an area worthy of attention with relationship to the concept of food sovereignty in First Nations on reserve communities.

In this thesis research, it was hypothesized that a broad range of factors and processes of which include, environmental, social, economic, and political influences, have shaped the high prevalence of food insecurity and associations with obesity in First Nations living on-reserve (Figure 3.2, Chapter 3). Although not directly tested for, studies examining the underlying factors of such issues, have identified various systemic drivers that have an influence over the distribution of health determinants including the impact of colonization, the establishment of residential schools, poverty and environmental dispossession. Such systemic drivers relate to

processes that can undermine Indigenous food sovereignty and social determinants that affect access to traditional and market foods. The results from this studies sample of First Nations households indicate that food insecurity remains a challenge and that extensive barriers remain that prevent First Nations households from using more traditional foods.

Further, this study revealed that food insecurity significantly varied by socio-demographic characteristics, region and by household composition. Specifically, food insecurity was highest for female respondents, households with children, households reliant on social assistance as a main source of income, households reliant on Employment Insurance or Worker's Compensation as a main source of income, those with lower education, young to middle age groups, and respondents residing in Alberta and British Columbia. It was also found that communities that did not have all-year round road access and households engaged with traditional food activities had higher odds of food insecurity. The relationship found between food insecurity and household traditional food activity supported the idea of, the nutrition transition, that has been observed for Indigenous populations in Canada and globally. The results from the present study, therefore, indicate that obesity is a diet-related health concern associated with First Nations living in food insecure households, contributing to the growing body of literature on health concerns associated with food insecurity and the nutrition transition.

## **7.2 Implications of Findings and Recommendations**

As one of the first studies to examine the relationship between food insecurity and obesity in First Nations households on-reserve in Canada (south of the 60<sup>th</sup> parallel), utilizing a nation-wide cross-sectional dataset, this study contributes to the scholarship on the determinants of food insecurity specific to First Nations on-reserve, as well as the evolving body of literature on food

insecurity and the obesity-paradox. The results of this study support findings from the literature that have revealed the inequitable prevalence of both food insecurity and obesity experienced by Indigenous populations. The historical circumstances of colonial laws and practices that have shaped the unequal distribution of health determinants through environmental dispossession, cultural assimilation and the exploitation of natural resources from traditional territories, highlight such food and diet-related health concerns as health inequities experienced by First Nations peoples on-reserve. Thus, the on-going challenges of food insecurity and the diet-related health concerns of obesity in First Nations on-reserve communities, highlight key areas for policy-makers to engage with the principles of Indigenous food sovereignty.

Indigenous food sovereignty provides a restorative framework (Morrison, 2011) to addressing the underlying factors and processes to achieve long-term food security for Indigenous communities in Canada and globally, while promoting Indigenous knowledge, values and practices essential for maintaining sacred relationships to the land and improving Indigenous health. Prioritizing the cultural values of Indigenous peoples related to traditional foods, and recognizing the importance of protecting Indigenous peoples' land and harvesting rights over commercialized harvesting and intensive resource extraction industries, represent key elements that should be considered by various policy sectors. The development of socially and culturally appropriate strategies that promote community-based food production, as supported by the framework of Indigenous food sovereignty, present opportunities to enable community capacity and empower First Nations peoples' ownership and control over resources and traditional land, while also promoting healthier eating patterns and contributing to food security.

Current interventions in place to address food insecurity must not only place an emphasis on supply (e.g. food banks) or nutrition education programs and food subsidies. Such approaches



have been critiqued for only providing short and medium term solutions that fail to address food insecurity as an issue rooted in income inadequacy and poverty. Rather, the implementation of strategies that focus on addressing issues of poverty and that enable community-based food production, not only offer long-term solutions to food insecurity, but may also facilitate healthier eating practices by enabling localized harvesting practices of traditional nutritious foods with implications for addressing obesity. Strategies that promote greater engagement with traditional food practices not only offer opportunities to improve diet quality, but also increased physical activity associated with traditional food acquisition activities such as the hunting and gathering of traditional foods. Such strategies present important considerations for improvements in diet and healthier eating patterns, and also address important elements of First Nations holistic perspective of health. Finally, the recommendations outlined in this thesis must directly incorporate First Nations peoples' knowledge and perspectives in order to consider culturally appropriate methods to tackle such issues as presented in this study.

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## Appendix A: Social, Health and Lifestyle Questionnaire

Participant ID: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

### IV. SOCIAL, HEALTH AND LIFESTYLE QUESTIONNAIRE

This questionnaire is short and addresses questions about your household and the role and use of traditional food in your household. Remember, traditional food is food that is coming from the local land and environment, such as fish, birds, land animals and plants. Can I start with the first question?

1. How many persons, including yourself, live in your household now? (i.e., this month)  
Include children and adults, but not visitors. To live in your household, this means that they have meals and sleep there at least 3 nights per week.
  - a. How many are less than 15 yrs of age \_\_\_\_\_
  - b. How many are between 15 and 65 \_\_\_\_\_
  - c. How many are over 65 \_\_\_\_\_
  
2. How many persons, including yourself, living in your household are either self-employed or an employee now? (i.e., this month)
  - a. Full-time ( $\geq 35$  hours/week) \_\_\_\_\_
  - b. Part-time ( $< 35$  hours/week) \_\_\_\_\_
  
3. What is your main source of income? (*circle one*)
  - a. Wages/salary/self-employment
  - b. Pension/seniors benefits
  - c. Social assistance
  - d. Worker's compensation/employment insurance
  - e. Other, please specify \_\_\_\_\_
  
- 4a. How many years of school have you completed? Please don't count partial years, kindergarten or grades repeated \_\_\_\_\_ years
  
- 4b. Have you obtained the following diplomas, certificates, or degrees?:
  - a. High school diploma YES ☐ NO ☐
  - b. GED (high school equivalency) YES ☐ NO ☐ Not applicable ☐
  - c. Vocational training certificate YES ☐ NO ☐
  - d. College diploma YES ☐ NO ☐
  - e. Bachelor's degree YES ☐ NO ☐
  - f. Master's degree YES ☐ NO ☐
  - g. Doctorate degree YES ☐ NO ☐

Participant ID: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

5. During the past year, did you personally:

- a. Hunt or set snares for food? YES ☐ NO ☐
- b. Fish? YES ☐ NO ☐
- c. Collect wild plant food? YES ☐ NO ☐
- d. Collect seafood? YES ☐ NO ☐
- e. Plant a garden? YES ☐ NO ☐

6. During the past year, did anyone else in your household:

- a. Hunt or set snares for food? YES ☐ NO ☐
- b. Fish? YES ☐ NO ☐
- c. Collect wild plant food? YES ☐ NO ☐
- d. Collect seafood? YES ☐ NO ☐
- e. Plant a garden? YES ☐ NO ☐
- ☐ NOT APPLICABLE (participant lives alone)

7. a) What do you think are the most important benefits of traditional food? Please state as many as you wish.

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b) What do you think are the most important benefits of market food? Please state as many as you wish.

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8a. Would your household like to have more traditional food?

YES ☐ NO ☐ (if NO, go to Q. 8c)

8b. Can you tell me what prevents your household from using more traditional food?

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Participant ID: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

8c. Some families might say, "**We worried whether our traditional food would run out before we could get more.**" In the last 12 months, did that happen often, sometimes, or never for your household?

- a. Often ☐
- b. Sometimes ☐
- c. Never ☐
- d. Don't know or refused ☐

8d. Some families might say, "**The traditional food that we got just didn't last, and we couldn't get any more.**" In the last 12 months, did that happen often, sometimes, or never for your household?

- a. Often ☐
- b. Sometimes ☐
- c. Never ☐
- d. Don't know or refused ☐

9a. Have you noticed any significant climate change in your traditional territory in the last 10 years?

YES ☐ NO ☐ DON'T KNOW ☐ (if NO or DON'T KNOW, go to Q. 10)

9b. Can you tell me one way how this has affected traditional food availability in your household?

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10. Do any of the following affect (or limit) where you can hunt, fish or collect berries?

- |                               |                              |                             |                                      |
|-------------------------------|------------------------------|-----------------------------|--------------------------------------|
| a. Mining                     | YES <input type="checkbox"/> | NO <input type="checkbox"/> | DO NOT KNOW <input type="checkbox"/> |
| b. Forestry                   | YES <input type="checkbox"/> | NO <input type="checkbox"/> | DO NOT KNOW <input type="checkbox"/> |
| c. Oil and gas                | YES <input type="checkbox"/> | NO <input type="checkbox"/> | DO NOT KNOW <input type="checkbox"/> |
| d. Hydro                      | YES <input type="checkbox"/> | NO <input type="checkbox"/> | DO NOT KNOW <input type="checkbox"/> |
| e. Farming                    | YES <input type="checkbox"/> | NO <input type="checkbox"/> | DO NOT KNOW <input type="checkbox"/> |
| f. Sports Outfitters/Lodges   | YES <input type="checkbox"/> | NO <input type="checkbox"/> | DO NOT KNOW <input type="checkbox"/> |
| g. Recreation boaters/fishers | YES <input type="checkbox"/> | NO <input type="checkbox"/> | DO NOT KNOW <input type="checkbox"/> |
| h. Snowmobiles/ATV's          | YES <input type="checkbox"/> | NO <input type="checkbox"/> | DO NOT KNOW <input type="checkbox"/> |
| i. Roadways                   | YES <input type="checkbox"/> | NO <input type="checkbox"/> | DO NOT KNOW <input type="checkbox"/> |
| j. Government restrictions    | YES <input type="checkbox"/> | NO <input type="checkbox"/> | DO NOT KNOW <input type="checkbox"/> |
| k. Other                      | YES <input type="checkbox"/> | NO <input type="checkbox"/> | DO NOT KNOW <input type="checkbox"/> |

if yes, please specify: \_\_\_\_\_



Participant ID: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

11. In general, compared to other people of your age, would you say your health is:

- a. Excellent
- b. Very good
- c. Good
- d. Fair
- e. Poor

12. Which of the following statements best describes your activities for most days when you are in the community?

- a. I am usually sitting and do not walk around very much.
- b. I stand or walk around quite a lot, but I do not have to carry or lift things very often.
- c. I usually lift or carry light loads or I have to climb stairs or walk up hills often.
- d. I do heavy work or carry heavy loads.

13. In general, compared to other people of your age, are you physically:

- a. More active
- b. Less active
- c. About average
- d. Don't know

14a. Did you smoke cigarettes yesterday? YES ☐ NO ☐

14b. **[IF YES ABOVE, ASK]** How many? \_\_\_\_\_

15. Have you ever been told by a health care provider that you have:

- a. diabetes YES ☐ NO ☐
- b. If yes to 15a, how long ago were you diagnosed? \_\_\_\_\_ # years  
\_\_\_\_\_ don't know
- c. If yes to 15a, circle type if known: Type 1    Type 2    Unknown

## Appendix B: Food Security Questionnaire

Participant ID: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

### V. FOOD SECURITY QUESTIONNAIRE

Food security has been defined as: “.... when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (World Food Summit, 1996).

This last section asks questions about being able to afford food for your household. Some of the questions are very personal and may be difficult for you to answer. Like the rest of the questionnaire, this information is strictly confidential and no names will be released to the community or government.

I'm going to read several statements that may be used to describe the food situation of a household.

Please tell me if the statement was true **often, sometimes or never** for your household in the last 12 months. **[INTERVIEWER, CHECK ONE BOX ONLY]**

Were the following statements <u>often</u> true, <u>sometimes</u> true or <u>never</u> true in the last 12 months:	Often true	Sometimes true	Never true	Don't know or refused
<b>Q1.</b> You and other household (HH) members couldn't afford to eat balanced meals.				
<b>Q2.</b> You and other HH members worried food would run out before you got money to buy more				
<b>Q3.</b> Food that you and other HH members bought didn't last and there wasn't any money to get more				

**Q3b.** Are there children living in the house who are under 18 years of age?

Yes ☐ If 'Yes', GO TO Q4 AND Q5

No ☐ 1) If ANY of Q1, Q2 OR Q3 WAS ANSWERED “often or sometimes” GO TO Q7

2) IF ALL of Q1, Q2 and Q3 WERE ANSWERED “never true” GO TO ADDITIONAL COMMENTS, PAGE 31

Participant ID: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

<b>IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK QUESTIONS 4 and 5</b>				
Were the following statements <u>often</u> true, <u>sometimes</u> true or <u>never</u> true in the last 12 months:	Often true	Sometimes true	Never true	<i>Don't know or refused</i>
<b>Q4.</b> You or other adults in your HH relied on less expensive foods to feed the children because you were running out of money to buy food				
<b>Q5.</b> You or other adults in your HH couldn't afford to feed children a balanced meal				



**IF PARTICIPANT ANSWERS "OFTEN" OR "SOMETIMES" TO ANY ONE OF QUESTIONS 1 TO 5, THEN CONTINUE TO Question 6; OTHERWISE, GO TO ADDITIONAL COMMENTS, PAGE 31**

Was the following statement <u>often</u> true, <u>sometimes</u> true or <u>never</u> true in the last 12 months:	Often true	Sometimes true	Never true	<i>Don't know or refused</i>
<b>Q6.</b> Children were not eating enough because you and other adults in your HH just couldn't afford enough food				


Participant ID: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

STAGE 2 QUESTIONS	Yes	No	Don't know or refused
<b>Q7.</b> Since October last year, did you or other adults in your HH ever cut the size of your meals or skipped meals because there wasn't enough money for food?			
<b>IF Yes to Question 7, go to Question 8</b>  <b>IF No, go to Question 9</b>			
<b>Q8.</b> How often did this happen... almost every month, some months but not every month, or in only 1 or 2 months? a. Almost every month <input type="checkbox"/> b. Some months but not every month <input type="checkbox"/> c. Only 1 or 2 months <input type="checkbox"/> d. Don't know or refused <input type="checkbox"/>			
Question	Yes	No	Don't know or refused
<b>Q9.</b> In the last 12 months, did <u>you</u> ever eat less than you felt you should because there wasn't enough money to buy food?			
<b>Q10.</b> In the last 12 months, were <u>you</u> ever hungry but did not eat because you couldn't afford enough food?			
<b>Q11.</b> In the last 12 months, did <u>you</u> lose weight because you didn't have enough money for food?			



**IF PARTICIPANT ANSWERED “Often” or “Sometimes” to Question 6, or “YES” TO ANY ONE OF QUESTIONS 7 TO 11, THEN CONTINUE TO Question 12; OTHERWISE, GO TO ADDITIONAL COMMENTS, PAGE 31**

Participant ID: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

STAGE 3 QUESTIONS	Yes	No	Don't know or refused
<b>Q12.</b> In the last 12 months, did you or other adults in your HH ever not eat for a whole day because there wasn't enough money for food?			
<b>IF Yes to Question 12, go to Question 13</b> <b>IF No and have children in the HH &lt;18, go to Question 14</b> <b>IF No and don't have children, go to Additional Comments, Page 31</b>			
<b>Q13.</b> How often did this happen... almost every month, some months but not every month, or in only 1 or 2 months? a. Almost every month <input type="checkbox"/> b. Some months but not every month <input type="checkbox"/> c. Only 1 or 2 months <input type="checkbox"/> d. Don't know or refused <input type="checkbox"/>			
 <b>IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK QUESTIONS 14 to 17; OTHERWISE, GO TO ADDITIONAL COMMENTS, PAGE 31</b>			
Question	Yes	No	Don't know or refused
<b>Q14.</b> In the last 12 months, did you or other adults in your HH ever cut the size of any of the children's meals because there wasn't enough money for food?			
<b>Q15.</b> In the last 12 months, did any of the children ever skip meals because there wasn't enough money for food?			
<b>IF Yes to Question 15, go to Question 16</b> <b>IF No go to Question 17</b>			
<b>Q16.</b> How often did this happen... almost every month, some months but not every month, or in only 1 or 2 months? a. Almost every month <input type="checkbox"/> b. Some months but not every month <input type="checkbox"/> c. Only 1 or 2 months <input type="checkbox"/> d. Don't know or refused <input type="checkbox"/>			
Question	Yes	No	Don't know or refused
<b>Q17.</b> In the last 12 months, were the children ever hungry but you just couldn't afford more food?			
<b>Q18.</b> In the last 12 months, did any your children ever not eat for a whole day because there wasn't enough money for food?			

## Appendix C: Multivariate Logistic Regression Analysis of Obesity

Table C.1 Multivariate Logistic Regression Analysis of Obesity (n=3126)

Predictor	Adjusted Odds Ratio	95% Wald Confidence Limits		P-value
Household Food Security Status				
Food Secure	Ref	-		
Marginally Food insecure	1.53	1.19	1.97	0.001
Moderately Food insecure	0.97	0.82	1.15	0.727
Severely Food insecure	0.74	0.56	0.97	0.030
Sex				
Male	Ref	-		
Female	1.32	1.13	1.53	<0.001
Age group				
71+	Ref	-		
19-30	1.12	0.72	1.74	0.041
31-50	1.59	1.05	2.41	0.031
51-70	1.87	1.27	2.74	<0.001
Region				
Manitoba	Ref	-		
Alberta	0.82	0.64	1.05	0.104
British Columbia	0.71	0.57	0.89	0.003
Ontario	1.00	0.98	1.03	0.574
Income Source				
Wages	Ref	-		
Workers compensation/ employment insurance	0.77	0.57	1.05	0.104
Social Assistance	0.83	0.69	1.0	0.054
Pension	1.06	0.8	1.42	0.676
Other	0.76	0.49	1.2	0.238
Years Education	1.00	0.98	1.03	0.803

**Table C.2 Females only: Multivariate Logistic Regression Analysis of Obesity (n=1905)**

Predictor	Adjusted Odds Ratio	95% Wald Confidence Limits		P-value
Household Food Security Status				
Food Secure	Ref	-		
Marginally Food insecure	1.57	1.15	2.15	0.005
Moderately Food insecure	1.12	0.9	1.39	0.330
Severely Food insecure	0.89	0.63	1.27	0.522
Age group				
71+	Ref	-		
19-30	1.26	0.72	2.21	0.425
31-50	1.83	1.08	3.12	0.026
51-70	2.18	1.34	3.552	0.002
Region				
Manitoba	Ref	-		
Alberta	0.77	0.57	1.05	0.097
British Columbia	0.69	0.52	0.92	0.010
Ontario	0.97	0.74	1.26	0.795
Income Source				
Wages	Ref	-		
Workers compensation/ employment insurance	0.8	0.53	1.21	0.291
Social Assistance	0.82	0.64	1.04	0.104
Pension	1.14	0.78	1.65	0.510
Other	0.7	0.4	1.2	0.195
Years Education	1.00	0.97	1.03	0.784

**Table C.3 Males only: Multivariate Logistic Regression Analysis of Obesity (n=1221)**

Predictor	Adjusted Odds Ratio	95% Wald Confidence Limits		P-value
Household Food Security Status				
Food Secure	Ref	-		
Marginally Food insecure	1.57	1.01	2.43	0.044
Moderately Food insecure	0.77	0.58	1.03	0.073
Severely Food insecure	0.56	0.36	0.87	0.011
Age group				
71+	Ref	-		
19-30	0.9	0.43	1.85	0.769
31-50	1.21	0.61	2.39	0.586
51-70	1.43	0.77	2.67	0.263
Region				
Manitoba	Ref	-		
Alberta	0.92	0.61	1.39	0.688
British Columbia	0.75	0.52	1.1	0.141
Ontario	1.27	0.89	1.83	0.192
Income Source				
Wages	Ref	-		
Workers compensation/ employment insurance	0.74	0.46	1.2	0.227
Social Assistance	0.86	0.64	1.16	0.312
Pension	0.98	0.62	1.55	0.936
Other	0.96	0.44	2.1	0.909
Years Education	1.02	0.98	1.07	0.304



## Appendix D: Food Insecurity as a Potential Mediator

**Table D.1 Multinomial Logistic Regression Analysis of  
Food Insecurity and Income Source (n=3126)**

Predictor	Food Insecurity	Odds Ratio	95% Wald Confidence Limits		P-value
Income Source					
Wages		Ref	-		
Workers compensation/ employment insurance	Marginal	0.91	0.54	1.54	0.726
Workers compensation/ employment insurance	Moderate	1.15	0.79	1.66	0.465
Workers compensation/ employment insurance	Severe	2.55	1.52	4.25	<0.001
Social Assistance	Marginal	1.07	0.78	1.48	0.684
Social Assistance	Moderate	3.09	2.53	3.77	<0.001
Social Assistance	Severe	6.19	4.57	8.37	<0.001
Pension	Marginal	0.6	0.4	0.89	0.012
Pension	Moderate	0.88	0.68	1.15	0.341
Pension	Severe	0.9	0.55	1.49	0.684
Other	Marginal	0.66	0.28	1.57	0.052
Other	Moderate	1.17	0.69	1.98	0.556
Other	Severe	3.04	1.55	5.95	0.001

**Table D.2 Simple Logistic Regression Analysis of Obesity and Food Insecurity (n=3126)**

Predictor	Odds Ratio	95% Wald Confidence Limits		P-value
Household Food Security Status				
Food Secure	Ref	-		
Marginally Food insecure	1.5	1.17	1.92	0.002
Moderately Food insecure	0.91	0.77	1.07	0.261
Severely Food insecure	0.68	0.52	0.88	0.003

**Table D.3 Simple Logistic Regression Analysis of Obesity and Income Source (n=3126)**

Predictor	Odds Ratio	95% Wald Confidence Limits		P-value
Income Source				
Wages	Ref	-		
Workers compensation/ employment insurance	0.78	0.58	1.06	0.115
Social Assistance	0.74	0.62	0.87	<0.001
Pension	0.98	0.79	1.22	0.873
Other	0.68	0.44	1.05	0.083

**Table D.4 Logistic Regression Analysis of Obesity and Income adjusting for Food Insecurity (n=3126)**

Predictor	Adjusted Odds Ratio	95% Wald Confidence Limits		P-value
Income				
Wages	Ref	-		
Workers compensation/ employment insurance	0.8	0.59	1.09	0.162
Social Assistance	0.78	0.66	0.94	0.007
Pension	1.00	0.81	1.24	0.985
Other	0.71	0.45	1.1	0.124
Household Food Security Status				
Food Secure	Ref	-		
Marginally Food insecure	1.5	1.17	1.93	0.001
Moderately Food insecure	0.96	0.81	1.13	0.602
Severely Food insecure	0.74	0.57	0.97	0.027

## Appendix E: Multi-level Analyses

Table E.1 Multi-level Regression Analysis of food insecurity (n=3565)

Predictor	Adjusted Odds Ratio	95% Wald Confidence Limits		P-value
Sex				
Male	Ref	-		
Female	1.38	1.17	1.62	<0.001
Age group				
71+	Ref	-		
19-30	2.39	1.49	3.83	<0.001
31-50	2.48	1.58	3.89	<0.001
51-70	1.71	1.14	2.58	0.008
Region				
Manitoba	Ref	-		
Alberta	1.48	0.78	2.82	0.236
British Columbia	1.19	0.62	2.31	0.621
Ontario	0.92	0.48	1.78	0.841
Income				
Wages	Ref	-		
Workers compensation/ employment insurance	1.49	1.09	2.05	0.013
Social Assistance	3.48	2.86	4.25	<0.001
Pension	1.53	1.12	2.08	0.007
Other	1.12	0.71	1.78	0.623
Years Education	0.96	0.93	0.98	0.002

<b>Presence of children in the household</b>				
No	Ref		-	
Yes	1.54	1.29	1.82	<0.001
<b>Type of access into a community</b>				
Year round road access	Ref		-	
Fly in	1.61	0.78	3.35	0.213
Winter road only	2.63	1.32	5.23	0.007
<b>Household traditional food activity</b>				
No	Ref		-	
Yes	1.318	1.098	1.582	0.004
<b>Community Traditional food activity</b>	1.002	1.013	1.016	0.819

**Table E.2 Covariance Parameter Estimates**

<b>Covariance Parameter</b>	<b>Subject</b>	<b>Estimate</b>	<b>P-value</b>
Intercept	Community	0.42	<0.001
Household Traditional Food Activity	Community	0.01	0.389