

Université de Montréal

**Dietary patterns associated with diet quality among First Nations women living on reserves in British Columbia**

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Dietary patterns associated with diet quality among First Nations women living on reserves  
in British Columbia

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## Résumé

Les Indigènes canadiens vivent une rapide transition nutritionnelle marquée par une consommation accrue des produits commercialisés au dépit des aliments traditionnels. Ce mémoire cherche à identifier les patrons alimentaires associés à une meilleure alimentation des femmes autochtones vivant dans les réserves en Colombie Britannique. L'échantillon (n=493) a été sélectionné de l'étude 'First Nations Food, Nutrition, and Environment Study'. L'étude a utilisé des rappels alimentaires de 24 heures. Pour identifier les patrons alimentaires, un indice de qualité alimentaire (QA) basé sur 10 éléments nutritionnels (fibre alimentaire, gras totaux/saturés, folate, magnésium, calcium, fer, vitamines A, C, D) a permis de classer les sujets en trois groupes (tertiles). Ces groupes ont été comparés sur leur consommation de 25 groupes alimentaires (GAs) en employant des tests statistiques non-paramétriques (Kruskal-Wallis et ANCOVA). Une analyse discriminante (AD) a confirmé les GAs associés à la QA.

La QA des sujets était globalement faible car aucun rappel n'a rencontré les consommations recommandées pour tous les 10 éléments nutritionnels. L'AD a confirmé que les GAs associés de façon significative à la QA étaient 'légumes et produits végétaux', 'fruits', 'aliments traditionnels', 'produits laitiers faibles en gras', 'soupes et bouillons', et 'autres viandes commercialisées' (coefficients standardisés= 0,324; 0,295; 0,292; 0,282; 0,157; -0,189 respectivement). Le pourcentage de classifications correctes était 83.8%.

Nos résultats appuient la promotion des choix alimentaires recommandés par le « Guide Alimentaire Canadien- Premières Nations, Inuits, et Métis ». Une consommation accrue de légumes, fruits, produits laitiers faibles en gras, et aliments traditionnels caractérise les meilleurs patrons alimentaires.

**Mots-clés** : patrons alimentaires, qualité alimentaire, indice de qualité alimentaire, analyse discriminante, autochtones canadiens.

## **Abstract**

Indigenous Canadians are going through a rapid nutrition transition marked by an increased consumption of market foods and a decreased intake of traditional products. The aim of this research is to identify dietary patterns associated with a better diet quality among Indigenous female adults living on reserve in British Columbia. The sample (n=493) was selected from the First Nations Food, Nutrition, and Environment Study. The study used 24-hour food recalls. To identify dietary patterns, individuals were classified in three groups (tertiles) according to points obtained on a dietary score (based on Dietary Reference Intakes for dietary fiber, total fat, saturated fat, folate, magnesium, calcium, iron, vitamins A, C, D). The tertiles were compared for their consumption of 25 food groups (FGs) using statistical non-parametric tests (i.e. Kruskal-Wallis and ANCOVA tests). A discriminant analysis was used to confirm the FGs significantly associated with diet quality.

Generally, subjects had poor diet quality since no food recall met the recommended intakes for all selected nutritional elements. The discriminant analysis confirmed that the FGs significantly associated with diet quality were “vegetables and vegetable products”, “fruits”, “traditional foods”, “low-fat dairy products”, “soups and broth”, and “other market meat” (standardized discriminant function coefficient= 0.324, 0.295, 0.292, 0.282, 0.157, - 0.189 respectively). The percentage of correct classifications was 83.8%.

In conclusion, our findings support the promotion of dietary choices according to the “Eating well with the Canadian Food Guide – First Nations, Inuit, and Métis”. It is greater use of vegetables, fruits, low-fat dairy products, and traditional foods that characterizes better dietary patterns.

**Keywords:** Dietary patterns, diet quality, dietary score, discriminant analysis, Indigenous Canadians.

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## **Acronyms and abbreviations**

**AMQI:** Adolescent Micronutrient Quality Index

**BC:** British Columbia

**b.f.:** butter fat

**DBS:** Dietary Behaviour Score

**DGI:** Dietary Guidelines Index

**DQI-I:** Diet Quality Index- International

**DRI:** Dietary Reference Intakes

**FAO:** Food and Agriculture Organization

**FN:** First Nations

**FNFNES:** First Nations Food, Nutrition, and Environment Study

**FNRS:** Framingham Nutritional Risk Score

**HEI:** Healthy Eating Index

**HS:** Healthfulness Score

**IOM:** Institute of Medicine

**MAR:** Mean Adequacy Ratio

**MAS:** Micronutrient Adequacy Score

**MDS:** Mediterranean Diet Score

**m.f. :** milk fat

**NAR:** Nutrient Adequacy Ratio

**NAS:** Nutrient Adequacy Score

**PCA:** Principal Component Analysis

**SD:** standard deviation

**s.e.m:** standard error of the mean

**USDA:** United State Department of Agriculture

**WHO:** World Health Organization

**w/:** with

**w/o:** without

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## **Chapter I: Introduction**

Nutrition-related chronic diseases, such as type 2 diabetes and obesity, are increasing among Canadian Indigenous peoples. Numerous studies done among these populations show that they are going through a rapid nutrition transition that largely explains these nutrition-related issues (Kuhnlein et al, 2004; 2007). This transition is characterized by an increased consumption of market foods and a decrease in their intakes of traditional foods. In general, when comparing their food choices to dietary food guidelines (c.f. “Eating Well with the Canada’s Food Guide – First Nations, Inuit, and Métis”), results indicate that they are not consuming the recommended daily servings for all the major food groups except the “meat and alternatives” food group (Chan et al, 2011; Garriguet, 2008; Kuhnlein et al, 1996; 2004). Furthermore, surveys that analyzed nutrient profiles of Canadian Indigenous individuals confirmed the inadequacies noted among their food choices. In fact, studies have reported insufficient intakes regarding multiple essential nutrients while other nutrients that require limited intakes are consumed in excess (Erber et al, 2010; Haman et al, 2010; Ho et al, 2008; Johnson-Down et al, 2010; Sharma et al, 2008; 2010). The way Indigenous communities acquire their food present many barriers to programs seeking to improve their diet quality (Receveur et al, 1997). Studies report limited access to traditional foods due to changes in the environment; government laws and regulations; energy, time, and cost of equipment required for traditional ways of acquiring food like fishing and hunting (Mead et al, 2010; Receveur et al, 1997). There is also limited access to certain store-bought food items with good diet quality like fruits and vegetables because they lack freshness and have high prices (Mead et al, 2010). Thus, one may question whether recommendations provided generally to the Canadian population are suitable to these specific cultures.

Many authors interested in populations that are living rapid nutrition transitions (e.g. Indigenous peoples, individuals residing in most developing countries, and immigrants) agree that public health agents should follow changes in dietary patterns of these populations, identify subgroups suspected to have diets with poorer quality, and thus

improve the prevention of nutritional-related problems like chronic diseases (Delisle et al, 2009; Satia, 2010; Tucker, 2010). In fact, even though nutritional epidemiology started with research on relationships between single food components and single health outcomes, nutritional epidemiologists now encourage the consideration of food patterns, i.e. a combination of food components and drinks, rather than individual nutritional elements, in the study of diet quality and/or nutritional effects on health (Kant, 1996). With increasing prevalence of chronic diseases, scientists are now suggesting that a maximum of dietary components should be considered simultaneously, i.e. as an unique exposure, in evaluating diet relation to health issues (Kant et al, 1996; 2004; 2010; Tucker et al, 2007). For instance, specific dietary patterns were thus linked to coronary heart diseases (Hu et al, 2000); to cardiovascular diseases (Nettleton et al, 2009); to type 2 diabetes (Nettleton et al, 2008), and obesity (Wolongevicz et al, 2009). Researchers support this innovative methodology for many reasons: for instance, they admit that foods, and nutrients and/or non-nutrients in a given diet, have synergistic interactions (when the foods are being metabolized in the body, processed, prepared or modified in any other way), which separate analysis of effects of a single nutritional element on single outcomes ignores (Tucker et al, 2010). Another reason is that the effect of single nutritional items on health may be too small to be seen when taken individually. Jones-McLean et al (2010) say that this is mostly the case for diet-cancer relationships. In fact, associations are found between prevention of many cancers and high consumption of fruits and vegetables; but isolating single nutrients and/or non-nutrients from the studied fruits and vegetables fails to ascertain those diet-cancer links (Baglietto et al, 2011; Hanf et al, 2005; Willett et al, 1994).

In summary, dietary patterns can help in operationalizing nutrient-based recommendations as well as departure from these recommendations (Hu et al, 2000; Jones-McLean et al, 2010; Pryer et al, 2001). We used this technique to identify the food patterns linked to a better diet quality among First Nations female adults living on reserves in British Columbia, Canada.

## **Chapter II: Literature review**

### **1. Introduction**

Nutrition transition is currently observed all around the world. Romaguera et al (2008) summarizes it as noteworthy changes in diet and activity patterns towards the “Western diet”; i.e. “a high-saturated-fat, high sugar, refined-and-processed foods and low-fiber diet and low physical work and leisure activities”. It is mostly a major concern for developing countries that not only face important migrations from rural regions to urban areas but also are submerged by influences from “western” countries (Becquey et al, 2010; Duravo-Arvizu et al, 2008). This process also characterizes some Indigenous populations, such as those residing in Canada (Kuhnlein et al, 2004; Kuhnlein et Receveur, 2007; Receveur et al, 1997). Thus, Canadian Indigenous peoples need strategies that would limit dietary shifts to diets of poorer and poorer quality.

In studying nutrition-related issues, researchers are favouring the determination of dietary patterns rather than effects of a single nutritional element on a given single outcome (Kant et al, 1996, 2004; Tucker et al, 2010). There are two distinct methods of defining food patterns: a priori opposed to a posteriori methods. Numerous scientists advance that the a priori technique, which evaluates the degree to which individuals or populations adhere to existing dietary guidelines, is simpler and more appealing. In fact, targeted populations would be more familiar with readily available, more sound recommendations that are developed specifically for them by truly qualified experts, i.e. mostly nutritionists (Hu et al, 2000; Reedy et al, 2010). The a posteriori technique requires statistical analyses after data collection on food and beverages consumption (Tucker, 2010; Kant et al, 2004).

This literature review presents the overall current diet quality of Canadian Indigenous populations on one hand and on the other methods utilized to determine dietary patterns among populations.

## **2. Determination of diet quality among Canadian Indigenous populations**

### **2.1. Nutrition-related health issues**

Prevalence of chronic diseases among Canadian Indigenous peoples has increased with an alarming pace. Scientists support that these diseases are largely correlated to these populations' food choices (Sharma et al, 2008).

Kuhnlein et al (2004) did numerous investigations with Arctic Canadian Indigenous communities: for instance they evaluated the interconnection between nutrition transition, dietary patterns and obesity in three different communities; namely the Yukon First Nations, the Dene/Métis and the Inuit. They did not announce any gender dissimilarities in traditional food consumption, except for the 20- to 40-year-old age group (where men ate larger portions) and for Inuit aged 41 to 60 years. Moreover, when checking for obesity (i.e. Body Mass Index (BMI) equal or above 30Kg/m<sup>2</sup>) they said that it was more important among Inuit adults than Yukon First Nations; and BMI increased with age. However, even though consumption of traditional foods increased somehow with age within BMI groups, there were no significant associations between traditional food intakes and BMI within age groups for all communities.

Ho et al (2008) analyzed factors that predisposed First Nations to type 2 diabetes and observed that this population was eating high amounts of fat and sugar but low amounts of fibre because they were purchasing more non-nutrient dense foods and frying even healthy foods like fish. They also said that most of the male respondents were older men living by themselves who had unhealthy food preparation techniques. Food preparation was again a problem for younger people who felt less self-efficacious towards traditional practices because family structures were changing, i.e. there were less multigenerational households; and so, learning through role modelling and/or observation of older generations had lost solid ground. It was also noted that both employed and unemployed people faced nutrition-

related problems: the former obliged to leave the reserve they lived on and ended up eating unhealthy products from restaurants while the latter suffered more from food insecurity.

It was also published that big industrial companies invade Canadian Indigenous peoples, pollute the lands and waters that nourish them and so limit their access to safer foods (Chan et al, 2011).

Generally, changes observed in Indigenous populations' food choices, which include more commercial foods and less traditional foods, explain these nutrition-related health problems.

## **2.2. Food choices of Indigenous Canadians: nutrition transition**

Experts wrote extensively on nutrition transition in Indigenous cultures (Kattelman, 2009). As a matter of fact, Kuhnlein and Receveur (1996) sought to identify determinants of Canadian Indigenous peoples dietary choices and classified them into three categories: food availability, cultural preferences and biological needs. They characterized these populations as communities that went through colonization but still distinguish themselves from the dominant societies they live in by fighting to keep their unique identity, i.e. their pre-colonial cultural practices, their social institutions, etc. Precisely, they maintain a special relationship with nature, which is regarded as a gift from the "Creator" and provides most of the things they consume, i.e. traditional foods. For instance, in Canada, hunting (i.e. consumption of birds and mostly terrestrial mammals such as caribou and moose), fishing (i.e. intake of fish like whitefish, salmon, char and trout) and gathering plants (e.g. intake of cloudberries and crowberries) still play key roles in nourishing households; so much so that many studies discovered more than one hundred wildlife species of animals, fish and plants being harvested (Kuhnlein et al, 2004; Kuhnlein and Receveur, 2007). But Indigenous peoples are going through rapid nutrition transitions where traditional foods are

being replaced by market items with less nutritious values.

Kuhnlein et al (2004) surveyed the Canadian Arctic areas and declared that from pre-colonial times until the turn of the 20<sup>th</sup> century dietary energy came 100% from wildlife resources; however, nowadays that amount has dropped to 10-36%. Actually, despite having access frequently to poor quality and yet very expensive groceries due to remoteness, these societies choose consuming provisions from stores because they are readily available, i.e. already prepared, and processed.

In addition, changes in social networks, like diminished transfer of cultural knowledge from older generations to younger ones, aggravate that shift (Kuhnlein et al, 2004). In fact, Kuhnlein and Receveur (2007) compared the intake of traditional and market foods in some communities located in the Yukon and the North-western Territories (5 communities) and noticed that on average Dene children (i.e. 10-12 year-olds) got only 4.5% of their energy intake from traditional foods while that portion increased to 15% for teens (i.e. 15-19 year-olds) and 28% for adults. Dene/Métis and Yukon children all taken together had similarly a poor consumption of traditional items. Another worrying factor was the high intake of animal-source products since they may contain too much saturated fat. It corresponded to 15% of total energy for those children and reached 35-37% for adults.

Sharma et al (2010) observed that Arctic Inuit (aged between 19 and 87 years) from two communities in Nunavut (i.e. one of the three territories in northern Canada) consumed more market foods than traditional foods. In fact, the most frequently eaten foods reported were coffee, white bread, sugar, juice, tea, butter or margarine; i.e. all purchased from stores. Precisely, sausages and lunchmeats, chips, pizza, and butter and margarine represented 25% of total fat in the diet while traditional foods corresponded to 14% of total fat. Sweetened juices and drinks like soft drinks represented above 30% of carbohydrates in the diet. These drinks in addition to sugar itself represented 73% of sugar consumption.



Although not being high in fibre, chips contributed 8% of fibre intake. Nevertheless, traditional foods still provided 41.3% of protein consumption and 41.2% of iron intakes.

Receveur et al (1997) showed not only gender variations in food sources but also variations among generations too. For instance, he noted that women opted more for grains to meet their energy requirements while men went for market meat (and more fat and sweets); and these divergences became more flagrant in older people. Older generations had certainly diets with less dairy products, fruits and vegetables, and mixed dishes; but they consumed more traditional fish and land mammals. In the same survey, Receveur et al (1997) observed that some community limited traditional food intakes were associated with community characteristics, namely population size, road access and availability of affordable market food, proximity to animal migration routes, and fishing and hunting practices currently employed. So, environmental barriers can not be overlooked as they are crucially linked to all elements that are needed for acquiring traditional foods, such as energy, time, financial expenses (for example in regards with equipment for hunting/fishing), and cultural practices.

Haman et al (2010) again studied the relationship between type 2 diabetes (and obesity) and dietary factors in First Nations. They stressed the importance of traditional foods in reducing the risk of having diabetes among a Northern Ontario (Canada) Indigenous community (i.e. the Oji-Cree of the Sandy Lake) but also in the sharing and the maintenance of their identity, their social norms and their spiritual practices. They also presented the threats rendering viability of those foods unsustainable, i.e. decreasing knowledge, economics, availability across the lands, land access, etc.

These shifts in food choices may negatively affect the adequacy of numerous nutritional elements among Canadian Indigenous populations.

### **2.3. Overall nutrient adequacy among Indigenous Canadians**

Inadequate food choices result in insufficient nutrient intakes. This aspect is important in these cultures marked by considerable nutrition transitions, even the Arctic inhabitants who occupy the farthest regions of North America and so are thought to still rely on traditional foods the most. This is illustrated by considerable amount of research done in Baffin Island: for instance, a study conducted among the Inuit population showed that intake of nearly all considered nutrients did not match the corresponding Recommended Dietary Allowances (Kuhnlein et al, 1996). In fact, only 46% of the examined individuals consumed between 66.6% and 100% of their energy requirements; while 37.9% exceeded them. Protein and iron intakes were above recommendations for 93.4% and 87.4% people respectively. The greatest elements of concern were calcium and vitamin A: 44.5% and 50.3% of the sampled Inuit consumed 50% of the recommended intakes, respectively; and only 21.8% and 19.8% of the sample took 66.6% to 100% of those recommendations, respectively. Other surveys confirmed these nutrient inadequacy tendencies: in general, whenever macronutrients were examined, the researchers agreed that compared to market products, traditional foods allowed people to have high protein consumption because of increased intakes of meat (Receveur et al, 1997). This resulted again in great intakes of iron and zinc due to importance of their bioavailability in meats. Such diets also improved the status of many other essential micronutrients, namely vitamin D, vitamin E, riboflavin, vitamin B6, copper, magnesium, manganese, phosphorus, potassium, and selenium. However, they provided less vitamin A, vitamin C, folate and fiber at least for certain communities like the Canadian Inuit who still had better vitamin D intakes (Kuhnlein et al, 2004).

Kuhnlein and Receveur (2007) justified improved vitamin C and folate in market foods with dietary fortification. Moreover, as for the Baffin Island Inuit, calcium and fibre were further found to be largely insufficient in other Inuit communities, and also in the Yukon and Dene/Métis populations. All these societies had similar trends for high sodium intake,

which worsened when more market items were present in the diets. These patterns supplied also greater quantities of carbohydrates, total fats, sucrose, saturated fats and polyunsaturated fats. The rise in sucrose and saturated fats consumed was more noticeable among the young (Receveur et al, 1997).

Downs et al (2009) brought attention to nutritional preoccupations of Canadian Indigenous Cree children (in grades 4 to 6) living in northern Québec: 29.9% were found to be overweight and 34.4% obese with only 19.1% consuming at least two servings of milk and 98.5% with fewer than five servings of fruit and/or vegetables. Three percent of total energy came from traditional foods and were crucial contributors to iron and zinc intakes. According to the three-day dietary records, 77.6% ate at least one restaurant meal and 18.6% three or more (overall restaurant meals consumed ranged from 0 to 5). In comparison, they announced that 25% Canadian children (from the general population) ate fast foods on any given day. This explained in part increased intakes of total fat, saturated fat, and calcium but low consumption of protein. Zinc, calcium, and vitamin D intakes were inadequate. In conclusion, there was coupling of healthy or unhealthy foods, e.g. households with more fruit and vegetables had also more milk while those with more sodas had more potato chips too. House crowding was not associated with the diet (but like low income and/or poverty, it was a risk for inadequate health).

Another study done on diets of Indigenous children (i.e. Inuit aged 3 to 5 years) showed that energy-dense foods (i.e. high-sugar and/or high-fat foods) provided 35% of energy consumption while  $8.4 \pm 13\%$  of energy intake came from traditional foods (Johnson-Down et al, 2010). When children with no, low, or high traditional food intakes were compared, those with no consumption had lower intakes of protein, iron, zinc, and higher intakes of carbohydrates. The group with higher traditional food intakes had higher consumption of cholesterol, vitamins A and D, and magnesium. When fibre intake was energy-adjusted, overweight children had lower intake than normal-weight children (yet, the two groups

consumed similar amounts of vegetables and fruits, fruit juice, and high-sugar soft drinks and punches, and traditional foods).

Sharma et al (2008) tested a food-frequency questionnaire that would serve in determining food intakes and their relationship to chronic diseases in Canadian First Nations living in northern Ontario. They compared non-First Nations populations residing in the same area (i.e. from the Canadian Nutrition Survey/Ontario Food Survey) and observed that First Nations consumed more energy from fat (for women the proportion was 33% versus 32.2% and for men 35% versus 31.6%). In addition, lower vitamin intakes were reported except those of vitamin B12 (due to high intakes of fish and other wild foods but not enough fruit, vegetables and dairy). However, percent energy from protein was similar (meat and alternatives were above national recommendations). The paper cited studies reporting 15% higher energy intake among the indigenous populations as a result of more traded foods (e.g. tea, sugar, flour, lard, etc) being used.

Sharma et al (2010) continued the development of a dietary tool, i.e. a quantitative food-frequency questionnaire, which would help in monitoring nutritional transitions among Indigenous Canadians. They did a cross-sectional study among Inuit living in Nunavut. The results showed that the percentage of energy from protein was high with values of 21% for men and 20% for women. Mean daily fibre intakes of 9g for men and 8g for women were again low when compared to recommended adequate intakes of 38g for men and 25g for women. Intakes of vitamins A, D and E, and folate were also inadequate. Mean daily intakes of calcium were 467mg for men and 327mg for women and thus did not reach the recommended adequate intake of approximately 1000mg. For iron intakes, men consumed much higher amounts than the recommended intake due to high consumption of traditional foods (mainly red meat); however, women consumption failed to meet the recommended intake.

In short, intakes of many foods/nutrients for Canadian Indigenous peoples are far from being satisfactory and specific analytical techniques of diet quality that will help to better understand these issues, thus allowing promotion of appropriate dietary choices are needed.

As mentioned earlier, numerous authors wrote on the multiple functions of food patterns, notably in the study of dietary quality of individuals/populations. The following part presents some of those studies that researched the two techniques used to identify dietary patterns. For the a priori method, the chosen studies are mainly relevant to Canadian populations and to the method used in the present research, i.e. nutrient- versus food-based indexes. For the a posteriori method, there is firstly a quick presentation of studies that focused on the two mostly used techniques and on diets that are relevant to Canadian populations. Then, this is followed by a presentation of all studies found on the statistical method of identifying dietary patterns used in the present research.

### **3. Methods for measuring diet quality**

#### **3.1. Dietary indexes: the a priori technique**

##### **3.1.1. General aspects of dietary indexes**

Kant et al (1996) presented three methods of constructing dietary indexes: indexes solely based on nutrients, those including foods or food groupings and finally those combining all these constituents. Numerous papers have been written on these a priori methods that combine either foods or food groups with nutrients. For example, the USDA Center for Nutrition Policy and Promotion, seeking to monitor dietary modifications among the American population, established the Healthy Eating Index (HEI) (Guenther, 2008; Wirt et al, 2009). On one hand, this original HEI covered food groups at the base of national nutritional recommendations, i.e. total fruit, total vegetables, total grains, milk (soy beverages included), and meat and beans (thus including meat, poultry, fish, eggs, soybean items except beverages, nuts, seeds and legumes). On the other hand, total fat, saturated fat,

cholesterol, sodium, and diet variety also constituted the HEI. Scoring ranged from 0 (undesirable) to 100 (best) points (from 0 to 10 for each component). Since then the HEI has on several accounts been slightly altered to better reflect the American population diet, e.g. it was changed to give the Alternative HEI, which, unlike the original HEI, used more detailed dietary recommendations within its food group components and acknowledged health benefits of unsaturated fats (McCullough et al, 2006); and to be suitable to other populations, e.g. the HEI-C was established for Canadians and was based on Canadian age- and sex-specific dietary recommendations (Shatenstein et al, 2005; Woodruff et al, 2009).

Seymour et al (2003) wrote on the Diet Quality Index (DQI) which again took foods and nutrients as an ensemble: six nutrients (total fat, saturated fat, cholesterol, protein, sodium and calcium) were added to two food groups (fruits/vegetables and grains) to define the DQI. Points allocated to each component were 0 when recommendations were met, 1 when they were almost met or 2 when they were not. A revised version of the DQI, termed as the DQI-Revised, was put together to better reflect renewed dietary guidelines (Haines et al, 1999).

Interestingly, these two American scores (i.e. the Healthy Eating Index and the Revised Diet Quality Index) led to a fully food-based dietary index. Indeed, when researching efficient tools for dietary monitoring or surveillance, McNaughton et al (2008) appreciated advantages scores based only on foods had on those solely based on nutrients and/or non-nutrients because the former better maintained the complexity of dietary intakes and could also give information on nutrients and non-nutrients in their food components. From there, they tempted to create a food-based dietary index specific to the Australian Adult population, the Dietary Guidelines Index (DGI). Basically, fifteen items related to recommendations on intakes of various food groups, nutrients, and drinks (i.e. vegetables and legumes, fruits, total cereals, meat and alternatives, total dairy, added sugar, sodium, saturated fats, and alcoholic) constituted the DGI. Data from a food habits questionnaire

was compared to age- and sex- specific recommendations from the Australian Guide to Healthy Eating for essential food groups (i.e. vegetables, fruits, cereals, meat and alternatives) and a group called 'extra foods' which is rich in non-required nutrients (e.g. too much fat, sugar and salt). In other terms, good dietary quality came from food groups that had a wide variety of items and included whole-grain cereals, lean meat, and low-fat dairy. Diet quality was precisely quantified by a scoring from 0 to 15 for each of the fifteen elements for a total of 0 to 150 points (the score increased as the participants met the recommendations). As a result, higher scores corresponded to lower intakes of energy, total fat, saturated fat, and monounsaturated fat but higher consumption of fibre,  $\beta$ -carotene equivalents, vitamin C, folate, iron, and calcium for both men and women ( $p < 0.05$  and energy-adjusted nutrient intakes showed similar results). Additionally, higher scores were related to increased intakes of protein, total sugars and carbohydrates.

In other cases, researchers have opted for indexes solely based on nutrients. Wolongevicz et al (2010), in order to better understand the incidence of obesity, utilized the Framingham Nutritional Risk Score (FNRS), a dietary index validated among the famous Framingham Offspring/spouse cohort. The FNRS was presented as a combination of nineteen nutrients, namely total energy, protein, total fat, monounsaturated, polyunsaturated and saturated fats, carbohydrate, fibre, alcohol, dietary cholesterol, sodium, calcium, selenium, vitamins C, B6, B12 and E, folate and  $\beta$ -carotene. They added that this selection was led by the implication of these nutrients in the occurrence of cardiovascular diseases. The FNRS was given a distinguishable, sample-dependent scoring, which consisted in ranking the participants according to data collected with three-day dietary records. In other words, quantities consumed by all individuals were ranked for each nutrient as follows: certain nutrients were classified low to high, i.e. energy, protein, alcohol, total, saturated, and monounsaturated fats, dietary cholesterol and sodium, and the remaining eleven nutrients high to low; as final goal, better nourished subjects received lower ranks. The final score was an average of the ranks separately attributed to all the nutrients. Ultimately, scores

were grouped into tertiles and found to be good predictors for risk of being overweight or obese; e.g. when compared to women in the lowest tertile, the risk of those in the highest tertile was 1.76 (95%CI: 1.16 – 2.69) times higher.

The following part presents references used to assess the adequacy of nutritional elements.

### **3.1.2. Food-based dietary references**

Many countries have developed scores for monitoring population food intakes based on nationally generalized dietary recommendations because food guidelines often suit very particular populations. That is why most indexes were built at the national level from well-known food guides. As an illustration of that, one can name the Healthy Eating Index (HEI) and its variations. The HEI was constructed originally for the American population with the United State Department of Agriculture (USDA) Food Guide Pyramid as reference. Schuette et al (1996) analyzed how effective this food guide was in assessing dietary adequacy and quality by establishing a scoring system based on the number of food groups that had at least the minimum number of servings recommended by the guide (i.e. six servings from the group of bread, cereal, rice, and pasta; three servings of vegetables; two servings of fruits; two servings from the grouping of milk, yogurt, and cheese; and two servings from the meat, poultry, fish, dry beans, eggs, and nuts group). The Food Guide Pyramid is part of a long chain of nutritional guides developed by the USDA since 1894 and that received additional upgrades mainly to be replaced by a set of slightly renewed guidelines known as MyPyramid and more recently as MyPlate. The latest guide has been depicted as a plate with different food categories, namely grains, vegetables, fruits, and protein with portions of 30%, 30%, 20%, and 20% respectively. Moreover, a circle has been added to represent a small portion of dairy. This illustration of a healthy dietary pattern has been taken as a more comprehensive message to the public rather than the previous image of the guide as a pyramid divided into five food groups (i.e. grains, vegetables, fruits, milk, and meat and beans) and a set of steps meant to recall the



importance of physical activity. Each division has received specific recommendations such as at least half of consumed grains as whole grains; more selection of dark green and orange vegetables; more dry beans and peas; increased variety of fruits but reduced fruit juices; low-fat milk and meat products; and better sources of oils like fish and nuts (Guenther et al, 2008).

More than one American score, that again underlie the Dietary Guidelines for Americans, have come to light. For instance, the Dietary Behaviour Score (DBS) highlighted general key behaviours picturing those healthy eating patterns rather than a combination of segregated recommendations for key nutrients, i.e. in the form of individualized numerical goals (Kant et al, 2009). The DBS featured characteristics of the diet organized into six sections: servings of vegetables per week (not counting potatoes and salads); servings of fruit per week (not counting juices); usual intake of whole-grain cereals and breads; usual intake of lean meat and poultry without skin; usual intake of low-fat dairy; and usual addition of solid fat after cooking to certain foods (e.g. Pancakes, waffles, french toasts, potatoes, rice, pasta, and meat (i.e. gravy)).

Publications showed how the HEI was altered to include recommended food patterns of other populations. For example, the HEI-C was established for Canadians (Shatenstein et al, 2005; Woodruff et al, 2009) and the Dietary Guidelines Index (DGI) for Australians (Collins et al, 2008; McNaughton et al, 2008). Instead of American guidelines, the HEI-C referred to the Canada's Food Guide for Healthy Eating while the DGI references came from the Dietary Guidelines for Australian Adults.

Reports on disease-preventing diets, which have geographical and/or cultural ties to specific regions around the globe, are numerous. Probably, the Mediterranean regimen is the most chosen one as reference and yet the most intriguing, the most variable in terms of food choices: finding its origins in Crete, it further describes many Mediterranean regions

that have recipes composed with almost the same foods, i.e. with globally equal nutritious values. This dietary pattern is attractive for including foods found to convey protection against chronic diseases like type two diabetes and cardiovascular diseases. In general, on one hand it is found to be rich in whole-grain foods, legumes, fruits and vegetables and on the other hand poor in full-fat dairy, red meat and sweets. Additional foods highly present in the Mediterranean diet are nuts, olive oil and wine. As a consequence, this pattern is limited in saturated lipids (Rumawas et al, 2009; Trichopoulou et al 1995, 2003). In 1995, Trichopoulou et al published a paper on the Mediterranean Diet Score (MDS), a tool for assessing the degree to which an individual or a population adheres to the Mediterranean dietary pattern. The MDS was changed when fish was added as one of its components (Trichopoulou et al, 2003). A nine-point scale was allocated to this original MDS which included nine food groups, i.e. vegetables, legumes, fruits and nuts, milk and dairy products, cereals, meat and meat products, fish, moderate alcohol consumption, ratio of monounsaturated to saturated lipids. So, each food group could score 0 or 1 point depending on the sex-specific median which was used as cut-off (except for alcohol intakes), i.e. for advantageous food groups like vegetables, legumes, fruits and nuts, fish, and cereal, a consumption below the median corresponded to 0; while the other “unhealthy” constituents obtained 0 when the eaten amount was at or above the cut-off. Some authors introduced a few changes to the original MDS and tested its relationships to specific health outcomes (Fung et al, 2006; Lagiou et al, 2006; McNaughton et al, 2012); while others identified other culturally defined populations with superior diet qualities, for example the Japanese or the Scandinavians (Tucker, 2010).

Improving particular health status has been pivotal in identifying high quality diets. Notably, the Dietary Approaches to Stop Hypertension (DASH) diet was created for people with high blood pressure. The DASH pattern contains more whole grains, vegetables, fruits, low-fat milk and other dairy products, poultry, seafood, and nuts; but incorporates less sodium, red and processed meats, sweets, and beverages rich in sugar. Therefore, it has

improved the contribution to needs of potassium, magnesium, calcium, and moderately to protein; but stands in opposite direction with regards to total and saturated fats (Bhupathiraju et al, 2011; Levitan et al, 2009). Interested in the relationship of nutrition and the incidence of heart failure, Levitan et al (2009) originated a DASH diet score with seven food/ beverages groups and a nutrient, i.e. fruits, vegetables, nuts and legumes, dairy products, whole grains, processed meats, sweetened beverages, and sodium. Quintiles were formed and allocated points from one to five as follows: for the first five components of the score, people in the highest quintile scored five while those in the lowest got one; and on the contrary, when studying the last three components subjects in the lowest quintile received five while the highest gained one point (points were for each component individually).

### **3.1.3. Dietary references for nutrient-based indexes: using Dietary Reference Intakes (DRIs) as cut-offs for nutrient adequacy scores**

DRIs are used to estimate the probability of dietary adequacy for a given person or population (Azadbakht et al, 2005; Britten et al, 2006; Murphy et al, 2002, 2006; Schenkel et al, 2007).

Preferably, the Estimated Average Requirements (EAR), i.e. a nutrient consumption supposed to meet the requirements of 50% of the healthy individuals in a gender- and age-specific group based on a review of the scientific literature, serves as benchmark for adequacy of nutritional intakes. In other words, the risk of inadequacy is measured as the number of individuals in the population whose usual intakes are below the EAR for a group. At an individual level, the EAR is used to show how one is confident that an individual's usual intake (experimentally determined) is below (or above) his or her particular requirement. Indeed, the probability of inadequacy is theoretically calculated by comparing the mean observed intake to the EAR. On one hand, the calculation takes into

consideration the EAR and the standard deviation of the requirement (which shows how much an individual's requirement for a given nutrient can deviate from the median requirement (EAR) of the population); and on the hand, it considers the usual intake and the within-person standard deviation of intakes (which shows how much the observed intake can deviate from the usual intake).

Unfortunately, not all nutritional elements have an EAR; in which case an adequacy intake (AI), i.e. a recommended consumption value based on observed estimates of nutrient intake by a group or groups of healthy people that are considered to be adequate, is assessed. In that case, assessment of inadequacy is based on a statistical hypothesis test (i.e. a z-test with the standard deviation of usual intake of the evaluated nutrient), where the empirically obtained intake is compared to the AI. However, one can assume that nutrient intake is probably adequate only when the observed consumption exceeds the AI; otherwise, no conclusions can be made. Fibre has been allocated an AI in numerous studies.

Additionally, the Tolerable Upper Intake Level (UL), i.e. the highest average daily nutrient intake level likely to cause no risk of undesirable health impacts to nearly all individuals in the general population, can provide the advisable nutrient consumption. The UL is often used in examining the amount of ingested sodium.

However, there are limitations when employing DRIs to study the nutrient adequacy of a given population. As a matter of fact, if the Recommended Nutrient Intake for Canadians (RNIs) (Ghadirian et al, 1996) (also known as the Recommended Dietary Allowance (RDA) for Americans), i.e. an intake level that exceeds the requirements of 97-98% of all the individuals when requirements of the population as a whole show a normal distribution, were taken as cut-off, the group nutrient inadequacy would be highly overestimated (Murphy et al, 2002). More problematic is the ability to describe usual intakes (Institute Of Medicine, 2000).

Nevertheless, the RDAs are useful in calculating two additional dietary references: the Nutritional Adequacy Ratio (NAR), i.e. the nutrient content measured as percentage of the RDA and truncated at 100, and the Mean Adequacy Ratio (MAR), i.e. the average of a given number of NAR.

Most dietary recommendations for macronutrients are given as percentages of total energy consumption: the Acceptable Macronutrient Distribution Ranges (AMDRs). Thus, ranges for carbohydrates, protein, total fat, and saturated fat were 45-65%, 10-35%, 20-35%, and <7% respectively (De Souza et al, 2008).

### **3.1.4. Application of nutrient-based scores in defining healthier food patterns**

#### **3.1.4.1. Nutrient adequacy and “healthy” food choices**

When considering major food groups from food guides, researchers mainly report the protective effects of fruits, vegetables, fish, low-fat milk, and whole grains against chronic diseases due to their better nutrient profiles (Bhupathiraju et al, 2011; Langsetmo et al, 2010; Shatenstein et al, 2005). For instance, Sodjinou et al (2009) noticed that a micronutrient adequacy score (MAS) was positively linked to the consumption of cereals, roots and tubers (and legumes and nuts).

In their study of the USDA Food Guide Pyramid as reference for nutritional quality (and adequacy), Schuette et al (1996) chose five nutrients (calcium, magnesium, iron, vitamins A and B6) in the calculation of a MAR named the MAR-5 score in order to reassess dietary quality of collected food records.

Song et al (1996) also used the MAR-5 score and evaluated the impact of the American Food Guide Pyramid on nutritional adequacy of young Americans. Considering the food groupings of the guide, they identified food patterns in three ways: the average and median

intake of each food group by all subjects (men and women separately), the percent of subjects consuming different number of servings of each food group in relation to the recommended servings, and the creation of a 'food group score'. The score was based on the consumption of the recommended servings of the five major groups (i.e. bread, cereal, rice and pasta; vegetables; fruits; milk, cheese and yogurt; and meat, poultry, fish, dry beans, eggs and nuts) from the Food Guide Pyramid, i.e. intake of at least the recommended servings scored 1 point for a range of 0 to 5 points. The patterns obtained then were further analyzed for nutrient adequacy using multiple approaches; namely the entire consumption of macro and micronutrients, nutrient density and MAR (named MAR-5 as an average of NARs of Ca, Fe, Mg, vitamins A and B6), the distribution of food group scores (FGS) in relation to MAR-5 scores, the odds ratio of food group pattern being adequate (i.e. FGS of 0 to 4 in reference to FGS of 5), and comparison of nutrient contents of FGS of 0 to 4 and FGS of 5. A score at or above 75% on MAR-5 was estimated adequate. In fact, the average nutrient density of those with MAR-5 at or above 75% differed significantly from those with MAR-5 below the cut-off point. When comparing FGS of 0-4 to FGS of 5, distribution of MAR-5 scores also differed significantly. From the odds ratios technique, the study found that for instance when comparing FGS of 4 to those of 5 inadequate servings from grain, vegetable, fruit, dairy, and meat food groups had 3.5, 7.0, 5.0, 8.8, and 2.0 times higher chances of being inadequate respectively. Nutrient contents of diets scoring 0 to 4 on the FGS diverged significantly from those scoring 5 for all nutrients and total energy.

Dairy products have been appreciated for their richness in many micronutrients. That is why many studies have analyzed the adequacy of multiple micronutrient intakes in relation to this food group. For instance, Nicklas et al (2009) recognized the important contribution of dairy products to intakes of three micronutrients, namely Ca, K, and Mg. Using data from the 1999-2004 NHANES database and American dietary guidelines, they determined dairy consumption in terms of daily servings and related it to the three considered nutrient adequacies. Adequacies were calculated according to percentages of people with mean

intakes at or above the AIs for Ca and K; while the EAR cut-point method was selected for Mg. The study confirmed the necessity of dairy products for adequacies of Ca, K, and Mg: for instance, people that consumed recommended daily servings or more were more likely to have mean intakes above the AI for Ca; in addition increasing dairy servings to 3-4 would double the portion of Americans having adequate K intake. Moreover, less than 1 daily serving resulted in children aged 2-8 years meeting 160% of the EAR for Mg while individuals aged 9-18 and > 51 years required 3.0 daily servings to meet 100% of the EAR and those aged 19-50 years 2.0 daily servings for the same goal.

McGill et al (2008) conducted a similar study and compared individuals consuming recommended daily servings of dairy products (as specified by the Dietary Guidelines for Americans 2005) to those who did not in terms of their K intake. The scientists used the AI for K to determine the adequate nutrient intake. They also concluded that the mean and the median K intakes were positively correlated to dairy intakes.

Chiplonkar et al (2010) noticed the importance of evaluating nutrient adequacy of vegetarians (precisely of female adolescents who they noted had greater tendencies to vegetarianism); and developed the Adolescent Micronutrient Quality Index (AMQI), a score that referred to dietary guidelines for Americans (and particularly for Indians). Then, they determined how well it related to the micronutrient adequacy ratio (MNAR), i.e. the average of the ratios of the observed intake value to the Recommended Dietary Intake for vitamin C,  $\beta$ -carotene, thiamine, riboflavin, niacin, folic acid, iron, zinc, copper, and calcium. The AMQI was thus found to have positive and statistically significant correlations with micronutrient intakes and total bioavailability of iron and zinc.

Okubo et al (2011) observed that fish and meat intakes had positive and negative linkage to the risk of certain chronic diseases respectively. They then conducted a cross-sectional study among young Japanese women and analyzed the relationship between diet quality

and fish versus meat consumption. Using a diet history questionnaire they calculated the ratio of fish to meat intake and studied its relationship to other food groups consumption and other key nutrients. Results showed that a higher ratio was positively related to consumption of fish, potatoes, vegetables, fruits, pulses, dairy products, and alcoholic beverages while being negatively associated with intakes of meat, nonalcoholic energy-dense beverages, and fat and oils. The ratio was not associated with intakes of rice, bread, noodle, eggs, confectioneries, or seasonings.

#### **3.1.4.2. Nutrient adequacy and “unhealthy” food choices**

In measuring diet quality, indicators have evolved to include assessment of moderation in intakes of distinct elements (Kim et al, 2003; Liu et al, 2011; O'Neil et al 2011). There are some nutrients that the body needs in order to function correctly, but one has to keep an eye on their amounts in foods due to their positive association to many chronic diseases. In fact, dietary recommendations globally encourage individuals to limit intakes of added sugars and fats (mainly saturated and trans), sodium, and cholesterol. These elements are always negatively scored in dietary indexes. For instance, the DQI-I checks for correct total fat intake: the highest score corresponds to a consumption of total fat not above 20% of total energy intake; and the lowest score is given when that percentage exceeds 30%. Protective and harmful limits are provided for saturated fats, cholesterol, and sodium too. The DQI-I also emphasizes restriction for “empty calorie” foods, i.e. nutrient-poor but energy-rich foods like sweets, sodas, 100% fruit juices, etc.

Song et al (1996) completed their study on recommendations from the American Food Guide Pyramid looking at intakes of nutritional items to limit, i.e. added fat and sugar. They concluded that 31% of their subjects consumed the recommended fat intake of 30% or less of total energy and 61% the recommended 10% or less of total energy from added sugar. But only 4% of all individuals followed the two recommendations simultaneously.



Moreover, only 1% followed the two guidelines and scored the maximum 5 points on their 'food group score' (which evaluated diet quality from intake of five major food groups from the Guide). Thus, correlations between the FGS and intakes of added fat and sugar were weak.

Sodjinou et al (2009) found that their healthfulness score used to evaluate two distinct dietary patterns was negatively associated with the intakes of animal products, sweets and fast food.

Libuda et al (2009) evaluated the diluting effects of sugar-sweetened beverages (SSB) on nutrient contents in diets of German children and adolescents. Thus, they created scores for measuring nutrient adequacy of single nutrients and overall diet, the intake quality score (IQS) and the nutritional quality index (NQI). The former index was defined as the percentage of age- and sex-specific dietary reference values for nutrient intakes of the German Nutrition Society and inadequate intake were considered to be less than two-thirds of the reference value for each nutrient. The NQI was the harmonic mean of the IQS of all considered micronutrients, namely vitamins A, E, K, B6, B12, and C, and thiamin, riboflavin, niacin, pantothenic acid, and folate, and Ca, Mg, Fe, P, K, and Zn. (i.e.  $NQI = n / \sum (1/IQS(i))$ ; with  $i = 1$  to  $n$  micronutrients.). NQI ranged from 0 to 100, i.e. 100 corresponded to a high diet quality meeting or exceeding the reference values of the studied micronutrients (values were truncated at 100 for values exceeding the reference values so that the excesses would not cover the deficiencies.). Regarding macronutrient intakes, the survey showed that SSB consumption was positively related to energy from carbohydrates but negatively associated to protein and fat intakes. However, the observed association with carbohydrate intakes was due to increased consumption of added sugars for energy from non-sugar carbohydrates decreased increased intakes of SSB. For micronutrient intakes among boys, negative associations with SSB consumption were observed for riboflavin, pantothenic acid, Ca, Fe, P, and K (with decrease of 6, 5, 6, 6, 5, and 3% respectively

according to reference values for each 1 MJ of SSB consumption). Positive correlations were found for vitamins E and C, and niacin due to SSB fortification. Among girls, decreases of 9, 37, 8, 5, 9, 10, 6, and 9% were noticed for vitamin A, vitamin K, riboflavin, folate, Ca, Mg, P and K respectively for each 1 MJ of SSB consumption. NQI decreased by 1.4 and by 2.6 points for each 1 MJ of SSB intake among boys and girls respectively. Thus, SSB consumption had a negative impact over total diet quality and in general had a diluting effect on nutrient density of diets explained by increased energy from added sugars but decrease in the majority of required nutrients.

### **3.1.5. The role of food diversity in diet quality scores**

On one hand, diet diversity is a major element in determining the degree to which food and/or nutrient intakes by individuals and/or populations are adequate (Fernandez et al, 2000). Thus, Kuhnlein and Receveur (2007) recognized that whenever North American dietary patterns comprised more diverse food items or groups dietary quality increased. Although many articles emphasize this idea, they employ a wide variety of methods to incorporate it in the particular indexes they build up. They also highlighted that various food sources contributed differently to food diversity: for instance, products taken from animals were not equal to those from plants in terms of nutrient densities; i.e. one animal food serving gave more nutrients than comparable amount of plant food.

Footo et al (2004) perceived this difficulty in providing a clear meaning to dietary variety that could be based on food codes, food groups or food ingredients (from decomposed mixed dishes). In other terms, they said that variety could be viewed as between-group variety (i.e. a count of unique food groups reported), within-group variety (i.e. a count of unique items within those different food groups), and/or total dietary variety (i.e. a simple count of unique foods on the report). Afterwards, they chose to briefly present the method used in the development of the HEI. For this index, diversity was thus regarded as the

number of food variety groups; and the USDA created a database where variety codes were attributed to each basic food (or ingredient of disaggregated complex recipes) while taking into account the commodity type (i.e. its agricultural properties) and its vitamin/mineral contents. Each code could be matched to specific Food Guide Pyramid.

Murphy et al (2006) took advantage of the HEI and defined dietary diversity in four different manners: firstly they counted the basic items consumed (i.e. commodity variety); which were followed by the USDA food codes announced (i.e. food code variety); then by a count of five Food Guide Pyramid food groups consumed (i.e. FGP5 variety); and finally they numbered the amount of foods consumed out of twenty-two Food Guide Pyramid subgroups (i.e. FGP22 variety). They further correlated these measurements to varying ways of assessing dietary quality and found correlations to be statistically significant: for energy intakes, correlations were between 0.28 and 0.46; for probability of nutrient adequacy, correlations varied from 0.43 to 0.46 for commodity and FGP22 varieties, then from 0.32 to 0.35 for FGP5 variety, and lastly from 0.22 to 0.24 for food code variety. Additional clarifications about dietary quality were made with a close look at added sugars, cholesterol, saturated fat, and sodium, (i.e. nutrients that need limited consumption); which had a weak association with dietary variety, yet statistically significant again. In final, they agreed that nutrient adequacy could be achieved by consuming at least a half-serving per day of diverse foods from the twenty-two Food Guide Pyramid subgroups. In their study on ways to measure food variety in relation to dietary quality, Murphy et al (2006) insisted in using fifteen vitamins and minerals (i.e. vitamins A, C, E, B6, and B12, and thiamine, riboflavin, niacin, folate, calcium, phosphorus, magnesium, iron, copper, and zinc) that had established DRIs in order to characterize the concept of diet quality.

In their analysis of the Australian diet with the DGI, McNaughton et al (2008) limited dietary diversity to food groups they considered to be at the core of the diets, i.e. fruits, vegetables, meat/protein, dairy, and cereals. And so, within each core food group it was

interpreted as the proportion of core foods minimally eaten once per week as a proportion of the total amount of core foods listed on the food-frequency questionnaire. Finally, the score was the summation of points (out of two) given to core food groups individually. The authors notified that this methodology was preferred to other definitions of diversity such as studies that only focus on variety in the fruit and vegetables classes or use collected data to create cut-offs like quartiles.

However, it has been advanced that promoting food variety could push people to overconsumption (Mirmiran et al, 2006), especially in regard to nutritional factors that have undesirable effects. Indeed, individuals could see food variety as a ‘healthy’ way to increase the number of food items they can eat and forget to limit their choices to their energy requirements and balance. This shows again how difficult it is to create dietary scores that capture well the idea of healthy/balanced patterns, i.e. food patterns that are adequate in terms of nutrient density/adequacy, macronutrient proportionality, moderation of less healthy items, and food variety.

### **3.2. Statistical analyses: the a posteriori technique**

#### **3.2.1. Factor Analysis/Principal Component Analysis (PCA)**

Hu et al (2000) applied factor analysis which they defined as “a multivariate technique that, in a dietary context, uses information reported on food-frequency questionnaire or dietary records to identify common underlying factors (patterns) of food consumption.” to evaluate nutritional risk factors related to coronary heart diseases. They found two distinguish patterns addressed to as the “prudent” and the “western” diets. For further comparisons, they segregated each pattern into quintiles; thus noticed the degree to which the former was protective and the latter had opposite effects.

Becquey et al (2010) surveyed the effect of urbanization on dietary profiles and related health matters in developing world city (i.e. Ouagadougou). They obtained the food

patterns by principal component analysis (PCA), i.e. a statistical tool that enabled data reduction by creating in a multidimensional space component representing the maximum of variability between subjects. Again, one reason of this choice was that the PCA brought an advantage in the study of diet-health associations by maintaining the collinearity between nutrients or foods. In their analysis, they kept two components (or patterns) explaining 28.5% of the total variance in the data set; and identified them as the “snacking” (19% of the total variance) and “modern foods” patterns. The former had almost all food groups and largely foods consumed outside the main meals while the latter had foods opposed to traditional meals and local snacks. Thus, it was not surprising that one unit increase in the “modern foods” score was positively correlated with the risk of being overweight or being obese. However, no correlation existed between the above health risks and the “snacking” score after consideration of confounding factors.

In 2008 and 2009, Nettleton et al conducted two separate surveys with participants of the Multi-Ethnic Study of Atherosclerosis. In the oldest research, they tried to shed light on the impact of dietary behaviours on incidence of type 2 diabetes and defined four food patterns using PCA (added to one (a priori) low-disease risk, author-defined dietary pattern, that was summarized by a weighted sum intake (in terms of servings per day) of whole grains, low-fat dairy, coffee, vegetables, nut and seeds positively scored on one side [+1 each] and on the other red and processed meat, high-fat dairy, and soda scored negatively [- 1 each]). The four components from PCA were named “fats and processed meats”, vegetables and fish”, “beans, tomatoes and refined grains”, and “whole grains and fruit”; and had -0.52; 0.05; -0.17; and 0.63 for correlations with the low-disease risk, author-defined pattern. In a model that adjusted for energy intake, study center, age, sex, race-ethnicity, education, physical activity, current smoking status, smoking pack-years, and weekly dietary supplement use, the “beans, tomatoes, and refined grains” factor explained the greatest risk to diabetes with 18% increased risk (for one-standard deviation increase in the score) and the “whole grains and fruit” had the least risk for diabetes with a 15% reduced risk (for

one-standard deviation increase in the score). Also, food group taken individually were not independently related to risk of diabetes. In their most recent examination, they focused on incidence of cardiovascular diseases (CVD) while keeping the four identifications of nutritional patterns via PCA. Among their new findings was the fact that, after adjustment for energy intake and the other early-mentioned socio-demographic and lifestyle factors, subjects in the lowest “fats and processed meat” quintile and at the same time in the highest “whole grains and fruit” quintile had 72% decreased CVD risk with comparison to those simultaneously in the highest “fats and processed meat” and in the lowest “whole grains and fruit” quintiles.

Since PCA defines dietary patterns through correlations of reported food intakes, it does not give the prevalence of those patterns in the population under examination. In reality, another statistical tool (i.e. cluster or hierarchical analysis) is more useful for that purpose because its goal is to create relatively homogenous groups of individuals according to specific dietary attributes.

### **3.2.2. Cluster Analysis**

Quatromoni et al (2002) followed an all-female cohort from the Framingham Offspring/spouse Study and investigated the associations between weight problems, i.e. being overweight, and dietary patterns. Although an analysis similar to factor analysis was firstly applied with the exception of getting non-overlapping groups; food profiles were mainly obtained from cluster analysis. Precisely, from 42 food categories, 13 food groups were statistically computed according to the level of frequency they were eaten, i.e. foods in the same group were consumed with a comparable daily frequency (e.g. reports of higher intakes of skinless poultry were associated with reports of higher intakes of other low-fat foods like fish and whole grains). After this method, cluster analysis was used to separate the women into groups with regard to the differences in their consumption of the 13 food

groupings. In the end, five clusters were retained and labeled as follows: “Heart Healthy” (i.e. the cluster with more servings of vegetables, fruits, low-fat milk, and other low-fat and fibre-rich foods but less diet beverages and firm vegetable fats); “High Fat” and “Empty Calories” clusters (i.e. the two clusters with more animal and vegetable fats, sweets and desserts, meats, and mixed dishes); “Light Eating” and “Wine and Moderate Eating” (i.e. the two more moderate eating clusters with higher amounts of beer and poultry with skin for the former and higher intake of wine for the latter). Cluster differences in food selection were mirrored in nutrient profiles (e.g. the “Heart Healthy” cluster consumed the least quantities of fat, saturated fat, and cholesterol; but had higher intakes of carbohydrate and fibre and overall more micronutrient density). They were again noticed in other characteristics and behaviours (e.g. compared to the “Heart Healthy” women, the “Empty Calorie” women were younger and less physically active; and presented an absolute increase of 17% in the risk of developing overweight, slightly diminished after adjustment for a couple of factors). These food patterns have been widely utilized in other investigations of dietary effects on health. Pencina et al (2008) reproduced these five patterns using the same methodology but they also included food choices of the male cohort. Men again were characterized by five clusters with differing labels, i.e. “Empty Calorie”; “Lower Variety”; “Higher Starch”; “Transition to Heart Healthy”; and “Average Male” patterns.

Hulshof et al (1992) collected data by means of two-day food records from participants of the Dutch national food consumption survey. In the final, 26 food groups were conceptualized (with consideration of convergence in nutrient composition and/or origin) for cluster analysis. They then retained eight clusters. Each pattern received a score based on recommended intakes for fat, ratio of polyunsaturated to saturated fats, dietary fibre, cholesterol, mono- and disaccharides, and alcohol. Clusters 1, 2, 3, 4, 5, 6, 7, and 8 scored 42; 31; 64; 50; 46; 61; 67; and 74 respectively. Scores could range from 20 to 100; so, clusters 1, 2, 4, and 5 (i.e. with scores of 50 or below) had moderate to poor dietary

quality; when clusters 3, 6, 7, and 8 had diets agreeing more with recommendations.

In a Swedish county, inhabitants participated in a cross-sectional survey on diet-health connections and completed food frequency questionnaires. Particularly, Hörnell et al (2010) acquired some of this data collection and made a classification of food items on the questionnaires into 36 food categories before estimating food pattern groups with cluster analysis. Women clustered in four distinct classes; namely “High fat”, “Tea and ice cream”, “Coffee and sandwich”, and “Fruits and vegetables”. Men had three meaningful pattern; notably “High fat”, “Tea, soda, and cookies”, and “Fruit and vegetables. Regarding health, the “Fruit and vegetables” female and male clusters had the highest prevalence of people with known and among family health issues. However, among subjects without previous health problems and with correct energy intake reports the “High fat” clusters were the troubled ones.

It is clear that a posteriori methods of elaborating dietary patterns have been dominated by factor and cluster analyses; yet, a third tool remains in the shadows, i.e. discriminant analysis.

### **3.2.3. Discriminant Analysis**

Experts in statistics have agreed that discriminant analysis, a technique comparable to logistic regression, is a powerful tool in the analysis of variance (Manly, 1986). Its aim is crudely to examine whether groups diverge with regard to the mean of a variable and then predict the belonging of (new) individuals to any of those groups. Specifically, different techniques can be used; for instance, Fisher linear discriminant analysis used for a two-group study or canonical analysis for the comparison of multiple groups. Therefore, it can aid nutritional epidemiologists interested in factors that segregate individuals/populations according to quality of their diets.



Patterson et al (2010) initiated a two-step survey on dietary quality among Swedish children and adolescents (data was collected with a 24-hour food recall for older children and a one-day food diary for the younger ones). Primarily, variations in energy densities of the diets allowed the creation of age- and gender-specific tertiles. These were then analyzed for differences in food group and nutrient intakes with a one-way analysis of variance (ANOVA). From there, findings were that only the low-energy-density tertile reached the population recommendations for energy from macronutrients. That group consumed more fruits, vegetables, pasta, rice and potatoes, and cereals and less sweets and chocolate, and sweetened beverages. After adjusting for energy, the food groups that differentiated most the tertiles were firstly fruit, then pasta, rice, potatoes, vegetables, sweets and chocolate and milk, fil (a soured-milk item) and yogurt. Energy-adjusted micronutrient and fibre intakes also differed significantly (e.g. across low-, mid-, and high-energy-density diets, on average intakes of vitamin C were 165mg, 108mg, and 87mg for girls aged 15 years while those of fibre were 19.4g, 15.8g, and 13.7g. P-value <0.001). For the second test, a discriminant function analysis was executed in order to confirm food groups that pinpointed to significant distinctions between energy-density tertiles. Those food groups were fruit; pasta, rice and potatoes; vegetables; sweets and chocolate; sweetened beverages; and milk, fil and yogurt (structure coefficients (adjusted for energy) were 0.430; 0.387; 0.352; -0.275; -0.245; and 0.220, respectively). These resembled those in the preceding analysis. 65% of the sample was classified in their original energy-density tertiles; and when only the low and high tertiles were considered that portion climbed to 89%.

### **3.3. Combination of methods used to identify dietary patterns**

Nutritional epidemiologists have adhered to the idea that the whole diet should be considered in the examination of the role nutrition has in the aetiology of diseases; and thus introduced the dietary pattern approach in measuring the adequacy of diets. However,

multiple methods of defining food patterns exist; so, their agreement can only serve to reinforce their validity as tools for capturing dissimilarities in dietary quality and the subsequent impacts on health status. As repeatedly proven in preceding paragraphs, both a priori and a posteriori analyses are usually accomplished after aggregation of foods reported on dietary data collection tools (e.g. Food frequency questionnaires, 24-hour recalls or food records) into researcher-determined food groups with the aim of reducing the data at hand and rendering it more meaningful. Yet, the two techniques may present similarities but divergences too. So, scientists have examined the reproducibility of dietary patterns identified using different techniques (Bountziouka et al, 2011; Newby et al, 2004; Okubo et al, 2010).

Particularly, Reedy et al (2009) studied colorectal cancer association to dietary patterns derived from multiple methods, namely four indexes (HEI-2005, AHEI, MDS, and RFS), factor analysis, and cluster analysis. They concluded that for men the vegetables and fruits cluster, fruit and vegetables factor, fat-reduced/diet foods factor, and all the indexes led to a reduced risk for the disease. Fifty-seven percent and 48% of men in the vegetables and fruits cluster were also in the highest quintile of the fruits and vegetables factor and in the highest quintile of the HEI-2005 respectively. Eighty-six percent and 37% of men of the fat-reduced cluster were in the fat-reduced/diet foods factor were in the highest quintile of the HEI-2005 respectively. Eighty-six percent and 5% of men in the fatty meats cluster were also in the highest quintile of the meat and potatoes factor and the highest quintile of the HEI-2005 respectively. Concordance of dietary patterns from these various methodologies was to a lesser degree for women.

In 2004, Kant et al inspected food patterns and their relationship to mortality: they applied a diet quality indicator, a slightly varied version of the Recommended Food Score (RFS) abbreviated as RFBS (which evaluated the compliance of dietary practices with food guidelines for intake of fruits, vegetables, whole grains, low-fat dairy, lean

meat/poultry/fish and meat alternates like beans/nuts and seeds; and behaviours to reduce fat, i.e. removal of poultry skin and fat from red meats). They employed the same collected data to define dietary patterns via factor and cluster analyses. Interestingly, they mentioned that approximately similar portions of subjects were classified in the best diet quality groups from the three approaches; i.e. the highest RFBS quartile, the highest quartile of fruit-vegetable-whole grain factor score, and the desirable dietary cluster.

Sodijnou et al (2009) used cluster analysis and identified dietary patterns among a sample of men and women living in Cotonou, the largest city in Benin. They named the two dietary patterns found “traditional” and “transitional” and compared their diet quality on the basis of diversity, micronutrient adequacy, and healthfulness. For this purpose, they created three scores: the dietary diversity score (DDS), the micronutrient adequacy score (MAS), and the healthfulness score (HS). The DDS was based on counting the total number of food groups consumed on 3 food-recall days (for a maximum of 18 food groups). The MAS was the % adequacy of intakes of 14 micronutrients (i.e. vitamins A, B6, B12, C and E, thiamine, riboflavin, niacin, pantothenic acid, folates, magnesium, calcium, iron and zinc), which was calculated by dividing the actual intake by the recommended dietary intake. Thus, 100% adequacy and above scored 1 and those below 100% scored 0. The HS was based on WHO/FAO recommendations for intakes of total fat, saturated fat, polyunsaturated fat, cholesterol, sugar, protein, fibre, fruits and vegetables. For each nutritional element, a score of 1 was given when the recommendation was met or 0 when it was not. It resulted that the “transitional” cluster had more intakes of bread and pasta, roots and tubers, nuts and seeds, white meat, red meat, eggs, milk, milk products, fats and sweets; and the “traditional” cluster ate more grains and fruits. The “transitional” cluster had better scores for vitamins E and B12, and pantothenic. It also had higher mean energy intake and percentage of energy from total fat, saturated fat, sugar, and cholesterol. Its fibre consumption was lower. In short, the “transitional” group scored higher on the DDS and MAS but lower on the HS. The MAS and the HS was positively associated with the intake of vegetables. The MAS

was also positively correlated with intakes of cereals, roots and tubers, legumes and nuts.

Quatromoni et al (2002) employed discriminant analysis in validating five food patterns obtained via cluster analysis (i.e. the already cited “Heart Healthy”; “Light Eating”; “Wine and Moderate Eating”; “High Fat”; and “Empty Calorie” patterns). The new procedure classified 80% of the sample correctly. Individual sensitivities were as follows: 75%, 78%, 80%, 90%, and 100% for the “High Fat”, “Heart Healthy”, “Light Eating”, “Empty Calorie”, and “Wine and Moderate Eating” clusters respectively. Separate specificities were 75% for the “High Fat” group, 89% for the “Light Eating” one, 90% for the “Heart Healthy” one, 98% for the “Empty Calorie” one, and 100% for the “Wine and Moderate Eating” one.

Pencina et al (2008) classified subjects of the Framingham Offspring/spouse Study in five food clusters for each gender (refer to paragraph 3.2.2.); yet, they acknowledged that their usage of cluster analysis would be limiting if one wished to extend their findings to new populations/individuals because the patterns they described were data-specific. That is why from the step of simplifying food items to 13 food groups they proceeded with a discriminant analysis, instead of a cluster analysis. Basically, this created a statistical scoring system where each of the five patterns got a classification function or formula that allowed the scoring of any new individual's food frequency questionnaire. A person was assigned to the cluster with the greatest classification function score. When comparing the two analyses, overall proportions classified correctly were 0.798 (95%CI: 0.781-0.821) for women and 0.800 (95%CI: 0.777-0.819) for men.

As previously seen, Hulshof et al (1992) arrived at eight dietary patterns following cluster analysis (refer to paragraph 3.2.2). Nevertheless, they accomplished two discriminant analyses in order to determine whether a few selected socio-demographic and health related lifestyle factors varied for the defined clusters; and to shed light to combinations of food

group intakes that best distinguished the clusters. For illustrating the first discriminant analysis, the first canonical variable (i.e. one of the variables that had a meaningful interpretation and explained nearly all the variance in the predictor variables) explained 64% of the variance of the socio-demographic and lifestyle characteristics and was mostly predicted by gender, smoking and weekdays. It discriminated mainly clusters 1 and 7 from clusters 2 and 6. The second analysis, the first canonical variable explained 51% of the variance in the food groups and was mostly predicted by sugar-rich products, fats and oils, high fat meat, soft drinks, eggs, cheese, and fruit. It discriminated particularly clusters 1 and 2 from clusters 7 and 8. Moreover, the second and third canonical variables corresponded to 26% and 14% of the variance respectively. Sugar-rich products and alcoholic drinks were most predictive of the former, which discriminated clusters 2, 6, and 8 from clusters 1 and 7. Breads, fats and oils, and alcoholic drinks were most predictive of the latter, which discriminated cluster 5 and clusters 4, 6, and 7.

Demydas (2011) used a sample of US adults from the 2005-2006 National Health and Nutrition Examination Survey in order to analyze the relation between their fruit and vegetables (F and V) consumption and socio-demographic, lifestyle and nutritional profiles. From cluster analysis, they concluded that three distinct vegetables and fruit consumption patterns described the sample: “low-intake F and V consumers” (i.e. with an average consumption of 255g per day per person, they had low intakes of all F and V subcategories); “consumers of healthier F and V options” (i.e. with an average consumption of 600g per day per person, they had higher intake of raw fruits, raw vegetables, and cooked vegetables without dressings but had low intake of fried vegetables); and “intensive juice consumers” (i.e. with an average consumption of 700g per day per person but 284g with the exclusion of fruit juice, they consumed great amounts of fruit juice). These patterns were then compared in terms of nutrient intakes: a score termed index of nutritional quality (INQ) was thus created and defined as the ratio of the observed density of a given nutrient to the recommended intake of that given nutrient within 1000 kcal.

(References were from the USDA Food Guide.). The authors selected key nutrients related to F and V intakes, i.e. dietary fibre, K, Ca, Mg, and vitamins C and A; and they added factors negatively associated with health, i.e. total fat, total saturated fatty acids, total sugar, Na, and cholesterol. The observed densities were based on the person's 2-day average intakes and a good INQ was  $> 1.0$ . The study concluded that while the "low-intake F and V consumers" cluster had more people with a worse nutrient profile than the remaining subjects, the "consumers of healthier F and V options" pattern was associated with a healthier nutrient profile. However, even the latter had few people with adequate densities for the undesirable health factors, i.e. fats, Na, and cholesterol. Though having more people with adequate vitamin C intake, the "intensive fruit juice consumers" group was worse for sugar intake. Moreover, the patterns were confirmed with a discriminant analysis, which showed 93.0% of correct classifications.

#### **4. Conclusion**

In conclusion, dietary patterns are being used often with success as indicators of diet quality. The creation of a dietary score combined with one a posteriori method is a powerful technique that can help in pinpointing to special characteristics of dietary patterns among populations threatened with poor diet quality, e.g. Indigenous Canadians living on reserve. Those dietary particularities could then be targets for nutritional interventions seeking to improve diet quality of these peoples. The article that follows was developed with that purpose in mind.

## **Chapter III: Research objective and question**

### **1. Research objective**

For the last few decades where lifestyle changes have been associated with a dramatic increase in chronic diseases, scientists have surveyed food choices among Canadian Indigenous peoples and noticed more and more dietary shifts. In that process of nutrition transition, consumption of traditional foods is decreasing while being replaced by market products of lower nutritional quality. Thus, the objective of the present research is to identify food choices related to better diet quality among British Columbian First Nations women living on reserves. This objective is one of the aims of the First Nations Food, Nutrition, and Environment Study.

### **2. Research question**

Which food groups are associated with a better diet quality among BC FN women living on reserves?

# Chapter IV: Methods

## 1. Subjects

The British Columbia (BC) First Nations Food, Nutrition and Environment Study (FNFNES) provided the database used in this research. The FNFNES, which aims at describing the diet of First Nations (FN) living on reserves and at helping these communities and health professionals in providing dietary recommendations to FN at the regional level, was initiated in BC. The study selected from each eligible household one responding adult (i.e. a person aged 19 years or older) who was able to provide a written informed consent (see annex 2 for the form used) and was self-identified as being a FN person living on reserve. For this article, only female data was utilized for a total of 493 women.

Sampling was ecosystem-based: FNFNES relied on data collected from probability samples of adult members living in First Nations on-reserve communities. Communities (Primary Sampling Units), households (Secondary Sampling Units) and individuals (Tertiary Sampling Unit in each household), were selected using random mechanisms. In addition to the 19 randomly selected communities, two communities were added: Nuxalk Nation because of the existence of extensive dietary data to which the study results could be compared, and Skidegate because of the uniqueness of its ecology. More detailed sampling methodology is described elsewhere (Chan et al, 2011). The BC FNFNES was approved by the Ethical review Boards at Health Canada, The University of Northern British Columbia and the Université de Montréal.

## 2. Data collection

After a three-day training, nutrition research coordinators (i.e. registered dietitians with a Master's degree) trained community research assistants for 2 to 3 days (the third day concerned only a part of the sample)(see annex 3 for the training agenda of community research assistants). Community research assistants were then responsible for data collection (see annex 4 for the role of community research assistants). Data was collected during Fall 2008 (in 9 communities) and 2009 (in 12 other communities). For the present



study, only food data from 24-hour recalls (one per individual) and responses on the socio, health, and lifestyle questionnaire (see annex 5) were used. The 24-hour diet recall was an “in-person” interview aimed at recording all food and beverage consumed on the previous day. Food and beverage models were used to estimate corresponding quantities of those intakes.

This interview used the multi-pass technique with 3 stages as follows: the first pass was to make a quick list of all foods consumed during a 24-hour period; the second one was to get a detailed description of the foods and beverages (brands, amounts, and amount eaten); and the third one was to review the recall with the participant to see if anything was missed. Food intake was coded using the CANDAT system (version 8.0, Godin, London, ON, 2007), based on the Canadian Nutrient File 2007 (Health Canada, 2007).

In order to determine the subjects’ body mass indexes (BMI), height and weight were either measured or self-reported.

### **3. Data analysis**

#### ***Food groups***

Three nutritionists explored independently how to regroup the 1076 food codes into food groups for this analysis. Reconciliation of the 3 groupings led to 25 groups, similar for the main to the classification of Desaulniers and Dubost (2007) developed for their food composition table.

For fruit beverages and juices, some items were excluded from the groupings since they were not detailed enough in order to differentiate without hesitation 100% natural juices from fruit-based sweetened beverages. The same issue arose for other sweetened versus non-sweetened beverages thus excluding, coffee, and tea. Drinking water and alcohol were also deleted since their reporting was deemed unreliable. However, protein supplements were included in dairy products since they are mostly based on cow’s dairy products. Traditional foods (i.e. foods harvested from the local environment) were identified and aggregated into one single group.

### ***Diet quality score***

Multiple studies shed light to dietary practices among various Canadian Indigenous Peoples (Ho et al, 2008; Kuhnlein et al, 1996; 2004; 2007; Receveur et al, 1997; Sharma et al, 2010). These surveys pinpointed key nutritional elements that need more attention in order to improve their diet quality. From these elements, ten were retained to include in the diet quality score: magnesium; calcium; iron; vitamins A, C, and D; folate; total and saturated fats; and fibre.

The score was similar to the construction of a Nutrient Adequacy Score (NAS) (Murphy et al, 1996) and based on a dichotomous points allocation for each selected key nutritional item using DRIs cut-offs: with a 1 when the DRI for a given element was met in the 24-hr, and a 0 otherwise. Therefore, diet quality scores could range from 0 (i.e. the poorest diet quality) to 10 (i.e. the best diet quality) when summed up over the 10 items. The diet quality scores were finally divided in tertiles for analyses.

### ***Statistical analyses***

Food groups' intakes were compared by tertiles of diet quality. Since data were not normally distributed, it was rank-transformed before using univariate tests for analysis of variance and covariance (Kruskal-Wallis and ANCOVA tests). To identify the relative contribution of the food groups to diet quality, the highest tertile was compared to the two lowest tertiles using discriminant analysis with the 25 potential food groups used as independent variables and adjusting for energy intake in the final model. Interpretation of the discriminant functions is based on standardized coefficients and the % correct classification. P values less than 0.05 were used to assess statistical significance. SPSS for Windows (version 17.0, SPSS Inc. Chicago, IL) was used for analyses.

## **Chapter V: Article**

The following article (i.e. “Key food groups are associated with higher diet quality for First Nations women living on reserves in British Columbia.”) is in preparation and will be submitted to the Canadian Journal of Dietetic Practice and Research.

Its principal authors (in order) are Sandrine Mutoni (myself), Karimou Morou (data analyst), and Olivier Receveur.

With regards to this article, my responsibilities were its writing. Thus, I did the literature review, verified that data analyses (done by Karimou Morou) were correct, and generated the results and their interpretation.

## **Key food groups are associated with higher diet quality for First Nations women living on reserves in British Columbia.**

Sandrine Mutoni, Karimou Morou, Olivier Receveur

### **ABSTRACT**

**Purpose:** To identify dietary patterns associated with a better diet quality among First Nations living on reserves in British Columbia (BC).

**Methods:** Subjects were 493 female adults selected from the BC First Nations Food, Nutrition, and Environment Study. A dietary score, based on ten nutritional elements, was developed and allowed the creation of tertiles corresponding to different levels of diet quality (DQ). Food data (from 24-hour recalls) was classified in 25 food groups (FGs) whose intakes were compared by tertiles using non-parametric statistical tests (Kruskal-Wallis and ANCOVA). To confirm FGs associated with DQ, a discriminant analysis completed these tests.

**Results:** Discriminant analysis confirmed that the FGs associated with a better DQ were “vegetables and vegetable products”, “fruits”, “traditional foods”, “low-fat dairy products”, “soups/broth”, and “other market meat” (standardized discriminant function coefficients = 0.324, 0.295, 0.292, 0.282, 0.157, and -0.189; respectively).

**Conclusions:** Our findings support the promotion of dietary choices according to the “Eating Well with the Canadian Food Guide – First Nations, Inuit, and Métis”. It is greater use of vegetables, fruits, low-fat dairy products, and traditional foods that characterizes better menus.

### **RÉSUMÉ**

**But:** Identifier les patrons alimentaires associés à une meilleure alimentation chez les Premières Nations vivant dans les réserves en Colombie Britannique.

**Méthodes:** 493 femmes ont été sélectionnées de l'étude ‘First Nations Food, Nutrition, and Environment Study’. Un indice basé sur 10 éléments nutritionnels a servi à classer les sujets en tertiles de qualité alimentaire (QA) différente. Après la classification des items rapportés sur des rappels de 24 heures en 25 groupes alimentaires (GAs), les tertiles ont été

comparés sur leur consommation de ces GAs en utilisant des tests statistiques non paramétriques (Kruskal-Wallis et ANCOVA) et une analyse discriminante (AD) pour confirmer les GAs associés à la QA.

**Résultats:** L'AD a confirmé que les GAs associés à une meilleure QA étaient “légumes et produits végétaux”, “fruits”, “aliments traditionnels”, “produits laitiers faibles en gras”, “soupes et bouillons”, et “autres viandes commercialisées” (coefficients standardisés = 0,324; 0,295; 0,292; 0,282; 0,157; et -0,189 respectivement).

**Conclusions:** Nos résultats appuient la promotion des choix alimentaires recommandés dans ‘Bien manger avec le Guide alimentaire canadien – Premières Nations, Inuit, et Métis’. Une consommation accrue des légumes, fruits, produits laitiers faibles en gras, et aliments traditionnels caractérise les meilleurs menus.

## INTRODUCTION

For the last few decades where lifestyle changes have been associated with a dramatic increase in chronic diseases, scientists have surveyed food choices among Canadian Indigenous peoples and noticed more and more dietary shifts (1-6). In that process of nutrition transition, consumption of traditional foods is decreasing and being replaced by market products of lower nutritional quality (3).

Recently, a study conducted among British Columbian First Nations adults on reserves compared dietary intakes, reported using 24-hour food recalls, to Dietary Reference Intakes (DRIs) and observed that though intakes of macronutrients were mainly comparable to those of the general Canadian population, insufficient intakes were prevalent for dietary fibre, vitamin A (except for older women), vitamin D, calcium, and potassium. On the contrary, sodium intake tended to be too high (7). When comparing intakes to recommended food groups servings in “Eating Well with Canada's Food Guide (CFG) – First Nations, Inuit and Métis”, recommendations for the meat and alternates food group were the only one being met (7) with 3.0 servings per day compared to the 2.0 recommended. On another hand, women ate on average 4.4 servings/day instead of 7 to 8 for the vegetables and fruit group, 4.0 servings/day instead of 6 to 7 for grain products, and

1.0 serving per day instead of 2 to 3 for milk and alternatives; however, 3 instead of 2 for meat and alternatives.

Evaluation of diet quality through comparisons to DRIs and/or the Canadian Food Guide is admittedly widely and rightly utilized; but when considering findings of undesirable dietary behaviors due possibly, in part, to a limited variety of available foods in Indigenous communities, one may question whether more detailed recommendations could possibly be made using readily available food products in the communities.

Other techniques that analyze diet quality by focusing on a combination of key nutritional elements rather than single items separately have been developed in order to identify the relationships between diet quality and specific dietary patterns (8-12). Among those, the techniques using diet scores based on nutrients combined with a-posteriori statistical analyses such as discriminant analyses are being used with success in describing food patterns associated with improved diet quality (13-16).

The objective of the present research is to identify food choices related to better diet quality among British Columbian First Nations women living on reserve.

## **METHODS**

### **Subjects**

The British Columbia (BC) First Nations Food, Nutrition and Environment Study (FNFNES) provided the database used in this research. The FNFNES, which aims at describing the diet of First Nations (FN) living on reserve and at helping these communities and health professionals in providing dietary recommendations to FN at the regional level, was initiated in BC. The study selected from each eligible household one responding adult (i.e. a person aged 19 years or older) who was able to provide a written informed consent and was self-identified as being a FN person living on reserve. For this article, only female data was utilized for a total of 493 women.

Sampling was ecosystem-based: FNFNES relied on data collected from probability samples of adult members living in First Nations on-reserve communities. Communities (Primary

Sampling Units), households (Secondary Sampling Units) and individuals (Tertiary Sampling Unit in each household), were selected using random mechanisms. In addition to the 19 randomly selected communities, two communities were added: Nuxalk Nation because of the existence of extensive dietary data to which the study results could be compared, and Skidegate because of the uniqueness of its ecology. More detailed sampling methodology is described elsewhere (7). The Ethical Review Boards at Health Canada, the University of Northern British Columbia, and the Université de Montréal approved the BC FNFNES.

### **Data collection**

Communities' research assistants collected the BC FNFNES data used in this study during Fall 2008 (in 9 communities) and 2009 (in 12 other communities). For the present study, only food data from 24-hour recalls was used (one per individual). The 24-hour diet recall was an "in-person" interview aimed at recording all food and beverage consumed on the previous day. Food and beverage models were used to estimate corresponding quantities of those intakes.

This interview used the multi-pass technique with 3 stages as follows: the first pass was to make a quick list of all foods consumed during a 24-hour period; the second one was to get a detailed description of the foods and beverages (brands, amounts, and amount eaten); and the third one was to review the recall with the participant to see if anything was missed. Food intake was coded using the CANDAT system (version 8.0, Godin, London, ON, 2007), based on the Canadian Nutrient File 2007 (17).

### **Data analysis**

#### ***Food groups***

Three nutritionists explored independently how to regroup the 1076 food codes into food groups for this analysis. Reconciliation of the 3 groupings led to 25 groups, similar for the main to the classification of Desaulniers and Dubost (18) developed for their food composition table.

For fruit beverages and juices, some items were excluded from the groupings since subjects could not detail them enough in order to differentiate without hesitation 100% natural juices from fruit-based sweetened beverages. The same issue arose for other sweetened versus non-sweetened beverages; thus excluding coffee and tea. Drinking water and alcohol were also deleted since their reporting was deemed unreliable. However, protein supplements were included in dairy products since they are mostly based on cow's dairy products. Traditional foods (i.e. foods harvested from the local environment) were identified and aggregated into one single group.

### ***Diet quality score***

Multiple studies shed light to dietary practices among various Canadian Indigenous Peoples (1-6). These surveys pinpointed key nutritional elements that need more attention in order to improve their diet quality. Thus, the diet quality score was based on recommended intakes for ten nutritional elements, namely magnesium, calcium, iron, folate, total and saturated fats, fibre, and vitamins A, C, and D.

The score was similar to the construction of a Nutrient Adequacy Score (NAS) (19) and based on a dichotomous points allocation for each selected key nutritional item using DRIs cut-offs: with a 1 when the DRI for a given element was met in the 24-hr, and a 0 otherwise. Therefore, diet quality scores could range from 0 (i.e. the poorest diet quality) to 10 (i.e. the best diet quality) when summed up over the 10 items. The diet quality scores were finally divided in tertiles for analyses.

### ***Statistical analyses***

Food groups' intakes were compared by tertiles of diet quality. Since data were not normally distributed, it was rank-transformed before using univariate tests for analysis of variance and covariance (Kruskal-Wallis and ANCOVA tests). To identify the relative contribution of the food groups to diet quality, the highest tertile was compared to the two lowest tertiles using discriminant analysis with the 25 potential food groups used as independent variables and adjusting for energy intake in the final model. Interpretation of the discriminant functions is based on standardized coefficients and the % correct



classification. P values less than 0.05 were used to assess statistical significance. SPSS for Windows (version 17.0, SPSS Inc. Chicago, IL) was used for analyses.

## **RESULTS**

### **Socio-demographic and lifestyle characteristics**

The mean age of the sampled population was  $43.4 \pm 12.6$  years with a little more than 50% being middle-aged. Level of education corresponded to an average of  $11 \pm 2.8$  years. Household sizes of less than 2, between 2 and 4, and above 4 individuals were almost equal in numbers (percentages were 36.1%, 34.9%, and 29.0% of the sample size respectively). In 2006, the percentages of one-person households in the general Canadian population and British Columbia that were 26.8% and 28.0%, respectively (20), were lower than the one found here among BC FN women living on reserves (i.e. 36.1%). The mean number of employed people in the household was  $1.0 \pm 0.8$ . More than 50% subjects were smokers (i.e. 53.1%); there was also a high percentage of obesity (i.e. 44.8% of the sample were obese and only 23.5% with normal weight (height and weight were either measured or self-reported and pooled since no difference in self-reported versus measured BMI was observed (7)). When looking at practice of traditional activities, participants were mostly involved in fishing, collecting foods in the wild, hunting, gardening, and collecting seafood; precisely in terms of percentages of subjects, 58.0%; 47.5%; 43.8%; 28.8%; and 12% participated in such activities respectively (Table 1).

### **Comparison of diet quality scores and food group intakes**

Table 2 presents the 25 food groups constructed along with their main food contributors. Items in the traditional food group were moose, groundhog, spruce grouse, elk, caribou (reindeer), deer (venison), salmon, Arctic char, whitefish, mussel, clam, eulachon, halibut, crab, eulachon grease, herring eggs, blackberry, Saskatoon berry, red huckleberry, cranberry, soapberry, strawberry, raspberry, blueberry, Labrador tea, rosehips, seaweed, pine mushroom, and peppermint.

Figure 1 illustrates the construction of the diet quality score. The lowest tertile was comprised of 24-hr recalls that had met less than 3 of the 10 DRIs; the intermediate tertile

24-hr recalls had met 3-4 DRIs; and the highest tertile the 24-hr recalls meeting more than 4 DRIs. No 24-hour recalls showed the maximum score of 10 points.

Table 3 compares the average consumption of each food group across the three distinct diet quality tertiles. For each food-group the mean daily intake (g/person/day) are presented first followed by these means adjusted for energy intake (21). The adjustment for energy intake allows to compare the contribution of each food group relatively to the total amount of energy consumed since it can be assumed that as energy intake increases, the total amount of food consumed increases with an associated tendency to increase the probability to meet requirements. In other words, our analysis answers the question: given the observed levels of energy intake, which food groups seem to contribute particularly to diet quality. Two-by-two comparisons of the three diet quality levels showed that the higher quality tertile differed from the other two for the “vegetables and vegetable products”, “low-fat dairy”, “other market meats”, and “nuts and seeds” groups. Precisely, compared to the lower quality category, 24-hr recalls of higher quality contained about twice the amount of the “vegetables and vegetable products”, 4 times more “low-fat dairy” items, about twice more “nuts and seeds” products and much less “other market meats”.

For “soups and broth”, “breakfast cereals”, and “sausages and cold meats”, it was hard to segregate 24-hr diet recalls of higher and mid quality. In other words, for those food groups it was only obvious that the lower diet quality tertile had significant different intakes; e.g. two times more “sausages and cold meats” foods but half the amount of the “breakfast cereals” and “soups and broth” groups.

Three food groups appeared to separate all the three diet quality levels: for example when comparing intakes from the “traditional foods” group the “mid” diet quality had twice the quantities consumed by the lower class while the higher had 4 times more consumption than the latter. The “fruits” and “breads” were the other two groups where intakes increased significantly across all three levels of diet quality.

Relationship to diet quality was not significant for the remaining food groups (i.e. “high-energy beverages”, “ready-to-eat foods”, “rice and pasta”, “high-fat dairy products”,

“market eggs”, “cakes and cookies”, “sweets”, “poultry”, “condiments and sauces”, “beef”, “snack and appetizers”, “french fries”, “added fat and oils”, “fruit-based sauces and canned products”, “market fish and seafood”).

To identify the distribution of food groups that best characterize the highest quality 24-hr recalls, the discriminant function (Table 4) correctly classified 83.8 % of the records based on the total energy consumed and a greater consumption of “vegetables and vegetable products” (0.324), “fruits” (0.295), “traditional foods” (0.292), “low-fat milk” (0.282); “soups and broth” (0.157) and less “other market meats” (-0.189).

Before adjustment for energy, the discriminant function correctly classified 77.7% of the 24-hr recalls based on “vegetables and vegetable products”, “low-fat dairy products”, “fruits”, “traditional foods”, “soups and broth”, “breads”, and “nuts and seeds”.

## **DISCUSSION**

When diet quality was measured using a dietary score composed of ten nutritional elements importantly related to diets of Canadian Indigenous populations, no 24-hr recall met the complete set of requirements (determined using DRIs). Nevertheless, given the observed pattern of food use, the food group of “vegetables and vegetable products” was the most positively related to diet quality followed by “fruits”, “traditional foods”, “low-fat dairy products”, “soups and broth”. These higher quality recalls also had less of the “other market meats” category.

These findings suggest that dietary recommendations that focus on increasing vegetables, fruits, traditional foods, and low-fat milk and alternates are relevant to adult First Nations women living on reserves in British Columbia. The importance of promoting traditional foods is also clear and in agreement with numerous studies (3-5, 22-23); In fact, by comparing the standardized coefficients of our discriminant functions it can be seen that the contribution of traditional foods to diet quality for First Nations women living on reserve in British Columbia is of the same magnitude as the contribution of fruits, vegetables, and low-fat dairy products even at current intake levels of approximately 96 g/person/day (7).

Food choices from the “other market meats” group (which included mostly pork meat) were negatively associated to diet quality possibly as those products tend to displace other traditional meats and fish.

Associations between the “breads” and also the “nuts and seeds” food groups and diet quality found from the ANCOVA results were confirmed in the non-energy adjusted discriminant analysis but not when food groups were adjusted for energy. This suggested that differences in energy intake were directly correlated with intake of these 2 items so that separate effects could not be dissociated.

Although many papers emphasize the importance of limiting added fats and sugars in the prevention of nutritional related issues (1, 24-25), the “added fat and oils” and “sweets” groups were surprisingly not related to diet quality in this population. Individuals with lower diet quality even consumed less items from the “cakes and cookies” food category. Also the “high-energy beverages” group, which again has been linked to dietary patterns with low quality (mostly in children and adolescents) (26-27), was not associated to diet quality in our sample. This may result from the exclusion of some drinks with high amounts of added sugar like fruit beverages and juices. But, it could also suggest that those energy-dense foods and beverages do not compromise directly nutrient intake in this population but may be advised against for other reasons such as their association with increased risk of excess body weight (28).

Methods chosen for this study have their strengths but also some limitations. Even though not one but three nutritionists determined independently food groups used for diet quality analyses, the fact that we selected these 25 groups is somewhat arbitrary. Vegetables could be further divided in subgroups (green leafy/yellow/others), and high fiber cereals separated from the others. Nevertheless it represents the consensus reached at this time given the distribution of use of the 1076 food codes recorded. Some misclassification may also have occurred as for example a pizza could either be classified as ready-to-eat food if only one code was used to record it, or broken down in its component codes if it was homemade and

its recipe available. Nevertheless, during data collection attention was given to record ingredients when known by the respondent.

Our choice of 10 nutritional elements was also limiting because other elements such as sodium, potassium, omega-3 fatty acids for example could have been included but since, with only 10 elements used, no 24-hr recall was observed to provide them all to required amounts, adding more nutritional criteria would have been counter-productive.

For the present study, only one 24-hour recall was used per subject. Due to day-to-day variation in food intakes, usual food consumption per person was not captured since capturing day-to-day variation in food intake is much more challenging: it would require a much larger sample size and more than two 24-hr recalls per person (29). Therefore, the interpretation of our results should be limited to the analyses of daily menus rather than usual diets. In other words, in the analyses of a sample of daily menus reported by 493 women randomly chosen from 21 BC First Nations communities, our findings supports the promotion of dietary choices according to “Eating Well with Canada's Food Guide – First Nations, Inuit and Métis”: it is greater use of fruits and vegetables, traditional foods and low-fat milk products that characterizes better menus.

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**Table 1: Socio-demographic and lifestyle characteristics of BC FN female adults living on reserves (n=493)**

SOCIO-DEMOGRAPHIC VARIABLES	Number of individuals (%)	LIFESTYLE VARIABLES	Number of individuals (%)
Age (years):		Smoking:	
19-30	83 (16.8)	Smokers	262 (53.1)
31-50	264 (53.5)		
51-70	146 (29.6)		
Mean±SD	43.4±12.6		
Education (years):		Body Mass Index:	
<10	183 (37.1)	Normal	116 (23.5)
10 to 12	212 (43.0)	Overweight	156 (31.6)
>12	98 (19.9)	Obese	221 (44.8)
Mean±SD	11.0±2.8	Mean±SD	30.0±6.7
Household size (tertiles):		Participation in traditional activities:	
<2	178 (36.1)	Hunting	216 (43.8)
2 to 4	172 (34.9)	Fishing	286 (58.0)
>4	143 (29.0)	Other wild foods gathering	234 (47.5)
Mean±SD	3.6±2.0	Seafood gathering	59 (12.0)
Number of employed individuals in the household:		Gardening	142 (28.8)
0	125 (25.4)		
1	210 (42.6)		
>1.0	158 (32.0)		
Mean±SD	1.0±0.8		

**Table 2: List of the five main contributors to each group of the 25 food groups obtained from 24-hour recalls of BC FN female adults living on reserves (n=493)**

Food group	Food code	Food label	% of total intake by weight	Total food group intake (g)
High-energy beverages	29200	Carbonated drinks, cola	63	94191
	28550	Carbonated drinks, ginger ale	8	
	28610	Carbonated drinks, root beer	7	
	28540	Carbonated drinks, cream soda	4	
	28580	Carbonated drinks, orange soda	4	
Vegetables and Vegetable products	25060	Potato, flesh and skin, cooked in skin, boiled, drained	8	62726
	7000504	Mashed potatoes w/ 2% milk + butter	8	
	22720	Vegetables, mixed, frozen, boiled, drained	7	
	23810	Carrot, boiled, drained	4	
	24600	Tomato, red, ripe, raw, year round average	4	
Ready-to-eat foods	7000022	Macaroni & cheese, Kraft	14	62611
	7000288	Chicken chow mein or chop suey with noodles.	8	
	49640	Mixed dishes, beef stew, canned	6	
	49620	Mixed dishes, pepperoni pizza, frozen	4	
	799914	Stew, beef, with potatoes and vegetables	4	
Rice and pasta	45230	Grains, rice, white, long-grain, regular, cooked	46	43916
	44640	Pasta, spaghetti, enriched, cooked	20	
	7000123	Noodles, ramen, cooked	11	
	45070	Pasta, macaroni (elbow), enriched, cooked	5	

	48740	Pasta, rice noodles, cooked	4	
Soups and broth	52440	Soup, chicken noodle, cup-a-soup, mix, water added	13	43030
	10550	Soup, chicken noodle, canned, condensed, water added	8	
	10960	Soup, vegetable beef, dehydrated, water added	6	
	10630	Soup, cream, mushroom, canned, condensed, water added	6	
	10750	Soup, vegetable w/ beef broth, canned, condensed, water added	4	
Low-fat dairy products	1440	Yogurt, fruit bottom, 1% to 2% m.f.	3	29120
	1450	Yogurt, fruit bottom, less than 1% m.f	2	
	1140	Milk, fluid, skim	2	
	1530	Milk, evaporated, partly skimmed, canned, undiluted, 2% m.f	1	
	7002036	Yogurt, Activia, strawberries, Danone, fat- free	1	
Traditional foods	35880	Game meat, native, moose, roasted	39	27482
	30530	Salmon, sockeye (red), baked or broiled	5	
	32230	Salmon, sockeye (red), canned, solids w/ bone & liquid, salted	4	
	31720	Crab, Dungeness, boiled or steamed	4	
	31570	Salmon, Chinook (spring), baked or broiled	4	
Breads	40660	Bread, white (includes soft crumbs), commercial	16	26232
	40670	Bread, whole wheat, commercial	13	
	40680	Bread, whole wheat, commercial, toasted	11	

	37320	Bread, white, commercial, toasted	11	
	39850	Roll, hamburger / hotdog, plain	7	
Fruits	17040	Banana, raw	31	22958
	16960	Apple, raw, with skin	27	
	16230	Tangerine (mandarin), raw	10	
	17220	Orange, all commercial varieties, raw	9	
	16160	Orange, California, navel, raw	4	
High-fat dairy products	1190	Cheese, cheddar	15	17450
	1130	Milk, fluid, whole, pasteurized, homogenized, 3.3% m.f.	15	
	41630	Dessert, frozen, ice cream, vanilla, 11% m.f.	8	
	1500	Cream, cereal (half and half), 10% m.f.	6	
	1410	Yogurt, plain, 2% to 4% m.f	5	
Breakfast cereals	14400	Cereal, hot, oats, quick, prepared, Quaker	52	16810
	13980	Cereal, hot, cream of wheat, regular, prepared, Nabisco	13	
	14140	Cereal, hot, oats, instant: regular, prepared, Quaker	4	
	14560	Cereal, hot, purity cornmeal, prepared, Robin Hood	4	
	14320	Cereal, hot, oats, porridge (w/ oat bran, wheat bran & flax seeds), prepared, Rogers	3	
Market eggs	1290	Egg, chicken, whole, fried	37	14737
	1330	Egg, chicken, whole, scrambled	29	
	1300	Egg, chicken, whole, boiled in shell, hard-cooked	25	
	1310	Egg, chicken, whole, omelette	5	
	1320	Egg, chicken, whole, poached	2	

Cakes and cookies	42300	Dessert, gelatine, dry mix, with water	18	13541
	7002008	Cake, carrot, from recipe, w/ cream cheese icing	6	
	39420	Pie, apple, prepared from recipe, 2 crust	5	
	39310	Pancake, plain (w/ buttermilk), dry mix, complete	4	
	38970	Doughnut, yeast-leavened (honey bun), glazed	4	
Sweets	43180	Sweets, sugars, granulated	40	13131
	28710	Hot chocolate, mix, powder, water added	10	
	52950	Hot chocolate, rich, mix, powder, water added	7	
	43170	Sweets, sugars, brown	6	
	52960	Hot chocolate with marshmallows, mix, powder, water add	4	
Poultry	6050	Chicken, broiler, drumstick, meat & skin, flour coated, fried	10	12246
	6890	Turkey, all classes, flesh and skin, roasted	7	
	5660	Chicken, broiler, flesh only, fried	6	
	8890	Chicken, roasting, breast, meat & skin, roasted	5	
	6040	Chicken, broiler, drumstick, meat & skin, battered, fried	5	
Condiments and sauces	24650	Tomato, sauce, canned	13	10396
	49990	Sauce, stir fry, ready-to-serve	12	
	10250	Sauce, salsa, ready-to-serve	7	
	7000035	Gravy, beef, homemade	6	
	24460	Tomato, sauce for spaghetti, canned	5	

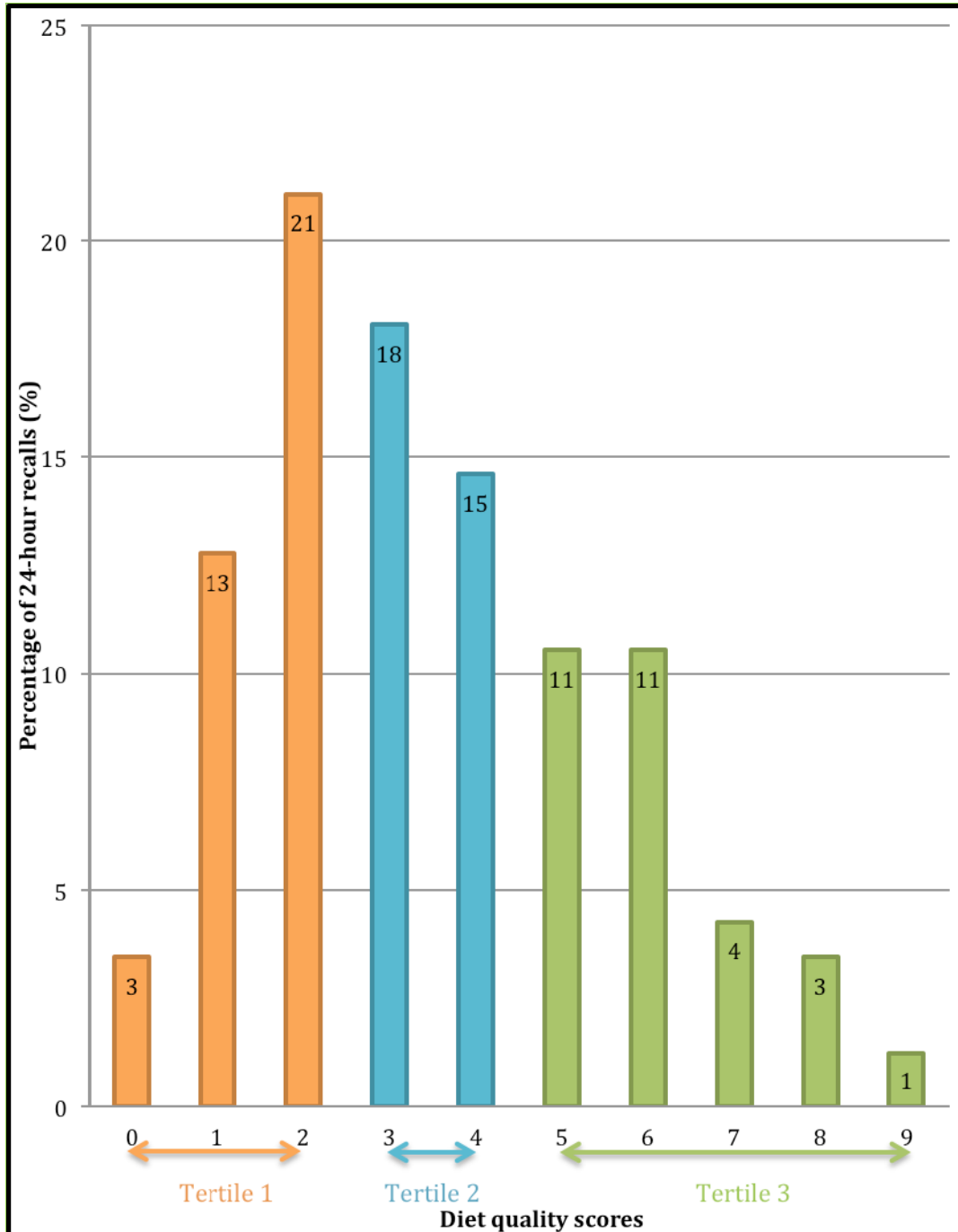
Beef	26950	Beef, ground, medium, pan-fried, degree of doneness: medium	18	10114
	26860	Beef, ground, lean, broiled, degree of doneness: medium	10	
	26880	Beef, ground, lean, pan-fried, degree of doneness: medium	10	
	26830	Beef, ground, lean, raw	7	
	59500	Beef, chuck, blade steak, boneless, lean & fat, 0 mm trim, raw	6	
Sausages and cold meats	54070	Pork, cured, bacon, cooked, pan-fried	12	9353
	11490	Ham, sliced, regular (approximately 11% fat)	8	
	11630	Sausage, pork and beef, fresh, cooked	7	
	11850	Wiener (Frankfurter), beef	7	
	11860	Wiener (Frankfurter), beef and pork	5	
Other market meats	18840	Pork, fresh, loin, center cut (chop), bone-in, lean & fat, pan-fried	17	7713
	19340	Pork, fresh, side ribs center cut (spareribs), lean & fat, simmered, roasted	12	
	61220	Pork, fresh, ground, medium, pan-fried	8	
	17910	Pork, fresh, loin, rib chop (rib end), bone-in, lean & fat, broiled	6	
	17900	Pork, fresh, loin, rib chop (rib end), bone-in, lean & fat, braised	6	
Snacks and appetizers	44070	Snacks, potato chips, plain	21	7378
	38720	Cracker, saltine (also oyster, soda, soup)	11	
	7000107	Popcorn, microwave, pop & serve bag	11	
	40720	Cracker, standard snack-type	8	

	40920	Snacks, corn-based, extruded, puffs or twists, cheese	6	
French fries	24310	Potato, hashed brown, plain, frozen, prepared	38	7184
	24350	Potato, french-fried, frozen, home-prepared, heated oven, unsalted	21	
	24360	Potato, french-fried, frozen, restaurant prepared with vegetable oil	20	
	21800	Potato, hashed brown, frozen, w/ butter sauce, prepared	10	
	21850	Potato, french-fried, frozen, restaurant-prepared, fried in vegetable oil & animal fat	7	
Added fat and oils	1180	Butter, regular	22	6603
	53120	Margarine, tub, composite	21	
	4510	Vegetable oil, canola	15	
	5270	Salad dressing, mayonnaise type, commercial, over 35% oil	13	
	5320	Salad dressing, Italian, commercial, regular	4	
Fruit-based sauces and canned products	15580	Fruit salad, canned, heavy syrup pack, solids & liquid	20	2544
	15030	Apricot, canned halves w/ skin, light syrup pack, solid & liquid	17	
	15540	Fruit cocktail, canned, light syrup pack, solids & liquid	14	
	17010	Apple sauce, canned, sweetened	11	
	7000480	Sauce, cranberry, whole cranberry, canned/home recipe	9	

Nuts and seeds	25260	Seeds, sunflower seed kernels, dried	17	1639
	33990	Peanut butter, smooth type, fat, sugar and salt added	11	
	25770	Nuts, mixed nuts, dry roasted with peanuts	9	
	33960	Peanuts, all types, raw	7	
	34140	Peanut butter, smooth type, fat and sugar added	6	
Market fish and seafood	31950	Cod (scrod), Atlantic, baked or broiled	15	1623
	30060	Fish portions and sticks, frozen and reheated	12	
	32030	Sardine, Atlantic, canned with oil, drained solids with bone	12	
	30860	Tuna salad	10	
	32120	Shrimp, mixed species, boiled or steamed	9	



**Figure 1: Percentage of 24-hour recalls according to scorings of BC FN female adults living on reserves (n=493) on a dietary quality score and corresponding tertiles (i.e. lower, mid, and higher levels of diet quality)**



**Table 3: Absolute and adjusted intakes (g per day per person) of 25 food groups across diets of lower, mid, and higher quality among BC FN female adults living on reserves (n= 493)**

Food group	Average g consumed per day per person across three levels of diet quality (s.e.m*)			ANCOVA
	Lower	Mid	Higher	P-value†
High-energy beverages	196.2 (42.3)	185.5 (31.4)	190.6 (33.9)	-
<b>Kcal adjusted</b>	<b>286.0 (36.5)</b>	<b>208.8 (36.3)</b>	<b>53.8 (43.3)</b>	<b>0.104</b>
Vegetables and vegetable products	75.9 (7.6)	90.3 (9.9)	231.2 (23.9)	-
<b>Kcal adjusted</b>	<b>95.5<sup>a</sup> (14.7)</b>	<b>95.4<sup>a</sup> (14.6)</b>	<b>201.2<sup>b</sup> (17.4)</b>	<b>&lt; 0.001</b>
Ready-to-eat foods	78.5 (8.9)	140.2 (17.5)	172.9 (25.2)	-
<b>Kcal adjusted</b>	<b>132.4 (16.6)</b>	<b>154.2 (16.5)</b>	<b>90.8 (19.7)</b>	<b>0.073</b>
Rice and pasta	60.5 (9.1)	86.8 (10.7)	127.0 (13.2)	-
<b>Kcal adjusted</b>	<b>74.1<sup>a</sup> (11.0)</b>	<b>90.4<sup>b</sup> (11.0)</b>	<b>106.2<sup>b</sup> (13.1)</b>	<b>0.054</b>
Soups and broth	67.2 (11.1)	99.2 (14.3)	99.2 (15.1)	-
<b>Kcal adjusted</b>	<b>58.1<sup>a</sup> (13.6)</b>	<b>96.9<sup>b</sup> (13.6)</b>	<b>113.1<sup>b</sup> (16.2)</b>	<b>0.027</b>
Low-fat dairy products	37.1 (6.4)	31.7 (6.5)	116.1 (25.9)	-
<b>Kcal adjusted</b>	<b>35.2<sup>a</sup> (14.9)</b>	<b>31.2<sup>a</sup> (14.8)</b>	<b>119.0<sup>b</sup> (17.6)</b>	<b>&lt; 0.001</b>
Traditional foods	24.2 (5.0)	54.7 (8.4)	96.1 (11.4)	-
<b>Kcal adjusted</b>	<b>24.7<sup>a</sup> (8.5)</b>	<b>54.8<sup>b</sup> (8.4)</b>	<b>95.4<sup>c</sup> (10.0)</b>	<b>&lt; 0.001</b>
Breads	33.2 (3.1)	54.2 (4.5)	76.9 (9.3)	-
<b>Kcal adjusted</b>	<b>43.0<sup>a</sup> (5.8)</b>	<b>56.7<sup>b</sup> (5.8)</b>	<b>64.1<sup>c</sup> (6.9)</b>	<b>&lt; 0.001</b>

Fruits	29.7 (5.8)	40.8 (6.6)	73.8 (9.3)	-
<b>Kcal adjusted</b>	<b>24.8<sup>a</sup> (7.3)</b>	<b>39.5<sup>b</sup> (7.2)</b>	<b>81.3<sup>c</sup> (8.6)</b>	<b>&lt; 0.001</b>
High-fat dairy products	23.9 (4.2)	27.5 (5.2)	58.2 (9.7)	-
<b>Kcal adjusted</b>	<b>32.2 (6.6)</b>	<b>29.7 (6.5)</b>	<b>45.6 (7.8)</b>	<b>0.942</b>
Breakfast cereals	21.4 (5.9)	41.4 (7.9)	41.9 (7.6)	-
<b>Kcal adjusted</b>	<b>21.0<sup>a</sup> (7.2)</b>	<b>41.3<sup>b</sup> (7.2)</b>	<b>42.5<sup>b</sup> (8.6)</b>	<b>0.002</b>
Market eggs	31.0 (4.2)	34.5 (5.2)	23.5 (3.6)	-
<b>Kcal adjusted</b>	<b>35.5 (4.5)</b>	<b>35.6 (4.4)</b>	<b>16.8 (5.3)</b>	<b>0.176</b>
Cakes and cookies	13.7 (3.2)	31.6 (6.0)	40.1 (5.9)	-
<b>Kcal adjusted</b>	<b>22.2<sup>a</sup> (5.0)</b>	<b>33.9<sup>b</sup> (5.0)</b>	<b>27.0<sup>b</sup> (6.0)</b>	<b>0.070</b>
Sweets	17.9 (2.8)	22.8 (4.7)	41.7 (8.3)	-
<b>Kcal adjusted</b>	<b>25.4 (5.5)</b>	<b>24.7 (5.4)</b>	<b>30.3 (6.4)</b>	<b>0.450</b>
Poultry	23.0 (4.8)	18.1 (3.6)	34.5 (7.3)	-
<b>Kcal adjusted</b>	<b>20.5 (5.4)</b>	<b>20.0 (5.4)</b>	<b>23.1 (6.4)</b>	<b>0.365</b>
Condiments and sauces	13.8 (2.8)	16.6 (3.7)	35.1 (6.7)	-
<b>Kcal adjusted</b>	<b>15.5 (4.6)</b>	<b>17.0 (4.6)</b>	<b>32.4 (5.5)</b>	<b>0.153</b>
Beef	20.1 (4.5)	13.1 (3.0)	29.2 (6.9)	-
<b>Kcal adjusted</b>	<b>29.8 (4.9)</b>	<b>15.6 (4.9)</b>	<b>14.3 (5.8)</b>	<b>0.177</b>
Sausages and cold meats	22.3 (3.1)	13.4 (2.7)	20.9 (3.9)	-
<b>Kcal adjusted</b>	<b>28.3<sup>a</sup> (3.2)</b>	<b>15.0<sup>b</sup> (3.2)</b>	<b>11.7<sup>b</sup> (3.8)</b>	<b>&lt; 0.001</b>

Other market meats	18.3 (4.7)	17.3 (4.4)	10.5 (3.3)	-
<b>Kcal adjusted</b>	<b>24.7<sup>a</sup> (4.3)</b>	<b>19.0<sup>a</sup> (4.3)</b>	<b>0.8<sup>b</sup> (5.1)</b>	<b>0.020</b>
Snacks and appetizers	8.9 (1.5)	12.5 (2.6)	25.2 (3.9)	-
<b>Kcal adjusted</b>	<b>13.7 (2.7)</b>	<b>13.7 (2.7)</b>	<b>17.9 (3.2)</b>	<b>0.102</b>
French fries	14.9 (3.0)	16.8 (4.3)	11.8 (2.8)	-
<b>Kcal adjusted</b>	<b>20.1 (3.5)</b>	<b>18.2 (3.5)</b>	<b>3.8 (4.1)</b>	<b>0.097</b>
Added fat and oils	10.9 (1.4)	12.1 (1.3)	18.0 (1.7)	-
<b>Kcal adjusted</b>	<b>13.3 (1.5)</b>	<b>12.7 (1.5)</b>	<b>14.3 (1.7)</b>	<b>0.134</b>
Fruit-based sauces and canned products	2.6 (1.5)	1.9 (0.9)	12.0 (4.8)	-
<b>Kcal adjusted</b>	<b>3.9 (2.8)</b>	<b>2.2 (2.8)</b>	<b>9.9 (3.3)</b>	<b>0.331</b>
Nuts and seeds	1.6 (0.7)	2.7 (0.9)	6.2 (1.8)	-
<b>Kcal adjusted</b>	<b>2.3<sup>a</sup> (1.2)</b>	<b>2.8<sup>a</sup> (1.2)</b>	<b>5.2<sup>b</sup> (1.4)</b>	<b>0.021</b>
Market fish and seafood	3.1 (1.4)	3.3 (1.4)	3.5 (1.9)	-
<b>Kcal adjusted</b>	<b>3.6 (1.6)</b>	<b>3.4 (1.6)</b>	<b>2.9 (1.9)</b>	<b>0.721</b>

(<sup>a</sup>), (<sup>b</sup>), and (<sup>c</sup>) represent two-by-two comparisons (Bonferroni): significant differences in average consumption of a given food group across diet quality levels correspond to different superscripts.

(†) adjusted for energy intake (kcal= 1761.96). Level of significance at P-value  $\leq 0.05$ .

(\*) standard error of the mean.

**Table 4: Adjusted and non-adjusted coefficients of standardized canonical discriminant functions**

ADJUSTED FOR KCAL		NON-ADJUSTED FOR KCAL	
INTRODUCED FOOD GROUP	FUNCTION COEFFICIENT	INTRODUCED FOOD GROUP	FUNCTION COEFFICIENT
Kcal	0.788		
Vegetables and vegetable products	0.324	Vegetables and vegetable products	0.597
Fruits	0.295	Fruits	0.370
Traditional foods	0.292	Traditional foods	0.476
Low-fat milk	0.282	Low-fat milk	0.386
Soups and broth	0.157		
Other market meats	-0.189		
		Breads	0.388
		Nuts and seeds	0.249
Wilks' lambda: 0.583 Percentage of correct classifications: 83.8%		Wilks' lambda: 0.737 Percentage of correct classifications: 77.7%	

## Chapter VI: Discussion

### 1. Contribution of food groups to diet quality

The FNFNES report (Chan et al, 2011) concluded that recommendations for three of the four major food groups from the Canadian Food Guide were not met since only meat and alternatives had sufficient intakes. The present research created more detailed food groups, which were again analyzed for their linkage to diet quality.

Many studies confirmed that increased intakes of vegetables and fruits improved diet quality due to the high contents of beneficial nutrients and non-nutrient elements in these foods (Glanz et al, 2012; Lohse et al, 2011; Shatenstein et al, 2005). These results are in agreement with conclusions from previous studies conducted among Indigenous Canadians, which reported that fruits and vegetables were poorly consumed because of their costliness and lack of freshness (Chan et al, 2011; Kuhnlein et al 1996; 2004; 2007; Mead et al, 2010; Receveur et al, 1997). When compared to the WHO/FAO recommended intake of 400g per day per person on average for the intake of vegetables and fruits (WHO/FAO, 2003), the fruit intake averaged at  $26.1 \pm 7.3$ ,  $40.6 \pm 7.3$ , and  $77.8 \pm 8.5$ g per day per person while the mean intake of vegetables and vegetable products was  $92.7 \pm 14.7$ ,  $94.6 \pm 14.7$ ,  $204.1 \pm 17.3$ g per day per person across diets of lower, mid, and higher quality respectively.

Vegetables, fruits and vegetable-related products reported on the recalls constitute a reasonable variety of ‘healthy’ choices that could help improve nutrient profiles of the studied communities. In fact, the “vegetables and vegetable products” and “fruits” food groups covered 133 and 31 food codes respectively. The most consumed vegetables, which represented almost a third of the total grams consumed for the vegetable group, were potatoes (boiled/drained or mashed), mixed frozen vegetables (boiled/drained), carrots (boiled/drained), and red tomatoes (raw/ripe). Other vegetable items included beans, salads, cucumbers, squash, peas, mushrooms, broccolis, corn, yam, turnips, beets, Brussels sprouts,

onions, La Choy chop suey vegetables, spinaches, cauliflowers, celery, peppers, hummus, garlic, radish. Fruit intakes included bananas, apples (with skin), tangerines, all commercial and navel oranges as the most eaten items (all raw), which represented 81% of total grams consumed from this food group. Other items from this food group were pears, fruit salad (without citrus fruits), grapes, peaches, melons (cantaloupes and honeydews), raisins, kiwifruits, pineapples, mixed fruits, prunes, apricots, watermelons, lemons, mangoes, papayas, pomegranates, and avocados.

Intakes from two other food groups that “Eating Well with the Canadian Food Guide – First Nations, Inuit, and Métis” relates positively to diet quality, i.e. traditional foods and low-fat dairy products, differentiated strongly diet recalls with lower, mid, and higher levels of diet quality. Thus, similarly to observations from other studies (Johnson-Down et al, 2010; Kuhnlein et al, 1996; 2004; Kuhnlein et Receveur, 2007; Sharma et al, 2008; 2010), diets with higher quality also included more traditional foods. For instance, traditional foods were reported as important contributors to vitamins A and D, iron, and magnesium intakes (Johnson-Down et al, 2010; Kuhnlein et al, 1996; 2004; Kuhnlein et Receveur, 2007; Sharma et al, 2008; 2010). The most consumed traditional foods were moose (roasted) that represented 39% of total grams consumed from this food group, salmon (boiled, baked or canned), and crab (boiled or steamed). Other traditional foods included elk, caribou, deer, groundhog, eulachon, halibut, mollusks, clam fritter, spruce grouse, whitefish, arctic char, herring eggs, Saskatoon berries, soapberries, blueberries, strawberries, cranberries, blackberries, raspberries, spices, red hackberries, seaweed, rosehips, pine mushrooms, and Labrador tea.

Generally, intakes reported on the recalls did not reach the recommended servings for dairy products (taken from “Eating Well with the Canadian Food Guide – First Nations, Inuit, and Métis”). For instance, instead of consuming the recommended intake of 2 to 3 daily servings for milk and alternatives the average intake was 1.0 daily serving (Chan et al, 2011). As a result, nutrients associated with the consumption of dairy products had poor

profiles: percentages of food recalls that met 100% of DRIs for Ca, Mg, and vitamin D were 14%, 31%, and 10% respectively. Other studies found that intakes of calcium among Canadian Indigenous populations are often considered to be low. Kuhnlein et al (1996) reported that only 44.5% of studied individuals had half of the required intake of calcium and only 21.8% consumed 66.6% to 100% of the required consumption. Sharma et al (2010) found that in their study women barely had a mean daily intake of calcium reaching a third of the recommended intake of about 1000 mg per day (men almost achieved half of the DRI). In comparison, Nicklas et al (2009) found that in order to meet 100% of the EAR for Mg individuals aged more than 50 years needed 3.0 daily servings of dairy products while those aged 19-50 years required 2.0 daily servings. Additionally, they recognized that individuals with the recommended servings of dairy items were more likely to have mean intakes above the AI for Ca. Ranganathan et al (2005) also reported positive associations between increased intakes of dairy products and multiple beneficial nutrients, namely Ca, Mg, and vitamin D (and also K, Zn, folate, thiamin, riboflavin and vitamins B6, B12, A, and E, and protein). Higher intakes of dairy items were also related to lower intakes of sweetened beverages. However, they concluded that only increased intakes of low-fat products should be encouraged because they also linked increasing servings of dairy items to a higher consumption of saturated fat and Na.

The present study classified dairy products in two groups based on their contents in fat: the high-fat items had more than 2% fat and those low in fat had this percentage at or below 2%. High-fat dairy products consumed with the greatest amounts were cheddar cheese, milk with 3.3% M.F, vanilla ice cream (with 11% M.F), cereal cream (with 10% M.G), plain yogurt (with 2% to 4% M.F). Low-fat dairy items with the greatest amounts were 1% to 2% M.F and less than 1% M.F yogurt (with fruit bottom), skim fluid milk, 2% M.F evaporated/canned milk, and fat-free, strawberry-flavored yogurt. Interestingly, while low-fat dairy products were consumed with significant differing amounts with regards to levels of diet (recalls with higher quality reported 3-3.5 times higher intakes), high-fat dairy products were not associated with diet quality.



The FNFNES report (Chan et al, 2011) also concluded that recommended intake servings from the “grain products” food group from “Eating Well the Canadian Food Guide – First Nations, Inuit, and Métis” were not met. Precisely, it was found that women consumed on average 4.0 daily servings of grain items instead of a recommendation of 6-7 daily servings for adult women. The shortage in intakes of grain products paralleled that of intakes of fiber (mostly present in whole-grain products) and folate (usually fortified in grain products like flour): only 8% and 35% met 100% of the DRIs respectively. These findings are similar to those published from other studies (Kuhnlein et al, 2004; Kuhnlein et Receveur, 2007; Sharma et al, 2010). For instance, Sharma et al (2010) found that in their survey of Inuit populations, men barely consumed a quarter of their recommended daily fiber intake while women only took about a third of their recommendations for fiber. They also reported low consumption of folate.

Three food groups, i.e. “breakfast cereals”, “breads”, and “rice and pasta”, were mainly related to the “grain products” group. Apart from the “rice and pasta” group, they were associated with diet quality. Even though all grain/cereal products were grouped together, numerous researchers reported opposing contributions to diet quality some items may have. For instance, several reports stressed the preference of whole-grain over white products because the latter were associated to nutrition-related problems such as weight issues or diabetes (Salas-Salvado et al, 2011; Aller et al, 2011). Other reports observed that higher intakes of the traditional bread known as bannock were linked to increased consumption of saturated fat (Morou, 2008). In fact, recipes included in the present research had high-fat contents like pan-fried bannock with oil (and water), deep-fried bannock with lard, water, and eggs, and bannock made with lard or oil. Thus, it is intakes of whole-grain products that need to be improved through consumption of items such as whole-wheat bread, white bread and/or bannock from improved recipes (i.e. including whole-grains and paying attention to added foods usually consumed with grain products like added fat).

Taking again into consideration the major food groups of the Canadian Food Guide, meat and alternatives (excluding traditional foods) were classified under multiple food groups. On one hand, some codes represented white meat (i.e. poultry, market fish and seafood). Of those codes, the ones with the greatest quantities were chicken (fried flesh only, flesh and skin stewed, meat and skin battered dipped or fried, oven-roasted breast roll) and turkey (roasted breast meat only) for the “poultry” group; and cod (baked or boiled), tuna salad, oyster (wild or canned), light tuna (canned in oil/drained/unsalted), and sardine (canned with oil/drained with bones) for the “market fish and seafood” food group. On the other hand, “sausages and cold meat” (e.g. pork and/or beef as ham, sausage, wiener, salami, luncheon, pepperoni, and bacon), “beef” (e.g. raw chuck, boneless, lean and fat blade steak; ground, lean, broiled at medium doneness; braised, lean and fat brisket; meatballs; and meatloaf), and “the other market meats” (i.e. pork and veal) categories included red meat.

Several studies reported better nutrient profiles for iron in comparison to other nutritional elements because of the importance of meat intakes (including traditional foods) among Indigenous Canadians (Downs et al, 2009; Kuhnlein et al, 1996; Receveur et al, 1997). In fact, 75% of the food recalls met 100% of the iron DRI (Kuhnlein et al (1996) reported a corresponding percentage of 87.4%). However, similarly to previous findings (Mente et al, 2009; Okubo et al, 2011; Staser et al, 2011) market red meat had a negative impact on diet quality.

As meat alternatives, market eggs were eaten in considerable amounts and solely comprised chicken eggs either as omelette, scrambled, boiled, poached, fried, or raw (fresh or frozen). But like poultry, beef, and market fish and seafood they were not associated with diet quality.

“High-energy beverages”, “ready-to-eat meals”, “cakes and cookies”, “sweets”, “sauces and condiments”, “snacks and appetizers”, “french fries”, “added fat and oils”, “fruit-based sauces and canned products” groups mainly contained items to consume with moderation

due to their high contents of added sugar and/or fat. Some researchers have linked nutrition-related issues among Indigenous Canadians to their increasing consumption of added sugar and fat as a result of the shifts from healthier traditional foods towards market foods like chips, high-energy drinks, and other ready-to-eat meals (Johnson-Down et al, 2010; Receveur et al, 1997; Sharma, 2008; 2010). Moreover, the present research showed that total fat and saturated fat were among the nutrients that better reached 100% of the respective DRIs (59% and 51% met 100% of the DRIs respectively).

However, subjects with the lower diet quality had significantly less consumption of items under the “cakes and cookies” group. Furthermore, intakes from other high-sugar and/or high-fat (i.e. high-energy) food groups (i.e. “fruit-based sauces and canned products”, “condiments and sauces”, “added fat and oils”, “high-energy beverages”, “snacks and appetizers”, “french fries”, “ready-to-eat foods”, and “cakes and cookies”) did not differ across diets of distinct quality. Song et al (1996) published comparable findings, which showed that sugar and fat intakes were not adequate even across diets with higher quality. They added that finding strategies that could help in limiting intakes of added sugar and/or fat is a complex task that implicates not only nutritional factors but also other lifestyle behaviours.

The “soups and broth” group includes “healthy” foods like vegetables, chicken, low-fat milk, and “unhealthy” foods such as fat and salt. Recipes reported mainly on the recalls were noodle tomato soup, chicken and vegetable or vegetable with beef broth canned, condensed soup with added water. This research found that soups and broth were positively associated with higher diet quality scores; however, our diet quality score did not include sodium. Thus, since only intakes among the lower diet quality group diverged significantly from the remaining groups (i.e. the mid and higher diet quality groups had comparable intakes), it is interesting to encourage “healthy” soup recipes in the diet.

Some food groups were poorly consumed. In fact, contributions of equivalent products from traditional foods explain in part the low consumption of market fish and seafood. Even though increasing their consumption was related to higher diet quality, nuts and seeds were also poorly consumed.

## **2. Strengths and limits of the present research**

Dietary patterns are an innovative methodology that allows a better study of diet quality among populations and associated nutrition-related issues. Numerous papers acknowledged also advantages that studies of food patterns, rather than a single nutrient, food item and/or food group, present (Jones-McLean et al, 2010; Kant et al, 2004, 2009, 2010; Moeller et al, 2007; Tucker et al, 2010). For instance, Moeller et al (2007) announced that it is better to study nutrients as a combination because they act in an interactive and/or synergistic manner. For this reason, the relationship of a single nutrient to specific outcomes may be too small to detect. In addition, Tucker (2010) observed that food patterns represent better the cultural, social, and family aspects of diets. In other terms, food patterns allow a better description of diet-related issues that studied populations are facing; and thus, they could better serve dietary interventions.

In order to identify food patterns, 1076 food items were classified in 25 food groups that are more descriptive than the four major groups included in “Eating Well with Canada’s Food Guide”. This kind of information may provide a better basis of dietary recommendations because it is more detailed and is based solely on food items already present in the studied communities.

However, methods for measuring food patterns are limited by the fact that they are developed specifically for the populations of interest; so, conclusions for these populations cannot be generalized to other groups of people. Thus, food patterns identified here strictly concern BC FN female adults living on reserve. Nevertheless, women are more responsible

for food preparation in households and so are better targets for interventions seeking to better households' food patterns.

The present research took into consideration not a single nutrient in particular but rather a combination of ten nutritional elements whose consumption needs shifts in order to improve overall diet quality among the population of interest. Nutrient-based indicators require that data collected as food items be converted in nutrients, which can be problematic. In fact, this process is achieved with the usage of food composition tables, which unfortunately are not always complete (e.g. information on all food components may not be existing). For instance, populations from distinct countries and/or cultures have different recipes, food labeling, food groupings, etc. Thus, the same food item can receive different nutrient contents from different researchers.

Both methods of identifying dietary patterns were utilized: the a priori (i.e. the dietary score) and a-posteriori method (i.e. a statistical (discriminant) analysis). The percentage of correct classifications was 83.8%, which is good.

A drawback of methods used to identify dietary patterns is that at multiple stages researchers have to make subjective choices (Moeller et al, 2007). This explains the lack of consistency in the literature on dietary patterns (Slattery et al, 2010). For the a priori method (i.e. dietary indicators), nutritional elements to be included in the index are selected arbitrarily. Ten nutritional elements were included in the score but other meaningful components of dietary indicators such as diversity and/or additional nutrients (e.g. polyunsaturated fatty acids, potassium, and vitamins E and B6, etc) were left out. Furthermore, the same score can be obtained in multiple ways. In other words, individuals can seem to have a similar score of diet quality while having health issues related to differing nutritional elements. This is true when components of the dietary score are equally weighted (i.e. considered to be equally important to nutrition-related issues). Moreover, the

dichotomized system of allocating points does not consider the full range of amounts that food intakes have.

A-posteriori techniques are data-dependent. Subjectivity is again introduced when grouping food items, selecting input variables like units of measurements (e.g. grams or percentage of energy), dietary elements to include in a given pattern, and/or labeling retained patterns. For instance, when looking at the development of the recent Canadian Food Guide, different food groups were introduced (Katamay et al, 2007). The guide only presents four major groups, i.e. “vegetables and fruit”, “grain products”, “milk and alternatives”, and “meat and alternatives”, and an additional group of “oils and fats”. But the authors showed how the methods used to identify these major groups considered additional food subgroups. In fact, a two-step modeling technique was chosen: in the first step, a food pattern was created starting from the food groups included in the preceding food guide (i.e. “Canada’s Food Guide to Healthy Eating” published in 1992) and then dividing them in subgroups in order to create patterns with better nutrient profiles without increasing the foods/calories eaten. In step two, simulated diets based on the pattern created in step one and on popular foods in the Canadian population were established and evaluated relative to the DRIs for different age and gender groups. This technique created less groups at the end; yet, more detailed recommendations were provided with the creation of subgroups, e.g. dark green and orange vegetables, low-fat whole grains, low-fat fluid milk, processed meat, etc.

In order to assess nutrient adequacy for an individual, the usual intake of a given nutritional element needs to be estimated from the mean observed intake (and standard deviation) recorded on multiple days and compared to the DRI corresponding to that element. However, even though this is a good technique it does not accurately quantify nutrient adequacy (Institute of Medicine (IOM) report, 2000). In fact, the problem results from the impossibility of measuring the usual intake of a given nutritional element and knowing its exact requirement for a given individual. The IOM report says that in order to determine usual intakes a large number of accurate food recalls and food composition data is required;

while a tight-controlled clinical setting, graded feedings of a given nutritional element and multiple physiological and biochemical measurements are needed for assessing that element's required intake for a given individual. We therefore chose to analyze a sample of only one 24-hour recall per subject, which represented the observed daily menus and not the usual intake of individuals; even though collecting only one 24-hour recall per subject does not report well his/her usual intake because of the day-to-day variation associated with food intake (Thompson et al, 2001).

The USDA Multiple Pass strategy was utilized to minimize misreports that can result from the usage of 24-hour recalls as measurement tools for food intakes (Conway et al, 2003; 2004; Moshfegh et al, 2008; Ribas-Barba et al, 2009, Thompson et al, 2001). For instance, since they require face-to-face interviews some food intakes can be overestimated and other underreported by the interviewee on one hand; and on the other the interviewer may record and/or interpret the information wrongly. They also require that subjects use their memory to recall food intakes; so, it is not always possible to report acutely all food items consumed the day preceding the interview and their portion sizes. The selected technique used three stages as follows: firstly a quick list of food and beverages consumed the day preceding the interview was asked, then a detailed description of the food and beverage intakes was obtained, and finally the recalls were reviewed to make sure nothing has been missed (Chan et al, 2011).

Measurement errors like those based on memory are involuntary but voluntary errors can also be made when conducting face-to-face interviews. For example, because of social desirability individuals may underreport food items socially considered to be "bad" like sweets, cakes, and/or added fat and sugar; and on the contrary they may overestimate their intakes of "good" foods like vegetables and fruits (Lissner, 2002).

Nevertheless, 24-hour recalls are a good method in terms of time constraints. Even though subjects have to report past food consumption, the length of time implied is short

(compared to that of a dietary food history for example). It is little burden on subjects (who do not have to be highly educated) and thus provides a good response rate (Thompson et al, 2001).

In the study of dietary patterns, another important issue is their stability. Indeed, some authors (Piperata et al, 2011; Popkin, 2001) stated that food patterns could be subject to changes in a short amount of time, especially in the context of rapid nutrition transition. Unfortunately, it is currently not possible to comment on changes, which could occur in dietary patterns identified in the present research, since no new data are currently available for that purpose.

### **3. Conclusion and future research**

The present research focused on one point in time in the process of nutrition transition that is undergoing among Indigenous Canadians who are shifting from intakes of traditional foods and including more and more market foods in their diets. Precisely, its aim was to identify food patterns associated with a better diet quality among indigenous populations living on reserve. Thus, two methods were utilized to determine dietary patterns among the population of interest: a dietary score, which allowed the creation of three distinct levels of diet quality, and a statistical (discriminant) analysis that sought to confirm the patterns obtained from the other method. This methodology was applied to the First Nations Food, Nutrition, and Environment Study food data of female participants. The food data was organized in food groups whose consumption allowed the comparison of the three different levels of diet quality. Globally, quality of diets among BC Indigenous peoples living on reserve needs improvement since all individuals did not obtain the maximum points on the dietary score. Moreover, food variety was not as considerable as that of food products provided to the general Canadian population; yet, specific food categories (or food items grouped in these categories) contributed to the improvement of diet quality. Among the 25 created food groups, six were found to be better targets of dietary interventions seeking to achieve that goal, namely “vegetables and vegetable products”, “fruits”, “low-fat dairy



products”, “traditional foods”, “soups and broth”, and “other market meats”. Opposed to traditional game meat (mostly red meat), market red meat products were negatively related to diet quality.

Thus the present research allowed pinpointing to particular food groups and/or food items that can be targeted in order to improve diet quality among the BC FN adult female living on reserves. Interestingly, those food groups paralleled the ones highlighted in “Eating Well with the Canada’s Food Guide- First Nations, Inuit, and Métis”. In other terms, foods from “low-fat dairy products”, “fruits”, “vegetables and vegetable products”, and “traditional foods” food groups described better dietary patterns.

For future research, studies should increase the sample size in order to allow the creation of different levels of diet quality (i.e. instead of having tertiles, quartiles or quintiles could be created). Furthermore, men were excluded from the studied sample because after analyzing their food recalls it was thought that they misreported their food intakes; thus, future studies should examine dietary patterns of Canadian Indigenous men and see how they relate to the women’s. Nevertheless, women are more responsible for food preparation in households and so are better targets when wanting to improve households’ food patterns. In other words, even though men were not included in this research, its findings can be used to improve their diets as well. Finally, when analyzing determinants of dietary patterns identified in the present research, future researchers should consider impacts of unemployment and/or living alone, and in general those of food security, because percentages of people who were unemployed and/or living alone were high.

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## Annexes

### Annex 1: List of food items reported on 24-hour food recalls among BC FN female adults (n=493) living on reserves after being classified in 25 food groups

Food group	Food code	Food label	Total g consumed
High-energy beverages	29660	Malt beverage, near beer (<0.5% alcohol by volume)	356
	7000027	Soft drink, Dr. Pepper	369
	59410	Energy drink, red bull, added caffeine, vitamins b3, b5, b6 and b12	492
	28590	Carbonated drinks, pepper type	738
	7000584	PowerAde option (low calorie), bottled	874
	7000609	Energy drink, red bull	1046
	28530	Carbonated drinks, club soda	1571
	29170	Sports drink, (Gatorade type), bottled	1815
	28560	Carbonated drinks, grape soda	2432
	28570	Carbonated drinks, lemon-lime soda	3222
	28580	Carbonated drinks, orange soda	3593
	28540	Carbonated drinks, cream soda	4124
	28610	Carbonated drinks, cola	6497
	28550	Carbonated drinks, ginger ale	7598
29200	Carbonated drinks, root beer	59464	
Vegetables and vegetable products	21380	Onion, dehydrated flakes	0
	24160	Pepper, sweet, green, boiled, drained, salted	0
	24850	Pepper, sweet, red/green, frozen, chopped, boiled, drained	2
	7000463	Onion, spring (green)/scallion, raw, reported as part of a salad	2
	23000	Pepper, sweet, red or green, freeze-dried	3



21410	Onion, frozen, chopped, boiled, drained	6
48600	Pepper, jalapeno, raw	6
24430	Radish, raw	7
24100	Peas, green, boiled, drained	10
48510	Broccoli, Chinese (gailon), cooked	11
48570	Pepper, banana, raw	12
21470	Peas, edible-podded (snow peas), frozen, unprepared	15
7000469	Cucumber, raw, reported as part of a salad	15
22250	Squash, summer, zucchini, raw	18
7000462	Lettuce, loose-leaf, raw, reported as part of a salad	21
33410	Beans, black, boiled, salted	22
23220	Pepper, hot chili, red or green, raw	23
20380	Cabbage, Chinese (pak-choi, bok choy), raw	24
23850	Cauliflower, raw	28
7000477	Tomato, red, ripe, raw, reported as part of a salad	31
48700	Hummus, commercial	32
21530	Peas, mature seeds, sprouted, bean sprouts, boiled, drained	33
21670	Potato, boiled, cooked in skin, skin only, drained	34
22580	Tomato paste, canned	34
23840	Carrot, frozen, boiled, drained	36
23880	Corn, sweet, raw	38
20280	Brussels sprouts, frozen, boiled, drained	39
24800	Broccoli, boiled, drained, salted	39
23170	Tomato, red, ripe, stewed (scaloped with breadcrumbs)	41
24740	Vegetables, mixed, canned, drained solids	41
20390	Cabbage, Chinese (pak-choi, bok choy), boiled, drained	42

25010	Beet, boiled, drained	42
20190	Beans, snap (Italian, green or yellow), frozen, boiled, drained	43
52840	Potato, russet, flesh and skin, raw	46
22140	Spinach, boiled, drained	48
7000390	La Choy chop suey vegetables, frozen	52
23530	Carrot, baby, raw	54
59580	Mushroom, white, stir-fried	54
21390	Lettuce, cos or romaine, raw, reported as part of a salad	56
21560	Peas and carrots, frozen, boiled, drained	56
7000461	Onion, canned, solids and liquid	56
21440	Onion, spring (green)/scallion (includes tops & bulb), raw	57
24760	Beets, pickled, canned, solids and liquid	57
22130	Spinach, raw	58
21830	Potato, whole, peeled, frozen, unprepared	60
21700	Potato, scalloped, home-prepared	61
24610	Tomato, red, ripe, boiled	61
33140	Beans, baked, canned, with pork	63
33740	Refried beans, canned	63
20480	Cauliflower, frozen, boiled, drained	68
22840	Yam, boiled, drained or baked	68
33470	Beans, kidney, light red, boiled, salted	71
21170	Lettuce, loose-leaf, raw	73
20680	Corn, sweet, on or off cob, boiled, drained	87
799921	Carrot-raisin salad	87
22410	Sweet potato, baked in skin	100

52790	Potato, mashed, home-prepared, 2% m.f. milk and butter added	105
23820	Carrot, canned, drained solids	109
21500	Peas, green, canned, seasoned, solids and liquid	113
59600	Onion, yellow, sautéed	117
21460	Peas, edible-podded (snow peas), boiled, drained	120
22700	Vegetables, mixed, canned, solids and liquid	122
23440	Pepper, sweet, yellow, raw	123
57070	Potato, white, flesh and skin, baked	127
57080	Potato, red, flesh and skin, baked	127
20700	Corn, sweet, canned, brine pack, drained solids	131
7005001	Potatoes, mashed, with 2% milk, no added fat	131
46530	Fast foods, side dish, coleslaw	132
55860	Tomato and vegetable juice, low sodium	132
32650	Beans, kidney, dark red, canned, solids and liquid	154
23710	Beans, snap (Italian, green or yellow), boiled, drained	155
23940	Garlic, raw	156
7000310	Greek salad	175
55740	Vegetables, mixed canned, unsalted	182
23990	Mushroom, raw	183
21490	Peas, green, canned, solids and liquid	186
48480	Cucumber, peeled, raw	199
24120	Peas, green, frozen, boiled, drained	203
24140	Pepper, sweet, green, boiled, drained	206
24700	Turnip, raw	208
23790	Brussels sprouts, boiled, drained	220
23060	Squash, winter, all varieties, baked	231
21160	Lettuce, cos or romaine, raw	238
24230	Potato, flesh, cooked in skin, microwaved	260

24190	Potato, flesh only, baked	278
20460	Cauliflower, boiled, drained	280
7000289	Caesar salad with romaine	297
21870	Potato salad	304
23610	Cabbage, raw	314
23620	Cabbage, boiled, drained	339
23740	Broccoli, raw	341
32480	Beans, baked, canned, plain or vegetarian	344
24840	Pepper, sweet, red, raw	356
23630	Cucumber, raw	411
33750	Beans, baked, canned, with pork and tomato sauce	426
21230	Mushroom, boiled, drained	476
24010	Onion, raw	490
22620	Turnip, boiled, drained	498
23720	Beans, snap (Italian, green / yellow, canned), drained solids	515
21690	Potato, mashed, home-prepared, whole milk and margarine added	525
52780	Potato, mashed, home-prepared, with 2% m.f. milk	525
20690	Corn, sweet, canned, brine pack, solids and liquid	528
24640	Tomato juice, canned	592
20620	Coleslaw (cabbage salad), with dressing, home prepared	630
33820	Beans, kidney, dark red, boiled	653
7000097	Cabbage rolls, stuffed	661
24130	Pepper, sweet, green, raw	702
25050	Potato, flesh and skin, raw	721
21400	Onion, frozen, chopped, unprepared	724
23860	Celery, raw	773

	20710	Corn, sweet, frozen, kernels on cob, boiled, drained	774
	23750	Broccoli, boiled, drained	777
	24000	Mushroom, canned, drained solids	855
	23890	Corn, sweet, canned, cream style	929
	45790	Fast foods, entree, salad, vegetable, no dressing	992
	57060	Potato, russet, flesh and skin, baked	1089
	23870	Celery, boiled, drained	1109
	24020	Onion, boiled, drained	1111
	21680	Potato, hashed brown, home-prepared	1160
	24170	Potato, flesh, raw	1175
	22710	Vegetables, mixed, frozen, unprepared	1177
	23800	Carrot, raw	1311
	24220	Potato, flesh, cooked without skin, boiled, drained	1367
	24210	Potato, cooked in skin, flesh only, boiled, drained	1491
	52770	Potato, mashed, home-prepared, 2% m.f. milk & margarine added	1528
	23900	Corn, sweet, canned, vacuum pack, niblets	1541
	24780	Potato, flesh and skin, baked	1754
	24620	Tomato, red, ripe, canned, whole	1919
	23980	Tomato, red, ripe, raw, year round average	1956
	24600	Lettuce, iceberg, raw	2240
	23810	Carrot, boiled, drained	2492
	22720	Vegetables, mixed, frozen, boiled, drained	4193
	7000504	Mashed potatoes w/ 2% milk + butter	5162
	25060	Potato, flesh and skin, cooked in skin, boiled, drained	5170
Ready-to-eat foods	45590	Fast foods, dessert, cookies, chocolate chip	12
	7000143	Pizza dough, plain, 12"	12
	7000072	Cheese quesadilla	25
	24040	Onion rings, breaded, frozen, heated in oven	27

40840	Dumpling	30
7000368	Chicken/turkey egg roll	31
40010	Wonton wrapper (egg roll wrapper)	32
7005105	Sausage rolls, with puff pastry	38
7005051	Chinese dumplings	45
50610	Baby food, dinners, veggie stew with beef, toddler, Heinz	50
7000416	Fettuccine, alfredo, Pastaria	50
8000012	Pizza, garlic and tomato	50
45540	Fast foods, breakfast, french toast sticks	56
46630	Fast foods, potato, french fried in beef tallow & vegetable oil	57
49570	Mixed dishes, corned beef hash, canned	59
49580	Mixed dishes, Hamburger Helper, cheeseburger macaroni, dry mix	69
46460	Fast foods, hotdog w/ corn flour coating (corndog)	75
45650	Fast foods, entree, chicken, breaded & fried, light meat (breast/wing)	82
45860	Fast foods, entree, shrimp, breaded and fried	82
46610	Fast foods, potato, baked, topped w/ sour cream and chives	99
49650	Mixed dishes, chicken pot pie, frozen	109
40	Mixed dishes, chop suey, with meat, canned	110
49310	Mixed dishes, chicken breast w/broccoli & cheese, frozen	118
45390	Fast foods, breakfast, biscuit with sausage	124
49200	Mixed dishes, beef ravioli in tomato & meat sauce, canned	125
45710	Fast foods, entree, chili con carne	126

45420	Fast foods, breakfast, croissant w/ egg, cheese and bacon	129
46470	Fast foods, roast beef sandwich, plain	139
12200	Chicken roll, light meat	140
49350	Mixed dishes, beef pot roast, whipped potatoes, frozen	146
49920	Mixed dishes, macaroni & cheese, unprepared	156
46320	Fast foods, sandwich, fish sandwich with tartar sauce	158
7000233	Quiche, spinach, meatless (broccoli quiche)	170
7002273	Nutrigo chicken breast strips with multigrain breading, flam	177
7000441	Assorted meat classic submarine, Mr.Sub	179
45350	Fast foods, breakfast, biscuit with egg and sausage	180
45980	Fast foods, Mexican, chimichanga with beef and cheese	183
7000066	Egg roll, meatless	192
46240	Fast foods, cheeseburger, large, 1 patty, w/bacon & condiments	195
46440	Fast foods, hotdog, plain	196
46160	Fast foods, cheeseburger, regular, single patty, plain	204
80	Mixed dishes, fried chicken w/ mashed potatoes & vegetables	215
46380	Fast foods, hamburger, regular, double patty, w/ condiments	215
7000298	Wendy's grilled chicken sandwich	216
46300	Fast foods, submarine sandwich with cold cuts	228
46500	Fast foods, sandwich, chicken fillet sandwich with cheese	228
7000591	Sandwich, crispy buffalo chicken, McDonald's	231

58630	Fast foods, pizza, meat and vegetable, rising crust, frozen	240
7002229	Mixed dishes, macaroni & cheese, Stouffer's	255
46520	Fast foods, submarine sandwich with tuna salad	256
7000537	Wonton, meat filled, fried	266
7000600	Vegetable chowder	292
49340	Mixed dishes, chicken & vegetables w/ vermicelli, frozen	297
54550	Mixed dishes, tortellini, pasta with cheese filling	297
7000023	Pizza pocket, deluxe, McCain	306
700899	Macaroni and cheese, baked, home recipe	326
45520	Fast foods, breakfast, english muffin w/ egg +cheese + sausage	330
46200	Fast foods, cheeseburger, regular, double patty, w/ condiments & vegetables	332
7002152	Frozen dinner, Swanson, Salisbury steak w/ apple cranberry	345
7000254	Chimichanga, w / chicken & sour cream, no cheese	350
62480	Fast foods, chicken tenders	355
46430	Fast foods, sandwich, ham, egg and cheese	358
49190	Mixed dishes, macaroni & cheese, canned entree	358
11640	Poultry salad sandwich spread, chicken and/or turkey	361
46420	Fast foods, sandwiches & burgers sandwich, ham & cheese	365
46170	Fast foods, cheeseburger, regular, 1 patty, w/ condiments	367
7000060	Macaroni salad, no cheese or egg	392
7000151	Pizza, cheese, w/ vegetables, ns as to crust	396
46390	Fast foods, sandwiches and burgers, steak sandwich	408



46490	Fast foods, hamburger, large, single patty, plain	411
7000181	Casserole, tuna noodle, homemade	416
46350	Fast foods, hamburger, regular, single patty, w/ condiments	421
799924	Sloppy Joe beef	422
7000309	Ravioli, meat-filled, with tomato or meat sauce	422
46510	Fast foods, submarine sandwich with roast beef	432
49390	Mixed dishes, oriental beef with vegetables & rice, frozen	440
49600	Mixed dishes, Salisbury steak w/ gravy, mashed potatoes & corn, frozen	454
7002151	Frozen entree, Hungry-man, boneless fried chicken, w/dessert	454
7000430	Oven roasted chicken submarine, Subway	462
58640	Fast foods, entree, chicken, breaded & fried, boneless, plain	471
58610	Fast foods, pizza, cheese, rising crust, frozen	474
46340	Fast foods, hamburger, regular, single patty, plain	480
46650	Fast foods, side dish, potato, mashed	480
7000032	Hamburger helper, beef noodle w/ tomato sauce	496
46050	Fast foods, Mexican, nachos with cheese	500
58650	Mixed dishes, lasagna, cheese, frozen	500
58700	Mixed dishes, lasagna with meat and sauce, frozen	500
58600	Fast foods, entree, pizza, cheese, regular crust, frozen	505
7000278	Mixed dishes, beef stroganoff w/ noodles	510
49630	Mixed dishes, chili con carne with beans, canned	522
7000226	Dumpling, potato and/or cheese filled, pierogi	578
62520	Mixed dishes, lasagna, cheese, frozen, prepared	710
58670	Mixed dishes, spaghetti, with meatballs, canned	721

	46290	Fast foods, sandwich, chicken fillet, plain	728
	7000033	Fast foods, side dish, potato, french fried in vegetable oil	732
	46640	Hamburger helper, cheeseburger macaroni	755
	7000100	Sauce, spaghetti, with meat, canned	779
	45560	Fast foods, breakfast, potatoes, hashed brown	816
	49370	Mixed dishes, spaghetti with meat sauce, frozen	852
	62380	Fast foods, hamburger, large, 1 patty, with condiments	852
	49260	Mixed dishes, frozen, stuffed peppers w/beef in tomato sauce	878
	33910	Chili with beans, canned	990
	55450	Vegetarian stew	1246
	50	Mixed dishes, chow mein, chicken, canned	1542
	49270	Mixed dishes, frozen, lasagna w/ meat & sauce	1602
	58620	Fast foods, pizza, meat & vegetable, regular crust, frozen	1742
	7002209	Sandwich, sweet onion chicken teriyaki wrap, Subway	1824
	799914	Stew, beef, with potatoes and vegetables	2347
	49620	Mixed dishes, pepperoni pizza, frozen	2428
	49640	Mixed dishes, beef stew, canned	3743
	7000288	Chicken chow mein or chop suey with noodles	5280
	7000022	Macaroni & cheese, Kraft	8872
Rice and pasta	45000	Grains, wheat flour, whole-grain	3
	44710	Grains, barley, pearled, cooked	10
	44860	Grains, rice, white, long-grain, regular, dry	30
	45240	Pasta, macaroni (elbow), non-enriched, dry	32
	45110	Pasta, macaroni (spirals), vegetable, enriched, cooked	33

	44560	Pasta, macaroni (elbow), whole wheat, dry	36
	44190	Grains, cornstarch	38
	44900	Grains, couscous, cooked	39
	44450	Grains, wheat flour, white, bread flour	40
	45010	Grains, wheat flour, white, all purpose	52
	44840	Grains, wheat flour, white, all purpose, en, calcium fortified	125
	7000597	Rice pilaf, dainty	218
	45170	Pasta, spaghetti, whole-wheat, cooked	280
	44570	Pasta, macaroni (elbow), whole wheat, cooked	301
	44580	Pasta, egg noodles, cooked, enriched	350
	44750	Grains, rice, white, medium-grain, cooked	365
	45060	Pasta, macaroni (elbow), enriched, dry	388
	7000125	Rice, fried, meatless	394
	44590	Pasta, Chinese noodles, chow mein	436
	45200	Pasta, macaroni (elbow), non-enriched, cooked	478
	44690	Pasta, spaghetti, non-enriched, cooked	595
	44970	Grains, rice, brown, long-grain, cooked	905
	7000065	Rice, fried, w/ meat	1362
	48740	Pasta, rice noodles, cooked	1766
	45070	Pasta, macaroni (elbow), enriched, cooked	1989
	7000123	Noodles, ramen, cooked	4733
	44640	Pasta, spaghetti, enriched, cooked	8668
	45230	Grains, rice, white, long-grain, regular, cooked	20250
Soups and broth	9720	Soup, chicken, broth or bouillon, dehydrated	1
	9680	Soup, beef, broth, cubed, dehydrated	6
	9670	Soup, beef, broth or bouillon, dehydrated	12
	48940	Soup, chicken noodle, cup-a-soup, mix, dry	19
	53470	Soup, ramen noodle, any flavour, dry	21

10530	Soup, cream, chicken, canned, condensed, water added	53
11090	Soup, beef mushroom, canned, condensed, with water	61
9240	Soup, bean with pork, canned, condensed	67
10860	Soup, chicken rice, dehydrated, water added	81
9530	Soup, cream, potato, canned, condensed	85
52490	Soup, tomato, cup-a-soup, mix, water added	112
7005015	Soup, gazpacho, cold tomato soup rec: 700	119
10620	Soup, mushroom barley, canned, condensed, water added	167
9450	Soup, lentil with ham, canned, ready-to-serve	170
7000507	Soup, butternut squash, homemade	171
11200	Soup, onion, dehydrated	179
10560	Soup, chicken rice, canned, condensed, water added	241
10840	Soup, chicken, broth, cubed, dehydrated, water added	244
8000003	Vegetable soup	253
10830	Soup, bean with bacon, dehydrated, water added	258
10770	Soup, chicken, broth or bouillon, dehydrated, water added	264
10940	Soup, tomato, dehydrated, water added	265
52480	Soup, ring noodle, cup-a-soup, mix, water added	280
9270	Soup, beef, broth or bouillon, canned, ready-to-serve	289
9490	Soup, cream, mushroom, canned, condensed	290
11250	Soup, pea, split pea with ham, canned water added	312
9390	Soup, chicken vegetable, chunky, canned, ready-to-serve	330
53360	Soup, stock, beef, home-prepared	330

10740	Soup, vegetarian (thick soup), canned, condensed, water added	331
10780	Soup, beef, broth or bouillon, dehydrated, water added	337
53450	Soup, vegetable, low sodium, canned, condensed	338
52600	Soup, cream, mushroom, canned, condensed, 2% m.f. milk added	341
9350	Soup, chicken noodle, chunky, canned, ready-to-serve	344
9460	Soup, minestrone, chunky, canned, ready-to-serve	360
49020	Soup, cream, potato, canned, condensed, 2% m.f. milk added	388
52520	Soup, spring vegetable, cup-a-soup, mix, water added	402
52630	Soup, spring vegetable, cup-a-soup, mix, dry	435
58560	Soup, ramen noodle, chicken flavour, dry	440
52470	Soup, chicken vegetable, cup-a-soup, mix, water added	479
10730	Soup, turkey vegetable, canned, condensed, water added	481
9600	Soup, turkey vegetable, canned, condensed	491
9280	Soup, beef noodle, canned, condensed	502
11210	Soup, tomato, canned, condensed	570
10800	Soup, beef noodle, dehydrated, water added	612
52510	Soup, cream, mushroom, cup-a-soup, mix, water added	613
7000036	Sauce, spaghetti, with meat, homemade	621
48950	Soup, chicken noodle with meat, cup-a-soup, mix, dry	624

	53480	Soup, broccoli cheese, canned, condensed, commercial	624
	9320	Soup, chicken, chunky, canned, ready-to-serve	626
	9630	Soup, beef, chunky, canned, ready-to-serve	666
	10520	Soup, broth, chicken, canned, condensed, water added	697
	9370	Soup, chicken rice, chunky, canned, ready-to-serve	717
	10570	Soup, chicken vegetable, canned, condensed, water added	723
	11280	Soup, tomato, canned, condensed, water added	746
	11260	Soup, vegetable with beef, canned, condensed, water added	943
	7000128	Soup, wonton	993
	7000387	Soup, tomato noodle	1044
	10910	Soup, mushroom, dehydrated, water added	1278
	9610	Soup, vegetable, chunky, canned, ready-to-serve	1288
	10950	Soup, tomato vegetable, dehydrated, water added	1306
	11080	Soup, vegetable w/ beef broth, canned, condensed, water added	1824
	10750	Soup, chicken noodle, dehydrated, water added	1882
	10630	Soup, cream, mushroom, canned, condensed, water added	2501
	10960	Soup, vegetable beef, dehydrated, water added	2571
	10550	Soup, chicken noodle, canned, condensed, water added	3460
	52440	Soup, chicken noodle, cup-a-soup, mix, water added	5752
Low-fat	7000153	Sour cream, 1% m.f.	15
dairy	1120	Milk, evaporated, skim, canned, undiluted, 0.2% m.f.	54
products	7000594	Yogurt, vanilla, silhouette, 0% b.f.	62

	53010	Yogurt, van or lemon flavour, non-fat milk, w/ low calorie sweetener	100
	7000357	Milk, fluid, Lacteeze, partly skimmed, 2% b.f.	122
	7000258	Milk, chocolate, skim milk base	125
	1430	Yogurt, coffee and vanilla flavours, 1.9% m.f.	129
	1340	Milk, dry, skim, powder, regular	130
	42640	Dessert, pudding, vanilla, dry mix, instant, prepared w/ 2% milk	142
	7002049	Yogurt, plain, silhouette, 0% b.f.	155
	7002291	Milk, fluid, Lactaid, partly skimmed, 2% b.f.	184
	7002184	Yogurt, tubes, Yoplait, all flavours	188
	1560	Yogurt, beverage	200
	7000590	Yogurt, fruit, Yoplait basket, non-fat	207
	1200	Cheese, cottage, (2% m.f.)	232
	710	Hot chocolate, cocoa, homemade, 2% b.f. milk	250
	55590	Yogurt, fruit variety, non-fat	259
	42650	Dessert, pudding, vanilla, dry mix, regular, prepared w/ 2% milk	280
	7002036	Milk, evaporated, partly skimmed, canned, undiluted, 2% m.f.	300
	1530	Yogurt, Activia, strawberries, Danone, fat free	412
	1140	Milk, fluid, skim	507
	1450	Yogurt, fruit bottom, less than 1% m.f.	541
	1440	Yogurt, fruit bottom, 1% to 2% m.f.	800
	630	Milk, fluid, partly skimmed, 1% m.f.	3394
	610	Milk, fluid, partly skimmed, 2% m.f.	20332
Traditional foods	951002	Labrador tea, leaves, dried	1
	941011	Rosehips, raw	3
	22050	Seaweed, dulse (laver, nori), raw	10

24990	Seaweed, dulse (laver, nori), dried	17
58210	Game meat, native, moose, bone marrow, cooked	30
923001	Eulachon (ooligan) grease	35
15150	Blackberry, raw	37
951004	Pine mushroom, raw	48
31930	Salmon, Coho, wild, baked or broiled	55
911008	Game meat, native, moose, kidney, raw	60
58270	Groundhog meat, cooked	67
58380	Arctic char, native, boiled	73
941008	Saskatoon berry, raw	73
31690	Whitefish, lake, native, baked	74
59350	Spruce grouse, native, flesh, cooked	75
32400	Clam fritter	98
31160	Molluscs, mussel, blue, boiled or steamed	110
941006	Red huckleberry, raw	118
47240	Spices, peppermint, fresh	122
57260	Game meat, elk, round, separable lean only, cooked, broiled	176
15380	Cranberry, raw	210
58290	Game meat, native, moose, liver, roasted	221
59650	Salmon, pink, canned, drained solids with bone	230
58230	Game meat, native, moose, fat, cooked	235
32180	Salmon, chum (Keta), canned, drained, solids w/ bone, salted	237
35870	Game meat, native, moose, raw	240
921013	Eulachon (ooligan) smoked, dried	250
31110	Molluscs, clam, mixed species, boiled or steamed	267
35780	Game meat, native, caribou (reindeer), meat, cooked	300
58850	Herring eggs, native, pacific, dry	303



	941009	Soapberry, raw	392
	17490	Strawberry, raw	417
	30120	Halibut, Atlantic or pacific, baked or broiled	422
	921020	Salmon, sockeye, smoked, canned	428
	17470	Raspberry, raw	448
	921018	Salmon, sockeye, half-smoked	455
	57240	Game meat, elk, ground, cooked, pan-broiled	472
	35820	Game meat, elk, roasted	531
	32260	Salmon, sockeye (red), canned, sol w/ bone & liquid, unsalted	534
	57290	Game meat, deer (venison), ground, cooked, pan-broiled	553
	35800	Game meat, deer (venison), roasted	554
	30500	Salmon, Chinook (spring), smoked	569
	17050	Blueberry, raw	617
	921019	Salmon, sockeye, hard dried	643
	58190	Game meat, native, moose, dried	1057
	31570	Salmon, Chinook (spring), baked or broiled	1108
	31720	Crab, Dungeness, boiled or steamed	1109
	32230	Salmon, sockeye (red), canned, solids w/ bone & liquid, salted	1193
	30530	Salmon, sockeye (red), baked or broiled	1459
	35880	Game meat, native, moose, roasted	10746
Breads	40850	Shake and bake, dry	5
	40690	Bread crumbs, dry, grated, plain	14
	38860	Croutons, seasoned	15
	38850	Croutons, plain	23
	40600	Bread crumbs, dry, grated, seasoned	23

40360	Bread, white, commercial, (includes soft crumbs), low salt	35
59100	Bread, Indian, fry, made with lard (Navajo)	37
39830	Roll, dinner, whole wheat	42
39870	Roll, hamburger / hot dog, calorie reduced	43
36720	Bagel, plain (w/ onion, poppy seed / sesame seed), toasted	45
37080	Bread, pita, white	56
39040	English muffin, raisin-cinnamon (apple cinnamon)	57
39970	Tortilla, ready-to-bake / fry, corn	61
7003001	Bannock made with lard, Cree recipe	73
7003003	Bannock made with milk, Cree recipe	91
37140	Bread, raisin	104
7003002	Bannock with oil, Cree recipe	104
9000017	Bannock deep fried with lard, water and eggs Cree recipe: 90000	111
37020	Bread, mixed-grain (also whole-grain, 7-grain)	113
7008018	Bannock, w/oil, water and milk powder, Inuit recipe	132
37260	Bread, rye, toasted	138
40280	Roll, dinner, plain, prepared from recipe, made w/ 2% milk	140
7000015	Bagel, plain (w/ onion, poppy seed and/or sesame seed)	150
36710	Bagel, whole wheat	156
39000	English muffin, plain (also sourdough)	171
40490	Tortilla, ready-to-bake / fry, flour	172
37150	Bread, raisin, toasted	192
62650	Fry bread, made with lard	193
36970	Bread, French or Vienna, (also sourdough), toasted	206

	37030	Bread, mixed-grain (also whole-grain, 7-grain), toasted	212
	36750	Bagel, cinnamon-raisin	215
	37380	Bread, French or Vienna (also sourdough)	378
	40630	Bread, whole wheat, from recipe (2/3 whole wheat flour), toasted	416
	7008013	Bannock, w/oil, water, baked, Inuit recipe	420
	37370	Bread, whole wheat, from recipe (2/3 whole wheat flour)	450
	37400	Bread stuffing, dry mix, prepared	469
	36880	Bread, banana, prepared from recipe, made w/ margarine	560
	7008012	Bannock, w/oil, water, pan-fried, Inuit recipe	1127
	40820	Bannock	1170
	37350	Bread, white, prepared from recipe with 2% milk	1362
	40730	Roll, dinner, plain (also brown and serve), commercial	1416
	39850	Roll, hamburger / hotdog, plain	1757
	37320	Bread, white, commercial, toasted	2849
	40680	Bread, whole wheat, commercial, toasted	2892
	40670	Bread, whole wheat, commercial	3518
	40660	Bread, white (includes soft crumbs), commercial	4319
Fruits	15110	Avocado, raw, all commercial varieties	10
	15880	Lemon, raw, with peel	13
	14900	Apple, dried, sulphured, uncooked	21
	16910	Watermelon, raw	29
	15070	Apricot, dried, sulphured, uncooked	32
	16050	Melon, honeydew, raw	32
	17450	Prune, dried, uncooked	37

	17420	Raisin, seedless (sultana)	42
	17460	Raisin, seeded	42
	15850	Kiwifruit, raw	45
	16930	Pear, Asian, raw	70
	16980	Apple, raw, without skin, sliced, cooked, boiled	85
	17280	Peach, raw	87
	17340	Pineapple, raw	87
	7000139	Salad, fresh fruit, no citrus	110
	16080	Mixed fruit, dried	128
	17440	Raisin, golden seedless	160
	17210	Melon, cantaloupe, raw	173
	16180	Orange, with peel, raw	199
	16030	Mango, raw	207
	15730	Grape, north American type (slip skin), raw	215
	16280	Papaya, raw	230
	7000138	Salad, fresh fruit, w/ citrus	370
	17180	Grapes, red/green (euro, Thompson seedless), adherent skin, raw	531
	16670	Pomegranate, raw	540
	17310	Pear, raw, with skin	836
	16160	Orange, California, navel, raw	980
	17220	Orange, all commercial varieties, raw	2053
	16230	Tangerine (mandarin), raw	2406
	16960	Apple, raw, with skin	6140
	17040	Banana, raw	7048
High-fat dairy products	59790	Dessert, frozen, ice cream, chocolate or caramel covered, w/ nuts	1
	660	Milk, dry, whole	3
	47800	Beverage, rice, rice dream, canned, enriched	5

55630	Cheese, parmesan, hard	5
400	Cheese, cream, low fat	10
39140	Ice cream, cone, sugar, rolled-type	10
470	Cheese, swiss (emmental)	14
7000265	Meal replacement, ready-to-drink shake, slim fast	15
56170	Cream, whipping, 35% m.f.	16
930	Cheese, mozzarella, part skim, (52% water, 16.5% m.f.)	20
1380	Beverage, soy, fluid, enriched	20
1110	Cheese, parmesan, shredded	30
34020	Cheese, swiss, low fat	32
1510	Cream, table (coffee), 15% m.f.	45
1400	Milk, evaporated, whole, canned, undiluted, 7.8% m.f.	48
7000291	Chocolate, milk, with fruit and nut	48
520	Cheese, processed food, swiss	50
7000193	Pudding, Yorkshire, made w / whole milk	50
540	Cream, whipped, cream topping, pressurized	52
52990	Cream, sour, light	62
41420	Dessert, frozen, pudding pop, vanilla	68
1390	Cream, sour, cultured, 14% m.f.	72
280	Cheese, cream	73
43760	Frosting, cream cheese-flavour, ready-to-eat	75
350	Cheese, mozzarella, (48% water, 25% m.f.)	78
7000019	Tzaziki (yogurt, cucumber & garlic)	80
390	Cheese, parmesan, grated	85
7002033	Yogurt, Activia, Danone, 3.6% m.f. (new 2007)	100
41570	Dessert, frozen, ice cream, vanilla, rich, 16% m.f.	107
190	Cheese, Brick	117

1230	Milk, fluid, whole, producer, 3.7% m.f.	122
7002047	Yogurt, Naturalia, plain, Danone, 2.2% m.f.	122
7000523	Cheese, curd	124
1370	Cheese, processed food, cheddar	125
940	Cream, whipping, 32% m.f.	135
7000172	Cheese, processed, mozzarella, Kraft	144
7000588	Yogurt, fruit, stirred, cream & fruit/creamy, Yoplait	175
42540	Dessert, pudding, vanilla, ready-to-eat	218
55650	Cheese spread, cream cheese base	256
55890	Chocolate flavour drink, whey and milk based	258
7000319	Ensure hp (high-protein)	268
799928	Ensure supplement.	273
42880	Dessert, frozen, ice cream, chocolate	313
7000353	Enriched (fortified) soy milk, plain, so nice	335
7000260	Meal replacement drink, boost	407
1360	Yogurt, fruit bottom, 2% to 4% m.f.	455
1460	Cream, table (coffee), 18% m.f.	498
41560	Dessert, frozen, ice cream, light, vanilla	512
1350	Cream, cereal (half and half), 12% m.f.	518
7002040	Yogurt, Danino, strawberries, Danone	518
7002025	Beverage, soy milk, fluid, enriched, silk plain	523
950	Cheese, processed spread, cheddar	540
1210	Cheese, processed, cheddar	576
1410	Cream, cereal (half and half), 10% m.f.	928
1500	Yogurt, plain, 2% to 4% m.f.	988
41630	Dessert, frozen, ice cream, vanilla, 11% m.f.	1348
1130	Milk, fluid, whole, pasteurized, homogenized, 3.3% m.f.	2676
1190	Cheese, cheddar	2704

Breakfast cereals	14680	Cereal, hot, oat bran, dry, Quaker	3
	12480	Cereal, ready-to-eat, froot loops, Kellogg's	14
	12970	Cereal, ready-to-eat, cinnamon mini buns, Kellogg's	20
	12700	Cereal, ready-to-eat, sugar crisp, Post	23
	13720	Cereal, ready-to-eat, raisin bran, Kellogg's	28
	12320	Cereal, ready-to-eat, bran flakes, Kellogg's	30
	14670	Cereal, hot, cream of wheat, instant: maple & brown sugar, prepared, Nabisco	32
	51510	Cereal, ready-to-eat, shredded oats: vanilla almond, Barbara's	35
	51610	Cereal, ready-to-eat, rice krispies, Kellogg's	36
	12650	Cereal, ready-to-eat, frosted flakes: lightly toasted, Pc	37
	14740	Cereal, ready-to-eat, cap'n crunch, Quaker	37
	13000	Cereal, ready-to-eat, corn flakes, Barbara's Bakery	38
	7002190	Cereal, ready-to-eat, raisin bran crunch, Kellogg's	38
	12840	Cereal, ready-to-eat, apple cinnamon o's, Nature's Path	40
	12940	Cereal, ready-to-eat, cheerios: frosted, General Mills	40
	13920	Cereal, ready-to-eat, multigrain and raisin, Nature's Path	40
	51260	Cereal, ready-to-eat, crispy rice, Leclerc	47
	12690	Cereal, ready-to-eat, frosted flakes, Kellogg's	50
	12550	Cereal, ready-to-eat, granola: raisin & nut, Nature's Path	52
	13310	Cereal, ready-to-eat, corn flakes: honey-nut, Kellogg's	55
7002002	Cereal, ready-to-eat, chex: wheat, General Mills	56	
7002060	Breakfast bar, oatmeal to go, baked apple, Quaker	56	

12560	Cereal, ready-to-eat, cheerios: honey nut, General Mills	62
62690	Cereal, Kellogg's two scoops crunch cranberry cereal	65
12580	Cereal, ready-to-eat, life, Quaker	66
12790	Cereal, ready-to-eat, shredded wheat, Post	75
51470	Cereal, ready-to-eat, fruity punch, Barbara's Bakery	76
14750	Cereal, ready-to-eat, cheerios, General Mills	79
12800	Cereal, ready-to-eat, just right, Kellogg's	84
12640	Cereal, ready-to-eat, shredded wheat: spoon size, Post	86
13690	Cereal, ready-to-eat, oatmeal crisp raisin, General Mills	90
7002181	Cereal, ready-to-eat, frosted mini-wheats, maple flavour, Kellogg's	95
51270	Cereal, hot, red river, prepared, Robin Hood	97
52320	Cereal, ready-to-eat, corn flakes: frosted, Leclerc	106
12570	Cereal, ready-to-eat, honeycomb, Post	107
12670	Cereal, ready-to-eat, special k, Kellogg's	121
12420	Cereal, ready-to-eat, corn flakes, Kellogg's	138
14380	Cereal, hot, oats, one minute, prepared, Quaker	163
14780	Cereal, ready-to-eat, mini-wheats: with white frosting, Kellogg's	182
12430	Cereal, hot, oats, instant: baked cinnamon roll, prepared, Quaker	193
51920	Cereal, ready-to-eat, mini-wheats: w/brown sugar frosting, Kellogg's	233
14040	Cereal, hot, cream of wheat, instant: original, prepared, Nabisco	282
12470	Cereal, ready to eat, shreddie, Post	290



	50780	Cereal, hot, corn meal, dry, Quaker	315
	14320	Cereal, hot, oats, porridge (w/ oat bran, wheat bran & flax seeds), prepared, Rogers	567
	14560	Cereal, hot, purity cornmeal, prepared, Robin Hood	688
	14140	Cereal, hot, cream of wheat, regular, prepared, Nabisco	699
	13980	Cereal, hot, oats, instant: regular, prepared, Quaker	2223
	14400	Cereal, hot, oats, quick, prepared, Quaker	8821
Market eggs	1170	Egg substitute, frozen (yolk replaced)	61
	1250	Egg, chicken, whole, fresh or frozen, raw	176
	1260	Egg, chicken, white, fresh or frozen, raw	203
	1320	Egg, chicken, whole, poached	237
	1310	Egg, chicken, whole, omelet	729
	1300	Egg, chicken, whole, boiled in shell, hard-cooked	3733
	1330	Egg, chicken, whole, scrambled	4216
	1290	Egg, chicken, whole, fried	5382
Cakes and cookies	37440	Cake, Angel Food, commercial	12
	38210	Cookie, animal crackers (arrowroot, social tea)	13
	38030	Cookie, chocolate sandwich, extra cream filling	15
	38380	Cookie, peanut butter, commercial	15
	7002271	Cookies, peanut butter waferstix, Kraft	16
	62740	Cookie, oat bran, digestive, simple pleasure, Dare	18
	7000564	Cake, chocolate, prepared from recipe, w/o icing (frosting)	22
	37590	Granola bar, soft, cereal bar, Special K, strawberry	28
	37670	Cake, fruitcake, commercial	28
	41020	Granola bar, soft, plain	28
	7000228	Bar, crisp rice, chocolate chip	28
	39390	Pancake, whole-wheat, dry mix, incomplete	29

40090	Cookie, oatmeal, prepared from recipe, without raisins	30
41010	Granola bar, hard, peanut	30
7000165	Brownie, chocolate, Snackwell's	30
7005014	Chocolate ice cream log cake, Christmas Yule log recipe: 700	35
40980	Granola bar, hard, plain	36
7000606	Trifle with custard	36
62700	Sweet roll, cinnamon, refrigerated dough, with icing (frosting)	37
39910	Granola bar, nutri-grain, fruit-filled (strawberry), Kellogg's	40
7000146	Granola bar, blueberry, low fat, Quaker	40
43680	Granola bar, hard, peanut butter	41
38270	Cookie, graham cracker, chocolate-coated	42
39610	Pie, pecan, commercial	44
7000240	Cake, frozen, devil's food, w/ whip cream & icing	44
38130	Cookie, chocolate chip, soft type, commercial	45
38560	Puff pastry, frozen, ready-to-bake, baked	47
38490	Cookie, sugar, commercial	50
39270	Muffin, wheat bran, dry mix, prepared	50
58570	Dessert, frozen, Fudgesicle bar, low fat	51
37570	Cake, chocolate (devil's food, fudge), dry mix, regular	55
38040	Cookie, brownie, commercial	56
37770	Cake, pound, commercial, made with butter	57
39250	Muffin, oat bran (wheat-free product)	57
54320	Granola bar, oat, fruits and nut	58
39100	French toast, frozen, ready-to-heat	59

42910	Dessert, frozen, ice pop	59
7002213	Cookies, 1905 tradition jelly sponge, Leclerc	59
38260	Cookie, graham cracker, plain or honey (cinnamon)	60
38450	Cookie, shortbread, commercial, plain	60
7000986	Cake, sponge, chocolate, with icing	60
38010	Cheesecake, prepared from mix, no-bake type	61
38250	Cookie, ginger snap	63
38930	Doughnut, cake-type, plain, sugared or glazed	63
7002206	Snack cake, caramel Marianne, Pâtisserie Fortin	63
48380	Granola bar, soft, cereal bar, fruit	65
7000566	Cookie, shortbread, chocolate coated, Leclerc	66
38080	Cookie, butter, commercial	72
37900	Cake, white, dry mix, regular	82
39450	Pie, blueberry, prepared from recipe, 2 crust	82
38440	Cookie, raisin, soft-type	85
38960	Cake, carrot, pudding-type, dry mix, w/o icing, prepared	85
7002064	Doughnut, yeast-leavened, cream filled	88
7005002	Apple crisp, recipe 7005002; recipe: 700	92
59730	Pancakes, plain (includes buttermilk), frozen, ready-to-prepare, microwave	96
7000092	Pie, sugar, 2 crust, 9", Quebec recipe	96
37920	Cake, white, prepared from recipe without frosting	97
39950	Toaster pastry, brown sugar and cinnamon	100
41650	Dessert, frozen, sherbet, orange	102
7000026	Scone /tea biscuit	103
39960	Toaster pastry, fruit (apple, blueberry, cherry, strawberry)	104
7000034	Muffin, chocolate chip	108

43550	Granola bar, soft (chewy), chocolate chip	113
42680	Dessert, frozen, gelatine pop	118
48220	Cake, snack cake, cupcake, chocolate, w/frosting (icing), low-fat	129
38120	Cookie, chocolate chip, commercial, 18-28% fat	137
7000206	Donut, apple fritter	137
38820	Croissant, butter	139
38110	Cookie, chocolate chip, commercial, 1207% fat	140
41050	Granola bar, soft (chewy), chocolate chip, chocolate coating	148
40580	Pie, pumpkin, commercial	167
7000147	Granola bar, chocolate chunk, low fat, Quaker	168
40770	Pie, chicken, commercial	170
38000	Cheesecake, commercial	176
38990	Éclair, custard filled w/ chocolate glaze, from recipe	200
37600	Cake, white, prepared from recipe, w/ coconut icing (frosting)	210
37860	Cake, sponge, commercial	211
38310	Cookie, oatmeal (with or without raisins), commercial	222
7000371	Muffin, raisin bran, Tim Hortons	228
40560	Pie, cherry, commercial, 2 crust	253
39160	Muffin, blueberry, commercial	296
39350	Pancake, plain, prepared from recipe	301
37540	Cake, chocolate (devil's food), commercial, w/ chocolate icing	361
40550	Pie, blueberry, commercial, 2 crust	382
39580	Pie, lemon meringue, commercial	383
39410	Pie, apple, commercial, 2 crusts	384

	38970	Doughnut, yeast-leavened (honey bun), glazed	515
	39310	Pie, apple, prepared from recipe, 2 crust	576
	39420	Pancake, plain (w/ buttermilk), dry mix, complete	727
	7002008	Cake, carrot, from recipe, w/ cream cheese icing	761
	42300	Dessert, gelatine, dry mix, with water	2396
Sweets	7000093	Candy, Tootsie Roll, bite size	3
	42020	Candies, m & m's, plain chocolate candies	7
	62330	Candies, toffee, prepared-from-recipe	8
	41430	Candies, caramel	9
	41730	Candies, goobers, chocolate covered peanuts	10
	42150	Candies, Starburst fruit chews	10
	41910	Candies, milk chocolate coated raisins	11
	7002221	Chocolate bar, Reese's Fast Break (US) / Hershey's Sidekick	12
	43190	Sweets, sugars, icing (powdered)	13
	43790	Sweets, jams and preserves, apricot	20
	41860	Candies, bars / chips, milk chocolate, plain	21
	43230	Sweets, syrups, corn, light	21
	43310	Sweets, topping (spread), butterscotch or caramel	21
	41990	Sweets, topping, strawberry	22
	7000341	Light marmalade	27
	41490	Candies, bars, sweet chocolate	32
	41450	Candies, caramels, chocolate flavour roll	34
	41830	Candies, marshmallows	35
	42210	Candies, chewing gum	35
	55240	Candies, chocolate covered, caramel with nuts	35
	7002157	Chocolate bar, jelly and chocolate, Big Turk	36
	41770	Candies, bars, Kit Kat wafer bar	40
	7000337	Jam raspberry light	40

43260	Sweets, syrups, maple, Bulk	41
42060	Candies, bars, Nestle crunch	45
41970	Candies, Reese's peanut butter cups	50
42090	Candies, bars, Mars	51
42110	Candies, Rolo caramels in milk chocolate	54
41950	Candies, bars, Hershey's, milk chocolate w/ almonds	56
47770	Hot chocolate, rich, mix	56
42950	Sweets, syrups, table blends, corn, Refiner's syrup & sugar	67
43300	Sweets, jams and preserves	67
43290	Sweets, syrups, table blends, cane and 15% maple	80
41800	Candies, Twizzlers (licorice), strawberry	84
41380	Candies, bars, Butterfinger	87
41740	Candies, Gumdrops	112
28690	Hot chocolate, mix, powder	122
41760	Candies, jellybeans	124
7000340	Double fruit strawberry jam	126
7999959	Glucerna bar, chocolate caramel	132
7000339	Light strawberry jam	153
7002153	Chocolate bar, Skor, milk chocolate coated toffee	155
48320	Candies, M&M's, mini milk chocolate	168
41840	Candies, bars, Oh Henry!	176
41930	Sweets, syrup, table blend, pancake	207
41750	Candies, hard	283
7000433	Cherry jelly/jam, Smucker's	319
8000007	Sweets, honey, strained or extracted	328
42940	Candies, bars, coffee crisp	386
39890	Strudel, apple	518

	52960	Hot chocolate with marshmallows, mix, powder, water add	549
	43170	Sweets, sugars, brown	594
	52950	Hot chocolate, rich, mix, powder, water added	889
	28710	Hot chocolate, mix, powder, water added	1254
	43180	Sweets, sugars, granulated	5296
Poultry	5910	Chicken, broiler, light meat, fried	15
	6000	Chicken, broiler, back, meat, fried	17
	6330	Chicken, broiler, wing, meat, roasted	21
	5670	Chicken, broiler, flesh only, roasted	34
	5920	Chicken, broiler, light meat, roasted	34
	6380	Chicken, roasting, flesh and skin, roasted	34
	6320	Chicken, broiler, wing, meat, fried	35
	8450	Chicken, broiler, drumstick, meat & skin, water chill, roasted	40
	6080	Poultry food prod, turkey roasts, -bone, frozen, light & dark, roasted	50
	8090	Chicken, broiler, leg, meat & skin, batter dipped, fried	50
	56910	Turkey, all classes, back, meat and skin, roasted	56
	7130	Chicken breast, oven-roasted, fat-free, sliced	59
	7290	Turkey, broiler, light meat and skin, roasted	59
	48770	Chicken breast, oven-roasted, fat free	59
	7170	Turkey, all classes, leg, meat and skin, roasted	63
	9190	Chicken, ground, lean, cooked	63
	55980	Turkey, light or dark meat, smoked, cooked, skin, bone removed	63
	9160	Chicken, roasting, back, meat, roasted	70

58530	Chicken, wing, frozen, glazed, barb flavour, heated/microwave	87
8960	Chicken, roasting, leg and back, meat and skin, stewed	90
6030	Chicken, broiler, breast, meat, fried	101
8420	Chicken, broiler, breast, meat, water chill, roasted	103
6240	Chicken, broiler, thigh, meat & skin, flour coated, fried	116
5880	Chicken, broiler, dark meat & skin, roasted	118
8410	Chicken, broiler, breast, meat, water chill, raw	118
6230	Chicken, broiler, thigh, meat & skin, batter dipped, fried	120
8240	Chicken, broiler, skin only, water chill, stewed	120
9130	Chicken, roasting, back, meat and skin, roasted	125
7090	Turkey, all classes, light meat only, roasted	132
6290	Chicken, broiler, wing, meat & skin, roasted	135
8920	Turkey, breast meat	151
11720	Chicken, roasting, breast, meat, roasted	153
6440	Chicken, roasting, light meat, roasted	189
6140	Chicken, broiler, leg, meat, roasted	190
6060	Chicken, broiler, drumstick, meat, fried	194
7050	Turkey, all classes, light meat and skin, roasted	207
7430	Turkey, broiler, breast, meat only, roasted	236
6280	Chicken, broiler, wing, meat & skin, flour coated, fried	251
56930	Chicken breast roll, oven-roasted	255
5960	Chicken, broiler, dark meat, roasted	267
9070	Chicken, roasting, thigh, meat and skin, roasted	268



	6010	Chicken, broiler, breast, meat & skin, batter dipped, fried	280
	58520	Chicken, wing, frozen, glazed, barbecue flavour	290
	5640	Chicken, broiler, flesh and skin, stewed	295
	700896	Chicken, boneless, ns as to part, w/o skin, battered, fried	305
	5630	Chicken, broiler, flesh and skin, roasted	338
	6100	Chicken, broiler, leg, meat & skin, roasted	342
	7150	Turkey, all classes, breast, meat and skin, roasted	350
	9220	Poultry food products: turkey, roast, boneless, roasted	356
	6250	Chicken, broiler, thigh, meat, fried	405
	9010	Chicken, roasting, drumstick, meat and skin, roasted	411
	9100	Chicken, roasting, thigh, meat, roasted	429
	6040	Chicken, broiler, drumstick, meat & skin, battered, fried	576
	8890	Chicken, roasting, breast, meat & skin, roasted	578
	5660	Chicken, broiler, drumstick, meat & skin, flour coated, fried	726
	6890	Turkey, all classes, flesh and skin, roasted	832
	6050	Chicken, broiler, flesh only, fried	1185
Condiments and sauces	1830	Spices, curry powder	0
	9910	Sauce, curry, dehydrated	1
	7000407	Dijonnaise creamy dijon mustard, Hellmann's	1
	1690	Spices, allspice, ground	2
	1770	Spices, chili powder	3
	1780	Spices, cinnamon, ground	4
	10100	Gravy, turkey, dehydrated	4
	1880	Spices, garlic powder	5

10110	Gravy, unspecified, dehydrated	6
140	Vinegar, distilled	8
10300	Sauce, pepper, Tabasco, ready-to-serve	8
7002196	Chili seasoning mix, Old el Paso	10
10020	Gravy, beef, dehydrated	12
11310	Sauce, tartar, ready-to-serve	15
11330	Sauce, Worcestershire, ready-to-serve	16
11370	Sauce, hot green chili pepper, canned	16
53520	Gravy, instant beef, dry	18
2020	Spices, poultry seasoning	23
53510	Gravy, brown instant, dry	24
23390	Pickle relish, hot dog	30
11350	Sauces, mustard, brown, prepared, ready-to-serve	32
11300	Sauce, steak, Hp or A1, ready-to-serve	35
53540	Olive, ripe, canned, small to extra large	45
16130	Sauce, chili, peppers, hot, chili, mature red, canned	47
47340	Sauce, cheese, ready-to-serve	48
53690	Gravy, meat or poultry, prepared, low sodium	60
61980	Sauce, white, thin, prepared-from-recipe, with butter	62
34030	Soy sauce (made with soy and wheat), shoyu, regular	64
7000214	Dip, herb & spice, Kraft	68
53640	Sauce, tomato chili sauce, bottled, salted	69
23370	Pickles, cucumber, sweet	70
7000203	Sauce, pizza, canned, ready-to-serve	77
61970	Dip, sour cream, buttermilk/onion	80
24860	Pickles, cucumber, sour	85
23380	Pepper, sweet, red, boiled, drained	88
10290	Sauce, pepper or hot, ready-to-serve	118
1990	Spices, pepper, red or cayenne	120

	24680	Tomato, sauce, w/ onions, green peppers & celery, canned	125
	7000156	Alfredo sauce, prepared w/ 2% milk & margarine, Knorr	126
	47290	Sauce, hoisin, ready-to-serve	128
	1980	Spices, pepper, black	149
	50000	Sauce, sweet and sour, ready-to-serve	162
	23400	Pickle relish, sweet	196
	49700	Sauces, ready-to-serve, mustard, prepared, yellow	233
	2140	Salt, table	249
	10170	Sauce, barbecue, ready-to-serve	263
	24950	Pickles, cucumber, dill (includes kosher and polish)	342
	33290	Soy sauce (made from soy), tamari	359
	24940	Tomato ketchup (catsup)	373
	10030	Gravy, chicken, canned	398
	10010	Gravy, beef, canned	407
	10090	Gravy, turkey, canned	491
	47350	Sauce, pasta, spaghetti or marinara, ready-to-serve	543
	24460	Tomato, sauce for spaghetti, canned	562
	7000035	Sauce, salsa, ready-to-serve	590
	10250	Gravy, beef, homemade	745
	49990	Sauce, stir fry, ready-to-serve	1199
	24650	Tomato, sauce, canned	1382
Beef	59840	Beef, chuck, cross rib roast, boneless, lean, cooked, braised	0
	26900	Beef, ground, medium, raw	30
	27980	Beef, tongue, potted or deviled	33
	26690	Beef, tongue, simmered	44
	27570	Beef, chuck, short ribs, lean and fat, simmered	47

60700	Beef, rib, rib eye steak, -bone, lean & fat, 3mm trim, cooked, broiled	49
26550	Beef, kidney, simmered	54
26970	Beef, ground, regular, baked, degree of doneness: medium	58
8000001	Meat balls for spaghetti	68
61680	Beef, composite cuts, roast, lean, cooked	72
61630	Beef, composite cuts, roast, lean & fat, 0mm trim, raw	74
60940	Beef, hip, sirloin tip roast, boneless, lean, cooked, roasted	85
60980	Beef, hip, sirloin tip steak, -bone, lean & fat, 0mm trim, cooked, braised	90
26770	Beef, brisket, lean, 6mm trim, braised	110
61660	Beef, composite cuts, roast, lean & fat, 0mm trim, cooked	112
26910	Beef, ground, medium, baked, degree of doneness: medium	115
7000276	Beef/steak, teriyaki, w/ sauce	122
56700	Roast beef spread	126
61720	Beef, composite cuts, steak, lean & fat, 0mm trim, cooked	134
27020	Beef, ground, regular, patty, pan-fried, degree of doneness: well done	149
59510	Beef, chuck, blade steak, -bone, lean & fat, 3mm trim, raw	167
28090	Beef, loin, t-bone steak (porterhouse), lean, cooked, broiled	170
61180	Beef, hip, rump roast, lean and fat, 6mm trim, roasted	185

	60880	Beef, rib, rib steak with bone, lean, cooked, roasted	192
	61440	Beef, loin, top sirloin steak, -boneless, lean & fat, 0mm trim, cooked, broiled	201
	7000208	Meatballs, beef	205
	26750	Beef, brisket, lean and fat, 6m trim, braised	235
	26840	Beef, ground, lean, baked, degree of doneness: medium	259
	27010	Beef, ground, regular, pan-fried, degree of doneness: medium	274
	61730	Beef, composite cuts, steak, lean and fat, 3mm trim, cooked	291
	26570	Beef, liver, pan-fried	393
	7000159	Meatloaf, beef	399
	61670	Beef, composite cuts, roast, lean and fat, 3mm trim, cooked	407
	59500	Beef, chuck, blade steak, boneless, lean & fat, 0mm trim, raw	628
	26830	Beef, ground, lean, raw	680
	26880	Beef, ground, lean, pan-fried, degree of doneness: medium	1009
	26860	Beef, ground, lean, broiled, degree of doneness: medium	1020
	26950	Beef, ground, medium, pan-fried, degree of doneness: medium	1827
Sausages and cold meat	55540	Meatless, bacon bits	10
	11980	Luncheon meat, mock chicken, loaved	13
	12120	Sausage, pork, fresh, raw	15
	53780	Luncheon meat, pork with ham, minced, canned	15

54600	Turkey ham, sliced, extra lean, pre-packaged or Deli-sliced	15
12210	Pepperoni, sausage, pork and beef	20
19790	Pork, cured, bacon bits, cooked	23
54060	Pork, cured, bacon, cooked, microwaved	23
18670	Pork, cured, ham, center slice, lean and fat, unheated	30
11880	Ham, cured, flaked, canned	34
27110	Beef, cured, thin-sliced	36
11870	Wiener (frankfurter), chicken	38
19360	Pork, cured, bacon, raw	40
56770	Sausage, turkey, breakfast links, mild	40
9000009	Luncheon meat, pork, canned Klik light	40
11750	Italian sausage, fresh pork, cooked	41
27090	Beef, cured, sausage, cooked, smoked	43
12140	Salami, cooked, pork	46
55760	Pork, cured, ham, low sodium, lean and fat, cooked	63
7000388	Pork, sweet and sour	70
12090	Luncheon meat, ham, spiced, loaved	92
11540	Luncheon meat, beef, thin sliced	105
11990	Sausage, pork, fresh, cooked	109
18690	Pork, cured, ham patties, grilled	118
11970	Polish sausage, pork	119
54050	Pork, cured, bacon, cooked, baked	131
11800	Bologna (baloney), beef and pork	150
11670	Smoked link sausage, pork	152
27910	Pork, cured, breakfast strips, cooked	160
18570	Beef, cured, corned beef, canned	190
11550	Luncheon meat, pork, canned	195
18880	Pork, cured, ham, boneless, lean and regular, roasted	197

	53810	Pork, cured, ham, boneless, regular (11% fat), roasted	221
	18610	Pork sausage, pre-cooked	234
	55770	Pork, smoked or cured, ham, low sodium, lean, cooked	236
	12010	Salami, cooked, beef and pork	240
	11890	Ham, cured, chopped, not canned	254
	53840	Beef sausage, fresh, cooked	292
	11620	Pepperoni, pork, beef	304
	18720	Pork, cured, ham, whole, lean and fat, roasted	304
	50030	Bologna (baloney), beef	314
	11790	Wiener (frankfurter), hot dog type, fat free	428
	18560	Pork, cured, bacon, broiled, pan-fried or roasted	431
	11860	Wiener (Frankfurter), beef and pork	508
	11850	Wiener (Frankfurter), beef	642
	11630	Sausage, pork and beef, fresh, cooked	694
	11490	Ham, sliced, regular (approximately 11% fat)	774
	54070	Pork, cured, bacon, cooked, pan-fried	1104
Other market meat	17800	Pork, fresh, loin, tenderloin, lean and fat, roasted	17
	19440	Pork, fresh, loin, whole, lean, roasted	47
	17940	Pork, fresh, loin, rib chop (rib end), bone-in, lean, braised	67
	19670	Pork, fresh, loin, center cut (chop), bone-in, lean & fat, raw	98
	17810	Pork, fresh, loin, center cut (steak), boneless, lean & fat, raw	110
	19060	Pork, fresh, loin, rib half (country-style ribs), lean & fat, braised	118

17880	Pork, fresh, loin, center cut (chop), bone-in, lean, roasted	126
19120	Pork, fresh, loin, sirloin steak, boneless, lean & fat, braised	126
18830	Pork, fresh, loin, rib chop (rib end), bone-in, lean, pan-fried	134
17830	Pork, fresh, loin, center cut (chop), bone-in, lean & fat, broiled	138
17920	Pork, fresh, loin, rib chop (rib end), bone-in, lean & fat, roasted	148
17980	Pork, fresh, loin, sirloin chop, bone-in, lean & fat, braised	160
19680	Pork, fresh, loin, center cut (steak), boneless, lean & fat, broiled	178
18260	Pork, fresh, shoulder, blade portion, bone-in, lean & fat, roasted	180
36490	Veal, grain-fed, cutlets (inside top round), raw	199
35080	Pork, fresh, loin, rib steak (rib end), boneless, lean & fat, pan-fried	221
18980	Veal, composite cuts, lean & fat, cooked	272
18850	Pork, fresh, loin, rib chop (rib end), bone-in, lean & fat, pan-fried	282
17840	Pork, fresh, loin, center cut (chop), bone-in, lean & fat, roasted	303
18920	Pork, fresh, composite, leg, loin, shoulder & spareribs, lean & fat, cooked	316
18940	Pork, fresh, back ribs, lean and fat, roasted	334
19030	Pork, fresh, loin, rib steak (rib end), -bone, lean, pan-fried	382



	17900	Pork, fresh, loin, rib chop (rib end), bone-in, lean & fat, braised	434
	17910	Pork, fresh, loin, rib chop (rib end), bone-in, lean & fat, broiled	492
	61220	Pork, fresh, ground, medium, pan-fried	606
	19340	Pork, fresh, side ribs center cut (spareribs), lean & fat, simmered, roasted	916
	18840	Pork, fresh, loin, center cut (chop), bone-in, lean & fat, pan-fried	1309
Snacks and appetizers	43840	Snacks, pretzels, hard, plain, non-enriched, salted	1
	7000135	Snacks, tortilla chips, taco	8
	41340	Crackers, vegetable thins	9
	44080	Snacks, potato chips, plain, unsalted	10
	41110	Snacks, popcorn, oil-popped	11
	41150	Snacks, popcorn, cheese	11
	40400	Cracker, saltine (+oyster, soda, soup), unsalted top	15
	41290	Snacks, tortilla chips, ranch	16
	43640	Snacks, potato sticks	18
	43660	Snacks, sesame sticks, wheat-based, salted	21
	40930	Snacks, cornnuts, plain	23
	43530	Snacks, cornnuts, nacho	28
	7000527	Crackers, toast thins (rye, wheat, white flour), Nutricrisp	29
	7002264	Snacks, potato chips, sea salt & malt vinegar, miss Vickie's	31
	55330	Snacks, pretzels, soft	40
38590	Cracker, cheese	45	
41240	Snacks, rice cakes, brown rice, plain	45	
41130	Snacks, popcorn, caramel-coated, with peanuts	50	

	41100	Snacks, popcorn, air-popped	56
	41200	Snacks, potato chips, dried potatoes, sour cream & onion	58
	7000187	Snacks, bits & bites, pretzel/nut/cereal mix	59
	40940	Snacks, crisped rice bar, chocolate chip	60
	7000062	Cracker, 100% stoned wheat	62
	38610	Cracker, crisp bread, rye	70
	43690	Snacks, potato chips, cheese	78
	39940	Taco shell, baked	91
	43600	Snacks, potato chips, dried potatoes, plain	103
	54440	Snacks, popcorn, sugar syrup/caramel, fat-free	105
	7000061	Cracker, Ritz	114
	40860	Snacks, beef jerky, chopped and formed	118
	7002240	Handi-snacks, breadsticks and cheese, Nabisco	185
	41180	Snacks, potato chips, sour cream and onion	208
	41270	Snacks, tortilla chips, plain	212
	41280	Snacks, tortilla chips, nacho	215
	54930	Snacks, rice cakes, crackers (include mini rice cakes)	264
	40870	Snacks, corn-based, extruded, chips, plain	327
	41170	Snacks, potato chips, barbecue	358
	40920	Snacks, corn-based, extruded, puffs or twists, cheese	476
	40720	Cracker, standard snack-type	590
	7000107	Popcorn, microwave, pop & serve bag	798
	38720	Cracker, saltine (also oyster, soda, soup)	800
	44070	Snacks, potato chips, plain	1560
French fries	24380	Potato, french-fried, frozen, par-fried, cottage cut, oven	40
	23240	Potato pancakes, home-prepared	44

	7000025	Pot, french-fried, frozen, restaurant-prepared, fried in vegetable oil & animal fat	234
	21850	Poutine (fries, gravy & cheese)	492
	21800	Potato, hashed brown, frozen, w/ butter sauce, prepared	711
	24360	Potato, french-fried, frozen, restaurant-prepared with vegetable oil	1423
	24350	Potato, french fried, frozen, home-prepared, heated oven, unsalted	1506
	24310	Potato, hashed brown, plain, frozen, prepared	2734
Added fat and oils	160	Butter, whipped	3
	57570	Margarine tub Becel light (non-hydrogenated)	5
	7002081	Margarine, tub, with olive oil, Becel	5
	5340	Salad dressing, blue cheese, commercial, regular	10
	55160	Salad dressing, coleslaw	11
	7002116	Vegetable oil, Becel, non- hydrogenated, canola and sunflower	12
	5310	Salad dressing, mayonnaise, commercial, over 65% oil	14
	4180	Vegetable oil, peanut	15
	5260	Salad dressing, thousand island, commercial, regular	16
	920	Butter, unsalted	19
	5330	Salad dressing, french, commercial, regular	21
	4810	Margarine, tub, canola, country crock	28
	4240	Vegetable oil, sesame	32
	4280	Salad dressing, oil and vinegar, prepared from recipe	32
	54900	Salad dressing, mayonnaise type, fat free	37
	60570	Margarine, tub, canola oil (liquid & hydrogenated), Compliments	41

	4920	Margarine, stick, corn & canola, Fleischmann	85
	4640	Animal fat, lard (pork)	125
	53100	Animal fat, bacon grease	137
	60090	Margarine, tub, canola and safflower oil (non- hydrogenated), Becel	149
	60100	Margarine, tub, soya oil (non- hydrogenated), Imperial	149
	53300	Salad dressing, ranch dressing, commercial, regular	169
	4820	Margarine, tub, canola & soya, Parkay	171
	55150	Salad dressing, caesar dressing, regular	190
	4220	Vegetable oil, olive	197
	5320	Salad dressing, Italian, commercial, regular	271
	5270	Salad dressing, mayonnaise type, commercial, over 35% oil	836
	4510	Vegetable oil, canola	987
	53120	Margarine, tub, composite	1374
	1180	Butter, regular	1462
Fruit-based sauces and canned products	16760	Raspberry, canned, heavy syrup pack, solids and liquid	32
	17500	Strawberry, frozen, unsweetened	37
	17360	Pineapple, canned, juice pack, solids and liquid	44
	17000	Apple sauce, canned, unsweetened	61
	15390	Cranberry sauce, canned, sweetened	83
	15560	Fruit cocktail, canned, extra heavy syrup, solids & liquid	130
	15520	Peach, canned halves/slices, extra light syrup pack, solids & liquid	159
	16340	Fruit cocktail, canned, juice pack, solids & liquid	197

	7000480	Sauce, cranberry, whole cranberry, canned/home recipe	234
	17010	Apple sauce, canned, sweetened	280
	15540	Fruit cocktail, canned, light syrup pack, solids & liquid	351
	15030	Apricot, canned halves w/ skin, light syrup pack, solids & liquid	426
	15580	Fruit salad, canned, heavy syrup pack, solids & liquid	510
Nuts and seeds	25590	Nuts, coconut meat, desiccated, unsweetened	2
	25900	Nuts, walnuts, English or Persian, dried	2
	25890	Nuts, walnuts, black, dried	10
	25280	Seeds, sunflower seed kernels, toasted	17
	25460	Nuts, cashew nuts, dry roasted	17
	7000605	Peanut sauce	30
	49760	Nuts, macadamia, dry roasted, salted	33
	26270	Nuts, cashew nuts, dry roasted, salted	34
	7000160	Peanut butter, natural, unsalted	35
	33980	Peanuts, all types, oil-roasted, salted	36
	25340	Nuts, almonds, dried, non-blanched	59
	26440	Nuts, pistachio nuts, raw	61
	26290	Nuts, cashew butter, plain, salted	64
	25580	Nuts, coconut meat, raw	65
	45280	Seeds, flaxseeds (linseeds), whole and ground	68
	33020	Peanuts, all types, dry-roasted, salted	73
	33620	Peanuts, all types, dry-roasted	73
	26330	Nuts, mixed nuts, oil roasted, without peanuts, salted	76
	25790	Nuts, mixed nuts, oil roasted without peanuts	90
	34140	Peanut butter, smooth type, fat and sugar added	94
	33960	Peanuts, all types, raw	109

	25770	Nuts, mixed nuts, dry roasted with peanuts	140
	33990	Peanut butter, smooth type, fat, sugar and salt added	177
	25260	Seeds, sunflower seed kernels, dried	274
Market fish and seafood	30950	Crab, Alaska king, imitation (surimi)	31
	30810	Tuna, light, canned with water, drained, salted	32
	30070	Flatfish (flounder/sole/plaice), baked or broiled	61
	31310	Tuna, light, canned in water, drained, unsalted	97
	31460	Lingcod, baked or broiled	97
	30540	Sardine, pacific, canned in tomato sauce, drained w/ bones	100
	32140	Tuna, light, canned with oil, drained, unsalted	118
	31210	Molluscs, oyster, eastern (blue point), wild, canned, solids & liquid	130
	32120	Shrimp, mixed species, boiled or steamed	149
	30860	Tuna salad	170
	32030	Sardine, Atlantic, canned with oil, drained solids with bone	189
	30060	Fish portions and sticks, frozen and reheated	199
	31950	Cod (scrod), Atlantic, baked or broiled	250

**Annex 2: Consent form****First Nations Food, Nutrition and Environment Study****Individual Consent Form**

Please take as much time as you want to read this form and accompanied pamphlet for the project, ask questions, and talk about this project with family or friends.

**What is this project about?**

Canada has been conducting health and total diet studies of the general Canadian population to understand more about food safety and how changes in diet relates to chronic conditions like heart disease and diabetes but First Nations people living on-reserve have not been included in these studies. This joint research venture is a 10-year study on the benefits and risks of food and water consumed by 100 First Nations communities across Canada. This study will gather information on current traditional and store-bought food use practices, as well as test many traditional foods for nutrient content and hazardous environmental chemicals, such as mercury. The study will also test samples of drinking water for trace metals, and surface water for pharmaceuticals. In order to determine if these foods increase exposure to contaminants and contribute to health risks, samples of hair will be analysed for the presence of mercury.

**Who is conducting this project?**

This study is being done in collaboration with the Assembly of First Nations, Health Canada, the University of Northern British Columbia and the Université de Montréal. Funding is provided through Health Canada. All aspects of this project have been discussed with your community leaders and they have agreed to include your community in the study.

**Why are we interested in this project?**

It is important to gather information specific to First Nations in order to develop intervention strategies that are appropriate to the situation, including the development of plans to protect traditional food systems, and to promote well-being and healthy lifestyles in communities.

**How will the survey results be used?**

Results may be used by your community for resources and health promotion planning purposes. Regional results will be used to identify pollution and food safety problems and will be used to develop guidelines for health promotion and disease prevention.

**What will happen if I agree to participate in this project?**

Participation in this study is voluntary. If you agree to participate, it will require about one to two hours of your time, mainly to answer questions about the food you eat. You only answer questions that you feel comfortable with and you can end your participation

at any time. You may withdraw from the project at any time and any information you have provided will be destroyed. We would also like to measure your height and weight and take a small sample of hair for mercury analysis. In some randomly selected households, we also propose to collect a water sample from the kitchen sink. These samples will be collected by the householder and the community researcher and sent for analysis at a independent laboratory selected by joint venture.

**What will happen if I don't agree to let hair samples be used in this project?**

You will not lose any benefits if you choose not to let your hair sample be used. If you don't agree to us taking a sample of your hair, this will not be done. If you have submitted a sample and change your mind about allowing it to be used in the study, it will be withdrawn from the study and will be returned to you.

**Will there be any compensation or expenses for participating in this study?**

There is no compensation or expense to you.

**How will you protect my privacy?**

All information you provide in this interview will be treated with respect and held in confidence. Information shared between you and the interviewer will be maintained in confidence. All hardcopies of the questionnaires collected will be protected by the Principal Investigator, Laurie Chan, or his research associate, Judy Mitchell. All records will be kept in a secured room in Dr. Chan's data lab at UNBC until the final report of this project is complete or a maximum of 5 years. Data will be entered into a computer without your names and the computerized dataset will be co-shared by the participating communities, the Assembly of First Nations, Health Canada, and the academic researchers.

All information derived from the study will be kept strictly confidential and your name will not be associated with the samples or data we collect except for the hair mercury data. The hair mercury data set will be kept at Health Canada as part of the ongoing database. Nobody can access these data without your written consent.

Your identity will remain confidential in all publications and public presentations related to this research.

**What are the benefits of having my sample and survey results used in this project?**

By participating in this study you will have a chance to provide input into the benefits and risks of traditional and commercial food use. Benefits to each community include development of baseline of exposure to contaminants through food, improved knowledge of levels of exposure of mercury in the environment and state of knowledge of regional risks associated with food such as the reliance on traditional foods and the importance of maintaining traditional foods in the daily diet.

**Is there any chance of harm if I participate in this study?**

There is no physical harm anticipated for participating in the project but inconveniences may include time taken away from other responsibilities (home and/or work), sharing of food for analysis, inconvenience for water and information collection, or possible laceration from collection of hair sample.



The study may pose the following risks to yourself and your community: fear/stress, concerns over collective privacy, misperception of traditional foods as negative, disruption of other First Nation projects or issues. The Researchers shall provide the community with information that can be taken to minimize these risks.

**Can I change my mind after I agree to let my sample or questionnaire results be used?**

At any time during this study you can choose to drop out or refuse to answer any questions you feel may be too personal. You can also ask that the data collected by questionnaire or laboratory analysis not be used in the study. In such cases the questionnaire and/or samples with associated test results will be destroyed or returned to you on request. No samples of hair, water or food will be collected without your permission.

**How will I find out what happens with this project?**

You will be informed of the results of the research through the community. The community will also receive a copy of the final report of the results of the community along with any recommendations they may have. The results of the hair analysis will be communicated directly to the individuals. If high levels of mercury are detected, a specialist in Environmental Medicine will oversee the deliverance of required treatment if needed. If high levels of metals are found in drinking water, the individual will also be contacted directly.

**Who can I talk to if I have questions or problems?**

The local community interviewer will answer any questions you may have about this study or you may want to contact the following project staff at any time in the future:

Collect calls will be accepted.

**Research Supervisor:**

Dr. Laurie Chan

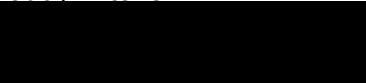
BC Leadership Chair in Aboriginal Environmental Health

University of Northern BC



**Research Coordinator:**

Judy Mitchell



**AFN:**

Dr. Donald Sharp



**Consent and Signature**

By signing this form, I agree that:

- The study has been explained to me.....Yes No
- All my questions were answered.....Yes No
- The possible harms and discomforts and the possible benefits (if any), of this study have been explained to me.....Yes No
- I understand that I have the right not to participate and the right to stop at any time.....Yes No
- I have the choice of not answering any specific questions.....Yes No
- I am free now, and in the future, to ask any questions.....Yes No
- I agree to give hair sample and have them tested.....Yes No
- I agree to collect drinking water samples from my household and have them tested .....Yes No
- I have been told that my personal information will be kept confidential.....Yes No
- I agree that in case of excess trace metals in drinking water the results will be communicated to the Regional Environment Health Manager.....Yes No
- I hereby consent to participate in the study.....Yes No

Signature \_\_\_\_\_

Date \_\_\_\_\_

Name of participant : \_\_\_\_\_  
Telephone number: \_\_\_\_\_

Mailing address (for returning results of hair mercury analysis):

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Name of person who obtained consent \_\_\_\_\_

Signature \_\_\_\_\_

Date \_\_\_\_\_

ID \_\_\_\_\_

(The Community research assistant keeps this page and gives the other 3, together with a flyer to the participant)

### **Annex 3: Community Research Assistant Training Agenda**

#### **DAY 1**

- Introductions
- Study Overview: Background, Purpose, Method (Information sheet and/or consent form)
- Role of Community Research Assistant
- Payment (Training; First Visit (Part I); Second Visit (Part II); Meetings with Nutrition Research Coordinator)
- General Interview Structure
  - Questionnaires
    - Traditional Food and Water
    - 24-Hour Recall
    - Social, Health and Lifestyle
    - Food Security
  - Hair sample for mercury assessment
  - Water sample for metals measurement
  - Repeated 24-Hour Recall
- Protecting confidentiality (Oath of Confidentiality, Consent Form, Participant ID)
- Steps to Interviewing
  - Initial Contact
  - Starting the Interview
  - Conducting the Interview

#### **PART 1**

##### Using Food Models

- Explanation/Demonstration and Practice

##### Traditional Food and Water Questionnaire – Traditional Food

- Purpose
- Demonstration and Practice

##### Traditional Food and Water Questionnaire – Water

- Purpose
- Demonstration and Practice

**DAY 2****PART 1, cont'd**24-Hour Recall

- Purpose
- Level of detail required and why; Computer program
- Completing the 24-hour diet recall: First, Second, Third Pass
- Recipes: when needed and how to record on Recipe Form and 24-hour diet recall
- Recording nutrient supplements
- Demonstration and Practice

## Recording Height and Weight

- Purpose
- Demonstration and Practice

Social, Health and Lifestyle and Food Security Questionnaires

- Purpose
- Demonstration and Practice

Hair Sample for Mercury Assessment

- Purpose
- Demonstration and Practice

- Random sampling of households for Part 1 (100)

**DAY 3****PART 2**Water Sample for Metals Measurement

- Purpose
- Demonstration and Practice

Repeated 24-Hour Recall

- Random sampling of households for Part 2 (20 of those selected for Part 1. Four will be selected for duplicate five-minute flushed sample)
- Practice of Interviews
- Review of questionnaires, record of interviews and consent forms by nutritionist research coordinator and community research assistant.
- Gifts to participants

## **Annex 4: Role of the Community Research Assistant**

### **Knowledge**

- Understand the purpose of the study and benefits to the community, how the participant's privacy will be protected, and how the results will be released, so that you can explain it in simple terms to others.
- Understand the purpose of each question.

### **Interview Skills**

- Take an oath of confidentiality.
- Make appointments with those people assigned to you.
- Ensure that each participant signs a consent form and receives a copy.
- Arrange a time to conduct the interview. (**Note: Provide the option of conducting the interview in the person's home or at another agreed upon location**)
- Make the participant feel comfortable (express interest in them as a person and in the value of their opinions; recognize sensitive questions).
- Be a good listener (listen and accept feelings of self and other person; listen carefully to answers; don't interpret answers. If person is annoyed, upset or very frustrated, ask if you could come back at a better time; give the person time to think).
- Understand how to ask each question (use the exact wording for each question; do not suggest answers or indicate when an answer is suitable; do not react in a negative or positive manner to answers; probe for more information when necessary).
- Act in a professional manner (stay on track; don't gossip, criticize or complain or reveal any information obtained from others; respect a person's privacy)
- Obtain accurate and complete information from each respondent.
- Minimize the number of refusals.

### **Management Skills**

- Keep a record of all interviews.
- Carefully check the questionnaires to ensure that they are complete.
- Complete all of the necessary forms.
- Return questionnaires to the nutrition research coordinator for checking.
- Complete survey within the arranged time period.
- Ensure food models are returned in good condition to the nutrition research coordinator.

**Note:** It is essential that each interviewer follows directions to the best of her/his abilities since differences between interviewers, if too many and too large, may ultimately make the whole project useless and a waste of time. However, it has been shown repeatedly that this type of data, when collected properly, can provide valuable information for those concerned.

Interviewers are responsible persons working for decent wages, but they must also demonstrate rigor and perseverance in what is often a difficult job: It is difficult to question people, and more difficult still to obtain reliable answers. When the interviewer has a special interest in the subject of concern, the work becomes easier and more meaningful.

### **Annex 5: Social, health and lifestyle questionnaire**

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

1. How many persons, including yourself, live in your household now? (i.e., this month) Include children and adults, but not visitors. To live in your household, this means that they have meals and sleep there at least 3 nights per week.

- a. How many are less than 15 yrs of age \_\_\_\_\_
- b. How many are between 15 and 65 \_\_\_\_\_
- c. How many are over 65 \_\_\_\_\_

2. How many persons, including yourself, living in your household are either self-employed or an employee now? (i.e., this month)

- a. Full-time ( $\geq 35$  hours/week) \_\_\_\_\_
- b. Part-time ( $< 35$  hours/week) \_\_\_\_\_

3. What is your main source of income? (circle one)

- a. Wages/salary/self-employment
- b. Pension/seniors benefits
- c. Social assistance
- d. Worker's compensation/employment insurance

4a. How many years of school have you completed? Please don't count partial years, kindergarten or grades repeated \_\_\_\_\_ years

4b. Have you obtained the following diplomas, certificates, or degrees?:

- a. High school diploma YES  NO

- b. GED (high school equivalency) YES  NO  Not applicable
- c. Vocational training certificate YES  NO
- d. CEGEP diploma (Quebec only) YES  NO  Not applicable
- e. Bachelor's degree YES  NO
- f. Master's degree YES  NO
- g. Doctorate degree YES  NO

5. During the past year, did you personally:

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

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

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

7. In the following question, we would like to know how you compare traditional (wild) and market (store-bought) foods:

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

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

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

YES  NO  (if NO, go to Q. 9)

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

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

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

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

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

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

YES  NO  (if NO, go to Q. 10)

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

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

- a. Mining YES  NO  DO NOT KNOW
- b. Forestry YES  NO  DO NOT KNOW
- c. Oil and gas YES  NO  DO NOT KNOW
- d. Hydro YES  NO  DO NOT KNOW
- e. Farming YES  NO  DO NOT KNOW
- f. Government restrictions YES  NO  DO NOT KNOW
- g. Other YES  NO  DO NOT KNOW

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

10b. Are any of the following traditional foods less available because of the above limits?

- a. Moose YES  NO  DO NOT KNOW
- b. Deer YES  NO  DO NOT KNOW
- c. Small mammals YES  NO  DO NOT KNOW
- d. Salmon YES  NO  DO NOT KNOW
- e. Other fish YES  NO  DO NOT KNOW

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

- f. Shellfish YES  NO  DO NOT KNOW
- g. Berries YES  NO  DO NOT KNOW
- h. Other plants YES  NO  DO NOT KNOW

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

- i. Other traditional foods YES  NO  DO NOT KNOW

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

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

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

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

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

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

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

14a. Did you smoke cigarettes yesterday? YES  NO

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

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

- a. pre-diabetes (borderline diabetes) YES  NO
- b. diabetes YES  NO

If yes, circle type if known: Type 1 / Type 2 / unknown

- c. cardiovascular (heart) disease YES  NO
- d. other chronic illness YES  NO

If yes, please specify \_\_\_\_\_



Health  
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Your health and  
safety... our priority.

Votre santé et votre  
sécurité... notre priorité.

# Eating Well with Canada's Food Guide

## First Nations, Inuit and Métis





## How to use Canada's Food Guide

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

### Recommended Number of Food Guide Servings per day

Children 2-3 years old	Children 4-13 years old	Teens and Adults (Females) (Males)	
4	5-6	7-8	7-10

Children 2-3 years old	Children 4-13 years old	Teens and Adults (Females) (Males)	
4	5-6	7-8	7-10

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

### What is one Food Guide Serving?

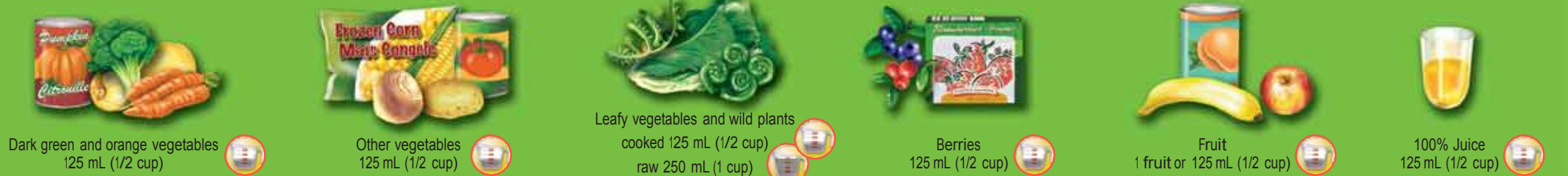
Look at the examples below.

### Eating Well Every Day

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

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

**Eat at least one dark green and one orange vegetable each day. Choose vegetables and fruit prepared with little or no added fat, sugar or salt. Have vegetables and fruit more often than juice.**



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



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



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



**Vegetables and Fruit**  
Fresh, frozen and canned.

**Grain Products**

**Milk and Alternatives**

**Meat and Alternatives**

### When cooking or adding fat to food:

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

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

## Respect your body... Your choices matter

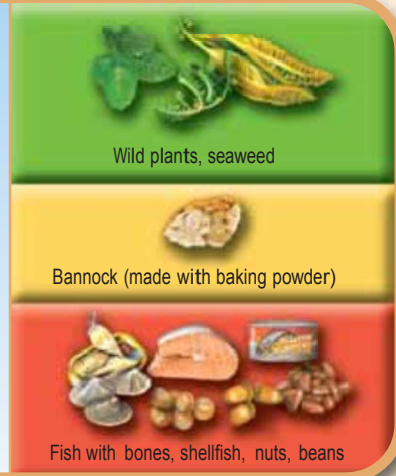
Following Canada's Food Guide and limiting foods and drinks which contain a lot of calories, fat, sugar or salt are important ways to respect your body. Examples of foods and drinks to limit are:

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

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

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

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



## Women of childbearing age

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

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

For example:

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

## Women and men over the age of 50

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

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

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



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

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

or contact: Publications • Health Canada • Ottawa, Ontario K1A 0K9 • E-Mail: [publications@hc-sc.gc.ca](mailto:publications@hc-sc.gc.ca) • Tel.: 1-866-225-0709 • TTY: 1-800-267-1245 • Fax: (613) 941-5366

Également disponible en français sous le titre : Bien manger avec le Guide alimentaire canadien – Premières Nations, Inuit et Métis

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

**Annex 7 :****CERTIFICAT D'APPROBATION DU COMITÉ D'ÉTHIQUE DE LA  
RECHERCHE DE LA FACULTÉ DE MÉDECINE (CERFM)**

Le Comité d'éthique a étudié le projet intitulé :

First Nations Food, Nutrition and Environment Study

Financé par : Santé Canada

présenté par : Dr Olivier Receveur et col.

et considère que la recherche proposée sur des humains est conforme à l'éthique.



Isabelle B-Ganache, présidente

Date de soumission ou d'étude: 22 avri12009

Date d'approbation: Modifié et approuvé le 6 juillet 2009

Numéro de référence: CERFM 103 (09) 4#350

N.B. Veuillez utiliser le numéro de référence dans toute correspondance avec le Comité d'éthique relativement à ce projet.

**OBLIGATIONS DU CHERCHEUR :**

SE CONFORMER À L'ARTICLE 19 DE LA LOI SUR LES SERVICES DE SANTÉ ET SERVICES SOCIAUX, CONCERNANT LA CONFIDENTIALITÉ DES DOSSIERS DE RECHERCHE ET LA TRANSMISSION DE DONNÉES CONFIDENTIELLES EN LIEN AVEC LA RECHERCHE.

SOLLICITER LE CERFM POUR TOUTES MODIFICATIONS ULTÉRIEURES AU PROTOCOLE OU AU FORMULAIRE DE CONSENTEMENT.

TRANSMETTRE IMMÉDIATEMENT AU CERFM TOUT ÉVÉNEMENT INATTENDU OU EFFET INDÉSIRABLE RENCONTRÉ EN COURS DE PROJET.

COMPLÉTER ANNUELLEMENT UN FORMULAIRE DE SUIVI.