DIETARY PATTERNS OF ETHNIC NON-INDIGENOUS POPULATIONS IN NORTHERN BRITISH COLUMBIA: A CROSS-SECTIONAL SURVEY STUDY

by

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Abstract

Dietary transitions and acculturation of different ethnic and immigrant subpopulations in western countries are associated with change in diet patterns and increased obesity risk. Loss of the "healthy immigrant effect" have been observed in such populations, so further research is critical. The study objectives were to a) explore dietary patterns for a sample from various ethnic backgrounds in northern British Columbia, b) examine the association between dietary patterns and healthy body weight status. A cross-sectional survey instrument including a food frequency questionnaire was developed to collect data from 444 participants. Two predominant patterns were identified and termed "western" and "prudent" dietary patterns. There was a positive association between a "western" diet pattern and increased BMI ($p < .05$). Men had higher adherence to "western" diet patterns, and higher risk of overweight and obesity ($p < .05$). Interventions promoting adherence to prudent diet and retention of ethnic food habits are warranted.

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Glossary

Caucasian: It refers to people whose ancestors originate from Europe or Western countries as distinguished from the Indigenous, Eastern and Oriental people

Chinese: It refers mainly to greater china including mainland Hon Kong, China, Taiwan, and Macau.

First Generation Canadian Immigrant: An individual born outside Canada who is a landed immigrant or permanent resident, a non-permanent resident who has a work/study permit, or a refugee claimant

Northern British Columbia (BC): It refers to the northern part of BC province which receives healthcare services through Northern Health Authority. Geographically, this region includes the communities of Altin, Burns Lake, Chetwynd, Dawson Creek, Fort Nelson, Fort St. James, Fort St. John, Haida Gwaii, Hazelton, Houston, Hudson's Hope, Kitimat, Mackenzie, Masset, McBride, Pouce Coupe, Prince Rupert, Prince George, Quesnel, Sandpit, Smithers, Terrace Tumbler Ridge, Valemount, and Vanderhoof

Second Generation Canadian Immigrant: An individual born in Canada and has at least one parent born outside Canada

South Asian: It refers mainly to the Indian subcontinent including Bangladesh, Nepal, Pakistan, India, Sri Lanka, Bhutan, and Maldives

Third Generation Canadian Immigrants: An individual born in Canada, and has both parents born in Canada. One or more grandparents were born outside Canada

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Dietary Patterns of Ethnic Non-Indigenous Populations in Northern British Columbia

Chapter 1: Introduction

Ethnic groups in Canada comprise a noteworthy segment of the population. In 2006, the foreign-born population represented 19.1% of the general Canadian population, and 27.5% of the total British Columbia (BC) population (Statistics Canada, 2008). Immigration to Canada is an important component of the country's economic development policy. It is estimated that Canada receives over 200,000 immigrants annually representing 60% of the annual population growth (Chui, Tran, & Maheux, 2006). According to Statistics Canada (2012), the three most common non-European ethnicities in BC are Indian, Chinese, and Filipino (Figure 1). Ethnic populations in northern BC are further marginalized and more studies are needed to explore their health status and needs (Sarkar, Chau, Lix, Bruce, & Young, 2010). Health disparities associated with ethnic minorities are attributed to several factors such as cultural & linguistic barriers and lower socio-economic status, which may contribute to unhealthy eating habits (Lai & Chau, 2007). This research study explored the current dietary patterns of ethnic populations in northern BC.

Diet plays a significant role in the development of obesity and obesity-related chronic diseases such as type 2 diabetes (T2D), metabolic syndrome (MetS), atherosclerosis, hypertension, and cardio-vascular disease (CVD) (Remington & Brownson, 2011). High energy diet and physical inactivity are the main determinants of the global obesity epidemic phenomenon, most notably in western industrialized countries (Kimokoti & Millen, 2011; World Health Organization, 2003). In Canada, obesity rates have tripled between 1985 and 2011 (Twells, Gregory, Reddigan, & Midodzi, 2014). Currently, it is estimated that approximately 27% of the adult Canadian population suffer from obesity (Public Health

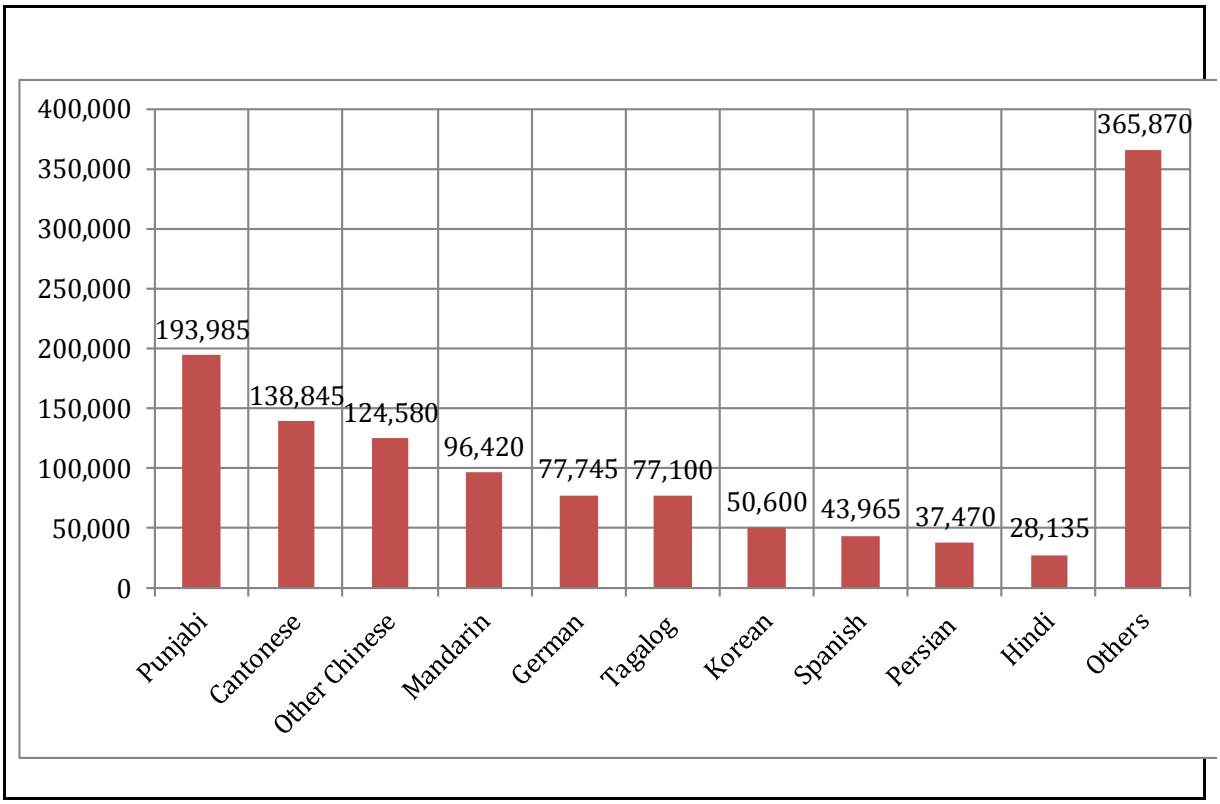

Figure1. Number of non-official mother tongue population in British Columbia in 2011 (Statistics Canada, 2012).

Agency of Canada, 2015). Furthermore, it is predicted that, by 2019, half of the Canadian provinces will have more overweight or obese adults than normal-weight adults with an alarming disproportionate increase in excessive obesity rates (Twells, et al., 2014).

In North America and Europe, immigrants have higher morbidity and mortality rates due to nutrition related diseases compared to the mainstream population, as well as the population of their native country despite the "healthy immigrant effect" that places recent immigrants at a better health status than that of average population in the host country (Gilbert & Khokhar, 2008; Satia et al., 2001). In Canada, candidates for immigration have to pass medical tests to screen out those who have significant health problems. However, there is abundant evidence in the literature that attribute both the loss of the "healthy immigrant effect" and the paradoxical adverse health outcomes of Canadian immigrants to transitions in

dietary habits (Sanou et al., 2014). More details about the dietary acculturation associated with immigration to a western country and more specifically to Canada are discussed in chapter two.

There is also an important evidence that area of origin plays a significant role in the healthfulness of dietary intake for ethnic groups. For example, some traditional diet patterns are considered to be heart healthy, such as the Mediterranean diet (Trichopoulou & Lagiou, 1997), whereas other traditional diet patterns are associated with an increased risk of MetS, such as the Mexican diet (Denova-Gutierrez et al., 2010). Traditional Indian diets are high in grains, fruits and vegetables, and low in meat and meat products (Varghese & Moore-Orr, 2002). Furthermore, traditional Chinese diets are high in fiber and carbohydrates (e.g., rice and noodles), and low in fat (Gilbert & Khokhar, 2008). Both traditional Indian and Chinese diets are considered healthier than western diet (Gilbert & Khokhar, 2008; Varghese & Moore-Orr, 2002). Further details on ethnic diet characteristics, associated dietary behaviors, and food beliefs that are relevant to this study are further discussed in chapter two.

The Western diet pattern (WDP) is considered as one of the less healthy diets, which includes whole fat dairy products, processed meat, processed food, high intake of energy rich foods and junk food (i.e., food containing high levels of calories or fat with little nutritional value such as candy and carbonated beverage), red meat, and refined sugars (Cordain et al., 2005). Some think further epidemiological research on the increasing incidence of coronary heart disease and certain types of cancer amongst populations adopting WDP is needed (Jemal, Center, DeSantis, & Ward, 2010; Yusuf, Redyy, Ounpuu, & Anand, 2001). For example, incidence and mortality rates of breast cancer in the U.S. and many other European countries are on average five times the rates in Africa, Asia, and South America (Jemal et al.,

2010). More interestingly, the researchers found the rates amongst U.S. Hispanics and Asians to be significantly higher compared to the rates in Latin America and Asia, respectively. Another study found out that the combined obesity and overweight rates amongst Filipino women living in the US have almost doubled compared to women living in the Philippines (Vargas & Jurado, 2016).

Healthy diet is an important pillar for wellbeing. It supports normal growth and development throughout different stages of life, promotes healthy body weight, and reduces chronic disease risks (Rogol, Clark, & Roemmich, 2000). Analysis of a single or few nutrients or foods in relation to a disease has been traditionally used in nutritional epidemiological studies (Tucker, 2010). However, such a method of analysis has several limitations including the inability to account for in-vivo chemical interaction between different nutrients and the failure to eliminate confounders associated with dietary patterns when performing "single" nutrient analysis (Hu, 2002). Dietary patterns are defined as "measures of the total usual intake of food combinations in individuals and groups" (Tucker, 2010, p. 212). The "dietary pattern" analysis is a holistic approach to determine the dietary habits and characteristics of food and nutrient intake. Recently, many authors have suggested to study the overall dietary patterns instead of a "single" nutrient analysis (Jones-McLean, Shatenstein, & Whiting, 2010; Quatromoni et al., 2002). Furthermore, some researchers ascertain the feasibility of introducing healthy "dietary patterns" as a successful new approach of nutrition intervention to chronic disease prevention and control, such as the DASH (Dietary Approach to Stop Hypertension) study and the Lyon Diet Heart Study (Hu, 2002). Dietary patterns are mainly identified through multivariate analysis techniques such as principal component analysis (PCA) and cluster analysis (Hu, 2002). In this study, PCA was

utilized to analyze average monthly frequency of food consumption. Information on food and nutrient intake, dietary acculturation, and general health and lifestyle of ethnic subpopulations was collected. Body weight status and risk factors for chronic disease were the main outcome measures. Further details about methods of data collection and analysis are discussed in chapter three.

1.1 Rationale of the Study

The increasing epidemic prevalence of "diseases of modernization" such as type 2 diabetes, high blood pressure, and cardiovascular disease is already being observed amongst northern rural and remote populations, particularly amongst low-income ethnic minority populations when compared to Caucasian, urban and higher socio-economic status population counterparts in northern BC (Hill, Chau, Luebbering, Koivras, & Zoellner, 2012; Sarkar et al., 2010). Although the literature shows some evidence that the pattern of dietary changes for ethnic groups differs from one country to another, and even from one region to another, only few studies were conducted in Canada to assess the dietary patterns of ethnic groups; and none of these studies were conducted in northern communities where there are knowledge gaps as to food patterns and lifestyle of ethnic populations.

1.2 The Purpose of the Study

The primary objective of this quantitative epidemiological study is to explore the dietary patterns of ethnic non-Indigenous populations in northern BC. This quantitative study included administering surveys to a convenience and snowballing sample to identify the dietary intake characteristics for such populations, and the healthy versus unhealthy patterns of their diet. In this community-based study, development of survey instrument and data collection was supported by key individuals and community leaders who played

significant role in raising the sense of ownership to the research project within the community. Key individuals in each ethnic community were key to assist in the recruitment of other members of each ethnic group, and also for gaining the trust and support of other possible participants in their community at large.

In this study, the following were the main objectives of the study:

- To identify the characteristics of food & nutrient intake, and dietary pattern structure for the overall study sample based on responses to the semi-quantitative food frequency questionnaire. This objective is explored using principal components analysis (PCA).
- To examine the influence of sociodemographic variables on the dietary behaviour of the study sample, and to test whether there are any gender differences regarding body weight status.
- To examine the relationship between dietary patterns of the study sample and body mass index (BMI) used as a measure of healthy body weight status after controlling for sociodemographic confounders which include age, gender, education, income, and marital status. The purpose of this objective is test dietary patterns as predictors for BMI using multiple regression model.
- To provide recommendations for ethnically appropriate public health promotion strategies through tailoring dietary interventions and nutritional education programs to promote healthy body weight and reduce the risk of obesity related chronic diseases.

Chapter 2: Literature Review

Recently, there has been great emphasis on studying the overall dietary patterns rather than individual nutrients when examining chronic disease epidemiology in relation to diet through (Tucker, 2010). Conceptually, there are two main approaches to derive dietary patterns in nutritional epidemiology depending on whether the study is being driven by a specific dietary guideline (i.e., hypothesis oriented) or exploratory in nature (Schulze & Hoffmann, 2006). In hypothesis-oriented approach, dietary indices or scores following specific pre-determined dietary guidelines are used to assess the degree to which an individual or a group of individuals adhere to the recommended dietary pattern (Désilets, Rivard, Shatenstein, & Delisle, 2007). For example, the Healthy Eating Index (HEI) is used as a measure to assess the degree to which the food consumed by an individual adheres to the recommendations of the US Department of Agriculture Food Guide Pyramid and the recommendations in the US Dietary Guidelines for Americans (Hu 2002; Kennedy, Ohls, Carlson, & Fleming, 1995; U.S. Department of Agriculture, 1992). There have been previous modifications to the 1995, 2005, and 2010 versions of the HEI to develop Canadian adaptations of the measure following Canada's Food Guide recommendations, known as Health Eating Index-Canada (HEI-C) (Jessri, Ng, & L'Abbe, 2017). In exploratory approach, existing dietary patterns are derived empirically from the available data without any guiding hypothesis (Schulze & Hoffmann, 2006). This is applied using exploratory analysis methods such as PCA and factor analysis, or cluster analysis. Cluster analysis is only preferred in case of planning nutritional intervention targeted to specific subgroups of the population (Tucker, 2010). On the other side, PCA has higher power when comparing linear variables with health outcomes, relative to multiple subgroups generated by cluster analysis (Tucker, 2010).

Exploratory PCA and factor analysis are considered as multivariate data reduction methods that produce components or factors, which account for the largest amount of variation in consumed food amongst individuals (Schulze & Hoffmann, 2006). The significant principal components or factors can produce component scores or factor scores, which could be used in multiple regression analysis to investigate the relationship between dietary patterns and health outcomes (Tabachnick & Fidell, 2013). PCA is more commonly used to identify dietary patterns because principal components scores represent mathematical transformation of the observed variables, whereas factor scores are only estimates of where each individual stand on the unobservable factor (Hu, 2002).

To identify dietary patterns, Information on food consumption could be obtained through various data collection tools such as diet records, multiple 24-h recalls, and food frequency questionnaires (FFQ) (Jones-McLean et al., 2010). Although all of these data collection methods have been previously used in different dietary analysis studies, FFQ has advantage over other methods because it takes into account that consumed food changes from one day to another. Thus, it produces a better representation of the long term dietary pattern rather than pattern of a single day diet (Tucker, 2010). Furthermore, FFQ is considered as a cost-effective method for assessing dietary intake over a period of time in any given population (Quatromoni et al., 2002). Further details about methods used for data collection and analysis are discussed in chapter three.

In a review of the literature, few dietary patterns were repeatedly identified during dietary pattern analysis. Most of the studies originating from North America and Europe that focused on the Caucasian populations has identified two main dietary patterns, namely "prudent" healthy and "western" unhealthy pattern (Kant, 2004). The prudent diet pattern is

rich in vegetables, fruits, legumes, whole grains, and fish, while the western diet pattern is rich in red meat, processed meat, refined grains, potatoes, and high-fat dairy products (Hu et al, 2000). Another important heart healthy diet pattern identified in the literature is the Mediterranean diet pattern, which is rich in vegetables, fruits, olive oil, nuts, and fish (Whayne, 2014). The Mediterranean diet pattern proved to be superior to other diet patterns regarding its health benefits as there is epidemiological evidence on the cardiovascular protective effect of the Mediterranean diet pattern (Enas, Senthilkumar, Chennikkara, & Bjurlin, 2003), which has been previously concluded through multiple studies including the randomized trials performed in the Lyon Diet Heart Study (de Lorgeril et al., 1999) and the PREDIMED study (Sala-Villa et al., 2014 & Toledo et al., 2013). Despite the fact that Mediterranean diet have deep roots in the south European region, further focus on the Mediterranean diet is warranted due to the study inclusion of significant number of ethnic participants from different regions that adopt Mediterranean or Mediterranean like diets including North Africa, Middle east, and western Asia (Altomare et al., 2013). Add to that, the promising prospect of using this healthy dietary pattern in nutritional interventions to high risk groups in North America.

Beyond North America and Europe, several traditional ethnic diet patterns have been identified in the literature. For example, the tradition Korean pattern, which is rich in anchovies, Soybean, and Kimchi sea (Yang et al., 2005), the traditional Latin American pattern, which is rich in bean and rice (Marchioni et al., 2005), and the Chinese diet pattern which is rich in vegetables, soy, and fish (Nettleton et al., 2006). In my review of the literature, there will be further focus on the characteristics of the traditional diets for the two

largest ethnic subpopulations in northern BC, namely the traditional Chinese and south Asian diets.

2.1 Dietary Acculturation

Acculturation is referred to as a mechanism by which various groups and individuals adapt to the norms, values and beliefs of a host culture while having the freedom to adhere to the original ethnic cultural norms and values (Broesch & Hadley, 2012). More specifically, dietary acculturation is determined by "the relationship between the uptake of 'new' non-traditional foods common in host culture, and the use of traditional food items" (Khamis, 1996, p. 46). Dietary acculturation and adoption of nutritional practices and diet similar to the host is closely related to the length of residence in the host country, which is considered as a marker of dietary acculturation. Sanou and colleagues found the duration of stay in Canada to be the primary measure of acculturation in most of the studies that investigated dietary habits of immigrants. Other significant measures of acculturation included country of origin, age at arrival to Canada, and official language proficiency Sanou et al., (2014).

Recently, there has been an increased attention to the effect of acculturation on diet and health in minority groups (Ngo, Gurinovic, Anderson, & Majem, 2009). According to a recent Scopus review by Gilbert and Khokhar (2008), dietary habits of ethnic communities in Europe shift towards unhealthy patterns due to increased consumption of processed foods (e.g., processed meat, sweetened breakfast cereal), which are high in sugar and fat, rather than healthy diet (e.g., fruits, vegetables). This shift results in predisposition to obesity-related morbidities due to increased fat, sugar, and salt intake (Ngo et al., 2009). These findings are consistent with the association between the increasing prevalence of obesity among Canadian immigrants and the longer duration of stay in Canada (Wahi, Boyle,

Morrison, & Georgiades, 2014). However, there seems to be lack of consensus in the literature regarding the risk of obesity amongst South Asian children in the UK relative to Caucasians (El-Sayed, Scarborough, & Galea, 2011).

2.2. Review of Major Dietary Patterns in Literature

2.2.1 Mediterranean Diet

Furthermore, the literature shows some evidence that more acculturated immigrants (e.g., those who have longer durations of stay in a western host country) have mixed food habits where some healthy dietary habits such as vegetables and fruit consumption are replaced by unhealthy dietary habits such as fast foods consumption (Vargas & Jurado, 2016); This is explained by the adoption of more westernized lifestyle, including western dietary pattern, associated with acculturation of immigrants (Davis et al., 2013; Ghaddar, Brown, Pagan, & Diaz, 2010; Landman & Cruickshank, 2001).

Dietary acculturation amongst ethnic groups is mainly influenced by food availability, socio-economic status, and cultural factors (Ottesen & Wandel, 2012; Satia, Patterson, Neuhouser, & Elder, 2002; Shatenstein, & Ghadirian, 1998). Some researchers attribute dietary changes to the unavailability of traditional cooking equipment or ingredients, and the availability of fast food outlets in the host countries, especially in rural environments (Dunn, Sharkey, & Horel, 2012; Varghese & Moore-Orr, 2002). Other researchers indicate that altered meal pattern is a key factor in changing ethnic dietary pattern (Garduño-Diaz & Khokhar, 2013).

A recent study about the dietary patterns of Indian immigrants in Newfoundland revealed that some of the traditional dietary habits were abandoned (Varghese & Moore-Orr, 2002). There was also a trend of increased fat and energy intake, reduction of carbohydrates,

switch from whole grains into more refined sources of carbohydrates, and increased intake of meat and dairy products. These dietary changes were consistent with results from other studies of south Asian immigrants in Europe (Gilbert & Khokhar, 2008; Ottesen & Wandel, 2012). A study conducted in United Kingdom (UK) to identify dietary patterns of South Asian ethnic population revealed that dietary acculturation was associated with significant changes in the ethnic food habits of immigrants who resided in the host country for longer periods of time (Garduño-Diaz & Khokhar, 2013). These changes included lower proportion of immigrants abstaining from meat consumption (i.e., less number of vegetarians), change in eating habits by having two meals per day instead of the traditional three meals per day pattern, and increased intake of caffeinated drinks. Such changes were associated with higher predisposition of type 2 diabetes (T2D) and Metabolic Syndrome (MetS) among South Asian individuals in the UK who shifted to a WDP, when compared to recent South Asian immigrants or the populations in their respective native countries.

A study by Lesser, Gasevic & Lear (2014) revealed that the dietary behaviour of South Asian immigrants in Canada is largely affected by dietary acculturation. In this study, there has been an indication regarding the shift into healthier methods of food preparation (e.g., stir-frying and grilling instead of deep frying), and higher intake of vegetables and fruits. However, there was also an indication of unhealthy food habits including increased consumption of convenience foods, sugar-sweetened beverages, red meat, and increased dinning out instead of home meals; which increased the risk of T2D and cardiovascular disease (CVD) in South Asian immigrants. Satia et al. (2001) found that western dietary acculturation of Chinese women who resided in Vancouver BC, and Seattle WA, was associated with higher intake of fatty and junk foods. The study also revealed an important

association between dietary acculturation and certain socio-demographic characteristics such as young age, high education, employment, and longer residence in North America. Another study revealed that longer length of residence (i.e., number of years lived in the host country) among Chinese immigrants is associated with an increased intake of juice, soft drinks, and chips (Rosenmoller, Gasevic, Sidell, & Lear, 2011).

The Mediterranean diet is considered as a heart-healthy dietary pattern when compared to other traditional diets (Panagiotakos, Polystipioti, Papairakleous, & Polychronopoulos, 2007). This Traditional Mediterranean diet is rich in vegetables, fruits, nuts, healthy plant fats (i.e., extra virgin olive oil), cereals and grains, with high legume consumption. It is also characterized by moderate intake of fish and dairy products, and low intake of sugary food products, red and processed meats, and dairy products as shown (Whayne, 2014). Figure 2 shows the Mediterranean diet pyramid.

A systematic review by Garcia-Fernandez et al., (2014) provided strong evidence that Mediterranean diet pattern is associated with reduced risk of cardio-diabetic morbidity and mortality. The Mediterranean diet has plenty of physical and mental health benefits, and regular exercise is an essential component of a Mediterranean life style (Henrique-Sanchez et al., 2012). In a study performed in the United States (USA), there was also strong evidence that linked the adherence to a Mediterranean diet with reduction in risk of death from all causes (Mitrou et al., 2007). The beneficial protective effects of Mediterranean diet extend to other non-communicable diseases including cancer, Parkinson's disease, Alzheimer's disease, and gout disease (Perona et al. 2010; Whayne, 2014).

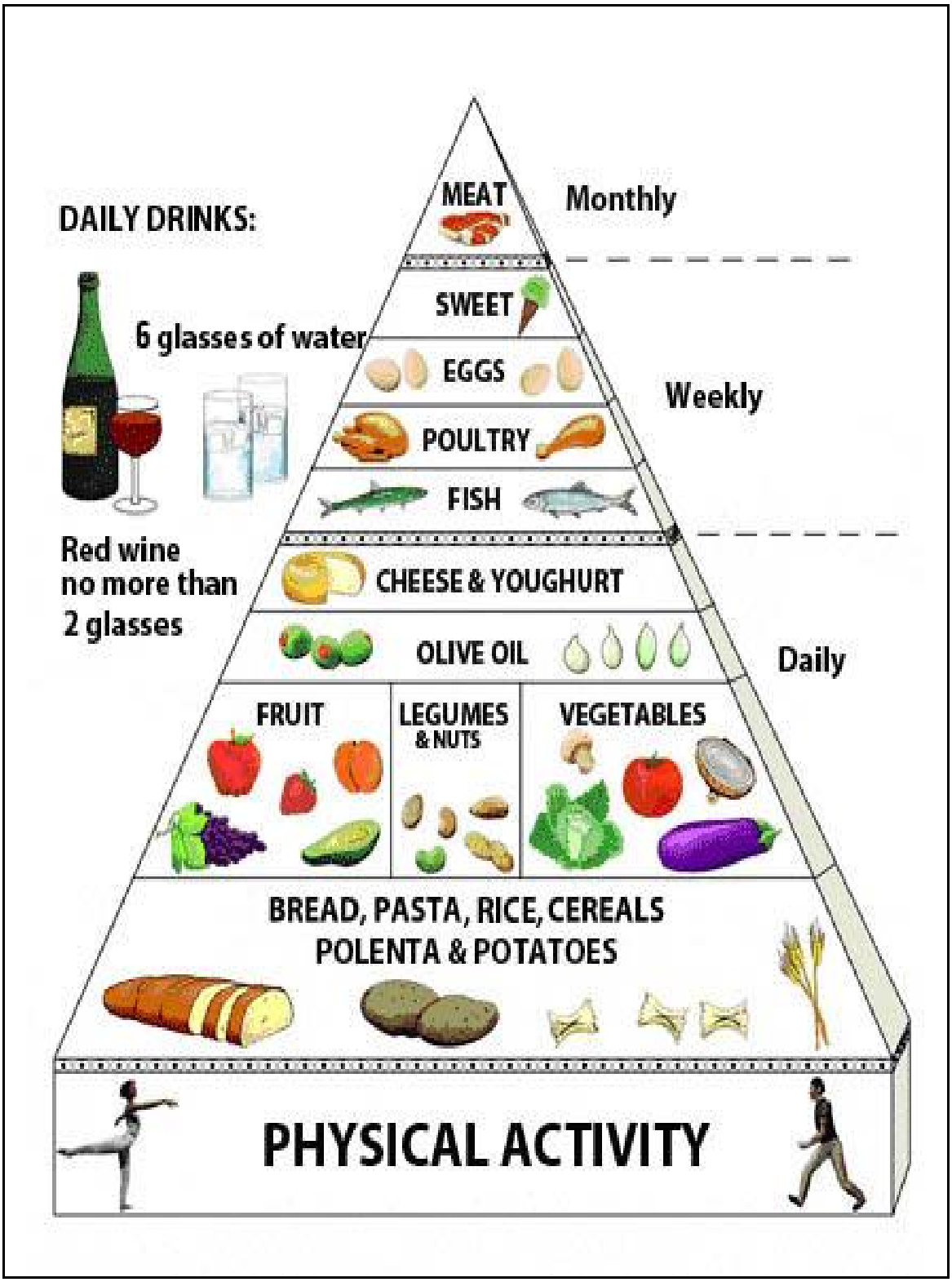

Figure 2. Mediterranean diet pyramid

My review of the literature also revealed an interesting finding regarding the positive effect of Mediterranean diet on health amongst specific migrant groups in France despite their limited access to primary health care services (Darmon & Khlat, 2001). The authors attributed the paradoxical lower rates of chronic diseases and higher life expectancy amongst North African and South European migrants when compared to the local French born, to the Mediterranean dietary pattern of these groups. Their food habits consisted mainly of high consumption of fruits, vegetables, and starchy products and lower consumption of alcohol. However, such positive effects are hypothesized to be lost within the second generation of migrants due to dietary acculturation and adoption of different dietary pattern similar to the local population (Darmon & Khlat, 2001).

2.2.1.1 Review of Studies: Mediterranean Diet and Cardiovascular Disease

In a multi-center, randomized controlled trial (RCT) known as the PREDIMED trial; participants with high cardio-vascular risk were assigned to either one of two intervention groups, Mediterranean diet supplemented with extra-virgin olive oil group, and Mediterranean diet supplemented with mixed nuts group, or a low fat diet control group. The results of the study suggested a causal association between a Mediterranean-type diet supplemented with extra-virgin olive oil or mixed nuts and the reduction in independent cardiovascular risk factors, which include blood pressure, plasma lipid levels, and carotid atherosclerosis (Buil-cosiales et al., 2008; Estruch et al., 2006; Sala-Villa et al., 2014 & Toledo et al., 2013). There has also been a similar relationship between Mediterranean diet and the prevention of major cardio-vascular events (i.e., stroke, myocardial infarction, and cardiovascular mortality) by reducing the incidence of such events by approximately 30% (Estruch et al., 2013; Panagiotakos, 2014; Ros et al., 2014). Furthermore, Damasceno et al.

(2013) asserted that consumption of a Mediterranean diet enriched with nuts plays a cardiovascular protective role through shifting lipoprotein sub-fractions to a less atherogenic pattern. Tresserra-Rimbau et al. (2014) revealed an association between greater intake of polyphenols, rich in vegetables and fruits in Mediterranean diet, and decreased cardiovascular risk.

Martínez-González et al. (2014) suggested that the anti-oxidant and anti-inflammatory effect of extra-virgin olive oil, in the context of Mediterranean dietary pattern, may play a significant role in reducing the risk of atrial fibrillation. Furthermore, a case-control study by Mattioli et al., (2013) revealed that patients with atrial fibrillation who had better adherence to Mediterranean diet were more likely to experience a better outcome through spontaneous conversion of atrial fibrillation.

2.2.1.2 Review of Studies: Mediterranean diet and Type 2 Diabetes

The literature review revealed inconsistent results regarding the role of a Mediterranean diet in reducing the incidence of type 2 diabetes (T2D). Some researchers assert that Mediterranean diet plays a significant role in the primary prevention of type 2 diabetes (T2D). An extensive meta-analysis that included 136,846 participants revealed that adherence to the Mediterranean diet was associated with 23% reduced risk of developing type 2 Diabetes (T2D) (Koloverou, Esposito, Giugliano, & Panagiotakos, 2014). Furthermore, a secondary analysis in a subgroup of the PREDIMED trial revealed that Mediterranean diet supplemented with extra virgin olive significantly reduced the risk of type 2 diabetes (T2D) in individuals with high cardiovascular risk (Salas-Salvadó et al., 2014). However, the Multi-Ethnic Study of Atherosclerosis (MESA) found no association

between adherence to the Mediterranean diet and incidence of diabetes despite the reported lower insulin levels among non-diabetics (Abiemo et al., 2013).

In patients with type 2 diabetes, consumption of Mediterranean diet has a significant role in management and control of the disease, with better prognosis and less complications. Esposito et al. (2014) revealed an association between adherence to Mediterranean diet and reduced HbA1c level, lower rate of diabetes remissions, and lower need for diabetic medications. Furthermore, Ceriello et al. (2014) concluded that a Mediterranean diet, using olive oil, prevents the acute hyperglycemia effect on the endothelial functions in T2D patients, which reduces the risk of CVD in such patients.

2.2.1.3 Review of Studies: Mediterranean diet and Metabolic Syndrome

Several epidemiological studies investigated the association between adherence to Mediterranean diet and the reduced risk of incidence of MetS. Babio, Bullo, & Salas-Salvado, (2009) asserted that consumption of Mediterranean diet is associated with reduced risk of the individual components of MetS. The ATTICA study utilized a cross-sectional survey to collect data about the dietary patterns of 2282 subjects in Greece. The results showed that adoption of Mediterranean diet was associated with 20% lower odds of having metabolic syndrome (Panagiotakos et al., 2004). In the SUN prospective cohort study, 3,497 participants were followed up after six years for adherence to Mediterranean diet, waist circumference, blood pressure, plasma glucose level, HDL cholesterol level, and triglycerides (Tortosa et al., 2007). The authors concluded the presence of an inverse relationship between adherence to Mediterranean diet and the cumulative incidence of the MetS.

The dietary intervention study by Esposito et al., (2004) revealed that following a Mediterranean diet for patients with MetS resulted in 51% net risk reduction of having the

disease, when compared to patients with MetS who followed a prudent diet. Many other recent clinical trials provided clear evidence about the beneficial role of Mediterranean-style diet in the management and reversion of metabolic syndrome (Babio et al., 2014; Salas-Salvado et al., 2008). Those findings have been explained by the reduction in oxidative damage of lipids and DNA, and the anti-inflammatory property of this dietary pattern (Esposito et al., 2004; Mitjavila et al., 2013).

2.2.2 South Asian Diet

Traditional South Asian diet is characterized by high intake of vegetables and fruits, and is also rich in cereals, legumes, and spices. It consists of low intake of meat, and low to moderate intake of fat with relatively high intake of saturated fat due to the widespread use of hydrogenated oils in South Asian cooking (i.e., Vanaspati). Some of the traditional patterns of food preparation for traditional South Asian diet include unhealthy food preparation practices such as deep frying. Although traditional South Asian diet is considered healthier diet when compared to western diet style, South Asian populations are at high risk of dyslipidemia, type 2 diabetes, cardiovascular disease, and metabolic syndrome (Vuksan et al., 2012) due to high intake of saturated fat and salt (Lesser et al., 2014).

Misra, Khurana, Isharwal, and Bhardwaj (2009) attributed the higher susceptibility to develop insulin resistance and MetS amongst Asian Indians and South Asians to dietary nutrients rather than a genetic role; Low intake of multi-unsaturated fatty acids (MUFA), and high intake of saturated fats, trans-fatty acids, and carbohydrate in traditional Indian diets result in several nutritional imbalances that are associated with higher prevalence of dyslipidemia and insulin resistance in South Asian ethnicity. Furthermore, the risk of such diseases increases significantly for South Asian immigrants when adopting mixed food habits

with higher intake of sugar and fat (Gilbert & Khokhar, 2008). According to the Southhall study by McKeigue & Shah (1991), the prevalence of type 2 diabetes among South Asian immigrants was four times that of their Caucasian counterparts in London, UK (20% vs. 5%) despite matching for age and BMI. Furthermore, UK Indian Asians were at higher risk of CVD and Metabolic Syndrome MetS when compared to the mainstream Caucasian population; including higher glucose and insulin levels, lower HDL cholesterol level, higher systolic blood pressure, and higher waist to hip ratio (Cleland & Sattar, 2004).

2.2.3 Chinese Diet

The traditional Chinese diet pattern is characterized by high consumption of rice, noodles, coarse grains, fresh vegetables, fruit, fish, shrimp, and beans. The ingredients and cooking style of traditional Chinese diet vary from one region to another (Gilbert & Khokhar, 2008). To illustrate, dietary intake in northern China is high in wheat, wheat products, and maize known as the "yellow earth" or "traditional northern" pattern, whereas dietary intake in southern China is high in rice, vegetables, and seafood known as the "green water" or "traditional southern" pattern (Batis et al., 2014). Dietary intake of Chinese populations is greatly influenced by food beliefs and the yin/yang belief system of traditional Chinese Medicine (TCM). According to this belief system, health is dependent on a balance of intake between cold foods (yin) such as honey and yogurt, and hot foods (Yang) such as ginger (Lee & Shen, 2008). The literature shows that traditional Chinese diet pattern is associated with various health benefits. A study by Shu et al. (2015) revealed that traditional Chinese diet pattern is inversely associated with BMI and waist circumference in both genders. Furthermore, a recent cross sectional study investigated the association between traditional Chinese diet pattern and impaired fasting glucose (i.e., prediabetes) concluded that increased

consumption of vegetables, fruit, and cereals in traditional Chinese diet reduces the risk of development of type 2 diabetes (Zhang et al., 2015).

Chapter 3: Design and Methods

A cross-sectional survey design was used as quantitative method for data collection. The study received UNBC Research Ethics Board approval for a period of 12 months on March 1, 2016 (Appendix D), and then later extended for another year. A renewal approval for another 12 months period was received on February 28, 2017. The study collected primary data on food consumption patterns for ethnic populations in northern BC through administration of a paper-and-pencil survey instrument (i.e., food frequency questionnaire). This approach intended to allow the researcher to gain knowledge about the diet behavior & food habits, life style, and health status of multi-ethnic adult population in northern BC, and also to explore factors that influence their dietary patterns. Multivariate statistical techniques were employed to explore dietary patterns using principal component analysis (PCA). The researcher was also interested in identifying relationship between dietary components and healthy body weight status, as assessed by body mass index (BMI) [BMI=weight(kg)/height(m^2)], using multiple regression analysis technique.

3.1 Recruitment Strategy

Participants from different non-Indigenous and non-Caucasian ethnic minorities in Northern BC were recruited to participate in the study. Partnerships were established with potential community stakeholders including Immigrant & Multi-Cultural Service Society (IMSS), Prince George Islamic Centre (PGIC), Prince George Tennis Club (PGTC), Northern Undergraduate Student Society (NUGSS), Northern British Columbia Graduate Student Society (NBCGSS), Gurugobind Singh Temple Association, and Gurudwara Sahib Guru Nanak Darbar Sikh Temple, Local Hindu Community. Research posters were attached to bulletin boards at UNBC, IMSS, and PGIC to recruit potential participants.

The researcher conducted a series of research recruitment events in collaboration with stakeholders between March 2016 and March 2017. UNBC research recruitment dinner event was held on March 19, 2016. Electronic recruitment invitations were sent out by email to UNBC graduate students and other community members from different ethnic minorities for this event. Social media was also used to recruit participants from UNBC and the local community (i.e., facebook event). Also, the researcher held a daily research booth for data collection at UNBC winter garden over a three-week period extending between end of March 2016 and mid April 2016.

The Immigrant Multicultural Service Society (IMSS) is a non-profit organization that provides a multitude of programs and services to new comers to Canada, recent immigrants & temporary foreign workers, who reside in northern BC. These programs and services include free English classes, settlement programs, and specific programs for youth and women. The overall goal of the organization is to create more welcoming and inclusive communities for immigrants through successful settlement and integration (IMSS, 2015). The researcher recruited current and previous IMSS clients through collaboration with the organization. Free information session for immigrants regarding healthy eating habits was organized on April 26, 2016 parallel to a research recruitment event. The information session was specifically conducted after data collection to avoid introducing any bias into participant responses.

The researcher carried out a research recruitment event during Holi celebration of light organized by local Hindu community in Prince George on April 2, 2016. The researcher provided a brief verbal recruitment message to all attendees to facilitate participation. All attendees were given an option to send the completed survey though pre-

paid stamped envelope to facilitate recruitment. The researcher conducted another research recruitment event during the Vaisakhi Celebration organized by Gurudwara Sahib Guru Nanak Darbar Sikh Temple on May 21, 2016. A similar event was conducted at the Gurugobind Singh Temple on March 26, 2017. Multiple small recruitment events were conducted at the Prince George Islamic Centre (PGIC) during the summer of 2016. The researcher directly recruited some members of the Prince George tennis club during the summer season of 2016. Lastly, two organized research recruitment events were carried out at Lheidli T'enneh Memorial Park on May 7 and May 14, 2016. Both event included participants with Arabic, Korean, and Caribbean heritage.

Participants were entered into a draw to win a monetary prize (i.e., iPad tablet and two fitbit trackers) to facilitate recruitment. Funding for those monetary prizes was secured through a graduate UNBC Research Project Award (RPA). A draw for prizes was conducted on March 29, 2017 to select three recipients, amongst all research participants. The researcher privately informed the winners to maintain their privacy and confidentiality. The initial three drawn participants claimed their prizes within the pre-specified 10 days period in the research proposal. No subsequent draws were required for this purpose.

3.1.1 Sample Size and Sampling Method

The survey instrument was administrated via paper and pencil method to 444 participants above 19 years of age or older from both genders. The estimated sample size of this study was determined a priori to need to be somewhere between 400-500 participants. The rationale behind sample size is to have optimal statistical power to identify statistically and clinically significant effects, especially for Principal Component Analysis of dietary intake variables. Further, Suresh & Chandrashekara (2012) indicates that “Descriptive

studies need hundreds of subjects to give acceptable confidence interval for small effects" p. 8.

Participants were recruited to this study using convenience sampling technique through approaching ethnic groups in northern BC. A snowball sampling technique was utilized as a sub-method of convenience sampling. Snowball sampling was very effective in recruiting large number of participants to the study. The initial group of participants acted as the "seeds" to recruit other eligible participants in subsequent waves. This has been seen largely during the research booth event held at UNBC. Some of the initial participants in the UNBC research dinner event were advocates for this study and recruited potential participants in their social cycle. Key individuals and community leaders in different ethnic groups were also identified as "seeds" to recruit other members within their ethnic communities. Multiple waves of snowball sampling were very effective in recruiting the targeted sample size (U.S. Geological Survey, 2015). Respondent-driven sampling, a modified form of snowball sampling was used to weight the sample and target specific population demographic. The intent for using this technique was to partially compensate for lack of random sampling and to recruit a more diversified sample (Abdul-Quader et al., 2008). Peers are considered more effective than researchers in locating and recruiting other individuals from a "less accessible" population such as ethnic population. Snowball sampling is an excellent method in recruiting individuals from unknown populations that have not been previously identified and are more difficult to contact. It provides a great opportunity for better understanding and complete characterization of unknown populations as well as being quick and cost-effective sampling method (U.S. Geological Survey, 2015). In a pilot study for recruiting drug users in New York City, Abdul-Quader et al. (2008) managed to recruit

618 participants in 13 weeks, beginning with only eight seeds. In my study, I managed to recruit 277 participants in 15 weeks using convenience and snowball sampling techniques. The rest of the sample was mainly recruited following respondent-driven sampling and later waves of snowball sampling until targeted sample size was reached. In this study, inclusion criteria included ethnic, non-Indigenous, and non-Caucasian adults living in northern BC who are 19 years of age and older. Exclusion criteria included participants being on special diet due to health or medical reasons (i.e., kidney failure andceliac disease), or participants residing outside northern BC.

3.1.2. Response Rate

There were 745 delivered paper-based surveys with 444 being returned. The number of participants recruited from different events is displayed in table 1. Despite survey length, there was approximately 59% response rate. Factors that might have helped to maximize response rate include providing participants with information about the purpose/importance of the study and the scarce research addressing health implications of dietary transitions in ethnic minorities in specific, and health status of immigrants and ethnic groups in general, especially in northern BC context. Also, the researcher offered collecting completed surveys through different venues including offering pre-paid stamped mail envelops, collecting completed surveys at the researcher's UNBC office, collecting surveys at the UNBC research booth, and personally collecting completed surveys. Offering financial incentives for a prize could be another factor in increasing response rate. Further, development of an effective recruitment plan was a key for high level of participation in this study.

Table 1

Recruitment Event Date and Number of Participants

Event	Date	Number of Participants
UNBC Research Recruitment Dinner Event	March 19, 2016	85
UNBC Research Recruitment Booth	From March 22, 2016 To April 11, 2016	103
Holi Celebration Research Recruitment Event	April 2, 2016	14
IMSS Research Recruitment Luncheon Event	April 26, 2016	42
Lheidli T'enneh Memorial Park First Research Recruitment Event	May 7, 2016	12
Lheidli T'enneh Memorial Park Second Research Recruitment Event	May 15, 2016	27
Vaisakhi Celebration Research Recruitment Event	May 21, 2016	14
Prince George Islamic Centre Multiple Research Recruitment Events	Summer 2016	24
Gurugobind Singh Temple Research Recruitment Event	March 26, 2017	15

3.2. Data Collection

Data were collected on food consumption patterns (i.e., semi-quantitative FFQ), measures of dietary acculturation (i.e., length of stay in host country, change in diet following relocation), information on self-reported health measures such as body weight status (i.e., BMI), level of physical activity, risk factors for chronic disease chronic disease (e.g., blood cholesterol level, diabetes status, and blood pressure level), and socio-demographic variables (e.g., education level, income level). A food frequency questionnaire (FFQ) was administered to participants in person. The researcher received an internal award from UNBC for this research study (i.e., Research Project Award – spring 2016 competition).

The funding secured for this research supported hiring research assistants, printing research surveys, organizing recruitment events, and purchasing prizes to facilitate recruitment. The research team included three undergraduate research assistants and nine volunteers. All volunteers and research assistants received relevant training and signed a confidentiality and non-disclosure agreement prior to their involvement in research recruitment, event organization, or data collection.

During the data collection phase, the researcher explained the purpose of the research to potential participants and provided answers and clarifications related to any questions or concerns. All participants were required to provide an informed consent prior to participation in the study and filling the survey. In the information letter and consent form, participants were informed about the ability to withdraw from the study at any point. All participants were assured that their identities will be protected in any future reports or publications, and that all collected data will remain confidential and stored in a secured cabinet in the researcher's office. Participants who were interested in knowing the results of this research were informed that a copy of the research thesis will be available at the UNBC library once the study is completed, and a summary report of the research results will be emailed to interested participants.

3.2.1. Survey Questionnaire Development

Quantitative data were collected via administering a cross-sectional survey to participants. The survey instrument includes information and consent sheet, demographic questions, FFQ instrument based on modification of the semi-quantitative FFQ by Hu et al. (2000) food groupings (Table 2), and dietary acculturation assessment component adapted from Rosenmoller et al., (2011). The semi-quantitative FFQ was used in this study to

provide an objective assessment to explore the dietary patterns of participants (Appendix A). The reproducibility and validity of this instrument has been previously reported in other studies (Rimm et al., 1992; Feskanich et al., 1993). An Additional demographic question was added to the questionnaire to measure length of residence in the host country, as it is one of the markers for dietary acculturation documented in the literature.

Regarding dietary assessment items, some questions were modified based on a literature review and informal communication with ethnic individuals from different heritages in order to make the survey more sensitive to different ethnic diets, and to improve the reliability of the answers without affecting the reported validity and reproducibility of the FFQ. For example, question 40 was modified to include "Ghee" other than butter and margarine to increase the reliability of answers particularly from south Asian participants. Modifications and new variables added to the adapted survey instrument were pilot tested to ensure clarity of wording and proper comprehension. The survey instrument included socio-demographic variables (i.e., age, gender, education level, annual household income, current marital status, ethnicity, place of birth, and number of years lived in Canada or any western country, and self-reported measures of weight and height to derive BMI.

The dietary acculturation assessment component of the survey has been adapted fully from Rosenmoller et al. (2011) with the addition of two sub-items. This segment of the survey was only applicable to immigrants who were born in a foreign country, and then relocated to Canada in a later stage of their life. The data were used to explore dietary acculturation within first generation immigrants, in addition to studying perceptions of participants regarding diet related issues following immigration to Canada. These issues include change in amount of food intake, awareness of healthy and unhealthy diet, change in

dietary pattern, change in method of food preparation, frequency of dining out, and availability of ethnic food ingredients & healthier diet choices.

The survey instrument was provided in English language. The researcher provided answers and clarifications to participants during all research data collection events. The researcher applied various methods to overcome language in this study. During the Vaisakhi research recruitment event, one research assistant who is proficient in English and Punjabi assisted some participants who were not proficient in the English language and communicated inquiries and answers between participants and the researcher whenever needed. Prior to the IMSS research event, it was known to the researcher that some of the potential participants, especially those who are more recent immigrants, have language barrier to some degree, which could potentially limit their ability to identify different food items in the survey questions. The researcher utilized a projector screen during survey administration to show pictures of dietary items in each question of the FFQ. This was done to help assist participants with language barrier to mitigate missing and unreliable responses. In addition, some participants had assistance from their family members who were proficient in English.

Table 2

Food Groupings Adapted from Hu et al. (2000)

Foods or food groups	Food items
Processed meats	Processed meats, bacon, hot dogs
Red meats	Beef, pork, lamb, hamburger
Organ meats	Beef, calf, and pork liver; chicken and turkey liver
Fish and other seafood	Canned tuna fish, dark-meat fish, other fish, shrimp, lobster, scallops
Poultry	Chicken or turkey with or without skin
Eggs	Eggs
Butter	Butter
Margarine	Margarine
Low-fat dairy products	Skim or low-fat milk, sherbet or ice milk, yogur
High-fat dairy products	Whole milk, cream, sour cream, ice cream, cream cheese, other cheese
Liquor	Liquor
Wine	Red wine, white wine
Beer	Beer
Tea	Tea
Coffee	Coffee
Fruit	Raisins or grapes, avocado, bananas, cantaloupe, watermelon, fresh apples or pears, oranges, grapefruit, strawberries, blueberries, peaches, apricots, plums
Fruit juices	Apple juice or cider, orange juice, grapefruit juice, other fruit juice
Cruciferous vegetables	Broccoli; coleslaw and uncooked cabbage; cooked cabbage; cauliflower; Brussels sprouts kale, mustard, and chard greens; sauerkraut
Dark-yellow vegetables	Carrots, yellow (winter) squash, yams
Tomatoes	Tomatoes, tomato juice, tomato sauce
Green, leafy vegetables	Spinach, iceberg or head lettuce, romaine or leaf lettuce
Legumes	String beans, peas or lima beans, beans or

	lentils, tofu or soybeans, alfalfa sprouts
Other vegetables	Celery, mushrooms, green pepper, corn, mixed vegetables, eggplant, summer squash
Garlic	Garlic
Potatoes	Potatoes
French fries	French fries
Whole grains	Cooked oatmeal, other cooked breakfast cereal, dark bread, brown rice, other grains, bran added to food, wheat germ
Cold breakfast cereal	Cold breakfast cereal
Refined grains	White bread, English muffins, bagels or rolls, muffins or biscuits, white rice, pasta, pancakes or waffles
Pizza	Pizza
Snacks	Potato chips or corn chips, crackers, popcorn
Nuts	Peanuts, other nuts, peanut butter
High-energy drinks	Cola with sugar, other carbonated beverages with sugar, fruit drinks
Low-energy drinks	Low-energy cola, other low-energy carbonated beverages
Oil and vinegar salad dressing	Oil and vinegar salad dressing
Mayonnaise and other creamy salad dressings	Mayonnaise and other creamy salad dressings
Chowder or cream soup	Chowder or cream soup
Other soup	Home-made soup, ready-made soup
Sweets and desserts	Chocolate bars or pieces, candy bars, cookies, brownies, doughnuts, cake, pie, sweet roll, coffee cake, pastry
Condiments	Red chili sauce (dry or prepared), mustard, pepper, soy or Worcestershire sauce, jam, jelly, syrup, honey

3.2.2 Modifications to the Cross-Sectional Survey Instrument

On one hand, modifications to the survey instrument were meant to include new relevant variables related to dietary acculturation. On the other hand, some of these modification were intended to make the semi-quantitative FFQ more culturally sensitive in order to increase the validity and reliability of the responses.

Modifications to the population demographics portion and the semi-quantitative FFQ

a) q65 was added to the demographic questions as follows:

q65. *How many years have you lived in Canada or any other western country?*

<1> Since birth

<2> Since the year of 19…/20…

b) q6e was modified through adding passion fruit to the list of exotic fruits as follows:

q6e. *EXCLUDING juices, over the past month, how often on average did you eat exotic fruits such as papaya, mango, avocado, passion fruit or pineapple including canned exotic fruits such as canned papaya, canned mango, and canned pineapple?*

c) q11 was modified through adding paratha, roti, and chapati to the list of products made of white flour as follows:

q11. *Over the past month, how often on average did you eat products made of white flour, such as white bread, pita, naan, paratha, roti, chapati muffins, bagels, buns, rolls, muffins, biscuits, pancakes, waffles, or plain crackers?*

d) q12 was modified through adding whole wheat paratha, whole wheat roti, and whole wheat chapati to the list of whole wheat foods as follows:

q12. *Over the past month, how often on average did you eat whole wheat foods, such as whole wheat bread, whole wheat pita, whole wheat naan, whole wheat paratha, whole*

wheat roti, and whole wheat chapati, whole wheat muffins, whole wheat bagels, whole wheat buns, whole wheat rolls, whole wheat biscuits, whole wheat pancakes, whole wheat waffles, or whole wheat crackers? Whole wheat means either 60% or 100%?

e) q13 was modified through adding rice pudding or kheer, and rice noodles as follows:

q16. Over the *past month, how often on average did you eat white rice including rice pudding or kheer, pasta, spaghetti, macaroni, noodles, rice noodles, or polenta?*

f) q27 will be modified through adding sesame butter as follows:

q27. *Over the past month, how often on average did you eat peanut butter, or sesame butter?*

g) q29 will be modified through adding papadum as follows:

q29. *EXCLUDING NUTS, over the past month how often on average did you eat snacks such as potato chips, corn chips, popcorn with butter, nachos, tortilla chips, or papadum?*

h) q34 was modified through adding paneer as follows:

q34. *Over the past month, how often on average did you eat paneer, cottage cheese, or ricotta cheese*?

i) q36 was modified through adding paneer to the excluded items as follows:

q36. *EXCLUDING paneer, cottage cheese, ricotta cheese, and cream cheese, over the past month how often on average did you eat cheese such as cheddar cheese, mozzarella cheese, brie, feta cheese or goat cheese*?

j) q40 was modified through adding some south asian and Chinese spices such as curry, turmeric, cardamon, fennel seeds, cumin, coriander, and Szechuan peppercorn as follows:

q40. *Over the past month, how often on average did you add spicy condiments such as chilli sauce, salsa, mustard, pepper, curry, turmeric, cardamon, fennel seeds, cumin, coriander, Szechuan peppercorns, chutney, steak sauce, soy sauce, Worcestershire sauce, or wasabi to your food*?

k) q44 was modified through adding ghee as follows:

q44. *Do you prefer to use ghee, butter or margarine in your food*?

Modifications to the dietary acculturation assessment component of the survey instrument.

a) q66 was added as follows:

q66. Has your general portion size (how much you eat in one meal) changed since coming to Canada?

(1- Eat much less, 3- No change, 5- Eat much more)

b) q67 was added as follows:

q67. How has your method of food preparation changed since coming to Canada?

- Stir-frying/BBQ (1-Much less often, 3- No change, 5-Much more often)
- Baking/grilling food (1-Much less often, 3- No change, 5-Much more often)
- Boiling food (1-Much less often, 3- No change, 5-Much more often)
- Deep frying food (1-Much less often, 3- No change, 5-Much more often)
- Microwaving food (1-Much less often, 3- No change, 5-Much more often)
- Eating vegetables raw (1-Much less often, 3- No change, 5-Much more often)
- Home-made foods (1-Much less often, 3- No change, 5-Much more often)

c) q68 was modified to include a new sub-item "Home-made foods" as follows

q68. How have the foods you generally eat changed since coming to Canada?

- Vegetables (1- Eat much less, 3- No change, 5- Eat much more)
- Potatoes, rice (1- Eat much less, 3- No change, 5- Eat much more)
- Convenience foods - Fruit (1- Eat much less, 3- No change, 5- Eat much more)
- Soft drinks/pop/soda (1- Eat much less, 3- No change, 5- Eat much more)

- Dairy products	(1- Eat much less, 3- No change, 5- Eat much more)
- High fat/fried foods	(1- Eat much less, 3- No change, 5- Eat much more)
- Deserts/candy/sweets	(1- Eat much less, 3- No change, 5- Eat much more)
- White meat	(1- Eat much less, 3- No change, 5- Eat much more)
- Red meat	(1- Eat much less, 3- No change, 5- Eat much more)
- Restaurant meals/dining out	(1- Eat much less, 3- No change, 5- Eat much more)

d) q70 was modified to include a new sub-item "Finding ethnic food ingredients" as follows:

q70. How do you feel about these issues in Canada compared to your home country?

- Finding fresh fruit and vegetables:
  (1- Much harder in Canada, 3- No change, 5- Much easier in Canada)
- Finding low fat food options:
  (1- Much harder in Canada, 3- No change, 5- Much easier in Canada)
- Choosing healthy food when dining out:
  (1- Much harder in Canada, 3- No change, 5- Much easier in Canada
- Finding ethnic food ingredients:
  (1- Much harder in Canada, 3- No change, 5- Much easier in Canada)

3.2.3 Pilot Testing of the Survey Instrument

Data collection started with survey pilot testing phase in mid-March 2016. The survey instrument was pilot tested through administering it to eight participants to identify issues related to wording or clarity of questions. Pilot testing revealed that q58 was unclear *"On the days that you are physically active, on average how many minutes do you usually spend being physically active in a typical week?"* Participants were not sure whether the question requested duration of exercise per day or week. Upon consultation with the study supervisor, the question has been modified to avoid any misinterpretation "On average how

many minutes/hours do you usually spend being physically active in a typical week?". No other changes or modification were applied.

3.3 Data Entry

Upon receiving completed surveys, the researcher assigned a numerical order to each survey that generally reflects the order upon which it was received. For example, the first completed survey was assigned number "001", while the last completed survey was assigned number "444". Data were entered into SPSS® for Windows statistical software package version 24.0 (SPSS Inc.). During data entry, each completed survey was assigned a respondent ID number that consisted of seven numbers. The first four numbers represent "year of data collection", and the last three numbers represent the numerical order. For example, the first received survey had the following respondent ID number "*2016001*", while the last received survey had the following respondent ID number "*2017444*". Assigning respondent ID number was introduced to avoid using personally identifiable information when referring to a specific survey. Research assistants were trained to use "respondent ID number" when manually logging data errors/issues for further examination by the researcher.

Three undergraduate research assistants were hired to assist with data entry into SPSS 24.0 for Windows software program on the researcher laboratory office desktop. The researcher provided individual training to each research assistant. This training consisted of providing an overview on the research study, information on protecting privacy and confidentiality of participants, familiarizing trainees with the SPSS software program, practical training on data entry, and guidelines on dealing with data errors/issues e.g. manually logging data errors in a laboratory notebook with both respondent ID and question number. Research assistants were responsible for entering dietary intake responses for each

survey. The researcher entered socio-demographic & health status variables, and dietary acculturation responses for each survey, in addition to reviewing data entry errors/issues documented by research assistants. The researcher had two separate meetings with the study supervisor to come into agreement regarding resolving some of the data errors/issues. Data entry commenced midway during data collection phase, and was completed by the end of data collection phase.

3.4 Data Recoding and Analysis

Following data entry, data was visually inspected as a check for data entry errors such as data points outside the normal range for each variable. Any detected errors were verified through referring to the original data.

3.4.1 Recoding of Dietary Variables

For the purpose of convenience, the questionnaire was constructed in a way where answers were arranged from highest frequency of consumption to lowest frequency of consumption. Recording of all dietary variables intended to make interpretation easier, and data values more meaningful. Responses to all dietary intake variable were numerically recoded to make higher values represent higher frequency consumption and lower values represent lower frequency of consumption as follows:

- A response *<1> More than once a day* was originally entered as data value "1", and later recoded as value "6"
- A response *<2> Everyday (7days per week)* was originally entered as a value "2", and later recoded as value "5"
- A response *<3> 5-6 days per week* was originally entered as a value "3", and later recoded as value "4"

- A response *<4> 2-4 days per week* was originally entered as a value "4", and later recoded as value "3"
- A response *<5> 1 day per week* was originally entered as a value "5", and later recoded as value "2"
- A response *<6> Less than 1 day per week (e.g., once or twice a month)* was originally entered as a value"6", and later recoded as value "1"
- A response *<7> Never* was originally entered as a value "7", and later recoded as value "0"

3.4.2 Deriving Body Mass Index

Body Mass Index (kg/m^2) is derived through dividing body weight in kilograms by height in meters squared (Poustie, Smyth, & Cole, 2005; Wallner-Liebmann et al., 2013). Height in meters was calculated using the following formula:

$$\text{Height in Meters} = \textit{Height in Centimeters} \div 100$$

Or

$$\text{Height in Meters} = (\textit{Feet} \times 0.3048) + (\textit{Inches} \times 0.0254)$$

Weight in Kilograms was derived from either stated weight in Kilograms or weight in Pounds using the following formula:

$$\text{Weight in Kilograms} = \textit{weight in Pounds} \times 0.453592$$

3.4.3 Deriving Age in Years

Age was mainly derived from "Year of Birth" variable rather than "Age in Years" variable. The following formula was used to derive age from "Year of Birth" variable:

$$\text{Age} = \textit{Year of data collection} - \textit{Year of Birth}$$

For example, when a conflict between an age derived from "Year of Birth" variable, and an age derived from "Age in Years" variable for the same participant, the former would take precedence over the latter as it is thought to be a more reliable response due to less chance of memory bias.

3.4.4 Deriving Length of Stay/Residence in Years

Length of residence for first generation immigrants was derived using the following formula:

Length of residence = *Year of data collection – Year of relocation*

Following a priori exclusion criteria, 30 cases with mainly Caucasian ethnicity were excluded from our study. Another three cases were excluded due to being on special diet regimen. Further, there was a consensus between the researcher and study supervisor to exclude another case due to consistent lack of reliability in answers i.e., multiple responses to each survey question. As a result, there were 410 cases that were deemed appropriate to enter the final analysis stage for this study

3.4.5 Data Analysis Techniques

All data were analyzed using the statistical analysis systems (SPSS®) for Windows (version 24.0). Descriptive frequency analysis was carried out on all data (continuous and categorical variables). Descriptive statistics were used to describe the study sample. An exploratory type of factor analysis known as principal components analysis (PCA) was used to derive the factorial structure of the qualitative FFQ items. This exploratory data reduction technique can be used to analyze and explain the interrelationship among a set of variables (e.g., food items). Principal Component Analysis (PCA) was used as a reduction technique for dietary intake variable leading to few principal components accounting for most

significant amount of variability amongst dietary variables. The association between principal components scores and BMI was tested using multiple regression analysis after adjusting for socio-demographic variables which include age, gender, marital status, income, and education. Bivariate analysis of BMI by gender was also performed.

Chapter 4: Results

The data were screened for missing responses. The amount of missing responses for 63 dietary items represents only 2.2%. Missing data across dietary items and cases had a relatively random pattern (Appendix B). Since missing data of dietary items accounted for quite a small percentage in a large dataset, using any method to address missing data would yield similar results (Tabachnick & Fidell, 2013). Deleting cases with any missing data seems impractical as it will lead to a much smaller sample size insufficient for analysis. For example, deleting a case with only one missing response, which represents less than 2% of all responses for this particular case, is not justifiable. Missing data could be estimated by a regression method or replaced by mean value; and using the regression method to replace missing data runs the risk of data overfitting and inflating correlation between variables (Tabachnick & Fidell, 2013). This could affect reliability of factors in PCA analysis and increase the risk of type I error in the subsequent multiple regression analysis. Also, estimated values through the regression method could fall outside the range of values for variables (i.e., 0-6). Thus, missing data was replaced using the mean.

4.1 Descriptive Statistical Analysis

Following data screening step, descriptive statistics including distributional properties of all quantitative and qualitative variables were examined for univariate normality and linearity of data. Large sample size (n = 410) is considered important factor in normalizing distributions.

4.1.1 Socio-demographic Characteristics

Approximately, 58% of study participants were males and 42% were females. The average age for participants was 30.9 years old (n = 397, SD = 12.21). The average age for

males participants was 30.1 (n = 228, SD = 11.54), and average age of females participants was 31.5 (n = 228, SD = 11.54). In terms of marital status, 41.7 % of participants were either married, in a common law relationship, or living with a partner, whereas 57.3% of participants were not in relationship with a partner (i.e., single). Further, 21.2% of participants had an education equivalent to high school diploma (i.e., grade 12 completion) or less, while 78.8% had post-secondary education. When participants were asked about their household family income for the year 2015, 54.2% of subjects had an annual household family income less than $40,000 Canadian dollars (CAD), 19.6% of participants were in the range of $40,000 CAD – 69,000 CAD, 13.0% of participants were in the range of $70,000 CAD - 99,000 CAD, and 13.3% of subjects had an annual household family income of $100,000 CAD or greater. The largest ethnic group participating in this study was South Asians (38.0%). Black, Chinese, Arab, Filipino, Korean, and West Asian participants accounted for 16.8%, 12.0%, 8.8%, 6.3%, 4.6%, and 4.4%, respectively. First generation immigrants who were born outside Canada represented 81.9% of all subjects, 17.2% were second generation immigrants, and only 1% were third generation immigrants. Average length of residence for first generation immigrants was 9.17 years (n = 316, SD = 10.45). A detailed description of socio-demographic characteristics of study sample is summarized in table 3.

Table 3

Sociodemographic Characteristics of Study Sample

variable	Subgroup	Frequency	Percentage
Age in years (n = 397)	18-25	176	44.3
	26-35	131	33.0
	36-45	39	9.8
	46-55	24	6.0
	56-65	18	4.5
	≥ 66	9	2.3
	Mean ± *SD*	30.85 ± 12.21	
Gender (n = 404)	Males	231	57.7
	Females	177	42.3
Gender*Age (n = 391)	Male (18-25)	104	26.6
	Female (18-25)	72	18.4
	Male (26-35)	80	20.5
	Female (26-35)	48	12.3
	Male (36-45)	19	4.9
	Female (36-45)	19	4.9
	Male (46-55)	14	3.6
	Female (46-55)	9	2.3
	Male (56-65)	5	1.3
	Female (56-65)	13	3.3
	Males > 65	6	1.5
	Female > 65	2	0.5
	Male (Mean ± *SD*)	30.06 ± 11.54	
	Female (Mean ± *SD*)	31.51 ± 12.76	
Marital Status (n = 406)	Married/Common law	142	35.0
	Living with a partner	27	6.7
	Never married	164	40.4
	Widowed	71	17.5
	Divorced	1	0.2
	Separated	1	0.2
Education level (n = 406)	Uncompleted high school	21	5.2
	Completed high school	65	16.0
	Some university or college	122	30.1
	Completed undergraduate degree	113	27.8
	Post graduate education	85	20.9
Annual household family income (n = 301)	Less than $10,000	58	19.3
	$10,000-$19.999	32	10.6
	$20,000-$29.999	34	11.3
	$30,000-$39.999	39	13.0

	$40,000-$49.999	19	6.3
	$50,000-$59.999	20	6.6
	$60,000-$69.999	20	6.6
	$70,000-$79.999	9	3.0
	$80,000-$89.999	17	5.6
	$90,000-$99.999	13	4.3
	$100,000-$150,000	25	8.3
	> $150,000	15	5.0
Ethnic background (n = 410)	Chinese	49	12.0
	South Asian	156	38.0
	Black	69	16.8
	Filipino	28	6.8
	Latin American	9	2.2
	South East Asian	9	2.2
	Arab	36	8.8
	West Asian	18	4.4
	Japanese	8	2.0
	Korean	19	4.6
	Indigenous	9	2.2
Length of residence (n = 408)	First generation (0-5 years)	165	40.4
	First generation (6-10 years)	60	14.7
	First generation (11-15 years)	28	6.9
	First generation (16-20 years)	19	4.7
	First generation (≥ 20 years)	44	10.8
	First generation (missing)	14	4.4
	First generation (Mean ± SD)	9.17 ± 10.45	
	Second generation	-	17.2
	Third generation	-	1.0

4.2 Body Mass Index

BMI (kg/m^2) value was calculated for 367 subject who had self-reported weight and height, leading to BMI response rate equivalent to 88.8%. Participants were classified according to the *Canadian Guidelines for Body Weight Classification in Adults* into four categories (Health Canada, 2003). This classification identified 210 subjects in normal body weight category (M = 22.25, SD = 1.77), 21 subjects in underweight category (M = 17.16, SD = 1.51), 102 subjects in overweight category *(*M = 27.05, SD = 1.37), and 34 subjects in

obese category ($M = 35.12$, $SD = 4.84$). BMI characteristics across gender are further illustrated in table 4.

Table 4

Mean, Standard Deviation & Categories of BMI and BMI by Gender

Variable	Class	Frequency	Percentage	*M*	*SD*
BMI	Normal weight	210	57.2	22.25	1.77
($n = 367$)	Underweight	21	5.7	17.16	1.51
	Overweight	102	27.8	27.05	1.37
	Obese	34	9.3	35.12	4.84
	Total	367	100.0	24.48	4.78
BMI by			Male		
Gender	Normal weight	120	54.3	-	-
($n = 362$)	Underweight	9	4.1	-	-
	Overweight	73	33.0	-	-
	Obese	19	8.6	-	-
	Total	221	100.0	24.7	4.32
			Female		
	Normal weight	88	62.4	-	-
	Underweight	12	8.5	-	-
	Overweight	28	19.9	-	-
	Obese	13	9.2	-	-
	Total	141	100.0	23.99	5.29

Females had higher missing BMI values (20.3%), compared to males (4.3%). Chi square test for a 2x2 table showed that pattern of missing BMI values between male and females was significantly different ($\chi 2$ (1, $N = 404$) = 16.26, $p < 0.001$). Chi square test was also performed to examine the relationship between gender of subject and BMI category. The test revealed BMI categories were not equally distributed for males and females ($\chi 2$ (3, $N = 362$) = 9.30, $p = .026$). Males were more likely to be overweight, and females were more likely to be underweight. Exactly, 33.0 % of males were in the overweight BMI category, compared to 19.9% for females. Alternatively, 8.5% of females were in the underweight BMI category, compared to 4.1% for males.

4.3 Multivariate Analyses Assumptions

Data was examined for multivariate analysis assumptions including multivariate linearity and normality, factorability of *R*, absence of multi-collinearity and singularity, and absence of outliers. The distribution shape for variables and bivariate scatterplots was inspected to examine normality and linearity assumptions. As a result, multivariate normality and linearity were assumed.

Mahalanobis test revealed the presence of 17 cases classified as potential multivariate outliers. This might be the result of mixing different groups in this sample (Tabachnick & Fidell, 2013). Influential multivariate outliers carry the risk of affecting correlations between variables and altering the fit of a model (Herman, Ryan, & Harry, 2013). To investigate the influence of outliers on multivariate analysis results (i.e., PCA, Multiple Regression). Two separate scenarios were performed to eliminate any risk related to lack of handling outliers. The first scenario included all cases with those identified as multivariate outliers (i.e., 410 cases), whereas the second scenario excluded multivariate outliers (i.e., 393 cases). The results indicated no difference between both scenarios in terms of significance and model fit. Based on these results, it was determined that outliers in this study were not influential. In this sense, keeping outliers was determined not to influence making proper inferences from study sample. There is a notion that deletion of non-significant number of outliers might make the sample a biased representation of the population (Herman et al., 2013).

To examine factorability of *R* to justify performing PCA, Bartlett's Test of Sphericity and the Kaiser-Meyer-Olkin Test of Sampling Adequacy (KMO) were performed. The result of Bartlett's Test of Sphericity was significant ($p < .001$), indicating correlation matrix is statistically different from a singular matrix, which suggests factorability of variables

(Tabachnick & Fidell, 2013). Further, the value of Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .84, which indicated shared variance between dietary items is meritorious for PCA (Beavers et al., 2013). Lack of multicollinearity and singularity assumption required for multiple regression analysis were assumed through examining tolerance and correlation between dependent variables.

In terms of adequacy of sample size**,** there were 410 cases eligible to enter the final multivariate analysis. According to Tabachnick and Fidell (2013), sufficient sample for PCA could range between 100 to well over 500 depending on strength of factors/principal components (i.e., number of variables loading into a factor and their degree of loading). A well determined factor has large number of indicators with high loading. Tabachnick and Fidell (2013) conclude "At least 300 cases are needed with low communalities, small number of factors, and just three or four indicators for each factor" p. 618. Our PCA analysis revealed that average communality for all 63 dietary variables was 0.4, and each factor had at least four unique variables with a loading higher than 0.6 for a four-factor solution, and 0.4 for a six-factor solution. Beavers et al. (2013) indicates that a sample of at least 300 cases is required when factors are comprised of few variables with moderate to low loading. A larger sample size has an advantage of producing a more stable solution with factorial analysis (Hogarty, Hines, Kromrey, Ferron, & Mumford, 2005). According to Wilson VanVoorhis and Morgan (2007), 300 cases would be considered a good sample size.

4.4 Principal Components Analysis

Principal components extraction was employed for all 63 dietary food items in the FQ using SPSS® for Windows statistical software package version 24.0. Initial extraction of components by PCA identified 17 components with eigenvalue more than one using Kaiser

Criterion for retention of components. Using the scree plot method identified that a bend in the elbow shaped slope occurring after the sixth component which suggests retaining six components in the final solution (Figure 3). For the purpose of interpretability of components and to avoid overestimation of components, subsequent PCA was done while retaining four, five and six components to evaluate the best solution in terms of interpretability and comprehensibility. Practically, this approach is accepted and commonly used practice (Beavers et al., 2013; Suhr, 2006).

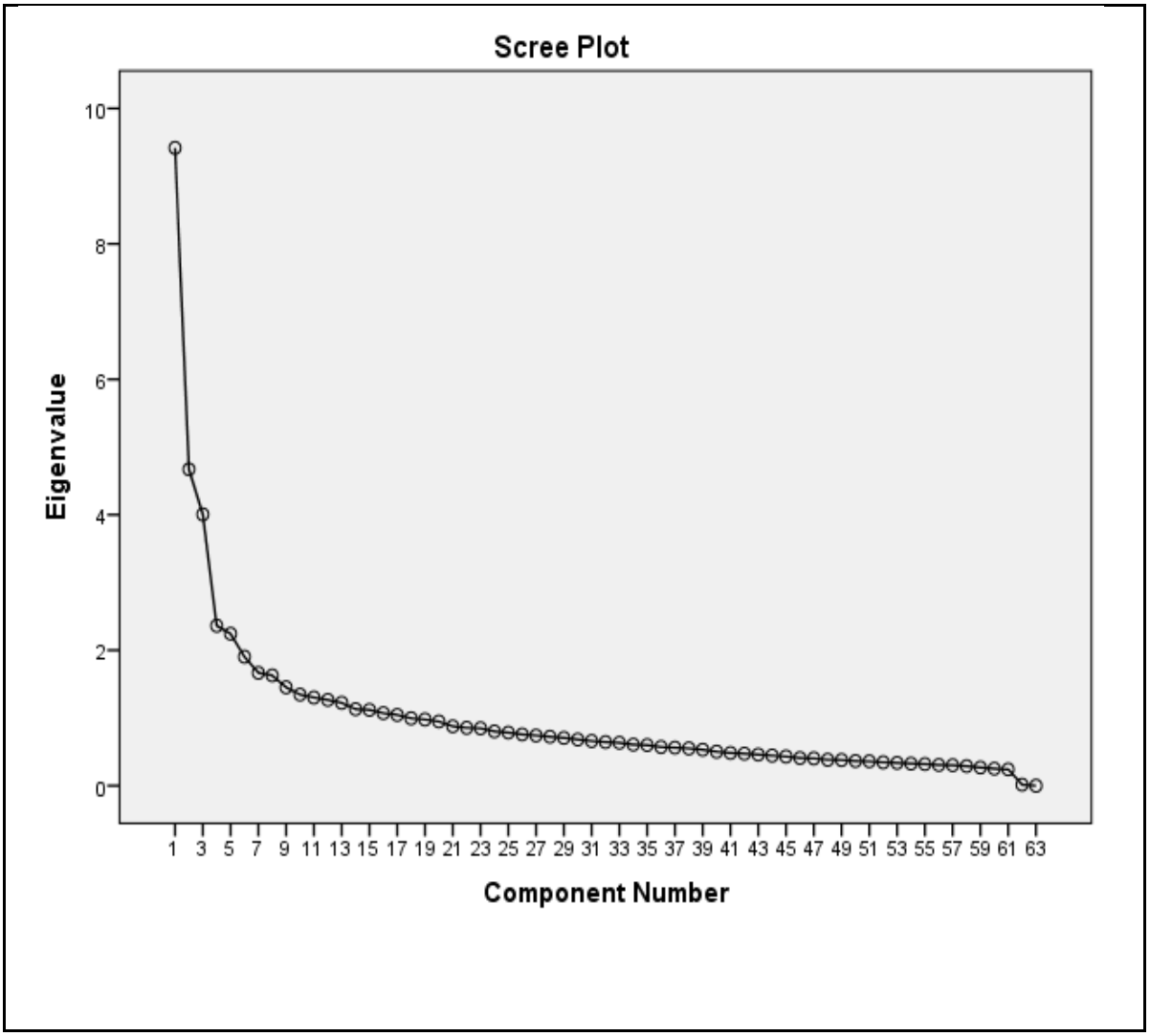

Figure 3. Scree plot produced by orthogonal Principal Components extraction method

The four-components solution accounted for 32.5% of variance within dietary items. Alternatively, the five-components solution accounted for an extra 3.5% of variance, compared to the four-components solution, leading to 36% of total variance being explained. six-components solution accounted for an extra 3.1% of variance, compared to the five-components solution, leading to 39.1% of variance being explained. Rotation of components is an essential step in any type of factorial analysis to achieve more interpretable and meaningful solutions (Fabrigar, Wegener, MacCallum, Strahan, 1999). Orthogonal rotation of components assumes independence of rotated components; it is widely considered the most appropriate method of rotation when the purpose of the analysis is to produce component scores (Beavers et al., 2013). On the other side, non-orthogonal oblique rotation of components is most appropriate when there is a theoretical hypothesis pertinent to correlation between factors (Tabachnick & Fidell, 2013). If the relationship between components is unknown, Fabrigar et al. (1999) suggests performing oblique rotation first. If correlation between components were found to be low, opting out to orthogonal rotation would be most appropriate. To assess inter-correlation between components, initial approach included PCA with oblique rotation (i.e., oblimen rotation) while extracting six principal components; this approach identified close to zero correlation among all components as components, Subsequent PCA was done while retaining four, five and six components to shown in table 5. The largest correlation existed between component 1 and component 4 (r = -.255). Since components were largely uncorrelated and component scores were required, orthogonal rotation of components was deemed most appropriate for this analysis. Orthogonal independent rotation is required when populating component scores is needed (Tabachnick & Fidell, 2013).

Table 5

Correlation among Six Dietary Components

Variable	COMP_1	COMP_2	COMP_3	COMP_4	COMP_5	COMP_6
COMP_1	—					
COMP_2	0.042	—				
COMP_3	-0.204	-0.079	—			
COMP_4	-0.255	-0.224	0.185	—		
COMP_5	0.081	-0.016	0.057	0.025	—	
COMP_6	0.181	0.238	-0.039	-0.224	0.100	—

Note. COMP_1 = high calorie fatty food & alcohol component, COMP_2 = high fiber food "vegetables & fruits" component; COMP_3 = high protein food "meats and fish" component; COMP_4 = plant oils component; COMP_5 = low fat dairy, whole grain products & nuts component; COMP_6 = high fat dairy, refined grain products & condiments component.

Varimax orthogonal rotation of components was used for all three PCA scenarios to find out the most interpretable and comprehensible solution. The results of beta component loading for all variables are illustrated in table 6, table 7, and table 8. Using a cut off equivalent to .32 for beta component loading, the six-components solution had 61 unique dietary items out of total 63 dietary items which loaded on one or more of the sixth components. Item q40 (i.e., 100% natural fruit juice) and item q17 (i.e., peas, beans, and lentils) were the only items that did not load into any of the six components. Each component was labelled based on dietary items loading on it. For example, component 3 was labelled *high protein food "meats and fish"*, as it had high loadings of red meat, poultry & turkey, fish, sea foods & shellfish, eggs, processed meats, organ meats such as liver and heart, deep fried fish or chicken, Veal, goat & rabbit meat, pasta & Spaghetti, and rice. Alternatively, component 1 was labelled *high calorie fatty food & alcohol*, component 2 was labelled *high fiber food "vegetables & fruits"*, component 4 was labelled *plant oils*, component 5 was labelled *low fat dairy and whole grain products & nuts*, and lastly component 6 was labelled *high fat dairy, refined grain products & condiments*. Results of

the beta component loadings for the six-factor component solution and percent of variance and covariance are illustrated in table 6. For the five-components solution, there were 60 unique dietary items out of total 63 dietary items which loaded on one or more of the sixth components. Item q40 (i.e., 100% natural fruit juice), item q32 (i.e., Milk 1%, 2% and skim milk), and item q14 (i.e., whole wheat pita, whole wheat bread, whole wheat bagel) did not load into any of the five components.

Compared to the six-components solution, the simple structure was generally similar except for *Low fat dairy and whole grain products & nuts* component dropping out of the factorial structure leaving five components with relatively similar loadings in terms of item type and degree of loading. Results of beta component loadings for the five-components solution are illustrated in table 7. For the four-components solution, there were 56 unique dietary items out of total 63 dietary items which loaded on one or more of the sixth components. Item q42 (i.e., spicy condiment), item q34 (i.e., plain or sweetened yogurt), item q39 (peanut butter or sesame butter), Item q40 (i.e., 100% natural fruit juice), item q32 (i.e., Milk 1%, and skim milk), item q22b (i.e., egg white), and q35a (i.e., homogenized milk) did not load into any of the four components. Compared to the five-components solution, the simple structure was relatively similar except for *high fat dairy, refined grain products & condiments* component dropping out of the factorial structure leaving four components with relatively similar loadings in terms of item type and degree of loading. Another observation was related to complex dietary items loading into more than one factor compared to the other two solutions. This might be problematic when interpreting the results, as it is ideal when each dietary item loads into one component (Tabachnick & Fidell, 2013). Results of beta component loadings for the four-components solution are illustrated in table 8.

Table 6

Six Dietary Components Extracted by PCA with Beta Component Loading and Percent of Variance and Covariance Using Varimax Orthogonal Rotation

Ordinal dietary variable item	Beta component loading
Component 1 (High Calorie Fatty Food & Alcohol)	
French Fries (q11a)	.65
Frozen potato product (q11b)	.62
Alcohol (q55)	.60
Lard/shortening (q52)	.59
Gravy/cheese sauce (q44)	.60
Soft drinks/fruit flavored drinks (q41a)	.57
Diet soft drinks (q41b)	.55
Pizza (q10b)	.51
Ketchup (q10a)	.53
Duck/goose (q21b)	.48
Chips (q31)	.46
Whipping cream/sour cream (q37b)	.45
Low fat ice cream/yogurt (q33)	.44
Ice cream (q35b)	.40
Cottage and ricotta cheese (q36)	.40
Homogenized milk (q35a)	.38
Peanut butter (q29)	.37
Cream (q37a)	.33
Potatoes (q11c)	.34
Sum of squared loadings = 6.28	
Percent of variance = 9.97	
Percent of covariance = 25.52	
Component 2 (High Fiber Food "Vegetables & Fruits")	
Other vegetables e.g., sweet peppers (q7)	.72
Cabbage-type vegetables (q6)	.71
Green leafy vegetables (q4)	.67
Orange and dark yellow vegetables (q5)	.61
Beans (q8)	.58
Berries (q9d)	.55
Exotic fruits (q9e)	.53
Citrus fruits (q9b)	.52
Non-citrus fruits (q9a)	.48
Melon (q9c)	.48
Soy (q39)	.48
Bran/whole unrefined grains (q16)	.42
Sum of squared loadings = 4.82	
Percent of variance = 7.65	
Percent of covariance = 19.60	
Component 3 (High Protein Food "Meats and Fish")	
Red meat (q26)	.76
Poultry/turkey (q21)	.68

Ground red meat (q23)	.68
Dark fish (q19)	.62
Sea foods/shellfish (q20)	.60
Eggs (q22)	.57
Processed meats (q25)	.57
White fish (q18)	.56
Organ meats (q24)	.51
Fish & chicken (deep fried/breaded) (q18a)	.46
Rice/pasta/spaghetti (q15)	.46
Veal/goat/rabbit meat (q27)	.42
Sum of squared loadings = 4.76	
Percent of variance = 7.55	
Percent of covariance = 19.33	
Component 4 (Plant Oils)	
Olive oil with food (q50)	.89
Corn oil and sunflower oil (q51)	.89
Olive oil in salad dressing (q49)	.67
Olive oil for frying or grilling (q48)	.60
Sum of squared loadings = 3.10	
Percent of variance = 4.91	
Percent of covariance = 12.58	
Component 5 (Low Fat Dairy, Whole Grain Products & Nuts)	
Yoghurt (q34)	.59
Whole wheat pita/bread/bagel (q14)	.44
Nuts (q30)	.44
Milk 1%, 2% and skim milk (q32)	.42
Low fat ice cream/yogurt (q33)	.38
Spicy condiments (q42)	.39
Garlic (q45)	.38
Cereals (q12)	.35
Cottage and Ricotta cheese (q36)	.33
Sum of squared loadings = 2.88	
Percent of variance = 4.57	
Percent of covariance = 11.70	
Component 6 (High Fat Dairy, Refined Grain Products & Condiments)	
Cheddar/mozzarella/feta cheese (q38)	.62
Chocolate/desserts (q28)	.53
White flour products (q13)	.45
Tomato sauce/paste (q10)	.40
Spicy condiments (q42)	.40
Sweet condiments (q43)	.39
Butter/margarine (q46)	.39
Chips (q31)	.37
Sum of squared loadings = 2.77	
Percent of variance = 4.40	
Percent of covariance = 11.26	
Percent of variance (all Components) = 39.05	

Table 7

Five Dietary Components Extracted by PCA with Their Beta Component Loading and Percent of Variance Using Varimax Orthogonal Rotation

Ordinal dietary variable item	Beta component loading
Component 1 (High Calorie Fatty Food & Alcohol)	
French Fries (q11a)	.64
Frozen potato product (q11b)	.62
Alcohol (q55)	.62
Lard/shortening (q52)	.58
Gravy/cheese sauce (q44)	.62
Soft drinks/fruit flavored drinks (q41a)	.56
Diet soft drinks (q41b)	.56
Pizza (q10b)	.49
Ketchup (q10a)	.52
Duck/goose (q21b)	.50
Chips (q31)	.47
Whipping cream/sour cream (q37b)	.46
Low fat ice cream and yogurt (q33)	.47
Regular ice cream (q35b)	.44
Cottage and ricotta cheese (q36)	.42
Homogenized milk (q35a)	.41
Organ meats (q24)	.39
Peanut butter (q29)	.37
Fish & chicken - deep fried/breaded (q18a)	.37
Veal/goat/rabbit meat (q27)	.36
Cream (q37a)	.35
Potatoes (q11c)	.35
Egg white (q22b)	.33
Sum of squared loadings = 6.48 Percent of variance = 10.29 Percent of variance = 28.55	
Component 2 (High Fiber Food “Vegetables & Fruits”)	
Other vegetables e.g., sweet peppers (q7)	.69
Cabbage-type vegetables (q6)	.69
Green leafy vegetables (q4)	.65
Orange and dark yellow vegetables (q5)	.59
Beans (q8)	.57
Berries (q9d)	.55
Exotic fruits (q9e)	.57
Citrus fruits (q9b)	.52
Non-citrus fruits (q9a)	.52
Melon (q9c)	.47
Soy (q39)	.44
Bran/whole unrefined grains (q16)	.47

Peas/beans/lentils (q17)	.35
Garlic (q45)	.34
Sum of squared loadings = 5.19	
Percent of variance = 8.24	
Percent of covariance = 22.88	
Component 3 (High Protein Foods "Meats and Fish")	
Red meat (q26)	.77
Poultry/turkey (q21)	.69
Ground red meat (q23)	.69
Dark fish (q19)	.59
Sea foods/shellfish (q20)	.60
Eggs (q22)	.58
Processed meats (q25)	.63
White fish (q18)	.50
Organ meats (q24)	.46
Fish & chicken - deep fried/breaded (q18a)	.43
Rice/Pasta/Spaghetti (q15)	.47
Veal/goat/rabbit meat (q27)	.35
Sum of squared loadings = 4.71	
Percent of variance = 7.48	
Percent of covariance = 20.76	
Component 4 (Oils)	
foods eaten with olive oil (q50)	.83
Other oils e.g., corn oil, sunflower oil (q51)	.83
Salad dressing with olive oil (q49)	.63
Fry/grill with olive oil (q48)	.58
Nuts (q30)	.35
Yoghurt (q34)	.35
Sum of squared loadings = 3.40	
Percent of variance = 5.39	
Percent of covariance = 14.97	
Component 5 (High Fat Dairy, Refined Grain Products & Condiments)	
Cheddar/mozzarella/feta cheese (q38)	.57
Chocolate/desserts (q28)	.49
White flour products (q13)	.45
Spicy condiments (q42)	.50
Tomato sauce/paste (q10c)	.43
Sweet condiments (q43)	.41
Butter/margarine (q46)	.48
Chips (q31)	.35
Sum of squared loadings = 2.91	
Percent of variance = 4.63	
Percent of covariance = 12.84	
Percent of variance (all Component) = 36.03	

Table 8

Four Dietary Components Extracted by PCA with Their Beta Component Loading and Percent of Variance Using Varimax Orthogonal Rotation

Ordinal dietary variable item	Beta component Loading
Component 1 (High Calorie Fatty Food & Alcohol)	
French Fries (q11a)	.59
Frozen potato product (q11b)	.58
Alcohol (q55)	.38
Lard/shortening (q52)	.37
Gravy/cheese sauce (q44)	.60
Soft drinks/fruit flavored drinks (q41a)	.53
Diet soft drinks (q41b)	.38
Pizza (q10b)	.51
Ketchup (q10a)	.53
Chips (q31)	.58
Whipping cream/sour cream (q37b)	.52
Low fat ice cream/yogurt (q33)	.34
Ice cream (q35b)	.48
Cottage and ricotta cheese (q36)	.49
Homogenized milk (q35a)	.34
Peanut butter (q29)	.30
Cream (q37a)	.35
Potatoes (q11c)	.39
Cheddar/mozzarella/feta cheese (q38)	.49
Butter/margarine	.49
Chocolate/desserts (q28)	.45
Sweet condiments (q43)	.43
White flour products (q13)	.45
Sum of squared loadings = 5.81	
Percent of variance = 9.22	
Percent of covariance = 28.40	
Component 2 (High Fiber Food "Vegetables & Fruits")	
Other vegetables e.g., sweet peppers (q7)	.69
Cabbage-type vegetables (q6)	.67
Green leafy vegetables (q4)	.64
Orange and dark yellow vegetables (q5)	.60
Beans (q8)	.57
Berries (q9d)	.55
Exotic fruits (q9e)	.53
Citrus fruits (q9b)	.52
Non-citrus fruits (q9a)	.51
Melon (q9c)	.41
Soy (q39)	.43

Bran/whole unrefined grains (q16)	.46
Peas/lentils (q17)	.39
Nuts (q30)	.38
Garlic (q45)	.38
Whole wheat pita/bread/bagel (q14)	.34
Sum of squared loadings = 5.17	
Percent of variance = 8.21	
Percent of covariance = 25.30	
Component 3 (High Protein Food "Meats and Fish")	
Red meat (q26)	.75
Poultry/turkey (q21)	.62
Ground red meat (q23)	.68
Dark fish (q19)	.59
Sea foods/shellfish (q20)	.63
Eggs (q22a)	.52
Processed meats (q25)	.65
White fish (q18a)	.55
Organ meats (q24)	.52
Fish & chicken - deep fried/breaded (q18a)	.47
Rice/Pasta/Spaghetti (q15)	.44
Veal/goat/rabbit meat (q27)	.41
Sum of squared loadings = 5.01	
Percent of variance = 8.05	
Percent of covariance = 24.78	
Component 4 (Plant Oils and Fatty Food)	
foods eaten with olive oil (q50)	.79
Other oils e.g., corn oil, sunflower oil (q51)	.79
Salad dressing with olive oil (q49)	.61
Fry/grill with olive oil (q48)	.52
Cereals (q12)	.46
Low fat ice cream/yogurt (q33)	.39
Duck/goose (q21b)	.38
Alcohol (q55)	.38
Lard/shortening (q52)	.37
Diet soft drinks (q41b)	.36
Sum of squared loadings = 4.40	
Percent of variance = 6.99	
Percent of covariance = 21.52	
Percent of variance (all Components) = 32.47	

Based on total amount of variance explained by the solution and beta component loading for dietary items, the six-components solution was the most fitting with better interpretability than other two solutions. Thus, it was considered as the final solution for this analysis. In the final solution, variables are well defined with large amount of their variance being explained by the final solution, and only two dietary variables had less than 20 % of their variance accounted for by the solution (Appendix C). Further, 13 dietary variables had 20-30% of their variance accounted for by the solution, 19 dietary variables had 30-40% of their variance explained, 19 dietary variables had 40-50% of their variance explained, 7 dietary variables had 50-60% of their variance explained, and three dietary variables had more than 60% of their variance explained. Altogether, 39.1% of the variance in the set of dietary variables was accounted for by the solution. Component 1 accounts for 10.0% of the variance in the set of dietary variables, and 25.5% of the variance in the solution. Component 2 accounts for 7.7% of the variance in the set of dietary variables, and 19.6% of the variance in the solution. Component 3 accounts for another 7.6% of the variance in the set of dietary variables, and 19.3% of the variance in the solution. Component 4 accounts for 4.9% of the variance in the set of dietary variables, and 12.6% of the variance in the solution. Component 5 accounts for 4.6% of the variance in the set of dietary variables, and 11.7% of the variance in the solution. Component 6 accounts for 4.4% of the variance in the set of dietary variables, and 11.3% of the variance in the solution. Together, all six components account for 39.1% of the variance in the set of dietary variables.

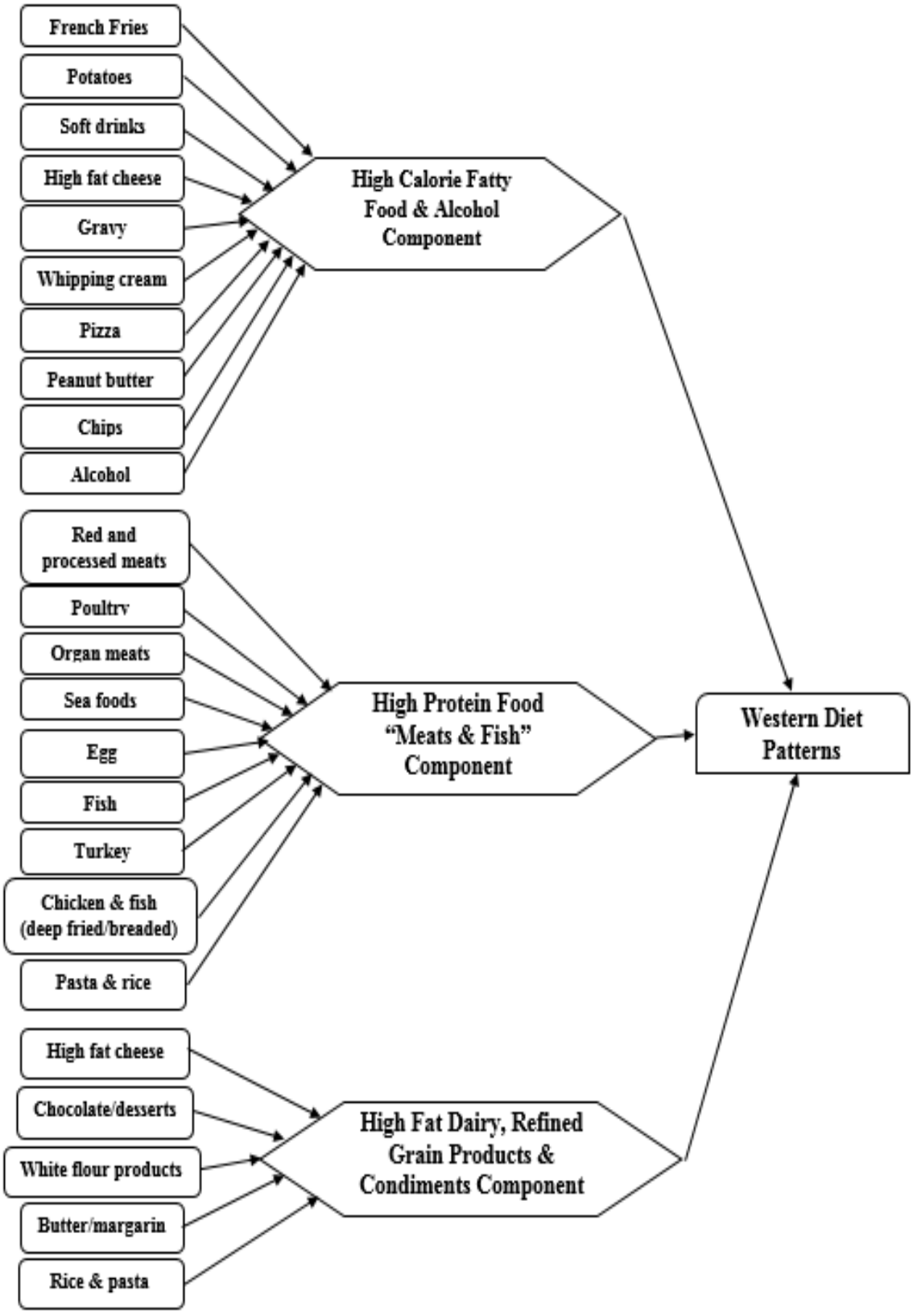

Figure 4. Western diet patterns identified from the food frequency questionnaire ($n = 410$)

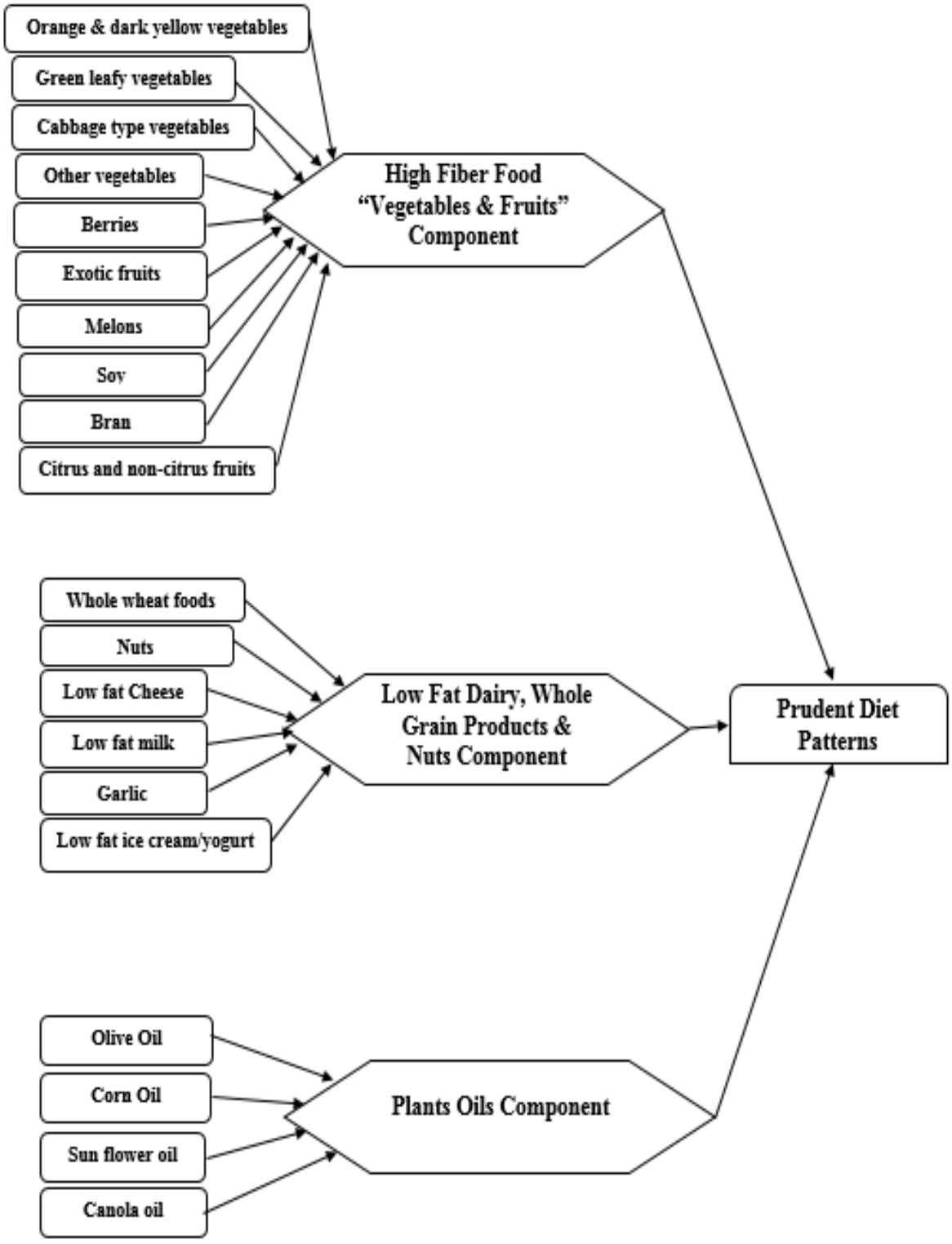

Figure 5. Prudent diet patterns identified from the food frequency questionnaire (n = 410)

Component scores were produced for all subjects using SPSS program though Bartlett's regression method. Component scores are considered variables that represent how much would a subject score on each principal component (Yong & Pearce, 2013). In this sense, each subject had six meaningful and representative component scores based on their 63 dietary responses and their weighted value on each component (e.g., S1 component Score 1, S1 component score 2, S1 component score 3, etc.). These factor scores can be subsequently used as variables in further statistical analyses such as multiple regression (Tabachnick & Fidell, 2013).

4.5 Multiple Regression

Multiple regression analysis was performed via SPSS® for Windows statistical software package version 24.0. In this analysis, BMI was considered as a "*criterion/outcome variable*", six dietary components scores variables were considered as "*predictor variables*", and five sociodemographic variables were considered as "*covariates*". Those sociodemographic variables included age, gender, marital status, education level, and income. There were 135 cases removed from the multiple regression analysis due to missing data for one or more of the abovementioned sociodemographic variables. Thus, 275 cases were entered into the multiple regression analysis. Evaluation of assumptions for multiple regression analysis revealed that number of cases to independent variables was large enough (Tabachnick & Fidell, 2013). Assuming medium size relationships, at least 110 cases are required for regression analysis with six predictor variables to test both the overall model and individual predictors (Wilson VanVoorhis & Morgan, 2007). Thus, sample size was deemed appropriate to test medium and large size effects in this analysis. Further, normal probability plot and scatterplot for residuals produced through SPSS output indicated that normality and

linearity assumption were to be assumed. Examining tolerance showed that independent variables were largely uncorrelated with lack of multicollinearity or singularity. Other multivariate assumptions including outliers were checked through examining Mahalanobis distance and Cook's distance for independent and dependent variables as previously discussed.

Table 9

Zero Order Correlations among Outcome and Covariate Variables

Variable	Raw_BMI	AGE	GENDER	MARITAL	EDUC	INCOME
Raw_BMI	—					
AGE	.076	—				
GENDER	.009	.078	—			
MARITAL	-.119*	-.556***	-.147**	—		
EDUC	-.050	-.046	-.062	-.042	—	
INCOME	-.020	.255***	-.058	-.201***	-.027	—

*$p < .05$, **$p < .01$, ***$p < .001$

Note. Raw_BMI = body mass index (kg/m^2); AGE = age in years at time of survey intake; GENDER = gender of participant; MARITAL = marital status; EDUC = highest grade/level of education completed; INCOME = 2015 annual household family income.

regression analysis was employed through SPSS program to determine if individual dietary components (COMP_1, COMP_2, COMP_3, COMP_4, COMP_5, COMP_6) contribute a significant unique proportion of variance to body mass index (Raw_BMI) while controlling for sociodemographic variables including age (AGE), gender (GENDER), marital status (MARITAL), level of education (EDUC), and 2015 annual household family income (INCOME). Correlations among criterion/outcome variable and covariate variables are displayed in table 9. Sociodemographic variables were entered in the first block of the analysis, and the six dietary component variables were entered in the second block of the analysis. Correlations among criterion/outcome variable and predictor variables are displayed in table 10.

Step one of the analysis revealed that sociodemographic variables (i.e., control variables) were not significant predictors for body mass index with R value of .141 and R^2 value of .020 ($F(5, 269) =$, MSE = 25.10, $p = 0.362$). Steps two of the analysis revealed that adding the dietary components variables to the model resulted in R^2 value of .048 and a non-significant R^2 change of .028 ($F(6, 263) = 1.28$, $p = .266$). Adjusted R^2 value for both step one and step two was .002 and .008, respectively. The gap between R^2 values and adjusted R^2 value reflects a large theoretical correction that could be explained by the small effect size and the large number of predictor variables (Lewis, 2007).

Table 10

Zero Order Correlations among Outcome and Predictor Variables

Variable	Raw_BMI	COMP_1	COMP_2	COMP_3	COMP_4	COMP_5	COMP_6
Raw_BMI	—						
COMP_1	.036	—					
COMP_2	-.064	.045	—				
COMP_3	.120*	-.029	-.070	—			
COMP_4	-.015	.028	-.049	-.029	—		
COMP_5	-.008	-.011	-.066	.007	-.026	—	
COMP_6	.024	.050	-.066	-.018	-.010	0.036	—

*$p < .05$, **$p < .01$, ***$p < .001$

Note. COMP_1 = high calorie fatty food & alcohol component, COMP_2 = high fiber food – vegetables & fruits component; COMP_3 = high protein food – meats and fish component; COMP_4 = plant oils component; COMP_5 = low fat dairy, whole grain products & nuts component; COMP_6 = high fat dairy, refined grain products & condiments component.

The overall model test was not significant ($F(11, 263) = 1.20$, $MSE = 24.94$, $p = .286$). Correlation among covariate and predictor variables is displayed in table 11. Significance test for individual predictors showed that one of the dietary component (i.e., component 3) contributed a significant unique proportion of variance to body mass index. With all BMI variance explained by sociodemographic variables being removed, component

3 accounted for a significant unique amount of variance to BMI (1.7%), which is not shared with other components. None of the other components accounted for any significant unique amount of variance to BMI.

Table 11

Zero Order Correlations among Covariate and Predictor Variables

Variable	COMP_1	COMP_2	COMP_3	COMP_4	COMP_5	COMP_6
AGE	-.219***	-.023	-.105*	.048	.144**	-.168**
GENDER	-.213***	.150**	-.090	-.073	-.013	.088
MARITAL	.220***	.014	-.049	-.057	-.228***	.039
EDUC	-.115*	-.158**	.170**	.128*	.114*	.045
INCOME	-.054	.082	.024	-.010	.000	-.003

*$p < .05$, **$p < .01$, ***$p < .001$

Note. AGE = age in years at time of survey intake; GENDER = gender of participant; MARITAL = marital status; EDUC = highest grade/level of education completed; INCOME = 2015 annual household family income, COMP_1 = high calorie fatty food & alcohol component, COMP_2 = high fiber food – vegetables & fruits component; COMP_3 = high protein food – meats and fish component; COMP_4 = plant oils component; COMP_5 = low fat dairy, whole grain products & nuts component; COMP_6 = high fat dairy, refined grain products & condiments component.

Table 12 displays the unstandardized regression coefficient, standardized regression coefficient, *p* value, semipartial correlation, and unique variance contributions for each predictor variable.

Table 12

Coefficients, p Value, Semipartial Correlations, and Unique Variance Contribution for Each Covariate and Predictor Variable in the Regression Analysis

Steps	Covariate/Predictor Variables	*B*	*β*	*p*	*sr*	sr^2
1	AGE	0.008	.019	.793	.016	.000
	GENDER	-0.159	-.017	.783	-.017	.000
	MARITAL	-0.278	-.124	.094	-.101	.010
	EDUC	-0.126	-.057	.352	-.056	.003
	INCOME	-0.075	-.053	.403	-.051	.003
2	COMP_1	0.351	.071	.268	.067	.004
	COMP_2	-0.330	-.064	.303	-.062	.004
	COMP_3	0.665	.134	.033	.129	.017
	COMP_4	-0.087	-.018	.774	-.017	.000
	COMP_5	-0.217	-.042	.505	-.040	.002
	COMP_6	0.196	.037	.549	.036	.001

Note. AGE = age in years at time of survey intake; GENDER = gender of participant; MARITAL = marital status; EDUC = highest grade/level of education completed; INCOME = 2015 annual household family income, COMP_1 = high calorie fatty food & alcohol component, COMP_2 = high fiber food – vegetables & fruits component; COMP_3 = high protein food – meats and fish component; COMP_4 = plant oils component; COMP_5 = low fat dairy, whole grain products & nuts component; COMP_6 = high fat dairy, refined grain products & condiments component

Chapter 5: Discussion & Conclusion

This community-based survey study provides new information on dietary pattern and eating habits of multiethnic population in northern British Columbia in relation to their risk of obesity, and subsequently chronic disease conditions. There was a relatively high response rate (59.6%) compared to average response rate of 20-25% to mail out surveys (Sax, Gilmartin, & Bryant, 2003). Generally, a downward trend in survey response rate has been evident over the last few decades. Survey response rate is heavily influenced by several factors such as mode of administration (e.g., paper-based versus web-based), length of survey, presence of financial incentive, protection of privacy and confidentiality, and sensitivity of survey research topic (Fincham, 2008; Korkeila et al., 2001; Sahlqvist et al., 2011). The high response rate to survey intake was paralleled with low item non-response rate for diet intake variables as well (2.2%). Such a high response rate is considered a very important indicator for well representativeness of study sample, and non-selection bias, especially for small populations (Fincham, 2008).

Other research has indicated that women tend to participate more actively than men in survey research studies (Korkeila et al., 2001; Sax, Gilmartin, & Bryant, 2003); In the current study however, men had a slightly larger representation compared to women (57.7% versus 44.3% respectively). Since the identity of non-respondents is unknown, it is not plausible to assume men had a higher response rate than women, given the non-random convenience and snowball sampling approach implemented in the current study. Furthermore, the study sample had higher representation from younger age groups. The results also revealed that composition of various ethnic groups in this research was not well representative of the relative ethnic population size in British Columbia (Statistics Canada, 2012). This is largely

due to using convenience sampling rather than random sampling method. Add to that, the distribution of ethnic population might vary from northern BC.

5.1 Dietary Patterns for Study Sample

Diet patterns could be defined from FFQ collected data through two main statistical methods, namely factor analysis and cluster analysis (Hu, 2002). Cluster analysis classifies subjects according to their pattern of food intake into homogenous clusters (Désilets et al., 2007; Lenighan et al., 2017), whereas factor analysis classifies food groups and dietary items into dimensions based on correlations of different food items with one another (Newby et al., 2004). Factor analysis includes both common factor analysis and PCA (Tabachnick & Fidell, 2013). Most previous research conducted to define dietary patterns favored PCA over common factor analysis (Brenner et al., 2011; Panagiotakos, Pitsavos, Skoumas, & Stefanadis, 2007; Rezazadeh et al., 2016). This presented an important consideration when selecting an analytical method to define dietary patterns in this study, particularly when comparing results is a matter of interest.

The results of the PCA in my study reduced 63 food items or food groupings into six main components or dietary patterns. The different dietary components were defined by 61 food items indicating a good fit for this analysis. Each component was labeled based on the defining food items leading to the following components in order of their strength *high calorie fatty food & alcohol* component, *high fiber food "vegetables & fruits"* component, *high protein food "meats & fish"* component, *plant oils* component, *low fat dairy and whole grain products & nuts* component, and *high fat dairy, refined grain products & condiments* component, respectively.

The *high calorie fatty food & alcohol* component was the most prominent diet pattern defined by mostly unhealthy energy dense and fatty food items that are consumed in western diet such as French fries, soft drinks, high fat cheese, gravy, whipping cream, ice cream, chips, pizza, high fat cheese, peanut butter, and alcohol. Duck and goose meat, which are mainly consumed by some ethnic sub-populations such as Chinese, were also part of this dietary component. Interestingly, duck and goose are often consumed as part of unhealthy fatty meals. This component was the largest and consequently most predictive explaining 10% of the between-subject variation in dietary intake. This high calorie fatty food and alcohol diet pattern was found to be associated with participants who have younger age ($p <$ .001), male gender ($p < .001$), unmarried ($p < .001$), and lower level of education ($p < .05$).

The *high fiber food "vegetables & fruits"* component was defined by food items rich in fiber including vegetables and fruits (e.g., zucchini, cabbage, lettuce, Orange, green beans, green peas, berries, pineapple, orange, apple, watermelon), and unrefined grains (e.g., brown rice, whole wheat pasta, and bran). Those food items are highly consumed in many ethnic diets including Arab, South Asian, and Chinese. All vegetable and fruit food items were defined by this component except for the tomato food item, which was defined by the *high fat dairy, refined grain products & condiments.* This might be attributed to lumping tomato with processed tomato products such as tomato sauce and tomato paste in the FFQ (q10c). This component is the second largest and consequently explains 7.7% of the between-subject variation in dietary intake. This high fiber diet pattern was found to be associated with participants with female gender ($p < .01$), lower level of education ($p < .01$), and higher level of income ($p = .08$).

The *high protein food "meats & fish"* component was defined by food items rich in protein that are largely part of western diet pattern including red meat, processed meats, chicken, poultry, turkey, fish, veal, deep fried and breaded chicken or fish, sea foods, and eggs. Further, food items that are commonly consumed with high protein food clustered on the same component such as white rice, pasta, and spaghetti. This component was the third largest component explaining 7.6% of the between-subject variation in dietary intake. It was almost a similar amount to that explained by the *high fiber food "vegetables & fruits"* component. This high protein diet pattern was found to be associated with participants who have younger age ($p < .05$), and male gender ($p = .06$), and higher level of education ($p < .01$). Lenighan et al. (2017) found total red meat intake in males is approximately 1.5 times that for females.

The *plant oils* component was purely defined by different types of plant-based sources of fat including olive oil, corn oil, sunflower oil, and canola oil. It explained 4.9% of the between-subject variation in dietary intake. This plant oils component was found to be associated with participants who have higher level of education ($p < .05$). The *low fat dairy and whole grain products & nuts* component was defined by healthier dietary items including low fat dairy product (e.g., low fat milk, low fat ice cream & yogurt, cottage and ricotta cheese), whole wheat products (e.g., whole wheat pita, whole wheat bread), nuts, and garlic, and cereals. It explained 4.6% of the between-subject variation in dietary intake. This low fat whole grain diet pattern was found to be associated with participants who have older age ($p < .01$), married ($p < .001$), with higher level of education ($p < .05$). Finally, the *high fat dairy, refined grain products & condiments* component was defined by unhealthy dietary items that are largely part of western diet pattern including high fat dairy products (e.g.,

cheddar & mozzarella cheese, and butter), refined grain products (e.g., white bread, white pita, muffins, pancakes, and waffles), chocolates & desserts, and margarine. Further, other food item clustered on this component included condiments and tomato products (e.g., tomato, tomato sauce, and tomato paste). It explained 4.4% of the between-subject variation in dietary intake. This high fat dairy refined grains diet pattern was found to be associated with participants who have younger age ($p < .01$).

Almost all dietary items in the FFQ clustered on the identified dietary components. Natural fruit juices, and peas & lentils were the only exception as none of them clustered with other food items in any component. Additionally, very few items clustered on two dietary components such as ricotta and cottage cheese loading on both the *high calorie fatty food & alcohol* component and *low fat dairy and whole grain products & nuts* component. Conversely, most dietary items clustered uniquely on one dietary component except very few dietary items that clustered on two factors. This indicates a more reliable solution with easier interpretability for the dietary components (Tabachnick & Fidell, 2013). Together, the six main dietary patterns in this study explained a significant amount of the variability in the dietary variables accounting for 39.1% of the between-subject variation in dietary intake.

Previous studies conducted to identify dietary patterns through the PCA have produced different dietary patterns that ranged between three to six main components. The difference in the number of identified diet patterns is attributed to using different food grouping classifications and different number of dietary items in the FFQ, in addition to the researcher's preference to extract a specific number of components or dietary patterns based on interpretability. Brenner et al. (2011) identified three distinct diet patterns amongst a sample of young adults living in Toronto with diverse ethnic backgrounds, which

cumulatively accounted for only 16% of the between person variance in dietary intake. Another study by Newby et al. (2004) identified six distinct diet food patterns amongst a sample of Caucasian and ethnic men and women living in the Baltimore area, which cumulatively accounted for 27% of the variance in dietary intake. The ATTICA study identified six diet patterns amongst a random sample of 3042 participants from Greece, which accounted for 56% of the total variation in the dietary intake. More importantly, this study identified independent association between diet patterns and components of the metabolic syndrome. The Peel and Nutrition Heart Health Survey study also identified six dietary patterns amongst 759 subjects from the Peel region in Ontario, Canada (Shubair, McColl, & Hanning, 2005). The study concluded the presence of an association between Mediterranean diet pattern and reduced prevalence of overweight and obesity.

Recent research produced the concept of healthy "prudent" diet, which is the antithesis of the western atherogenic diet (Hu 2002; Hu et al., 2000; Hu & Willet, 2002). Prudent diet is characterized by higher consumption of fruits, vegetables, legumes, nuts, whole grains, low fat dairy products, fish, and soy products. On the other side, western diet is characterized by higher consumption of energy dense foods rich in calories and saturated fat & trans-fat with higher glycemic index which includes increased intake of red & processed meats, high fat dairy products, French fries & potatoes, sweets & desserts, refined grains, and alcohol (Cordain et al., 2005). Prudent diet, a modification of Mediterranean diet, is believed to be applicable to populations from different ethnic and cultural backgrounds (Enas, Senthilkumar, Chennikkara, & Bjurlin, 2003). According to the study results, three dietary components were identified as western diet patterns including the *high calorie fatty food & alcohol* component, the *high protein food "meats and fish"* component, and the *high*

fat dairy, refined grain products & condiments component (Figure 4). The western diet patterns consisted of mainly unhealthy food items and were significantly associated with younger age men. Conversely, the other three dietary components were identified as prudent diet patterns including the *high fiber food "vegetables & fruits"* component, the *plant oils* component, and the *low fat dairy and whole grain products & nuts* component (Figure 5). The prudent diet patterns consisted of mainly healthy food items and were associated significantly with higher level of education and mostly women.

5.2 Healthy Body Weight Status and Association with Dietary Patterns

Men had higher BMI than woman with relatively larger proportion of men being overweight (i.e., pre-obese), compared to women. This finding was echoed in a study by Brenner et al. (2011), which explored dietary patterns for ethno-culturally diverse population of young adults in Toronto. Overall, approximately 37% of participants were considered either obese or pre-obese. More importantly, the three prudent-like diet patterns identified in this study were inversely correlated with BMI, where the *high fiber food* "*vegetables & fruits*" diet pattern had the strongest negative association. On the other hand, the other three western-like diet patterns were positively correlated with BMI, where the *high protein food* "*meats & fish*" diet pattern had the strongest positive association.

To test the relationship between diet patterns identified in our study and body mass index while taking into consideration sociodemographic variables, the results of a multi-adjusted multiple regression analysis revealed that a diet pattern that includes meats, pasta and rice was a significant predictor of body mass index. Participants with higher consumption of red meats, processed meats, sea foods, breaded and fried chick and fish, eggs, and rice & pasta tend to have higher body mass index even after controlling for

sociodemographic variables. This is a significant finding in our study that indicates acculturation to western diet is associated with higher risk of morbid obesity and subsequently other chronic disease conditions such as hypertension, type 2 diabetes mellitus, and cardiovascular disease. A working group related to the International Agency for Research on Cancer (IARC) classified the consumption of processed red meat in humans as "probably carcinogenic" based on epidemiological evidence from several cohort studies that concluded positive associations with colorectal and other types of cancer (Bouvard et al., 2015).

The other two western diet patterns were not significant predictors of body mass index. The results also indicated a significant correction for the adjusted squared multiple correlation (SMC) between the dietary component variables and body mass index while adjusting for sociodemographic variables. This could potentially explain the inability to detect some significant association with the statistical power of our study, which was geared towards medium and large size effects based on sample size. The findings were consistent with the results from Newby et al. (2004), who hypothesized that a healthy food pattern would predict small modest changes in the BMI and waist circumference than would a non-healthy diet pattern. This is attributed to BMI being influenced by total energy intake, which minimally changes with healthier diet patterns. This theoretical hypothesis also justifies the non-significance of the three prudent diet patterns as predictors for BMI in the present study.

5.3 Study Limitations

Dietary patterns were not examined separately for each gender or ethnic group due to the inadequate number of subjects in each of these groups, and an inability to make sufficiently powered statistical comparisons. Also, there was neither an equal representation

of men and women (58% males versus 42% females), nor a true ethno-cultural representation of different ethnic minorities in BC at large. According to the 2006 Canadian census, Chinese were the largest ethnic minority in BC representing 40% of the total non-Caucasian ethnic population (Statistics Canada, 2010). South Asians, Filipino, Korean, South East Asians, and Japanese were the other largest ethnic minorities in BC representing 26%, 9%, 5%, 4%, and 3%, respectively. On the other hand, the sample population in this study had 12% Chinese, 38% South Asians, 17% Black, and 9% Arabs, 7% Filipino, and 5% Koreans. The misrepresentation and lack of generalizability in the sample population might have influenced the study results. Another limitation to this study is the possibility of response bias and socially desirable responses, which is anticipated when responding to measures of healthfulness of diet and body weight status. Using PCA as an analytical technique has its own limitations regarding assuming independence between dietary dimensions (components), and the subjectivity of choosing the number of factors by the researcher. Similar to all observational research designs, causal relationship cannot be inferred from this study.

5.4 Future Research

As concluded in this study, men and women have differences in their dietary habits, and also their risk of obesity. Diet patterns are likely to differ by gender as indicated by previous research by Brenner et al. (2011) and Newby et al. (2004). Further research should examine dietary patterns separately for men and women to test whether such findings are due to biologic interaction between diet and gender rather than possible methodological limitations. Also, further research is needed to investigate the relationship between dietary patterns in ethnic populations and risk of the metabolic syndrome and CVD. There is a need

to examine dietary patterns separately for each ethnic subpopulation. This might yield unique results that are possibly masked by lumping different heterogeneous subgroups together. Exploring dietary pattern specific to ethnicity and culture shall help guide a more sensitive and effective dietary interventions. In light of some findings in this study regarding socioeconomic influences on diet patterns and dietary intake, future research examining food security in northern Canadian rural communities is warranted.

5.5 Conclusion

To the best of my knowledge, this is the first study to examine dietary patterns among different non-Indigenous ethnic population in a Canadian northern rural community or elsewhere in British Columbia. This study investigated the association between the dietary patterns and healthy body weight status. Most previous studies on dietary patterns of ethnic populations were conducted with residents of large urban Canadian cities including Toronto, and Montreal (Brenner et al., 2011; Désilets et al., 2007). Recent research suggests that studying diet pattern rather than individual nutrients is considered a more robust and holistic approach. This is based on research findings indicating that diet acts via different metabolic pathways through synergistic mechanisms and complex interactions where beneficial healthy food effects are augmented when certain types of food are consumed in conjunction (Jacobs & Steffen, 2003). From a nutritional epidemiology point of view, studying diseases in relation to "dietary pattern" rather than "single nutrient" is a more superior approach with less conceptual and methodological limitations (Hu, 2002). Similarly, introducing dietary modifications and interventions altering dietary pattern is far more effective than single nutrient supplementation (Enas et al., 2003). There is also a multitude of prospective research

studies that suggests examining the relationship between diet patterns and risk for different chronic diseases (Kenfield et al., 2014; Mattei et al., 2017; VanKim et al., 2017).

The current study found that six dietary components might characterize the dietary intake of participants from multi-ethnic background in northern British Columbia. Further examination identified some patterns related to western diet, which typically occurs as a result of dietary transitional process following immigration to western countries referred to as "dietary acculturation". Such dietary patterns consistent with western diet are found to place ethnic individuals at higher risk of obesity. More significantly, younger ethnic men regardless of their level of education were found to be at a disadvantage of higher adherence to western diet patterns. Men in general were also found to be at higher risk of obesity. It was found that the diet pattern structure for ethnic minorities include some prudent-like diet patterns defined by healthy dietary intake, which is typically part of many ethnic diets such as Chinese, South Asian, and Mediterranean diets. There has been emerging research around promoting prudent diet in ethnic minorities to reduce the risk of obesity, type 2 diabetes, cardiovascular disease, and the metabolic syndrome. Enas and colleagues assert that promoting prudent diet rich in vegetables, fruits, nuts, legumes and olive oil with moderate intake of fish and poultry and low intake of red meats, eggs, dairy products and wine is feasible through applying adaptations to different ethnic diets and related food preparation methods. Such prudent diet is more beneficial than low fat and low carbohydrate diet regimens commonly adopted for body weight management (Enas et al., 2003). Bedard et al. (2010) showed an evidence that promoting a Mediterranean diet intervention in healthy French-Canadian women led to significant reduction in both unhealthy fast food consumption and body weight. Dietary interventions in the form of promoting healthy eating

pattern consistent with prudent diet is a cornerstone in addressing the ever-rising epidemics of obesity, diabetes and CVD. This has a greater importance for populations getting acculturated to unhealthy eating habits including immigrant and ethnic populations. Promoting adherence to ethnic food culture and habits in these populations definitely has scientific merit. Such recommendations for tailoring ethnically appropriate dietary interventions promise to promote healthier life style modification including healthy dietary intake in vulnerable ethnic populations.

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Appendix A

Dietary Pattern Survey Questionnaire

Thesis Title: Dietary Patterns of Ethnic Non-Indigenous Populations in Northern British Columbia: A Cross-Sectional Survey Study

Yaser Ahmed

March 29, 2016

The next question is included for screening purposes:

SCREEN_1. Are you on a special diet regimen because of **kidney failure** or **Celiac disease**?

<1> Yes

<2> No

<98> Don't know

SOCIO_1. What is your age?

Enter age between 19 years and 130 years:_|_|_|_|_| *AND* year of birth: :_|_1|9_|_|_|

OR ☐ Don't know

SOCIO_2. Gender: Are you a male or female?

<1> Male

<2> Female

<3> Other

<4> Do not wish to disclose

<98> Don't know

SOCIO_3. Weight: What is your weight? Can you please measure your body weight using a scale and indicate weight below?

Enter your weight:

|_|_|_| in ☐Pounds (lbs) ***or*** ☐Kilograms (kg)

OR ☐ Don't know

SOCIO_4. Height: What is your height?

Enter your Height:

|_| Feet (ft.) and |_|_| Inches (in)

OR |_|_|_| Centimeters (cm)

OR ☐ Don't know

Postal code

What are the first three digits of your postal code?

Enter the first three digits: |_|_|_| *OR* ☐ Don't know

First Section:

I'd like to start by asking you **three** questions regarding your health status:

q1. Are you presently…?

<1> diabetic
<2> prediabetic
<3> non-diabetic

q2. Do you have high blood pressure…?

<1> yes
<2> no
<98> Don't know
<99> Refused

q3. Do you have high cholesterol…?
<1> yes
<2> no
<98> Don't know
<99> Refused

Second Section: Diet Pattern Questions:

I would like to ask some questions about your eating habits for specific foods. There are nine sections to this part of the survey. Please circle one response only.

Please review in your mind how often on overage have you eaten certain vegetables and fruits over the past month. You will be able to respond in the following categories: *More than once per day*; *Everyday*; *Five to six days per week*; *Two to four days per week*; *One day per week*; *Less than one day per week*; *Never; or Don't know*.

q4. First, over the past month, how often on average did you eat **green leafy vegetables** such as lettuce, spinach, bok choy?

<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q5. Over the past month, how often on average did you eat **orange and dark yellow vegetables** such as carrots, squash, or sweet potatoes, including such vegetables in soups, casseroles, or stir fries AND fresh, frozen, or canned vegetables?

<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q6. Over the past month, how often on average did you eat **cabbage-type of vegetables** such as Chinese cabbages, broccoli, coleslaw and uncooked cabbage, cooked cabbage, cauliflower, Brussels

sprouts, kale, mustard greens, chard greens, or collard greens, including fresh, frozen, or canned vegetables?

<1> More than once per day

<2> Everyday (7 days per week)

<3> 5-6 days per week

<4> 2-4 days per week

<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)

<7> Never

<98> Don't know

q7. Over the past month, how often on average did you eat **other vegetables** such as celery, mushrooms, sweet peppers, corn, mixed vegetables, eggplant, zucchini, okra, bean sprouts, or alfalfa sprouts including fresh, frozen, or canned vegetables?

<1> More than once per day

<2> Everyday (7 days per week)

<3> 5-6 days per week

<4> 2-4 days per week

<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)

<7> Never

<98> Don't know

q8. Over the past month, how often on average did you eat **green and yellow beans, fava beans, OR green peas or snow peas**? This includes fresh, frozen, or canned beans or peas?

<1> More than once per day

<2> Everyday (7 days per week)

<3> 5-6 days per week

<4> 2-4 days per week

<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)

<7> Never

<98> Don't know

q9a. Over the past month, how often on average did you eat **non-citrus fruits** such as apples, grapes, pears, peaches, apricots, plums, or bananas? This is EXCLUDING fruit juices, but would include non-sweetened canned (e.g., apple sauce), frozen, or dried fruits (e.g., dried apricots).

<1> More than once per day

<2> Everyday (7 days per week)

<3> 5-6 days per week

<4> 2-4 days per week

<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)

<7> Never

<98> Don't know

q9b. Over the past month, how often on average did you eat **citrus fruits** such as oranges, lemon, or grapefruit? Again, this EXCLUDES juices, but would include non-sweetened canned or jarred fruit?

<1> More than once per day

<2> Everyday (7 days per week)

<3> 5-6 days per week

<4> 2-4 days per week

<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)

<7> Never

<98> Don't know

q9c. EXCLUDING juices, over the past month, how often on average did you eat **melons** such as cantaloupes, watermelons?

<1> More than once per day

<2> Everyday (7 days per week)

<3> 5-6 days per week

<4> 2-4 days per week

<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)

<7> Never

<98> Don't know

q9d. EXCLUDING juices, over the past month, how often on average did you eat **berries** such as strawberries, blueberries, raspberries, or blackberries including unsweetened canned or frozen berries?

<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q9e. EXCLUDING juices, over the past month, how often on average did you eat **tropical fruits** such as papaya, mango, avocado, passion fruit or pineapple including canned tropical fruits such as canned papaya, canned mango, and canned pineapple?

<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q10a. Over the past month, how often on average did you eat or use **ketchup** with your food?

<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q10b. Over the past month, how often on average did you eat **pizza** which used tomato sauce or tomato paste as a topping?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q10c. EXCLUDING ketchup and tomato sauce or tomato paste on pizza; over the past month, how often did you eat **tomatoes, tomato sauce, or tomato paste** in your food or drink tomato juice?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

Third Section:
The next set of questions deals with how often you have eaten grains, lentils, and starch-type foods over the past month. You will be able to respond in the following categories: *More than once per day*; *Everyday*; *Five to six days per week*; *Two to four days per week*; *One day per week*; *Less than one day per week*; or *Never*.

q11a. Over the past month, how often on average did you eat **french fries** which were deep fried in oil, including fries made at home or fries eaten away from home including hash brown for example?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week

<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q11b. EXCLUDING french fries, over the past month, how often on average did you eat **frozen potato products**?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week 7
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q11c. Over the past month, how often on average did you eat **baked, boiled, mashed, or roasted potatoes** BUT EXCLUDING french fries, potato chips, or any frozen potato products?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q12. Over the past month, how often on average did you eat **cooked breakfast cereals** such as porridge, oatmeal, cream of wheat, or other cooked breakfast cereal?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q13. Over the past month, how often on average did you eat **products made of white flour**, such as white bread, pita, naan, paratha, roti, chapatti, muffins, bagels, buns, rolls, muffins, biscuits, pancakes, waffles, or plain crackers?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q14. Over the past month, how often on average did you eat **whole wheat foods**, such as whole wheat bread, pita, or naan, whole wheat paratha, whole wheat roti, whole wheat chapati, whole wheat muffins, whole wheat bagels, whole wheat buns, whole wheat rolls, whole wheat biscuits, whole wheat pancakes, whole wheat waffles, or whole wheat crackers?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q15. Over the past month, how often on average did you eat **white** rice including rice pudding or kheer, pasta, spaghetti, macaroni, noodles, rice noodles, or polenta?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week

<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q16. Over the past month, how often on average did you eat **brown** rice, **whole wheat** pasta, **other grains** i.e., barley, millet, whole wheat couscous, buck wheat, kasha, bulgar, OR bran included in your food, wheat germ, roti, chapatti, or tabouli?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q17. Over the past month, how often on average did you eat **split peas, chickpeas or hummus, or dried beans such as kidney beans, black beans, white beans, fava beans, pinto beans, or lentils**?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

This section of the survey, we will be asking you how often on average have you eaten meats, fish, and poultry over the past month.

q18a. Over the past month, how often on average did you eat **deep fried or breaded** fish or chicken?
<1> More than once per day

<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q18b. **Excluding deep fried and breaded fish products**, over the past month how often on average did you eat fresh, frozen, or canned **white fish**, such as sole, halibut, cod, whitefish, haddock, or other white fish?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q19. EXCLUDING deep fried and breaded fish products, over the past month how often on average did you eat fresh, frozen, or canned **dark fish**, such as salmon, sardines, mackerel, trout, herring, tuna, bluefish, or swordfish?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q20. EXCLUDING deep fried and breaded shellfish products, over the past month how often on average did you eat **shellfish or other sea foods**, such as shrimp, lobster, crab, squid, octopus, clams, oysters, mussels, scallops or other shellfish?

<1> More than once per day

<2> Everyday (7 days per week)

<3> 5-6 days per week

<4> 2-4 days per week

<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)

<7> Never

<98> Don't know

q21a. EXCLUDING deep fried and breaded chicken or turkey, over the past month how often on average did you eat **chicken or turkey** whether it's roasted, baked, or grilled?

<1> More than once per day

<2> Everyday (7 days per week)

<3> 5-6 days per week

<4> 2-4 days per week

<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)

<7> Never

<98> Don't know

q21b. EXCLUDING deep fried and breaded duck or goose, over the past month how often on average did you eat **duck or goose** whether it's roasted, baked, or grilled?

<1> More than once per day

<2> Everyday (7 days per week)

<3> 5-6 days per week

<4> 2-4 days per week

<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)

<7> Never

<98> Don't know

q22a. Over the past month, how often on average did you eat **eggs with yolks**?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q22b. Over the past month, how often on average did you eat **egg whites**; that is to say eggs without yolks?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q23. Over the past month, how often did you eat **foods made with ground meats**, such as meat balls, meat loaf, ground meats in sauces such as spaghetti meat sauce, hamburgers or cheeseburgers?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q24. Over the past month, how often on average did you eat **organ meats**, such as liver, kidney, heart, or other organ meats?

<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q25. Over the past month, how often on average did you eat **processed meats** such as hot dogs, salami, corned beef, bologna, wieners or sausages, bacon, ham, luncheon meats or other processed deli-style or canned meats?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q26. EXCLUDING ground meats AND processed meats, over the past month how often on average did you eat **beef, pork, or lamb** such as steaks, roasts, stews, chops or other cuts?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q27. EXCLUDING ground meats AND processed meats, over the past month how often on average did you eat **veal, goat, or rabbit** such as steaks, roasts, stews, chops or other cuts?

<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

The following section deals with **Snack-type foods**. You will be able to respond in the following categories: *More than once per day*; *Everyday*; *Five to six days per week*; *Two to four days per week*; *One day per week*; *Less than one day per week*; or *Never*.

q28. Over the past month, how often on average did you eat **chocolate** bars, chocolate pieces, cookies, brownies, doughnuts, cake, pie, coffee cake, sweet roll, or pastry?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q29. Over the past month, how often on average did you eat peanut butter, or sesame butter?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q30. Over the past month, how often on average did you eat **nuts** such as peanuts, pistachios, almonds, hazelnuts, pecans, cashews, chestnuts, walnuts, or pine nuts?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q31. EXCLUDING NUTS, over the past month how often on average did you eat **snacks** such as potato chips, corn chips, popcorn with butter, nachos, tortilla chips, or papadum?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q32. EXCLUDING cream and homogenized milk, over the past month, how often on average did you drink **2% milk, 1% milk, or skim milk**? This includes both **fresh milk or evaporated or powdered milk**. This also includes milk used in cereals, sauces, or soups?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

The next set of questions deals with dairy and other high-protein foods.

q33. Over the past month, how often on average did you eat **frozen low-fat dairy products**, such as low-fat or non-fat ice cream, frozen yoghurt, ice milk or sherbet?

<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q34. Over the past month, how often on average did you eat **plain or sweetened yoghurt**?

<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q35a. Over the past month, how often on average did you drink **homogenized milk**? This includes milk used in cereals, sauces, or soups?

<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q35b. Over the past month, how often on average did you eat **regular or rich ice cream**?

<1> More than once per day

<2> Everyday (7 days per week)

<3> 5-6 days per week

<4> 2-4 days per week

<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)

<7> Never

<98> Don't know

q36. Over the past month, how often on average did you eat **paneer, cottage cheese or ricotta cheese**?

<1> More than once per day

<2> Everyday (7 days per week)

<3> 5-6 days per week

<4> 2-4 days per week

<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)

<7> Never

<98> Don't know

q37a. Over the past month, how often on average did you use **cream in your coffee or tea**?

<1> More than once per day

<2> Everyday (7 days per week)

<3> 5-6 days per week

<4> 2-4 days per week

<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)

<7> Never

<98> Don't know

q37b. EXCLUDING cream added to your coffee or tea, over the past month how often on average did you use **whipping cream, sour cream, or cream cheese** in your food?

<1> More than once per day

<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q38. EXCLUDING paneer, cottage cheese, ricotta cheese, and cream cheese, over the past month how often on average did you eat cheese such as **cheddar cheese, mozzarella cheese, brie, feta cheese or goat cheese**?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q39. Over the past month, how often on average did you eat **soy products** such as soybeans, tofu, miso, tempeh, soy 'milk', soy cheese, soy flakes, soy grits, or soy flour, but NOT soy sauce?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

Sixth Section:

The next set of questions deals with various beverages you may drink.

q40. EXCLUDING tomato juice, over the past month, how often on average did you drink **100% or natural fruit juices** such as apple juice, orange juice, grapefruit juice, or other 100% fruit juices?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q41a. Over the past month, how often on average did you drink **regular soft drinks** such as regular coke, regular pepsi, or regular gingerale, OR fruit-flavoured drinks such as *Kool-Aid*, *Fruite*, *Gatoraide*, *Sunny Delight*, lemonade, fruit punch, or iced tea?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q41b. Over the past month, how often on average did you **drink diet soft drinks** such as diet coke, diet pepsi, diet gingerale, or any other diet soft drink?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

The next set of questions will ask you about foods that are commonly used as flavourings.

q42. Over the past month, how often on average did you add **spicy condiments** such as chilli sauce, salsa, mustard, pepper, curry, turmeric, cardamon, fennel seeds, cumin, coriander, Szechuan peppercorns, chutney, steak sauce, soy sauce, Worcestershire sauce, or wasabi to your food?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q43. Over the past month, how often on average did you **add sweet condiments** such as jam, jelly, corn or maple syrup, honey, or molasses to your food?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q44. Over the past month, how often on average did you **add gravy, hollandaise, or cheese sauce** (such as *Velveeta cheese sauce*) to your food?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never

<98> Don't know

q45. EXCLUDING garlic supplements, minced or powdered garlic, and garlic salt over the past month how often on average did you use **fresh garlic** in your food?

<1> More than once per day

<2> Everyday (7 days per week)

<3> 5-6 days per week

<4> 2-4 days per week

<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)

<7> Never

<98> Don't know

Eighth Section:

Now I would like to ask you about Fats and Oils that you use in your food.

q46. Do you prefer to use **ghee, butter or margarine** in your food?

<1> More than once per day

<2> Everyday (7 days per week)

<3> 5-6 days per week

<4> 2-4 days per week

<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)

<7> Never

<98> Don't know

q47. Over the past month, did you include **olive oil in your meals**?

<1> Yes [go to q48]

<2> No [skip to q51] – EXIT olive oil questions and go to *other liquid cooking oils* question

<98> Don't know

q48. Over the past month, how often on average did you eat food that was **fried or grilled** with olive oil?

<1> More than once per day

<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q49. Over the past month, how often on average did you eat **salad dressings** made with olive oil?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q50. Over the past month, how often on average did you eat **other foods with olive oil**, for example olive oil added to food such as pita bread, hummus, tabouli, or olive oil on top of other foods?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q51. Over the past month, how often on average did you eat food that was **fried or grilled with liquid cooking oils OTHER THAN olive oil**, such as canola oil, peanut oil, corn oil, safflower oil, or soybean oil but EXCLUDING "spray-on oils" such as PAM?
<1> More than once per day
<2> Everyday (7 days per week)

<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

q52. Over the past month, how often on average did you eat food that was **fried or grilled with lard or shortening**?
<1> More than once per day
<2> Everyday (7 days per week)
<3> 5-6 days per week
<4> 2-4 days per week
<5> 1 day per week
<6> Less than 1 day per week (e.g., once or twice a month)
<7> Never
<98> Don't know

We are coming towards the end of the survey. I just have a few more questions dealing with demographics, so that we can see how our sample compares to the general Canadian population.

q53. Over the past five years, have you changed your diet or eating habits?
<1> Yes
<2> No [go to q54]
<98> Don't know
If **Yes**, how have you changed your diet or eating habits over the past five years?
_____
_____
_____
_____
(open-ended question)

q54. Do you consider yourself a vegetarian or vegan?

<1> Yes

<2> No

<98> Don't know

q55. Over the past month, how often on average did you have a drink containing alcohol?

<1> More than once per day

<2> Every day (7 days per week)

<3> 5-6 days per week

<4> 2-4 days per week

<5> 1 day per week

<6> Less than 1 day per week (e.g., once or twice a month)

<7> Never

<98> Don't know

The next three questions are about leisure-time (recreational) physical activity.

q56. First, which of the following best describes your physical activity pattern?

<1> I am not physically active.

<2> I do light activity like washing a car, walking the dog.

<3> I do moderate activity, like brisk walking, dancing, skating.

<4> I do heavy activity, like aerobics, jogging, or hiking

<5> I do strenuous activity, like hockey, running, squash.

<98> Don't know

q57. In a typical week, how often are you physically active? Would you say daily or almost every day, three to five times per week, one or two times per week, or a few times per month?

<1> Daily or almost every day

<2> 3 to 5 times per week

<3> 1 to 2 times per week

<4> A few times per month

<5> Never

<98> Don't know

q58. On average how many minutes/hours do you usually spend being physically active in a typical week?

|_|_|_|_| in ☐ Minutes (mins) ***or*** |_|_|_|_| in ☐Hours (hrs)

OR ☐ Don't know

q59. In general, how would you describe your health? Would you say excellent, good, fair, or poor?

<1> Excellent

<2> Good

<3> Fair

<4> Poor

<98> Don't know

q60. Do you consider yourself to be overweight, underweight, or just about right?

<1> Overweight

<2> Underweight

<3> Just about right

<98> Not sure/ Don't know

q61. Would you like to do something to lose weight?

<1> Yes

<2> No

<98> Undecided/ Don't know

q62. What is your current marital status?

<1> Married or common law or living with a partner

<2> Living with a partner

<3> Living alone

<4> Divorced

<5> Separated

<6> Never married

q63. What is the highest grade or level of education you have completed?

_____ highest grade or level of education

<1> No formal schooling
<2> Some elementary school
<3> Completed elementary school (Grade 8)
<4> Some high school/junior high
<5> Completed high school (Grade 12 or 13)
<6> Some community or technical college
<7> Completed community or technical college
<8> Some university
<9> Completed bachelors or undergraduate degree (arts, science, engineering, etc.)
<10> Postgraduate degree: MA, MSC, MLS, MSW, etc.
<11> Postgraduate degree: PhD or Doctorate
<12> Professional degree: Law, Medicine, Dentistry, Engineering etc.
<13> Other (Specify)

_____

<98> Don't know

q64. Could you please tell me how much income you and other members of your household received in the year ending **December 31, 2015**, before taxes?
Please include income FROM ALL SOURCES such as savings, investments, pensions, rent, and unemployment insurance as well as salaries and wages.
We do NOT need the exact amount; could you tell me which of these broad categories it falls into…
<1> Less than $10,000
<2> Between $10,000 and $19,999
<3> Between $20,000 and $29,999
<4> Between $30,000 and $39,999
<5> Between $40,000 and $49,999
<6> Between $50,000 and $59,999
<7> Between $60,000 and $69,999
<8> Between $70,000 and $79,999
<9> Between $80,000 and $89,999
<10> Between $90,000 and $99,999
<11> Between $100,000 and $150,000
<12> More than $150,000
<98> Don't know

q65. What is the place of your birth?

_____

q66. Where were your parents born?

Place of birth (mother) _____

Place of birth (father) _____

q67a. People living in Canada come from many different cultural and ethnic backgrounds. Are **you**:

1. White?
2. Chinese?
3. South Asian (e.g., East Indian, Pakistani, Sri Lankan, etc.?)
4. Black?
5. Filipino?
6. Latin American?
7. Southeast Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese, etc.)?
8. Arab?
9. West Asian (e.g., Afghan, Iranian, etc.)?
10. Japanese?
11. Korean?
12. Aboriginal Peoples of North America (North American Indian, Métis, Inuit)?
13. Other (please specify): _____
14. Nothing
15. Don't know

q67b. How about **your parents'** cultural or ethnic background?

1. White?
2. Chinese?
3. South Asian (e.g., East Indian, Pakistani, Sri Lankan, etc.?)
4. Black?
5. Filipino?
6. Latin American?
7. Southeast Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese, etc.)?
8. Arab?
9. West Asian (e.g., Afghan, Iranian, etc.)?
10. Japanese?
11. Korean?
12. Aboriginal Peoples of North America (North American Indian, Métis, Inuit)?
13. Other (please specify): _____
14. Nothing
15. Don't know

q68. How long have you been living in Canada or any other western Country?

<1> Since the year of 19____ /20____

<2> Second generation immigrant (i.e. one parent or both born outside Canada)

<3> Third generation immigrant or more (i.e., both parents born in Canada but at least one grandparent or more born outside Canada

<97> Nothing

<98> Don't know

Ninth Section (Acculturation):

At the end, I would like to ask you few questions about your eating habits before and after moving to Canada from your home country. You should not answer this set of questions if you were born in Canada, moved at a very young age, or think that this set of questions does not apply to you:

q69. Has your general portion size (how much you eat in one meal) changed since coming to Canada?
(1- Eat much less, 3- No change, 5- Eat much more)

q70. How has your method of food preparation changed since coming to Canada?

- Stir-frying/BBQ (1-Much less often, 3- No change, 5-Much more often)
- Baking/grilling food (1-Much less often, 3- No change, 5-Much more often)
- Boiling food (1-Much less often, 3- No change, 5-Much more often)
- Deep frying food (1-Much less often, 3- No change, 5-Much more often)
- Microwaving food (1-Much less often, 3- No change, 5-Much more often)
- Eating vegetables raw (1-Much less often, 3- No change, 5-Much more often)
- Home-made foods (1-Much less often, 3- No change, 5-Much more often)

q71. How have the foods you generally eat changed since coming to Canada?

- Vegetables (1- Eat much less, 3- No change, 5- Eat much more)
- Potatoes, rice (1- Eat much less, 3- No change, 5- Eat much more)
- Fruit (1- Eat much less, 3- No change, 5- Eat much more)
- Soft drinks/pop/soda (1- Eat much less, 3- No change, 5- Eat much more)
- Dairy products (1- Eat much less, 3- No change, 5- Eat much more)
- High fat/fried foods (1- Eat much less, 3- No change, 5- Eat much more)

- Deserts/candy/sweets (1- Eat much less, 3- No change, 5- Eat much more)
- White meat (1- Eat much less, 3- No change, 5- Eat much more)
- Red meat (1- Eat much less, 3- No change, 5- Eat much more)
- Restaurant meals/dining out (1- Eat much less, 3- No change, 5- Eat much more)

q72. Has your interest in information about the food you eat, such as ingredients, nutrition information and taking note of food labels, changed since coming to Canada?

- I look at ingredients in the food I buy:
(1- Much less often, 3- No change, 5- Much more often)
- I put effort into making sure the food I buy has good nutritional value:
(1- Much less often, 3- No change, 5- Much more often)
- I read the nutritional information table on food products:
(1-Much less often, 3- No change, 5-Much more often)
- I understand the nutritional information table on food products:
(1-Much less often, 3- No change, 5- Much more often)
- I hear about which foods are good for me through the media and advertising:
(1-Much less often, 3- No change, 5-Much more often)

q73. How do you feel about these issues in Canada compared to your home country?

- Finding fresh fruit and vegetables:
(1- Much harder in Canada, 3- No change, 5- Much easier in Canada)
- Finding low fat food options:
(1- Much harder in Canada, 3- No change, 5- Much easier in Canada)
- Choosing healthy food when dining out:
(1- Much harder in Canada, 3- No change, 5- Much easier in Canada)
- Finding ethnic food ingredients:
(1- Much harder in Canada, 3- No change, 5- Much easier in Canada)

Thank you for your participation. This is the *END* of the Survey.

Appendix B

Number of Missing Responses by Dietary Item

Dietary item	"do not know" response	No response	Missing responses	% Missing responses
q4	1	3	4	1.0%
q5	2	0	2	0.5%
q6	2	2	4	1.0%
q7	2	3	5	1.2%
q8	9	5	14	3.4%
q9a	2	0	2	0.5%
q9b	7	1	8	2.0%
q9c	8	1	9	2.2%
q9d	7	1	8	2.0%
q9e	7	1	8	2.0%
q10a	2	2	4	1.0%
q10b	3	2	5	1.2%
q10c	2	1	3	0.7%
q11a	2	8	10	2.4%
q11b	8	2	10	2.4%
q11c	5	0	5	1.2%
q12	6	3	9	2.2%
q13	5	0	5	1.2%
q14	6	0	6	1.5%
q15	5	1	6	1.5%
q16	6	2	8	2.0%
q17	9	2	11	2.7%
q18a	3	4	7	1.7%
q18b	6	1	7	1.7%
q19	10	2	12	2.9%
q20	2	4	6	1.5%
q21a	0	3	3	0.7%
q21b	5	2	7	1.7%
q22a	1	1	2	0.5%
q22b	6	2	8	2.0%
q23	4	2	6	1.5%
q24	10	12	22	5.4%
q25	4	2	6	1.5%
q26	1	1	2	0.5%
q27	7	5	12	2.9%
q28	0	1	1	0.2%
q29	6	1	7	1.7%
q30	5	1	6	1.5%

q31	5	1	6	1.5%
q32	1	4	5	1.2%
q33	4	1	5	1.2%
q34	2	3	5	1.2%
q35a	8	3	11	2.7%
q35b	10	3	13	3.2%
q36	11	2	13	3.2%
q37a	0	4	4	1.0%
q37b	15	5	20	4.9%
q38	7	3	10	2.4%
q39	7	1	8	2.0%
q40	6	15	21	5.1%
q41a	2	4	6	1.5%
q41b	4	3	7	1.7%
q42	4	3	7	1.7%
q43	4	1	5	1.2%
q44	7	2	9	2.2%
q45	3	1	4	1.0%
q46	10	0	10	2.4%
q48	23	8	31	7.6%
q49	14	4	18	4.4%
q50	15	3	18	4.4%
q51	18	18	36	8.8%
q52	32	2	34	8.3%
q55	4	7	11	2.7%
Total	392	185	577	2.2%

Appendix C

Communality for 63 Dietary Items following PCA with Varimax Orthogonal Rotation

Dietary item	Communality
q4	0.47
q5	0.39
q6	0.53
q7	0.54
q8	0.41
q9a	0.31
q9b	0.30
q9c	0.41
q9d	0.36
q9e	0.45
q10a	0.31
q10b	0.38
q10c	0.21
q11a	0.51
q11b	0.45
q11c	0.27
q12	0.37
q13	0.23
q14	0.24
q15	0.26
q16	0.29
q17	0.24
q18a	0.40
q18b	0.47
q19	0.45
q20	0.44
q21a	0.52
q21b	0.42
q22a	0.38
q22b	0.22
q23	0.56
q24	0.45
q25	0.54
q26	0.61
q27	0.40
q28	0.35
q29	0.22
q30	0.33

q31	0.36
q32	0.20
q33	0.41
q34	0.41
q35a	0.28
q35b	0.33
q36	0.41
q37a	0.23
q37b	0.35
q38	0.44
q39	0.31
q40	0.11
q41a	0.37
q41b	0.35
q42	0.39
q43	0.31
q44	0.47
q45	0.26
q46	0.39
q48	0.45
q49	0.54
q50	0.42
q51	0.85
q52	0.41
q55	0.85

Appendix D

UNBC Research Ethics Board Approval Letter

UNIVERSITY OF NORTHERN BRITISH COLUMBIA

RESEARCH ETHICS BOARD

MEMORANDUM

To: Yaser Ahmed
CC: Mamdouh Shubair

From: Henry Harder, Chair
Research Ethics Board

Date: March 1, 2016

Re: **E2015.1014.091.00**
Dietary Patterns of Ethnic Non-Indigenous populations in Northern British Columbia: A Cross-Sectional Survey Study

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Thank you for submitting the above-noted proposal to the Research Ethics Board (REB). Your proposal has been approved pending the receipt of approval from the UNBC Provost for the recruitment of UNBC students for this project. Once the Provost approval has been received by you and you have sent a copy to reb@unbc.ca you may begin recruitment of UNBC students.

We are pleased to issue approval, pending the Provost approval for UNBC student recruitment for the above named study for a period of 12 months from the date of this letter. Continuation beyond that date will require further review and renewal of REB approval. Any changes or amendments to the protocol or consent form must be approved by the REB.

If you have any questions on the above, or require further clarification, please feel free to contact Isobel Hartley in the Office of Research (reb@unbc.ca or 250-960-6735).

Sincerely,

Dr. Henry Harder
Chair, Research Ethics Board