University of Alberta

Assessment of food accessibility, availability and adherence to dietary recommendations among diabetic older adults living in subsidized retirement homes

by

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Abstract

The availability and accessibility of healthy foods for type 2 diabetes patients may limit their food choices and adherence to dietary recommendations. The accessibility and availability of food for low-income, diabetic, older adults was evaluated. Information was gathered regarding self-care activities, perceived dietary adherence, food accessibility and availability, food security, and 24 hour dietary recall.

Macronutrient intake distribution was appropriate but total calories were low. Fibre and calcium were below and saturated fat and sodium were above the recommendations. Overall diet quality was poor. One-third of participants were classified as *food insecure, severe* but food insecurity did not affect actual intakes.

These results demonstrated that older adults had poor diet quality. Physical accessibility and availability were not barriers to proper food intake but lack of knowledge and financial accessibility may have affected intakes. Nutrition education may improve the ability of diabetic older adults to adhere to recommended diets.

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List of Abbreviations

American Diabetes Association (ADA)

Adequate Intake (AI)

Analysis of variance (ANOVA)

Alberta Seniors Benefit (ASB)

Canadian Diabetes Association (CDA)

Committee on Economic, Social and Cultural Rights (CESCR)

Center for Nutrition Policy and Promotion (CNPP)

Dietary Quality Index (DQI)

Food frequency questionnaire (FFQ)

Hemoglobin A1c (HbA1c)

Healthy Diet Indicator (HDI)

Healthy Eating Index (HEI)

Healthy Eating Index –Canada (HEI-C)

Household Food Security Survey Module (HFSSM)

International Diabetes Federation (IDF)

Low Income Cut-offs (LICO)

National Health and Nutrition Examination Survey I (NHANES I)

Physical Activity and Nutrition for Diabetes in Edmonton (PANDA)

Recommended Dietary Allowances (RDA)

Seniors Association of Greater Edmonton (SAGE)

Socioeconomic status (SES)

Tolerable Upper Intake Level (UL)

United States Department of Agriculture (USDA)

Chapter 1: Introduction

The Canadian Diabetes Association (2008) classifies diabetes mellitus into three main categories. Type 1 diabetes usually develops during childhood. It occurs when the insulin-producing cells of the pancreas are destroyed by the body's immune system; however, scientists believe that genetics and environmental factors might also play a role. Type 2 diabetes usually develops during adulthood. It occurs when the body does not produce sufficient insulin and/or does not respond well to the insulin it produces (insulin resistance). This type affects up to 90% of people with diabetes (Canadian Diabetes Association (CDA), 2008).

In the past few decades the rates of type 2 diabetes have increased dramatically. In 1985, roughly 30 million people worldwide had been diagnosed with diabetes. In 2000, the total number of those afflicted had increased to over 150 million, and by 2025, the number of cases of diabetics is predicted to reach roughly 380 million people (CDA, 2008). Similarly, Shaw, Sicree and Zimmet (2010) found that the current prevalence of diabetes is 285 million adults and it will increase to 439 million adults by 2030.

As of 2005, about 1.8 million Canadian adults had been diagnosed with type 2 diabetes. Researchers predict the number of cases will rise to 2.4 million by the year 2016 (CDA, 2008). According to Johnson, Balko, and Edwards (2009), diabetes is a large and growing health problem in Alberta. There were approximately 164,000 Albertans with diabetes in 2007, which was double the number from 10 years earlier. As the population ages, the number of cases of

diabetes is increasing. Age groups 55-59 and 60-64 years had the highest prevalence of diabetes in 2007. When Albertans with diabetes reach 65 years, the prevalence remains high; however, after that it begins to decrease, apparently as people die (Johnson et al., 2009).

Type 2 diabetes is considered to be incurable and has a negative impact on lifespan and quality of life. Unfortunately, evidence shows that one in 20 deaths are from complications related to diabetes; worldwide 8,700 deaths every day; six deaths every minute (WHO, 2011). Researchers have also demonstrated a link between diabetes and long-term health complications affecting different parts of the body. Individuals with diabetes are at higher risk for heart disease and stroke, high blood pressure, blindness, kidney disease, nervous system disease (neuropathy), and amputation (American Diabetes Association, 2011). According to the CDA (2008), diabetes increases the prevalence of coronary artery disease approximately 2- to 3-fold. People with type 2 diabetes are more likely to have hypertriglyceridemia, low high-density lipoprotein cholesterol and normal low-density lipoprotein cholesterol due to statin therapy, and these can lead to a higher risk of vascular disease (CDA, 2008).

Diabetes is caused by complex interactions between multiple factors. These factors are genetic, environmental and behavioural in nature and include age, obesity, sedentary lifestyle, dietary factors, a positive family history, history of gestational diabetes, hypertension, and dyslipidemia (Rosenthal, 2009). Many risk factors are linked to a western lifestyle, which tends to increase dietary intakes and sedentary behaviour (Pasala, Rao, & Sridhar, 2010). Bazzano,

Serdula and Liu (2002) in their systematic review found that obesity, physical inactivity, a high fat diet, especially saturated fatty acids, low intake of dietary fibre, non-drinking and heavy drinking of alcohol, and cigarette smoking increased the risk of type 2 diabetes.

Several studies link socioeconomic status (SES) with a higher incidence of diabetes. Both Canadian (Ross, Gilmour & Dasgupta, 2010) and European studies (Espelt et al., 2008) suggest there is an inverse relationship between SES and incidence of diabetes. Conversely, some studies show that there is no relationship between either current or early life SES and incidence of diabetes (Kowall et al., 2011) or a negative effect of low SES on diabetes in women only (Best, Hayward & Hidajat, 2005). An American study found that the impact of social status was diminished in an elderly cohort (Wray, Alwin, McCammon, Manning & Best, 2006).

A healthy diet is vital to diabetes treatment and glycemic control in order to avoid complications, especially for older adults. However, several external factors influence food choices such as cultural environment, religious beliefs, time, food cost, food availability, food accessibility, and socioeconomic status. Also, social and psychological factors play a role in eating behaviours in older adults. Payette and Shatenstein (2005) illustrated the determinants of healthy eating in community-dwelling elderly people. Socioeconomic factors, physiological issues, psychological attributes, life practices, knowledge, beliefs and behaviour were individual determinants of healthy eating. Accessible food labels, an appropriate food shopping environment, healthy food messages, social

support, and meal delivery service were collective determinants of healthy eating.

The 4-A Framework can help to explain environmental barriers to a healthy diet. The 4-A Framework is derived from food security indicators and is a framework for use in the monitoring and evaluation of food aid programs (Riely, Mock, Cogill, Bailey & Kenefick,, 1999). The 4-A Framework includes **A**dequacy, **A**ccessibility, **A**cceptability and **A**vailability of foods. Adequacy is defined as “food satisfying dietary needs, taking into account individual status, such as age, living conditions, occupation and sex, and is safe and culturally acceptable” (United Nations Human Rights, 2008). Accessibility to food has two parts: economic and physical accessibility. Economic accessibility is defined as "Personal and household financial costs associated with the acquisition of food for an adequate diet should be at a level such that the attainment and satisfaction of other basic needs are not threatened or compromised" (United Nations Committee on Economic, Social and Cultural Rights (CESCR), 1999). Physical accessibility to food is defined as "Adequate food must be accessible to everyone, including physically vulnerable individuals, such as infants and young children, the elderly, the physically disabled, the terminally ill and persons with resistant medical problems, including the mentally ill" (CESCR, 1999). Food acceptability includes palatability, liking/disliking, food preferences, and pleasantness/unpleasantness (Meiselman & MacFie, 1996); also it refers to cultural and traditional habits. Food availability is defined as "the possibility to either feed oneself directly from land or other natural resources, or for well

functioning distribution, processing and market system that can move food from one site of production to where it is needed in accordance of demand" (CESCR, 1999). Some researchers have tried to identify the barriers to dietary adherence using the 4-A Framework, but it has not been well studied in the literature.

1.2 Rationale

The number of older adults in Canada is increasing. In 2005, older adults 65 and over accounted for 13.2% of the general population, and this group will reach 11.5 million people (27.2%) in 2056 (Statistics Canada, 2006). Because of the high prevalence of diabetes among older adults, the total number of people with diabetes will increase. For older adults with diabetes a healthy diet is essential for treatment and glycaemic control as well as avoiding complications. Also, the economical burden is already overwhelming health care systems in Canada with estimated costs at 5.6 billion dollars in 2005 (CDA, 2008). Several external factors impact on the food selection of older adults. However, there has not been enough research on specific environmental and behavioural factors that affect diet quality for diabetic seniors with low SES. Therefore, this thesis focuses on availability and accessibility of healthy foods for diabetic seniors with low income, and how this affects their ability to adhere to a recommended diet with adequate nutrient composition. From this research we will have a better understanding of the factors that influence the ability of diabetic seniors to adhere to an adequate diet.

1.3 Aim

Diabetes treatment, particularly dietary aspects, involves considerable day-to-day decision-making and management by the patient. Health practitioners can provide better assistance to patients if the difficulties of dietary management are understood for a particular population. This study aims to investigate the barriers that senior citizens with diabetes living in subsidized retirement (low to moderate income) homes face with respect to adherence to the nutrition therapy guidelines for diabetes. The study also evaluates participants' diet quality in the context of the identified barriers.

1.4 Objectives

- To determine the barriers that affect adherence to an appropriate eating plan for senior citizens with type 2 diabetes, using a 4-A framework approach, which consists of accessibility, availability, acceptability and adequacy.
- To examine the quality of diet for senior citizens with type 2 diabetes and the relationship of diet quality to the identified barriers.

1.5 Research questions

1. Does the nutrient intake of senior citizens with type 2 diabetes living in subsidized retirement homes in Edmonton meet the dietary recommendations of the Canadian Diabetes Association?

2. What is the diet quality of senior citizens with type 2 diabetes living in subsidized retirement homes?

3. Are foods recommended for senior diabetic patients living in subsidized retirement homes accessible and available?

4. Does availability and accessibility of foods impact the quality of diet?

Chapter 2: Literature review

2.1 Introduction

This chapter provides a background into the growing prevalence of diabetes among older adults, and highlights the effect of socioeconomic factors on diabetes. It also outlines previous studies illustrating barriers to healthy food consumption for older adults with type 2 diabetes.

2.2 Older adults in Canada

According to the Statistics Canada 2006 Census there were over 4.3 million Canadians age 65-85 and over a half million Canadians aged 85 and above. Women were the majority of the senior population in Canada (56%). Roughly 71% of seniors lived in their own house, 19% rented accommodation, about 7% lived in provincial housing including seniors' lodges and around 3% of them lived in long-term care facilities (Statistics Canada, 2006).

In Alberta, there are over 147,600 low-income seniors across the province who are provided monthly benefits from the Alberta Seniors Benefit (ASB) program. The maximum annual benefit of ASB program for a single senior is $15,780, and for a senior couple is $23,160 (Government of Alberta, 2010). This amount of income may not guarantee a high quality of life among seniors because it is below the Low Income Cut-offs in 2010, which was $18,759 or less after taxes (Statistics Canada, 2006).

2.3 Diabetic health status in older adults

Many older adults wish to be independent and therefore try to remain healthy throughout their lives. Through good nutrition and exercise older adults can reduce the risk of disease delay death and live independent lives.

Aging is usually associated with chronic diseases such as heart disease, stroke, hypertension, obesity, osteoporosis, inflammatory diseases and diabetes. The prevalence of diabetes increases in the elderly population as the rate of metabolism slows down due to decreasing lean body mass and increasing sedentary lifestyle (Rizvi, 2009). Body composition also changes, with increased fat mass and decreased lean body mass, and bone mineral mass (Fuhrman, 2009). Also, physical changes occur including: impaired vision and hearing, decreased sense of smell and taste, poor dentition, and frailty. Confusion, dementia, depression, isolation and changing socioeconomic status occur frequently in elderly population (Furman, 2009). These factors may decrease mobility and the enjoyment of eating.

Life expectancy is increasing compared to the 20th century (Lutz & Qiang, 2002). The average life expectancy in Canada was 81.36 years in 2011, ranking 12th among 222 countries (Central Intelligence Agency, 2011). However, diabetic patients have shorter lifespans than non-diabetes patients. According to the Framingham Heart Study, diabetic men and women aged 50 years or older live an average of 7.5 and 8.2 years less than non-diabetic people, respectively (Franco, Steyerberg, Hu, Mackenbach & Nusselder, 2007). Elderly diabetes patients require more health care to manage diabetes and control

complications. The results based on data from NHANES III of diabetic adults aged 45–74 years showed that 47% of deaths were directly due to diabetes (Russell et al., 2005).

2.4 Nutrition and older adults

Eating Well with Canada's Food Guide has changed as scientists discover more about the effect of food on health. The Guide provides information in 10 different languages to promote good health and reduce the risk of chronic diseases through diet and physical inactivity. Eating Well with Canada's Food Guide recommends that older adults consume 7 servings of fruits and vegetables and 3 servings of milk and alternatives for both genders. Also, 7 servings of grain products are recommended for males, while 6 servings are recommended for females. In addition, 3 servings of meat and alternatives are recommended for males and 2 servings for females per day. Besides these recommendations, vitamin D supplement of 400IU are recommended daily for older adults 50 years and older (Health Canada, 2007).

The Canadian Diabetes Association's 2008 nutrition therapy recommendations state that people with diabetes should consume a variety food from the four food groups from Eating Well with Canada's Food Guide. Diabetic patients should consume 45-60% of their daily intake from carbohydrate, and try to eat low-glycemic-index foods instead of high-glycemic-index foods. A recent meta-analysis shows that both low glycemic index and low glycemic load diets improved glycemic control statistically and clinically compared with high

glycemic index diets (Thomas & Elliott, 2009). Also, the CDA Clinical Practice Guidelines (2008) suggests consuming between 15-20% of daily total energy from protein and less than 35% of total calories intake from fat. They suggest restricting saturated fat to less than 7% of total energy, while keeping trans-fat intake to a minimum, and limiting polyunsaturated fat to less than 10% of total daily energy intake. In addition, they encouraged consumption of monounsaturated fat and polyunsaturated omega-3 fatty acids.

Sahyoun and Basiotis (2000) analyzed data from NHANES III to examine the nutritional status of the elderly American population. They found from 24-hour dietary recall data that intake of calories and the macronutrients protein, fat and carbohydrate were lower than recommended. Furthermore, there were insufficient intakes of several vitamins and minerals. Elderly people who had insufficient nutritional status had an average BMI below 19. Another analysis from the NHANES III data found that 62% of older adults with type 2 diabetes ate fewer than five servings of fruits and vegetables per day. Two-thirds of the participants consumed >30% of their daily calories from fat and >10% of total calories from saturated fat (Nelson, Reiber & Boyko, 2002). An Australian study concluded that only 4.3% of older citizens with diabetes met all macronutrient recommendations. Older Australians reported eating more protein, fat and saturated fat and less carbohydrate and dietary fibre, with only 2.4% meeting fibre recommendations (Barclay, Miller & Mitchell, 2006).

Johnson and Begum (2008) examined the adequacy of food intake among older adults living in home care settings in Ontario. They found that 54% were at

moderate nutritional risk and 37% were at high nutritional risk according to the Nutrition Risk Tool. A range of 82% to 87% of older adults met the caloric intake from macronutrients of Recommended Daily Intakes (DRI). Only 88% of older adults met the amount of carbohydrate recommended, while the amount of protein was higher than the recommendation. Fat intake range was 69% to 100% of the recommendation.

2.5 Physical activity in older adults

It is well known that a balance between energy intake and energy expenditure avoids causing obesity and prevents chronic diseases. Around 13% of Canadian older adults are classified as obese and 39% as overweight (Kaplan, Huguet, Newsom, McFarland & Lindsay, 2003). Many studies including The Finnish Diabetes Prevention Study, The Nurses Health Study, and The Health Professional Study have shown that physical activity may reduce the incidence of type 2 diabetes in high-risk individuals (Laaksonen et al.,. 2005; Hu et al., 1999; Hu et al., 2001). Several studies have shown the beneficial effects of physical activity on insulin resistance (Nassis et al., 2005; McAuley et al., 2002). Boulé, Haddad, Wells and Sigal (2001) in their systematic review and meta-analysis found that physical activity significantly lowers HbA1c levels in people with diabetes.

Lack of physical activity is common among older adults due to the typical experience of decreasing lean body mass along with an increasing sedentary lifestyle, which is compounded by illnesses that restricts adherence to

exercise programs (Rizvi, 2009). Nelson et al. (2002) found that 31% of older adults with type 2 diabetes reported no physical activity at all, and another 38% reported less than recommended levels of physical activity. Mathews et al. (2010) identified barriers to being physical active among older adults; heart disease, arthritis, back problems, and functional limitation were the most commonly reported. In addition, fear of falling, lack of knowledge, financial cost, and an inconvenient environment were mentioned. Walking is the most typical exercise engaged in by older low-income adults. Nevertheless, time, place for activities, sidewalk conditions, and weather were environmental barriers to physical activity (Clark, 1999).

2.6 Diet and lifestyle interventions in elderly diabetic people

Many studies showed the effect of nutrition and lifestyle on improving diabetes management. Nutrition education combined with the provision of meals is a type of intervention showing positive results in a variety of settings. These include seniors centres (Ellis, Johnson, Fischer, & Hargrove, 2005) and community-based interventions in the United States (Speer et al., 2008) After a 4-month intervention, participants were more likely to follow healthy eating plans, to consume five or more servings of fruits and vegetables daily, to space carbohydrates, to inspect the insides of shoes and to increase physical activity. Also, there was a significant decrease in mean HbA1c (Speer et al., 2008). Subsequently, Hendrix et al. (2008) evaluated a community-based fruit and vegetable intervention. After the 4-month intervention, there was a 21% increase

in the number of participants who consumed at least 7 servings of vegetables and fruits daily. In addition, knowledge about the amount of servings of vegetables and fruits increased by 50%. Three barriers to fruit and vegetable intake from participants' perspective included difficulties with digestion, too many are recommended and "too much trouble", yet these barriers decreased after the intervention. Miller, Edwards, Kissling and Sanville (2002) conducted a study to evaluate an intervention to improve food label knowledge and skill among elderly people with type 2 diabetes, which was shown to improve their knowledge and skills for diabetes management.

2.7 Food insecurity in older adults

Food insecurity is a serious phenomenon becoming pervasive in the world that emerges even in affluent nations such as Canada. Food insecurity is defined as "the inability to acquire or consume an adequate quality diet or a sufficient quantity of food in socially acceptable ways or the uncertainty that one will be able to do so" (Davis & Tarasuk, 1994). In 2004, about 8.8% of the population lived in food insecure households (2.7 million Canadians). Food insecurity was generally higher among adults than children. Food insecurity affects 10.7% of households (7.2% are moderately food insecure and 3.5% severely food-insecure) in Alberta (Health Canada, 2007). Having low income, suffering from chronic illness and disability, living in unsafe and in remote communities are factors leading to food insecurity (Agriculture and Agri-Food Canada, 2006).

Food insecurity may impact health conditions. Vozoris et al. (2003) found from the 1996-1997 National Population Health Survey that people from food-insufficient households reported more heart disease, diabetes, high blood pressure, and food allergies than those from food-sufficient households. A high prevalence of diabetes was documented in conjunction with food insecurity (Gucciardi, Vogt, Demelo & Stewart, 2009). Furthermore, Seligman, Bindman, Vittinghof, Kanaya and Kushel (2007) found that people with severe food insecurity were two times more likely to have diabetes than those not experiencing food insecurity, even after adjusting for socio-demographic factors, body mass index (BMI), and physical activity.

Food insecurity can also be a barrier to successful diabetes self-management. Seligman, Davis, Schillinger and Wolf (2010) found that food-insecure participants were more likely to put off buying testing supplies and diabetes medication in order to buy food. Others reported that they were more likely to put off buying food to have sufficient money for testing supplies, and diabetes medication. Food-insecure participants had a high incidence of hypoglycemia due to insufficient food. Moreover, Homenko, Morin, Eimicke, Teresi and Weinstock (2010) stated that diabetic seniors with food-insecure status were more likely to take into account the cost of ingredients in food preparation compared to food-secure participants. In an American population where nearly half of the low-income older adults were food insecure, multiple chronic conditions and prescription cost burden were related to medication non-adherence (Bengle et al., 2010).

Lee and Frongillo (2001) examined factors associated with the food insecurity of elderly population in the US from the NHANES III (1988–94) and the Nutrition Survey of the Elderly in New York State (1994). They found food insecurity associated with low socio-economic status (SES), enrolment in food assistance programs, and social isolation. Moreover, low affordability and availability, and inaccessibility to the food was associated with food insecurity. Therefore, food-insecure elderly people could not achieve nutritional well-being and were compelled to seek food assistance programs.

2.8 Socioeconomic status as a risk factor for diabetes

Low SES is associated with higher rates of morbidity and mortality in populations (Adler & Newman, 2002; Adler & Ostrove, 1999). Also, low SES correlates with unhealthy eating (Melchers, Gomez & Colagiuri, 2009), high stress (Corcoran & Franklin, 2002) and physical inactivity (Janssen, Boyce, Simpson & Pickett, 2006), and the prevalence of multi-morbidity among older adults (Tucker-Seeley, Li, Sorensen & Subramanian, 2011). An inverse relationship between SES and incidence of diabetes was documented in Canada (Ross, Gilmour & Dasgupta, 2010) and Europe (Espelt et al., 2008). Conversely, some studies showed that there is no relationship between either current or early life SES, and incidence of diabetes in older cohorts (Kowall et al., 2011) or a negative effects of low SES on diabetes in women only (Best, Hayward & Hidajat, 2005). An American study found that the impact of social status was diminished in an elderly cohort (Wray et al., 2006).

2.8.1 Education levels and incidence of diabetes, diet quality and health care access

Scientists have found a strong inverse relationship between educational attainment and diabetes incidence. High incidence of diabetes and low education was documented in the NHANES I Epidemiologic Follow-Up Study (Robbins, Vaccarino, Zhang & Kasl, 2005), the Alameda County Study (Maty, Everson-Rose, Hann, Raghunathan & Kaplan, 2005), the National Health Interview Survey (Saydah & Lochner, 2010) and two Canadian studies (Tang, Chen & Krewski, 2003; Choi & Shi, 2001). Contrarily, a study done in a rural area in Japan did not find a significant association between duration of education and incidence of diabetes (Hayashino, Yamazaki, Nakayama, Sokejima & Fukuhara, 2010). Taken as a whole, it appears that a short duration of education is a vital contributor to increase the risk of type 2 diabetes.

Educated people can attain more access to information and recourse to promote health (Adler et al., 2002). For example, education supports the cognitive skills to read nutrition labelling. A study in the U.S. identified how people with diabetes use food labels to manage their food intakes. Educated patients were more likely to be label readers, especially those who completed 4 years of college (Kessler & Wunderlich, 1999). Also, a person's level of education may affect his accessibility to health care, but few studies have examined this. Chin, Zhang and Merrell (1998) in their study found that African-Americans were less likely to have measurement of glycosylated haemoglobin

and have ophthalmological examinations than white people. The majority of African-Americans in the study had not completed high school. Another study found that diabetic people with low education received fewer foot examinations (Baker, Watkins, Wilson, Bazargan & Flowers, 1998). In short, duration of education affects the accessibility to health care; therefore, it affects health conditions.

2.8.2 Income and diabetes, diet quality and health care

Income plays a role in determining levels of nutrition, housing, schooling, and recreation (Adler et al., 2002); for instance, fruits and vegetables are expensive and they are less likely to be affordable to low-income people (Cassady, Jetter & Culp, 2007).

There was an inverse association between income and incidence of diabetes documented in the NHANES I Epidemiologic Follow-up study in the United States (Robbins et al., 2005), the Alameda County Study (Maty et al., 2005), and in Canada (Manuel & Schultz, 2003; Wilkins, Berthelot & Ng, 2002). On the other hand, a few studies have not shown an association between income and incidence of diabetes (Hayashino et al., 2010; Williams et al., 2010).

A high incidence of diabetes has been shown in wealthy countries such as the Gulf States (Alwan, 1997; Al-Lawati & Tuomilehto, 2007). Socioeconomic transformation unfortunately changes lifestyle, nutrition patterns and traditional social and family structures, and has an unfavourable impact on raising the incidence and prevalence of diabetes. In addition, in China a higher

prevalence of diabetes was associated with high SES (Wong & Wang, 2006). Physical inactivity, diets high in fat and sodium and low in fruit and vegetables, and increase work-related stress were lifestyle factors associated with urbanisation and high SES (Wong et al., 2006).

Income has been associated with accessibility to health care. Uninsured diabetics in the United States were three times less likely to have eye exanimations and received fewer foot examinations (Saaddine et al., 2002). Also, uninsured diabetic people had poorer glycemic control (Gregg et al., 2001). Diabetic Ontario residents with low-income status were less likely to have undergone eye examinations (Buhrmann, Assaad, Hux, Tang & Sykora, 2003). In brief, low-income status is associated with a higher incidence of diabetes and less accessibility to health care.

2.8.3 Occupation and diabetes

Occupation, too, plays an important role in increasing the risk of having diabetes for everyone. Adler et al. (2002) found that there is a different aspect being employed or unemployed; employed people have better health than those who are unemployed. Also, early retirement is associated with increased mortality (Bamia, Trichopoulou & Trichopoulos, 2008). Poor health was observed after early retirement in seven out of ten European countries and diabetes was significantly connected to early retirement (Alavinia & Burdof, 2008).

Occupation is a major socioeconomic factor and has been related to poor glycemic control. Cesana et al. (1985) reported that concentrations of HbA1c were higher in blue collar workers under stressful working conditions than in clerks. A study in male Japanese workers found that greater job strain correlated with higher concentrations of HbA1c (Kawakami et al, 2000). Also, blue-collar shift workers who were younger than 50 years had a higher prevalence of insulin resistance markers and insulin resistance syndrome (Nagaya, Yoshida, Takahashi & Kawai, 2002).

Thus, having low SES can contribute to worsening diabetes since a healthy lifestyle is needed to control or prevent diabetes. Healthy lifestyles are not easy to achieve for people with low SES.

2.9 Barriers to adherence to diabetic diets among older adults

Older adults can meet energy and nutrient requirements by choosing more nutrient-dense foods. However, several external factors influence food choices such as cultural environment, religious beliefs, socioeconomic status and food cost, availability and accessibility.

2.9.1 Food availability

Food availability is defined as "the possibility to either feed oneself directly from land or other natural recourses, or for a well functioning distribution, processing and market system that can move food from one site of production to where it is needed in accordance of demand" (CESCR, 1999).

The availability of recommended foods for diabetics may influence food choice. Several studies have demonstrated that fresh fruits and vegetables were often unavailable in low-income area supermarkets (Godwin & Tegegne, 2006; Zenk et al., 2005). Further research has shown that recommended foods for diabetics were less likely to be available in low-income neighbourhoods in New York (Horowitz, Colson, Hebert& Lancaster, 2004). Moreover, Latham and Moffat (2007) showed that lower-income people living in the Hamilton area in Canada had fewer healthy food choices, including fresh produce. Briefly, low-income and remote neighbourhoods have a shortage of grocery outlets, which make it difficult to attain fresh and healthy food.

2.9.2 Food accessibility: Physical accessibility

Physical accessibility to food is defined as "Adequate food must be accessible to everyone, including physically vulnerable individuals, such as infants and young children, the elderly, the physically disabled, the terminally ill and persons with resistant medical problems, including the mentally ill" (CESCR, 1999).

Automobiles provide the opportunity for many people to drive to either local supermarkets or the suburbs. D'Angelo, Suratkar, Song, Stauffer and Gittelsohn (2011) found that purchasing more healthy food was associated with low-income adults who drove or had a ride to the food source. In contrast, an unexpected outcome showed that households who owned cars consumed lower amounts of fruits and vegetables (Rose & Richards, 2004). The topic of

accessibility to supermarkets in Canada has been studied. In Montreal, low-income people tended to have better accessibility near the centre of the city, but less accessibility to distant parts of the city. Meanwhile, car ownership tended to increase the accessibility to retail and fast food, although not increasing the accessibility in the suburbs (Páez, Gertes Mercado, Farber, Morency & Roorda, 2010). In London, Ontario, residents of the inner-city of low socioeconomic status had the poorest access to supermarkets (Larsen & Gilliland, 2008). In Edmonton, six neighbourhoods had poor accessibility to supermarkets (Smoyer-Tomic, Spence & Amrhein, 2006). Inaccessible transportation was one of the major interpersonal factors influencing food intake for community-living seniors with low-income status in Ontario. Also, using public transportation or cabs, and cold weather were environmental factors that participants mentioned (Keller, Dwyer, Senson, Edwards and Edward, 2006).

Payette et al. (2005) illustrated the determinants health of healthy eating in community-dwelling elderly people. An appropriate shopping environment was a collective determinant of healthy eating. Locher et al. (2009) found that being unable to shop was the most frequency reported barrier to consume food in homebound older adults. Sharkey (2004) documented that over 90% of homebound Mexican-American elderly people reported being physically unable to shop, cook, or feed themselves.

2.9.3 Food accessibility: Cost of eating healthy

A healthy diet is crucial for everyone especially diabetic people. However, the availability of healthy food depends on the cost of the food, which is directly related to the ability to afford food. Lack of affordability of a nutritious diet for low-income households has been studied in Nova Scotia (Williams et al., 2006), Saskatchewan (Diettitians of Canada, 2010), British Columbians (Dietians of Canada, 2007) as well as Alberta (Dietitians of Canada, 2009). Food costs were affordable to a female senior living on a pension in Alberta, but shelter cost 46% to 69% of income.

Locher et al. (2009) found that price was the most frequent response affecting food selection motivation among homebound older adults. Another study by Sharkey (2004) stated that 58% of homebound Mexican-American elderly reported food insecurity–did not have enough money for food. Keller et al, (2006) documented that price was a factor that affected food access among community-living Ontario seniors with low-income status. A longitudinal study recruited seniors who regularly received home-delivered meals and examined the effect of the food insufficient on diabetes status. It found that food insufficiency worsened for older adults with diabetes due to inadequacy of economic resources (Sharkey, 2005).

2.10 Summary

Abundant literature supports that the hypothesis that low SES affects dietary adherence as well as health conditions for people with diagnosed type 2

diabetes mellitus. Social, psychological, and environmental factors can be barriers to an adequate diet. There has not been enough research focused on availability and accessibility of healthy foods for diabetic seniors. Therefore, the research project in this thesis focuses on barriers that diabetic seniors face to adhere to an adequate diet.

Chapter 3: Methodology

3.1 Introduction

This chapter describes the approaches used to address the objectives of this research. It begins with a brief outline of the study design, study population, inclusion and exclusion criteria and data collection. The next part of this chapter highlights the various methods and questionnaires used to address the aims and objectives of this research. The last part of this chapter summarizes the data analysis procedures.

3.2 Study design

Our study was conducted at the University of Alberta, Department of Agricultural, Food and Nutritional Science. This study had a cross-sectional design in which face-to-face interviews were conducted with senior diabetic participants in subsidized retirement homes in order to complete a series of questionnaires. The study was approved by the University of Alberta Research Ethics Board (ethics approval number: pro00016938).

3.3 Study population

Our target population was senior citizens with type 2 diabetes living in subsidized retirement (low to moderate income) homes in Edmonton. Seventeen participants consented to be a part of our study, and 16 (94.1%) completed all questionnaires. All participants were given a 20 dollar gift card for a grocery store of their choice for taking part in the study.

3.3.1 Inclusion criteria

1) Participants had to have type 2 diabetes (self-identified).

2) Participants had to be 60 years of age or older.

3) Participants had to speak English because the questionnaires were written in English.

4) Participants had to live in subsidized retirement homes with independent living (i.e, responsible for their own meals) because we aimed to assess the availability and accessibility to an adequate diet in a non-institutional setting. People living in these homes must have limited financial means to qualify for a housing subsidy.

3.3.2 Exclusion criteria

1) People with type 1 diabetes.

2) People unable to speak English.

3) Participants who were on dialysis, which required additional dietary restrictions.

3.4 Recruitment of study participants

Type 2 diabetes patients were recruited from subsidized retirement homes in the Edmonton area beginning in December 2010. First, we identified retirement homes having independent living in Edmonton by consultation with N. Cameron, who had collected information on retirement residences for people with low income, as well as the Seniors Association of Great Edmonton web site

(www.mysage.ca). Managers of the homes were contacted and asked for their approval of and assistance with our study. After we obtained the managers approval, we advertised by placing a poster on bulletin boards in public areas of the residences in mid-February 2011. The poster contained the inclusion criteria and contact information for the study coordinator. To screen for eligibility, we conducted telephone interviews with respondents who had called or emailed us, and explained to them the purpose, the procedure, and the benefit of our study. When respondents were both interested in participating and met the study inclusion criteria, the study coordinator met them in their retirement home. All participants gave written consent to complete the questionnaires. Interviews were conducted three times over a one-month period, and lasted between 45-60 minutes in each visit. All the interviews took place a private setting in the retirement homes.

3.5 Data collection

Data were collected January through May 2011. Face-to-face interviews were conducted with participants to obtain socio-demographic information and 24-hour dietary recalls (repeated at three times at two-week intervals). Also, additional questionnaires previously used in the Physical Activity and Nutrition for Diabetes in Edmonton (PANDA) study (Durai Raj, 2012; Maxwell, 2011) were administered to gather information about participants' perceptions of their current diet, the cost of what they eat, and their observations about the availability and acceptability of the foods that they consume in relation to their

diabetes diet. Furthermore, food frequency questionnaires were given to the participants to assess long-term healthy food intake. Finally, the Household Food Security Survey from Canadian Community Health Survey Cycle 2.2, Nutrition (2004) was used to assess food security over the 12 months previous (Health Canada, 2007). The questionnaires were comprised of multiple-choice questions. In the first meeting, we obtained demographic information, 24-hour dietary recall and the household food security survey responses. In the second meeting, we completed 24-hour dietary recall and the food availability and accessibility questionnaire. In the third meeting, we completed 24-hour dietary recall and the food frequency questionnaire (FFQ). All participants were giving a 20 dollar gift card for a grocery store of their choice for taking part in the study. One participant who did not complete the third meeting received a gift certificate.

3.6 Questionnaires

To answer the research questions, we used different methods and instruments as described below.

3.6.1 Demographic information

Participants were asked to state their age, gender, duration of diabetes, ethnicity, education, employment, number of household occupants and annual income (Appendix 1). Questions were developed based on the Canadian Community Health Survey (Statistics Canada, 2005; 2007). The number of household occupants and annual income gives information on the availability and distribution of money. This information was necessary to identifying the

socio-demographic characteristics of our population. Descriptive statistics (mean ± SD, ranges, proportions, as appropriate) were used to describe the participants.

3.6.2 General health and diabetes treatment

Participants were asked to state their diabetes treatment, and list all medications and health problems that had been diagnosed by doctors (Appendix 2). The questionnaire was adapted from a previous study conducted by the research group (Tomoe Watanabe, 2010) at the University of Alberta. Descriptive statistics were used to summarize diabetes treatment and health problems in the sample population.

3.6.3 Self-care activities and diabetes treatment questionnaires

Participants were asked to answer multiple-choice questions about whether they have received any advice and are aware of the self-care activities that had been prescribed by their health care team (Appendix 3). Self-care activities including diet, physical activity, medications and blood glucose monitoring. This questionnaire was developed based on the summary of self-care recommendations outlined by Toobert and Glasgow (2000). However, the questionnaire was modified to take into account the CDA recommendations (CDA, 2008). Descriptive statistics were used.

3.6.4 Physical activity

Physical activity level was assessed over the previous 7-day period using the physical activity adherence questionnaire (Appendix 4) developed by Godin (1985). It consists of three categories: strenuous physical activities, moderate physical activities, and mild physical activities. The level of physical exertion was determined by querying the presence of heart rate changes and perspiration. When the heart was beating rapidly accompany with sweating, it was categorized as strenuous physical activity. Persons who exercised without an elevated heart rate and with light perspiration were categorized as having a moderate physical activity level. We considered a person to have mild physical activities when she/ he did not perspire or have an elevated heart rate. Descriptive statistics were used to measure the exertion level and period of physical activities.

3.6.5 Diabetes adherence questionnaire

Participants were asked about their diabetes diet activities during the past 7 days (Appendix 5). This questionnaire was developed from the Summary of Diabetes Self-Care Activities (SDSCA) measure (Toobert, Hampson, & Glasgow, 2000), which is a self-report questionnaire of diabetes self-management, adapted to the CDA nutrition therapy guidelines (CDA, 2008). The questionnaire consisted of ten questions, and tested the consumption of various food categories listed in the CDA recommendations during the past 7 days. Responses were based on 7-point Likert scale. High scores indicate a high diet

adherence with exception of the following questions: On how many of the last seven days did you eat foods high in sugar as cakes, cookies, dessert, candies, etc?; On how many of the last seven days did you eat foods high in fat (such as high fat dairy products, fatty meat, fired food or deep fried food)?; On how many of the last seven days did you consume alcohol?; On how many of the last seven days did you consume red wine? Mean scores for each category were computed. Total scores were also computed. For the latter questions, scores were inverted (i.e. A person consuming foods high in sugar on 7 days was given a score of 0) and summed.

3.6.6 Accessibility to food and food resources

Questions were asked about convenience, ease of transportation to food outlets and the cost of foods (Appendix 6). These questions were generated from the framework outlined in the USDA Food Security Assessment Toolkit (Cohen, 2002), and adapted to the Canadian diabetes perspective. This information was important in addressing the first objective of this study, which was to examine the barriers that affect diet adherence. We assessed whether food resources were located within a reasonable distance of the participants' residences. Also, we assessed the ability of participants to get transportation to food outlets. Shopping trip duration, including commuting time was assessed by minutes. The cost of foods was assessed by asking participants how much money they spent on certain food groups after their diabetes diagnosis compared with before their

diagnosis. Three options were given: less, same, more. Descriptive statistics were applied to measure their responses.

3.6.7 Food availability questionnaires

The food availability questionnaire (Appendix 7) was adapted from Cohen (2002). Participants were asked about the variety of foods suitable for a diabetes diet existing in retail stores, and whether the stores carried a wide variety of foods. Also, participants were asked about the availability of the major food groups in regular grocery store. Participants were asked how they found out about where to find diabetic foods. The frequency of responses was summarized.

3.6.8 Dietary intake and nutrient adequacy

3.6.8.1 Macronutrient intake

Participants were interviewed and dietary intake was assessed by a 24-hour dietary recall (Appendix 8) consisting of the quantification of foods and beverages consumed in the previous 24 hours. A 24-hour dietary recall was obtained three times: at the beginning of the month, the middle of the month, and the end of the month. Most of the 24-hour dietary recall data was obtained for weekdays, which was at the participants' convenience. We used home utensils as a guide to portion size. Participants were asked about the cooking method and brand names of each food to capture more details in order to obtain the appropriate nutrient values. Food items and weights of each item were entered

into Food Processor version 10.5. The Canadian Nutrient Data File was the first choice to calculate nutrient intake, then the USA Data File. Food Processor software was also used to estimate total caloric intake and calories from carbohydrates, proteins and fats and to compare the data with the CDA 2008 Clinical Practice Guidelines (CDA, 2008). The Food Processor software calculates total calories by adding up the calories of the individual foods in a recipe or food list, but carbohydrate or protein calories are not calculated individually, only carbohydrate and protein weights. We used the "4-4-9 method", which is to multiply 1 gram of carbohydrates by 4, multiply 1 gram of protein by 4, and multiply 1 gram of fat by 9, to calculate the total calories from carbohydrates, and proteins. However, when we add up the total calories derived from the 4-4-9 method, it does not equal total calories reported by Food Processor because the method that Food Processor uses is different (Elizabeth Stewart Hands and Associates, *esha* Research). Even though there is inequality in the total calories, the 4-4-9 method is the appropriate method used to estimate the mean intake of whole group, and *esha* Research advises anyone if he/she wants to used 4-4-9 method or any other methods to calculate the calories manually. We used repeated measures ANOVA to compare between the three 24-hour dietary intakes.

3.6.8.2 Micronutrient intake

Mineral intake was calculated from the 24-hour dietary recall that was obtained three times. Food Processor version 10.5 was used to estimate minerals

and compared the median with Canadian Recommended Dietary Allowances (RDA) (Health Canada, 2010).

3.6.8.3 Food and food groups

From the three 24 hour dietary recall questionnaires, the number of servings in each food group based on portion recommendations of Eating well with Canada's Food Guide (Health Canada, 2007) was calculated manually. Mean servings and standard deviation were calculated for each food group.

3.6.9 Choosing an appropriate diet quality index

In order to measure how well American diets conform to recommended healthy eating patterns, the Center for Nutrition Policy and Promotion (CNPP) used the data from the 24-hour recall of the dietary intake in national surveys in 1995 to create the Healthy Eating Index (HEI) (United States Department of Agriculture (USDA), 1995). The index has 10 components, and each component has a score ranging from zero to 10. The first five components measure the serving recommendations for grains, vegetables, fruits, milk and meat according to the USDA Food Guide Pyramid. The sixth component measures the total fat energy intake as a percentage of total energy intake, and the seventh component measures saturated fat as a percentage of total energy intake. The 8th and 9th components measure total cholesterol and sodium, respectively. The tenth component examines the amount of variety of the foods in a person's diet. The HEI has three grading scales used to classify the index score. A HEI score

greater than 80 is classified as "good". An HEI score between 80-51 is classified as “needs improvement". A HEI score less than 51 is classified as “poor". Guenther, Reedy and Krebs-Smith (2008) changed the HEI to reflect My Pyramid (USDA) food patterns and the Adequate Intake (AI) and Tolerable Upper Intake Levels (UL) for sodium that reflect the change of the American dietary guidelines in 2005. Dubois, Girard & Bergeron (2000) analysed the data from the Quebec Nutrition Survey to compare three diet quality methods: the Dietary Quality Index (DQI), the Healthy Eating Index (HEI), and the Healthy Diet Indicator (HDI). The researchers found the HEI was the best method for analysing the data compared to DQI and HDI. Glanville and McIntyre (2006) adapted HEI to reflect the Canada’s Food Guide to Healthy Eating. Table 3.1 shows the components and scoring criteria of the HEI-C (2009). Later on Woodruff and Hanning (2010) updated the HEI with Eating Well with Canada's Food Guide Recommendation 2007 and called it the HEI-Canada (HEI-C) and the index was no longer scored taking into account the daily total energy intake.

Table 3.1 Scoring system for HEI-Canada

Component	**Maximum scores**	**Minimum scores**	**Consideration for subsequent HEI-C calculation**
Grains (10 points)	≥6 serving	0 serving	Half of daily intake should be from whole grains low in fat, sugar or salt
Vegetable/ fruit (20 points)	≥6 serving	0 serving	One dark green vegetable daily One dark orange vegetable daily No added fat, sugar or salt Have vegetable and fruit

			more often than juice
Milk (10 points)	≤ 1600 kcal: 3 servings; 1600-2200 kcal: 3.5 servings; ≥2200 kcal: 4 servings	0 serving	Drink skimmed, 1% or 2% milk daily Select lower-fat milk alternative
Meat (10 points)	≤ 1600 kcal: 1 serving; 1600-2200 kcal: 1.5 servings; ≥2200 kcal: 2 servings	0 serving	Have meat alternatives often Eat at least 2 servings of fish each week Select lean meat and alternatives Little or no added fat or salt
Other (10 points)	≤ 1600 kcal: ≤4 servings; 1600-2200 kcal: ≤6 servings; ≥2200 kcal: ≤8 servings	≤ 1600 kcal: >8 servings; 1600-2200 kcal: >11 servings; ≥2200 kcal: >14 servings	
Total fat (10 points)	≤ 30% of energy from fat	≥ 45% of energy from fat	Current Dietary Reference Intake has changed (ie. 20-35% total fat acceptable)
Saturated fat (10 points)	≤10% of energy from saturated fat	≥15% of energy from saturated fat	
Cholesterol (10 points)	<300 mg	≥450 mg	
Variety (10 points)	At least one serving from each food group	Failure to eat a serving from any food group	
Total	100	0	

The HEI-C was chosen as measure of dietary quality for the 24-hour recall because it was updated with Eating Well with Canada's Food Guide recommendations (Health Canada, 2007), which is recommended to diabetic patients (CDA). Also, HEI-C uses a 100-point scoring system to determine a diet quality as good, needs improvement, or poor. The statistical relationship between

HEI scores and nutrient level can be assessed by the correlation coefficient (Kennedy, Ohls, Carlson & Fleming, 1995). In this study, the 24-hour dietary recall was used to generate HEI scores on three occasions two weeks apart and observe the difference between them. Also, the average HEI score was obtained for each participant. From these scores, participants were classified as having "good", "needs improvement", or "poor" diet quality. Table 3.2 provide dietary information and scoring criteria that we have modified to calculate a HEI-C score for diabetic older adults. Grain, fruits/vegetables, milk products, meat and alternatives were calculated by using Eating Well with Canada's Food Guide recommendations (Health Canada, 2007) as well as incorporating the recommendations of the CDA (2008). Foods that were not classified as Grain Products, Vegetables and Fruits, Milk Products and Meat and Alternatives according to Canada's Food Guide were categorized as "other" foods. Total fat, saturated fat and cholesterol were calculated and generated from the Food Processor database version 10.5 and the value between the minimum and maximum was calculated by linear interpolation (Appendix 9). An example for scoring the HEI-C is given in Appendix 12.

Table 3.2 Scoring for the HEI-Canada modified for senior citizens and nutrition recommendations for people with diabetes

Component	**Maximum scores ***	**Minimum scores**	**Consideration for subsequent HEI-C calculation**
Grains [1] Female male	 ≥6 serving ≥7 serving	0 serving	Half of daily intake should be from whole grains low in fat, sugar or salt

(10 points)			
Vegetable/ fruit[1] (20 points)	≥7 serving	0 serving	One dark green vegetable daily One dark orange vegetable daily No added fat, sugar or salt Have vegetable and fruit more often than juice
Milk [1] (10 points)	≥ 3 servings	0 serving	Drink skimmed, 1% or 2% milk daily Select lower-fat milk alternative
Meat [1] Female Male (10 points)	 ≥2 servings ≥3servings	0 serving	Have meat alternative often Eat at least 2 servings of fish each week Select lean meat and alternatives Little or no added fat or salt
Other [1],[2] (10 points)	≤ 1600 kcal: ≤4 servings; 1600-2200 kcal: ≤6 servings; ≥2200 kcal: ≤8 servings	≤ 1600 kcal: >8 servings; 1600-2200 kcal: >11 servings; ≥2200 kcal: >14 servings	Fats, oil, sugar, coffee creamer, confectionery, soft drinks, fruit drinks, packaged snacks, jams, condiments.
Total fat [3] (10 points)	≤ 35% of energy from fat	≥ 45% of energy fat	Current Dietary Reference Intake has changed (e.g. 20-35% total fat acceptable)
Saturated fat [3] (10 points)	≤7% of energy from saturated fat	≥10.5% of energy from saturated fat	
Cholesterol [3] (10 points)	<300 mg	≥450 mg	
Variety (10 points)	At least one serving from each food group	Failure to eat a serving from any food group	
Total	100	0	

[1] serving recommendation from Eating Well with Canada's Food Guide

[2] variable of Other: Glanville and McIntyre 2006

[3] Canadian Diabetes Association 2008 guideline

*Individuals with servings between the minimum and maximum cut-offs are assigned a proportional score for the category

3.6.10 Household food security

Participants were asked to answer The Household Food Security Survey Module (HFSSM) Canadian Community Health Survey (cycle 2.2) of nutrition (Appendix 10) (Health Canada, 2007). The survey consisted of 18 questions and estimated the degree of household food security over the previous 12 months due to financial limitations. We used 10 questions that apply for adults without children. Three categories were used to describe the food security status: "food secure"; "food insecure, moderate"; and "food insecure, severe". If a participant indicated difficulty with income-related food access on zero or one question, the person was classified as *food secure*. If a participant answered 2 to 5 questions that they had difficulty with income-related food access, the person was classified as *food insecure, moderate*. If a participant answered 6 or more questions that they had difficulty with income-related food access, the person was classified as *food insecure, severe*.

We used the Mann-Whitley *U*-test for non-parametric data to compare HEI score, macronutrients intakes, micronutrient intakes and food groups between *food secure, severe* and *food secure* groups.

3.6.11 Food frequency questionnaire

We used a food frequency questionnaire (FFQ) that has been adapted from Canadian version of the Diet History Questionnaire (DHQ) (Csizmadi, et al., 2007). The FFQ consisted of many questions to measure the frequency of consuming foods, beverages and supplement use and dose (Appendix 11). In this study we analyzed only the supplement part to assess frequency of supplement use and dose.

3.7 Correlations

Correlations between the HEI-C and distance from their retirement home to their grocery store and between HEI-C and travel time was used in order to test the relation between accessibility to food and quality of diet. Also, we examined the correlation between the type of transportation on the HEI-C scores.

3.8 Data analysis

All interview information was recorded on paper and was then coded and inputted into Microsoft Excel. All data and informed consent materials were housed in a secure cabinet. Statistical analyses were performed using SPSS version 19. Data tabulations, percentages, and bar charts were used to illustrate salient findings in the study.

Chapter 4: Results

4.1 Demographic information

Table 4.1 displays socio-demographic characteristics of the recruited participants with type 2 diabetes. Of the 17 participants, 67.7% were female and 35.3% were male. The average age of the participants was 71.5 ± 6.3 (SD), and the average of duration of diabetes was 17.6 ± 12.6 years. The majority of the participants were white 76.5%, while 12% were Aboriginal. Nearly half (47%) of the participants graduated from college or university. Around 18% of the participants completed high school, and 18% attained less than high school education. All of the participants were retired. Most (65%) participants had annual incomes less than $21,000 and one participant refused to disclose income. The majority of participants lived alone (94%).

Table 4.1: Demographic characteristics of the participants

Variable	Number (n=17)	Mean± SD or Proportion
Age (years)		71.47 ± 6.27
Duration of diabetes (years)		17.64± 12.61
Gender		
Male	6	35.3%
Female	11	67.7%
Ethnicity		
White	11	76.5%
Aboriginal	2	11.8%
South Asian	1	5.8%
Arab	1	5.8%
Education		
Less than high school	3	17.6%
High school	3	17.6%
Some college or university	3	17.6%

College	4	23.5%
University	4	23.5%
Employment		
Retirement income	17	100%
Number in household		
1	16	94.1%
2	1	5.9%%
Household annual income		
≤$21,000	12	64.7%
$21,000 to $39,999	3	17.6%
$40,000 to $59,999	2	11.8%

4.2 General health and diabetes treatment

Table 4.2 shows diabetes treatment and the major diseases that had been diagnosed by doctors. A minority of the participants was not on medication to control their diabetes (18%), while the majority of the participants used oral antidiabetic drugs (53%). Oral hypoglycemic drugs were prescribed and taken by 82.3% of the participants followed by hypertension, hyperlipidemia and heart disease medications. The most common concurrent diseases were arthritis, high blood pressure, high cholesterol, bladder control difficulties, back problems, foot problems and balance problems (each affecting more than 50% of participants). Most of the participants had not smoked ever (70%), while (18%) were former smokers and (12%) were smokers.

Table 4.2: General health and diabetes treatment

Variable	**Number (n=17)**	**Proportion**
Diabetes treatment [1]		
Diet + exercise	3	17.6%
Oral antidiabetic drugs	8	52.9%
Insulin	1	5.8%

Oral antidiabetic drugs + insulin	4	23.5%
Type of medication condition [1]		
Hypertension	12	70.5%
Hyperlipidemia	10	58.8%
Hyperglycemia	14	82.3%
Arthritis	7	41.1%
Heart diseases	10	58.8%
Thyroid disorder	5	29.4%
Digestive disorder	5	29.4%
Osteoporosis	2	11.7%
Depression	4	23.5%
Sleep	3	17.6%
Water pill	4	23.5%
Muscles spasms	2	11.7%
Prostatic hyperplasia	1	5.8%
Asthma	2	11.7%
Concurrent illness [1]		
Arthritis	11	64.7%
High blood pressure	10	58.8%
High cholesterol	10	58.8%
Bladder control difficulties	10	58.8%
Back problem	9	52.9%
Foot problem	9	52.9%
Balance problem	9	52.9%
Allergies	8	47%
Other health problem	8	47%
Osteoporosis	7	41.1%
Trouble hearing	6	35.2%
Poor appetite	6	35.2%
Burning foot	5	29.4%
Heart problem	5	29.4%
Cancer	4	23.5%
Trouble seeing	4	23.5%
Chronic asthma, emphysema, or bronchitis	1	5.8%
Kidney problem	1	5.8%
Hepatitis	0	0%
Smoking		
Current	2	11.7%
Former smoker	3	17.6%
Non-smoker	12	70.5%

[1] More than one response was possible.

4.3 Self-care activities for diabetes

Table 4.3 illustrates the self-care activities that the participants had been advised to do as part of their diabetes treatment. Participants were asked if they had received nutrition information to help them manage their diabetes. Most had been advised to follow Eating Well with Canada's Food Guide (65%) and to avoid food high in fat (53%). Also, many participants had been advised to eat food high in dietary fiber (41%) and to eat lots of fruits and vegetables (47%). The main advisors for nutrition were doctors followed by dietitians. Participants were asked if they had received any advice about physical activity from their health care team. Almost three-quarters (76%) of participants had been advised to fit physical activity into their daily routine and doctors were the chief advisor. Participants were asked if they had been given advice either about testing blood or urine sugar level by their health care team. The majority of participants used a meter to test their blood sugar levels (53%), and the rest used ships to test their blood sugar level. This advice came predominantly from doctors.

Table 4.3 Recommended self-care activities for diabetes treatment

Question	**Number (n=17)**	**Proportion**
Diet [1]		
Follow Eating Well with Canada's Food Guide	11	64.7%
Eat a low glycemic index diet	2	11.7%
Reduce number of calories	6	35.3%
Eat foods high in dietary fiber	7	41.1%
Eat lots of fruits and vegetables	8	47%
Eat fewer sweets	6	35.2%
Avoid food high in fat	9	52.9%
Advised by	11	64.7%

Doctor	6	35.2%
Nurse	9	52.9%
Dietitian	3	17.6%
Diabetic educator		
Physical activitiy [1]		
Daily regular physical activity	3	17.6%
Fit physical activities into your daily routine	13	76.4%
Exercise at least 30 minutes 5 times a week	5	29.4%
Advised by		
Doctor	8	47%
Nurse	5	29.4%
Dietitian	4	23.5%
Diabetic educator	1	5.8%
Blood sugar level [1]		
Blood sugar using color chart	8	47%
Blood sugar using machine [meter]	9	52.9%
Urine test	2	11.7%
Advised by		
Doctor	15	88.2%
Nurse	3	17.6%
Dietitian	1	5.8%
Diabetes educator	3	17.6%

[1] More than one response was possible.

4.4 Physical activity adherence

Figure 4.1 displays the percentage of participants doing physical activity. Nearly all (77%) of the participants reported being active. Figure 4.2 shows the intensity level (strenuous, moderate, mild) of physical activities that the participants performed. Most participants engaged in mild physical such as walking.

Figure 4.1 Participation in physical activities

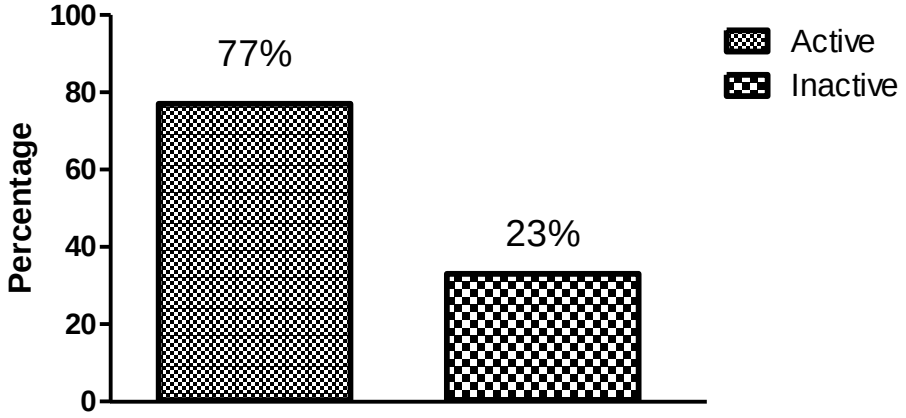
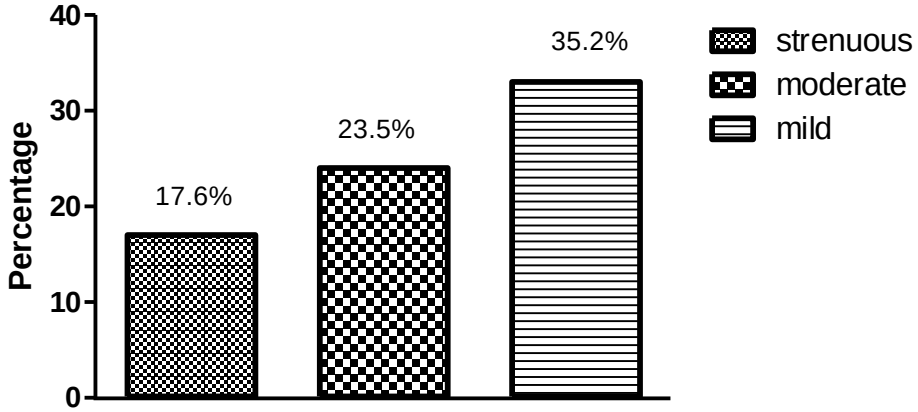


Figure 4.2 Intensity levels of physical activities

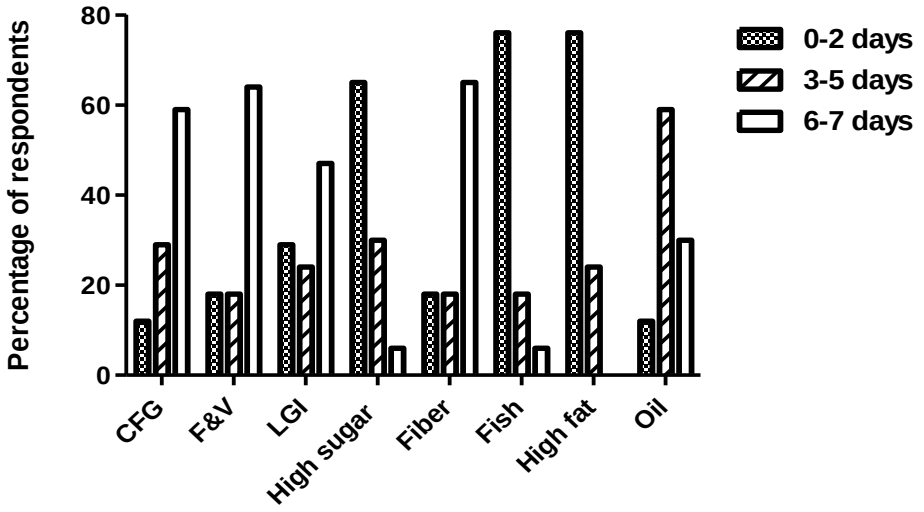


4.5 Participant perception of adherence to a diet recommended for diabetes

Figure 4.3 shows participants' responses about their dietary intakes during the previous 7 days. Responses were grouped into 0-2, 3-5 and 6-7 days of the week for presentation. Less than 60% of the participants reported following Eating Well with Canada's Food Guide on 6-7 days of the previous

week using the Diabetes Dietary Adherence questionnaire. Also, over the week, most (65%) reported consumption of 7 or more servings of fruits and vegetables on 6-7 days, and 47% reported consuming foods with a low glycemic index on 6-7 days. Few participants (6%) reported consuming foods high in sugar on 6-7 days of the previous week. A majority (64.7%) ate foods high in fibre daily. However, more than half of the participants (76%) did not eat the recommended amount of fish or foods high in omega-3 fats in the last 7 days. Furthermore, only ~30% reported using canola, walnut, olive or flax oils for food preparation on 6-7 days of the previous week.

Figure 4.3 Perceptions of participants' adherence to a diet recommended for diabetes in the previous week



Abbreviations: CFG, Eating Well with Canada's Food Guide; F&V, Fruits and vegetables; LGI – low glycemic index foods; Oil – foods high in omega-3 fatty acids

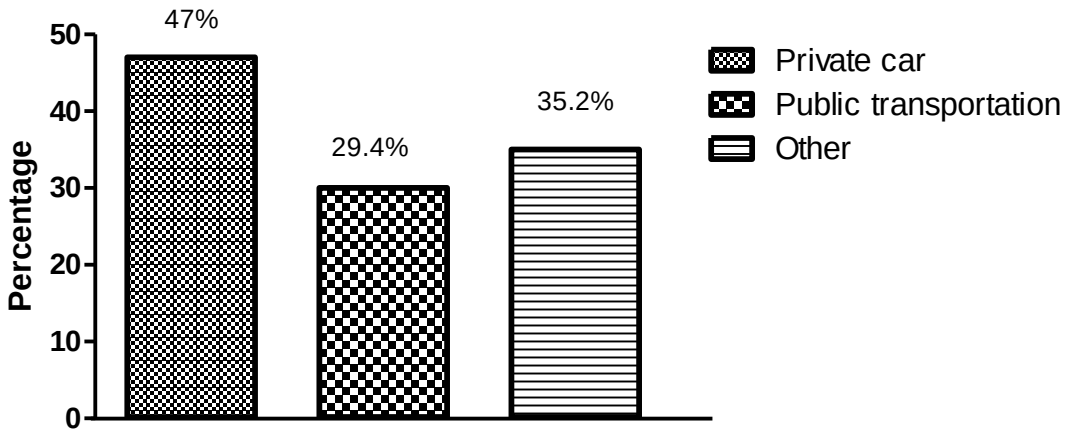
4.6 Food accessibility

Food accessibility was assessed by using questions about convenience, ease of transportation to food outlets and the cost of foods after diagnosis of diabetes.

4.6.1 Distance, time, and transportation to purchase food

Grocery stores were within 3.5 ± 2.9 km of the participants' place of residence. The minimum distance was 0.16 and the maximum distance was 9.6 km, and three of participants travelled to a grocery store less than 1 km away. The time participants spent shopping including transportation was 97.7 ± 52.5 minutes per trip. Figure 4.4 displays the type of transportation that participants used for grocery shopping. Approximately half owned a car while 30% used public transportation. However, 35% of participants used scooters (n=2) for grocery shopping or a family member (n=4) gave them a ride to a grocery store and (n=1) walked for grocery shopping.

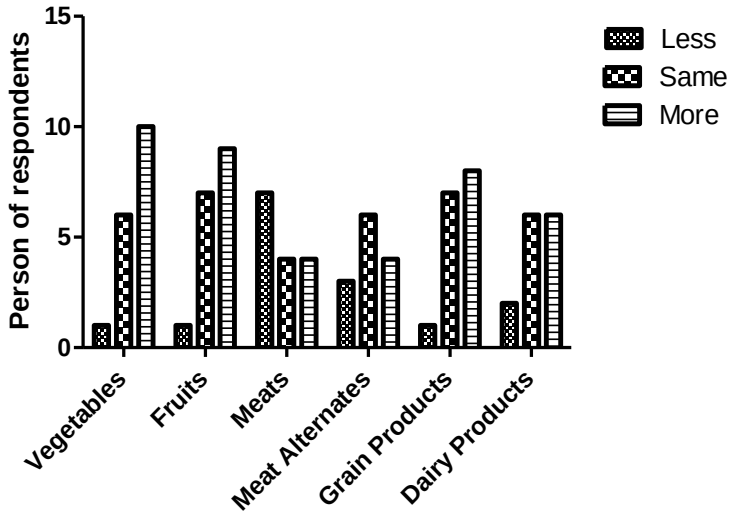
Figure 4.4 Type of transportation used for grocery shopping



4.6.2 Cost of food

Figure 4.5 shows how much money participants spent on certain food groups after their diabetes diagnosis compared with before their diagnosis. Most participants reported spending more amount of money on vegetables and fruit after their diabetes diagnosis. Also, many of the participants reported spending more amount of money on grain products and dairy products.

Figure 4.5 Cost of food after diabetes diagnosis relative to before diagnosis



Abbreviations: Less, spending less amount of money after diabetes diagnosis; Same, spending the same amount of money after diabetes diagnosis; More, spending more amount of money after diabetes diagnosis

4.7 Food availability

Table 4.4 displays responses for questions that had been asked of the participants regarding the availability of foods in their local grocery store. The majority (88%) reported that foods recommended for their diabetes diets were available in their regular grocery store. All of our participants reported that foods recommended for their diabetes diets were easy to find in the stores where they go. Also, almost everyone (94%) reported that the stores where they buy these foods carried a wide variety of foods. However, there was lack of some food categories in the regular grocery store of some participants.

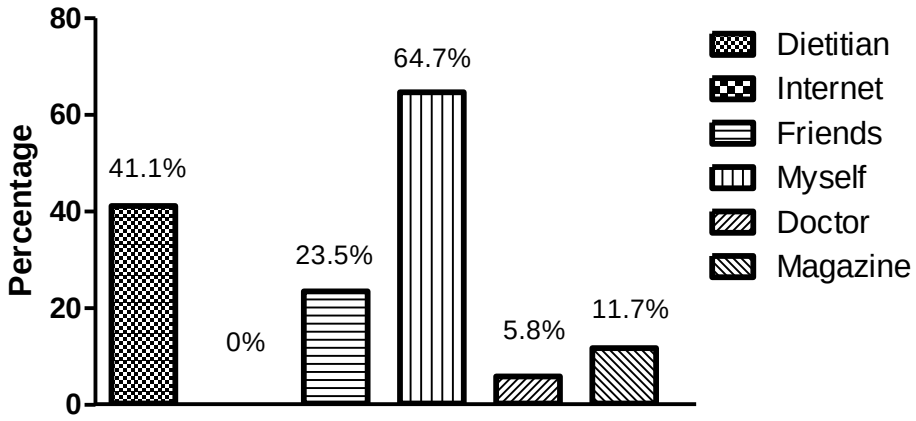
Figure 4.6 shows how participants found out about what foods were appropriate for diabetic diets. Mainly, they found diabetic food by themselves (65%) followed by dietitians (42%). Nearly a quarter (24%) reported that a friend referred them diabetic foods that they can found it in a grocery store, and

(12%) reported that they found diabetic food by magazine. Only 6% said that a doctor referred them diabetic foods that they can find in a grocery store. However, none of the participants used the internet to find diabetic food.

Table 4.4 Food availability survey questions and responses

Question and possible responses	**Proportion of respondents**
Are diabetic foods available in your regular grocery store?	
Yes	88.2%
No	11.7%
Are these foods easy to find in the stores where you go?	
Yes	100%
No	0%
Do the stores where you buy these foods carry a wide variety of foods?	
Yes	94.1%
No	5.8%
Which of these foods can you buy at your grocery store?	
Fresh meat	94.1%
Processed meat	88.2%
Fresh poultry	94.1%
Fresh seafood	88.2%
Packed meat	82.3%
Fresh fruits and vegetables	94.1%
Dairy products	94.1%
Egg	92.1%
Cereal	88.2%
Bakery product	94.1%
Ready to eat	81.3%

Figure 4.6 How participants found out about foods suitable for their diabetic diet



4.8 Dietary intake and nutrient adequacy

4.8.1 Food intake analyzed by food groups from Eating Well with Canada's Food Guide

Intakes were derived from the three 24-h recalls for each food group and averaged for each person. Table 4.5 shows the mean number of servings of each food group, for both males and females. Consumption of all food groups was below the recommended servings per day. The deficit in daily servings per food groups in males were: grains, 2.5 servings; fruits and vegetables, 4.5 servings; milk and alternatives, 2 servings; meat and alternatives, 0.5 servings. The mean daily servings deficit per food group in females was: grains, 2.5 servings; fruits and vegetables, 2.5 – 3.0 servings; milk and alternatives, 1.5 servings; meat and alternatives, 0 – 0.5 servings. Table 4.6 displays the number of participants meeting the number of servings of each food group. Only one participant met

grain products, fruits and vegetables, and milk and alternatives recommendation. However, four participants met the meat and alternative recommendation.

Table 4.5 The average servings of each food group from the three 24-h recalls

Variable	Male		Female	
	Actual	Recommended[1]	Actual	Recommended[1]
Grain products	4.45±0.89	7	3.66±1.05	6
Fruits & vegetables	2.65±0.63	7	4.24±2.3	7
Milk & alternatives	1.21±0.9	3	1.55±0.67	3
Meat & alternatives	2.51±0.18	3	1.74±.59	2

[1] Health Canada Eating Well with Canada's Food Guide

Table 4.6 The number of participants meeting the recommendation for each food group from the three 24-h recalls

Variable	Number	percentage
Grain products	1	6.25%
Fruits & vegetables	1	6.25%
Milk & alternatives	0	0%
Meat & alternatives	4	25%

4.8.2 Macronutrient intake

The mean daily intake of energy, macronutrients (carbohydrates, protein and fat) derived from the average of three 24-hour recalls is presented in Table 4.7. The average total caloric intake was 1339 ± 406 kcal. The contributions of

carbohydrate, protein and fat to total energy were 49%, 20%, and 31%, respectively, which was within the range of CDA 2008 Clinical Practice Guidelines. The participants did not meet the fibre recommendation, whereas their intake of saturated fat was above the recommendation. Table 4.8 displays the number of participants meeting the macronutrient recommendations according to CDA 2008 Clinical Practice Guidelines. All of the participants met the carbohydrate recommendation, while only 18.8% met the fibre recommendation. More than half of the participants (56.3%) met the protein recommendation. Three-quarters of the participants met the total fat recommendation, yet only 13% met the saturated fat recommendation. Nearly 69% met the cholesterol recommendation. Table 4.9 illustrates a comparison of the three 24-hour recalls. There were no significant differences in total caloric intake between the beginning, middle and end of the month (P= 0.075 using repeated measure analysis of variance (ANOVA), or in fat (P=0.057) and protein (P=0.695). Yet carbohydrate (P=0.049) differed between the beginning, middle and end of the month. The consumption of carbohydrate at the beginning and the middle of the month were more than at the end of the month (Table 4.9).

Table 4.7 Macronutrient intake (average of three 24-hour recalls)

Variable	Actual intake	Recommended intake[1]
Total calories	1339 ± 406	
% energy from carbohydrate	49.5 ± 10.8	45-60%
Fibre (g)	16.2 ± 8.6	25-50 g
% energy from protein	19.6 ± 5.9	15-20%
% energy from fat	30.8 ± 9.9	<35%
% energy from saturated fat	9.6 ± 4.5	<7%
% energy from polyunsaturated fat	4.6 ± 3.0	<10%
Cholesterol (mg)	248.0 ± 180.6	300 mg

[1] Canadian Diabetes Association 2008 Clinical Practice Guidelines

Table 4.8 The number of participants meeting the recommendations for macronutrient intake

Variable	Number	Percentage
% energy from carbohydrate	16	100%
Fibre (g)	3	18.8%
% energy from protein	9	56.3%
% energy from fat	12	75%
% energy from saturated fat	2	12.5%
Cholesterol (mg)	11	68.8%

Table 4.9 Macronutrient intake estimated from repeated 24-h recalls obtained at the beginning, middle and end of the month

Variable	Beginning	Middle	End	P-value [1]
Total calories	1388 ± 406	1167 ± 274	1463 ± 324	0.075
% energy from carbohydrate	51.9 ± 11	51.7 ± 8.4	44.9 ± 11.6	0.049
Fibre (g)	18.7 ± 7.9	13.1 ± 5.8	16.7 ± 10.8	0.114
% energy from protein	19.9 ± 7.4	18.7 ± 5.6	20 ± 4.4	0.695
% energy from fat	28.1 ± 7.6	29.4 ± 8.5	34.9 ± 12.2	0.057
% energy from saturated fat	9.5 ± 4.2	9.7 ± 4	9.4 ± 5.3	0.962

[1] P-value < 0.05 was considered significant.

4.8.3 Micronutrient intake

Table 4.10 presents median intakes of minerals from food calculated from the three 24-h recalls. There was a tendency for the median intake of sodium to be higher than the RDA, meanwhile the intakes of calcium and vitamin D were below the RDA. Table 4.11 illustrates the number of participants meeting the micronutrients recommendation from food with and without supplements. None of the participants met sodium, and vitamin D recommendations from food. However, around 68.8% and 62.5% of the participants met the recommended amount of iron and vitamin B12 respectively. When participants took supplements, 93.8% and 68.8% met daily vitamin requirements for Vitamin B12 and Vitamin D respectively. With supplements 63% met the recommendation for calcium. The proportion of participants who met the iron requirements remained the same with supplements intakes (69%).

Table 4.10 Micronutrient intake from food (median) estimated from three repeated 24-h recalls

Variable	Actual intake	Recommended intake
Calcium (mg)	579.5	1200 mg
Iron (mg)	9.3	8 mg
Sodium (mg)	1983.9	1200 mg
B12(mg)	3.0	2.4 (ug)k
Vitamin D(IU)	125.3	800 IU

Table 4.11 The number of participant meeting the micronutrient recommendations from food only, and from food plus supplements

Variable	Food only (n)	Food only (%)	Food +supplements (n)	Food +supplements (%)
Calcium	0	0%	10	62.5%
Iron	11	68.8%	11	68.8%
Sodium	0	0%	NA	NA
B12	10	62.5%	15	93.8%
Vitamin D	0	0%	11	68.8%

4.9 Supplement use of participants

Table 4.12 shows the number of supplements taken by participants. About one-third of the participants took 5 kind of supplements daily or several times a week, and 25% of participants took 4 kind of supplements daily or several times a week. Multivitamins, vitamin D, calcium, and fibre were the most frequent supplements were taken. Whereas, garlic was the most frequent herbal was taken by participants.

Table 4.12 Supplement use by participants

Variable	Total (n=16)	Percentage
Number of supplements taken		
0	1	6.25%
1	1	6.25%
2	0	0%
3	4	25%
4	2	12.5%
5	0	0%
6	1	6.25%
7	5	31.25%
8	0	0%
9	0	0%
10	1	6.25%
11	1	6.25%
Type of supplement		
Multivitamins	12	75%
Vitamin D	11	68.8%
Calcium	10	50%
Fibre	10	50%
Fish oil	7	43.8%
Vitamin E	6	37.5%
B complex	5	31.25%
Vitamin C	4	25%
Iron	3	18.8%
Vitamin A	3	18.8%
Flaxseed oil	3	18.8%
Glucosamine	3	18.8%
Zinc	2	12.5%
Folic acid	2	12.5%
B-6	1	6.25%
Selenium	1	6.25%
Cod liver oil	1	6.25%
Herbal or botanical		
Garlic	5	31.25%
Cranberry	2	12.5%
Ginger	2	12.5%
Cayenne	1	6.25%
Echinacea	1	6.25%
Ginko biloba	1	6.25%
Grapeseed extract	1	6.25%

4.10 Healthy Eating Index-Canada

The distribution of HEI-C scores for each of the HEI-C components is shown in Figure 4.7. The mean total HEI-C score was 64.4 ± 14.6. The highest mean scores were obtained from other (9.5), total fat (8.1), cholesterol (7.4), and meat consumption (7.6), all out of a maximum score of 10.0. In contrast, the participants in this study consumed fewer fruits and vegetables (9.98 out of a maximum score of 20.0), whole grains (6.1) and milk products (4.6), both out of a maximum of 10.0.

Figure 4.8 displays the percentage of participants that reached total scores categorized as "good" (> 80), "needs improvement" (51–80), and "poor" (<51). The majority of the participants' diet quality was classified as "needs improvement" (87.5%) while the rest of the participants were deemed to have "poor" diet quality.

Figure 4.7 Healthy Eating Index-Canada scores

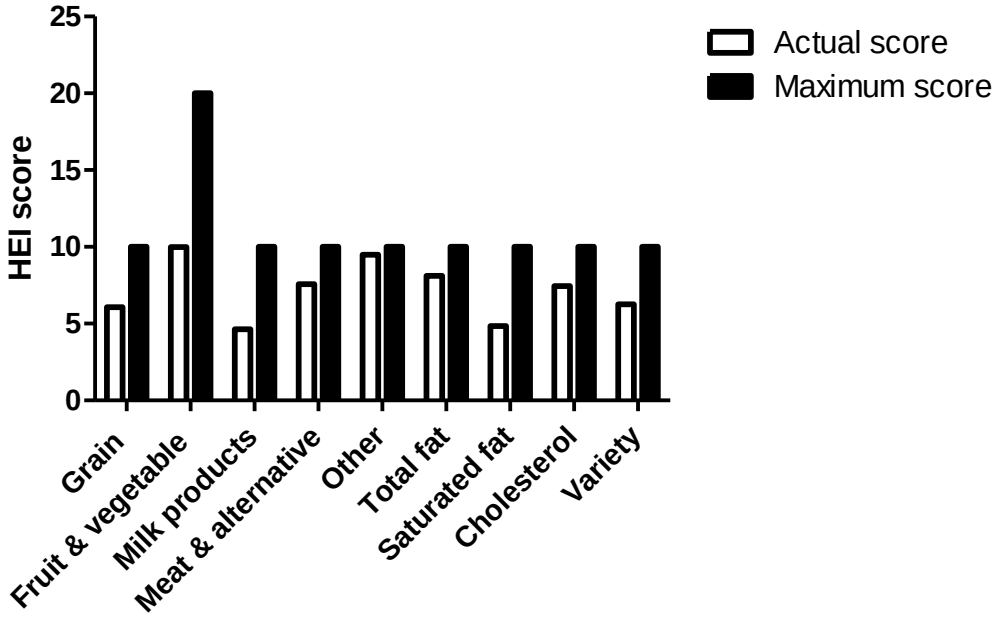
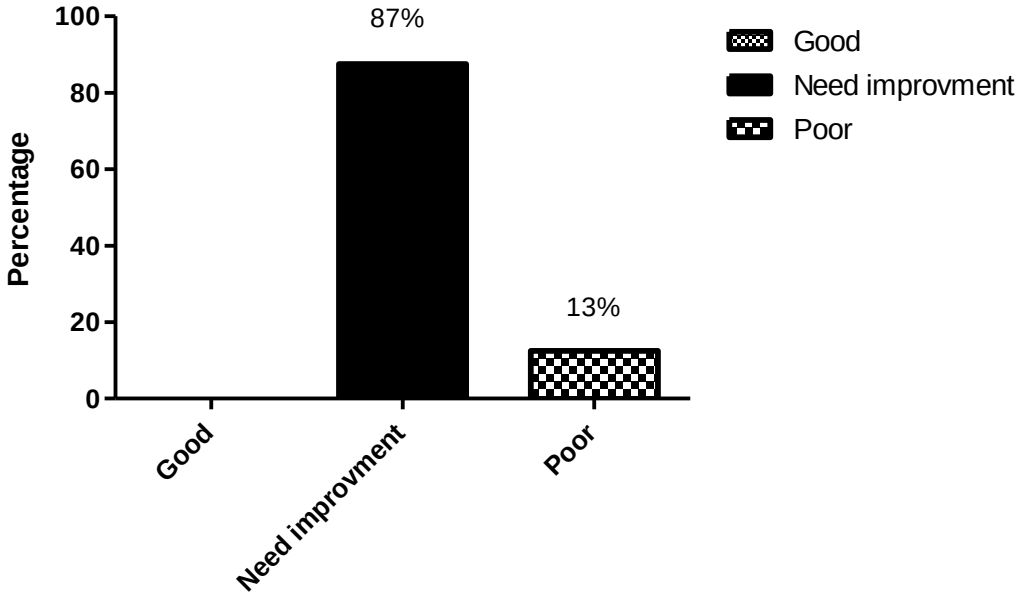


Figure 4.8 Overall diet quality of participants



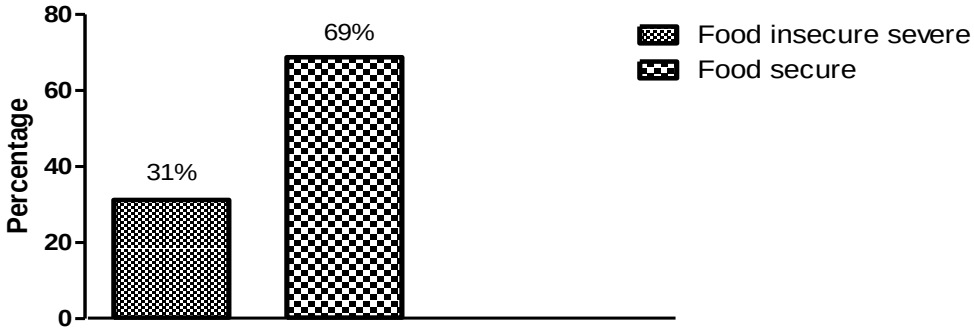
4.10.1 Relationship of Healthy Eating Index-Canada score with distance to shopping, shopping trip duration, and type of transportation

HEI-C scores were compared with several potential modulators of diet identified in the food accessibility questionnaire. HEI scores were not significantly correlated with the distance travelled from their home to their local grocery store ($r = 0.087$ and $P=0.749$) or with shopping trip duration including commuting ($r=0.146$ and $P=0.589$). HEI-C scores for participants who owned their own car ranged between 78.9 to 42.0, while HEI scores for participants who used public transportation ranged between 80.0 to 56.5. Other participants who used scooters or had a family member gave them a ride to a grocery store had HEI scores between 72.0 and 54.3.

4.11 Household food security status

Figure 4.9 demonstrates the reported food security status among the study participants. Less than one-third of the participants were categorized as *food secure* and the remainder was categorized as *food insecure, severe.*

Figure 4.9 Food security status



4.11.1 Food security status compared with HEI-C, caloric intake and servings of food groups

We conducted a comparison between food secure and food insecure, severe groups (Table 4.13). Total caloric intake was marginally higher in the severe food, insecure group (P=0.079). Furthermore, iron intake was significantly higher in the food insecure group (P=0.008). Comparing servings of food groups, only grains were higher in the food insecure, severe group (p=0.013).

We conducted repeated measure analysis of variance (ANOVA) to compare between macronutrients intakes between at the beginning, middle and end of the month within food secure and severe food insecure, severe groups. There were no significant differences between food secure and severe food insecure groups in all macronutrients intakes (Table 4.14) at the beginning, middle and end of the month.

Table 4.13 Comparison between food secure and food insecure participants by Mann-Whitney *U* test

Variables	Median food secure	Median of severe food insecure	Mann-Whitney U	P-value [1]
Total calories	1300.9	1457.2	12	0.079
Total fat%	32.8	29.4	27	0.955
Saturated fat%	9.1	9.7	20	0.396
Protein %	17.2	20.8	20	0.396
Carbohydrate%	51.9	50.5	22	0.533
Fibre (g)	13.7	16.0	27	0.955
Cholesterol (mg)	254.4	234.5	24	0.692
Calcium (mg)	598.4	561.6	26	0.865
Iron (mg)	8.1	14.3	4	0.008
Sodium (mg)	2189.6	2389.7	20	0.441
B12 (mg)	2.47	3.74	14	0.145
Vitamin D (mg)	130.9	100.7	25	0.827
HEI score	63.0	68.9	19	0.377
Grain servings	3.3	4.7	6	0.013
Fruits & vegetables servings	3.2	3.3	26	0.913
Milk & alternative servings	1.5	1.8	24	0.743
Meat & alternative servings	1.7	2.5	15	0.180

[1] P-value < 0.05 was considered significant by Mann Whitney U-test.

Table 4.14 Comparison of macronutrient intake at the beginning, middle and end of the month between food secure and food insecure, severe participants

Variable	Beginning	Middle	End	P-value [1]
Total calories				0.370
FS	1329.5±372.4	1181.3±273.8	1358.4±325.8	
FIS	1516± 490.5	1134.8±288.9	1693.1±177.4	
% energy from carbohydrate				0.357
FS	53.1±11	52.3±9.6	43.2±11.8	
FIS	49.2±11.8	50.6±5.5	48.6±11.7	
Fibre (g)				0.594
FS	19.8±9.3	14.3±5.5	16.3±12	
FIS	16.3±3.2	10.7±6.5	17.8±8.9	
% energy from protein				0.191
FS	18.2±7.1	18.2± 6.4	20.8±5.2	
FIS	23.7±7.6	20.1±3.8	18.5±2.1	
% energy from fat				0.907
FS	28.6±8.1	29.5±9.7	35.9±12.8	
FIS	27.0±7.2	29.2±5.8	32.9±11.9	
% energy from saturated fat				0.956
FS	9.2±4.7	9.6±4.4	8.9±9.5	
FIS	10.2±3.8	10.2±3.7	10.5±4.3	

[1] P-value < 0.05 was considered significant by repeated measures two-way ANOVA.
Abbreviations:
FS= food secure
SFI= severe food insecure

4.11.2 Food security status compared with annual income, distance, time, and transportation to purchase food

Table 4.15 shows the effect of food security status on annual income, distance, time, and transportation to purchase food. All of the participants of the food insecure, severe group had annual income less than $21,000; meanwhile,

only half the participants of the food secure group had annual income less than $21,000. The two groups travelled similar distances to the grocery store ($p>0.05$) and the time spent on shopping was also similar ($p>0.05$). More participants in food secure group reported owning car (n=6) than severe food insecure group (n=2) but this was not statistically different.

Table 4.15 Comparison between food secure and severe food insecure in household annual income, distance, time, and transportation to purchase food

Variable	Food secure (Mean ±SD) or % out of n=11	Food insecure, severe (Mean±SD) or % out of n=5
Household annual income*[1]		
≤$21,000	50	100
≤$21,000	50	0
Distance (Km)[2]	3.4 ± 2.7	4.8 ± 3.7
Time (minutes)[2]	104.5 ± 61.9	90 ± 30
Type of transportation[1]		
Private car	55	40
Public transportation	18	40
Other	27	40

* One participant in the food secure group declined to disclose annual income

[1] More than one answer was possible. Compared by Chi-square test, $p>0.05$.

2 Compared by unpaired t-test, $p>0.05$.

4.11.3 Food security status compared with cost of food

Table 4.16 illustrates how much amount of money participants reported spending on certain food groups after their diabetes diagnosis compared with before their diagnosis. Most participants of food secure group reported spending more amount of money on vegetables and fruit (60-70%) than severe food insecure groups on vegetables and fruits (40%) after their diabetes diagnosis but this was not statistically significant.

Table 4.16 Comparison of cost of food after diabetes diagnosis between food secure and food insecure, severe

Variable*	Food secure, % of n=11			Food insecure, severe, % of n=5		
	Less	Same	More	Less	Same	More
Vegetables	0	27	73	0	60	40
Fruits	0	36	64	20	40	40
Meats	45	18	27	20	40	40
Meat alternates	18	36	27	20	20	20
Grain products	9	45	45	0	20	80
Dairy products	18	45	27	0	40	60

* No significant differences were detected using Chi-square test.

4.11.4 Food security status compared with supplement use

Table 4.17 displays the number of participants in both food secure and food insecure, severe groups taking supplements. More participants in the food secure group took fibre (n=6), multivitamins (n=8), fish oil (n=6), calcium (n=8),

vitamin D (n=7), vitamin E (n=5), and B-complex (n=5) than severe food insecure.

Table 4.17 Comparison of supplement use in the food secure versus food insecure, severe group

Variable	Food secure, % of n=11	Food insecure, severe, % of n=5
Fibre	55	40
Multivitamins	73	80
Iron	18	20
Folic Acid	9	20
Cod Liver Oil	0	0
Fish Oil	55	20
Calcium	73	40
Vitamin D	64	80
Vitamin A	18	20
Vitamin C	36	0
Vitamin E	45	20
B-6	9	0
B-Complex	45	0
Flaxseed Oil	27	0
Glucosamine	27	0
Selenium	9	0
Zinc	18	0

Chapter 5: Discussion

5.1 Introduction

This chapter describes the findings of this study. These findings are compared with previous research in order to illustrate relevant aspects of the results including similarities and differences. Because there have been few contributions to the literature describing diabetic nutrition status and barriers that affect diet adherence among diabetic seniors with low income, this study will make a contribution to the prescription for diet for such individuals.

5.2 Demographics of the study population

The population of this study was senior citizens (age greater than 60) living in Edmonton many who had low incomes. This segment of the population was recruited by specifically targeting retirement homes providing subsidized rent for people with limited income but which did not provide meals. Thus, all subjects were retired, living independently in low-income retirement homes. The participants purchased their own groceries and prepared their own meals. In all, 17 participants were recruited who met the inclusion criteria. They were predominantly female, white and well-educated.

Senior citizens with a university degree are more likely to be in excellent or very good health than 25- to 54-year-olds who did not complete high school (Statistics Canada, 2006). Thus, the high percentage of participants with post-secondary education in this study's sample may have affected its results.

It is not surprisingly that most of the participants were women. Older adult females have lower average annual incomes ($23,644) than males ($37,659) (Statistics Canada, 2005) and would be more likely to qualify for subsidized housing. Also according to Johnson et al. (2009) women from age groups 80 and older have a higher prevalence of diabetes than men because of longer life expectancies. Most of the participants lived alone, which may affect their diet quality. It is documented that older adults who live with a relative eat more variety of food than those who live alone (Dean, Raats, Grunert & Lumbers, 2009).

Statistic Canada's Low Income Cut-offs (LICO) defines "income thresholds below which families devote a larger share of income to the necessities of food, shelter and clothing than the average family would" (Statistics Canada, 2010). Between 1996 and 2003, 13.7% of seniors fell below the after-tax LICO (Statistic Canada, 2006). Thus, for an individual in 2010, annual income was set at a threshold of $18,759 or less after taxes to meet the LICO designation. Two-thirds of the participants in this study had an annual income less than $20,000, close to the LICO of Statistics Canada. Seniors living in low-income retirement homes pay 30% of their gross annual household income for rent, with the rest subsidized by the Alberta Seniors Ministry (SAGE).

5.3 Medical status

A self-reported diagnosis of type 2 diabetes was an inclusion criterion for participation in this study. These self-reports were not validated from medical records but 12 of the 17 participants also reported being prescribed oral hypoglycaemic drugs. Also, the duration of diabetes was such that all participants became diabetic in adulthood, again suggesting that the self-report was accurate. The main common medical condition beyond diabetes reported in this study was arthritis, followed by hypertension, hyperlipidemia and heart diseases. Our results concur with Shatenstein (2008), which showed arthritis then hypertension were the most frequently reported chronic conditions among Canadian seniors. A similar finding (Beverly et al., 2011) listed hypertension, arthritis, hyperlipidemia and heart disease as the four most common diseases found in older patients with type 2 diabetes. The most commonly prescribed medications were for hyperglycaemia (diabetes) followed by hypertension. Most participants (65%) had received nutrition information from doctors, with only 17.6% and 53% respectively received from diabetic educators and dietitians. Doctors were the main advisors among health care team members to encourage exercise. This finding indicates that doctors were the main advisors and guidance for diabetic patients under treatment, while diabetic educators and dietitians provided less advice and guidance. It would have strengthened the data to know how long ago diabetes advice was received, given the low level of knowledge of some aspects of diabetes care (see section 5.5.1).

5.4 Physical activity participation

Two-thirds of participants reported being active while one third were reported being inactive. Most active participants engaged in mild physical activity such as easy walking. Walking has been found to be the most typical exercise engaged in by older low-income adults (Clark, 1999). One-third of participants being inactive could be explained by the fact that the majority of our participants had arthritis (67.6%) and back problems (52.9%). This result is not surprising as older adults typically experience decreasing lean body mass along with an increasing sedentary lifestyle compounded by illnesses that restrict adhering to exercise programs (Rizvi, 2009). In 2003, 27% of men aged 65 to 74 were active, meanwhile 17% of women aged 65 to 74 were active (Statistic Canada, 2006). Nelson et al. (2002) using data collected by NHANES III, found that diabetic, low-income older women were less likely to report engaging in regular exercise than those with higher incomes. Mathews et al. (2010) identified barriers to being physical active; health problems such as heart disease, arthritis, back problems, and functional limitation were most commonly reported. Fear of falling, lack of knowledge, financial cost, and an inconvenient environment were also barriers mentioned by the subjects. Since we collected our data during the winter, related weather conditions could have been a barrier to participation in physical activities. Time, place for activities, sidewalk conditions, and weather are environmental barriers to physical activity (Clark, 1999).

5.5 Nutrition status

5.5.1 Participants' perception of their own dietary adherence to CDA recommendations

Most of the participants (65%) had been advised to follow Eating Well with Canada's Food Guide by their health care team and more than half of the participants did so in the previous 6-7 days using the diabetes dietary adherence questionnaire. Furthermore, nearly half of the participants had been advised to eat lots of fruits and vegetables, but 65% reported consuming 7 or more servings of fruits and vegetables, as recommended by Eating Well with Canada's Food Guide, over the previous 6-7 days. Only 12% had been advised to follow a low glycemic index diet, yet half of the participants reported frequently consuming foods with a low glycemic index over the previous 6-7 days. Many participants (41%) had been advised to eat food high in dietary fiber; nevertheless, 65% reported consuming foods high in fibre daily. Few participants (6%) reported consuming foods high in sugar, while only 36% had been advised to minimize sugar. None of the participants reported consumption of food high in fat such as high-fat dairy products, fatty meat, fried foods or deep fried foods in the previous 6-7 days; on the other hand 53% had been advised to avoid food high in fat. One third reported using canola, walnut, olive or flaxseed oils for food preparation over the previous 6-7 days. However, more than half (76%) did not eat the recommended amount of fish or foods high in omega-3 fats in the previous 6-7 days.

Taken as a whole, the majority of the sample perceived themselves having good dietary adherence by following Eating Well with Canada's Food Guide, which emphasizes consuming more fruits and vegetables, and avoiding foods high in sugar and fats. However, from these data it appears that the intake of foods in the previous 6-7 days could be improved in some areas, such as choice of oils but also in fruits and vegetables and fibre for many participants. It appears that some of the participants have a limited knowledge of following Eating Well with Canada's Food Guide or eating low glycemic index foods. Without nutritional knowledge, a diabetic person may not have the ability to manage their blood sugar levels, which may potentially lead to the development of complications.

5.5.2 Analysis of macronutrient intakes

Generally, participants had low caloric intake, averaging less than 1400 kcal/day. Our result is consistent with Dewolfe and Millan (2003) who found generally low energy intake in community dwelling elderly women and men. Because body weight data were not collected in this study, the recommended caloric intake could not be computed and compared. The contributions of carbohydrate, protein and fat to total energy were 49%, 20%, and 31%, respectively, which were within the ranges recommended in the Canadian Diabetes Association 2008 Clinical Practice Guidelines (CDA, 2008). The mean intake of fibre was about 65% of the minimum recommendation of 25 grams/day, whereas their intake of saturated fat was above the recommendation.

Every one of our participants met the carbohydrate recommendation, but less than 20% met the fibre recommendation. More than half of the participants met the protein recommendation. Three-quarters of the participants met the total fat recommendation, yet only 13% met the saturated fat recommendation. These results indicate that our participants have not adhered consistently to an appropriate diet. Some studies have reported similar high rates of inadequate nutrient intake in the older adult population. An Australia study found that over half of the subjects with type 2 diabetes had protein consumption within the recommended range, but fat and saturated fat intakes were more than the recommendation, and carbohydrate intake was less than recommended (Barclay et al., 2006). Nelson et al. (2002), analyzing data for diabetic older adults reported that the majority had a high intake of fat as well as saturated fat. However, diabetic people who had incomes less than the federal poverty level were less likely to consume >10% of their daily calories from saturated fats. Bowman (2009) reported similar results among older Caucasian and African-American adults with saturated fat intake above the recommendation (10.8% of total energy for males and 10.5% for females). Dietary fibre was below recommendations. Similarly, nearly half of seniors living in service houses consumed less than 1570 kcal/day of energy and less than 60 g/day of protein. Also, 98% ate less fibre than recommended (Vikstedt et al., 2011). Another study (Johnson et al., 2008) found that elderly people who received home care did not meet the DRI recommended for carbohydrate and fibre whereas protein was higher than recommended. Soini, Routasalo and Lagström (2004) found that

48% of elderly people living at home and receiving regular home-care services were at risk for malnutrition, especially those who lived alone.

5.5.3 Analysis of intakes by food groups compared with perceived adherence to guidelines

It is notable that this sample did not meet the minimum serving recommendation of each food group as outlined in Eating Well with Canada's Food Guide. Just one participant met grain products, fruits and vegetables, and milk and alternatives recommendations. Yet four participants met the meat and alternative recommendation.

The shortfall of 2.5-3 servings of fruits and vegetables is interesting because the participants' self-report of daily fruits and vegetable servings suggested that two-thirds were consuming 7 or more servings daily. The food group analysis indicates that the diet of the elderly is poor, lacking in variety four food groups. It is also possible that the participants did not understand what constituted a serving of fruit and vegetables.

Several studies documented failure to meet food group servings. McBee, Cotugna and Vickery (2001) found that Canadian older men living in seniors centers reported that they ate enough fruits and vegetables over a day. However, the median fruit and vegetable intake was 3.2 servings per day. Some key barriers to meeting fruit and vegetable recommendations were cost, time, availability and taste (McBee et al, 2001). Moreover, Nelson et al. (2002) documented that 63% of diabetic older adults ate fewer than five servings of

fruits and vegetables. Similar findings were reported by Maruapula and Novakofski (2010) among older adults in urban, semi-urban and rural settings in Botswana. In our study, barriers to consumption of fruits and vegetables were not assessed specifically. Availability in stores was not an issue for participants but cost may have been, because 10 of the 17 respondents reported spending more on fruits and vegetables since their diabetes diagnosis (see Sections 5.6 and 5.7 below).

The failure to meet the grains recommendation documented in our study is similar to results found by Ellis et al. (2005). They used a food frequency questionnaire that contained 19 questions about the intake of specific whole and non-whole grain foods to assess the consumption whole grain foods. They found that only 10% of older adults consumed whole grain foods three or more times daily.

The shortfall of servings of milk & alternative is not surprising. Garriguet (2008) reported from the data Canadian Community Health Survey-Nutrition 2004 that the consumption of milk dropped with advancing age. Another study in USA reported the same findings (Elbon et al., 1998). Furthermore, Nesbitt et al. (2008) documented that Ontarian older adults were less likely to consume milk than younger.

Low consumption of meat & alternative was also documented in this study. This is broadly related with Dewolfe & Millan (2003) who found that the majority of older adults consumed less than 2 servings of meat. In contrast,

Nesbitt et al., 2008 documented a high consumption of fish, nuts and egg among Ontarian older adults.

Even though participants met the macronutrient recommendations as a group based on Canadian Diabetes Association 2008 Clinical Practice Guidelines, they did not meet the minimum Eating Well with Canada's Food Guide serving requirements as a group or individually. Therefore, while macronutrient distribution was adequate, the total intakes were low. In addition, comparison of perceived intake with actual servings suggests inaccurate perceptions of fruit and vegetable intake, as well as fat intake.

5.5.4 Micronutrient intake

There is not any literature of the specific micronutrient intake requirements for diabetic older adults. For that reason, the current Dietary Reference Allowances (DRA) for older adults was used to analyze micronutrient intake. We assessed vitamin D because it is essential for older adults and deficiency causes osteomalacia, rickets and myopathy (Sinclair, 2009). In addition, calcium is important to prevent causes of osteoporosis (Sinclair, 2009). Vitamin B12 deficiency can potentially cause depression and poor memory for older adults (Sinclair, 2009). Sodium intake associates with development of hypertension (Sinclair, 2009). The median intake of sodium was found to be higher than the RDA, meanwhile median intake of calcium was below the RDA. Yet the median of iron was above the RDA. The overall low intakes of micronutrients are due to low energy intakes and low consumption of fruits and

vegetables. Without supplements none of the participants met the calcium, sodium, and vitamin D from food. However, around 60% of the participants met the recommended amount of iron and vitamin B12, respectively, likely due to relatively good adherence to meat and alternatives recommendations and fortification of foods such as breakfast cereals. By adding supplements, 94% and 69% of participants met daily vitamin requirements for Vitamin B12 and Vitamin D respectively. Also, with supplements, 63% of participants met the calcium recommendation. A similar result was found in a study of food consumed by seniors in Ontario. The consumption of calcium was below the recommendation, whereas sodium and iron were exceeding the recommended level (Johnson et al., 2008). Another Canadian study found that vitamin B12 and iron exceeded the estimated adequate requirement among older adults. Sharkey et al. (2002) documented low calcium intake among the homebound elderly.

High intake of sodium is associated with the kind of food eaten. Prepared food, canned food, fast food, and bread can contribute to raised sodium intakes. Many of the participants in our study may have relied on these types of foods because they are easy and convenient to prepare. Low intake of calcium was an expected outcome because of the low intake of milk and alternatives food group..

5.5.5 Health Eating Index-Canada

We used the HEI-C as an indicator of diet quality. The mean score achieved on the HEI-C was 64. The overall low scores for diabetic older adults

indicate nutritional risk. Our study categorized participants into two levels; "needs improvement" and "poor". Unfortunately, none of the participants' scores ranged from 80–100 points, which is defined as a "good" diet. Analysis of scores for the individual components of the HEI-C showed where participants did well and where their diets could improve. Participants had the highest score from "other", which refers to avoidance of sugar and oil intake, meaning that intakes of foods high in sugars and fats were low. This is consistent with their self-report on the perceived dietary adherence survey. It is interesting to note that participants consumed fat and cholesterol in amounts giving them close to maximum score, which contributed to higher overall HEI-C score. As noted in the analysis of food group servings, participants consumed close to the recommended servings of meat and alternatives, a major source of fat and cholesterol. Nonetheless, lower scores than optimal for fruits and vegetables (10 out of a possible 20), whole grains (6 out of 10), and milk products (4.6 out of 10) contributed to lower overall HEI-C score.

Some previous studies in North America used the HEI to evaluate diet quality. Our findings are consistent with Finke and Huston (2003) who found a sample of elderly people had a mean score of 66 on the HEI, with fruit the lowest scoring individual component. Another study was conducted by Savoca et al., 2009 among older adults in the U.S. The mean average total HEI-2005 score was 62, and only 2% of the sample achieved HEI-2005 scores of 80 points or more. Furthermore, Juan et al. (2008) did not find a significant improvement in HEL total scores from 1994-96 to 2001-02 in older Americans. In 2001-2002,

older adults had the lowest scores for whole grains, dark green and orange vegetables, legumes and milk.

International studies suggest similarly poor diet quality among older participants. Elderly Botswana residents only met requirements for the grains group. They obtained high HEI scores on fat, saturated fat, cholesterol, sodium, and grains groups, while variety, milk, fruits, and vegetables had low HEI scores. Nearly 38% of elderly people had a poor diet, 59% needed improvement their diet, and only 3% had a good diet (Maruapula et al., 2006). Moreover, Ledikwe et al. (2004) found that community-dwelling older adults with a high-nutrient dense diet pattern had a mean HEI score of 74, while those in the low-nutrient-dense diet pattern had a mean HEI score of 67. By contrast, a Brazilian study documented high HEI scores among elderly people attending a Rehabilitation Center. About 45% of the subjects had good diets, while 54% of them needed to improve their diets, and only 1% of the studied group consumed a poor diet. Consumption of fruits, cholesterol, vegetables and the variety of diet contributed to high scores on the HEI. The intake of cereals and milk was lower than the recommended values, but fats were over the dietary guidelines. Where the result differs from other studies, a possible explanation may be that the living environment affects HEI. Almost 79% of participants in the Brazilian study lived with relatives. More than 90% of women and 12.5% of men were responsible for meals, whereas 83% of women and 50% of men purchased groceries (Borges, Regina & Gracioso, 2003). In contrast, our study focused on independent-living seniors, most of whom lived alone.

The results of these studies suggest that diet quality is generally sub-optimal in elderly populations. Other studies did not target populations with type 2 diabetes but obtained similar HEI scores as what was found in our current study. However, considering that diet is an important part of diabetes therapy, the lack of a good diet may have more important health outcomes than in the generally healthy elderly population.

5.6 Food accessibility

5.6.1 Distance, time, and transportation to purchase food and relationship to diet quality

City neighbourhoods lacking a grocery store are termed *food deserts* and may force people to shop at convenience stores with less variety of foods (Smoyer-Tomic et al 2006). Only three of 17 participants travelled to a grocery store within one km. Other research defines 0.8 km as walking distance to a grocery store (Smoyer-Tomic et al 2006) and has been identified as a particular barrier for seniors' access to food (Cameron et al 2010). However, in this case a longer distance between grocery stores and the participants' place of may be due to the individual's preference of grocery store companies because there was no correlation between HEI-C scores with the distance travelled from participants' place of residence to the grocery store. This finding demonstrates that grocery stores were easily accessible to participants' place of residence and distance did not affect diet quality. Smoyer-Tomic et al. (2006) examined the accessibility of

supermarkets in Edmonton. They concluded that "although for the majority of Edmonton's neighborhoods, including those with high-need populations, supermarkets are relatively accessible, there is a subset of the population who live in unsupportive local food environments and who have few resources for accessing supermarkets". Some previous studies have shown a positive correlation between consumption of fruits and vegetables and the proximity of grocery stores (Morland et al., 2002a; Morland, et al., 2002b). Travers (1995) documented poor accessibility to healthy food as a contributing factor to food insecurity, poor nutrition, and high-calorie consumption among Canadian aboriginals with type 2 diabetes.

Round-trip travel time to the store and back including shopping was about 100 minutes per trip, which is consistent with a short distance to grocery stores in their neighbourhood and no correlation was found between commuting time and HEI-C scores. This provides further evidence that grocery stores accessibility was not a limiation to diet quality for most participants. D'Angelo et al., (2011) found that walkers, drivers or those getting a ride in low-income areas had a significantly shorter mean travel time compared with those taking the bus or metro, which is consistent with our results. Nearly half of the participants in our study owned a car while 30% used public transportation. Owning a car and living in safe neighbourhoods might provide much greater access to food. Conversely, using public transportation and living in unsafe neighbourhoods may limit access to food. Also, the type of transportation can affect quality of diet. Dean et al., (2009) found that older adults who had access to a car had a

more varied diet. Usually aging is associated with decreasing lean body mass and increasing sedentary lifestyle (Rizvi, 2009). Therefore lack of access to a car for older adults can limit their ability to carry a variety of food items. Burns, Bentley, Thornton & Kavanagh (2010) found a strong linear association between age and difficulty carrying groceries. A study by Rose et al. (2004) yielded unexpected results: people who owned a car consumed lower amounts of fruits and vegetables, yet elderly and single-person households consumed greater amounts of fruits and vegetables despite that fact that they had lower rates of car ownership. D'Angelo et al. (2011) found that purchasing more healthy food was associated with low-income adults who drove or had a ride to the food source, whereas purchasing unhealthy food was associated with walking. Since only one participant in this study reported walking to the grocery store, it was not possible to segregate the results in this way.

5.6.2 Cost of Food

Generally, participants stated that they were spending more money on vegetables and fruit after their diabetes diagnosis. Also, many of the participants reported spending more money on grain products and dairy products. Although inflation may have altered perceptions of cost, participants did differentiate between paying more for fruits and vegetables but less for meats. The cost of food impacts food choices. Because our participants were from low to moderate income their ability to spend more money on vegetables and fruit may be limited. People with low-SES were significantly less likely to purchase foods

that were high in fibre and low in fat, salt and sugar (Turrell, Van Lenthe, Brug, Mackenbach & Turrell, 2009). Moreover, residents of low-SES in Australia were less likely to purchase food consistent with national dietary guideline recommendations (Giskes et al., 2007). Locher et al. (2009) identified motivations and perceived barriers associated with food selection in older adults with price being one of the most frequent responses. Nonetheless, Didsdall, Lambert, Bobbin and Frewer (2003) reported that two-thirds of low-income people in England did not think that being short of money prevented them from consuming fruits and vegetables.

5.7 Food availability

Most of the participants held that a good variety recommended foods were available in their regular grocery store, were easy to find and. This result confirms the availability and ease of finding recommended foods for diabetic patients. However, the fact that approximately 10% of participants reported some issues related to availability suggests that the situation is not entirely ideal. Several studies in the USA stated that fresh fruits and vegetables were often unavailable in low-income area supermarkets (Godwinet al., 2006; Zenk et al., 2005; Morland et al., 2002). Horowitz et al. (2004) found that recommended foods for diabetic patients were less likely to be available in a poor, non-white community. In Hamilton, Canada healthy foods were less likely to be available in low-income areas (Latham et al., 2007).

5.8 Impact of household food security status on nutrient intake

Even though the majority of participants were low-income, two-thirds perceived themselves as food secure. The median HEI-C score in the food insecure, severe group was 6 points higher than the food secure group, although it was not statistically different. Moreover, no significant differences were noted in total calories, macronutrient or fibre intakes between the food secure and food insecure, severe groups; however the number of servings within the grains food group was higher in the food insecure, severe group. In addition, iron intake was higher in the food insecure, severe group. These results are surprising but suggest that food insecure people make more careful decisions about food purchases.

Several studies associated food insecurity and poor diet quality. Kirkpatrick and Tarasuk (2007) observed nutrient inadequacy among Canadian adults and adolescent in food insecure households. Champagne el al., (2007) also found food insecurity associated with low HEI scores. Guthrie and Lin (2002) concluded that lower-income older adults consumed significantly fewer calories than high-income older adults, and consumed fewer servings of Food Pyramid food groups. We cannot assess this last comparison in our study because the participants were all selected to be low-income. This likely limits our ability to detect differences in diet associated with income or food security status. However, we did attempt to identify factors with the potential to influence food choices within the food availability and accessibility paradigm. Likely due to the small number of participants, no significant effects of household food

security were detected. However, all of the food insecure, severe group had income less than $21,000 and there was a trend for this group to be less likely to report spending more on fruits and vegetables but more likely to spend more on grain products since their diabetes diagnosis.

5.9 Supplement use of participants

The pattern of supplement use showed that multivitamins, vitamin D, calcium, and fibre (50%) were the most frequent supplements taken, similar to other reports (Weeden, Remig, Holcomb, Herald and Baybutt, 2010). Although vitamin D is recommended to be taken as a supplement at 400 IU a day for older adults (Health Canada, 2007), only 69% of the participants took vitamin D every day. However, usage of supplements (16/17 participants reporting at least one) was much higher than in other studies that reported usage by 30-50% of senior citizens (Kolmers, 2006; Minor and Driskell, 2009). Supplements not having been prescribed or recommended, being unsure which supplement to take, or expense were given as reasons for low usage (Minor and Driskell, 2009). Similar findings in the Netherlands reported only ~40% of older adults using one or more supplements with 17% using vitamin D supplement (Engels, Lechner, Dorant, Assema & van 2001). Thus, supplement usage was relatively high in our population but whether the diabetes diagnosis contributes to supplement use is unclear. Supplement use was lower in the food insecure, severe group, indicating that financial status is an important determinant.

5.10 Strengths and limitations

This study investigated factors of food security, accessibility and availability that affected food choice and diet quality for low-income diabetic older adults. This study was unique in measuring the accessibility and availability of food specifically for low-income, diabetic older adults. Furthermore, the study gave us a picture of low-income diabetic older adults' nutritional risk. Repeating 24-hour recall three times provided an improved estimation of usual intake.

The study however has limitations. The restriction of participants to those diagnosed with type 2 diabetes, low-income, and independent living in retirement homes may have led to some sampling bias that may limit generalization of findings. However, since the sample population purchased and prepared their own food, the results likely apply to similar demographically described groups living outside of retirement homes. Another limitation was that our small sample may not have been representative of elderly, low-income type 2 diabetics because the participants were predominantly female and had higher education than the general population in this age-group. Although cognitive disabilities may have affected the results, collecting the data in face-to-face interviews allowed facilitation of recall through prompting and also likely contributed to the high retention rate in the study.

We did not collect data from medical records, such as body weight or haemoglobin A1c, which would have facilitated comparisons of diabetes and weight control with dietary intakes and other variables. In addition, participants

answered questions from their perspective and embarrassment or forgetfulness may be reasons for inaccurate information. The data of the 24 hour recalls may be subject to underreporting or underestimating food intake, which could impact the outcomes. Moreover, this study had a cross-sectional design, which cannot infer a cause-and-effect relationship from the data. We used HEI-C modified to Eating Well with Canada's Food Guide and the Canadian Diabetes Association recommendations for older adults with type 2 diabetes; however, it was not validated with these modifications. Also, the study focused on the availability and accessibility of food. An assessment of social, psychological, and environmental factors associated with diet and nutritional status would be useful to explain some results.

5.11 Conclusion

In summary, even though participants did not have a high caloric intake, the macronutrient intakes were within the range of Canadian Diabetes Association 2008 Clinical Practice Guidelines recommendations with the exception of saturated fat. The participants had difficulties meeting fibre, vitamin D and calcium recommendations, and exceeded the amount of sodium intake recommended. Low HEI-C scores were found in both food secure and food insecure, severe groups. Furthermore, the consumption of all food groups was below the recommended servings per day. Nevertheless, most of the participants perceived themselves as having good dietary adherence by following Eathing Well with Canada's Food Guide.

Although the majority of participants were low income, most did not report have major accessibility and availability barriers to the proper food. Lack of information between the patients and health care providers including dietitian/diabetes educator may have been a factor in poor dietary compliance. Although more than half reported receiving advice from a dietitian, and two-thirds from a doctor, the proportion reporting appropriate self-care activities with respect to diet was less than half for most items. The average duration of diabetes for this sample was more than 15 years; thus updated diabetes education could be of benefit to this group.

Another factor contributing to low dietary adherence to recommendations was the low total intake and servings of individual food groups. Other factors may be contributing, such as low energy expenditure due to low physical activity, active dieting to reduce calories, lack of interest in food due to sensory loss, social situation or other environmental factors that were not measured in this study.

5.11 Implications, recommendations and future research directions

Further research is needed to increase understanding of the complexity of adherence to an appropriate diet for older adults with type 2 diabetes living independently on limited income. Studying a larger number of people would help to generalize outcomes. Also, measuring HbA1c levels would allow researchers to determine the effect of diet quality on diabetes control. Studies could include other factors such as social, psychological, and environmental

factors that may contribute to understanding barriers that affect diet and nutritional status.

Diet plans for people with type 2 diabetes must take into account the affordability of foods. Healthy eating habits, regular exercise and supplement use should be encouraged by diabetes educator and dietitians as adjunct therapy for people with type 2 diabetes. Interventions should target older adults with type 2 diabetes through recurring diabetes education programs so that new information can be incorporated into an individual's treatment plan. By improving dietary quality and encouraging using of supplements and doing regular exercise, the nutritional and health status of diabetic older adults can be optimized.

Bibliography

Adler, N. E., & Newman, K. (2002). Socioeconomic disparities in health: Pathways and policies. *Health Affairs, 21*(2), 60-76.

Adler, N. E., & Ostrove, J. M. (1999). Socioeconomic status and health: What we know and what we don't. *Annals of the New York Academy of Sciences, 896*, 3-15.

Alavinia, S., & Burdorf, A. (2008). Unemployment and retirement and ill-health: a cross-sectional analysis across European countries. *International Archives of Occupational and Environmental Health, 82*(1), 39-45.

Al-Lawati, J., & Tuomilehto, J. (2007). Diabetes risk score in Oman: A tool to identify prevalent type 2 diabetes among Arabs of the Middle East. *Diabetes Research and Clinical Practice, 77*(3), 438-444.

Alwan, A. (1997). Noncommunicable diseases: a major challenge to public health in the Region. *Eastern Mediterranean Health Journal, 3*(1), 6-16.

American Diabetes Association. Diabetes Statistics. Retrieved October 13, 2011, from http://www.diabetes.org/diabetes-basics/diabetes-statistics/?utm_source=WWW&utm_medium=DropDownDB&utm_content=Statistics&utm_campaign=CON

Baker, R. S., Watkins, N. L., Wilson, M. R., Bazargan, M., & Flowers, C. W.J. (1998). Demographic and clinical characteristics of patients with diabetes

presenting to an urban public hospital ophthalmology clinic. *Ophthalmology, 105*(8), 1373-1379.

Bamia, C., Trichopoulou, A., & Trichopoulos, D. (2008). Age at retirement and mortality in a general population sample. *American Journal of Epidemiology, 167*(5), 561-569.

Barclay, A. W., Brand-Miller, J., & Mitchell, P. (2006). Macronutrient intake, glycaemic index and glycaemic load of older Australian subjects with and without diabetes: Baseline data from the Blue Mountains eye study. *British Journal of Nutrition, 96*(1), 117-123.

Bengle,R., Sinnett, S., Johnson, T., Johnson, M, A., Brown, A., & Jungsun, L. E. E. (2010). Food insecurity is associated with cost-related medication non-adherence in community-dwelling, low-income older adults in Georgia. *Journal of Nutrition for the Elderly, 29*(2), 170-191.

Best, L. E., Hayward. M. D., & Hidajat, M. M. (2005). Life course pathways to adult-onset diabetes. *Social Biology, 52*(3-4), 94-111.

Beverly, E. A., Wray, L. A., Chiu, C. J., & Weinger, K. (2011). Perceived challenges and priorities in co-morbidity management of older patients with type 2 diabetes. *Diabetic Medicine, 28*(7), 781-784.

Borges,T., Regina, S., & Gracioso, R. (2003). Nutritional evaluation and adherence to dietary guidelines of a healthy elderly group. *Alimentos e nutrição, 4*(10), 25-30.

Boulé, N., Haddad, E., Kenny, G., Wells, G., & Sigal, R. (2001). Effects of exercise on glycemic control and body mass in type 2 diabetes mellitus: a meta-analysis of controlled clinical trials. *JAMA: The Journal Of The American Medical Association, 286*(10), 1218-1227.

Bowman, S. A. (2009). Socioeconomic characteristics, dietary and lifestyle patterns, and health and weight status of older adults in NHANES, 1999-2002: A comparison of Caucasians and African Americans National Health and Nutrition Examination Survey. *Journal of Nutrition for the Elderly, 28*(1), 30-46.

Buhrmann, R., Assaad, D., Hux,J. E., Tang, M. & Sykora, K. (2003). Diabetes and the Eye. In: Hux JE, Booth GL, Slaughter P, Laupacis A, editors. Diabetes in Ontario: An ICES Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences. Retrieved October 13, 2011, from http://www.ices.on.ca/file/DM_Chapter10.pdf

Burns, C., Bentley, R., Thornton, L., & Kavanagh, A. (2011). Reduced food access due to a lack of money, inability to lift and lack of access to a car for food shopping: a multilevel study in Melbourne, Victoria. *Public Health Nutrition, 14*(6), 1017-23.

Cameron, N., Amrhein, C.G., Smoyer-Tomic, K.E., Raine, K.D., & Chong, L.Y. (2010). Cornering the market: restriction of retail supermarket locations. *Environment and Planning C-Government and Policy,* 28(5), 905-922.

Canadian Diabetes Association (2008). Canadian Diabetes Association 2008 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada. Retrieved October 13, 2011, from http://www.diabetes.ca/files/cpg2008/cpg-2008.pdf

Cassady, D., Jetter, K. M., & Culp, J. (2007). Is price a barrier to eating more fruits and vegetables for low-income families? *Journal of the American Dietetic Association, 107*(11), 1909-1915.

Central Intelligence Agency. The World Factbook. Retrieved October 13, 2011, from https://www.cia.gov/library/publications/the-world-factbook/rankorder/2102rank.html

Cesana, G., Panza, G., Ferrario, M., Zanettini, R., Arnoldi, M., & Grieco, A. (1985). Can glycosylated hemoglobin be a job stress parameter? *Journal Of Occupational Medicine, 27*(5), 357-360.

Champagne, C. M., Casey, P. H., Connell, C. L., Stuff, J. E., Gossett, J. M., Harsha, D. W., McCabe-Sellers, B., Robbins, J. M., Simpson, P. M., Weber, J.L., & Bogle, M.L. (2007). Poverty and food intake in rural America: Diet quality is lower in food insecure adults in the Mississippi delta. *Journal of the American Dietetic Association, 107*(11), 1886-1894.

Chin, M. H., Zhang, J. X., & Merrell, K. (1998). Diabetes in the African-American Medicare population: Morbidity, quality of care, and resource utilization. *Diabetes Care, 21*(7), 1090-1095.

Choi, B. C., & Shi, F. (2001). Risk factors for diabetes mellitus by age and sex: Results of the National Population Health Survey. *Diabetologia, 44*, 1221-1231.

Clark, D. O. (1999). Identifying psychological, physiological, and environmental barriers and facilitators to exercise among older low income adults. *Journal of Clinical Geropsychology, 5*(1), 51-62.

Cohen, B. E. (2002). Community food security assessment toolkit. (USDA). Retrieved October 13, 2011, from http://www.ers.usda.gov/publications/efan02013/efan02013.pdf

Corcoran, J., & Franklin, C. (2002). Multi-systemic risk factors predicting depression, self-esteem, and stress in low SES and culturally diverse adolescents. *Journal of Human Behavior in the Social Environment, 5*(2), 61-76.

Csizmadi, I., Kahle, L., Ullman, R., Dawe, U., Zimmerman, T., Friedenreich, C., & Subar, A. (2007). Adaptation and evaluation of the National Cancer Institute's Diet History Questionnaire and nutrient database for Canadian populations. *Public Health Nutrition*, *10*(1), 88-96.

Davis, B. B., & Tarasuk, V. V. (1994). Hunger in Canada. *Agriculture And Human Values*, *11*(4), 50-57.

D'Angelo, H., Suratkar, S., Song, H. J., Stauffer, E., & Gittelsohn, J. (2011). Access to food source and food source use are associated with healthy and unhealthy food-purchasing behaviours among low-income African-American adults in Baltimore city. *Public Health Nutrition*, *14*(9), 1632-1639.

Dean, M., Raats, M., Grunert, K., & Lumbers, M. (2009). Factors influencing eating a varied diet in old age. *Public Health Nutrition*, *12*(12), 2421-2427.

DeWolfe, J., & Millan, K. (2003). Dietary intake of older adults in the Kingston area. *Canadian Journal of Dietetic Practice & Research, 64*(1), 16-24.

Dibsdall, L.A., Lambert, N., Bobbin, R.F. & Frewer, L.J. (2003). Low income consumers' attitudes and behaviour towards access, availability and motivation to eat fruit and vegetables. *Public Health Nutrition*, *6*, 159–168.

Dietitians of Canada. (2010). The cost of healthy eating in Saskatchewan 2009: Impact on food security. Retrieved October 13, 2011, from http://www.dietitians.ca/Downloadable-Content/Public/Cost-of-Eating-Saskatchewan.aspx

Dietitians of Canada. (2009). Cost of eating in Alberta 2008. Retrieved October 13, 2011, from http://www.afbna.ca/media/uploads/resources/2009costofeatingreport.pdf

Dietitians of Canada. (2007). The cost of eating in BC 2007. Retrieved October 13, 2011, from http://www.dietitians.ca/Downloadable-Content/Public/BC_CostofEating_2007.aspx

Dubois, L., Girard, M., & Bergeron, N. (2000). The choice of a diet quality indicator to evaluate the nutritional health of populations. *Public Health Nutrition, 3*(3), 357-365.

Durai Raj, G.D. (2012). Dietary adherence and food acceptability among individuals with type 2 diabetes. University of Alberta, Edmonton. 177 pp.

Elbon, S. G., Johnson, M. A., & Fischer, J. G. (1998). Milk consumption in older Americans. *American Journal Of Public Health, 88*(8), 1221-1224.

Ellis, J., Johnson, M. A., Fischer, J. G., & Hargrove, J. L. (2005). Nutrition and health education intervention for whole grain foods in the Georgia older Americans nutrition program. *Journal of Nutrition for the Elderly, 24*(3), 67-83.

Engels, Y., Lechner, L., Dorant, E., & Assema, P. (2001). Factors associated with the intention to use vitamin D supplements: Quantitative study among

a sample of elderly people in a medium-sized town in the Netherlands. *Journal of Nutrition Education, 33*(3), 134-142.

esha Research. The Food Processor. Retrieved October 13, 2011, from http://www.esha.com/kb/questions/50/

Espelt, A., Borrell, C., Roskam, A. J., Rodríguez-Sanz, M., Stirbu, I., Dalmau-Bueno, A., Regidor, E., Bopp, M., Martikainen, P., Leinsalu, M., Artnik, B., Rychtarikova, J., Kalediene, R., Dzurova, D., Mackenbach, J., & Kunst, A.E. (2008). Socioeconomic inequalities in diabetes mellitus across Europe at the beginning of the 21st century. *Diabetologia, 51*(11), 1971-1979.

Finke, M. S., & Huston, S. J. (2003). Healthy eating index scores and the elderly. *Family Economics and Nutrition Review, 15*(1), 67-73.

Franco, O., Steyerberg, E., Hu, F., Mackenbach, J., & Nusselder, W. (2007). Associations of diabetes mellitus with total life expectancy and life expectancy with and without cardiovascular disease. *Archives of Internal Medicine, 167*(11), 1145-1151.

Fuhrman, M. P. (2009). Home care for the elderly. *Nutrition in Clinical Practice: Official Publication of the American Society for Parenteral and Enteral Nutrition, 24*(2), 196-205.

Garriguet, D. (2008). Beverage consumption of Canadian adults. *Health Reports, 19*(4), 23-29.

Giskes, K., Van Lenthe, F., Brug, J., Mackenbach, J. P., & Turrell, G. (2007). Socioeconomic inequalities in food purchasing: The contribution of respondent-perceived and actual (objectively measured) price and availability of foods. *Preventive Medicine, 45*(1), 41-48.

Glanville, N., & McIntyre, L. (2006). Diet quality of Atlantic families headed by single mothers. *Canadian Journal Of Dietetic Practice And Research, 67*(1), 28-35.

Godwin, S. L., & Tegegne, F. (2006). Lack of easy accessibility as a potential barrier to adequate fruit and vegetable consumption by limited-resource individuals. *Journal of Food Distribution Research, 37*(1), 81-86.

Government of Alberta. (2010). Seniors and Community Support annual report 2010-11. Retrieved October 13, 2011, from http://www.seniors.gov.ab.ca/about_ministry/ASCSAnnualReport.pdf

Gregg, E., Geiss, L., Saaddine, J., Fagot-Campagna, A., Beckles, G., Parker, C., & .Engelgau, M. (2001). Use of diabetes preventive care and complications risk in two African-American communities. *American Journal of Preventive medicine, 21*(3), 197-202.

Gucciardi, E., Vogt, J. A., Demelo, M., & Stewart, D. E. (2009). Exploration of the relationship between household food insecurity and diabetes in Canada. *Diabetes Care, 32*(12), 2218-2224.

Guenther, P. M., Reedy, J., & Krebs-Smith, S. (2008). Development of the healthy eating index-2005. *Journal of the American Dietetic Association, 108* (11), 1896-1901.

Guthrie, J. F., & Lin, B. (2002). Overview of the diets of lower- and higher-income elderly and their food assistance options. *Journal of Nutrition Education & Behavior, 34* (2), S31-S41.

Hayashino, Y., Yamazaki, S., Nakayama, T., Sokejima, S., & Fukuhara, S. (2010). The association between socioeconomic status and prevalence of diabetes mellitus in rural Japan. *Archives of Environmental & Occupational Health, 65*(4), 224-229.

Health Canada. (2007). Canadian Community Health Survey, cycle 2.2, Nutrition income-related Household Food security in Canada. Retrieved October 13, 2011, from http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/surveill/income_food_sec-sec_alim-eng.pdf

Health Canada. (2007). Eating Well With Canada`s Food Guide. Retrieved October 13, 2011, from http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/food-guide-aliment/view_eatwell_vue_bienmang-eng.pdf

Health Canada.(2010). Dietary Reference Intakes Tables. Retrieved October 13, 2011, from http://hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/nutrition/dri_tables-eng.pdf

Hendrix, S. J., Fischer, J. G., Reddy, S., Lommel, T. S., Speer, E. M., Stephens, H., Park, S., & Johnson, M.A. (2008). Fruit and vegetable intake and knowledge increased following a community-based intervention in older adults in Georgia senior centers. Journal of *Nutrition for the Elderly, 27*(1-2), 155-178.

Homenko, D. R., Morin, P. C., Eimicke, J. P., Teresi, J. A., & Weinstock, R. S. (2010). Food insecurity and food choices in rural older adults with diabetes receiving nutrition education via telemedicine. *Journal of Nutrition Education & Behavior, 42*(6), 404-409.

Horowitz, C. R., Colson, K. A., Hebert, P. L., & Lancaster, K. (2004). Barriers to buying healthy foods for people with diabetes: Evidence of environmental disparities. *American Journal of Public Health, 94*(9), 1549-1554.

Hu, F., Leitzmann, M., Stampfer, M., Colditz, G., Willett, W., & Rimm, E. (2001). Physical activity and television watching in relation to risk for type 2 diabetes mellitus in men. *Archives of Internal Medicine, 161*(12), 1542-1548.

Hu, F., Sigal, R., Rich-Edwards, J., Colditz, G., Solomon, C., Willett, W., Speizer, F., & Manson, J. (1999). Walking compared with vigorous physical activity and risk of type 2 diabetes in women: a prospective study. *JAMA: The Journal Of The American Medical Association, 282*(15), 1433-1439.

Janssen, I., Boyce, W. F., Simpson, K., & Pickett, W. (2006). Influence of individual- and area-level measures of socioeconomic status on obesity, unhealthy eating, and physical inactivity in Canadian adolescents. *American Journal of Clinical Nutrition, 83*(1), 139-145.

Johnson, C. S., & Begum, M. N. (2008). Adequacy of nutrient intake among elderly persons receiving home care. *Journal of Nutrition for the Elderly, 27*(1-2), 65-82.

Johnson, J.A., Balko, S.U., & Edwards, A.L. (2009). Epidemiological trends of diabetes in Alberta. Alberta Diabetes Atlas 2009. Retrieved October 13, 2011, from http://www.albertadiabetes.ca/pdf/atlas/09/Atlas-2%28web%29.pdf

Juan, W. Y., Kott, P. S., & Guenther, P. M. (2008). Diet quality of older Americans in 1994-96 and 2001-02 as measured by the Healthy Eating Index-2005. *Nutrition Insights*, 41. Alexandria, Virginia: USDA Center for Nutrition Policy and Promotion, November.

Kaplan, M., Huguet, N., Newsom, J., McFarland, B., & Lindsay, J. (2003). Prevalence and correlates of overweight and obesity among older adults: Findings from the Canadian National Population Health Survey. *Journals Of Gerontology Series A-Biological Sciences And Medical Sciences, 58*(11), 1018-1030.

Kawakami, N., Akachi, K., Shimizu, H., Haratani, T., Kobayashi, F., Ishizaki, M., Hayashi,T., Fujita, O., Aizawa, Y., Miyazaki, S., Hiro, H., Hashimoto, S., & Araki, S. (2000). Job strain, social support in the workplace, and haemoglobin A1c in Japanese men. *Occupational and Environmental Medicine, 57*(12), 805-809.

Keller, H. H., Dwyer, J. J. M., Senson, C., Edwards, V., & Edward, G. (2006). A social ecological perspective of the influential factors for food access described by low-income seniors. *Journal of Hunger & Environmental Nutrition, 1*(3), 27-44.

Kennedy, E., Ohls, J., Carlson, S., & Fleming, K. (1995). The Healthy Eating Index: design and applications. *Journal of the American Dietetic Association, 95*(10), 1103-1108.

Kessler, H., & Wunderlich, S. M. (1999). Relationship between use of food labels and nutrition knowledge of people with diabetes. *The Diabetes Educator, 25*(4), 549-559.

Kirkpatrick, S. I., & Tarasuk, V. (2007). Adequacy of food spending is related to housing expenditures among lower-income Canadian households. *Public Health Nutrition, 10*(12), 1464-1473.

Kolmers, A. M. (2006) Dietary patterns and supplement intake of older adults in Northeast Georgia. Masters Thesis, The University of Georgia, Athens, Georgia.

Kowall B, Rathmann W, Strassburger K, Meisinger C, Holle R, & Mielck A. (2011). Socioeconomic status is not associated with type 2 diabetes incidence in an elderly population in Germany: KORA S4/F4 cohort study. *Journal of Epidemiology and Community Health, 65*(7), 606-612.

Laaksonen, D., Lindstrom, J., Lakka, T., Eriksson, J., Niskanen, L., Wikstrom, K., Aunola, S., Keinanen-Kiukaanniemi, S,. Laakso, M., Valle, T., Ilanne-Parikka, P., Louheranta, A., Hamalainen, H., Rastas, M., Salminen, V., Cepaitis, Z., Hakumaki, M., Kaikkonen, H., Harkonen, P., Sundvall, J., Tuomilehto, J, & Uusitupa, M. (2005). Physical activity in the prevention of type 2 diabetes: the Finnish Diabetes Prevention Study. *Diabetes, 54*(1), 158-165.

Larsen, K., & Gilliland, J. (2008). Mapping the evolution of 'food deserts' in a Canadian city: Supermarket accessibility in London, Ontario, 1961-2005. *International Journal of Health Geographics, 7*, 1-16.

Latham, J., & Moffat, T. (2007). Determinants of variation in food cost and availability in two socioeconomically contrasting neighbourhoods of Hamilton, Ontario, Canada. *Health and Place, 13*(1), 273-287.

Ledikwe, J., Smiciklas-Wright, H., Mitchell, D., Miller, C., & Jensen, G. (2004). Dietary patterns of rural older adults are associated with weight and nutritional status. *Journal of the American Geriatrics Society, 52*(4), 589-595.

Lee, J. S., & Frongillo, E. A., J. (2001). Factors associated with food insecurity among U.S. elderly persons: Importance of functional impairments. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 56*(2), S94-S99.

Locher, J. L., Ritchie, C. S., Roth, D. L., Sen, B., Vickers, K. S., & Vailas, L. I. (2009). Food choice among homebound older adults: Motivations and perceived barriers. *The Journal of Nutrition, Health & Aging, 13*(8), 659-664.

Lutz, W., & Qiang, R. (2002). Determinants of human population growth. *Philosophical Transactions of the Royal Society of London.Series B, Biological Sciences, 357*(1425), 1197-1210.

Manuel. D.G & Schultz. S. E. (2003). Diabetes Health Status and Risk Factors. In: Hux JE, Booth GL, Slaughter P, Laupacis A, editors. Diabetes in Ontario: An ICES Practice Atlas. Toronto: Institute for Clinical Evaluative Sciences, p. 77–94. Retrieved October 13, 2011, from http://www.ices.on.ca/file/DM_Chapter4.pdf

Maruapula, S. D., & Chapman-Novakofski, K. (2006). Poor intake of milk, vegetables, and fruit with limited dietary variety by Botswana's elderly. *Journal of Nutrition for the Elderly, 25*(3-4), 61-72.

Maruapula, S. D., & Novakofski, C. K. (2010). Nutrient intake and adequacy of Botswana elderly. *African Journal of Food, Agriculture, Nutrition & Development, 10*(7), 1-20.

Mathews, A. E., Laditka, S. B., Laditka, J. N., Wilcox, S., Corwin, S. J., Liu, R., Friedman, D, Hunter, R, Tseng, W, & Logsdon, R. (2010). Older adults' perceived physical activity enablers and barriers: A multicultural perspective. *Journal of Aging & Physical Activity, 18*(2), 119-140.

Maty, S. C., Everson-Rose, S., Haan, M. N., Raghunathan, T. E., & Kaplan, G. A. (2005). Education, income, occupation, and the 34-year incidence (1965-99) of type 2 diabetes in the Alameda County study. *International Journal of Epidemiology, 34*(6), 1274-1281.

Maxwell, D. (2011). Type 2 Diabetes: Economics of Dietary Adherence. University of Alberta, Edmonton, 222 pp.

McAuley, K., Wilson, N., Williams, S., Story, G., Mann, J., McLay, R. Goulding, A., Harper, M., Chisholm, A., & Jones, I. (2002). Intensive lifestyle changes are necessary to improve insulin sensitivity - A randomized controlled trial. *Diabetes Care*, *25*(3), 445-452

McBee, S., Cotugna, N., & Vickery, C. E. (2001). Fruit and vegetable consumption in an elderly population. *Journal of Nutrition for the Elderly, 21*(1), 59-67.

Meiselman, H. L., & MacFie, H. J. H. (1996). Food choice, acceptance and consumption. Springer Netherlands, pg 2.

Melchers, N. V. S. V., Gomez, M., & Colagiuri, R. (2009). Do socio-economic factors influence supermarket content and shoppers' purchases? *Health Promotion Journal of Australia, 20*(3), 241-246.

Miller, C. K., Edwards, L., Kissling, G., & Sanville, L. (2002). Evaluation of a theory-based nutrition intervention for older adults with diabetes mellitus. *Journal of the American Dietetic Association, 102*(8), 1069-1081.

Minor, S.A., & Driskell, J.A. (2009). Reasons given by homebound older adults living in a large midwestern city for taking or not taking vitamin and mineral supplements. *Journal of Nutrition For the Elderly, 28*(2), 174-187.

Morland, K., Wing, S., Diez Roux, A., & Poole, C. (2002). Neighborhood characteristics associated with the location of food stores and food service places. *American Journal of Preventive Medicine, 22*(1), 23-29.

Morland, K., Wing, S., & Roux, A. D. (2002). The contextual effect of the local food environment on residents' diets: The Atherosclerosis Risk in Communities study. *American Journal of Public Health, 92*(11), 1761-1767.

Nagaya, T., Yoshida, H., Takahashi, H., & Kawai, M. (2002). Markers of insulin resistance in day and shift workers aged 30–59 years. *International Archives of Occupational & Environmental Health, 75*(8), 562-568.

Nassis, G., Papantakou, K., Skenderi, K., Triandafillopoulou, M., Kavouras, S., Yannakoulia, M., Chrousos, G., & Sidossis, L. (2005). Aerobic exercise training improves insulin sensitivity without changes in body weight, body fat, adiponectin, and inflammatory markers in overweight and obese girls. *Metabolism: Clinical And Experimental, 54*(11), 1472-1479.

Nelson, K. M., Reiber, G., & Boyko, E. J. (2002). Diet and exercise among adults with type 2 diabetes: Findings from the third National Health and Nutrition Examination Survey (NHANES III). *Diabetes Care, 25*(10), 1722-1728.

Nesbitt, A, Majowicz, S, Finley, R, Pollari, F, Pintar, K, Marshall, B, Cook, A, Sargeant, J, Wilson, J, Ribble, C, & Knowles, L . (2008). Food consumption patterns in the Waterloo Region, Ontario, Canada: a cross-sectional telephone survey. *BMC Public Health, 8*.

Páez, A., Gertes Mercado, R., Farber, S., Morency, C., & Roorda, M. (2010). Relative accessibility deprivation indicators for urban settings: Definitions and application to food deserts in Montreal. *Urban Studies, 47*(7), 1415-1438.

Pasala, S. K., Rao, A. A., & Sridhar, G. R. (2010). Built environment and diabetes. *International Journal of Diabetes in Developing Countries, 30*(2), 63-68.

Payette, H., & Shatenstein, B. (2005) Determinants of healthy eating in community-dwelling elderly people. *Canadian Journal of Public Health, 96,* S27-S31.

Riely, F., Mock, N., Cogill, B., Bailey, L. & Kenefick, E (1999). Food security indicators and framework for use in the monitoring and evaluation of food aid programs. In Food and Nutrition Technical Assistance 46 (U.S. Agency for International Development, Washington, D.C.).

Rizvi, A. (2009). Cytokine biomarkers, endothelial inflammation, and atherosclerosis in the metabolic syndrome: emerging concepts. *The American Journal of the Medical Sciences, 338*(4), 310-318.

Robbins, J. M., Vaccarino, V., Zhang, H., & Kasl, S. V. (2005). Socioeconomic status and diagnosed diabetes incidence. *Diabetes Research and Clinical Practice, 68*(3), 230-236.

Rose, D., & Richards, R.(2004). Food store access and household fruit and vegetable use among participants in the US food stamp program. *Public Health Nutrition, 7*(8), 1081-1088.

Rosenthal, M. S. (2009*). The Canadian type 2 diabetes sourcebook*. Mississauga, Ont.: J. Wiley & Sons Canada, 2009; 3rd ed.

Ross, N. A., Gilmour, H., & Dasgupta, K. (2010). 14-year diabetes incidence: The role of socio-economic status. *Health Reports, 21*(3), 19-28.

Russell, L. B., Valiyeva, E., Roman, S. H., Pogach, L. M., Suh, D., & Safford, M. M. (2005). Hospitalizations, nursing home admissions, and deaths attributable to diabetes. *Diabetes Care, 28*(7), 1611-1617.

Saaddine, J. B., Engelgau, M. M., Beckles, G. L., Gregg, E. W., Thompson, T. J., & Narayan, K. M. V. (2002). A diabetes report card for the United States: Quality of care in the 1990s. *Annals of Internal Medicine, 136*(8), 565-574.

Sahyoun, N. N., & Basiotis, P. P. (2000). Food insufficiency and the nutritional status of the elderly population. *Nutrition Insights,* (18).

Savoca, M. R., Anderson, A., Kohrman, T., Quandt, S. A., Chen, H., Anderson, A., Kohrman, T., & Quandt, S. A. (2009). The diet quality of rural older adults in the south as measured by Healthy Eating Index-2005 varies by ethnicity. *Journal of the American Dietetic Association, 109*(12), 2063-2067.

Savoca, M., & Miller, C. (2001). Food selection and eating patterns: Themes found among people with type 2 diabetes mellitus. *Journal of Nutrition Education,* 33, 224-233.

Saydah, S., & Lochner, K. (2010). Socioeconomic status and risk of diabetes-related mortality in the U.S. *Public Health Reports, 125*(3), 377-388.

Seligman, H. K., Davis, T. C., Schillinger, D., & Wolf, M. S. (2010). Food insecurity is associated with hypoglycemia and poor diabetes self-management in a low-income sample with diabetes. *Journal of Health Care for the Poor & Underserved, 21*(4), 1227-1233.

Seligman, H. K., Laraia, B. A., & Kushel, M. B. (2010). Food insecurity is associated with chronic disease among low-income NHANES participants. *The Journal of Nutrition, 140*(2), 304-310.

Seligman, H. K., Bindman, A. B., Vittinghoff, E., Kanaya, A. M., & Kushel, M. B. (2007). Food insecurity is associated with diabetes mellitus: Results from the national health examination and nutrition examination survey (NHANES) 1999-2002. *Journal of General Internal Medicine, 22*(7), 1018-1023.

Seniors Association of Great Edmonton (SAGE). Retrieved October 13, 2011, from http://www.mysage.ca/index.cfm

Sharkey, J. R. (2004). Variations in nutritional risk among Mexican American and non-Mexican American homebound elders who receive home-delivered meals. *Journal of Nutrition for the Elderly, 23*, 1-20.

Sharkey, J. R., Branch, L. G., Zohoori, N., Giuliani, C., Busby-Whitehead, J., & Haines, P. S. (2002). Inadequate nutrient intakes among homebound elderly and their correlation with individual characteristics and health-related factors. *American Journal of Clinical Nutrition, 76*(6), 1435-1445.

Sharkey, J. R. (2005). Longitudinal examination of homebound older adults who experience heightened food insufficiency: Effect of diabetes status and implications for service provision. *Gerontologist, 45*(6), 773-782.

Shatenstein, B. (2008). Impact of health conditions on food intakes among older adults. *Journal of Nutrition for the Elderly*, *27*(3-4), 333-361.

Shaw, J. E., Sicree, R. A., & Zimmet, P. Z. (2010). Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Research & Clinical Practice, 87*(1), 4-14.

Sinclair, J.A. (2009) *Diabetes in Old Age (Third ed.).* Wiley and Sons, Chichester, UK, 500 pp.

Smoyer-Tomic, K., Spence, J. C., & Amrhein, C. (2006). Food deserts in the prairies? Supermarket accessibility and neighborhood need in Edmonton, Canada. *Professional Geographer, 58*(3), 307-326.

Soini, H., Routasalo, P., & Lagstrom, H. (2004) Characteristics of the Mini-Nutritional Assessment in elderly home-care patients. *European Journal of Clinical Nutrition, 58*, 64-70.

Speer, E. M., Reddy, S., Lommel, T. S., Fischer, J. G., Stephens, H., Park, S., & Johnson, M.A. (2008). Diabetes self-management behaviors and A1c improved following a community-based intervention in older adults in Georgia senior centers. *Journal of Nutrition for the Elderly, 27*(1-2), 179-200.

Statistics Canada. (2006). Census. Retrieved November 6, 2011, from http://www12.statcan.ca/census-recensement/2006/dp-pd/tbt/Rp-eng.cfm?TABID=1&LANG=E&APATH=3&DETAIL=0&DIM=0&FL=A&FREE=1&GC=0&GK=0&GRP=1&PID=96247&PRID=0&PTYPE=88971,97154&S=0&SHOWALL=0&SUB=0&Temporal=2006&THEME=72&VID=0&VNAMEE=&VNAMEF=

Statistics Canada. (2006). A Portrait of Seniors in Canada 2006. Retrieved October 13, 2011, from http://www.statcan.gc.ca/pub/89-519-x/89-519-x2006001-eng.pdf

Statistics Canada. (2010). Low Income Cut-offs for 2006 and Low Income Measure for 2005. Retrieved October 13, 2011, from http://www.statcan.gc.ca/pub/75f0002m/75f0002m2007004-eng.pdf

Statistics Canada. (2010). Low Income Lines, 2009-2010. Retrieved October 13, 2011, from http://www.statcan.gc.ca/pub/75f0002m/75f0002m2011002-eng.pdf

Tang, M., Chen, Y., & Krewski, D. (2003). Gender-related differences in the association between socioeconomic status and self-reported diabetes. *International Journal of Epidemiology, 32*(3), 381-385.

Thomas, D., & Elliott, E. (2009). Low glycaemic index, or low glycaemic load, diets for diabetes mellitus. *Cochrane Database Of Systematic Reviews, 1*, 1-31.

Travers, K. D. (1995). Using qualitative research to understand the sociocultural origins of diabetes among Cape Breton Mi'kmaq. *Journal of Chronic Diseases in Canada, 16,* 140-143.

Toobert, D., Hampson, S., & Glasgow, R. (2000). The Summary of Diabetes Self-Care Activities measure: results from 7 studies and a revised scale. *Diabetes Care, 23*(7), 943-950.

Tucker-Seeley, R., Li, Y., Sorensen, G., & Subramanian, S. V. (2011). Lifecourse socioeconomic circumstances and multimorbidity among older adults. *BMC Public Health, 11,* 1-9.

Turrell, G., Bentley, R., Thomas, L. R., Jolley, D., Subramanian, S. V., & Kavanagh, A. M. (2009). A multilevel study of area socio-economic status

and food purchasing behaviour. *Public Health Nutrition, 12*(11), 2074-2083.

United Nations Committee on Economic, Social and Cultural Rights (CESCR). (1999). General comment 12: the right to adequate food (art. 11). Retrieved October 13, 2011, from http://repository.forcedmigration.org/show_metadata.jsp?pid=fmo:3654

United Nations Human Rights. (2008). The Right to Adequate Food. Retrieved October 13, 2011, from http://www.ohchr.org/Documents/Publications/FactSheet34en.pdf

United States Department of Agriculture (USDA). (2011). Healthy Eating Index. Retrieved October 13, 2011, from http://www.cnpp.usda.gov/healthyeatingindex.htm

Vikstedt, T., Suominen, M., H., Joki, A., Muurinen, S., Soini, H., & Pitkälä, K., H. (2011). Nutritional status, energy, protein, and micronutrient intake of older service house residents. *Journal of the American Medical Directors Association, 12*(4), 302-307.

Vozoris, N. T., & Tarasuk, V. S. (2003). Household food insufficiency is associated with poorer health. *The Journal of Nutrition, 133*(1), 120-126.

Watanabe, T. Knowledge, attitudes and behaviours about diet and glycemic index in diabetes. University of Alberta, Edmonton. 152 pp.

Weeden, A., Remig, V., Holcomb, C. A., Herald, T. J., & Baybutt, R. C. (2010). Vitamin and mineral supplements have a nutritionally significant impact on micronutrient intakes of older adults attending senior centers. *Journal of Nutrition for the Elderly, 29*(2), 241-254.

Wilkins, R., Berthelot, J., & Ng, E. (2002). Trends in mortality by neighbourhood income in urban Canada from 1971 to 1996. *Health Reports, 13*, 45-71.

Williams, E. D., Tapp, R. J., Magliano, D. J., Shaw, J. E., Zimmet, P. Z., & Oldenburg, B. F. (2010). Health behaviours, socioeconomic status and diabetes incidence: The Australian Diabetes Obesity and Lifestyle study (AusDiab). *Diabetologia, 53*(12), 2538-2545.

Williams, P. L., Johnson, C. P., Kratzmann, M., Johnson, C., Anderson, B. J., & Chenhall, C. (2006). Can households earning minimum wage in Nova Scotia afford a nutritious diet? *Canadian Journal of Public Health, 97*(6), 430-434.

Wong, K. C., & Wang, Z. (2006). Prevalence of type 2 diabetes mellitus of Chinese populations in Mainland China, Hong Kong, and Taiwan. *Diabetes Research & Clinical Practice, 73*(2), 126-134.

Woodruff, S. J., & Hanning, R. M. (2010). Development and implications of a revised Canadian Healthy Eating Index (HEIC-2009). *Public Health Nutrition, 13*(6), 820-825.

World Health Organization. Diabetes is a life-threatening condition. Retrieved October 13, 2011, from http://www.who.int/diabetes/actionnow/lifethreatening/en/

Wray, L. A., Alwin, D. F., McCammon, R. J., Manning, T., & Best, L. E. (2006). Social status, risky health behaviors, and diabetes in middle-aged and older adults. *Journals of Gerontology Series B: Psychological Sciences & Social Sciences, 61B*(6), S290-S298.

Zenk, S. N., Schulz, A. J., Israel, B. A., James, S. A., Bao, S., & Wilson, M. L. (2005). Neighborhood racial composition, neighborhood poverty, and the spatial accessibility of supermarkets in metropolitan Detroit. *American Journal of Public Health, 95*(4), 660-667.

APPENDIX 1: Demographic Questionnaire

Please write or mark the appropriate answer for the following questions.

Date: _____

Age: _____

Gender: Male / Female

Years with diabetes diagnosis: _____

Ethnicity:

Please circle the appropriate answer(s).

- White
- Latin American
- Japanese
- Black
- Chinese
- Korean
- Filipino
- West Asian (e.g., Afghan, Iranian)
- Arab
- Other ( )
- Aboriginal (First Nations, Metis or Inuit)
- South Asian (e.g., East Indian, Pakistani, Sri Lankan)
- Southeast Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)

Education:

Please put a checkmark in the box

- ☐ Less than high school
- ☐ High school graduate
- ☐ Some college or university (have some post secondary education, but not completed)
- ☐ College
- ☐ University graduate
- ☐ Above

Employment

- Wages and salaries
- Income from self-employment
- Retirement income (pensions, old age security and GIS, etc.)
- Unemployed (not including retirement)
- Other ( )

Household annual income:

Number of people in the household: _____

- < $ 20,999
- $ 21,000 to $39,999
- $ 40,000 to $ 59,999
- $ 60,000 to $ 79,999
- $ 80,000 to $ 99,999
- $ 100,000 to $ 119,999
- ≥ $ 120,000

APPENDIX 2: GENERAL HEALTH AND DIABETES TREATMENT QUESTIONNAIRE

Diabetes Treatment:

- ☐ Lifestyle (Diet + Exercise)
- ☐ Lifestyle + oral antidiabetic drugs
- ☐ Lifestyle + insulin

Please list all medications you take on a regular basis:

MEDICATION	CONDITION IT IS USED FOR	FREQUENCY	DOSE	BEFORE/AFTER FOOD

Have you been diagnosed by a doctor as having… (Please check that all apply)

	Heart trouble		Allergies
	Cancer		Trouble hearing
	Chronic asthma, emphysema, or bronchitis?		Trouble seeing
			Bladder control difficulties
	Osteoporosis		Balance problem or frequent falls
	Arthritis		
	High blood pressure		Burning foot
	High cholesterol		Poor appetite
	Hepatitis		Kidney problems
	Back problem		Other health problems
	Foot problems		

Are you a… (Please check one)

- ☐ Current, regular smoker
- ☐ Occasional smoker
- ☐ Former smoker
- ☐ Non-smoker

APPENDIX 3: SELF-CARE ACTIVITIES AND DIABETES TREATMENT QUESTIONNAIRE

Circle all the appropriate response(s)

1. Which of the following has your health care team (doctor, nurse, dietitian, or diabetes educator) advised you to do?

   a. Follow Canada's Food Guide
   b. Follow a complex carbohydrate diet or a low glycemic index diet
   c. Reduce the number of calories you eat to lose weight
   d. Eat foods high in dietary fiber
   e. Eat lots (at least 7 servings per day) of fruits and vegetables
   f. Eat very few sweets (for example: desserts, non-diet sodas, candy bars)
   g. Avoid foods high in fat (especially trans-fats from hydrogenated sources and saturated fats)
   h. Other (specify):
   i. I have not been given any advice about my diet by my health care team.

2. Which of the following has your health care team (doctor, nurse, dietitian or diabetes educator) advised you to do?

   a. Get regular physical activity (such as walking) on a daily basis.
   b. Fit physical activity into your daily routine (for example, take stairs instead of elevators, park a block away and walk, etc.)
   c. Exercise continuously for at least 30 minutes at least 5 times a week.
   d. Engage in a specific amount, type, duration and level of exercise.
   e. Other (specify):
   f. I have not been given any advice about exercise by my health care team.

3. Which of the following has your health care team (doctor, nurse, dietitian, or diabetes educator) advised you to do?

   a. Test your blood sugar using a drop of blood from your finger and a color chart.
   b. Test your blood sugar using a machine to read the results.
   c. Test your urine for sugar.
   d. Other (specify):
   e. I have not been given any advice either about testing my blood or urine sugar level by my health care team

4. Which of the following medications for your diabetes has your doctor prescribed?

a. An insulin shot 1 or 2 times a day.
b. An insulin shot 3 or more times a day.
c. Diabetes pills to control my blood sugar level.
d. Other (specify):
e. I have not been prescribed either insulin or pills for my diabetes.

APPENDIX 4: Physical Activity Adherence

Considering a **7-Day period** (a week), how many times on average do you do the following kinds of exercise for **more than 15 minutes.**

	Times Per Week
A. STRENUOUS PHYSICAL ACTIVITY (heart beats rapidly, sweating)	
(e.g., running, jogging, hockey, soccer, squash, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling, vigorous aerobic dance classes, heavy weight training)	_____
B. MODERATE PHYSICAL ACTIVITY (not exhausting, light perspiration)	
(e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)	_____
C. MILD PHYSICAL ACITIVITY (minimal effort, no perspiration)	
(e.g., easy walking, yoga, archery, fishing, bowling, lawn bowling, shuffleboard, horseshoes, golf, snowmobiling)	_____

Considering a **7-Day period** (a week), how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?

1. Often 2. Sometimes 3. Never/rarely

APPENDIX 5: DIETARY ADHERENCE QUESTIONNAIRE
Please Circle the best answer.

The questions below ask you about your diabetes diet activities during the past 7 days. If you were sick during the past 7 days, please think back to the last 7 days that you were not sick.

1. How many of the last SEVEN DAYS have you followed a healthful eating plan such as Eating Well with Canada's Food Guide with appropriate serving sizes?

   0 1 2 3 4 5 6 7

2. On average, over the past MONTH, how many WEEKS have you followed your eating plan for diabetes?

   0 1 2 3 4

3. On how many of the last SEVEN DAYS did you eat the number of fruit and vegetable servings you are supposed to eat based on Canada's Food Guide (women aged19 – 50: 7–8 servings; males aged 19 – 50: 8 – 10 servings; women and men over 50: 7 servings)?

   0 1 2 3 4 5 6 7

4. On how many of the last SEVEN DAYS did you eat carbohydrate-containing foods with a low Glycemic Index? (Example: dried beans, lentils, barley, pasta, low fat dairy products)

   0 1 2 3 4 5 6 7

5. On how many of the last SEVEN DAYS did you eat foods high in sugar as cakes, cookies, desserts, candies, etc.?

   0 1 2 3 4 5 6 7

6. On how many of the last SEVEN DAYS did you eat foods high in fibre such as oatmeal, high fibre cereals, whole grain breads?

   0 1 2 3 4 5 6 7

7. On how many of the last SEVEN DAYS did you space carbohydrates evenly throughout the day?

   0 1 2 3 4 5 6 7

8. On how many of the last SEVEN DAYS did you eat fish or other foods high in omega-3 fats?

   0 1 2 3 4 5 6 7

9. On how many of the last SEVEN DAYS did you eat food which contained or was prepared with canola, walnut, olive, or flax oils?

   0 1 2 3 4 5 6 7

10. On how many of the last SEVEN DAYS did you eat foods high in fat (such as high fat dairy products, fatty meat, fried foods or deep fried foods)?

    0 1 2 3 4 5 6 7

11. On how many of the last SEVEN DAYS did you consume any alcohol?

    0 1 2 3 4 5 6 7

12. On how many of the last SEVEN DAYS did you consume red wine?

    0 1 2 3 4 5 6 7

APPENDIX 6: ACCESSIBILITY TO FOOD AND FOOD RESOURCES

Accessibility refers to "the physical and economic access to foods for all, at all times".

The following questions ask you about convenience, ease of transportation to outlets, availability of foods for your diabetes, the cost of foods compared to non-diabetic diet and time preparing meals.
Food resources include: retail food stores (grocery stores, convenience stores, discount food stores or club stores (e.g. Costco)), farmers' markets, food cooperatives and anywhere that you would regularly shop for foods.

For each question, please circle the best one that applies.

Location and Convenience of Food Resources

1. Are there places where you buy foods that are right for your diabetes close to where you live?

Yes No

2. Are there places where you buy foods that are right for your diabetes close to where you work?

Yes No NA

3. How far do you travel to buy food?

_____ miles or _____ km

4. How many different stores do you go to, to buy the foods you need for a week?

a. 1-2
b. 3-4
c. 5-7
d. More than 7

5. Where are groceries usually purchased for you and your family? (Check all that apply)

Chain supermarket (Safeway, Sobey's, Superstore, etc.)
_____

Independent grocery store (Planet Organic, Wild Earth, etc)
_____

Farmer's Market or similar

_____

Other (please specify)_____

6. Are there food items in your diet plan that are not available at your regular grocery store?

Yes No I don't know

7. How long does it take for a typical shopping trip, including commuting time? If you shop at more than one store, include time for each store, and include both shopping and commuting time.

Hours_____ minutes_____

8. If there are items in your diet plan that you don't buy at your regular grocery store, what do you do?

a. Not buy them at all
b. Go to another store
    i. If you go to another store, over SEVEN DAYS, how often do you go to another store?
    0 1 2 3 4 5 6 7

c. Other (be specific) _____

9. Do the food resources you use regularly have:

Convenient store hours for you? Yes No

Good customer service? Yes No

Information that you can use to help you with your diet for diabetes? Yes No

10. Aside from grocery stores, convenience stores, discount stores/club stores, farmers' markets, and food co-ops, are there other places that you go to for food on a regular basis? Include food outlets that you go too often (e.g. eating lunch at a work cafeteria or Tim Horton's for breakfast on Saturdays)

Yes No

If yes, describe the situation:

Eating occasion _____

Place or food outlet _____

Transportation

11. When you go grocery shopping, how do you get there?

Private car Public Transportation Other (be specific) _____

12. Do any of the stores you shop at for groceries offer delivery service?
Yes No Don't know

Food Costs

13. Please indicate whether you spend the **same, less or more** on the following foods compared with a non-diabetic diet

Food Group	Less	Same	More	Not sure
Vegetables				
Fruit				
Meats				
Meat Alternates				
Grain Products				
Dairy Products				

Grocery shopping patterns and time use

14. Who is the MAIN grocery shopper in your home? If shared, circle all applicable

You Spouse Parent Roommate Other Not applicable

15. How often in the past month have you prepared a grocery list?

0 1 2 3 4 5 6 7 8 9 10 More than 10

16. How often in the past month has another family member prepared a grocery list?

0 1 2 3 4 5 6 7 8 9 10 More than 10 Don’t know

17. How long (minutes) did it **typically** take to prepare the grocery list?

Less than 10 10-20 21-30 31-40 41-50 51-60 More than 60 Not applicable

18. Is there a separate shopping list for the foods or ingredients you eat for your diabetes?

Yes No

19. How often in the past month have you or someone in your household gone grocery shopping?

0 1 2 3 4 5 6 7 8 9 10 More than 10 Don’t know

APPENDIX 7: FOOD AVAILABILITY QUESTIONNAIRE

Food availability refers to the variety of food available in retail stores.

1. Are the foods that you would like to eat to follow a diet that is best for your diabetes are readily available in your regular grocery store?

Yes No Don't know

2. Are these foods easy to find in the stores that you go to?

Yes No Don't know

3. Do the stores where you buy these foods carry a wide variety of foods?

Yes No Don't know

4. Think about the 1 or 2 stores that you go to most often to buy food. Which of the foods listed below can you buy at these stores?

Fresh Meat	Yes	No	Don't know
Processed Meat	Yes	No	Don't know
Fresh Poultry	Yes	No	Don't know
Fresh seafood	Yes	No	Don't know
Packaged meat	Yes	No	Don't know
Fresh fruits and vegetables	Yes	No	Don't know
Dairy products	Yes	No	Don't know
Eggs	Yes	No	Don't know
Cereals	Yes	No	Don't know
Bakery products	Yes	No	Don't know
Ready to eat foods	Yes	No	Don't know
Other foods	Yes	No	Don't know

5. How did you find out about where to find these foods? Example: Dietitian, Internet, friends. Please be as specific as possible.

APPENDIX 8: 24- hours dietary recall

Interviewer Name: _____

Date/ time of Recall: dd/mm/yyyy

Place eaten	Time	Food items / beverages consumed (Method of preparation) Brand names if applicable	Condiments, Sauces, Spreads	Portion/ serving sizes	NOTES

*Is the recall representative of your usual dietary intake? Yes No, in what way:

APPENDIX 9: Calculation of HEI-C scores for total fat, saturated fat and total cholesterol. Linear interpretation of scores is done using algebraic formulae to arrive at the final equations used to determine the scores. For example, for total fat, an intake of 38% (x) would yield a score of 7 (y) in the equation y = -x + 45.

Total fat

35≥=10
45≤=0
Y=ax+b
10=a35+b
0=a45+b
45a=-b
10=a35-45a
1=-a
45(-1)=-b
b=45
y=-x+45

Saturated fat

7≥=10
10.5≤=0
Y=ax+b
10=a7+b
0=a10.5+b
b=-10.5a
10=7a-10.5a
a=-2.86
b=(-10.5)(-2.86)
b=30
y=-2.86x+30

Total cholesterol

Y=ax+b
10=a300+b
0=a450+b
b=-450a
10=a300-a450
a= -0.06
b=-450(-0.06)
b=30
Y=-0.06+30

APPENDIX 10: Household Food Security Survey Module

The following questions are about the food situation for your household in the past 12 months.

Q1. Which of the following statements best describes the food eaten in your household in the past 12 months, that is since [current month] of last year?
1. You and other household members always had enough of the kinds of food you wanted to eat.
2. You and other household members had enough to eat, but not always the kinds of food you
wanted.
3. Sometimes you and other household members did not have enough to eat.
4. Often you and other household members didn't have enough to eat.
– Don't know / refuse to answer (Go to end of module)

Questions 2–6 — ask all households
Now I'm going to read you several statements that may be used to describe the food situation for a household. Please tell me if the statement was often true, sometimes true, or never true for you and other household members in the past 12 months.

Q2. The first statement is: you and other household members worried that food would run out before you got money to buy more. Was that often true, sometimes true, or never true in the past 12 months?
1. Often true
2. Sometimes true
3. Never true
– Don't know / refuse to answer

Q3. The food that you and other household members bought just didn't last, and there wasn't any money to get more. Was that often true, sometimes true, or never true in the past 12 months?
1. Often true
2. Sometimes true
3. Never true
– Don't know / refuse to answer

Q4. You and other household members couldn't afford to eat balanced meals. In the past 12 months was that often true, sometimes true, or never true?
1. Often true
2. Sometimes true
3. Never true
– Don't know / refuse to answer

IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK Q5 AND Q6; OTHERWISE, SKIP TO FIRST-LEVEL SCREEN

Now I'm going to read a few statements that may describe the food situation for households with
children.

Q5. You or other adults in your household relied on only a few kinds of low-cost food to feed the
children because you were running out of money to buy food. Was that often true, sometimes
true, or never true in the past 12 months?

1. Often true
2. Sometimes true
3. Never true

– Don't know / refuse to answer

Q6. You or other adults in your household couldn't feed the children a balanced meal, because you couldn't afford it. Was that often true, sometimes true, or never true in the past 12 months?

1. Often true
2. Sometimes true
3. Never true

– Don't know / refuse to answer

IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK Q7; OTHERWISE SKIP TO Q8

Q7. The children were not eating enough because you or other adults in your household just
couldn't afford enough food. Was that often, sometimes or never true in the past 12 months?

1. Often true
2. Sometimes true
3. Never true

– Don't know / refuse to answer

The following few questions are about the food situation in the past 12 months for you or any other adults in your household.

Q8. In the past 12 months, since last [current month] did you or other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money for food?

1. Yes
2. No (Go to Q9)

– Don't know / refuse to answer

Q8b. How often did this happen?

1. Almost every month

2. Some months but not every month
3. Only 1 or 2 months
– Don’t know / refuse to answer

Q9. In the past 12 months, did you (personally) ever eat less than you felt you should because there wasn’t enough money to buy food?
1. Yes
2. No
– Don’t know / refuse to answer

Q10. In the past 12 months, were you (personally) ever hungry but didn’t eat because you couldn’t afford enough food?
1. Yes
2. No

– Don’t know / refuse to answer
Q11. In the past 12 months, did you (personally) lose weight because you didn’t have enough money for food?
1. Yes
2. No
– Don’t know / refuse to answer

Q12. In the past 12 months, did you or other adults in your household ever not eat for a whole day because there wasn’t enough money for food?
1. Yes
2. No (IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK Q13; OTHERWISE SKIP TO END)
– Don’t know / refuse to answer

Q12b. How often did this happen?
1. Almost every month
2. Some months but not every month
3. Only 1 or 2 months
– Don’t know / refuse to answer

Now, a few questions on the food experiences for children in your household.
Q13. In the past 12 months, did you or other adults in your household ever cut the size of any of the children’s meals because there wasn’t enough money for food?
1. Yes
2. No
– Don’t know / refuse to answer

Q14. In the past 12 months, did any of the children ever skip meals because there wasn’t enough money for food?
1. Yes

2. No

– Don’t know / refuse to answer

Q14b. How often did this happen?
1. Almost every month
2. Some months but not every month
3. Only 1 or 2 months
– Don’t know / refuse to answer

Q15. In the past 12 months, were any of the children ever hungry but you just couldn’t afford more food?
1. Yes
2. No
– Don’t know / refuse to answer

Q16. In the past 12 months, did any of the children ever not eat for a whole day because there wasn’t enough money for food?
1. Yes
2. No
– Don’t know / refuse to answer

APPENDIX 11: Food Frequency Questionnaire
PART IX: SUPPLEMENTS

The next questions are about your use of fiber supplements or vitamin pills. Please do NOT include fortified foods in this section.

135. Over the **12 MONTHS,** did you take any of the following types of **fibre or fiber supplements** on a regular basis (more than once per week for at least 6 of the last 12 months)? (**Mark all that apply.**)

□ NO, didn't take any fiber supplements on a regular basis (GO TO QUESTION 145)

□ YES, psyllium products (such as Metamucil, Prodiem, Correctol)

□ YES, Bran (such as wheat bran, oat bran, or bran wafers)

136. Over the **12 MONTHS,** did you take any **multivitamins,** such as One-a-Day-, or Centrum-type multivitamins (as pills, liquids, or packets)?

□ NO (GO TO QUESTION 146)
□ YES (CONTINUE TO 145a)

145a. How often did you take **One-a-Day-, or Centrum-type** multivitamins?
□ Less than 1 day per month
□ 1-3 days per month
□ 1-3 days per week
□ 4-6 days per week
□ Every day

145b. Does your **multivitamin** usually contain **minerals** (such as iron, zinc, etc.)?
□ NO
□ YES
□ Don't Know

145c. For how many consecutive years have you taken **multivitamins**?
□ Less than 1 year
□ 1-4 years
□ 5-9 years
□ 10 or more years

These last questions are about the vitamins, minerals, or herbal <u>supplements</u> you took that are NOT part of a One-a-Day- or Centrum-type of multivitamin Please do NOT include fortified foods in this section.

137. Over the **12 MONTHS,** how often did you take **Iron supplements** (**NOT** as part of a multivitamin mentioned in Question 145)?

□ NEVER (GO TO QUESTION 147)
□ Less than 1 day per month
□ 1-3 days per month
□ 1-3 days per week
□ 4-6 days per week
□ Every day

146a. When you took **Iron supplements,** about how much did you take in one day?

□ Don't Know
□ Less than 19 mg
□ 20 to 24 mg
□ 25 to 29 mg
□ 30 to 34 mg
□ 35 to 39 mg
□ 40 mg or more

146b. For how many consecutive years have you taken **Iron supplements**?

□ Less than 1 year
□ 1-4 years
□ 5-9 years
□ 10 or more years

138. How often did you take **Folate or Folic Acid supplements** (**NOT** as part of a multivitamin mentioned in Question 145)?

□ NEVER (GO TO QUESTION 148)
□ Less than 1 day per month
□ 1-3 days per month
□ 1-3 days per week
□ 4-6 days per week
□ Every day

147a. When you took **Folate or Folic Acid supplements,** about how much did you take in one day?

□ Less than 699 μg
□ 700 to 799 μg
□ 800 to 899 μg
□ 900 to 999 μg
□ 1000 μg or more
□ Don't Know

147b. For how many consecutive years have you taken **Folate or Folic Acid supplements**?

□ Less than 1 year
□ 1-4 years

□ 5-9 years
□ 10 or more years

139. How often did you take **Cod Liver Oil** (**NOT** as part of a multivitamin mentioned in Question 151)?
□ NEVER (GO TO QUESTION 149)
□ Less than 1 day per month
□ 1-3 days per month
□ 1-3 days per week
□ 4-6 days per week
□ Every day

148a. When you took **Cod Liver Oil,** about how much **vitamin D** did it contain? (Mark the amount you took in one day.)
□ Less than 49 IU
□ 50 to 99 IU
□ 100 to 149 IU
□ 150 to 199 IU
□ 200 IU or more
□ Don't Know

148b. For how many consecutive years have you taken **Cod Liver Oil**?
□ Less than 1 year
□ 1-4 years
□ 5-9 years
□ 10 or more years

140. How often did you take **Fish Oil (Omega 3 fatty acids)** (**NOT** as part of a multivitamin mentioned in Question 145)?
□ NEVER (GO TO QUESTION 150)
□ Less than 1 day per month
□ 1-3 days per month
□ 1-3 days per week
□ 4-6 days per week
□ Every day

149a. When you took **Fish Oil (Omega 3 fattyacids),** how much did you take in one day? (If possible, please check the label)
□ Less than 499 mg
□ 500 to 999 mg
□ 1,000 to 1,499 mg
□ 1,500 to 1,999 mg
□ 2,000 mg or more
□ Don't Know

149b. When you took **Fish Oil,** how much **EPA (Eicosapentaenoic acid)** did each daily amount contain? (If possible, please check the label)
□ Less than 499 mg
□ 500 to 999 mg
□ 1,000 to 1,499 mg
□ 1,500 to 1,999 mg
□ 2,000 mg or more
□ Don't Know

149c. When you took **Fish Oil,** how much **DHA (Docosahexaenoic acid)** did each daily amount contain?

□ Less than 499 mg
□ 500 to 999 mg
□ 1,000 to 1,499 mg
□ 1,500 to 1,999 mg
□ 2,000 mg or more
□ Don't Know

149d. For how many consecutive years had you taken **Fish Oil (Omega 3 fatty acids)**?

□ Less than 1 year
□ 1-4 years
□ 5-9 years
□ 10 or more years

141. How often did you take **Calcium supplements or Calcium-containing antacids** (**NOT** as part of a multivitamin mentioned in Question 145)?

□ NEVER (GO TO QUESTION 151)
□ Less than 1 day per month
□ 1-3 days per month
□ 1-3 days per week
□ 4-6 days per week
□ Every day

150a. When you took **Calcium <u>supplements</u> or Calcium-containing antacids,** about how much elemental calcium did you take in one day? (If possible, please check label for elemental calcium.)

□ Less than 499 mg
□ 500 to 999 mg
□ 1,000 to 1,499 mg
□ 1,500 to 1,999 mg
□ 2,000 mg or more
□ Don't Know

150b. For how many consecutive years had you taken **Calcium supplements or Calcium-containing antacids**?

□ Less than 1 year
□ 1-4 years
□ 5-9 years
□ 10 or more years

142. How often did you take **Vitamin D supplements** on its own or as part of a calcium supplement (**NOT** as part of a multivitamin mentioned in Question 145)?

□ NEVER (GO TO QUESTION 152)
□ Less than 1 day per month
□ 1-3 days per month
□ 1-3 days per week
□ 4-6 days per week
□ Every day

151a. When you took **Vitamin D supplements**, about how much did you take in one day?

□ Less than 125 IU
□ 125 to 249 IU
□ 250 to 399 IU
□ 400 IU or more
□ Don't Know

151b. For how many consecutive years had you taken **Vitamin D supplements**?

□ Less than 1 year
□ 1-4 years
□ 5-9 years
□ 10 or more years

143. Please mark any of the following **single supplements** you took more than once per week (**NOT** as part of a multivitamin mentioned in Question 145):

□ Beta-Carotene
□ Vitamin A
□ Vitamin C
□ Vitamin E
□ B-6
□ B-Complex
□ Flaxseed Oil
□ Glucosamine
□ Hydroxytryptophan (HTP)
□ Niacin
□ Selenium
□ Zinc
□ Brewer's yeast

144. Please mark any of the following **herbal or botanical supplements** you took more than once per week:

Please Note: Only include herbs and botanicals consumed as SUPPLEMENTS.

□ Aloe Vera
□ Astragalus
□ Bilberry
□ Cascara sagrada
□ Cat's claw
□ Cayenne
□ Cranberry
□ Dong Duai (Tangkwei)
□ Echinacea
□ Evening primrose oil
□ Feverfew
□ Garlic
□ Ginger
□ Ginko biloba
□ Ginseng (American or Asian)
□ Goldenseal
□ Grapeseed extract
□ Kava,
□ Milk thistle
□ Saw palmetto
□ Siberian ginseng
□ St. John's wort
□ Valerian
□ Other _____

APPENDIX 12: Sample of Scoring the Healthy Eating Index

Food items	Portion	Scores			
		G	F&G	Mi	Me
toast	1 slice	1			
Cheddar chesses	45 g			1	
Saw spinach	2 cups		2		
pudding	1 cup			1	
Boiled egg	2				½
tuna	1 can				1
Milk	1 cup			1	

Abbreviations

G= grain products
F&G= fruits and vegetables
Mi= Milk & alternative
Me= Meat & alternative