Prevalence and correlates of food insecurity in Inuit communities

Catherine Huet

School of Dietetics and Human Nutrition, McGill University, Montreal

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ABSTRACT

Limited information is available on food security prevalence in Inuit populations. The majority of research is limited to a small number of communities. Under the International Polar Year, a cross-sectional Inuit Health Survey was conducted which included 2595 adults from 36 Inuit communities. Information on community, household, individual and dietary characteristics was collected throughout interviews and clinical assessments. Food security status of households and adults was measured using the USDA food security survey module. Overall, 33.6% of households were moderately food insecure and 29.1% were severely food insecure. Household crowding, low education and income, Healthy Eating Index scores ($P \leq 0.001$) and other dietary characteristics were associated with increased risk of food insecurity.

RÉSUMÉ

Peu d'informations sont disponibles sur la prévalence de la sécurité alimentaire chez la population inuite. Limitées à quelques communautés inuites, aucune étude ne rapporte la prévalence pour l'ensemble du Nord canadien. Durant l'Année Polaire Internationale, l'enquête transversale *Inuit Health Survey* a été réalisée dans 36 communautés inuites (2595 participants). Des informations sur les caractéristiques communautaires, domestiques, individuelles et alimentaires ont été recueillies au moyen d'entrevues et de mesures cliniques. Le niveau de sécurité alimentaire des ménages et des adultes a été mesuré avec le questionnaire sur la sécurité alimentaire provenant du *United States Department of Agriculture*. Chez les ménages, 33,6% vivaient en insécurité alimentaire modérée et 29,1% en insécurité alimentaire sévère. La surpopulation des ménages, le niveau de scolarité, le revenu, le score du *Healthy Eating Index* ($P \leq 0.001$) ainsi que d'autres caractéristiques alimentaires ont été associées à l'augmentation du risque d'insécurité alimentaire.

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CONTRIBUTION OF AUTHORS

The author was considerably implicated in research team training, data collection, data entry, cleaning, analysis and interpretation of results as well as thesis and manuscript writing. Dr Grace Egeland planned and guided the research methods and statistical analyses and reviewed and gave feedback on the thesis and manuscript. Ms Renata Rosol participated in data collection, helped in cleaning, analysing and interpreting results (she previously looked at Nunavut) and reviewed the manuscript.

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LIST OF ABBREVIATIONS

95 % CI	95% confidence interval
BMI	Body mass index
BMR	Basal metabolic rate
CCGS	Canadian Coast Guard Ship
CCHS	Canadian Community Health Survey
CFG	Canadian Food Guide
CINE	Centre for Indigenous Peoples' Nutrition and Environment
CNF	Canadian Nutrient File
DRI	Dietary reference intake
EI	Energy intake
FAO	Food and Agriculture Organization
FFQ	Food frequency questionnaire
FI	Food insecurity
FS	Food security
HEI	Healthy Eating Index
IHS	Inuit Health Survey
INAC	Indian and Northern Affairs Canada
IPY	International Polar Year
ISR	Inuvialuit Settlement Region
NAHO	National Aboriginal Health Organization
NL	Newfoundland and Labrador
NLCYS	National Longitudinal Children and Youth Survey
NPHS	National Population Health Survey
NU	Nunavut
RR	Rate ratio
SD	Standard deviation
SES	Socio-economic status
USA	United States of America
USDA	United States Department of Agriculture

WHO	World Health Organization

1. STUDY BACKGROUND

Aboriginal and non-Aboriginal populations in Canada live in distinct and contrasting situations. Indeed, beyond cultural and dietary differences, economic aspects such as lower earnings also contribute to the gap between Aboriginal and non-Aboriginal Canadians (Pendakur & Pendakur, 1998). From the Canadian 2006 census, the Canadian population (31,241,030 individuals) encompassed 1,172,790 Aboriginal people which included 50,480 Inuit (Statistics Canada, January 2008). Fifty-two percent of Aboriginal and 66% of Inuit did not complete high school compared to 33% of all Canadians. Nineteen percent of Aboriginal and 22% of Inuit were unemployed compared to 7% of all Canadians (Health Council of Canada, January 2005a; National Aboriginal Health Organization (NAHO)). Based upon the 2001 Aboriginal Peoples survey, 53% of Inuit lived in an overcrowded household. Inuit are younger (39.7 ± 0.3 years) than the general Canadian population (47.2 ± 0.1 years; $P < 0.05$) and have a lower income (where 27.1% of Inuit have an income less than 10,000 CAD compared to 12.4% for the general Canadian population) (Garner et al., 2010). Health disparities are noted between Aboriginal and non-Aboriginal peoples in Canada based upon diverse studies of varying methodology (Health Council of Canada, January 2005b). Indeed, "in 2000/01, 23.1% of Aboriginal people living off reserve rated their health as either fair or poor, a level 1.9 times higher than for the non-Aboriginal population" (Tjepkema, 2002).

During the International Polar Year (IPY), the Inuit Health Survey (IHS) "*Qanuqitpit? Qanuippitali? Kanuivit? How about us, how are we?*" was launched to provide a comprehensive and uniform assessment of health status, socioeconomic indicators, dietary habits and food security status. IHS is a cross-sectional study which took place in late summer and fall 2007 and 2008 aboard the Canadian Coast Guard Ship (CCGS) *Amundsen*. The research team on board the *Amundsen* travelled to all coastal communities of Inuvialuit Settlement Region (ISR), Nunavut and Nunatsiavut (Table 5 and Figure 2). Men and women aged

18 and older were eligible to participate. The study provides a portrait of northern living conditions that can be used as a basis to develop public health interventions. The project *Prevalence and correlates of food insecurity in Inuit communities* is one component of the IHS.

2. LITERATURE REVIEW

2.1 Food security

2.1.1 Definition

While described in the *Universal Declaration of Human Rights* in 1948, the definition of food security has dramatically evolved since the 1970s (Frankenberger & McCaston, 1998; Power, 2007; World Health Organization (WHO), 2008). In the mid-1980s, it was observed that even though food was available at the national level, it did not necessarily mean that it was accessible at the individual and household levels. Therefore, the "inaccessible, even though available, food" text was added to the food insecurity definition since household access to food depends upon different socio-economic factors. Indeed, in 1974, it was understood that famines were a result of a decrease in food availability. However, as Sen explains a few years later, "starvation is a matter of some people not *having* enough food to eat, and not a matter of there *being* not enough food to eat" (Sen, August 1981), adding to the link between accessibility and availability of food. Subsequently, availability and sustainable accessibility of foods were emphasized for the national, regional and local levels. Further, as food security is among different competing objectives of poor households, going hungry may represent a strategy enabling preservation of household possessions and resources that can provide future incomes and assist in the long-term alleviation of hunger (Frankenberger & McCaston, 1998).

Food security, which is influenced by multiple factors (Bergeron, October 2002), has various definitions but all definitions include components of availability, acceptability and accessibility of foods (Bergeron, October 2002; Food and Agriculture Organization (FAO), 1996; Ford, 2009; Ford & Berrang-Ford, 2009; Goldhar et al., 2010; Guyot et al., 2006; Lambden et al., 2007; Lambden et al., 2006; Power, 2007, 2008). In general, these terms are described as follows: *food availability* implies "the overall ability of the food system to meet

demand" (Ford & Berrang-Ford, 2009); *food acceptability* encompasses both preferences and cultural acceptance; and *food access* involves "the economic ability to purchase foods in the food system" (Power, 2008). In addition to the economic component of *food access*, food sharing networks are also important parts of *food access,* such as in Inuit culture (Sen, August 1981). Some authors also mention *food adequacy*, i.e. "nutritional quality, safety and sustainability of available resources and methods of food supply" (Myers et al., 2004), and *food utilization*, i.e. occurs when there is "appropriate biophysical conditions (i.e., good health) required to adequately utilize food to meet dietary needs" (Bonnard, March 2001) and when "environments supplied appropriate care, clear ware, and good sanitation and health services" (Haddad & Frankenberger, June 2003) as characteristics of food security. Haddad and Frankenberger also underline the low "risk of losing these levels of food availability, access and utilization" (Haddad & Frankenberger, June 2003).

Canada endorsed the food security definition from the 1996 World Food Summit: "Food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (Power, 2007, 2008). Dietitians of Canada also adopted the World Food Summit definition of individual and household food security (Dietitians of Canada & Power, 2005) and provided a supplementary community food security definition: "Community food security exists when all community residents obtain a safe, personally acceptable, nutritious diet through a sustainable food system that maximizes healthy choices, community self-reliance, and equal access for everyone" (Dietitians of Canada & Slater, 2007).

On the other hand, as mentioned by Roberts, "food insecurity exists when people can't get enough food to eat that is safe, that they like to eat, and that helps

them to be healthy" (Roberts, 2006). For instance, a study in the Mississippi Delta showed that food secure individuals scored statistically significantly higher on the Healthy Eating Index (HEI) compared to food insecure adults. However, no differences were observed when multiple factors (household food security, age group, income group, race, sex, education and household size) were included in the regression model. Still, food secure adults seemed to achieve higher percentages of Dietary Reference Intakes (DRI) but both groups did not reach the fiber recommendations (Champagne et al., 2007).

At the individual level, food insecurity can been seen as nutritional inadequate food, insufficient intake, lack of choice, physiological sensation of hunger as well as disrupted eating patterns (Dietitians of Canada & Power, 2005). At the household level, food insecurity is linked to food supply, management and acquisition such as unsuitable food and diet, food depletion, food anxiety and restriction of socially acceptable ways of acquiring food (Dietitians of Canada & Power, 2005; Hamelin et al., 2002). The lack of control of household over its food situation may induce different reactions like socio-familial perturbation, hunger and physical impairment and psychological suffering (Hamelin, et al., 2002). Furthermore, individuals within a household may experience food insecurity differently. It was seen that mothers protect their children from hunger by compromising their own intake (Dietitians of Canada & Power, 2005; McIntyre et al., 2003). Food insecurity may also be chronic or transitory with variable frequency, duration and periodicity (Dietitians of Canada & Power, 2005).

2.1.2 Canada's food security commitments, policies and initiatives

Canada's first commitment toward food security was in 1948 with the *Universal Declaration of Human Rights* where right to food was first mentioned as an essential human right. Since then, six other international agreements such as the *World Declaration on Nutrition* in 1992 and the *Rome Declaration on World*

Food Security and *World Food Summit Plan of Action* in 1996 were signed by the Canadian government as a commitment that it would fulfill Canadians' basic needs (Dietitians of Canada & Power, 2005; Rideout et al., 2007).

At the federal level, the *Canadian Charter of Rights and Freedoms* was passed in 1982 and includes rights to life and equality (Rideout, et al., 2007). In 1998, Canada presented *Canada's Action Plan for Food Security* in response to the 1996 World Food Summit's seven commitments which led to the creation of the Food Security Bureau (Agriculture and Agri-Food Canada, 1998). The goal of *Canada's Action Plan for Food Security* is "to reduce by half the number of undernourished people no later than the year 2015". Among its ten priorities which include right to food, reduction of poverty and promotion of access to safe and nutritious food, priority 5 concerns Aboriginal populations. Indeed, the importance of traditional food acquisition and sharing to Aboriginal communities is acknowledged (Agriculture and Agri-Food Canada, 1998, January 12, 2007; Myers, et al., 2004). Four progress reports followed up this Action Plan (Agriculture and Agri-Food Canada, 1999, 2004, 2006; Reid, 2002).

Although some provinces have acknowledged the influence of income on health, Quebec is currently the only province where a law was unanimously adopted to "combat poverty and social exclusion". Since December 2002, Bill 112 addresses "poverty as a health issue, with food security as part of the solution" (Dietitians of Canada & Power, 2005; Noël, 2004, December 2002).

Even though Canada was approving international agreements and has economic strength (gross domestic product of Canada is ranked 10th in the world global economy (The World Bank, July 1, 2010)), food security is yet to be obtained for all Canadian citizens (Rideout, et al., 2007). Thus, authors noticed

that the goals of all signed agreements and commitments have not been reached by Canada and that "Canada lacks a coordinated, systematic plan for monitoring food insecurity, either nationally or provincially" (Anonymous, April 5, 2005; Dietitians of Canada & Power, 2005). This issue was however addressed as the 10th priority in *Canada's Action Plan for Food Security* (Agriculture and Agri-Food Canada, January 12, 2007). This monitoring nonetheless requires knowledge of the economic circumstances of households and use of a validated tool (Kirkpatrick & Tarasuk, 2008a). Currently, food security assessments have been conducted in small sample of vulnerable populations such as low-income, single-parent and bank users (Tarasuk, 2005).

In the 1980s, years before the publication of the *Canada's Action Plan for Food Security*, food banks were created because people were going hungry. The need for food banks did not disappear since then but has in fact increased (Dietitians of Canada & Power, 2005; Tarasuk, 2005). This was the first time food insecurity was recognized in Canada (Tarasuk, 2005). In Canada, some groups are more at risk of food insecurity such as single-parent families, particularly those with children under 13, households receiving social assistance as major source of income, those renting their dwelling and Aboriginal people living off reserve (Anonymous, April 5, 2005; Dietitians of Canada & Power, 2005; Tarasuk & Vogt, 2009; Vozoris & Tarasuk, 2003). Food Banks Canada reported that 794,738 individuals used food banks in an average month in 2009 among which 1,429 were from Yukon, Northwest Territories and Nunavut (Food Banks Canada, 2010). During the same year, 115,467 individuals asked for food in a food bank in Montreal each month (Moisson Montreal, 2010).

Adequate food intake may be difficult to achieve for low-income Canadians. In fact, food skills, food preferences, traditions, norms and values, housing and access to healthy foods are all affected by income, which interacts with social

aspects and policies (Power, 2005). As mentioned by Dietitians of Canada and Power, "income is the most important determinant of food insecurity and hunger although the relationship between income and measures of food security is not linear" (Dietitians of Canada & Power, 2005). For instance in 1998/99, approximately 25% of Canadian households earning less than 18,604 CAD reported food insecurity. In 2004, it was approximately 48.3% of Canadian households earning less than 10,000 CAD if four people (or less in the household, or less than 15,000 CAD if five people or more) that were food insecure (Health Canada, 2007a). In the Ontario component of the Canadian Community Health Survey (CCHS) Cycle 2.2, households reliant on social assistance had an adjusted odds of having food insecurity of 3.69 (95% CI 2.33-5.84) compared to those receiving salary or wages (Tarasuk & Vogt, 2009) demonstrating that "household food insecurity is a product of poverty" (Dietitians of Canada & Power, 2005) and is inextricably related to financial insecurity (Tarasuk, 2001).

2.1.3 Food market evolution

Food market has evolved in the past decades over the dimension of food availability with an increase of 81% in food disappearance (food availability) per capita from 1960 (877 kg/person) to 2003 (1587 kg/person) in Canada. However, food adequacy changed but not in a healthy direction since Canadian fat consumption per capita increased by 28% from 1993 to 2003 (Goddard, 2006). This latter can be explained by economic and food availability data from 1962 to 1994. Thus, cheap vegetable oils and fats are now available globally which greatly increased fat consumption at the same time among low-income countries (Drewnoski & Popkin, 1997). A similar trend was seen for sweeteners. In Canada, a decline in cost of fructose corn syrup, as a result of US agricultural subsidies, made soft drinks cheaper compared to real cost of milk which has been stable over time (Goddard, 2006). As mentioned by this author, nutritious foods are not more accessible when soft drinks are sold at 60% of milk's real cost (Goddard, 2006).

Consequently, these two changes in the diet nutrient content (more fat and more sugar) are not contributing to healthy food choices given the sensory perceptions and preference for fat and sweet-tasting food. Thus, "fat consumption may be governed not by physiological mechanisms but by the amount of fat available in the food supply" (Drewnoski & Popkin, 1997). For instance, proportion of energy coming from beverages (mainly sweetened beverages) significantly increased between 1965 (11.8%) and 2002 (21.0%) in the USA which equals to an overall increase of 132 to 222 calories per person per day (Bray et al., 2004; Duffey & Popkin, 2007; Popkin & Nielsen, 2003). Currently, beverage consumption includes a greater proportion of beverages such as soda and diet beverages which are a considerable source of daily energy intake (Duffey & Popkin, 2007; Popkin & Nielsen, 2003). Emerging literature suggests that high fructose intake can lower the circulating insulin and leptin which can lead to weight gain and metabolic syndrome (Elliott et al., 2002).

Studies show mitigated results related to weight gain and weight loss in relation with consumption of sugared liquids such as soft drinks and fruit drinks (Drewnoski & Bellisle, 2007; Gibson, 2008). However, as Drewnoski and Bellisle mentioned, "it would appear that the obesity-promoting capacity of different beverages is linked not so much to their sugar content (which is the same) but to their low price". Obesity in the USA has been associated with limited economic resources and may involve preferential selection of low-cost beverages and foods. Authors suggest that studies of sugar content of diets, dietary choices, and health outcomes should take food costs into account (Drewnoski & Bellisle, 2007). This change in beverage consumption has increased worldwide implying an increase in caloric sweetener consumption (Popkin & Nielsen, 2003).

Consequently, weight gain in adults may be due in part to overconsumption of energy coming from inexpensive high energy-dense foods (Apovian, 2004; Dinour et al., 2007). Thus, higher energy intakes are related to the high energy density and palatability of sweets and fats (Drewnoski & Specter, 2004). The inverse relation between energy density (kcal/kg) and energy cost ($/kcal) may be the lowest-cost option to the consumer (Drewnoski & Specter, 2004). Therefore, people who must limit food costs will choose high-energy dense foods which are inexpensive to the detriment of other more expensive food choices such as lean meats, fish, fresh vegetables and fruits (Dinour, et al., 2007; Drewnoski & Specter, 2004).

Lower food expenditures, fewer fruits and vegetables and dairy, and lower diet quality (lower fibre intake and higher energy density) associated with poverty (Drewnoski & Specter, 2004; Kirkpatrick & Tarasuk, 2008b) may directly affect health (Kim & Popkin, 2006) and increase the prevalence of chronic diseases (diabetes, hypertension and cardiovascular diseases) among food insecure households (Anonymous, April 5, 2005; Dietitians of Canada & Power, 2005; Kim & Popkin, 2006; Kirkpatrick & Tarasuk, 2008a; Vozoris & Tarasuk, 2003).

Indeed, in CCHS Cycle 2.2, food insecurity was associated with higher inadequacies in nutrient intakes, particularly for protein, vitamin A, thiamine, riboflavin, vitamin B_6, folate, vitamin B_{12}, magnesium, potassium and zinc (Dietitians of Canada & Power, 2005; Kirkpatrick & Tarasuk, 2008a). Food insecurity was also shown to be associated with obesity possibly because of "periods of both under- and overconsumption, physiologic adaptation of increased body fat in response to episodic food shortages, and higher consumption of cheaper foods that are higher in fat" (VanEenwyk et al., 2003).

However, overweight and obesity appear to coexist with underweight in low-income households (Doak, 2002; Doak et al., 2000). Indeed, looking at body mass index of women aged 20-49 years old (n = 148,579) living in urban and rural settings of 36 countries, Mendez and collaborators observed a higher prevalence of overweight compared to underweight in both developed and developing countries (Mendez et al., 2005). Even though there is a correlation between food insecurity and obesity in adults, findings reported in literature are inconsistent about the linearity of the effect between risk of obesity and severity of food insecurity (Dinour, et al., 2007; Doak, et al., 2000). Nonetheless, there seems to be an increase in obesity worldwide and this varies by socio-economic status (SES) indicators: in highly developed countries, women had a negative association in combination with high education and occupation compared to women in medium- and low-development countries where a positive association was seen with income and material possessions (McLaren, 2007). As mentioned by Drewnoski and Specter, population with high poverty and low education show high rates of obesity (Drewnoski & Specter, 2004).

In addition, food insecurity may induce various psychological changes leading to preoccupation with food, stress or depression and subsequently, increase risk of obesity as well (Dinour, et al., 2007). However, as mentioned by Dietitians of Canada, it is a challenge to look at the health consequences of food insecurity per se since "food insecurity occurs within the context of poverty, which has its own independent adverse effects on health" (Dietitians of Canada & Power, 2005).

2.1.4 Food security measuring tool

The currently most used food security assessment tool is provided by the United States Department of Agriculture (USDA). The USDA food security survey module contains 18 questions related to different aspects of food security such as food shortage and meal skipping. Ten questions are related to the status of adults

in a household and eight questions are for the children of the same household. Following the answers selected by the respondent, a value is given to each question (either 0 or 1). A value of 1 corresponds to affirmative answers such as "yes", "often" and "sometimes" as well as "almost every month", "some months" and "1-2 months" for three questions asking about the frequency (Bickel et al., 2000). A total score is afterwards calculated and households are classified in one of three categories: "food secure", "low food secure" and "very low food secure" (Nord & Hopwood, 2008).

In Canada, the USDA survey module and classification methodology were used in various food security research conducted by Health Canada prior to 2007 (Nord & Hopwood, 2008). Yet, the USDA tool was recently used for the CCHS Cycle 2.2 (Statistics Canada, 2005) but different food security categories were defined by Health Canada (Health Canada, 2006, 2007a). Their labels are "food secure", "moderately food insecure" and "severely food insecure". The "moderately food insecure" category represents problems of inadequacy of food supplies in households resulting in reduced quality or desirability of food consumed. Generally, there is an absence in disrupted eating patterns and food shortages. The "severely food insecure" category includes the conditions of the previous category with disrupted eating patterns and reduced food intake, such as reducing the size meals, skipping meals, going hungry, and going a whole day without eating (Health Canada, 2007a). Adult and children scales are assessed separately. The overall food security status of the household is determined combining the adult status and the children status, with the worst of the two statuses determining the household's status (Table 6). Adult score categories and the overall household status are assessed differently compared to the USDA (Table 7). Health Canada's classification will be used for the current thesis.

It is worth noting however that since the USDA survey module is administered to one person per household, results assume that everybody in the household answers in the same way as the respondent but this might not be true (Ledrou & Gervais, 2005). Furthermore, the current USDA tool "defines food insecurity in financial terms", therefore "rates reflect household income" (Ledrou & Gervais, 2005).

The difference between both American and Canadian methodologies impact on the result obtain for each food security category. In fact, Health Canada obtains a somewhat lower household prevalence of food insecurity compared to the USDA since the USDA combines adult and child items to calculate the household status. On the other hand, adult food insecurity prevalence is slightly higher in Canada since the adult categories are not defined in the same manner for both countries. Health Canada has a lower food insecurity threshold compared to that of the USDA which explains these differences (Table 7) (Nord & Hopwood, 2008).

2.1.5 Prevalence of food security

In Canada, estimated household food insecurity prevalence is measured by National Population Surveys since 1994. However, either one question (National Longitudinal Children and Youth Surveys (NLCYS) in 1994 and 1996) or three questions (National Population Health Surveys (NPHS) in 1996/97, 1998/99 and Canadian Community Health Survey (CCHS) Cycle 1.1 in 2000/01) were asked (Kirkpatrick & Tarasuk, 2008a; Tarasuk, 2005). The USDA food security survey module was used in 2004 for CCHS Cycle 2.2. Results showed that 90.8% of the Canadian households were food secure, 6.3% were moderately food insecure and 2.9% were severely food insecure (Health Canada, 2007a). Similar findings were observed in the USA, with 85.4% of the households being food secure, 8.9% having low food security and 5.7% having very low food security (Nord et al., November 2009). Previous Canadian surveys showed that approximately 4% of

Canadians (1.1M people) lived in food-insufficient households during the NPHS 1996/97 (Vozoris & Tarasuk, 2003). During the NPHS 1998/99, 10.4% of individuals were living in household experiencing food insecurity over the past 12 months compared to 14.7%, during the CCHS Cycle 1.1 2000/01 (Kirkpatrick & Tarasuk, 2008a; Tarasuk, 2005). However, since different methods were used, results are hardly comparable and thus ecologic analyses on social or economical changes and food insecurity prevalence cannot be done (Kirkpatrick & Tarasuk, 2008a). Furthermore, the surveys did not include vulnerable subgroups like Aboriginal on reserves, Yukon and Northwest Territories populations, people living in remote Quebec and Ontario regions nor homeless people (Tarasuk, 2005).

In contrast, for Northern Canada, CCHS Cycle 1.1 reported that between September 2000-October 2001, 56% of the population of Nunavut, 28% of Northwest Territories and 21% of Yukon was food insecure. All were significantly higher than Canada's food insecurity prevalence of 14.7% ($P < 0.05$). Among the low- and lower-middle-income households, 68% of the population in Nunavut, 49% in Northwest Territories and 30% in Yukon (Yukon was equal to the national level) lacked some money to buy enough food at least once during the past year (Ledrou & Gervais, 2005). In 2001-2002, the *Food Mail Pilot Project* carried out in two Inuit communities, Kugaaruk and Kangiqsujuaq, showed a high prevalence of food insecurity. Indeed, the two communities varied in food security rates: 14% to 49% of all households were food secure, 20% to 40% were moderately food insecure and 10% to 66% were severely insecure (Lawn & Harvey, 2003, 2004).

Even though these estimates showed a critical situation in Northern Canada, the rates may not be generalizable to all northern regions as only two communities were surveyed (for further details, see Section 2.3). Further, studies used different

methodologies as CCHS Cycle 1.1 determined the food security status based on three questions (Ledrou & Gervais, 2005) and the *Food Mail Pilot Project* used the USDA survey module (Lawn & Harvey, 2003, 2004). As mentioned by Power (Power, 2007, 2008), the questionnaire used for the surveys was developed for non-Aboriginal populations and therefore does not take into account different realities such as the use and importance of traditional foods, harvesting practices and food-sharing systems. Willows underlined that "commonly used food insecurity questions may need to be adapted to accommodate First Nations, Métis and Inuit languages, cultural perceptions and unique life experiences" (Willows, 2005). Food security as a subjective concept is also perceived in a different way (Ledrou & Gervais, 2005; Power, 2007, 2008) and is qualified as "cultural food security" by Power since its conceptualization is unique and particular to this population (Power, 2007, 2008). For Power, "cultural food security" describes another level of food security and encompasses the "ability of Aboriginal People to reliably access important traditional/country food through traditional harvesting methods" (Power, 2007, 2008). This dimension is not included in the current USDA tool therefore some questions relating to these aspects were added by Indian and Northern Affairs Canada (INAC). On the other hand, consequences of food insecurity on food selection are currently unknown, "given tradition of obligation, sharing and reciprocity that are inherent to many Aboriginal people's culture" (Willows, 2005).

2.2 Inuit context

2.2.1 Traditional food system and nutrition transition

Traditional foods include a large variety of country foods, such as marine and land mammals, birds, berries and plants (Chan, 2006; Kuhnlein et al., 1996), and contribute to the daily intake of adults and children. Indeed, elders and men consume more traditional foods than youth and women (Kuhnlein & Receveur, 2007; Kuhnlein, et al., 1996) and traditional food consumption has been observed to increase with age ($P < 0.001$) (Delormier & Kuhnlein, 1999; Egeland et al.,

2004; Egeland et al., 2009; Kuhnlein & Receveur, 2007; Kuhnlein et al., 2004; Kuhnlein, et al., 1996). It was observed that the contribution of traditional foods to daily energy intake is different between and within communities with a variation ranging from 6% to 40%. The contribution of traditional food and market food in the diet also differs geographically (Kuhnlein, et al., 1996). Thus, more northern communities have been noted to rely more on traditional foods than communities that are near commercial centers (Kuhnlein & Receveur, 2007). In addition, traditional foods also bring significant amounts of various nutrients to the diet such as protein, *n*-3 fatty acids, vitamins A, B_2, B_6, D and E, iron, zinc, copper, magnesium, manganese, phosphorus, potassium and selenium. These nutrients improve the quality and the adequacy of the diet compared to a diet including only market foods (Bersamin et al., 2008; Berti et al., 1999; Chan, 2006; Kuhnlein & Receveur, 2007; Kuhnlein, et al., 2004; Kuhnlein, et al., 1996). As mentioned by Cone, "beluga whale has 10 times the iron of beef, twice the protein, and five times the vitamin A" (Cone, 2005). In fact, while calcium and fiber intakes are observed to be higher, most nutrients such as those mentioned above are noted to be lower on days when market foods are consumed. Thus, risks of insufficiency are arising and affect food security of the individuals, particularly in the youth who eat less traditional foods compared to older people (Kuhnlein, et al., 1996).

Food sharing of country foods influences traditional food consumption as well. Complex and dynamic distribution networks exists (Chan et al., 2006; Condon et al., 1995) and help add traditional food to the diet. In fact, households with a male head and/or an active hunter have a higher traditional food consumption level than households without a male or active hunter (Chan, 2006; Duhaime et al., 2002).

The introduction of market foods which gradually replace traditional foods in the Inuit diet has decreased diet quality (Duhaime, et al., 2002; Myers, et al., 2004) (for further details on changes in nutritional composition of market foods, see Section 2.1.3). New varieties of fresh and processed foods now come on the shelves of the stores. However, shipping costs, food handling and shipping influence their quality and freshness, and it has been noted that food is sold beyond the expiration date because of long and sometimes delayed transport (Boult, 2004; Ford, 2009). The cost of food in northern communities is twice that of southern communities (Lawn & Harvey, 2003, 2004) and therefore, market foods commonly purchased and consumed in the north are often of poor quality with a low nutrient density and high refined carbohydrate and sodium contents (Chan, et al., 2006; Kuhnlein & Receveur, 2007; Kuhnlein, et al., 1996). Further, the shift to market foods increases saturated fat intakes as the percentage of energy from traditional food was inversely related to saturated fat intake in an analysis of Inuit residing in 18 communities (Egeland, et al., 2009; Kuhnlein, et al., 1996). Following CCHS Cycle 2.2 results, regular soft drinks were the main caloric source of "other foods" in the Canadian population, but among the 19-50 years old group, these beverages were more consumed by off-reserve Aboriginal individuals compared to their non-Aboriginal counterparts. Another difference exists in women where Aboriginal women seem to obtain more calories from snacks compared to non-Aboriginal women; no differences were observed for men (Garriguet, 2008). These eating behaviours in women induce an excess of calories and can explain the higher overweight/obesity and obesity rates in women observed in off-reserve Aboriginal people (19-50 y) compare to non-Aboriginal individuals (Garriguet, 2008).

These dietary changes likely occur together with reductions in physical activity leading to obesity and type 2 diabetes mellitus (Chan, 2006; Ford, 2009). In fact, compared to highly developed countries of Europe and North America, the current prevalence of obesity among Inuit is ranked second (Jergensen & Young,

2008). On its side, the low prevalence of diabetes is expected to increase at a fast pace as anticipated from the high prevalence of impaired glucose tolerance among Inuit. In Greenland, it was observed that diabetic status was also inversely associated with frequent intake of fresh fruit and seal meat (Jergensen & Young, 2008). Consequently, the nutritional and cultural changes of food consumption have induced a nutrition transition in Inuit populations.

Factors affecting food security

Barriers to food security are numerous and include income level, food choices and preferences, food appearance, taste, packaging and place of origin, education, social structure and lifestyle changes, social problems, season and traditional food accessibility and availability (Boult, 2004; Roberts, 2006). It was observed that as family income decreases, level of food insecurity increases (Boult, 2004). In fact, as mentioned by Tarasuk, "expenditures on the goods and services are sometimes foregone to free up money for food, but the reverse is also true" (Tarasuk, 2001). Food supply is also affected by socioeconomic, cultural and geographical contexts as well as life experiences. Thus, food security is challenged by food prices and cultural contexts in Northern Canada (Roberts, 2006). In fact, in the Inuit context, lack of employment opportunities and overall low-income levels may cause a lack of adequate income and therefore, a lack of food (Boult, 2004). In general, youth, women, and elderly are more vulnerable to food insecurity than others (Chan, 2006).

Different community initiatives can help improve food security such as community freezers, hunters and trappers' organizations, informal food sharing networks, food banks and other community initiatives. Government initiatives such as *Healthy Children's Initiative and Aboriginal Head Start*, *Brighter Futures*, *Hunter support*, *Country foods development* and *Gas subsidy* programs are also beneficial (Anonymous, April 5, 2005; Boult, 2004; Myers, et al., 2004).

Indeed, the *Food Mail Program* aims to increase accessibility of perishable foods and other essential items by decreasing their shipping cost (Health Canada & Minister of Indian Affairs and Northern Development, 2002). Near 58 million CAD were spent for this program in 2008-2009 (Indian and Northern Affairs Canada, January 12, 2010). A revision to adjust for food cost increase and demand is ongoing (Dargo, 2008).

Consumption of country foods and harvesting practices are also influenced by different factors such as climate change, environmental contamination, cost associated with harvesting, cost of market foods and federal and territorial regulations which limit the number of animals that can be harvested (Boult, 2004; Chan, 2006; Duhaime, et al., 2002; Ford, 2009; Van Oostdam et al., 2005). In fact, Inuit communities need to adapt themselves to climate changes. With environment and harvesting being key elements of the aboriginal culture and subsistence, modifications of the climate now create new challenges to actual hunting and fishing practices. Ice thickness, changes in animal migrations, unavailable/inaccessible animals as well as weather and water changes are among different situations that can affect food security (Ford, 2009; Furgal & Seguin, 2006; Goldhar, et al., 2010; Guyot, et al., 2006). As a result, food security and nutritional health of the Inuit are affected. Climate changes vary between regions as well as the vulnerability and ability of the communities to adapt to these changes. Besides, climate-related changes affect the nutrient intakes of the Aboriginal populations. For instance, new animal and plant species will increase consumption of particular nutrients, such as protein and vitamins. On the opposite, change in bird migration might impact on the number of geese hunted by shortening the hunting period hence possibly decreasing proteins, zinc and iron intakes. Consequently, in addition to loss of cultural knowledge, this situation clearly affects food security (Guyot, et al., 2006).

Sharing of knowledge is also difficult because of the current westernizing lifestyle. Related health outcomes are appearing like diabetes because of a new lifestyle and more severe accidents due to more extreme weather (Furgal & Seguin, 2006). Consequently, because of environmental changes and increasing prices of gas and equipment, people tend to rely more on market foods even though their prices are high. These situations create food insecurity (Ford, 2009; Lambden, et al., 2006). At the same time, the traditional food system is changing. In fact, younger generations live less from subsistence hunting (decreased traditional food use and consumption) and more from market food; therefore causing a gap in harvest skills, knowledge and traditional food preparation between the youth and the elders (Boult, 2004; Chan, et al., 2006). Thus, people of remote communities face unique food security challenges such as expensive market foods, often unavailable or of poor quality and nutritional value, on the one hand, and traditional foods which require equipment for harvest and traditional knowledge and is endangered by contaminants and a changing climate on the other hand (Anonymous, April 5, 2005; Dietitians of Canada & Power, 2005).

2.3 Studies on food security in Aboriginal People

At the present time, there is no comprehensive assessment of food security status among Inuit residing throughout Inuit Nunangat, the homeland (Inuit Tapiriit Kanatami (ITK), June 2009), representing the four distinct Inuit land-claim regions of Canada. The available literature is limited in geographic scope and in the extent of assessments with many studies assessing food security based upon one to four questions (Blanchet & Rochette, 2008; Lambden, et al., 2007; Lambden, et al., 2006; Plante & Rochette, July 2009; Rochette & Blanchet, 2007), upon the adult 10-item questionnaire in one community (Ford & Berrang-Ford, 2009; Goldhar et al., 2009; Goldhar, et al., 2010), or upon the full 18-item questionnaire but limited in geographic scope to two communities (Lawn & Harvey, 2003, 2004) or preschoolers in one territory (Egeland et al., 2010a).

In 2001-2002, two pilot projects related to the *Food Mail Program* were evaluated in Kugaaruk, Nunavut (n = 92 households) and Kangiqsujuaq, Nunavik (n = 95 households). Participants completed a nutrition questionnaire (24-hour dietary recall, food frequency questionnaire (FFQ) and questions on food preparation) and a household questionnaire which included the 18-item USDA food security survey module. This latter was slightly modified to improve acceptability among Inuit populations. Women aged between 15-44 years old completed the nutrition questionnaire. Authors noted that food security status varied following the community, with adults and children having similar figures (Table 8) (Lawn & Harvey, 2003, 2004).

Ford and Ford did a cross-sectional food survey in Igloolik, Nunavut, in July 2007. Their sample was of 50 Inuit (20 women, 30 men aged over 18). The survey included questions on demographics, food system and food availability as well as the adult part of the USDA food security survey module (10 questions). Their results showed that 12% of the participants were food secure, 24% were marginally food secure and 64% were food insecure to some degree in the past year. An association was found between food security and hunting activity ($P = 0.004$) as well as with gender ($P = 0.05$), men being more food secure. Consumption of traditional food was also associated with high food security ($P = 0.04$). However, even though food security did not significantly differ by age, results need to be considered with caution because of the small sample size and also because the sample was not randomly selected, as a quota and convenience sampling method was used (Ford & Berrang-Ford, 2009).

A similar study was conducted in April 2008 in Qeqertarsuaq, Greenland, using the same questionnaires as Ford & Berrang-Ford (2009) and semi-structured interviews on food security determinants. Sixty-one participants (33 women, 28

men aged over 18) were chosen by simple randomization sampling. The authors observed that 78% of the participants were food secure, 8% were moderately food insecure and 8% were severely food insecure, with participants over 35 having a lower food security status. Women were more likely to be food insecure. However, statistical significance was not calculated because of the small sample size. Actually, the purpose of the study was primarily a baseline descriptive one (Goldhar, et al., 2009; Goldhar, et al., 2010).

A cross-sectional survey was done in 44 Arctic communities (including Yukon First Nations, Dene/Métis and Inuit communities) between 1993-2000 with women over 20 years old because women are at higher risk of food insecurity (n = 1711). Four open-ended questions asked the roles of traditional foods in Arctic food security and a fifth question was on "cultural responses to harvesting and using traditional foods". Seven questions were also asked about food accessibility (market foods and traditional foods). Results showed that traditional foods continue to be important to the Arctic women and that food security is dependent on these foods. Among Inuit and Dene/Métis women, age seemed to play a role for the access to fishing and hunting equipment. Therefore, traditional foods are essential for food security to be achieved and their harvest are influenced by age (Lambden, et al., 2007; Lambden, et al., 2006).

Interestingly, the "*Qanuippitaa? How are we?*" survey carried out in Nunavik, Northern Quebec in 2004 showed that 24% of the households did not have enough food in the previous month. However, this was the only question asked on food security. One question on food sharing and one on the use of the community freezer were also asked (Blanchet & Rochette, 2008; Plante & Rochette, July 2009; Rochette & Blanchet, 2007).

A recent paper presents results on household and child food security status among Nunavut Inuit households with preschoolers who participated in the *Nunavut Inuit Child Health Survey* in 2007-2008 (Egeland, et al., 2010a). Sixteen Nunavut communities were surveyed with a total sample of 388 randomly selected Inuit children (3-5 years of age). Based upon the USDA 18-item questionnaire, the study found that 35.3% (95% CI 30.1%-40.5%) of the preschoolers lived in moderately food insecure households and 34.4% (95% CI 29.2%-39.5%) lived in severely food insecure households. For child food security, 31.0% (95% CI 31.0%-35.9%) of preschoolers lived. in a home that was moderately child food insecure and 25.1% (95% CI 20.4%-29.9%) lived in a home that was severely child food insecure (Egeland, et al., 2010a). This study provides the most comprehensive assessment of food security status of homes with Inuit preschoolers. Further, in a direct comparison of the USDA and Canadian classification schemes utilizing the Nunavut Inuit Child Health Survey data, a weighted prevalence of 65.2% of households with preschoolers were identified as food insecure using the USDA definition compared to 69.9% (95% CI 64.7%-74.6%) based upon the Health Canada definition (Egeland et al., in press).

However, beyond the important food insecurity prevalence observed in Inuit communities, food security has improved over time in this population. As mentioned by Bjerregaard and colleagues, "nutrition has generally improved, if not qualitatively then at least with respect to reliability" (Bjerregaard et al., 2008). Indeed, seasonal starvation which was present up North in the past (McGhee, 1994; Weissling, 1991) has now disappeared (Bjerregaard, et al., 2008).

3. RATIONALE

In summary, current studies measuring food security level in Aboriginal communities are limited. This thesis seeks to provide a comprehensive assessment of food security status of three Inuit land claims regions in Canada (Inuvialuit Settlement Region (ISR), Nunavut and Nunatsiavut) using the most extensive food security assessment tool currently in use supplemented with questions on traditional food consumption relevant to Indigenous Peoples' food security. In addition with the lack of information on the context of food insecurity in the Arctic, this thesis evaluates correlates of food security which will help to improve understanding of the nature of food insecurity and ultimately help in the development of interventions.

3.1 Aim and objectives

The aim of the thesis is to identify the prevalence and the correlates of food insecurity in Inuit communities.

Within the context of the *Inuit Health Survey*, the objectives of this research project are:

I. To determine the prevalence of food security in three Inuit jurisdictions in the Canadian Arctic;
II. To identify social, demographic and nutritional correlates of household food security in Inuit communities.

3.2 Hypotheses

The null hypotheses are that food insecurity prevalence of Inuit adults in ISR, Nunavut and Nunatsiavut will be similar to non-Aboriginal Canadians and that food insecurity status will not be related to traditional food intake, dietary quality

and nutrient intakes, and community and individual socio-economic and demographic characteristics.

4. METHODS

4.1 Inuit Health Survey (IHS)

4.1.1 Study sample

Based on the 2005 Aboriginal population census (Statistics Canada, 2008), an estimate of the 2007 population was calculated based on an increase of 2% per year to account for population growth. The sample size was determined to facilitate recruitment of participants into a prospective International Inuit Cohort in which a minimum of 2,000 participants were needed from three jurisdictions to reach overall international sample size requirements. The sample size provides ample statistical power to identify the prevalence and correlates of food insecurity. Stratified random sampling was used to select households where communities were strata and where homes were randomized using either a computer random generation of numbers or a random digit table. A total of 2595 adults participated in the Inuit Health Survey (IHS).

4.1.2 Procedure

IHS was developed through a participatory research process involving a steering committee for each jurisdiction. The steering committees included members from the northern government health agencies, research institutes, associations and communities and the University of Toronto and McGill University, Centre for Indigenous Peoples' Nutrition and Environment (CINE). The committees reviewed and developed questionnaires and facilitated all aspects of the survey work.

The survey involved land teams which recruited participants and coordinated survey activities and a ship team which conducted the majority of assessments and administered the majority of questionnaires. Each of the three land teams included trained bilingual community assistants and a nurse. Potential participants

watched the consent form DVD and completed the written informed consent form. An identification chart (ID chart) recording age and gender of household members as well as a home-based questionnaire on country food harvesting and consumption, food security and income, were completed by the head of the household. The food security questionnaire used in IHS is the USDA food security survey module which was slightly modified by INAC (Lawn & Harvey, 2003). Wording was changed to be more acceptable for the Inuit culture and two questions were added on reasons why the household was not able to buy enough food and coping strategies. The aim of these changes was to improve the determination of food security status for Inuit. Participant's current medicine and supplement use was recorded by the land team or ship nurse.

When on board the ship, participants were matched with a bilingual interviewer who, in addition to the interview, also escorted the participant to the different stations for scheduled measurements. Nurses conducted anthropometric measurements such as weight, height, and body composition using a Tanita (Tanita TBF-300GS with goal setter, Tanita Corporation of America, Inc., Arlington Heights, Illinois, USA) and measured blood pressure three times and cardiac pulse (BpTRU^{TM} Vital Signs Monitor, VSM MedTech LTD., Coquitlam, BC, Canada). In the majority of cases, a venous blood sample and toenail clippings were also obtained.

In addition to 33 communities that were visited by ship, three non-coastal communities (Inuvik, Aklavik and Baker Lake) were also included in the survey by a visiting research team in which similar protocols were followed.

Four questionnaires were completed by a face-to-face interview: a 24-hour dietary recall; a FFQ on consumption of a comprehensive list of traditional foods

and on an abbreviated list of market foods; an individual questionnaire on medical and dental health histories, sun exposure, physical activity, and tobacco and alcohol use; and an individual and community wellness questionnaire about suicidal thoughts, gambling, drug consumption, violence, and sexual abuse. All questionnaires as well as informed consent forms (DVD and paper) were translated into different Inuit dialects appropriate for the regions surveyed.

All adult health survey research team interviewers were trained on interviewing skills. Ship and land interviewers were also trained on dietary interviewing. Interviewing consisted of reading through each of the questions to clarify the meaning of each if it was not clear. Interviewers were instructed to read questions as worded in the questionnaire and to offer clarification only when requested. Interviewers were instructed to use an objective tone when interviewing and not to ask leading questions.

Ship and land interviewers were trained to use a four stage, multiple pass technique for collecting 24-hour dietary recall information. First, participants were asked to list everything they ate and drank in the past 24 hours (from midnight to midnight). Once a list of food and drink was generated, participants were asked to give more detailed information about the foods and drinks (ex: brand name, flavour or method of cooking) and were further probed to try to remember foods and drinks that they may have forgotten such as water, juice and snacks. Food model kits were used to help estimate portion sizes. Some participants knew the volumes of liquid of food consumed and this information was recorded. Recipes were noted if needed. Listed food and beverages were reviewed and probes were used for any missing items.

Each participant was asked to complete a qualitative FFQ. The FFQ was designed to capture consumption information about a comprehensive list of common country foods (37 items) that are available in the regions of ISR, Nunavut and Nunatsiavut based on older CINE FFQs which were updated as needed through feedback from steering committee members and hunters and trappers organizations. The FFQ was adapted to reflect the species available in each region. The participant was asked about how often a particular traditional food was eaten in the past year (in and off season). Harvest calendars from each community helped identify the time periods for the in and off season by community. An abbreviated list of market foods (5 items) with a focus on sugar drinks, fruit juices, milk and chips was also included in the FFQ. The participant was asked how often a particular market food was eaten in the past month. For all food items, the participant was asked to quantify his usual serving using the food models and pictures provided if needed.

4.1.3 Ethics

The McGill Faculty of Medicine Institutional Review Board awarded a Certification of Ethical Acceptability for Research Involving Human Subjects to the "Inuit Health Survey: Inuit Health in Transition and Resiliency". Scientific Research Licences were also obtained from the Nunavummi Qaujisaqtulirijikkut (Nunavut Research Institute) and from the Aurora Research Institute – Aurora College (Inuvik, Northwest Territories). The Nunatsiavut review board waived the requirement for a license as they indicated that the CINE team engaged in such extensive participatory processes that a research license was not required. Renewals were approved for each year of data collection.

4.2 Variables

Food security

Food security was assessed using Health Canada's definition and classification of food security (Health Canada, 2007a) (Table 6).

Social and demographic correlates of food insecurity in Inuit communities were explored using the following variables:

- Latitude and jurisdiction of communities;
- Size of communities;
- Household crowding[1];
- Income support;
- Public housing;
- Home in need of major repairs;
- Food sharing;
- Presence of an active hunter[2] in household[3];
- Education;
- Income.

These variables were analysed in relation to food insecurity risk.

Nutritional correlates of food insecurity were identified using the following variables determined with the 24-hour dietary recall and the FFQ:

- Healthy Eating Index (HEI);
- Energy intake;

[1] Crowding is defined as "more than one person per room in the dwelling" (Statistics Canada, 2009) where rooms are bedrooms, kitchen and living room.
[2] An "active hunter" designates someone who actively hunt, fish and/or harvest traditional foods. Active hunters were identified by the participants throughout the following question: "Is there an active hunter in your household?" (yes / no / do not know).
[3] A "household" is defined as people living under the same roof in a particular point in time (which was determined as "during the survey" for the purpose of IHS).

- Percentage of energy from carbohydrates, protein, fat and saturated fat;
- Percentage of energy from high sugar beverages/foods;
- Traditional food consumption;
- Sodium intake;
- First Nations, Inuit and Métis Food Guide Recommendations;
- Body mass index (BMI), percentage of body fat and waist circumference.

Latitude, jurisdiction and size of community

Latitude of community was reported to impact on dietary intakes. Indeed, intake of traditional and market foods is dependent on geography since access and availability of traditional foods as well as remoteness or proximity to commercial centers differ between southern and northern communities (Kuhnlein & Receveur, 2007; Kuhnlein, et al., 1996). To our knowledge the impact of community size on food security status among the Inuit has not been reported in the literature yet. However, it has been observed that low-income lone mother-led households in Atlantic Canada (Newfoundland, New Brunswick, Nova Scotia and Prince Edward Island) experienced more food insecurity over the past month in smaller communities ($P = 0.008$; community size not described) (McIntyre et al., 2002). Therefore, latitude of community was designated as south vs. north ($< 65°18'N$ vs. $\geq 65°18'N$) and community size of each community was designated as small or not-small (≤ 200 households vs. > 200 households): cut-offs representing the mean latitude between the most northern and southern communities in the Canadian Arctic and the mean number of households per community.

24-hour dietary recall and FFQ

Food frequency information was entered using Epi Info™ (Centers for Disease Control and Prevention Atlanta, Atlanta, Georgia) and data was double verified (2007) or double entered (2008). 24-hour dietary recall information was entered using CANDAT Software (Godin London Incorporated, London, Ontario).

Nutrient composition of foods was determined using the 2007b Canadian Nutrient File (CNF) (Health Canada, 2007b). An additional food file was also created to add foods not on the CNF: nutrients for these foods were obtained using food labels, recipes, and other resources found on the internet (nutrient values from the USA were checked for possible fortification differences with Canadian products). All 24-hour recalls were double verified. When information on foods or portion sizes was missing from the 24-hour recall, some assumptions were made using a documented default value. For example, when a food was not well described such as the ingredients in a stew, a default food was entered. Default foods/beverages were determined using information from 24-hour recalls where this information was provided in detail or resources obtained from communities. Defaults were applied to recalls equally. Any recalls or FFQ considered invalid were approved by the Dietary Data Management Coordinator.

Healthy Eating Index

The Healthy Eating Index (HEI) was developed by the USDA to evaluate the overall quality of the diet of American individuals (type and quantity of foods consumed and compliance with the American guidelines) (Fransen & Ocké, 2008; Gibson, 2005; Kourbala & Panagiotakos, 2009). HEI includes ten components: the five first components are related to the five food groups of the USDA's Food Guide Pyramid, components 6 to 9 are related to total fat (percentage of energy intake), saturated fat (percentage of energy intake), total cholesterol intake and total sodium intake, and the last component evaluates diet variety. Each component has a minimum score of 0 (less compliance with recommendations) and a maximum of 10 (close to recommendations). A final score of ≤ 50 indicates a poor diet, 51 to 80 indicates a diet that needs improvements and ≥ 81 indicates a good diet (Table 9) (Fransen & Ocké, 2008; Gibson, 2005; Kourbala & Panagiotakos, 2009).

This index was recently adapted for Canadian dietary guidelines using the Canadian Food Guide (CFG) and nutritional recommendations (Shatenstein et al., 2005). The Canadian HEI includes nine components for a total score of 100 (each worth 10 points except the vegetables/fruit component which is a combined food group and therefore worth 20 points). The dietary variety component is based on having at least one serving from each food group based on their validated FFQ (Table 10). The same final score categories are used.

Even though three dietary records were used by the USDA and a FFQ was used by Shatenstein and colleagues to determine the dietary variety subscore, we assume that our large sample makes it feasible for us to use only one 24-h recall. For the current study, Canadian HEI scores were determined with the 24-h recall using the number of servings eaten per food group as well as the percentage of energy coming from total fat and saturated fat, and the quantity of cholesterol and sodium eaten. The dietary variety score was based on eating at least one serving or more of each of the four food groups of the CFG during the past 24 hours. An overall total score was calculated for the surveyed population and similar scores were done within each jurisdiction.

High sugar beverages and foods

Sugar beverages and foods having more than 25% of their energy content coming from sugar were considered as "high sugar beverages and foods". This cut-off was used given that a consumption over this threshold compromise essential nutrient consumption (Institute of Medicine of the National Academies, 2006). High sugar beverages and foods also impact on health since they increase in risk of coronary heart disease (Fung et al., 2009). When identifying foods to be included in this category, fruit and vegetables, as well as their juices, were excluded because of their healthier nutrient profile compared to other high sugar foods.

Traditional food consumption

Traditional food consumption was evaluated using the 24-hour dietary recall. After identifying traditional foods among the foods that were eaten in the past 24 hours, the percentage of energy of traditional foods was calculated.

First Nations, Inuit and Métis Food Guide recommendations

The CFG (Health Canada, 2007c) promotes food quantities and types of food that are part of a healthy diet and is designed to fulfill the needs of people aged 2 years old and over. It was adapted for the First Nations, Inuit and Métis food habits with mainly the same recommendations. This tool was used to determine if sufficient servings of each food group is eaten by the participants. Figure 3 and Figure 4 present the CFG and First Nations, Inuit and Métis Food Guide recommendations per age range and gender and the recommended serving sizes for each food group.

To determine the number of servings eaten daily for each participant, data from the 24-hour dietary recall was used. First, all foods were categorized into their corresponding food group (a meal would be divided into it ingredients). Afterwards, quantities eaten for each food were compared to the recommended serving size of their corresponding food group to determine the number of eaten servings. Total number of servings per food group was obtained for each individual. Overall mean of all participants was calculated for each food group and compared with the recommended number of servings to identify if recommendations are globally reached by this population.

Body mass index (BMI), waist circumference and percentage of body fat

BMI classification is used to assess health risk associated with body weight among people aged 18 years old and over. This health indicator is currently the most useful to evaluate health risk associated with body weight. BMI categories of obese and overweight reflect health risks compared to the category "normal weight" (Table 11). Underweight may be associated with undernutrition and osteoporosis among others and overweight may be associated for instance with type 2 diabetes, hypertension and coronary heart disease (Health Canada, 2003).

Waist circumference is also an important health indicator as it reflects risk associated with abdominal adiposity. Having a waist circumference above compared to below the cut-offs (Table 12) increases risk of type 2 diabetes, coronary heart disease and hypertension (Health Canada, 2003).

Both BMI and waist circumference cut-offs were determined to identify different levels of health risk. Combining these two indicators is also useful to assess health risk (Table 13).

Body composition includes two compartments: fat and fat-free mass. Fat, as a main storage of excess energy, may reflect the extent of energy balance such as under- and overnutrition. Body fat content varies among gender, representing 26.9% of total body weight in women and 14.7% in men, and increases with age (Gibson, 2005; Wells, 2006). Studies showed percentage body fat ranging from 31% to 33% in women and from 20% to 21% in men with a BMI $\geq$ 25 ("overweight"). Body fat increases to between 37% to 39% of body weight in women and between 25% to 29% in men with a BMI $\geq$ 30 ("obese") (Gallagher et al., 2000; Zhu et al., 2003). A BMI $\geq$ 35 is associated with 43% body fat in women and 36% body fat in men (Zhu, et al., 2003). Therefore, in this study,

percentage of body fat was considered at risk when over 31% in women and 20% in men.

4.3 Other questionnaires management

The ID chart, home-based questionnaire, medicine and supplement use questionnaire, individual questionnaire, community and wellness questionnaire and clinical information were entered into a Microsoft Access Database designed for the Inuit Adult Health Survey using Microsoft Access 2003. Data was entered into the database exactly as it was recorded in the questionnaire according to a standard protocol. Then, data was generated and checked for data entry errors. Any questionnaires considered invalid were approved by the Database Manager. All biomarker data were imported into the database.

4.4 Statistical analyses

All analyses were performed using Stata/SE version 11.1 (Stata Corp LP, College Station, Texas).

Objective I: *To determine the prevalence of food security in three Inuit jurisdictions in the Canadian Arctic.*

Weighted household prevalence estimates and 95% confidence intervals (95% CI) of food insecurity were calculated for each jurisdiction. Weighting of samples reflect the proportion of participating households in each jurisdiction. Difference in the weighted prevalence of food insecurity between jurisdictions was evaluated using the Chi-squared (χ^2) tests for difference in proportion.

Objective II: *To identify social, demographic and nutritional correlates of household food insecurity in Inuit communities.*

The prevalence of food insecurity was evaluated by household, nutritional and other individual characteristics using rate ratio (RR) and 95% CI. Specifically, the categorical variables included were:

- Community size (≤ 200 households vs. > 200 households);
- Latitude of community (< 65°18'N vs. ≥ 65°18'N);
- Public housing (yes vs. no);
- Income support (yes vs. no);
- Household crowding (yes vs. no);
- Home in need of major repairs (yes vs. no);
- Home distributes traditional foods (yes vs. no);
- Presence of an active hunter in household (yes vs. no);
- Education (secondary not completed vs. other education);
- Income (< 20,000 CAD vs. other income);
- At-risk BMI (BMI ≥ 25.0 (overweight and obese) vs. BMI < 25.0 (normal weight and underweight[4]));
- Obesogenic waist circumference (yes vs. no);
- Percentage of body fat (at risk vs. normal).

Dietary quality indicators are presented as means (standard deviation (SD)) for normally distributed variables and as medians (interquartile ranges) for skewed data. P-values evaluating differences in each dietary variable by food security status were determined from logistic regression adjusting for age, gender, and region with household entered as a cluster variable given that we had on average 1.38 persons participate per household.

[4] As for "overweight" and "obese" categories, "underweight" category has its own risks for mortality. However, "underweight" was combined with "normal weight" as it included only 1% of our sample (n = 22 participants).

4.5 Bridge

The following manuscript provides evidence on the prevalence of food insecurity in Inuit communities across Northern Canada. Descriptive data are presented which include food security prevalence across all three jurisdictions, socio-economic and health characteristics, household characteristics and dietary characteristics.

5. MANUSCRIPT

Prevalence and correlates of food insecurity of Inuit communities

Catherine Huet, MSc, RD, Renata Rosol, MPH, Grace M. Egeland, PhD

Centre for Indigenous Peoples' Nutrition and Environment (CINE) and the School of Dietetics and Human Nutrition, McGill University, Canada (CH, GE) and Simon Fraser University, Vancouver, Canada (RR)

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Correspondence: Dr. Grace M. Egeland, School of Dietetics and Human Nutrition, Macdonald Campus, McGill University, 21111 Lakeshore Rd., Ste-Anne-de-Bellevue QC H9X 3V9; fax: 514 398-1020; grace.egeland@mcgill.ca; study website: www.inuithealthsurvey.ca

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Short running head: Food Insecurity in Inuit Communities

ABSTRACT

Background: The Arctic ecosystem and its inhabitants are undergoing transitions with implications for food security.

Objectives: To determine the prevalence, socio-demographic and dietary correlates of food insecurity in Northern Canadian Inuit communities.

Design: A cross-sectional health survey was conducted in 36 Inuit communities in 2007-2008 and included 2595 participants aged 18 years and over. Food security, 24-hour dietary recalls and socio-demographic information were assessed and anthropometric measurements taken.

Results: Food insecurity was identified in 62.6% of households (95% confidence interval (CI) 60.3%-64.9%). Overall, 27.2% (95% CI 25.1%-29.3%) of households were severely food insecure. The percent with an at-risk body mass index, waist circumference and percent body fat was significantly lower among individuals from food insecure households when compared to food secure households ($P \leq 0.001$). Adults from food insecure households had a significantly lower healthy eating index score and consumed less vegetables and fruit, grains, dairy products and consumed a greater percent of energy from high-sugar foods than adults from food secure households ($P \leq 0.05$). Food insecurity was associated with household crowding, income support, public housing, and having a home in need of major repairs ($P \leq 0.001$). The prevalence of having an active hunter in the home was lower in food insecure compared to food secure households ($P \leq 0.05$).

Conclusions: Food insecurity prevalence is high in Inuit communities with implications for diet quality which over the long-term would be anticipated to exacerbate risk of diet-sensitive chronic diseases. Actions are required to improve food security which incorporate the traditional food system and healthy market food choices.

Keywords: food security, Inuit, Inuit Health Survey, Northern Canada communities

INTRODUCTION

As defined by the 1996 World Food Summit, food security exists "when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (World Health Organization (WHO), 2008). Inadequate food quality or quantity may cause nutritional deficiencies or health problems (Seligman et al., 2010). In 2004, more than 90% of the Canadian households were food secure with nearly 3% identified as severely food insecure (Health Canada, 2007a) with similar prevalence observed in the United States (Nord, et al., November 2009). However, among Inuit, a high prevalence of food insecurity has been observed (Blanchet & Rochette, 2008; Egeland, et al., 2010a; Egeland, et al., in press; Ford, 2009; Ford & Berrang-Ford, 2009; Lawn & Harvey, 2003, 2004). For example, household food insecurity rates in Nunavut homes with preschoolers was over seven fold higher than rates observed for Canadian households participating in the Canadian Community Health Survey (CCHS) Cycle 2.2 (Egeland, et al., 2010a; Health Canada, 2007a).

Currently, the Arctic ecosystem and its inhabitants are undergoing transitions which are likely to influence food security. Climate change has been noted to modify ice thickness and animal migration (Ford, 2009), which in turn can have an impact on access to hunting and harvesting areas and traditional food species availability (Egeland et al., 2010b). Westernization has introduced market foods which can be of poor nutritional quality (Chan, et al., 2006; Kuhnlein & Receveur, 2007; Kuhnlein, et al., 1996) and of high cost as a result of the long transportation to Arctic communities. The cost of market foods is at least twice that of the southern Canadian cities (Lawn & Harvey, 2003, 2004) however, a dietary transition to more market food continues in Inuit communities due to several factors including market labour activities which reduce the time available to hunt, environmental changes which create new challenges to hunting and

fishing practices (Ford, 2009), and an increase in the cost of gas and equipment necessary for hunting, harvesting and fishing (Ford, 2009; Lambden, et al., 2006).

The inconsistent and unpredictable access to traditional foods, the ongoing cultural and nutritional transitions, the high cost of market food (Indian and Northern Affairs Canada, January 20, 2010) and low employment and income (Egeland, et al., 2010a; Ford, 2009; Ford & Berrang-Ford, 2009; Lawn & Harvey, 2003, 2004) raise concerns regarding the nature, extent, and consequences of food insecurity in the Arctic.

The aim of the current study was to determine the prevalence, socio-demographic and dietary correlates of food insecurity in a comprehensive survey of Inuit communities in Canada.

SUBJECTS AND METHODS

Subjects

As part of the International Polar Year (IPY) research activities, a cross-sectional Inuit Health Survey was conducted in the summer and fall 2007 and 2008 utilizing the Canadian Coastguard Ship (CCGS) Amundsen which visited 33 coastal communities. Three additional non-coastal communities were visited by land teams in 2008, thereby all 36 communities in the three jurisdictions of Inuvialuit Settlement Region (ISR), Nunavut, and Nunatsiavut, were included in the survey (**Figure 1**). The communities are located from a latitude of 54°10'N to 76°25'N.

Stratified random sampling was carried out by trained research staff where communities were strata and where homes were randomized using either a computer random generation of numbers or a random digit table. Non-pregnant

adults in randomly selected homes were eligible to participate in the individual assessments.

Ethics and participatory processes

The survey was developed through a participatory research process (World Health Organization (WHO) & Centre for Indigenous Peoples' Nutrition and Environment (CINE), 2003) involving a steering committee for each jurisdiction. The steering committees included members from the government health agencies responsible for public health in each jurisdiction, community representatives, land-claim organizations, University of Toronto, and the Centre for Indigenous Peoples' Nutrition and Environment (CINE), McGill University. Details of steering committee membership are provided elsewhere (www.inuithealthsurvey.ca). The committees reviewed and developed questionnaires and facilitated all aspects of the survey work. Scientific research licences were obtained from the Nunavummi Qaujisaqtulirijikkut (Nunavut Research Institute) and from the Aurora Research Institute – Aurora College (Inuvik, Northwest Territories). The Nunatsiavut review board waived the requirement for a license given the extensive consultations that took place. A certificate of ethical acceptability was awarded by the McGill Faculty of Medicine Institutional Review Board. Consent forms, questionnaires and the DVD were translated into different Inuit dialects appropriate for the regions surveyed and all participants signed a written consent form.

Process

The survey involved three land teams which recruited participants and coordinated survey activities followed by a ship team which conducted individual assessments. Each of the three land teams included trained bilingual (English and Inuit dialects) assistants and a nurse who interviewed the primary respondent of

the household collecting information on household composition, traditional food harvesting and consumption, food security and socio-economic indicators.

Food security was assessed using the 18-item United States Department of Agriculture (USDA) food security survey module (Bickel, et al., 2000; Nord, et al., November 2009) slightly modified by Indian and Northern Affairs Canada (INAC) to improve acceptability among Inuit population (Lawn & Harvey, 2003). Ten questions were related to the status of adults and eight questions pertained to children in the household. Following the answers selected by the respondent, a value was given to each question (either 0 or 1). A value of 1 corresponded to affirmative answers such as "yes", "often" and "sometimes" as well as "almost every month", "some months" and "1-2 months" for three questions asking about the frequency. Using the food security classification of Health Canada, 0-1 affirmative response to the 10-item adult questions indicated "food secure" adults; 2-5 affirmative responses indicated "moderately food insecure" adults; and six or more affirmative answers indicated "severely food insecure" adults. For the 8-item children questions, 0-1 affirmative response indicated "food secure" children; 2-4 affirmative responses indicated "moderately food insecure" children; and five or more affirmative responses indicated "severely food insecure" children (Health Canada, 2007a). The "severely food insecure" adult category corresponds to the USDA "very low food secure" adult category.

"Moderate food insecure" category represents problems of inadequacy of food supplies in households resulting in reduced quality or desirability of food consumed. Generally, there is an absence in disrupted eating patterns and food shortages. The "severely food insecure" category includes the conditions of the previous category with disrupted eating patterns and reduced food intake (Health Canada, 2007a).

The overall food security status of the household was determined combining the adult status and the children status, with the worst of the two statuses determining the household's status.

Assessments

Trained bilingual (English and Inuit dialects) interviewers administered questionnaires including a 24-hour dietary recall, a food frequency questionnaire (FFQ) and an individual questionnaire.

Ship and land interviewers were trained to use an adaptation of the USDA five stage, multiple pass technique for collecting 24-hour dietary recall information (United States Department of Agriculture (USDA) & Agricultural Research Service (ARS), March 24, 2010). "Quick list" and "time/occasion" were combined as well as "forgotten foods" and "detail cycle". Description of amounts and final review followed. Food model kits were used to help estimate portion sizes.

The FFQ completed by each participant was designed to capture consumption information about a comprehensive list of common traditional foods (37 items) available in the regions of ISR, Nunavut and Nunatsiavut. The list of traditional foods is based on older CINE FFQs which were updated as needed through feedback from steering committee members and hunters and trappers organizations. The FFQ was adapted to reflect the species available in each region. The participant was asked about how often a particular traditional food was eaten in the past year (in and off season). Harvest calendars from each community helped identify the time periods for the in and off season by community. An abbreviated list of market foods (5 items) with a focus on sugar drinks, fruit juices, milk and chips was also included in the FFQ (past month

consumption). For all food items, the participant was asked to quantify usual serving sizes using the food models and pictures provided.

Food frequency information was entered using Epi Info™ (Centers for Disease Control and Prevention Atlanta, Atlanta, Georgia) and data was double verified (2007) or double entered (2008). 24-hour dietary recall information was entered using CANDAT Software (Godin London Incorporated, London, Ontario). Nutrient composition of foods was determined using the 2007b Canadian Nutrient File (CNF) (Health Canada, 2007b). An additional in-house food file was also used for foods not on the CNF: nutrients for these foods were obtained using food labels, recipes, and other resources found on the internet (nutrient values from the USA were checked for possible fortification differences with Canadian products). All 24-hour recalls were double verified. When information on foods or portion sizes was missing from the 24-hour recall, some assumptions were made using a documented default value. For example, when a food was not well described such as the ingredients in a stew, a default food was entered. Default foods and beverages were determined using information from 24-hour recalls where this information was provided in detail or resources obtained from communities. Defaults were applied to recalls equally. Any recalls or FFQ considered invalid were approved by the Dietary Data Management Coordinator.

The Healthy Eating Index (HEI) was used to assess diet quality. This index was recently adapted for Canadian dietary guidelines using the Canadian Food Guide (CFG) and nutritional recommendations (Shatenstein, et al., 2005). A final score of ≤ 50 indicates a poor diet, 51 to 80 indicates a diet that need improvements and 81 to 100 indicates a good diet. Sugar beverages and foods (> 25% of energy) were also used as indicators of diet quality since consumption over this threshold compromises essential nutrient consumption (Institute of Medicine of the National Academies, 2006) and may impact health by increasing the risk of coronary heart

disease (Fung, et al., 2009). When identifying foods to be included in this category, vegetables and fruit, as well as their juices, were excluded because of their healthier nutrient profile compared to other nutrient-poor high-sugar foods.

Number of servings eaten daily for each participant was determined using data from the 24-hour dietary recall. Overall mean intake for all participants was calculated for each food group and compared with the recommended number of servings to identify whether global recommendations were reached by this population. A similar comparison was done within each jurisdiction. Recommendations of the Canada's Food Guide to Healthy Eating for the First Nations, Inuit and Métis were used (Health Canada, 2007d) which are similar to recommendations from Canada's Food Guide to Healthy Eating (Health Canada, 2007c).

Based on body mass index (BMI) (kg/m^2), body weight classifications were as follows: "underweight" (BMI <18.5), "normal weight" (BMI 18.5-24.9), "overweight" (BMI 25.0-29.9) and "obese" (BMI >30.0). Overweight and obese were combined for analyses as these two BMI categories reflect health risks compared to the category "normal weight" (Health Canada, 2003).

At-risk waist circumference was ≥ 88 cm for women and ≥ 102 cm for men (Health Canada, 2003).

Based on the literature, the percentage of body fat considered to pose a health risk was defined as greater than 31% for women and 20% for men (Gallagher, et al., 2000; Gibson, 2005; Zhu, et al., 2003).

Community size of each community was designated as small or not-small (those having 200 or fewer households vs. other) and latitude was designated as south vs. north (< 65°18'N vs. ≥ 65°18'N): cut-offs representing the mean number of households per community and mean latitude between the most northern and southern communities in the Canadian Arctic.

Statistical analyses

The prevalence of household food security status by region was weighted using Stata/SE 11.1 (StataCorp LP, College Station, TX) and 95% confidence intervals (95% CI) using svyset and svy where communities were strata and sampling weights reflected the proportion of participating households in each community (for household level data).

For the evaluation of the correlates of food security, the data presented in the current analyses represent two types of analyses: the household characteristics and the individual characteristics associated with household food insecurity.

For analyses of the demographic and dietary correlates of food insecurity, unweighted and weighted data were very similar. Thus, the observed unweighted means and medians are presented for household, individual and dietary characteristics by food security status. Differences in proportions were evaluated by Chi-square tests. Prevalence of food insecurity by jurisdiction was evaluated using rate ratios (RR) and 95% CI. P-values for differences in demographic and dietary variables by food security status were obtained from logistic regression adjusting for age, gender, and region with household entered as a cluster variable given that we had on average 1.38 persons participating per household and because individuals within households would share dietary habits and food security status.

RESULTS

Overall, 2796 eligible households were approached from which 841 refused to participate in the survey and 54 cancelled or failed to attend their scheduled visit, thereby leaving a total of 1901 participating households and an overall household response rate of 68% for the 36 communities surveyed. A total of 2,595 individuals (38.5% men) participated in the health survey, representing an average of 1.3 participants per household. The mean age was 43.3 ± 0.4 years. More than 65% were married and nearly 62% did not complete secondary school. Nearly 53% of the adults surveyed had an income lower than 20,000 CAD and the reported overall average grocery cost was of 387.96 CAD (95% CI 374.10 - 401.82 CAD) per week (results not shown).

Of the 1901 participating households, 93.9% (n=1785) had complete information on household composition and food security status. Overall, 37.4 % (95% CI 35.1%-39.7%) of all households were food secure, 33.6% (95% CI 31.3%-35.9%) were moderately food insecure and 29.1% (95% CI 26.9%-31.2%) were severely food insecure, resulting in a prevalence of household food insecurity of 62.6% (95% CI 60.3%-64.9%). Nunavut had a higher prevalence of food insecurity with 68.8% (95% CI 66.1%-71.4%) of households designated as food insecure compared to 43.3% (95% CI 37.2%-49.3%) in ISR and 45.7% (95% CI 39.7%-51.7%) in Nunatsiavut ($P \leq 0.001$) (**Table 1**). Likewise, the prevalence of severe household food insecurity was highest in Nunavut (Table 1). The prevalence rates of adult food insecurity were similar to those of household food insecurity.

Overall, 51.3% (95% CI 48.5%-54.0%) of the households were child food insecure with 21.9% (95% CI 19.6-24.2%) severely food insecure (Table 1). Similar to the household and adult food security assessments, the prevalence of households with child food insecurity was higher in Nunavut (56.5%; 95% CI

53.3%-59.6%) than ISR (32.7%; 95% CI 25.5%-40.0%) and Nunatsiavut (25.8%; 95% CI 18.0%-33.6%).

Household correlates of household food insecurity

Among the food insecure households, there was a greater prevalence of household crowding, households receiving income support, public housing, and homes in need of major repairs ($P \leq 0.001$) (**Table 2**). Further, food insecure homes had a greater number of people living in the home than food secure homes ($P \leq 0.001$) (results not shown).

A northern latitude showed a significant protective effect (RR 0.9; 95% CI 0.8-1.0, $P \leq 0.05$) for severe food insecurity (Table 2). Among food insecure households, there was a lower prevalence of having an active hunter in the home than in food secure households ($P \leq 0.05$).

Participants' adiposity and diet quality as correlates of food insecurity

The percent overweight, with an at-risk waist circumference and an at-risk body fat percent was lower among food insecure adults compared to food secure adults ($P \leq 0.001$) (**Table 3**). More individuals did not complete secondary high school and had a low income (< 20,000 CAD) among the food insecure adults compared to the food secure adults ($P \leq 0.001$).

Adults living in food insecure households and in severely food insecure households had significantly lower HEI scores compared to those living in food secure households ($P \leq 0.001$) (**Table 4**). However, there were no differences observed in energy, macronutrient intake, or in the percent consuming traditional

food in the past-day. The traditional FFQ, however, identified a lower frequency of traditional food intake per day among adults from food insecure households compared to food secure households ($P \leq 0.05$).

Also, adults living in food insecure and severely food insecure households obtained more energy from high-sugar foods ($P \leq 0.05$) but had similar consumption levels of high-sugar drinks when compared to adults from food secure households. Adults from food insecure households were less likely to report consuming grains and vegetables and fruit in the past-day relative to adults from food secure households.

DISCUSSION

The current paper represents the first comprehensive assessment of food insecurity throughout the Canadian Arctic representing three Inuit jurisdictions. A high prevalence of food insecurity was observed among surveyed households (62.6% (95% CI 60.3%-64.9%)) (Table 1). The findings are compatible with a survey of 388 Inuit preschoolers residing in 16 Nunavut communities in which 69.6% of households with preschoolers were child food insecure (Egeland, et al., 2010a). The current data, however, contrasts with results from the CCHS Cycle 2.2 which reported that in 2004, 9% of Canadian households and 33% of off-reserve Aboriginal households were food insecure (Health Canada, 2007a; Willows et al., 2008). In the USA in 2008, 14% of the households were identified as food insecure in an annual national survey (Nord, et al., November 2009). However, the high rates observed in the current study agree with observations of high food insecurity reported by the Food Mail Project in Kugaaruk, Nunavut (86%) and Kangiqsujuaq, Nunavik (50%) (Lawn & Harvey, 2003, 2004), and among females in Igloolik (88%) (Ford & Berrang-Ford, 2009). Lower food insecurity rates were observed in Qeqertarsuaq, Greenland (33 women, 28 men; 16% food insecure) (Goldhar, et al., 2009). All studies mentioned here used the

18-item USDA assessment tool. CCHS 2.2 used the same classification system as our IPY Inuit Health Survey. A survey conducted in Nunavik reported 24% of 521 households not having enough food in the previous month based upon a single questionnaire item (Blanchet & Rochette, 2008; Rochette & Blanchet, 2007).

Food insecure households had a significantly greater prevalence of indicators of socioeconomic disadvantage including crowded households, having any household member on income support, living in public housing, and having a home in need of major repairs (Table 2). These results are similar to the characteristics associated with child food insecurity in the Nunavut Inuit Child Health Survey (Egeland, et al., in press). Furthermore, our 36-communities IPY Inuit Health Survey results corroborate previous observations made by Chan and colleagues where income level was one of the barriers to food security and where the absence of a hunter increased vulnerability to food insecurity (Chan, et al., 2006). Traditional food sharing is a key aspect of Inuit culture and the current analyses found no significant difference in the percentage reporting sharing of traditional food in the past year between food secure and food insecure households. The lower prevalence of food insecurity observed in northern communities may reflect the different access to market and traditional foods compared to that of the southern communities (Kuhnlein & Receveur, 2007).

Body weight

Studies evaluating the association of obesity with food insecurity have identified inconsistent results with some observing a greater risk of overweight/obesity while other studies have identified either a greater degree of underweight, or no difference in weight status by food security status (Doak, et al., 2000; Duffy et al., 2009; Isanaka et al., 2007; Mendez, et al., 2005; Sarlio-Lahteenkorva & Lahelma, 2001; Tayie & Zizza, 2009; Townsend et al., 2001; Wilde & Peterman, 2006).

Inconsistencies between studies in the severity of food insecurity or access to food or consumption of cheaper low nutrient but energy-dense foods may explain the variable relationship between food insecurity and weight status (Townsend, et al., 2001; Wilde & Peterman, 2006). In the current report, a significantly lower prevalence of having an at-risk BMI, waist circumference and percentage body fat were observed among adults residing in food insecure households particularly in severe food insecure households relative to the food secure households.

Dietary characteristics

Even though we observed macronutrients intake close to the recommendations (Institute of Medicine of the National Academies, 2006), HEI scores of food secure and food insecure households ranged between 51 and 80 indicating that regardless of food security status, northern diets are in need of improvement. HEI scores were lower among Inuit preschoolers from child food insecure households compared to child food secure households (Egeland, et al., in press). Further, a similar association was found between food insecurity and low quality diet in the Mississippi Delta (Champagne, et al., 2007), where food secure individuals had an unadjusted HEI score ($n = 1,252$; 60.6 ± 0.4) which was higher than that observed among food insecure individuals ($n = 355$; 57.4 ± 0.7; $P < 0.0001$). The lower HEI score in the current survey is reflected in food group intakes where the majority of the sampled population did not reach recommended minimum servings per day (Table 4) (Health Canada, 2007d). Vegetables and fruit were not as frequently consumed in food insecure households compared to food secure households which agree with results of a previous study showing a lower weekly frequency of consumption of vegetables and fruit among food insecure respondents ($P = 0.004$) (Kendall et al., 1996). Low consumption of vegetables and fruit may be explained by the poor availability, poor quality and high cost of these foods at grocery stores (Chan, et al., 2006). These conditions are similar for the other three food groups which may explain why individuals rely on less nutritive but cheaper items such as high-sugar foods. However, 70% of the

individuals consumed the recommended minimum of 2 meat servings per day, reflecting the importance of meat in the Inuit diet (Bjerregaard & Jorgensen, 2008). The significant relation between food insecurity severity level and food group intake was also observed by Pérez-Escamilla and colleagues (Perez-Escamilla et al., 2004).

Over 50% of the survey population consumed traditional food and when consumed, nearly a quarter of total energy came from traditional foods. Although traditional foods are considered healthy, nutritious and culturally beneficial (Bjerregaard & Jorgensen, 2008; Lambden, et al., 2007), their consumption is influenced by the capacity of being able to afford to hunt and harvest traditional foods and having a hunter in the household. The presence of an active hunter was significantly lower and the prevalence of income support was higher in food insecure households than in food secure households. The Santé Québec Inuit Health Survey which included 226 Inuit women from Nunavik showed a similar traditional food intake with 18% to 21% of energy coming from traditional foods (Blanchet et al., 2000).

The IPY Inuit Health Survey has several strengths providing the first comprehensive assessment of food security status in the Canadian Arctic as it includes all 36 Inuit communities. In addition, the participatory research process involving representatives of communities and Inuit organizations made this survey more adapted to Inuit realities and needs. The survey also presents a broad assessment of socio-demographic and dietary habits. Given that dietary differences were observed by food security status, the data suggests the concurrent validity of the USDA food security survey module for Inuit populations.

However, the food security assessment tool does not take into account the use and the importance of traditional foods, harvesting practices and food-sharing systems for their contribution to food security, which includes both monetary access to market and traditional food systems. Further, the USDA module does not provide the frequency or duration of food insecurity as it simply assesses any occurrence of food insecure events over the past year. As mentioned by Gundersen (Gundersen, 2008), the selected food security measures and questions also impact on the prevalence of food insecurity. Indeed, the magnitude of the difference observed between American Indians, including Eskimo, and non-American Indians is dependent of the chosen measure. Furthermore, it is reported by Power that food security is perceived differently by this population. Indeed, Power qualifies this concept as "cultural food security" which encompasses "the ability of Aboriginal People to reliably access important traditional/country food through harvesting methods" (Power, 2008). Finally, as mentioned by Egeland and colleagues, some of the question items in the USDA module lack construct validity for Inuit, for example, the concept of "skipping meals" is not relevant in a traditional context in that Inuit would eat throughout the day and not consume distinct meals (Egeland, et al., in press).

Limitations

The Inuit Health Survey is a cross-sectional survey and therefore, cause and effect relations cannot be drawn between variables. Another limitation is that the dietary assessment relied upon one 24-hour recall as survey logistical constraints precluded the collection of a repeat recall. Nonetheless differences in dietary quality were identified between adults from food secure and insecure households.

The Inuit-specific food security data will for the first time provide ISR, Nunavut and Nunatsiavut with comprehensive information to help guide future policies and programs to mitigate the negative health impacts of household food insecurity. The study identified an alarming prevalence of food insecurity which calls for

immediate action and consideration for improving access to both traditional and market food systems, as well as increase peoples' knowledge and awareness around market food choices. These data also provide an opportunity to develop a monitoring system - one that will take into account current validated measures alongside characteristics relevant to Inuit. Indeed, a more adapted tool measuring food security in Inuit context is required.

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Table 1: Weighted prevalence of household, adult and child food security (%) (95% CI): International Polar Year Inuit Health Survey, 2007-2008.

Region (n)	Percent food secure (95% CI)	Percent total food insecure[1] (FI) (95% CI)	Percent moderately FI (95% CI)	Percent severely FI (95% CI)
HOUSEHOLDS				
ALL (1788)	37.4 (35.1-39.7)	62.6 (60.3-64.9)	33.6 (31.3-35.9)	29.1 (26.9-31.2)
Nunavut (1,298)	31.2 (28.6-33.9)	68.8 (66.1-71.4)	34.6 (31.9-37.3)	34.1 (31.5-36.8)
ISR (266)	56.7 (50.7-62.8)	43.3 (37.2-49.3)***	31.1 (25.3-36.8)	12.2 (8.3-16.1)***
Nunatsiavut (224)	54.3 (48.3-60.3)	45.7 (39.7-51.7)***	29.2 (23.3-35.1)	16.5 (11.7-21.4)***
ADULTS				
ALL (1788)	38.3 (36.0-40.6)	61.7 (59.4-64.0)	34.5 (32.2-36.8)	27.2 (25.1-29.3)
Nunavut (1,298)	32.4 (29.7-35.1)	67.6 (64.9-70.3)	35.8 (33.0-38.6)	31.8 (29.2-34.5)
ISR (266)	57.2 (51.1-63.2)	42.8 (36.8-48.9)***	30.6 (24.9-36.4)	12.2 (8.3-16.1)***
Nunatsiavut (224)	54.3 (48.3-60.3)	45.7 (39.7-51.7)***	30.5 (24.6-36.5)	15.2 (10.5-19.9)***
CHILDREN				
ALL (1299)	48.7 (46.0-51.5)	51.3 (48.5-54.0)	29.4 (26.8-32.0)	21.9 (19.6-24.2)
Nunavut (1015)	43.5 (40.4-46.7)	56.5 (53.3-59.6)	30.9 (27.9-33.9)	25.6 (22.8-28.3)
ISR (166)	67.3 (60.0-74.5)	32.7 (25.5-40.0)***	26.6 (19.6-33.6)	6.1 (2.8-9.3)***
Nunatsiavut (118)	74.2 (66.4-82.0)	25.8 (18.0-33.6)***	14.8 (8.3-21.3)***	11.0 (5.4-16.6)***

#P ≤ 0.10, *P ≤ 0.05, **P ≤ 0.01, ***P ≤ 0.001 (ISR and Nunatsiavut separately compared to Nunavut as reference), χ^2 for differences in proportion.

[1] Percent total food insecure includes both moderate and severe food insecure.

Table 2: Household characteristics prevalence (%) and rate ratios (RR) (95% CI) by household food security status: International Polar Year Inuit Health Survey 2007-2008.

Household variable (n of participants)	Food Secure % (n)	Food Insecure[1] % (n)	Food Insecure vs. Secure RR (95% CI)	Severe Food Insecure % (n)	Severe Food Insecure vs. Secure RR (95% CI)
Household crowding[2]	17.0 (109)	32.5 (354)***	1.9 (1.6-2.3) ***	36.4 (185)***	2.1 (1.7-2.6) ***
Income support	23.6 (152)	56.2 (633)***	2.4 (2.1-2.8) ***	65.7 (345)***	2.8 (2.4-3.2) ***
Public housing	42.9 (275)	76.4 (863)***	1.8 (1.6-2.0) ***	82.9 (437)***	1.9 (1.8-2.1) ***
Home in need of major repairs	29.1 (182)	50.1 (542)***	1.7 (1.5-2.0) ***	59.0 (298)***	2.0 (1.8-2.3) ***
Community size (> 200 households)	60.6 (396)	63.3 (718)	1.0 (1.0-1.1)	63.0 (332)	1.0 (1.0-1.1)
Latitude of community (≥ 65°18'N)	56.9 (372)	54.2 (615)	1.0 (0.9-1.0)	50.1 (264)*	0.9 (0.8-1.0)*
Home distributes traditional foods	78.2 (502)	75.1 (834)	1.0 (0.9-1.0)	74.7 (384)	1.0 (0.9-1.0)
Active hunter in household	70.8 (460)	65.8 (739)*	0.9 (0.9-1.0)*	63.3 (329)**	0.9 (0.8-1.0) **

#P ≤ 0.10, *P ≤ 0.05, **P ≤ 0.01, ***P ≤ 0.001

[1] Food insecure includes both moderate and severe food insecure.

[2] Crowding is defined as "more than one person per room in the dwelling" (Statistics Canada, 2009).

Table 3: Individual characteristics prevalence (%) and rate ratios (RR) (95% CI) by adult food security status: International Polar Year Inuit Health Survey 2007-2008.

Household variable (n of participants)	Food Secure % (n)	Food Insecure[1] % (n)	Food Insecure vs. Secure RR (95% CI)	Severe Food Insecure % (n)	Severe Food Insecure vs. Secure RR (95% CI)
Education (secondary not completed)	47.7 (257)	69.2 (618)***	1.5 (1.3-1.6)***	73.6 (323)***	1.6 (1.4-1.7)***
Income (< 20,000 CAD)	29.2 (144)	63.1 (512)***	2.2 (1.9-2.5)***	72.7 (283)***	2.5 (2.2-2.9)***
At-risk BMI[2]	77.3 (412)	60.4 (551)***	0.8 (0.7-0.8)***	54.7 (245)***	0.7 (0.7-0.8)***
At-risk waist circumference[3]	65.3 (347)	45.3 (408)***	0.7 (0.6-0.8)***	39.7 (176)***	0.6 (0.5-0.7)***
At-risk body fat[4]	76.5 (404)	62.8 (570)***	0.8 (0.8-0.9)***	60.0 (267)***	0.8 (0.7-0.9)***

#P ≤ 0.10, *P ≤ 0.05, **P ≤ 0.01, ***P ≤ 0.001

[1] Food insecure includes both moderate and severe food insecure.

[2] An at-risk BMI is defined as having a BMI ≥ 25.0.

[3] An at-risk waist circumference is defined as having a waist circumference ≥ 88 cm for women and ≥ 102 cm for men (Health Canada, 2003).

[4] An at-risk body fat is defined as having body fat greater than 31% for women and greater than 20% for men.

Table 4: Mean ± standard deviation (SD) or median (25^{th}–75^{th} percentiles)[1] of dietary characteristics of adults by household food security status: International Polar Year Inuit Health Survey, 2007-2008.

Characteristics of the adults	Food Secure	All Food Insecure[2]	Severe Food Insecure
Healthy Eating Index (HEI) score[3]	55.8 ± 12.8	52.3 ± 12.6***	51.6 ± 12.9***
Energy intake (kcal)	1932 (1420-2630)	1923.5 (1297.5-2652.5)	1889.5 (1233-2663)
% Energy from carbohydrates	45.9 (34.8-55.7)	47.0 (35.0-58.9)	47.1 (34.6-59.9)
% Energy from protein	18.8 (13.7-26.0)	18.4 (12.5-26.5)	17.6 (12.3-26.3)
% Energy from fat	31.6 (24.8-38.8)	30.7 (24.0-38.5)	30.3 (24.2-39.0)
% Energy from saturated fat	9.9 (7.7-12.9)	10.0 (7.5-13.1)	9.8 (7.3-13.2)
Traditional foods (TF)			
Percent consuming TF in past day	57.0 ± 2.2	57.6 ± 1.7	58.4 ± 2.4
% Energy intake *among the consumers*[4]	21.3 (11.3-38.7)	25.4 (12.7-43.2)	26.0 (11.9-44.8)
Daily frequency of consumption (per day)[5]	0.9 (0.4-1.7)	0.8 (0.3-1.6)*	0.9 (0.3-1.7)
% Energy from high-sugar foods[6]	23.9 (12.2-37.7)	28.5 (16.1-42.3)*	29.3 (15.3-43.3)*
High-sugar drinks[6]			
Percent consuming high-sugar drinks	28.1 ± 2.0	35.2 ± 1.6	35.7 ± 2.4
% Energy intake *among the consumers*[4]	10.5 (6.0-16.1)	10.1 (5.6-17.9)	12.3 (5.9-18.1)
Sodium (mg)	2355 (1347-3680)	2112 (1207-3489)	2068 (1087-3564)

Characteristics of the adults	Food Secure	All Food Insecure[2]	Severe Food Insecure
Food groups			
Grain[7]:			
- Percent consuming grain	92.7 ± 1.2	86.6 ± 1.2*	83.0 ± 1.9***
- Number of servings *among consumers*[8]	4.1 (2.3-6.3)	4.2 (2.3-6.6)	4.2 (2.4-6.7)#
- % reaching recommendations	24.1%	23.5%	22.7%
Vegetables and fruit[7]:			
- Percent consuming vegetables and fruit	77.6 ± 2.1	57.8 ± 1.9***	55.6 ± 2.8***
- Number of servings *among consumers*[8]	1.8 (0.9-3.4)	1.4 (0.7-2.6)	1.4 (0.7-2.6)
- % reaching recommendations	3.8%	3.0%	2.5%
Dairy[7]:			
- Percent consuming dairy	39.7 ± 2.8	27.5 ± 1.9	23.0 ± 2.6
- Number of servings *among consumers*[8]	0.7 (0.3-1.4)	0.6 (0.3-1.1)	0.5 (0.3-1.1)
- % reaching recommendations	6.9%	4.7%*	3.9%*
Meat[7]:			
- Percent consuming meat	97.5 ± 0.7	94.8 ± 0.8#	94.4 ± 1.2#
- Number of servings[8]	3.5 (1.9-6.2)	3.6 (1.9-6.2)	3.5 (1.8-6.0)
- % reaching recommendations	70.0%	68.5%	67.0%

#P ≤ 0.10, *P ≤ 0.05, **P ≤ 0.01, ***P ≤ 0.001 (P-values were determined from logistic regression adjusting for age, gender, region with household entered as a cluster variable.)

[1] Unless otherwise noted as percent.

[2] Food insecure households include both moderately and severely food insecure households.

[3] Canadian version (Shatenstein, et al., 2005).

[4] Since 890 participants did not have any energy coming from traditional foods and 1388 participants did not consume any high-sugar drinks, these null value were excluded from each of the variable to look at those who did consumed these drinks and foods.

[5] Daily frequency of consumption was determined based on frequencies recorded on the FFQ. All frequencies were converted into daily frequency.

[6] Sugar beverages and foods having more than 25% of their energy content coming from sugar were considered as "high sugar drinks and foods".

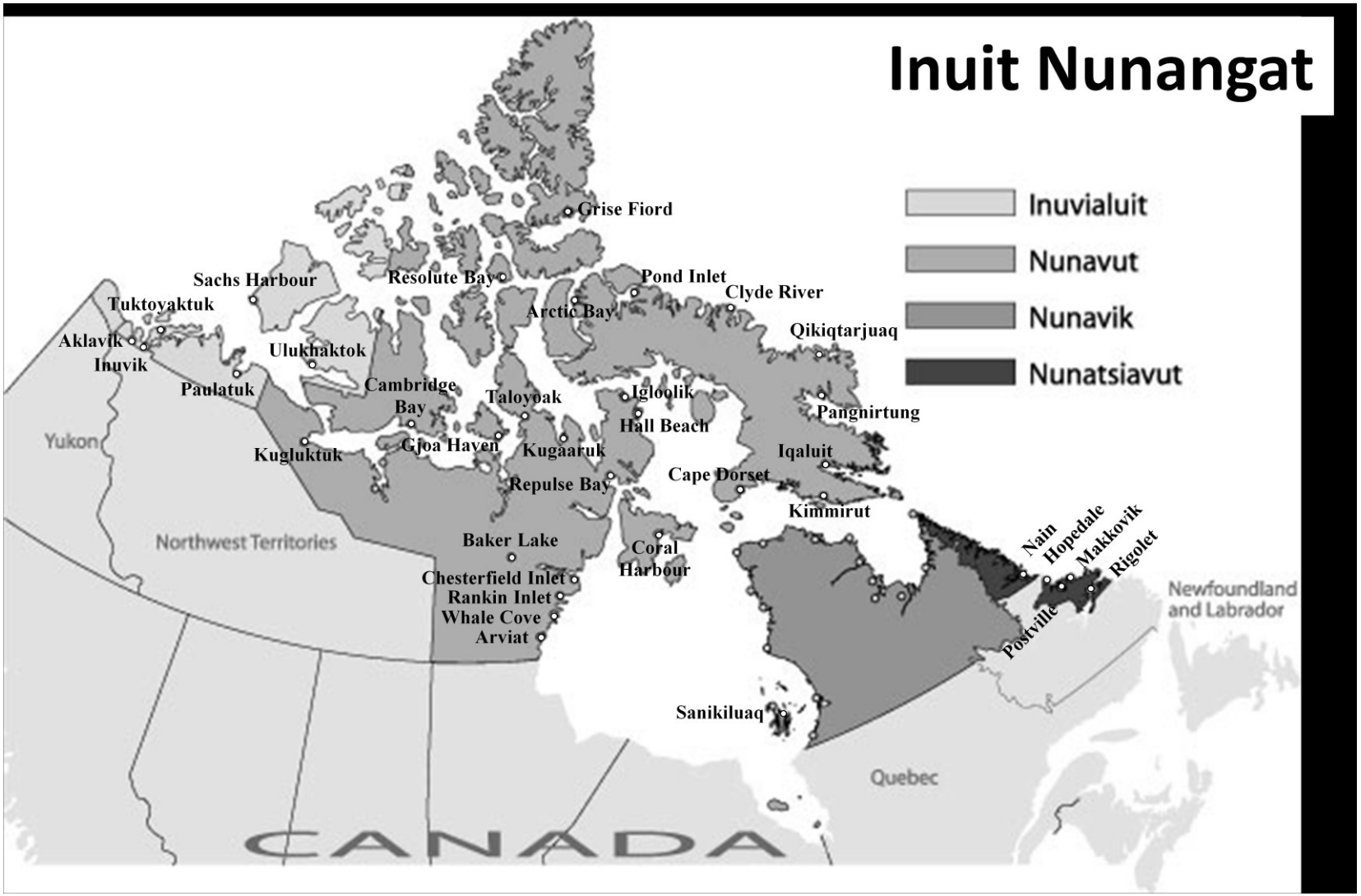
[7] Canada's Food Guide to Healthy Eating for First Nations, Inuit and Métis (Health Canada, 2007d).

[8] Participants who did not have any serving from grain (225 participants), vegetables and fruit (575 participants) and dairy (877 participants) were excluded from each of the variables to look at those who did consumed these foods. However, all participants were considered for meat as only 94 of them did not have serving from this food group.

Figure

Figure 1: Map of Inuvialuit Settlement Region (ISR), Nunavut and Nunatsiavut showing communities that participated in the Adult Inuit Health Survey, 2007-2008.[5]

[5] Adapted and used with permission from Inuit Tapiriit Katanami (2009/07/28), Inuit regions of Canada, http://www.itk.ca/sites/default/files/InuitNunaat_Basic.pdf, retrieved July 22, 2010.


Inuit Nunangat
Inuvialuit
Nunavut
Nunavik
Nunatsiavut
Grise Fiord
Resolute Bay
Pond Inlet
Clyde River
Sachs Harbour
Tuktoyaktuk
Arctic Bay
Qikiqtarjuaq
Aklavik
Inuvik
Ulukhaktok
Paulatuk
Cambridge Bay
Taloyoak
Igloolik
Pangnirtung
Hall Beach
Yukon
Kugluktuk
Gjoa Haven
Kugaaruk
Iqaluit
Cape Dorset
Repulse Bay
Kimmirut
Northwest Territories
Baker Lake
Coral Harbour
Nain
Hopedale
Makkovik
Rigolet
Chesterfield Inlet
Rankin Inlet
Whale Cove
Arviat
Newfoundland and Labrador
Postville
Sanikiluaq
Quebec
CANADA

6. SUMMARY AND CONCLUSION

In addition to the descriptive results presented in the manuscript, Appendix A presents the prevalence of affirmative answers to the 18 food security questions; as concrete examples, some of them ask for concerns. For instance, when asking about worrying that food would run out before having enough money to buy more, 61.5% (95% CI 59.3%-63.8%) of all respondent answered that it happened at least "sometimes" in the last 12 months; in contrast to 97.6% (95% CI 96.2%-98.9%) in severely food insecure adults. Adults cutting meal size or skipping meals because of not having enough money for food was seen in more than 90% of severely food insecure respondents compared to 0% in food secure respondents. Over 60% of severely food insecure individuals responded affirmatively to the question "did you ever not eat for a whole day in the past year because you were missing money for food?". Childrens' meals were cut for nearly 60% of severely food insecure respondents. Furthermore, nearly 41% of severely food insecure adults lived in a situation where children did not eat for a whole day because there was not enough money for food.

As food insecurity is one of many indicators of economic hardship, it is not surprising that in the current report and in the literature, food insecurity is related to low economic status indicators (Duhaime, et al., 2002; Willows, et al., 2008). Economic hardship in the Arctic, however, is likely of more consequence for food security than in southern cities given that market-food costs are generally twice as high as in southern cities (Indian and Northern Affairs Canada, January 20, 2010). Further, hunting and fishing equipment and maintenance costs are high in Arctic communities (Duhaime, et al., 2002). Indigenous Peoples experience greater economic disparities (Bernier, 1997; George & Kuhn, 1994), as observed here 61.3% of all food insecure individuals had an income < 20,000 CAD (manuscript, Table 3), which contributes to disparities in food security and health (Egeland & Harrison, 2010).

This is the first study to report food security prevalence across Northern Canada; giving a striking descriptive portrait of the situation in Inuit communities. Indeed, severe household food insecurity prevalence observed in this study equals ten times that of Canada (2.9%) (Health Canada, 2007a). However, both food insecurity prevalence found here (moderate (33.6%) and severe (29.1%) household food insecurity) are in accordance with that observed in Kugaaruk and Kangiqsujuaq (20-40% moderate food insecurity and 10-66% severe food insecurity) (Lawn & Harvey, 2003, 2004). Results are also very similar to those of Egeland and colleagues in Nunavut (35.3% moderately and 34.4% severely food insecure households) (Egeland, et al., 2010a). In contrast, household food security presented here was less than half that of Canada's (90.8%) (Health Canada, 2007a). Furthermore, less than one child out of two was food secure across Canadian Arctic.

Household characteristics were also associated with household food security status as the prevalence of household crowding, income support, public housing, and having a house in need of major repairs was higher among food insecure households particularly among severe food insecure households. Further, the presence of having an active hunter in the household was lower among food insecure and severely food insecure households relative to food secure households. Community size and latitude, however, were not strongly associated with household food insecurity, but food insecure severe households showed a tendency to be southern communities. Distribution of traditional food seemed to be similar in all food security categories. For selected individual characteristics, education less than secondary and income less than 20,000 CAD showed higher rate ratio between food insecurity and food security as well as between severe food insecurity and food security, at the opposite of BMI risk, waist circumference risk and body fat risk.

Regarding dietary characteristics of adults by household food security status, we observed lower HEI score as food security worsened. However, macronutrient

distribution seemed adequate following the recommendations even though protein intake was lower in severely food insecurity status. Traditional food consumption was different between food security categories when looking at daily frequency, with higher frequency in food secure households. Finally, very few people reached the food group recommendations except for meat where nearly 70% reached recommended intake levels.

However, estimation of food serving size, obtained during the 24h recall and FFQ, was quite a challenge for the study participants. Indeed, it is an Inuit practice to make the whole piece of meat common to everyone so eaters can cut desired pieces throughout the meal. Therefore, estimation of the quantity eaten during the entire meal was a difficult exercise for the participants. Further, Inuit traditionally consumed food as needed throughout the day and not distinct meals, which reduced the cultural relevance of some of the question items in the USDA assessment module (Egeland, et al., in press). Thus, because of these cultural differences, the estimation of the diet collected here could be under- or over reported. Following the Goldberg cut-off method, calculation of the ratio of the reported energy intake (EI) over the basal metabolic rate (at rest energy expenditure of an individual who is lying in a fasted state (BMR)) would help determine underreporters when the ratio is under a certain cutoff (Gibson, 2005).

This study gave a portrait of the food security situation across Northern Canada and aims to serve as a baseline for future interventions and research. Thus, future interventions should focus on improving accessibility and availability of foods for food insecure individuals and also ensure that those who are food secure maintain their food security situation. Traditional foods and market foods should be both concerned by strategies as both are parts of the Inuit diet. For instance, a Traditional Food Initiative could be developed based on the *Food Mail Program* (which subsidizes a part of the cost of the transportation of selected perishable foods and non-perishable items up North (Agriculture and Agri-Food Canada, 2004)) to improve access to harvesting, hunting and fishing equipment by

subsidizing their cost of delivery as well as cost of fuel. Interventions should also increase awareness of consumers for healthy eating by using different activities such as educational labels on the grocery shelves, grocery guided tours, food tasting, vouchers of promoted healthy foods and cooking classes. Besides, growing culture of vegetables and fruit in greenhouses could be a first step in increasing freshness of foods and avoiding cost of transportation of these already expensive foods. Already existing in Iqaluit (Minogue, June 20, 2007), this also allows people to taste fresh foods for the first time. Presence of community freezers and distribution of food baskets are however important strategies to be sustained.

Nevertheless, this study was done using the USDA food security survey module which does not take into account Inuit realities. Therefore, a tool adapted for that particular context is warranted to more adequately estimate food security prevalence in these regions. Traditional food consumption, traditional culture as well as consequences of socio-economic and cultural transformations affecting Inuit society (such as coping mechanisms to get money to buy food, and substance addiction and gambling which may directly affect money available for purchasing food or sustaining harvesting activities) (Ford & Beaumier, in press) need to be considered in addition to financial issues as it is the case with the USDA tool. Furthermore, as IHS is a cross-sectional survey, no cause-and-effect relation can be drawn.

Yet, this observational study is a step forward in estimating food security status in Inuit communities. Information collected on the availability, accessibility and harvesting methods of country food as well as on food sharing practices will provide additional background for understanding the Inuit context of food security. A greater understanding of these determinants of food security and identification of key correlates of food insecurity as it exists in Northern Canada will also help guide in the development of prevention and intervention strategies and improve resiliency as arctic food systems rapidly change. The results from the

IPY IHS will help prioritize food insecurity for policies and programs aimed at improving food security status in Arctic communities.

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8. TABLES

Table 5: Communities surveyed by the Adult Inuit Health Survey in 2007-2008.

Community	Date	Community	Date
2007		**2008**	
Sanikiluaq, NU	August 6 – 8, 2007	Tuktoyaktuk, ISR	August 10 – 12, 2008
Arviat, NU	August 18 – 21, 2007	Sachs Harbour, ISR	August 13, 2008
Whale Cove, NU	August 22, 2007	Paulatuk, ISR	August 14, 2008
Rankin Inlet, NU	August 23 – 25, 2007	Ulukhaktok, ISR	August 15, 2008
Chesterfield Inlet, NU	August 26, 2007	Aklavik, ISR*	September 1 – 7, 2008
Coral Harbour, NU	August 27 – 28, 2007	Inuvik, ISR*	September 8 – 23, 2008
Repulse Bay, NU	August 29 – 30, 2007	Kugluktuk, NU	August 16 – 18, 2008
Hall Beach, NU	August 31 – September 1, 2007	Cambridge Bay, NU	August 19 – 21, 2008
Igloolik, NU	September 1 – 3, 2007	Gjoa Haven, NU	August 22 – 24, 2008
Cape Dorset, NU	September 5 – 6, 2007	Taloyoak, NU	August 25 – 27, 2008
Kimmirut, NU	September 7, 2007	Kugaaruk, NU	August 30 – 31, 2008
Iqaluit, NU	September 8 – 12, 2007	Resolute Bay, NU	September 2, 2008
Pangnirtung, NU	September 14 – 15, 2007	Baker Lake, NU*	September 7 – 20, 2008
Qikiqtarjuaq, NU	September 17, 2007	Nain, NL	October 7 – 8, 2008
Clyde River, NU	September 18 – 19, 2007	Hopedale, NL	October 9, 2008
Grise Fiord, NU	September 21, 2007	Postville, NL	October 10, 2008
Pond Inlet, NU	September 22 – 24, 2007	Makkovik, NL	October 11, 2008
Arctic Bay, NU	September 25, 2007	Rigolet, NL	October 12, 2008

NU – Nunavut; ISR – Inuvialuit Settlement Region; NL – Newfoundland and Labrador

*These communities were land-based. All other communities were ship-based.

Table 6: Definition and classification of food security used by Health Canada (Health Canada, 2007a).

Category	Definition	10-item adult food security scale	8-item child food security scale
Food secure	No, or one, indication of difficulty with income-related food access	0 or 1 affirmed responses	0 or 1 affirmed responses
Food insecure, moderate	Indication of compromise in quality and/or quantity of food consumed	2 to 5 affirmed responses	2 to 4 affirmed responses
Food insecure, severe	Indication of reduced food intake and disrupted eating patterns	≥ 6 affirmed responses	≥ 5 affirmed responses

Table 7: Comparison between Health Canada and the USDA food security status categories based on the total number of affirmative answers[1].

	Health Canada[2]		USDA[3]		
Food security categories	Adult status (10-item scale)	Children status (8-item scale)	Adult status (10-item scale)	Children status (8-item scale)	**Food security categories**
Food secure	0 to 1	0 to 1	0 to 2	0 to 1	**Food secure**
Moderately food insecure	2 to 5	2 to 4	3 to 5	2 to 4	**Low food secure**
Severely food insecure	6 to 10	5 to 8	6 to 10	5 to 8	**Very low food secure**
Overall household status	Determined by the worst of the two statuses		Total of both status		**Overall household status**

[1] Affirmative answers are "yes", "often" and "sometimes"; and "almost every month", "some months" and "1-2 months" for three questions asking about the frequency.

[2] (Health Canada, 2007a)

[3] (Nord & Hopwood, 2008)

Table 8: Food security status of adults and children from the communities evaluated by the *Food Mail Program Pilot Project* (percentage) (Lawn & Harvey, 2003, 2004).

Population	Food secure (%)	Food insecure – moderate (%)	Food insecure – severe (%)
Kugaaruk			
Adult	17	24	59
Children	17	30	52
Kangiqsujuaq			
Adult	60	33	7
Children	60	34	6

Table 9: Components of the Healthy Eating Index (HEI) (Gibson, 2005).

Component	Score range (points)	Criteria for score of 0	Criteria for score of 10
1. Grains	0-10	0 servings	6-11 servings
2. Vegetables	0-10	0 servings	3-5 servings
3. Fruit	0-10	0 servings	2-4 servings
4. Milk	0-10	0 servings	2-3 servings
5. Meat	0-10	0 servings	2-3 servings
6. Total fat	0-10	≥ 40% energy from fat	≤ 30% energy from fat
7. Saturated fat	0-10	≥ 15% energy from saturated fat	≤ 10% energy from saturated fat
8. Cholesterol	0-10	≥ 450 mg cholesterol	≤ 300 mg cholesterol
9. Sodium	0-10	≥ 4,800 mg sodium	≤ 2,400 mg sodium
10. Variety over a 3-day period	0-10	≤ 6 different food items	16 different food items

Table 10: Components of the Canadian Healthy Eating Index (HEI) (Shatenstein, et al., 2005).

Component	Score range (points)	Criteria for score of 0	Criteria for score of 10
1. Grain products	0-10	0 servings	Women 18-49 y: 9 servings Women 50+ y: 6 servings Men 18-49 y: 12 servings Men 50+ y: 9 servings
2. Vegetables and fruit	0-20	0 servings	Women 18-49 y: 7 servings Women 50+ y: 5 servings Men 18-49 y: 10 servings Men 50+ y: 7 servings
3. Milk products	0-10	0 servings	2 portions
4. Meat and meat alternatives	0-10	0 servings	Women 18-49 y: 2.5 servings Women 50+ y: 2 servings Men 18-49 y: 3 servings Men 50+ y: 2.5 servings
5. Total fat (%)	0-10	≥ 45% energy from fat	≤ 30% energy from fat
6. Saturated fat (%)	0-10	≥ 15% energy from saturated fat	≤ 10% energy from saturated fat
7. Cholesterol intake	0-10	≥ 450 mg cholesterol	≤ 300 mg cholesterol
8. Sodium intake	0-10	≥ 4,800 mg sodium	≤ 2,400 mg sodium
9. Dietary variety	0-10	< 1 serving from each of food groups of CFG	≥ 1 portion from each of food groups of CFG

Table 11: Body mass index (BMI) categories (Health Canada, 2003).

BMI categories	BMI label	Risk
< 18.5	Underweight	Increased risk
18.5 - 24.9	Normal weight	Least risk
25.0 - 29.9	Overweight	Increased risk
> 30	Obese	
30.0 – 34.9	Obese Class I	High risk
35.0 – 39.9	Obese Class II	Very high risk
≥ 40.0	Obese Class III	Extremely high risk

Table 12: Waist circumference cut-offs (Health Canada, 2003).

Gender	Waist circumference cut-offs
Women	≥ 88 cm (35 in.)
Men	≥ 102 cm (40 in.)

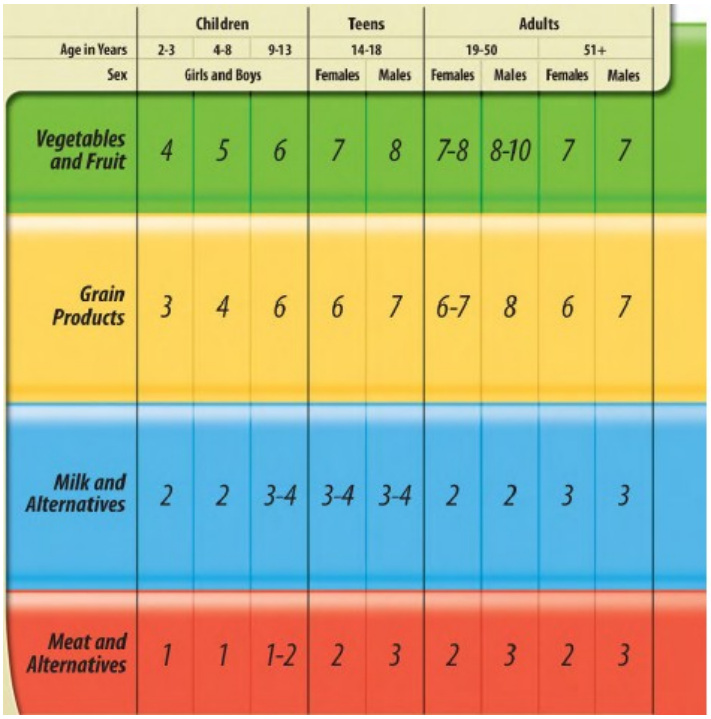
Table 13: Health risk classification according to body mass index (BMI) and waist circumference (Health Canada, 2003).

		BMI		
		Normal 18.5-24.9	**Overweight 25.0-29.9**	**Obese > 30**
Waist circumference	**< 88 cm (women) < 102 cm (men)**	Least risk	Increased risk	High risk
	≥ 88 cm (women) ≥ 102 cm (men)	Increased risk	High risk	Very high risk

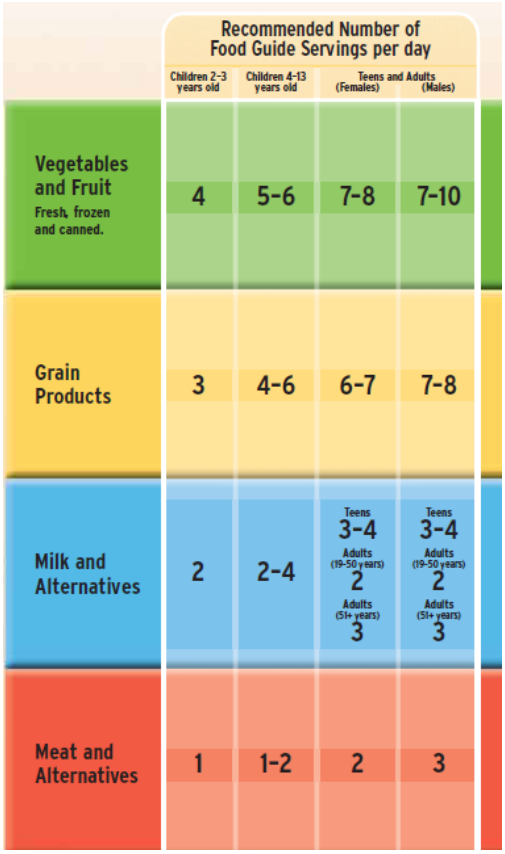
9. FIGURES

Figure 2: Inuit Health Survey (IHS) 2007-2008 itinerary (Inuit Health Survey (IHS), 2010).

Figure 3: Recommended number of Food Guide servings per day [Canadian version (left); First Nations, Inuit and Métis version (right)] (Health Canada, 2007c, 2007d).

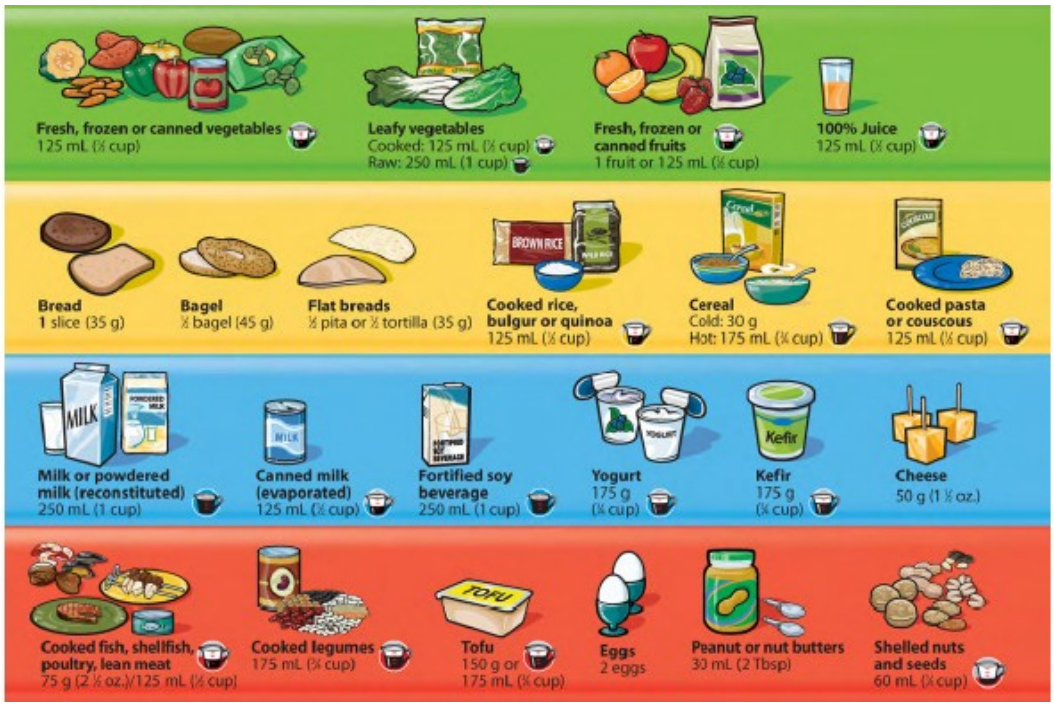


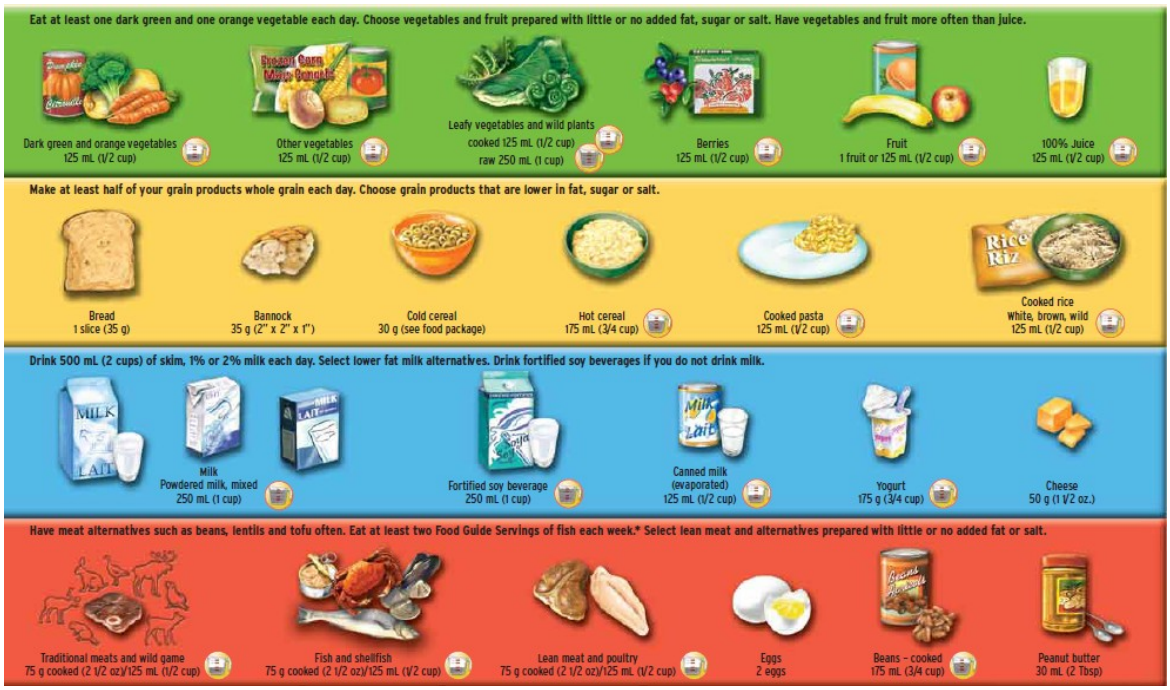
	Children			Teens		Adults			
Age in Years	2-3	4-8	9-13	14-18		19-50		51+	
Sex	Girls and Boys			Females	Males	Females	Males	Females	Males
Vegetables and Fruit	4	5	6	7	8	7-8	8-10	7	7
Grain Products	3	4	6	6	7	6-7	8	6	7
Milk and Alternatives	2	2	3-4	3-4	3-4	2	2	3	3
Meat and Alternatives	1	1	1-2	2	3	2	3	2	3



Recommended Number of Food Guide Servings per day				
	Children 2-3 years old	Children 4-13 years old	Teens and Adults (Females)	Teens and Adults (Males)
Vegetables and Fruit Fresh, frozen and canned.	4	5-6	7-8	7-10
Grain Products	3	4-6	6-7	7-8
Milk and Alternatives	2	2-4	Teens 3-4 Adults (19-50 years) 2 Adults (51+ years) 3	Teens 3-4 Adults (19-50 years) 2 Adults (51+ years) 3
Meat and Alternatives	1	1-2	2	3

Figure 4: Recommended serving size for each food group [Canadian version (top); First Nations, Inuit and Métis version (bottom)] (Health Canada, 2007c, 2007d).





10. APPENDIX

Appendix A: Prevalence of positive responses* to the questions of the food security questionnaire.

Questions "In the last 12 months…"	Prevalence, % (95% confidence interval) All Respondent	Food Secure Adults	Moderate Food Insecure Adults	Severe Food Insecure Adults
1. Did you ever worry whether the food for you and your family would run out before you have enough money to buy more?	61.5 (59.3-63.8)	10.9 (8.5-13.2)	87.5 (85.0-90.1)	97.6 (96.2-98.9)
2. Were there times when the food for you and your family just did not last, and there was no money to buy more?	60.6 (58.3-62.8)	6.6 (4.7-8.4)	88.8 (86.3-91.3)	98.4 (97.2-99.5)
3. Were there times when you and your family could not afford to eat healthy food?	51.2 (48.9-53.5)	5.4 (3.7-7.1)	66.3 (62.6-70.0)	94.7 (92.7-96.7)
4. Were there times when you could only feed your children less expensive foods because you were running out of money to buy food?	58.0 (55.4-60.7)	11.3 (8.4-14.3)	72.3 (68.1-76.4)	94.5 (92.3-96.8)
5. Were there times when it was not possible to feed the children a healthy meal because there was not enough money?	49.4 (46.6-52.1)	4.2 (2.4-6.1)	54.8 (50.2-59.4)	93.8 (91.4-96.1)
6. Were there times when the children in the house were not eating enough because there was no money to buy enough food?	41.3 (38.7-44.0)	1.1 (0.1-2.1)	37.8 (33.3-42.3)	90.3 (87.4-93.2)
7. Did you or other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money for food?	31.5 (29.4-33.7)	0	18.5 (15.5-21.6)	91.2 (88.7-93.7)
8. How often did this happen? †	26.5 (24.4-28.5)	0	11.8 (9.3-14.4)	81.3 (77.8-84.7)
9. Did you ever eat less than you felt you should because there wasn't enough food?	32.6 (30.4-34.8)	0.2 (-0.1-0.4)	20.3 (17.1-23.4)	92.7 (90.4-95.0)

Questions "In the last 12 months…"	Prevalence, % (95% confidence interval) All Respondent	Food Secure Adults	Moderate Food Insecure Adults	Severe Food Insecure Adults
10. Were you ever hungry but didn't eat because you couldn't afford enough food?	24.9 (22.9-27.0)	0	8.0 (5.9-10.1)	80.7 (77.2-84.2)
11. Did you lose weight because you didn't have enough money for food?	18.0 (16.2-19.7)	0	4.0 (2.5-5.5)	60.3 (55.9-64.6)
12. Did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food?	18.1 (16.3-19.9)	0	2.2 (1.1-3.4)	63.1 (58.9-67.4)
13. How often did this happen? †	17.5 (15.7-19.3)	0	1.9 (0.8-3.0)	61.3 (57.0-65.6)
14. Did you ever cut the size of the children's meal because there wasn't enough money for food?	22.4 (20.1-24.7)	0.4 (-0.2-1.1)	11.2 (8.3-14.1)	59.5 (54.6-64.3)
15. Did any of the children ever skip meals because there wasn't enough money for food?	20.0 (17.8-22.2)	0	6.9 (4.6-9.3)	57.0 (52.1-61.8)
16. How often did any of the children ever skip meals because there wasn't enough money for food? †	16.9 (14.8-18.9)	0	4.5 (2.6-6.4)	49.5 (44.6-54.4)
17. Were the children ever hungry but you just couldn't afford more food?	23.9 (21.6-26.3)	0.2 (-0.2-0.7)	10.5 (7.7-13.4)	65.4 (60.8-70.1)
18. Did your children ever not eat for a whole day because there wasn't enough money for food?	13.6 (11.8-15.5)	0	2.9 (1.3-4.5)	40.8 (36.0-45.6)

*"Yes", "often" and "sometimes" were considered to be positive answers.

†"Almost every month", "some months" and "1-2 months" were considered to be positive answers.