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Dietary adherence and food acceptability among individuals with type 2 diabetes

by

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Abstract

This cross-sectional study of 80 type 2 diabetes patients examined adherence to and food acceptability of current Canadian diet recommendations and their association with hemoglobin A1c using uni- and multivariate analysis. Socio-demographic, perceived dietary adherence and food acceptability information was collected using questionnaires and a 3-day food record to measure actual adherence. Average intakes of saturated fat and sodium were above the recommendations. Diet acceptability in terms of choosing to buy and cook, and enjoyment of eating recommended foods was generally good. However after diagnosis of diabetes decreased enjoyment in dining away from home, lower consumption of ethnic foods and changes in frequency of eating certain foods were reported. Dietary adherence and better food acceptability was associated with lower A1c levels. Focusing on reducing sugar, fat and sodium intakes and incorporating culturally appropriate foods would help to improve adherence.

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ABBREVIATIONS

ADA	American Diabetes Association
BMI	Body mass index
CDA	Canadian Diabetes Association
CFG	Canada's Food Guide
CHD	Coronary heart disease
CPG	Clinical Practice Guidelines
CVD	Cardio vascular disease
GI	Glycemic index
EER	Estimated energy requirements
FPG	Fasting plasma glucose
HbA1c	Glycosylated hemoglobin
HBE	Harris Benedicts equation
HDL	High density lipoprotein
LDL	Low density lipoprotein
MNT	Medical nutrition therapy
OHA	Oral hypoglycemic agents
PA	Physical activity
SD	Standard deviation
T1D	Type 1 diabetes
T2D	Type 2 diabetes
TE	Total energy
VLDL	Very low density lipoprotein
WC	Waist circumference

Chapter 1: Introduction

1.1 Overview

The combination of increasing incidence rates, severity of complications, and increased mortality and morbidity rates associated with diabetes presents a significant challenge to the health care system and lowers the quality of life of those afflicted (Yach et al., 2006). Studies suggest that achieving optimal glycemic control will help minimise long term complications (DCCT, 1993; Vijan et al., 2005). To optimize glycemic control, diabetes patients need to integrate multiple treatment strategies including adherence to medication, diet and physical activity prescriptions.

Dietary management is one of the essential treatment components to be followed over the long term (DCCT, 1993). Various studies have put forth the importance of dietary treatment in achieving glycemic control because adherence to dietary recommendations can prevent or delay micro- and macrovascular complications (Fuller et al., 1983; Metz et al., 2000; Barnard et al., 1994). Clinical Practice Guidelines (CPG) outlined by the Canadian Diabetes Association (CDA) (2008) and American Diabetes Association (ADA) (2004) provide information on pharmacology, nutrition therapy and several other self-management areas for effective management of diabetes. These guidelines are aimed at health care professionals, such as doctors, nurses and registered dietitians in order to assist diabetes patients to translate these scientific based guidelines to everyday life (CDA, 2008). CDA nutrition therapy guidelines recommend that individuals with type 2 diabetes (T2D) follow a healthy eating plan as summarised in Eating Well

with Canada`s Food Guide (CFG recommendations are presented in table 1.1). In addition, the CDA recommends that patients should include high fibre, low glycemic index (GI) foods, reduce intakes of high fat and high sugar foods, and increase intakes of foods containing omega 3 fatty acids and to limit saturated fats. However evidence from several studies suggests that translation of nutrition recommendations into daily routine is considered a challenge by the majority of diabetes patients, as summarized below.

Studies conducted in various countries around the world show that adherence to dietary recommendations remains poor among diabetes patients (Monnier et al., 2004; Barclay et al., 2006; Vijan et al., 2005). Also, dietary management was perceived to be the most difficult to achieve of all the aspects of self-care management (Whittemore et al., 2002; Glasgow, 1986). Furthermore, compared to people with other chronic diseases, diabetes patients were found to be more resistant to modifying their dietary habits (Groop & Tuomi, 1997). Meeting the recommendations for each nutrient category is considered essential; however, from the research conducted so far it seems evident that fat and fibre recommendations are the two least likely to be achieved by patients (Nelson et al., 2002; DCCT, 2006; Rivellese et al., 2007; Eilat-Adar et al., 2008).

Researchers have tried to identify the barriers to dietary adherence from patient's point of view and some studies put forth what dietitians and diabetes educators perceive about the factors that forms the barriers to dietary adherence by their patients. To address both patient and diabetes educator's perspectives on adherence barriers several studies have been conducted. According to Nagelkerk

et al. (Nagelkerk et al., 2006), the common barriers reported by T2D patients were lack of knowledge and understanding of the diet plan, feelings of helplessness and frustration from lack of glycemic control and continued disease progression despite adherence. While a study by Vijan et al. (Vijan et al., 2005) emerges with the results stating that cost, family and social issues were reported to be the most common barriers among T2D patients living in urban areas and for those in rural areas difficulty in communicating with providers was identified to be the major barrier. In general most commonly reported barriers include time constraints, family and friends support, lack of social support and knowledge about dietary management, negative emotions and economic factors (Glasgow et al., 1986; Glasgow, 1994; Schlundt et al., 1994). Brown et al. (Brown et al., 1998) studied the dietitians' perception of barriers to patients adherence and the top five barriers determined were "Poor understanding of the diet/disease relationship, Complication with lifestyle/competing demands, Denial/perceive diabetes is not serious, Poor understanding of diet/disease relationship, and Lack of self-efficacy/Misinformation from unreliable sources".

These identified barriers show that modifications have to be made to make standard practices for nutrition for diabetes more practical. To make it possible, as a first step we need to know how patients implement the dietary advice they receive, and study the factors that influence their dietary habits. Dietary habits of a person are linked with many factors including a person's emotion, culture and social relation (Devine, 2005; Holm et al., 2008; Mennell et al., 1994). Oshaug et al. (Oshaug et al., 1985) implies that it is important to involve people and their

tradition rather than forcing one to eat foods that are culturally unacceptable. He also states that when change in dietary pattern is promoted in order to obtain optimal nutrition conditions it is essential to consider the food culture of a society. As discussed earlier, nutrition therapy is one of the main treatments for diabetes (DCCT, 1993). To stick to the recommended diet plan one might need to change his existing eating habits based on dietary patterns followed before being diagnosed with diabetes. Changing a dietary pattern is a complex process as it requires alterations in the eating habits that have been followed over long time. Although possible benefits of dietary recommendations prevail, significant dietary adherence may not be achievable if they are not acceptable to the people to whom they are recommended. Therefore it is necessary to study the aspect of food acceptability of diabetes patients; that is, whether or not the recommended diet plan is acceptable to patients.

Food acceptability is widely referred to terms such as palatability, liking/disliking, food preferences, and pleasantness/unpleasantness (Meiselman & MacFie, 1996). The concept of food acceptability is incorporated into food security along with other factors such as food availability, accessibility and adequacy to understand the concept of food security at national and household levels. The Food and Agriculture Organization defines "Food security" as “that food is available at all times; that all persons have means of access to it; that it is nutritionally adequate in terms of quantity, quality and variety; and that it is acceptable within the given culture” (Koc, 1999).

Similarly in diabetes populations, a person is able to follow the prescribed diet only when the foods specific for diabetes are available at an affordable price with easy access and are acceptable culturally and personally. The association between these factors and dietary adherence is not widely studied in diabetes. Understanding these factors would help to plan an intervention programme that would be effective and convenient for diabetes patients. As a first step to moving towards higher adherence to CDA recommendations, the food acceptability of CDA's current nutrient recommendations and its association with dietary adherence is assessed in this study. By the term "food acceptability" here we refer to personal and cultural food acceptability. CDA's Clinical Practice Guidelines (CDA, 2008) do advise that the health care team consider cultural and personal preference when formulating diet plans for clients but how well these preferences are incorporated is not widely studied.

In culturally diverse countries like Canada, it is important to measure cultural acceptability to foods along with personal acceptability. Few studies assess the effect of cultural acceptability on dietary adherence (Holm et al., 2008; Chowdhury et al., 2000). Results suggest that diabetic individuals have difficulty altering their foods habits and often tend to consume traditional foods that are high in fat and sugar (Chowdhury et al., 2000; Lawton et al., 2008). Choosing unfamiliar foods from a different ethnic heritage might make dietary adherence to diabetes guidelines more complicated and could contribute to low adherence rates, while acceptability of a recommended diet could increase adherence. Success of an intervention is based on food acceptability, yet it is under-studied. Therefore,

understanding the personal and cultural barriers that are associated with dietary adherence faced by people with diabetes could contribute to a future intervention programme. It is suggested that when patients are educated in how to overcome the barriers a considerable improvement in adherence may be noted (Anderson et al., 1993). It is also important to measure dietary practices currently followed among a population to identify the existing nutrient issues. In this way, more focus can be placed on those areas needed to improve dietary adherence.

Table 1.1: Canada's Food Guide's recommended number of food group servings per day

Food Groups	Males		Females	
	19-50 yrs	51 and above	19-50 yrs	51 and above
Vegetables and Fruits	8-10	7	7-8	7
Grain Products	8	7	6-7	7
Milk and Alternatives	2	3	2	3
Meat and Alternatives	3	2	2	2

1.2 Purpose

The main purpose of this study was to understand how well patients with T2D in the Edmonton area follow the nutrition recommendations of the CDA, to assess whether the recommended foods are acceptable to the patients and also to study the influence of food acceptability on dietary adherence.

1.3 Specific Objectives

- To assess the dietary adherence of diabetes patients
- To measure personal and cultural acceptability of the recommended diet
- To assess the associations between dietary adherence and diet acceptability
- To assess the association of sociodemographic and diabetes-related variables and A1c to dietary adherence and food acceptability.

1.4 Hypothesis

The two specific hypothesis of this study were

- Patients with better dietary adherence possess better glycemic control.
- Patients who consider their diets to have a high level of acceptability will have better glycemic control.

1.5 References

American Diabetes Association (ADA). (2004). Clinical Practice Recommendations. Diabetes Care, 27 (1), S1-S78.

Anderson, E. J., Richardson, M., Castle, G., Cercone, S., Delahanty, L., Lyon, R., et al.(1993). Nutrition interventions for intensive therapy in the diabetes control and complications trial. The DCCT research group. Journal of the American Dietetic Association, 93(7), 768-772.

Barclay, A. W., Brand-Miller, J. C., & 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.

Barnard, R., Jung, T., & Inkeles, S. (1994). Diet and exercise in the treatment of NIDDM. The need for early emphasis. Diabetes Care, 17(12), 1469-1472.

Brown, S L., Janet F. P., Alice E. H., & Tolman, N. M. (1998). Motivational strategies used by dietitians to counsel individuals with diabetes. The Diabetes Educator, 24,313-318.

Canadian Diabetes Association (CDA). (2008). Clinical Practice Guidelines for the prevention and management of diabetes in Canada. Canadian Journal of Diabetes, 32, S1-S201.

Chowdhury, A. M., Helman, C., & Greenhalgh, T. (2000). Food beliefs and practices among British Bangladeshis with diabetes: Implications for health education. Anthropology & Medicine, 7(2), 209-226.

Devine, C. M. (2005). A life course perspective: Understanding food choices in time, social location, and history. Journal of Nutrition Education and Behavior, 37(3), 121-128.

Diabetes Control and Complications Trial Research Group (DCCT). (1993). The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. New England Journal of Medicine, 329, 977-986.

Diabetes Nutrition and Complication Trial (DNCT). (2006). Adherence to the ADA nutritional recommendations, targets of metabolic control, and onset of diabetes complications. A 7-year, prospective, population-based, observational multicenter study. Journal of Diabetes Complications, 20(6), 361-366.

Eilat-Adar, S., Xu, J., Zephier, E., O'Leary, V., Howard, B. V., & Resnick, H. E. (2008). Adherence to dietary recommendations for saturated fat, fiber, and sodium is low in American Indians and other US adults with diabetes. Journal of Nutrition, 138(9), 1699-1704.

Fuller, J., Shipley, M., Rose, G., Jarrett, R., & Keen, H. (1983). Mortality from coronary heart disease and stroke in relation to degree of glycaemia: The Whitehall study. British Medical Journal (Clinical Research Ed.), 287(6396), 867-870.

Glasgow, R. E. (1994). Social-environmental factors in diabetes: Barriers to diabetes self-care. Handbook of Psychology and Diabetes: A Guide to Psychological Measurement in Diabetes Research and Practice, Harwood Academic, Switzerland, pp 315-326.

Glasgow, R. E., McCaul, K. D., & Schafer, L. C. (1986). Barriers to regimen adherence among persons with insulin-dependent diabetes. Journal of Behavioral Medicine, 9(1), 65-77.

Groop, L. C., & Tuomi, T. (1997). Non-insulin-dependent diabetes mellitus-a collision between thrifty genes and an affluent society. Annals of Medicine, 29(1), 37-53.

Holm, L., Hoff, A., Erichsen, L., Møhl, M., Toubro, S., & Astrup, A. (2008). Social and cultural acceptability of fat reduced diets among Danish overweight subjects: High-protein versus high-carbohydrate diets. Food Quality and Preference, 19(1), 43-50.

Koc, M. (1999). For hunger-proof cities: Sustainable urban food systems. International Development Research Centre, pp 1-7.

Lawton, J., Ahmad, N., Hanna, L., Douglas, M., Bains, H., & Hallowell, N. (2008). 'We should change ourselves, but we can't': Accounts of food and eating practices amongst British Pakistanis and Indians with type 2 diabetes. Ethnicity & Health, 13(4), 305-319.

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

Mennell, S., Murcott, A., & Van Otterloo, A.H. (1994). International Sociological Association. The sociology of food: Eating, diet and culture. Sage Publications, London, p 28.

Metz, J. A., Stern, J. S., Kris-Etherton, P., Reusser, M. E., Morris, C. D., Hatton, D. C., et al. (2000). A randomized trial of improved weight loss with a prepared meal plan in overweight and obese patients: Impact on cardiovascular risk reduction. Archives of Internal Medicine, 160(14), 2150-2158.

Monnier, L., Grimaldi, A., Charbonnel, B., Iannascoli, F., Lery, T., Garofano, A., et al. (2004). Management of French patients with type 2 diabetes mellitus in medical general practice: Report of the Mediab observatory. Diabetes & Metabolism, 30(1), 35-42.

Nagelkerk, J., Reick, K., & Meengs, L. (2006). Perceived barriers and effective strategies to diabetes self-management. Journal of Advanced Nursing, 54(2), 151-158.

Nelson, K. M., Reiber, G., & Boyko, E. J. (2002). Diet and exercise among adults with type 2 diabetes. Diabetes Care, 25(10), 1722-1728.

Oshaug, A., Eide, W.B., & Holmboe-Ottesen, G. (1985). Introducing nutritional considerations into rural development programs with focus on agriculture: Report 1. University of Oslo, Institute for Nutrition Research, Oslo, pp 5-13.

Rivellese, A., Boemi, M., Cavalot, F., Costagliola, L., De Feo, P., Miccoli, R., et al. (2007). Dietary habits in type II diabetes mellitus: How is adherence to dietary recommendations? European Journal of Clinical Nutrition, 62(5), 660-664.

Schlundt, D. G., Rea, M. R., Kline, S. S., & Pichert, J. W. (1994). Situational obstacles to dietary adherence for adults with diabetes. Journal of the American Dietetic Association, 94(8), 874-879.

Shultz, J. A., Sprague, M. A., Branen, L. J., & Lambeth, S. (2001). A comparison of views of individuals with type 2 diabetes mellitus and diabetes educators about barriers to diet and exercise. Journal of Health Communication, 6(2), 99-115.

Vijan, S., Hofer, T. P., & Hayward, R. A. (1997). Estimated benefits of glycemic control in microvascular complications in type 2 diabetes. Annals of Internal Medicine, 127(9), 788-795.

Vijan, S., Stuart, N., Fitzgerald, J., Ronis, D., Hayward, R., Slater, S., et al. (2005). Barriers to following dietary recommendations in type 2 diabetes. Diabetic Medicine, 22(1), 32-38.

Whittemore, R., Chase, S. K., Mandle, C. L., & Roy, C. (2002). Lifestyle change in type 2 diabetes: A process model. Nursing Research, 51(1), 18-25.

Wild, S. H., Roglic, G., Green, A., Sicree, R., & King, H. (2004). Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. Diabetes Care, 27(10), 1047-1053.

Yach, D., Stuckler, D., & Brownell, K. D. (2006). Epidemiologic and economic consequences of the global epidemics of obesity and diabetes. Nature Medicine, 12(1), 62-66.

Chapter 2 Literature Review

2.1 Definition, Classification and Diagnosis of Diabetes:

Diabetes mellitus is a metabolic disorder characterised by the presence of elevated blood glucose concentration and is caused by defective insulin secretion, defective insulin action or both (ADA, 2004; CDA, 2008). Primary symptoms of hyperglycaemia include polyuria, polydipsia, polyphagia and blurred vision. Hyperglycaemia over the long term is associated with failure of various organs, micro- and macro-vascular complications (ADA, 2004; CDA, 2008). In certain cases, chronic hyperglycemia may also result in susceptibility to certain infections (ADA, 2004; CDA, 2008).

Diabetes is classified into four types: Type 1 diabetes (T1D), Type 2 diabetes (T2D), gestational diabetes mellitus (GDM) and "other", which may be caused by a variety of factors such as genetic defects, drugs, and diseases of the exocrine pancreas (CDA, 2008). T1D is caused by destruction of pancreatic beta cell resulting in no insulin secretion and is more prevalent among children whereas T2D is more common among adults and is caused due to lack of sufficient insulin secretion. GDM occurs during pregnancy and is associated with glucose intolerance (CDA, 2008).

The diagnostic criteria for diabetes include casual plasma glucose ≥11.1 mmol/L along with diabetes related symptoms or a fasting plasma glucose (FPG) ≥ 7.0 mmol/L. A 2-hour plasma-glucose value of ≥ 11.1 mmol/L in a 75g oral glucose tolerance test is an indication of T2D (CDA, 2008).

2.1a Hemoglobin A1c (HbA1c)

Blood glucose control within an individual over the long term can be measured a number of ways including regular, daily glucose monitoring, continuous glucose monitoring, measurement of fructosamine, and/or measurement of hemoglobin A1c. A1c is the most commonly used method to assess blood glucose concentrations over the period of 2 to 3 months. Hemoglobin is a protein that is found in red blood cells. Glucose circulating in the blood stream attaches to the hemoglobin, and this process is known as glycosylation. When there is elevated amount of blood glucose, the amount of glucose bound to hemoglobin will also be higher. The typical life span of red blood cells is 120 days or three months, therefore A1c reflects the percent of hemoglobin that has been glycosylated by blood glucose over the past 3 months (Frank, 2008).

The CDA recommended target for A1c is $\leq$ 7% for both T1D and T2D patients. An A1c value of >7 is associated with increased risk for developing microvascular and macrovascular complications (CDA, 2008). The benefits of improved glycemic control on complications associated with diabetes, including retinopathy, nephropathy and neuropathy, have been demonstrated in studies conducted over the past several decades. The Diabetes Control and Complications (DCCT) research group evaluated the effect of glycemic control on the development on diabetes related complications among T1D individuals. The results of this study showed that a 10% reduction in the A1c of intensive therapy participants was related to 54% reduction in retinopathy, 50% reduction in nephropathy and 60% reduction in neuropathy (DCCT, 1993).

A randomised controlled trial of 3867 newly diagnosed individuals with T2D was conducted by the United Kingdom Prospective Diabetes Study group to examine the effect of glycemic control on the risk of developing micro and macrovascular complications in this population. This study showed that intensive glycemic control helps in reducing the complications that are associated with T2D. In this study, an 11% reduction in the A1C of participants in the intensive treatment group showed a 25% reduction in risk of microvascular complications and a 16% reduction for myocardial infarction (UKPDS, 1998). Both of these studies concluded that lower A1c concentrations were associated with reductions in diabetes-related complications, but that care must be taken to avoid hypoglycemic events.

2.2 Pathophysiology of T2D

T2D is a condition characterized by a combination of insulin resistance and inadequate insulin secretion. Insulin is a hormone secreted from the beta cells in the islets of Langerhans in the pancreas; it helps in regulating blood glucose concentrations within the normal range by stimulating glucose uptake by peripheral tissues and by inhibiting gluconeogenesis and glycogenolysis in the liver. Insulin resistance impairs the ability of the cells (primarily muscle cells) to uptake glucose and suppress hepatic glucose production, which results in elevated blood glucose concentrations (Goldstein & Dirk, 2007; Codario, 2009).

Insulin resistance is strongly linked with obesity. The large adipocytes in obese patients are resistant to insulin to cause increased lipolysis, which results in increased release and circulation of free fatty acids and glycerol. Excessive free

fatty acids are implicated in causing insulin resistance in skeletal muscle and liver (Codario, 2009).

2.3 Prevalence:

The number of people with diabetes is increasing in North America and in other parts of the world (Boyle et al., 2001, Wild et al., 2004). The incidence of diabetes was 4.9% in 1990 and it rose to 7.3% in 2000 worldwide. The number of people with diabetes was projected to rise from 171 million in 2000 to 366 million in 2030 globally (Wild, et al, 2004). This increased trend is also observed in Canada. In 2005 1.3 million Canadians aged 12 years or older had been reported to be diagnosed with diabetes (Sanmartin & Gilmore, 2008). According to the Canadian Diabetes Association (CDA, 2008) the increasing number of individuals with T2D is due to the aging population, an increased population of immigrants belonging to high risk groups and growth in the Aboriginal population. Other common reasons suggested were urbanization, increasing incidence of obesity and insufficient physical activity (CDA, 2008).

2.4 Complications of Diabetes

Elevated blood glucose levels over long term can lead to vascular disease-related complications which can involve both macrovascular disease such as cardiovascular disease (CVD) and microvascular disease such as retinopathy, neuropathy and nephropathy. The prevalence of coronary artery disease (CAD) is approximately 2 to 3 fold higher among people with diabetes compared to people without diabetes. More than 75% of mortality in people with diabetes is due to

coronary and cerebrovascular disease (CDA, 2008). Especially women with diabetes are at greater risk of developing heart disease at earlier age compared to people without diabetes. Also, the prevalence of myocardial ischemia is higher among the diabetes population.

Hypertension is a common co-morbidity of diabetes and it increases the risk of developing micro- and macro-vascular complications. The recommended blood pressure target for people with diabetes is <130/80 mm/Hg. (CDA, 2008). Diabetic retinopathy is one common cause for blindness among individuals with diabetes at working age group. About 2 million individuals in Canada have been found to be diagnosed with some form of diabetic nephropathy. Nephropathy due to uncontrolled diabetes can lead to chronic kidney disease (CKD), which is one of the leading causes of kidney failure among Canadian individuals with diabetes (CDA, 2008).

2.5 Health care cost of diabetes

Diabetes poses a huge burden on health care costs (Ohinmaa, et al., 2004). According to the CDA, diabetes is considered to be expensive to society in terms of mortality and health care cost (CDA, 2009). The economic burden of diabetes in Canada was expected to be 12.2 billion in 2010 and increase up to 16.9 billion in 2010 (CDA, 2009). Given the increased prevalence of T2D, the cost is also expected to increase with the greater increase in province such as Alberta (89.9%) and British Columbia (85.5%) (Ohinmaa et al., 2004). Direct cost for medication and diabetes supplies for a person with diabetes ranges from $1000 -$15,000 per year (CDA, 2009). The number of hospitalization days, visits to physicians and

amputations for people with diabetes are also expected to increase and such activities results in higher health care costs for government (CDA, 2009). Therefore achieving optimal blood glucose level prevents or delays the onset of diabetes complications thereby reducing the health care cost.

2.6 Lifestyle Intervention for T2D Management

One of the major treatments for diabetes is lifestyle modification involving both nutrition and physical activity. Overall, lifestyle interventions trials have been shown to improve the glycemic status in T2D patients. This section discusses both short term and long term intervention trials focused on the management of T2D through lifestyle modification.

Only few long-term studies have been conducted to show the effectiveness of lifestyle intervention programs. The Look AHEAD (Action for Health in Diabetes) study, is a randomized clinical trial that was conducted to evaluate the effectiveness of lifestyle intervention on changes in weight, fitness and cardiovascular disease (CVD) risk factors over a period of four years (Look AHEAD Research Group, 2010). A total of 5145 overweight or obese individuals with T2D were randomly assigned to either intensive lifestyle intervention (ILI) or diabetes support and education (DSE). The intervention was based on diet modification and physical activity. The goal was 7% weight loss after the first year with maintenance over the next three years. In the first six months patients in the ILI group were followed up every week and for next six months follow up was three times a week. For next two years patients were followed up once a month. The DSE group was provided with sessions on diet, physical activity or social

support three times a year. By the fourth year participants from the ILI group showed a greater percentage of weight loss (-6.15%) than the DSE group (-0.88%). Similarly, at year four, greater improvements in glycemic control assessed by measuring hemoglobin A1c (-0.36% vs -0.09%), HDL (3.67 vs 1.97 mg/dL) and triglycerides (-25.56 vs -19.75 mg/dL) were seen in the ILI group.

Another long term study conducted to show the effectiveness of lifestyle intervention was the POWER (Pounds Off With Empowerment) study led by Mayer-Davis et al. (Mayer-Davis et al., 2004). Patients were randomized into intervention, reimbursement intervention or usual care groups. The intervention group was aiming for moderate weight loss with 25% calories from fat and physical activity for a minimum of 150 minutes per week. The intervention group was followed up every week for the first four months, every alternate week for the next two months, and monthly for the last six months. Patients were asked to attend a total of four one-hour sessions, which included three group sessions and one individual session. The reimbursement group patients were provided with four intervention sessions and the duration of the sessions were planned according to the number of hours per year for which the medical insurance plan would provide reimbursement. The control group attended one individual session at the beginning of the study period. At six months, weight loss in the intervention group was significantly greater than the other groups ($p<0.01$). A1C was reduced by 1.6% in intervention group and by 0.8% in reimbursement group compared with 1.1% in the control group.

ICAN (Improving Control with Activity and Nutrition), a twelve months randomized control trial, was conducted in 147 T2D patients to study the efficacy of a case management lifestyle approach program led by registered dietitians that was more practical, economical and achievable than the usual medical care for patients with diabetes. Participants were randomized into either case management (n=73) or usual care (n=74) (Wolf et al., 2004). Case management participants attended six individual sessions and six one-hour group sessions with registered dietitians throughout the year. Primary outcomes were weight and waist circumference and secondary outcomes were A1C and lipid profile. Participants were followed up at 4, 6, 8 and 12 months. By month 8 a greater weight loss was noted in case management group. By the 12^{th} month there was an improvement in average weight loss of 2.4 kg in the case management group while a weight gain of 0.6 kg was noted in the usual care group. Similarly waist circumference was also reduced by 5.5 cm in the case management group compared with usual care group. Improvements in secondary outcomes were observed in the intervention group but were not significant.

Another trial was designed to assess whether intense lifestyle intervention has the same effect as that of insulin treatment on glycemic control and also whether the intervention could prevent the weight gain associated with the introduction of insulin on patients treated using oral hypoglycemic agents (OHA) (Aas et al., 2005). Twenty-eight obese, poorly controlled T2D patients on OHA were randomized into one of the three intervention groups: lifestyle intervention programme (L, n=9), combination of lifestyle intervention program and insulin

(L+I, n=10) or insulin treatment alone (I, n=9). In the dietary intervention programme 15 group meetings and 2 individual sessions were held to provide dietary advice and to focus on the primary goal of weight reduction. No specific diet plan was recommended but a booklet containing 20 suggested ways to plan a diet based on the Norwegian Nutrition Council was provided to patients. Weights were monitored continuously. To understand the extent of diet modification made, the participants' dietary intake was recorded using 5 day food records before randomization and at 12 months. The exercise programme included a group-based exercise for 1 hour twice a week. OHA were stopped and insulin was used to treat participants in group L+I and I. The primary outcomes were change in A1c and fasting blood glucose, which were measured from the beginning to 12 months. Secondary outcomes were change in body weight, body composition and lipid profile. From the results, a reduction in A1c value of -1.2% was noted in the lifestyle intervention group. The changes observed in the levels of A1c and lipid profiles from the beginning to 12 months were similar in all 3 groups. However weight change was significantly different among the 3 groups. Weight reduction was observed in group L with a median of -3.0 kg and weight gain was observed in the other 2 groups with median of 3.5 kg and 4.9 kg in L+I and I groups, respectively. Participants in group L reduced their energy intake and modified their diet content to more carbohydrate and less fat during the intervention. Hence lifestyle intervention is as effective as insulin in glycemic control and helps in weight reduction.

A 12-week randomized controlled pilot study was conducted to determine whether a community-based, group-centered nutrition and exercise programme could improve glycemic control and cardiovascular risk factors among T2D patients in Costa Rica (Goldhaber-Fiebert et al., 2003). A total of 75 individuals with T2D was randomized into the intervention group (n=40) or control group (n=35). Standard diabetes education was provided to both groups before randomization. Participants in the intervention group attended 11 nutritional classes (90 min/session) where they were instructed on eating a specific diet pattern developed according to the local customs. The session focused on portion control for weight management and use of healthy food alternatives. Subjects were asked to be involved in a 60 min walking group sessions\ three times per week throughout the intervention period. Height, weight, A1c, fasting blood glucose and lipid profiles were measured at baseline and at 12 weeks. After 12 weeks, mean BMI (-0.4±0.9 kg/m2; 0.2±1.2kg/m2) and weight (-1.0±2.2 kg; 0.4±2.3kg) decreased in the intervention group and increased in the control group. A1c decreased by 1.8±2.3% in the intervention group and increased by 0.4±2.3% in the control group while the changes in the lipid profile throughout intervention period were small and not statistically different. Therefore a community based intervention may help in improving the glycemic status of T2D individuals.

The Mediterranean Lifestyle Programme (MLP) was a randomized controlled trial conducted among postmenopausal T2D women to reduce the risk of coronary heart disease (CHD) and improve glycemic control (Toobert et al., 2003). This group of women was at high risk of developing CHD. Since diet,

physical activity, stress and smoking remain as the most important modifiable risk factors for CHD, this study was conducted to assess the interactions between lifestyle behaviors and the physical and social environment. Participants (n=279) were randomized into the control condition (UC, n=116) or the treatment condition (MLP, n=163). The MLP recommended diets rich in polyunsaturated n-3 fat and monounsaturated fats, increased root vegetables, greens, legumes and fish, reflecting the Mediterranean diet pattern. Moderate physical activity of 30 min was preferable on all days per week along with 10 strength training exercises twice/week. A1c, BMI, plasma lipids, blood pressure were measured. After 6 months a significant reduction in the A1c (-0.4%) value and BMI (-0.32kg/m2) was noted in the intervention group.

Lifestyle intervention including both nutrition and physical activity can be effective in improving the glycemic status, improve weight loss and also improves quality of life. Individuals with diabetes should consider modifying their diet and physical activity pattern in order to manage diabetes and its complications.

2.7 Medical Nutrition Therapy in Diabetes Management

Self management is highly essential for patients with type 2 diabetes to benefit from the team approach of diabetes care. Medical Nutrition Therapy (MNT) is a very important component of treatment and self management of diabetes. The main objectives of MNT are to improve and maintain the quality of life, physiological health and to prevent and manage acute and long term complications associated with diabetes (CDA, 2008). MNT is an effective

treatment for several disease conditions; however for diabetes nutrition therapy must work along with the pharmacological treatment. Medication alone is sufficient to treat some disease conditions where diet may not be very essential but in diabetes insulin or oral medications alone cannot adequately optimise the condition. In addition during the early stage of onset of diabetes diet and physical activity alone helps to delay introducing oral medications, which is very cost effective and provides better quality of life (American Dietetic Association, 1999).

2.7.1. Dietary recommendations

The CDA develops and updates the nutrition therapy guidelines and suggests that nutrition therapy and meal plans should consider factors such as patients preference, age, needs, culture, economic status, lifestyle and activity level (CDA, 2008). According to the 2008 CDA guidelines people with diabetes in general should follow a healthy diet as outlined in Eating Well with Canada's Food Guide, which was developed for the general population. As per this guide people are allowed to chose variety of foods from four food groups: vegetables and fruits, grain products, milk and alternatives and meat and alternatives. Consuming low energy density foods and avoiding over consumption is suggested along with adequate intake of carbohydrates, fibre, protein, essential fatty acids, vitamins and minerals in order to maintain health body weight. Furthermore the Guidelines specify that inclusion of snacks in the meal plan should be made considering meal spacing, metabolic control and treatment as it has a potential risk of weight gain.

Nutrition guidelines of CDA recommend a carbohydrate allowance of > 45% of total energy per day and promotes the use of low GI foods instead of high GI foods. Due to potential benefits of dietary fibre for reducing the risk of CVD, recommendation of this is higher than for the general population at 25-50 g/day. Energy from sugars such as table sugars and added sugars are allowed up to <10% of total energy. Although there is no evidence to support that optimised inclusion of sugars help in glycemic control and lipid levels, consuming them above this limit are reported to causes a rise in blood glucose and triglyceride levels (Coulston et al.,1985; Jellish et al.,1984). Protein allowance is not different from that of general population with a daily limit of 15-20% of total energy. Daily fat intake is limited to <35% of total calories and saturated fat intake is restricted to <7% total calories considering the cardiovascular risk factors associated with diabetes. Trans fat are recommended to be consumed at minimal quantity and polyunsaturated fat is to be kept at <10% of total energy. Also, emphasis is made on a preference for monounsaturated fats. Since people with diabetes are encouraged to meet their vitamin and mineral needs through a well balanced diet, supplements are generally not recommended; however a vitamin D supplement of 10 µg/day is recommended for people aged over 50 years. Like for the general population, the alcohol recommendation for people with diabetes is ≤2 drinks/day.

2.8 Dietary Intervention in Diabetes Management

Medical nutrition therapy is an important component of diabetes management. MNT is either used alone or in combination with other treatment modalities to improve the glycemic status of individuals with diabetes. To

understand the importance of dietary intervention in diabetes management this section specifically illustrates the evidences that support the effectiveness of MNT.

Franz et al. (Franz et al., 1995) conducted a randomized controlled trial among 179 T2D patients to assess the effectiveness of MNT provided by dietitians on metabolic outcomes. Participants with T2D aged 38-76 years were recruited from diabetes centres located in 3 states in the United States. Participants were either treated with diet alone, or diet with OHA, or diet with insulin, or diet with insulin and OHA before entering the study. Two hundred and forty-seven subjects were randomly assigned to either of two groups: Basic nutrition care group (BC) or ii) PGC groups (Practice Guidelines nutrition Care). In the BC group, participants meet with the dietitian only once for approximately one hour where a nutrition care plan was developed for the patient and general principles of nutrition was discussed. In the PGC group there was an initial 1 hour session and two follow-up sessions of about 30-45 minutes. The nutrition intervention designed to achieve target blood glucose values was implemented and during the follow-up visit the participant's achievement on target glucose values were evaluated. Medical outcomes collected during at the initial visit, 3 and 6 months included FPG, A1C and lipid profile. In the BC group, FPG value dropped at 3 months ($p<.001$) but increased at 6 months ($p<.01$). A similar trend was also seen in A1c values; however the values seemed to be lower than the initial visit. In the PGC group significant improvements in both FBG and A1c values were noted during the final visit. At 6 months 63% of participants in PGC

group maintained the glucose outcome. The FPG level dropped by 50-100mg/dl and the A1c decreased by 1-2%. Significant reductions in total cholesterol and triglycerides were observed at 3 months ($p<0.001$). At 6 months 19% of the PGC group achieved a targeted weight loss of >4.5 kg. Results from this study imply that when the intense nutrition therapy is provided a significant improvement in blood glucose control can be achieved.

Kulkarni et al., conducted a prospective randomizes trial to examine the effectiveness of using practice nutrition guidelines to the use of usual nutrition care provided by dietitians for T1D individuals (Kulkarni et al., 1998). Dietitians were assigned randomly to practice guidelines groups (n=13) and usual care groups (n=14) and they were responsible for recruiting T1D patients to the study. Dietitians in the usual care were asked to provide the nutritional advice as they normally do and the practice guidelines dietitians were asked to match the nutrition guidelines by making necessary modification of the nutrition care they usually provide to patients. Dietitians in the practice guidelines group focused mainly on glycemic control and the usual care dietitians focused on weight loss. Patients in the practice guidelines groups had 3 to 4 visits and the initial visit was about 1 hour and about 30 minutes for usual care group. A1c was measured at baseline and at 3 months. Fifty three percent of usual care group and eighty eight percent of practice guidelines group showed improvement in A1c. A significant reduction in A1c from baseline to 3 months was observed in practice guidelines group (-1.00 ± 1.92) than the usual care group (-0.33 ± 1.04).

The U.K. Prospective Diabetes Study Group (UKPDS, 1990) recruited 3044 newly diagnosed patients aged between 25-65 years from 15 diabetes centres. Nutrition counselling was provided to participants where they were asked to follow British Diabetic association recommendations for 3 months, the diet constituted 50% carbohydrate, 30% fat and 20% protein and energy according to patients obesity and activity level. There were 3 follow-up sessions every month up to 3 months. Fasting blood glucose (FBG) was measured and participants were weighed during every visit. After 3 months of following the dietary advice a significant reduction in FBG ($r=0.76$, p'0.001) was noted among participants who had higher FBG values at the beginning of the study. The mean FBG decreased from 11.4±3.3 to 8.1±1.8 mmol/L. After 3 months of nutrition intervention participants were randomized into treatment group (sulphonylurea, metformin or insulin) or diet therapy group based on their FBG values. Participants from diet therapy group continued to be on diet and studied after one year. A significant reduction in mean FPG from 10.0 ±3.3 to 5.8 ±0.7 mmol/L and weight loss from 132±25% to 121±55% of ideal body weight (IBW) was noted among 447 patients of the diet group after 3 months.

Another study demonstrated the effect of following MNT on glycemic control among both T1D and T2D patients (Christensen et al., 2000). Christensen et al. completed the study to evaluate the effect of MNT provided by dietitians on glycemic control. Participants were recuited from outpatient clinic and dietitians provided MNT outlined by the ADA to 15 T1D and 87 T2D patients. A minimun of 2 visits was scheduled 2 weeks apart for each participant. The primary goal was

to improve glycemic control and to incorporate diabetes self monitoring education into the MNT. A1c was measured during the first visit and at 3 months after the initial visit with the dietitian. Both type 1 (9.24±1.75% to 7.97±1.29%) and type 2 (9.35±2.12% to 7.70±1.53%) diabetes patients achieved a significant reduction in A1c after receiving the nutritional education.

Results from the above studies suggest that MNT not only helps managing the outcomes during diagnosis or at initial stages, it also helps during disease progression stages. It is also clear that participant's compliance towards dietary recommendations is better when nutrition education is provided under controlled settings. However sustaining dietary adherence over long term is considered to be a burden and dietary adherence are always not maintained by majority of diabetes patients in their everyday life despite all the beneficial effects of MNT. To understand the reason behind the success and failure of dietary adherence in everyday life, nutritional intake and the factors that affect the dietary intake have to be evaluated.

2.9 Dietary Adherence Trends

According to Haynes, adherence is "the extent to which a patient's behaviour (in terms of taking medications, following diet or executing lifestyle changes) coincides with medical or health advice" (Haynes et al., 1979). The extent of adherence rate varies among different treatment regimens. Compared to medication adherence, level of adherence to dietary recommendations and physical activity is lower and considered to be difficult (Glasgow et al., 1986; Kavanagh et al., 1993).

The EURODIAB complications study (Toeller et al., 1997) was performed to assess the prevalence of acute and chronic diabetes complications. As there were many risk factors associated with diabetes complications and as diet was portrayed to be one main risk factor, the study also aimed to measure the associations between nutrient intake and diabetes complications. As a first stage of this, nutrient intake was measured using 3 day diet records from 2868 T2D patients in 30 centres around Europe. Then macronutrient intake was assessed and compared to the recommendations outlined by the Diabetes and Nutrition Study group of the EASD. Results showed that the average protein consumption was 110.0 ± 30.8 g/day and 22% of the participants had protein intake that was more than recommended amount of 20% of total energy. Mean energy intake from fat was 38 ± 7% calories/day and average cholesterol intake was 373 ± 195 mg/day. Only 14% of participants consumed <30% of energy/day from fat intake or <10% of energy/day from saturated fat. Fifteen percent of participants consumed <40% of energy/day from carbohydrate. Fibre intake was reported to be 17 ± 8 g/day and only 7% of participants reported consuming more than 30 g/day. In this large cross-sectional study the major issues reported were intakes of carbohydrate, fibre, fat, saturated fat and cholesterol.

In 2002 Nelson et al. used the data from NHANES III (National Health and Nutrition Examination Survey) (Nelson et al., 2002) to examine the diet and physical activity patterns of T2D patients. The nutrient outcomes measured in this study were intakes of total fat, saturated fat, fruits and vegetables. Dietary intake was measured using FFQ and 24-hour recall from 1480 diabetes patients between

1994 and1998. Analysis of the dietary data suggested that 42% of participants obtained 30-40% of calories/day from fat and 26% consumed >40% of calories/day from fat; 62% consumed less than the recommended servings of fruits and vegetables. Overall, people in this nationally representative sample of T2D patients consumed a higher amount of fat intake and a lower number of fruit and vegetable servings than is recommended.

Rivellese et al. studied the dietary adherence of Italian T2D patients to dietary recommendations of the Diabetes and Nutrition Study Group of the European Associations for the study of Diabetes (Rivellese et al., 2007). T2D patients aged between 50 and 70 years were recruited from six Italian diabetes centers located in different parts of Italy to participate in the Multifactorial Intervention Study in Type 2 Diabetes-Italy (Mind.it). Dietary data was collected at baseline through weighted 3 day dietary records (n=540). To understand the inter-regional differences in nutrition intake, diet intakes of participants from different locations were analysed separately. Also dietary records from different regions were combined and analysed to capture the overall nutrient intake pattern of Italian T2D patients. Anthropometrics, lipid parameters and A1C were measured. Analysing the diet records according to the Italian food composition table showed that average nutrient consumption was adequate. However when adherence to each nutrient was analysed individually, adherence to the fibre recommendation was very low, with only 6% meeting the recommendation of at least 20g/1000kcal. Similarly, adherence to the saturated fat intake recommendation was low with 57% of participants consuming more than the

recommended amount. Only 3% of participants met all the nutrient recommendations. Region-wise, nutrient analysis showed that the energy intake was higher in northern Italy than the southern part ($p<0.00$). Fibre intake was lower in northern part of Italy (10 ± 3 g/1000kcal) than southern part (15 ± 4 g/1000kcal). Adherence to fibre and saturated fat recommendations were low among Italian individuals with T2D; however few participants were able to meet all the recommendations. Dietary intake also seemed to differ from region to region.

The Diabetes Nutrition and Complication trial (GSEDNu, 2006) was a 7-year, population-based, observational study conducted among diabetic individuals in Spain to assess the adherence to ADA nutrient recommendations and its relation to metabolic control and the onset of micro and macro vascular complications. A total of 192 diabetic subjects (93 T1D and 99 T2D) from four centers were recruited in 1993. At baseline (1993) and at follow up (2000) height, weight, waist hip circumference, A1C and lipid profiles were measured. According to the reports of nutritional data analysed during follow up in 2000, the recommendation for PUFA intake was met by <13% and saturated fat was met by 27% of respondents. In comparison, the protein recommendation of 15-20% total energy/d and fibre of >15g/day were met by > 60% of participants.

Later, in 2008, Eilat-Adar et al. wanted to assess the dietary patterns of American Indians because diabetes was more prevalent among this group than the general population (Eilat-Adar et al., 2008). Here they also compared dietary intakes of American Indians and US adults with diabetes in the NHANES. The

data source for American Indians (n=1008) was from the Strong Heart Study (SHS) and that of other individuals with diabetes (n=441) was from NHANES 1999-2000 survey. Twenty-four-hour dietary recall was used to collect the dietary data. The main outcome was fibre, saturated fat and sodium intakes because the SHS study aimed at quantifying the risk factors for CVD. The data were compared against both 1997 and 2006 ADA recommendations. Mean intakes of protein, carbohydrates, PUFA and MUFA of both groups met the 1997 ADA recommendations, yet saturated fat and sodium intakes were high with lower than recommended fibre intake. However, 2006 ADA recommendations for protein, fat, cholesterol and sodium were not met by more than half of the participants. Above 85% of diabetes participants did not meet recommendations for saturated fat. Also 2006 guidelines for fat and fibre were met only by 31% of diabetes patients.

To determine whether individuals with diabetes, dyslipidemia, cardiovascular disease or hypertension adhere to their respective dietary guideline recommendations, Neuhouser et al., conducted a study of 1782 adults (Neuhouser et al., 2002). Participants were from the Olestra Post-Marketing Surveillance Study (OPMSS). A 122-item FFQ was used to assess nutrient intake. Patients with diabetes consumed 37% of energy from fat and non diabetics consumed 35% of energy from fat. Males with hypertension consumed more energy from saturated fat than non-hypertensives. Other than the cholesterol recommendation, mean intakes of all participants did not meet their respective diet recommendations of fat (<30% of energy), saturated fat (<10% of energy) and

fruits and vegetables (at least 5 servings/day). In general, participants from each group engaged in very little daily physical activity since they reported doing about 17 minutes/day. In summary approximately 45% of adults, irrespective of the disease condition, followed a poor dietary pattern.

By looking at the results from above studies adherence towards certain nutrients seems to be poor, predominantly fibre and saturated fat. In some countries like Italy adherence to nutritional intake appeared to vary among different regions. Therefore it is important to measure the dietary intake pattern of a particular region to identify the existing nutritional issues. This will help to modify the strategies to improve adherence to dietary recommendations.

2.10 Measuring Dietary Intake

Since dietary intake is an important contributor to glycemic control, it is critical that it be measured with precision and accuracy. Over the past years many methods have been used by the researchers to measure dietary intake. The most common methods used currently are the 24-hour recall, multi-day food records and food frequency questionnaires (FFQ). Every method has its own advantages and disadvantages and the method chosen is based on many factors including the study design, research question, cost and burden on the participants.

Twenty four hour recall is one of the methods that are widely used in large scale studies (Willet, 1998). The data is obtained either through structured interview or self administered questionnaire and the subjects are asked to provide detailed information on everything they ate and drank over the previous 24 hours (Burk & Pao, 1979). Advantages of this method are: it is less time consuming,

less expensive and less burdensome on the subjects than the other methods such as dietary record and FFQ. Generally a single 24-hour recall is effective in determining the mean group nutrient intake of large population such as national level surveys but it is not an accurate method to assess individual's intake. As one day of intake may not represent one's long term or usual intake (Dodd et al., 2006), multiple 24-hour recalls can be used to capture usual or habitual nutrient intake (Karvetti & Knuts, 1985; Carter et al., 1981; Kahnn et al., 1985). On the other hand the major disadvantage of this method is it mainly depends on patient's memory. Therefore estimation of consumed foods and their portion sizes may be subject to memory bias. In a study led Karvetti & Knuts, the validity of 24 hour recall was assessed using 141 participants aged between 15 and 57 years (Karvetti & Knuts, 1985). The food intake was directly observed and measured by the interviewer and was recalled the following day by the study participant. The correlation coefficients (r^2) for recalled and omitted foods ranged from 0.58-0.74. The foods that were actually eaten but omitted (4% of times for fish and 50% for fruits and vegetables) and foods that were not eaten but were mentioned were found in the food lists (ranges from 2% of times for bread and 29% of times recalled for sugar). Findings from this study showed the possibility of inaccurate recall and/or errors in recording food intake.

Food records are usually used in studies which require detailed information on nutrient intake of study participants. This method requires subjects to record everything they consumed over a given period of time (Rutishauser, 2005; Willet, 1998). As participants are asked to record everything immediately

after they eat or drink, the recall bias is limited in this method. Usually to collect diet intake of individuals or population a minimum of 3 days is recorded, including 2 weekdays and one weekend day. If recorded for several days it can provide usual intake pattern of subjects and some studies collect as much as 5 days to 10 days of data (Friedenreich et al., 1992; Bingham, 1987). This method also has its own disadvantages as it requires greater cooperation from the subjects, is more time consuming for the subject and for data entry, moreover the subject must be a literate to complete them. Therefore food records cannot be used in rural areas where literacy or time may be a limitation. Maintaining a detailed food record sometimes causes people to change what they eat or the way they actually eat. Another limitation is subjects may not report everything they ate and chances of underreporting is also possible (Cook, 2000). Despite all the disadvantages 24 hour recall and food records are some of the most commonly used methods for dietary assessment.

To validate Estimated Food Record (EFR) using Weighed Food Records (WFR) as a reference, a study was conducted by Chinnock et al. who included sixty adults between 20 and 65 years of age (Chinnock et al., 2006). Both EFR and WFR were collected for seven days from each subject. In case of WFR team members weighed the ingredients and portion sizes and in EFR participants were asked record the food intake as instructed by the team members. Average intake estimates for macronutrients assessed by EFR were significantly lower than the weighed foods records. However, the correlation coefficients of nutrient intakes estimated by both the methods ranged from 0.68 (polyunsaturated fats) to 0.87

(calcium) and it was greater than 0.8 ($p<0.00$) for nutrients such as energy, carbohydrate, protein and fibre. This study suggests that estimated food records can be used in place of weighed food records.

Another commonly used method is the FFQ. This method determines the frequency at which certain foods were consumed during a given period of time usually daily, weekly, monthly or yearly. Semi-quantitative FFQ also ask subjects to report the portion size of the foods that they indicate that they ate. To evaluate dietary intake list of commonly consumed foods are created and the subject is asked to complete the questionnaire or an interviewer performs the evaluation. Subjects are asked to respond the frequency of consumption of specified foods provided on list. FFQ are usually developed for specific populations. Foods that are included in the FFQ must be carefully considered and must represent significant sources of the nutrients of interest. Otherwise there is strong chance of missing specific foods that contain high amounts of a nutrient. Other disadvantages include lack of knowledge about preparation methods and lack of information about portion sizes, especially when more than one portion size of a particular food is consumed at the same meal or on the same day and cannot be accurately listed. As many details of dietary intake are not recorded it is subject to measurement errors and not as accurate as recall or food records (Thompson & Subar, 2001). However FFQ are also one of the widely used methods in large cohort studies due to cost effectiveness. (Anderson, 1988; Bingham, 1987; Sempos et al., 1998).

In general all dietary methods are subject to error. It is therefore important to consider these errors in data analysis, apart from the method used in the study.

2.11 Factors Affecting Dietary Adherence

In general, chronic conditions require strict adherence to a treatment plan in order to have a better outcome. Specifically, individuals with diabetes are expected to follow their treatment plan to help keep the condition under control (DiMatteo, 2004; Kavanagh et al., 1993). However many studies suggest that diabetes patients have difficulty following their diet plans and therefore researchers have made efforts to explore the factors that affect dietary adherence. Understanding the barriers would help to develop guidelines or programs that would benefit patients by improving dietary adherence. Below are some of the studies that examine the social and environmental factors that affect dietary adherence.

In a study by Travis the effect of selected factors on dietary adherence was probed along with determining the relationships between the factors and demographic characteristics of the participants (Travis, 1986). A multiple choice questionnaire developed by the researcher was administered to 75 participants recruited through a teaching hospital. The questionnaire contained 3 sections: demographics, adherence to diet plan and education. The dietary adherence part of questionnaire consisted of questions regarding participants' thoughts on their adherence to their diet plan. To characterize the effect of specific social and environmental factors on dietary adherence participants were asked to choose one of the following responses: "positively", "neutral" or "negatively" to answer

questions about how these factors influenced their dietary adherence. A negative response was interpreted to be detrimental to the use of diet plan, neutral was interpreted to have no effect on diet plan and a positive response was interpreted to promote the use of the diet plan (Travis, 1986). Results from this study showed that personal motivation was the most common factor that positively enhanced adherence. Cooking habits, influence of family members, friends, restaurant dining and holidays had a neutral effect and emotions, schedule and holidays had negative impacts on adherence. Issues regarding the understanding and use of diabetes related education materials were also covered in the questionnaire. Results concerning the diabetes education suggested that knowing what foods to buy and understanding one's meal plan helped dietary adherence. Analysis from demographic section showed that patients less than 65 years were more likely affected by emotional factors and were likely to have a negative impact on their diet plan. Also females (53.5%) were more affected by emotional issues than males (25%) when adhering to the diabetic diet plan.

Schlundt et al. focused on the situations that diabetes patients found to be challenging in everyday life for dietary adherence. Twelve adults with T1D and 14 adults with T2D were recruited and interviewed for 45-60 minutes to identify and describe the type of eating situations which were challenging (Schlundt et al., 1994). The questions were framed to collect detailed information on the individual's diet plan, adherence and opinion about the diet plan. They were more specific on time, place, social contexts, feelings and triggering events. From reviewing the data, a total of 86 problem situations were described, which were

then classified according to the situational taxonomy method developed by Schlundt & Mc Fall (Schlundt & Mc Fall, 1987). The results suggested that negative emotions, resisting temptations, eating out, feeling deprived, time pressure, planning, social events, lack of family support, food refusal and lack of friends' support were some of the situations that seemed to be obstacles for dietary adherence.

Williamson et al. in 2000 (Williamson et al., 2000) surveyed registered dietitians to identify the factors that contributed to the five barriers to dietary adherence identified by registered dietitians. The barriers included i) Complications with Lifestyle/Competing Demands, ii) Denial/Perception that Diabetes is Not Serious, iii) Poor Understanding of Diet/Disease Relationship, iv) Lack of Self-Efficacy and v) Misinformation from Unreliable Sources. The study was conducted through telephone interviews; a 10-item open ended questionnaire was administered to 75 registered dietitians who were all members of the American Diabetes Association's Diabetes Care and Education Dietetic group. They were asked to identify the factors that contributed to these barriers and to provide recommendations to overcome these barriers. From the findings, the most common factor that contributed to the barrier of complications with lifestyle/competing demands was time constraints (73%). Other factors were eating out, lack of finances, problems with portion control and denial/unwillingness to make changes. To overcome these barriers, 69% of the dietitians recommended individualising the meal plan or planning ahead to save time. Simplifying the meal plan was also specified. A patient being asymptomatic

was identified as the main factor for contributing to denial since it may lead to a perception that diabetes is not serious. One recommendation made from this observation this was to have additional education on the complications of diabetes. To overcome the barrier of poor understanding of the Diet/Disease Relationship, dietitians suggested more education, with more follow up sessions as they felt that patients may lack education in this area. Incorrect or poor quality of information was identified to be a second major factor this barrier. For the fourth barrier, Lack of Self-Efficacy, 39% of participants noted poor self esteem/lack of empowerment as a contributing factor. Therefore setting obtainable goals was recommended to overcome this barrier. Factors such as families/peers/others with diabetes were cited to contribute to the last barrier Misinformation from Unreliable Sources was the final barrier identified. To overcome this barrier, presenting facts through education, and making referrals to health professionals were suggested as helpful measures. In this study dietary adherence was identified to be the complex problem and the dietitians believed that they could help patients to overcome these barriers with intense education.

To understand the barriers to dietary management, Vijan et al. (Vijan et al., 2005) conducted a study using a written survey and focus groups. Barriers to self management were assessed both qualitatively and quantitatively, and this particular study focused on barriers to dietary adherence alone. Participants diagnosed with diabetes were recruited from the primary care of the academic medial hospital and two veteran administration hospitals in United States. Participants who had been diagnosed with diabetes before age of 30 were

excluded from the study to minimise participation of T1D patients. This study was conducted in two phases. Phase I was quantitative where a questionnaire was randomly mailed to participants to understand the patients' comparative views of diabetes treatment (n=197). Patients' attitudes towards diabetes treatment were measured. Self reported adherence to dietary treatment and experience with the treatments were also measured. Phase II was qualitative where individual patient's views on treatment was assessed. There were 6 focus groups: 3 groups from urban and other 3 from suburban areas having 6-12 patients in each. Attitudes towards diabetes care were assessed. Interviews were audiotaped and transcribed. Results from the quantitative phase revealed that patients reported following a moderately simple diet (low calorie, fat and sugar diet) was more complicated than taking pills. Diabetic treatment that required strict meal timing was burdensome. The burden of a moderate diet was significantly and inversely associated with age; older patients reported following this diet to be less burdensome than younger patients. From the focus group data (qualitative phase) the common problems that were associated with dietary adherence were cost and portion size. Support from family members was seen as enhancing adherence. Other barriers included were emotions, holidays, lack of clear knowledge of diet recommendations, dislike of the foods recommended in the diet and difficulty in meal scheduling. Therefore, the authors concluded that food preferences and barriers to adherence such as socioeconomic status should be considered by health care professionals when prescribing diet plans.

Nevenka et al. (Nevenka et al., 2004) conducted a qualitative study to identify diabetes patients' attitudes and thoughts related to their disease condition and the obstacles faced by them while following the prescribed treatment regime. Forty-nine T2D patients were recruited to this study to attend focus group discussions, which were audiotaped and transcribed for analysis. During the discussions participants were asked to express their views to several open ended questions and statements which asked about their experience at the time of diagnosis, their opinion on diabetes treatment and how they manage their treatment. Results from this study showed that, according to most patients, diabetes is a condition where they need to modify their diet and become involved in more physical activity; however they did not follow the prescribed diet even during situations when they received support from their family members. Also, to stick to their diet at work was found to be difficult for most patients. To overcome these behaviours they believed it was important to realise they themselves are responsible for their health status and not others, however, participants found this difficult and thought change could be facilitated by health practitioners. Unwillingness, lack of motivation and financial situation were stated as main reasons for not following their diets. Also most of them were not completely aware of the importance of following a diet. In their opinion, frequent visits with physicians, gaining knowledge through periodic education about the disease and its treatment, meeting with other patients to share and learn from other's experiences and more information from media would help them improve their glycemic control.

2.12 Food Acceptability

The concept of food acceptability is studied mainly in two different ways. One is related to sensory acceptance of food and the other is related to perception and attitude towards a recommended diet. Sensory acceptability is studied mainly when introducing new foods. Perception and attitude towards foods is widely studied in acceptance of therapeutic diets; under this concept researchers seek to understand the activities pertaining to buying, liking, cooking and social relevance to eating. Studies discussing the second concept are mainly discussed in this paper due to its relevance to the concept of cultural and personal acceptance. These types of studies are conducted in both general and diabetes and other populations with chronic disease (Barnard et al., 2000; Berkow et al., 2010; Holm et al., 2008). In diabetes populations, food acceptability of specific diets such as low carbohydrate, high fibre, low fat, and low GI diets are evaluated more often than the acceptability of nutrition therapy guidelines developed by CDA, ADA or other diabetic associations (Barnard et al., 2009; Story et al., 1985). The studies conducted to investigate food acceptability of general and therapeutic diets are discussed in this chapter.

Coyne et al. used data from two different studies to investigate the satisfaction of the modified protein eating pattern and the associations of diet satisfactions to dietary adherence and socio-demographic factors (Coyne et al., 1995). Both studies measured dietary adherence and satisfactions but did not assess the association between them. In study A, 585 participants with moderate loss of renal function were randomly assigned to a usual protein (1.3g/kg/day) or

a low protein diet (0.58g/kg/day). In study B, 255 participants with severe loss of renal function were assigned randomly to a low or very low protein (0.28g/kg/day) eating pattern group. A 30-item Dietary Satisfaction Questionnaire was used to assess and monitor changes in "satisfaction with food quantity and quality, problems in meal planning and preparation and acceptability of the eating pattern". The questionnaire was administered at baseline, at 6 months follow-up visits, annual and at final visits. The overall satisfaction was rated between 1 (dislike extremely) and 5 (like very much). In this study they discussed only the results from the first item of the questionnaire which describes the overall satisfaction of the diet. A significant association between acceptability and food related behaviours were noted. In particular, those who liked the eating pattern also reported fewer difficulties in shopping and preparing foods, eating in restaurants and in other people's home. At baseline at least 50% of participants from all groups reported that they "liked" their current eating pattern. Participants who were more satisfied with the eating pattern at final visit from all groups had mean protein intakes closer to the recommended intake. No associations were observed between demographic characters and satisfaction of the diet.

A randomized crossover design was conducted by Jimenez-Cruz et al. to identify whether a low and high GI Mexican style diet plan that is flexible have an impact on biochemical data and BMI among overweight and obese subjects with T2D (Jimenez-Cruz, et al., 2003). Study period included two 6-week periods with a 6-week washout period between treatments. Each participant was allocated to both lower and higher GI diets for 6 weeks. Dietary advice was provided on

flexible diets with low GI foods, the foods chosen were based on the traditional Mexican foods; typical low GI foods recommended were corn tortillas, beans, yogurt and pasta. The high GI foods included corn flakes, white bread, potatoes and ripe banana. Participants completed foods records during 1st, 4th and 6th week of the study period. A1c was measured at the beginning and end of the study period. Results showed that energy contributed by macronutrients from both diets were similar but higher fibre intake was noted during the low GI period. A1c ($p=0.02$) and BMI $p=0.05$) were significantly lower after the low GI period compared with the high GI period. However no significant changes were observed in the lipid profiles. The study showed that providing culturally-based, flexible, low GI diets improved compliance and helped in achieving better glycemic levels and reduction in BMI.

In 2004 James (James, 2004) completed a study to explore the impact of culture and community on nutritional attitudes, food choices and dietary habits among African American adults. Forty participants (19 women and 21 men) were recruited to six focus groups. Focus group questions covered topics such as "concepts of healthy eating" and "barriers and motivators to healthy eating". Results showed that some of the participants believed that the USDA food pyramid mainly focused on the people from the dominant culture and did not include any foods from their tradition. Most claimed that the nutrition education materials provided in the clinics were not relevant and culturally specific to African Americans and some remarked that "the recipes they gave out for are for things I would never eat". Participants considered their traditional foods as their

“comfort foods” and “soul foods”. Unfortunately their traditional foods such as fried chicken were high in fat, and some did not want to give up their traditional foods even if they thought they would harm them. On the other side, participants showed interest in learning the appropriate serving sizes of different food groups, advice on making healthful choices while dining out and in modifying some of their traditional foods to make them healthier. The study concluded that traditional foods are considered to be important in their meal pattern and therefore should not be completely avoided from the diet. instead, the frequency of consumption may be reduced or modified depending on the type of food. This study suggested provision of education materials that are culturally relevant to promote healthier food choices.

To understand how people from ethnic minorities with T2D experience and implement the dietary advice provided by the health care team Fagerli et al. (Fagerli et al., 2005) conducted a study recruiting 15 Pakistani-born Indians aged between 30 to 6o living in Norway. Data was collected through semi-structured interviews focusing on their experience with changes in food habits before and after being diagnosed with diabetes. The interviews were audiotaped and transcribed by the researcher. Every participant in this study had received some form of dietary advice from the healthcare team. However they mentioned that the dietary advice focused only on limited dietary practices such as the required fruits and vegetable servings or to reduce the intake of food items rich in fat and sugar. Constraints related to communication problems included lack of clear explanations on ways to follow the recommended diet; the advice provided about

the amount of foods to eat was too general and use of specific term such as “diet” or “dietary regimen” sounded more complicated than necessary. Some participants felt that their health care practitioner provided sufficient advice while some felt that their dietary advice was culturally insensitive by not considering their dietary preferences. This made them deviate from the Norwegian bread-based dietary advice because their preferences were for traditional Pakistani foods. Limited availability of preferred foods during the work day was one other constraint. The major concern identified through this study was the lack of translation of professional knowledge to everyday life. Participants also had poor understanding of dietary advice. The participants were interested in obtaining professional interpreters and requested culturally appropriate nutrition education materials to improve their diet.

Others studied eating practices and the effect of social and cultural factors on dietary patterns among British Pakistani and Indians with T2D (Lawton et al., 2008). Interviews were conducted to collect information on participants’ “food and eating practices during a typical day and on special occasions; changes in diet after migration and after diagnosis of T2D”. Most participants claimed that they have made some changes to their meal pattern following diagnosis of diabetes, such as replacing full fat milk for half fat milk to manage the disease. Respondents reported consuming western food for daytime meals and traditional foods for evening meals. Most of them perceived South Asian foods such as ‘roti’ to be detrimental to disease management. Despite their perceived concerns they continued to eat their traditional foods for evening meals as they considered those

foods as ‘strength giving’ and the expectation to take part with family or community members. Some of the patients complained that the dietary advice provided was insensitive to their cultural and food preferences. Most claimed that refusing foods or eating different foods from others led to differentiation and loss of identity in community gatherings. Especially, first generation respondents were unable to change their eating pattern. Therefore this study concluded that guidelines should be modified by considering their current food practices and preferences to enable South Asian communities to manage their diabetes.

Bernard et al. (Barnard et al., 2009) conducted a 74-week controlled trial to assess the adherence and acceptability of 2 types of therapeutic diets. Ninety-nine T2D patients were randomly assigned either to American Diabetes Association guidelines (ADbA) group or a low fat vegan diet. Attrition, dietary adherence, food acceptability and food craving were main study outcomes. Results relevant to food acceptability are discussed here. The food acceptability questionnaire included questions related to the diet that they followed during the study. The answers were based on a 7-point Likert scale. The questions addressed how well they liked those foods, whether it was easy or difficult for them to buy and cook those foods, maintain the diet at restaurants and overall whether or not they are satisfied with the diet. Perceived benefits or adverse effects the patients faced due to following the diet such as weight loss or gain, increased or decreased energy, better or worse sleep, or better digestion were evaluated. Results showed that no difference in food acceptability was observed between the two diets. At week 22, both groups rated 5 (median) in response to a question of how well they

liked these foods. The median response to the question of how well they were satisfied with the diet showed they were moderately satisfied with the vegan diet and more satisfied than dissatisfied with the ADbA diet. Preparing foods was rated to be easier in the ADbA group than the vegan group. In week 74 no significant differences were seen between the two groups. Increased energy, weight loss, better digestion and better sleep were reported by participants in both groups at week 22. In this study both the ADbA diet and vegan diet were considered to be acceptable by diabetes patients.

From these studies it can be clearly understood that food acceptability has an impact on dietary behaviour. These studies conducted among various group of participants showed that diet acceptability is essential to improve dietary compliance. Dietary adherence has to be sustained over long term to be benefited from it however when personal preferences are not considered a decline in adherence occurs. Studies exploring the relationship between dietary acceptability and dietary adherence among diabetes patients are limited. Few studies have examined the constraints faced by the people from ethnic minorities that affect their dietary adherence. Therefore it becomes important to understand patients' perceptions of recommended foods. This information will be helpful to plan an intervention to improve adherence.

2.13 References

Aas, A., Bergstad, I., Thorsby, P., Johannesen, Ø., Solberg, M., & Birkeland, K. (2005). An intensified lifestyle intervention programme may be superior to insulin treatment in poorly controlled type 2 diabetic patients on oral hypoglycaemic agents: Results of a feasibility study. Diabetic Medicine, 22(3), 316-322.

American Diabetes Association (ADA). (2004). Clinical Practice Recommendations. Diabetes Care, 27, S1-S78.

American Dietetic Association; Position of the American Dietetic Association (1999). Medical nutrition therapy and pharmacotherapy. Journal of American Dietetic Association, 99(2), 227-230.

Anderson, S.A. (1988). Guidelines for use of dietary intake data. Journal of American Dietetic Association., 88(10), 1258-1260.

Barnard, N., Scialli, A. R., Bertron, P., Hurlock, D., & Edmonds, K. (2000). Acceptability of a therapeutic low-fat, vegan diet in premenopausal women. Journal of Nutrition Education, 32(6), 314-319.

Barnard, N., Gloede, L., Cohen, J., Jenkins, D. J., Turner-McGrievy, G., Green, A. A., et al. (2009). A low-fat vegan diet elicits greater macronutrient changes, but is comparable in adherence and acceptability, compared with a more conventional diabetes diet among individuals with type 2 diabetes. Journal of the American Dietetic Association, 109(2), 263-272.

Barnard, N., Katcher, H. I., Jenkins, D. J. A., Cohen, J., & Turner-McGrievy, G. (2009). Vegetarian and vegan diets in type 2 diabetes management. Nutrition Reviews, 67(5), 255-263.

Berkow, S. E., Barnard, N., Eckart, J., & Katcher, H. (2010). Four therapeutic diets: Adherence and acceptability. Canadian Journal of Dietetic Practice and Research, 71(4), 199-204.

Bingham, S.A (1987). The dietary assessment of individuals: methods, accuracy, new techniques and recommendations. Nutrition Abstracts Review, 57, 705-742.

Boyle, J.P., Honeycut A. A., Narayan K.M., Hoerger T.J, Geiss L.S., et al. (2001). Projection of diabetes burden through 2050: Impact of changing demography and disease prevalence in the US. Diabetes Care, 24, 1936-1940.

Burk, M, Pao, E. (1979). Methodology for large scale surveys of household and individual diets. Home Economics Research Report 40. Department of Agriculture, Wahington D.C., pp 38-66.

Canadian Diabetes Association (CDA). (2008). Clinical Practice Guidelines for the prevention and management of diabetes in Canada. Canadian Journal of Diabetes, 32, S1-S201.

Canadian Diabetes Association (CDA). (2009). An economic tsunami the cost of diabetes in Canada. Available at http://www.diabetes.ca/documents/get-involved/FINAL_Economic_Report.pdf

Carter, R.L., Sharbaugh, C.O., & Stapell, C.A (1981). Reliability and validity of the 24-hour recall. Journal of American Dietetic Association.79(5),542-547.

Christensen, N. K.., Steiner, J., Whalen, J., & Pfister, R. (2000). Contribution of medical nutrition therapy and diabetes self-management education to diabetes control as assessed by hemoglobin A1c. Diabetes Spectrum, 13(2), 72-79.

Codario, R.A. (2009). Type 2 Diabetes, Pre-Diabetes, and the Metabolic Syndrome (2nd edition). Humana Press Inc, New York, p 4.

Cook, A., Pryer, J., & Shetty, P. (2000). The problem of accuracy in dietary surveys. Analysis of the over 65 UK National Diet and Nutrition Survey. Journal of Epidemiological Community Health, 54(8), 611-616.

Coulston, A.M., Hollenbeck, C.B., & Donner, C.C. (1985). Metabolic effects of added dietary sucrose in individuals with noninsulindependent diabetes mellitus (NIDDM). Metabolism. 34, 962-966.

Coyne, T., Olson, M., Bradham, K.., Garcon, M., Gregory, P., & Scherch, L. (1995). Dietary satisfaction correlated with adherence in the modification of diet in renal disease study. Journal of the American Dietetic Association, 95(11), 1301-1306.

DCCT Research Group (Diabetes Control and Complications Trial). (1993). The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. New England Journal of Medicine, 329, 683-689.

DiMatteo, M. R. (2004). Variations in patients' adherence to medical recommendations: A quantitative review of 50 years of research. Medical Care, 42(3), 200-209.

Dodd, K.W., Guenther, P.M., Freedman, L.S., Subar, A.F., Kipnis, V., Midthune, D, Tooze, J.A., & Krebs-Smith, S.M. (2006). Statistical methods for estimating usual intake of nutrients and foods: a review of the theory. Journal of American Dietetic Association. 106(10), 1640-1650.

Eilat-Adar, S., Xu, J., Zephier, E., O'Leary, V., Howard, B. V., & Resnick, H. E. (2008). Adherence to dietary recommendations for saturated fat, fiber, and sodium is low in American Indians and other US adults with diabetes. Journal of Nutrition, 138(9), 1699-1704.

Fagerli, R. A., Lien, M. E., & Wandel, M. (2005). Experience of dietary advice among Pakistani-born persons with type 2 diabetes in Oslo. Appetite, 45(3), 295-304.

Frank, H., Jeremiah, F. (2008). Diabetes Self-Defense. R&R Graphics Inc, Denver. P 11.

Franz, M. J., Monk, A., Barry, B., McClain, K., Weaver, T., & Cooper, N. (1995). Effectiveness of medical nutrition therapy provided by dietitians in the management of non-insulin-dependent diabetes mellitus: A randomized, controlled clinical trial. Journal of the American Dietetic Association, 95(9), 1009-1017.

Franz, M.J., Bantle, J. P., Beebe, C. A., Brunzell, J. D., Chiasson, J. L., Abhimanyu, G., et al. (2002). Evidence-based nutrition principles and recommendations for the treatment. Diabetes care 25(1), 148-198.

Friedenreich, C M ., Slimani, N., & Riboli, E. (1992). Measurement of past diet: Review of previous and proposed methods. Epidemiologic Reviews, 14, 177-196.

Glasgow, R. E., McCaul, K. D., & Schafer, L. C. (1986). Barriers to regimen adherence among persons with insulin-dependent diabetes. Journal of Behavioral Medicine, 9(1), 65-77.

Goldhaber-Fiebert, J. D., Goldhaber-Fiebert, S. N., Tristán, M. L., & Nathan, D. M. (2003). Randomized controlled community-based nutrition and exercise intervention improves glycemia and cardiovascular risk factors in type 2 diabetic patients in rural Costa Rica. Diabetes Care, 26(1), 24-29.

Goldstein, B.J., Dirk, M.W. (2007). Type 2 Diabetes; Principles and Practice (2nd edition). Informa Healthcare USA Inc, Ney York, pp 13-14.

Haynes, R.B., Taylor, D.W., & Sackett, D.L. (1979). Compliance in health care. Johns Hopkins Press, Maryland, pp 2-3.

Holm, L., Hoff, A., Erichsen, L., Møhl, M., Toubro, S., & Astrup, A. (2008). Social and cultural acceptability of fat reduced diets among Danish overweight subjects: High-protein versus high-carbohydrate diets. Food Quality and Preference, 19(1), 43-50.

James, D. (2004). Factors influencing food choices, dietary intake, and nutrition-related attitudes among African Americans: Application of a culturally sensitive model. Ethnicity and Health, 9(4), 349-367.

Jellish, W.S., Emanuele, M.A., & Abraira, C (1984). Graded sucrose/carbohydrate diets in overtly hypertriglyceridemic diabetic patients. American Journal of Medicine, 77,1015-1022.

Jimenez-Cruz, A., Bacardi-Gascon, M., Turnbull, W. H., Rosales-Garay, P., & Severino-Lugo, I. (2003). A flexible, low-glycemic index Mexican-style diet in overweight and obese subjects with type 2 diabetes improves metabolic parameters during a 6-week treatment period. Diabetes Care, 26(7), 1967-1970.

Kahn, H.A., Whelton, P.K., Appel, L.J., Kumanyika, S.K., Meneses, J.L., Hebert P.R., & Woods, M (1995). Validity of 24-hour dietary recall interviews conducted among volunteers in an adult working community. Annals of Epidemiology. 5(6), 484-489.

Karvetti, R.L., & Knuts, L.R (1985). Validity of the 24-hour dietary recall. Journal of American Dietetic Association. 85(11), 1437-1442.

Kavanagh, D., Gooley, S., & Wilson, P. (1993). Prediction of adherence and control in diabetes. Journal of Behavioral Medicine, 16(5), 509-522.

Kulkarni, K., Castle, G., Gregory, R., Holmes, A., Leontos, C., Powers, M., et al. (1998). Nutrition practice guidelines for type 1 diabetes mellitus positively affect dietitian practices and patient outcomes. Journal of the American Dietetic Association, 98(1), 62-70.

Lawton, J., Ahmad, N., Hanna, L., Douglas, M., Bains, H., & Hallowell, N. (2008). 'We should change ourselves, but we can't': Accounts of food and eating practices amongst British Pakistanis and Indians with type 2 diabetes. Ethnicity & Health, 13(4), 305-319.

Look AHEAD Research Group. (2010). Long-term effects of a lifestyle intervention on weight and cardiovascular risk factors in individuals with type 2 diabetes mellitus: Four-year results of the Look AHEAD trial. Archives of Internal Medicine, 170(17), 1566-1577.

Mayer-Davis, E. J., D'Antonio, A. M., Smith, S. M., Kirkner, G., Levin Martin, S., Parra-Medina, D., et al. (2004). Pounds off with empowerment (POWER): A clinical trial of weight management strategies for black and white adults with diabetes who live in medically underserved rural communities. American Journal of Public Health, 94(10), 1736-1742.

Nelson, K. M., Reiber, G., & Boyko, E. J. (2002). Diet and exercise among adults with type 2 diabetes. Diabetes Care, 25(10), 1722-1728.

Neuhouser, M. L., Miller, D. L., Kristal, A. R., Barnett, M. J., & Cheskin, L. J. (2002). Diet and exercise habits of patients with diabetes, dyslipidemia, cardiovascular disease or hypertension. Journal of the American College of Nutrition, 21(5), 394-401.

Nevenka, V.R., Goranka,P., Millica,K., et al. (2004). Obstacles which patients with Type 2 Diabetes meet while adhering to the therapeutic regimen in everyday life: Qualitative study. Croatian Medical Journal, 45(5), 630-636

Ohinmaa A, Jacobs P, Simpson S & Johnson JA. (2004). The projection of prevalence and cost of diabetes in Canada: 2000 to 2016. Canadian Journal of Diabetes, 28 (2), 116- 123.

Rivellese, A., Boemi, M., Cavalot, F., Costagliola, L., De Feo, P., Miccoli, R.. et al. (2007). Dietary habits in type II diabetes mellitus: How is adherence to dietary recommendations? European Journal of Clinical Nutrition, 62(5), 660-664.

Rutishauser, I.H. (2005). Dietary intake measurements. Public Health Nutrition 8(7A), 1100-1107.

Sanmartin, C., & Gilmore, J. (2008). Diabetes: Prevalence and care practices. Statistics Canada, catalogue no. 82-003-XPE. Health Reports, 19 (3), 1-5.

Schlundt, D. G., & McFall, R.M. (1987). Classifying social situations: a comparison of five methods. Behaviour Assessment, (9), 21-42

Schlundt, D. G., Rea, M. R., Kline, S. S., & Pichert, J. W. (1994). Situational obstacles to dietary adherence for adults with diabetes. Journal of the American Dietetic Association, 94(8), 874-879.

Sempos, C.T., Flegal, K.M., Johnson, C.L., Loria, C.M., Woteki, C.E., Briefel, R.R., et al. (1993). Issues in the long-term evaluation of diet in longitudinal studies. Journal of Nutrition, 123(2), 406-412.

Story, L., Anderson, J. W., Chen, W. J., Karounos, D., & Jefferson, B. (1985). Adherence to high-carbohydrate, high-fiber diets: Long-term studies of non-obese diabetic men. Journal of the American Dietetic Association, 85(9), 1105-1110.

The Diabetes and Nutrition Study Group of the Spanish Diabetes Association (GSEDNu). (2006). Diabetes nutrition and complications trial: Adherence to the ADA nutritional recommendations, targets of metabolic control, and onset of diabetes complications: A 7-year, prospective, population-based, observational multicenter study. Journal of Diabetes Complications, 20(6), 361-366.

Thompson, F. E., & Subar, A. (2001). Dietary assessment methodology. Nutrition in the Prevention and Treatment of Disease, Academic press, San Diego, pp 2 -39

Toeller, M., Buyken, A., Heitkamp, G., Milne, R., Klischan, A., & Gries, F. A. (1997). Repeatability of three-day dietary records in the EURODIAB IDDM complications study. European Journal of Clinical Nutrition, 51(2), 74-80.

Toobert, D. J., Glasgow, R. E., Strycker, L. A., Barrera, M., Radcliffe, J. L., Wander, R. C., et al. (2003). Biologic and quality-of-life outcomes from the Mediterranean lifestyle program. Diabetes Care, 26(8), 2288-2293.

Travis, T. (1997). Patient perceptions of factors that affect adherence to dietary regimens for diabetes mellitus. The Diabetes Educator, 23(2), 152-156.

U.K. Prospective Diabetes Study (UKPDS). (1990). Response of fasting plasma glucose to diet therapy in newly presenting type II diabetic patients. Metabolism 39, 905–912.

U.K. Prospective Diabetes Study Group (UKPDS). (1998). Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes. Lancet, 352, 837-853.

Vijan, S., Stuart, N., Fitzgerald, J., Ronis, D., Hayward, R., Slater, S., et al. (2005). Barriers to following dietary recommendations in type 2 diabetes. Diabetic Medicine, 22(1), 32-38.

Wild, S., Roglic, G., Green, A., Sicree, R., & King H. (2004). Global prevalence of diabetes: Estimates for the year 2000 and projection for 2030. Diabetes Care, 27 (5), 1047-1053.

Willett, W. (1998). Nutritional Epidemiology (2nd edition). Oxford University Press, New York, pp 50-74.

Williamson, A. R., Hunt, A. E., Pope, J. F., & Tolman, N. M. (2000). Recommendations of dietitians for overcoming barriers to dietary adherence in individuals with diabetes. The Diabetes Educator, 26(2), 272-279.

Wolf, A. M., Conaway, M. R., Crowther, J. Q., & Hazen, K. Y. (2004). Translating lifestyle intervention to practice in obese patients with type 2 diabetes. Diabetes Care, 27(7), 1570-1576.

Chapter 3: Study Design, Recruitment, Development of Questionnaires and Methods

3.1 Introduction

Healthy eating is vital in diabetes management. Nutrition therapy guidelines outlined by the CDA (CDA, 2008) provide diabetes patients with a wide variety of food choices to make. However, the ability to consistently choose appropriate foods on a long term basis is lacking in a majority of diabetes patients, although some people are successfully able to adapt to the recommended diet (Resnick et al., 2006; Thanopoulou et al., 2004). In order to modify or improve diet-related behaviours, it becomes essential to assess the current dietary pattern and understand whether the diets recommended to diabetes patients are considered as acceptable by them or not. In this way, existing nutritional issues can be identified and considered for future modifications.

This chapter describes the questionnaires used in this study to assess dietary adherence and acceptability of prescribed dietary recommendations. It also summarises the study design, recruitment, data entry and statistical analysis.

3.2 Recruitment of Study Participants

This study was cross-sectional and involved the recruitment of 80 participants with type 2 diabetes.

3.2.1. Inclusion Criteria:

The inclusion criteria for this study were as follows: over 18 years of age, diagnosed with type 2 diabetes (self-identified).

3.2.2. Exclusion Criteria:

Participants were excluded if they had any digestive conditions that could confound dietary intakes, or were unable to read and write English.

3.2.3. Recruitment:

Eighty participants were recruited through posters on public bulletin boards around Edmonton, newspaper advertisements, a newspaper article in the local daily newspaper and through a television interview inviting participants. Individuals willing to take part in the study contacted the study coordinators either by phone or email. This initial contact included a brief description of the study and the inclusion criteria. The expected time commitment was explained, after which interested participants were scheduled to attend a data collection session.

3.2.4. Ethical Review and Informed Consent:

This study was approved by Health Research Ethics Board, University of Alberta. Written informed consent was obtained from all participants.

3.3. Study Design

3.3.1. Information and Data Collection Session:

All recruited participants were asked to attend an information and data collection session held at the Human Nutrition Research Unit (HNRU) at University of Alberta. The duration of the session was approximately two and a half hours. Each participant was given a study-specific identification number and provided with a package containing an information sheet (Appendix B), two informed consent forms (Appendix C), an anthropometric measurement sheet (Appendix D), a series of questionnaires (Appendices E-M) and a three-day food

record sheet (Appendix N). The package also contained an aid for determining serving sizes (Appendix O) and a stamped and addressed envelope to return materials by mail.

During the session a Powerpoint-assisted presentation was made by one of the study coordinators where a brief introduction about the PANDA project was given. This was followed by obtaining signed informed consent forms from participants willing to take part in the study. After that participants filled in the eight different questionnaires (Appendix E to Appendix M, see description below, Section 3.3.1a). Concurrently one participant at a time was taken for anthropometric measurements. After completion of questionnaires, participants were instructed on how to complete the three day food record (Appendix N) using illustrations of serving sizes in PowerPoint and plastic food models. They were provided with a snack at the end of the information session and asked to record that as a practice on a sample food record sheet.

3.3.2. Three-Day Food Record and Follow-up:

Participants were contacted by email or telephone to remind them to complete the three-day food record two weeks after their data collection session. The completed three-day food record was returned to the study coordinator by mail using a stamped and addressed envelop supplied with the study materials. Each food record was checked by the study coordinator to identify any missing information. Some of the commonly missed information included brand names, quantity of vegetables added in a recipe and in salads, size of a fruit (large, medium or small), type of cheese, and portion size consumed per meal (while

portion size of a recipe prepared was mentioned). Participants were telephoned to collect missing details and to clarify data entries that may have been incorrect.

3.4 Questionnaires

3.4.1. Socio-demographic Questionnaire

This questionnaire included items for age, gender, education, employment, number of people in household and household annual income. Questions were developed based on the Canadian Community Health Survey (Statistics Canada, 2005; 2007).

3.4.2. General Health and Diabetes Related Information

This questionnaire contained questions on diabetes related variables such as duration of diabetes, medications used, treatment plan and presence of co-morbidities. This was adapted from a previous study conducted by the research group (Tomoe Watanabe & Rhonda Bell, unpublished data) at University of Alberta.

3.4.3. Self-care Activities and Diabetes Treatment Questionnaire

This survey was developed based on the summary of self-care recommendations outlined by Toobert, Hampson & Glasgow (2000). This questionnaire determines whether participants have received any advice and are aware of the self-care activities that they are expected to follow to maintain optimal blood sugar. Recommendations made by the participant's health care team on four aspects of self care activities including diet, physical activity, medications and blood glucose monitoring were queried. The questionnaire was modified to take into account the CDA guidelines. For example, the number of

fruits and vegetables servings was modified from 5 servings to 7 servings, and a low glycemic index diet option was included along with a diet including complex carbohydrates. No modifications were made to other 3 components.

3.4.4. Physical Activity Adherence

The amount of time spent on strenuous, moderate and mild physical activity over a period of one week was measured using the self report questionnaire developed by Godin & Shephard (Godin & Shephard, 1985).

3.4.5. Perceived Dietary Adherence

Perceived dietary adherence was assessed using a questionnaire adapted from Toobert, Hampson & Glasgow (2000). The instrument was modified according to Nutrition Therapy guidelines of the CDA (2008). These guidelines emphasise that diabetes patients should follow Eating Well with Canada's Food Guide, and also to include low glycemic index foods, high fibre foods, avoid high sugar foods, and include regular use of omega 3 fats and vegetable oils (CDA, 2008). To conform to Canadian guidelines, the recommendation for fruits and vegetables was included separately for men and women, subdivided into different age groups. Additional questions were structured to cover low GI foods, high fibre foods, high sugar foods, carbohydrate spacing, omega-3 fats and healthy oils such as canola, walnut, olive or flax oil. In total the questionnaire consisted of ten questions focusing on consumption of the recommended food groups over the previous seven days. Responses were based on a seven-point Likert scale.

3.4.6. Food Acceptability

This questionnaire was used to understand whether the foods that are recommended are considered acceptable by diabetes patients. Here both personal and cultural acceptability was measured. Questions pertaining to personal food acceptability were framed to assess the frequency of consuming, buying and enjoying recommended and non-recommended foods over a period of one week. To assess cultural acceptability of recommended diets, questions were structured to ask the frequency of including ethnic and non-ethnic heritage foods, and whether they had changed the frequency of consuming ethnic heritage foods after they had been diagnosed with diabetes. All the questions in this questionnaire were based on the conceptual framework outlined by Jastran et al (Jastran et al., 2009).

3.4.7. Three-day Food Record

A three-day food record was used to assess self-reported actual adherence to nutrition recommendations while perceived adherence was measured using a questionnaire (see Section 3.4.5). This method provides detailed information on nutrient intake and is reliable at capturing the usual intake of respondents (Bingham, 1987; Friedenreich et al., 1992; Rutishauser, 2005). Participants were assigned days to record their food intake which included a weekend day and two weekdays. Participants were also instructed not to change their routine eating habits during those three days. To obtain the appropriate nutrient values, the portion size of foods, method of cooking and brand names of each food were recorded as instructed during the information session. This allowed matching the

exact food or foods with nutrient values from the Food Processor Software SQL (version 10.5) so far as possible.

3.4.8 Questionnaire Pretesting

All the questionnaires developed were pretested with student volunteers from the University of Alberta. Based on their feedback, complicated or confusing questions were rephrased to make it simpler for participants.

3.4.9 Other Questionnaires

Appendices K through M were administered but will not be discussed in this thesis.

3.5. Anthropometric Measures and Blood Sampling

Anthropometric assessment of each participant included height, weight, waist and hip circumference measurements, and calculation of BMI. To measure height and weight participants were asked to wear light clothing and remove their shoes. Height was measured with the participant standing against a wall-mounted stadiometer. Weight was measured using a digital scale (Stand-on-scale). BMI was calculated using the formula height squared (m^2) divided by weight (kg). Study coordinators were trained by a PhD candidate from University of Alberta to measure waist and hip circumference. The protocol for these measurements is in Appendix P. The waist-hip ratio was obtained using these measurements. All measurements were taken in triplicate and averaged. Hemoglobin A1C values were obtained using an autoanalyser (DCA 2000+, Michigan Laboratory Systems) from a blood sample obtained by the finger prick method.

3.6 Data entry

All the questionnaires were coded before entering them in spreadsheet or statistical software programs. For “Yes” or “No” response type of questions a zero was given for a negative response and one for a positive response. For most of the other categorical response type of questions such as education, frequency of choosing recommended foods etc., values were assigned starting from 0 in ascending order. For categorical questions with options of “very unlikely” to “likely” or from “decreased” to “increased” with a “neutral” response included, responses were coded as -1, 0 and 1. All data collected from questionnaires were entered in SPSS software version 17 by trained student volunteers or the study coordinator. Three-day food record data were entered into Food Processor software SQL and nutrient intake was calculated according to the Canadian Nutrient Data File (2007). Food record data entry was done according to the protocol developed by the Alberta Pregnancy related Outcomes and Nutrition (APRON) study group (Appendix Q). Any food records that did not contain sufficient information to obtain nutrient intake and that missed a day’s intake or several meals of the day were excluded from the analysis. Data entered from questionnaires and food records were checked for accuracy by study coordinators.

3.7 Data Analysis:

3.7.1. Adherence Assessment

Dietary adherence was assessed using two different methods discussed below.

3.7.1.1. Perceived Adherence Score

The score for items in which having a high score was undesirable was inverted, i.e. 1 became 7 and vice versa. A total perceived adherence score was obtained from the dietary adherence questionnaire by summing up the answers from all ten questions. The score obtained by this method range from zero to a maximum of 67. This score quantified the extent to which individuals perceived themselves adhering to dietary recommendations. A higher score indicated a higher perceived adherence to diet recommendations.

3.7.1.2. Actual Adherence Score:

Actual nutrient intake of participants obtained from three day food records was used to calculate this score. The actual adherence score was developed including percent of calories from carbohydrate, protein, total fat, saturated fat, MUFA, PUFA and sugar, total cholesterol, total fibre and sodium intakes. Intake of these 10 nutrients was compared to the CDA Clinical Practice Guidelines recommendations. A score of 1 was given to participants who met nutrient recommendations. Participants whose average intake was above or below the nutrient recommendations were given a score of 0. Scores from the 10 nutrients plus total energy intake were added to get and "actual adherence score". Compliance with recommended total energy intake was measured by comparing it against the Estimated Energy Requirements (EER). To obtain a score of 1, up to 5% difference between total energy and EER was allowed. EER was calculated individually using the Harris Benedict equation (Harris & Benedict, 1919) to get the Basal Metabolic Rate (BMR); it was then multiplied by the physical activity

coefficients. Benedicts equation was reported to be a valid method to estimate calorie requirements (da Rocha et al., 2005; Frankenfield et al., 1998). Activity level of each participant was obtained from the physical activity questionnaire based on the reported frequency of involvement in different activity levels (Strenuous, moderate and mild physical activity). Activity coefficients were then chosen according to their physical activity level (McArdle et al., 1996). Coefficients (Table 3.1) and the Harris Benedict equation are listed at the end of this section.

3.7.1.3: Perceived vs Actual Adherence

Association between perceived and actual adherence was identified by performing two simple correlation analyses. i) In the first analysis overall perceived adherence score was compared against the three-day mean intake of nutrients obtained from the food record. ii) In the second method, to make relevant comparisons of data from the food record to the questionnaire, eight groups were chosen to match the questions or food groups as given in the perceived adherence questionnaire. Actual adherence to eight components was calculated by looking at participant's food record individually. The eight groups include: recommended servings of fruits and vegetables, low GI foods, high sugar foods, fibre rich foods, carbohydrate spacing, omega 3 rich foods, olive/canola oil and fat rich foods. If the participant had included any of these foods during the day they were given a code of one and zero if they did not include them. Likewise the data was obtained from days 1, 2 and 3 of the food record. To compare these

data to perceived adherence, the mean of three days was converted to seven days by using a simple arithmetic calculation.

3.7.1.4. Food Acceptability Questionnaire:

Each question from the food acceptability questionnaire was analysed separately using descriptive statistics because the questions focused on different dimensions such as willingness to buy, cook and eat recommended foods, basic awareness about their recommended foods such as beneficial foods and foods to be avoided. To know the overall acceptability of recommended foods, the food acceptability score was obtained by summing up the answers of eight questions (questions 2, 4-9 and 11 of the food acceptability questionnaire) for each participant. These questions correspond to a participant's willingness to buy and cook recommended foods, frequency of enjoyment eating recommended foods and ethnic foods. The scores obtained range from 0-41. A higher score indicated greater acceptability of recommended foods.

All data from the other questionnaires were analysed using descriptive statistics and are presented as mean ± SD, unless specified otherwise.

3.7.2. Simple Correlations

Pearson's correlation analysis was performed to examine the relationships between socio-demographic data, anthropometry variables and A1C versus dietary adherence or food acceptability. Similarly Pearson's correlation analysis was conducted to compare perceived and actual adherence data. A p-value of 0.05 was considered statistically significant.

3.7.3. Multivariate Analyses

Multiple linear regression models were applied to assess the association between dietary adherence and food acceptability to A1c. A1c was assigned as the dependent continuous variable. Dietary adherence score, food acceptability score and other potential covariates relating to dietary glycemic control were assigned as the independent variables. The covariates included in the model were gender, age, BMI, income, physical activity, duration of diabetes and diabetes treatment. A p-value of <0.05 was required to consider an association to be significant.

Harris Benedict Equation (Harris & Benedict, 1919) to calculate EER

Male: EER = [66.47 + 13.75 x weight (kg) + 5 x height (cm) - 6.76 x age (yrs)] x PA coefficient

Female: EER = [655.1 + 9.56 x weight (kg) + 1.85 x height (cm) - 4.68 x age (yrs)] x PA coefficient

Table 3.1: Physical Activity coefficients (PA) McArdle (1996)

Activity level	Physical Activity Coefficients
Sedentary	1.2
Mild	1.375
Moderate	1.55
Active	1.725

3.3.1.a List of Appendices

Appendix A: Recruitment poster
Appendix B: Information Sheet
Appendix C: Consent form
Appendix D: Anthropometric assessment sheet
Appendix E: Socio-demographic questionnaire
Appendix F: General health and diabetes related information
Appendix G: Self-care activities and diabetes treatment questionnaire
Appendix H: Physical activity adherence questionnaire
Appendix I: Dietary adherence questionnaire
Appendix J: Food acceptability questionnaire
Appendix K: Accessibility to food and food resources questionnaire
Appendix L: Food availability questionnaire
Appendix M: Food-related time use for diabetics and household members
Appendix N: Three-day food record sheet
Appendix O: Serving size sheets
Appendix P: Measurements
Appendix Q: Protocol for entering three day food records data (from APRON).

3.8 References

Bingham, S. A. (1987). The dietary assessment of individuals: methods, accuracy, new techniques and recommendations. Nutrition Abstracts Reviews, 57, 705-742.

Canadian Diabetes Association (CDA). (2008). Clinical Practice Guidelines for the prevention and management of diabetes in Canada. Canadian Journal of Diabetes, 32, S1-S201.

Friedenreich, C M, Slimani, N., & Riboli, E (1992). Measurement of past diet: Review of previous and proposed methods. Epidemiologic Reviews, 14, 177-196.

Godin, G., & Shephard, R. J. (1985). A simple method to assess exercise behavior in the community. Canadian Journal of Applied Sport Sciences. 10(3), 141-146.

Harris, J. A., & Benedict, F. G. (1919). A biometric study of basal metabolism in man. Carnegie Institution of Washington, Washington, p 227.

Jastran, M. M., Bisogni, C. A., Sobal, J., Blake, C., & Devine, C. M. (2009). Eating routines, embedded, value based, modifiable, and reflective. Appetite, 52(1), 127-136.

McArdle.,William, D., Frank, K., & Victor, K. (1996). Exercise Physiology: Nutrition, Energy and Human performance (4th edition). Lippincott Williams and Watkins, Baltimore, pp 642-649.

Resnick, H. E., Foster, G. L., Bardsley, J., & Ratner, R. E. (2006). Achievement of American Diabetes Association clinical practice recommendations among US adults with diabetes, 1999–2002. Diabetes Care, 29(3), 531-537.

Rutishauser, I.H., (2005). Dietary intake measurements. Public Health Nutrition 8(7A): pp 1100-1107.

Statistics Canada. (2005). Population health surveys: Canadian Community Health Survey (CCHS). Retrieved January 21, 2008. Available at http://www.statcan.gc.ca/concepts/hs-es/index-eng.htm.

Statistics Canada. (2007). Canadian Community Health Survey Cycle 2.2, Nutrition (2004): Income-related household food security in Canada. Ontario: Health Canada.

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.

Thanopoulou, A., Karamanos, B., Angelico, F., Assaad-Khalil, S., Barbato, A., Ben, M. D., et al. (2004). Nutritional habits of subjects with type 2 diabetes mellitus in the Mediterranean basin: Comparison with the non-diabetic population and the dietary recommendations. Multi-centre study of the Mediterranean group for the study of diabetes (MGSD). Diabetologia, 47(3), 367-376.

Chapter 4 Results

A total of 80 participants were recruited for this study. These 80 participants completed all the questionnaires and 48 out of these 80 participants completed all questionnaires and the three-day food record. The results reported here are based on 80 and 48 participants assessed for questionnaires and food record separately.

4.1 Anthropometric Information, Demographics and General Health Information

Participants had a mean (SD) age of 61.2 (10.4) years and 60% of them were female. The average BMI was 32.6 (7.3) kg/m^2, placing this group in the obese category. Waist circumferences were 110.7 (23.1) cm for men and 99.8 (15.1) cm for women (Table 4.1). The majority of the participants were white, had been diagnosed with Type 2 diabetes more than 8 years and average hemoglobin A1C was 7.3 (1.3) %. Lifestyle modification plus OHA were used by 65% of participants to treat their diabetes. Fifty percent of participants reported having hypertension and 50% had hypercholesterolemia while 2.5% had renal disorders. Approximately 60% of participants reported having arthritis and 88% of participants reported having more than one chronic condition. Around 53% percent of participants were lifetime non-smokers and 10% of them currently smoked (Table 4.2).

About three-fourths of the participants had at least completed some college or university, 37.5% were retired and 40% were employed or self-

employed as a source of income. Five out of 80 reported being in the lowest annual household income category (<$20,000), and the proportion of participants in every other income category, ranging from >$21,000 to >120,000, were similar (~15%) (Table 4.2).

Table 4.1: Anthropometrics and diabetes related information of participants [1]

	Mean ± SD	**Range**
Age		
Total	61.2 ± 10.4	38-84
Male	61.9 ± 10.7	38-84
Female	60.7 ± 10.3	40-82
Gender		
Male	32	
Female	48	
Height (cm)	166 ± 9.8	
Weight (kg)	91.1 ± 25.8	
BMI (kg/m2)		
Total	32.6 ± 7.3	20.2-73.2
Male	33.9 ± 9.1	24.5-73.2
Female	31.6 ± 5.8	20.2-47.7
Waist circumference (cm)		
Total	104.2 ± 19.4	69.2-190.4
Male	110.7 ± 23.1	82.5-190.4
Female	99.8 ± 15.1	69.0-130.0
Hip circumference (cm)		
Total	108.4 ± 15.1	85.2-186.4
Male	109.0 ± 18.0	90.3-186.4
Female	108.0 ± 12.9	85.2-148.8
Waist hip ratio		
Total	1.0 ± 0.1	0.8-1.3
Male	1.0 ± 0.09	0.9-1.3
Female	0.9 ± 0.07	0.8-1.1
Duration of diabetes (years)	8.5 ± 7.1	0.08-35
Hemoglobin A1C, %	7.3 ± 1.3	5.4-11.2

[1] n =80

Table 4.2: Demographic and general health information of participants [1]

	N	%
Diabetes treatment		
Lifestyle	7	8.8
Lifestyle + OHA	52	65.0
Lifestyle + insulin	10	12.5
Lifestyle + OHA + insulin	6	7.5
Chronic illness[2]		
Heart trouble	13	16.3
High blood pressure	40	50
High cholesterol	40	50
Arthritis	49	61.3
Renal problem	2	2.5
Ethnicity		
White	65	81.3
Latin American	1	1.3
Black	2	2.5
Chinese	1	1.3
Filipino	1	1.3
Aboriginal	2	2.5
South Asian	6	7.5
Other	2	2.5
Education		
Less than high school	4	5
High school graduate	15	18.8
Some college or university	14	17.5
College university or above	47	58.8
Employment [2]		
Wages and salaries	29	36.3
Income from self - employment	9	11.3
Retirement income	30	37.5
Unemployed	1	1.3
Other	3	3.8
Smoking		
Non smoker	42	52.5
Current, regular smoker	8	10
Occasional smoker	1	1.3
Former smoker	29	37.2

Household annual income		
≤ $ 20,999	4	5
$ 21,000 to $39,999	11	13.8
$ 40,000 to $ 59,999	12	15.0
$ 60,000 to $ 79,999	13	16.3
$ 80,000 to $ 99,999	11	13.8
$ 100,000 to $ 119,999	7	8.8
≥ $ 120,000	13	16.3

[1] n =80, [2] More than one response was possible

Table 4.3 Socio-demographics, A1C and dietary adherence score of completers and non completers

	Completers (n=48)	Non completers (n=32)
Age, y	61 ± 11	62 ± 9
BMI, Kg/m^2	32 ± 5.4	31.2 ± 5.4
Ethnicity, %		
White	68.6	76.9
South Asian	5.9	7.7
Black	6.8	3.8
Others	2.0	3.8
Education, %		
Less than high school	3.4	3.9
High school	18.3	19.6
College	40.2	37.8
University	38.1	36.7
Annual household Income, %		
<$60,000	52.3	46
≥$60,000	35.7	42.2
Employment, %		
Wages and salaries	27.5	38.5
Retirement	41.2	23.1
Income from self employment	3.9	19.2
Others	2.0	7.7
A1C	7.2 ± 1.1	7.6 ± 1.7
Mean perceived dietary adherence score	41.3	36.2

Table 4.3 describes the socio-demographic, perceived dietary adherence score and A1c of study participants who completed the questionnaires and 3 day food record (completers) and those who completed only the questionnaires (non-completers). Completers and non-completers were similar in age (61 ± 11 vs. 62 ± 9) and BMI (32 kg/m^2 ± 5.4 vs. 31.2 kg/m^2 ± 5.4). Seventy-eight percent of completers completed college or university and 74.5 % of non completers were college or university graduates. Approximately 41% of completers and 21.3% of non-completers were retired. Mean A1C of completers was 7.2 ± 1.1 and of non-completers was 7.6 ± 1.7; A1C did not differ significantly between these two groups ($p>0.19$). Mean perceived dietary adherence score of completers (41.3) was slightly higher than non completers respondents (36.2) but this difference was not statistically significant ($p>0.37$).

4.2. Diabetes Self-Care:

Table 4.4 summarises the self-care components that were recommended to participants by their health care team.

4.2.1. Diet

All participants had received some dietary advice from their health care team. The primary focus was to follow Canada's Food Guide, which was advised for about 98% of participants. Other frequent dietary recommendations reported by participants included increasing fibre intake, lowering dietary fat intake and including more fruits and vegetables in the diet.

4.2.2. Physical Activity:

Similar to dietary advice, the results show that all participants had been advised to undertake some form of regular physical activity. More than half of the participants had been advised to incorporate physical activity into their daily routine and to consider exercising 30 minutes per day for at least five days in a week.

4.2.3.. Blood glucose monitoring:

The predominant advice for glucose monitoring was to use a finger prick and glucometer whereas a finger prick and colour chart method was suggested to 20% of participants.

4.2.4. Medications:

The majority of the participants (>75%) were advised to take OHA and one-fifth was prescribed insulin.

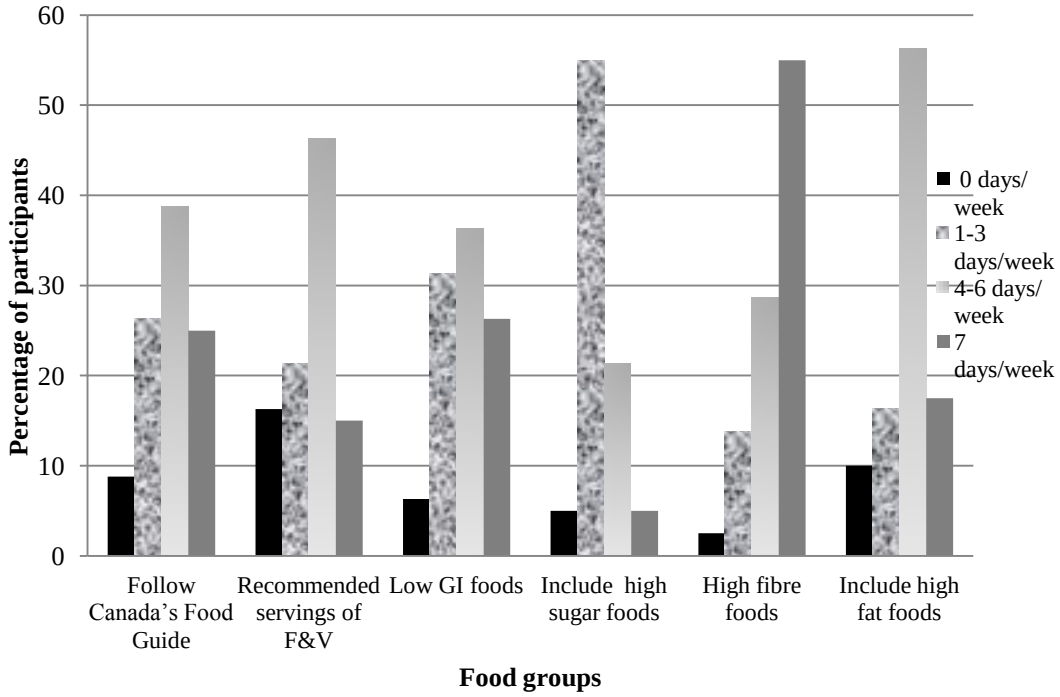
Table 4.4: Components of self care activities recommended to participants.

Diet	**Percent of cases**	**Physical activity**	**Percent of cases**
Follow Canada's Food Guide	94.7	Regular physical activity	93.6
Include Complex CHO[1]/Low GI[2]foods	40.8	PA incorporated into daily routine	66.7
Reduce caloric intake	55.3	30 min*5 times/week	55.1
High dietary fibre	76.3	Any specified time	20.5
More fruits and vegetables	71.1	Others	1.3
Less sweets	59.2	No advice	6.4
Avoid fat	73.7		
Others	2.6		
Diet plan not advised	0.0		
Glucose monitoring	**Percent of cases**	**Medications**	**Percent of cases**
Finger prick & Colour chart	19.2	Insulin shot 1 or 2 /day	11.7
Finger prick & Glucometer	88.5	Insulin shot 3 or more/day	10.4
Urine sugar	5.1	Diabetes pills	85.7
Others	1.3	Others	3.9
No advice	1.3	No advice	9.1

[1] CHO (Carbohydrate[), 2] GI (Glycemic Index)

4.3 Perceived adherence

Figure 4.1: Perceived weekly inclusion of food groups and CDA recommendations reported by participants[1]



[1] n=80

Figure 4.1 summarises participants' perceived inclusion of listed food groups and CDA recommendations in their everyday diet on a weekly basis. Only 26.3 % of them reported including low GI foods every day whereas 6.6 % of them reported not including them at all. Only 5 % of participants did not include any sugar rich foods and more than half of them reported including them up to 3 days in a week. Around 80% of participants reported including high fibre foods for more than 4 days a week whereas only 2% did not include them on any day. On the contrary more than half of the participants reported including high fat foods on 4-6 days a week, and around 20% included high fat foods every day. Only 10% of

participants reported not including high fat food at all. Around 65% of them were able to include omega 3 fats up to 3 days in a week.

4.4 Actual Adherence (Three-day Food Record)

Table 4.5: Mean macronutrient intakes of participants who completed all questionnaires and the three-day food record. [1]

Nutrients	Mean ± SD	Range	Recommendations[2]
Calories, kcal	1973 ± 392	995 - 2766	
Fat calories, kcal	614 ± 221	181 - 1060	
SFA calories, kcal	201 ± 82	81 - 432	
Protein, g	89 ± 23	29 - 141	
Protein, %TE	18 ± 3	8 - 27	15-20
Carbohydrate, g	256 ± 53	137 - 378	
Carbohydrate, %TE	53 ± 8	30 - 66	45-60
Fibre, g	29 ± 10	5 - 56	25-50
Sugar, g	89 ± 31	26 - 159	
Fat, g	68 ± 25	20 - 118	
Fat, % TE	31 ± 7	18 - 48	<35
SFA, g	22 ± 9	9 - 48	
SFA, % TE	10 ± 3	4 – 16	<7
MUFA, g	20 ± 10	6 – 49	
MUFA, % TE	9 ± 3	3 – 18	
PUFA, g	10 ± 5	2 – 25	
PUFA, % TE	5 ± 2	2 – 9	<10
Cholesterol, mg	283 ± 147	42 - 643	

[1] n=48
[2]CDA Clinical Practice Guidelines, 2008
SFA, saturated fatty acid; MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid; TE, total energy

Table 4.6: Participants' (n=48) mean intake of vitamins obtained from diet alone and from both diet and supplements.

	Food Only		**Food and Supplements**		**p-value[1]**
Nutrients	Mean ± SD	Range	Mean ± SD	Range	
Vitamin A, IU	860 ± 990	0 - 4710	2519 ± 3611	0 - 19244	0.002
Vitamin B1, mg	1.7 ± 0.5	0.9 - 3.4	15.5 ± 38.4	1.1 - 206.5	0.015
VitaminB2, mg	2.1 ± 0.6	1 - 3.9	12.8 ± 35.8	1.2 - 208.8	0.042
Vitamin B3, mg	20 ± 7	6 - 38	50 ± 89	6 – 58.6	0.025
Vitamin B6, mg	1.9 ± 0.5	0.5 - 3.3	13.1 ± 34.8	0.8 - 212.4	0.026
Vitamin B12, mcg	3.9 ± 1.9	1 - 12	61.9 ± 170.5	1.5 - 1004.6	0.023
Vitamin C, mg	132 ± 63	14 - 248	198 ± 194	30 - 1291	0.013
Vitamin D, IU	169 ± 130	18 -507	760 ± 713	26 - 2716	0.000
Vitamin E, mg	6 ± 4	1 -21	6 ± 4	1 – 21	0.322
Folate, mcg	254 ± 89	64- 509	341± 237	64 - 1425	0.010
Vitamin K, mcg	119 ± 115	5 -519	147 ± 130	14 – 532	0.003
Pantothenic acid, mg	6 ± 2	3 - 10	23 ± 53	4 – 284	0.028

[1]P-value less than 0.05 was considered significant

Mean intake of macronutrients and their contribution to total energy are presented in Table 4.5. Mean energy intake was 1973 ± 392 kcals/day. Mean carbohydrate intake was 256 ± 53 g/day which was 52 ± 8 % of total energy

intake. On average 18 ± 3% of total energy comes from protein with 89 ± 23 g/day as mean intake and 31 ± 7% total energy from fat with daily mean intake of 68 ± 25 g. Mean intakes of sugar, fibre and cholesterol were 89 ± 31 g/day, 28 ± 10 g/day and 283 ±147 mg/day respectively. On average 10 ± 3% of energy was provided by saturated fat.

Table 4.7: Participants' (n=48) mean intake of elements and omega fatty acids obtained from diet alone and from both diet and supplements.

	Food only		**Food and Supplements**		
Nutrients	**Mean ± SD**	**Range**	**Mean ± SD**	**Range**	**p-value[1]**
Calcium, mg	883 ± 298	427 - 1829	1187 ± 558	441 - 2459	0.000
Iron, mg	17 ± 9	8 - 71	21 ± 13	8 – 79	0.002
Magnesium, mg	334 ± 96	117 - 554	377 ± 125	117 - 734	0.001
Manganese, mg	4.0 ± 1.9	0.6 - 8.7	5.8 ± 3.7	1.3 - 17.5	0.000
Phosphorous, mg	1280 ± 379	482 - 2258	1303± 383	482 - 2258	0.015
Potassium, mg	3197 ± 879	1029-5994	3212 ± 885	1029 - 5994	0.079
Sodium, mg	2866± 1194	822 - 5870	n/a	n/a	n/a
Zinc, mg	10.5 ± 3.9	1.6 - 20.7	15.5 ± 8.7	1.6 – 36.8	0.000
Omega-3, g	0.1 ± 0.2	0.0 - 1.2	0.2 ± 0.5	0.0 - 3.0	0.083
Omega-6, g	0.9 ± 1.6	0.0 - 9.2	0.9 ± 1.6	0.0 - 9.2	0.096

[1] P-value of less than 0.05 was considered significant.

n/a, not applicable.

Table 4.8: Supplement use by participants (n=48)

Supplements	**N**	**Percent, %**
Multivitamin and mineral	24	50.0
Vitamin D	27	56.3
Calcium	20	41.7
Iron	2	4.2
Omega-3 and Omega-6 fatty acids	12	25.0

A summary of micronutrient intakes from food, with and without supplements, is presented in Tables 4.6 and 4.7. Mean intakes of the fat soluble vitamins A, D and K, from food were 860 ± 990 IU/day, 169 ± 130 IU/day, and 119 ± 115mcg/day respectively, which were significantly lower than the mean intakes after inclusion of dietary supplements. The average intake of all B-vitamins, folate, vitamin C and pantothenic acid was significantly higher when supplements were included than when food alone was considered. The average intake of vitamin E did not differ when compared between food alone and food plus supplements. A large proportion of participants took supplements to meet daily vitamin requirements. Multivitamin and vitamin D supplement intake was reported by 50% and 56.3% of participants respectively.

Average calcium intake both from food and supplements was significantly higher than the daily mean intake without supplements, with 41.7% reporting taking calcium supplements. Supplements also significantly increased intakes of iron, magnesium, manganese and zinc but not phosphorus or potassium. Being only 25% of participants took omega 3 and omega 6 fatty acid supplements, the

daily average consumption of the two omega fatty acids from food was not significantly affected by supplement intake.

Table 4.9: Participants meeting the recommendations for energy and 10 other nutrients combined (actual adherence score, n=48).

Actual adherence score[1]	Percentage, %
0 or 1	0
2	4.2
3	4.2
4	22.9
5	35.4
6	14.6
7	16.7
8	2.1
9, 10 or 11.0	0

[1] Nutrients included in the actual adherence score: Energy, percent of calories from total carbohydrate, total protein, total fat, saturated fat, MUFA, PUFA and sugar, total cholesterol, total fibre and sodium.

A summary of the total number of recommendations met out of eleven as assessed by the three-days food record is listed in Table 4.9. Less than ten percent met 3 recommendations or fewer. Approximately 75% met 4-6 recommendations. About one fifth of participants were able to meet seven out of eleven recommendations daily. A maximum of 8 nutrient recommendations was met by only 2.1% of participants and none were able to adhere to all nutrient recommendations.

Figure 4.2: Percentage of participants meeting each nutrient recommendation (n=48)

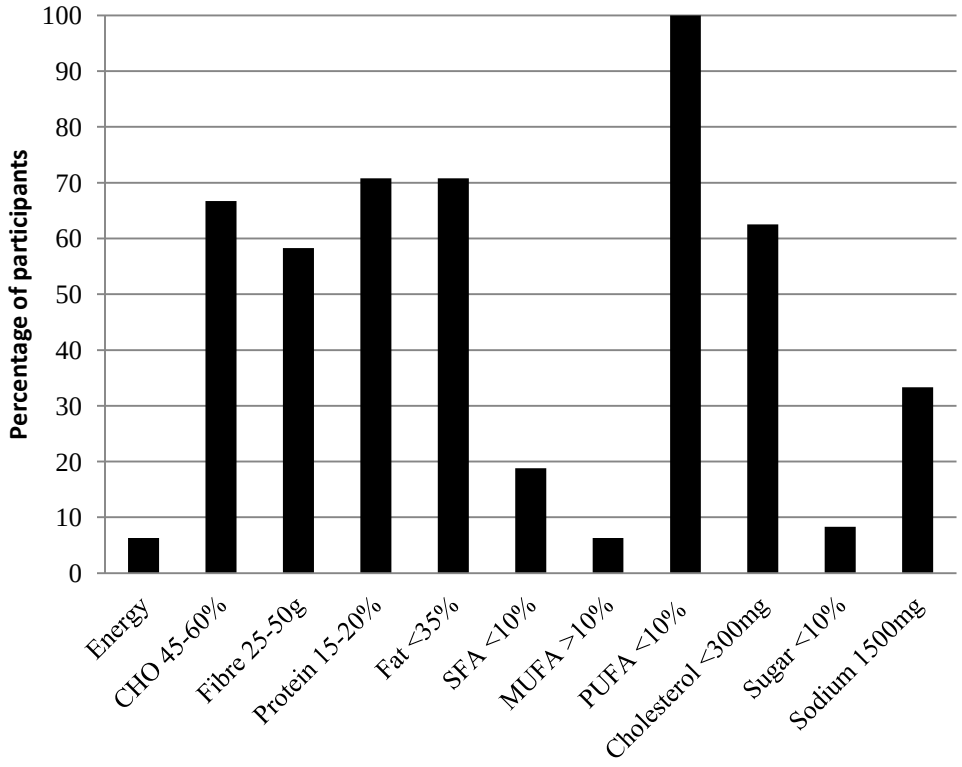


Figure 4.2 summarises the percentage of participants who adhered to individual dietary recommendations. More than half of the participants met the recommendations for carbohydrate, protein, total fat and cholesterol intake. Approximately 60% of participants met the recommendations for fibre intake of 25-50g/day. Eight to ten percent of the participants met the recommendations for total energy, MUFA and sugar intake. Of the total participants, 18.8% met the recommendations for saturated fat and 33.3% met the sodium recommendations.

4.5 Correlations

Pearson correlation analysis were used to identify the strength of relationships between both perceived and actual adherence to anthropometric, socio-demographic variables and A1c; and to identify if perceived adherence (perceived adherence from questionnaire) to the recommended diet plan is different from the diet pattern that was actually followed (actual adherence from three-day food intake).

4.5.1. Perceived adherence vs. anthropometric or socio-demographic variables and A1C

The total perceived dietary adherence score was positively associated with waist circumference ($r=.298$, $p<.005$) and education status ($r=.276$, $p<.05$) and negatively associated with A1c ($r=-.384$, $p<.005$). No associations were observed between total perceived adherence score and gender, age, duration of diabetes or household annual income.

4.5.2. Actual adherence vs. anthropometric or socio-demographic variables and A1C

Participant age was found to be negatively associated with intakes of total calories ($r=-.376$, $p=.008$), carbohydrate ($r=-.290$, $p=.046$), fat ($r=-.328$, $p=.023$), saturated fat ($r=-.318$, $p=.028$), and sodium ($r=-.322$, $p=.026$). Gender and BMI showed no associations with nutrient intake, while waist circumference was positively associated with total fat ($r=.414$, $p=.003$), MUFA ($r=.298$, $p=.040$) and sodium intakes ($r=.425$, $p=.003$). Duration of diabetes was associated with

cholesterol intake (r=.358, p=.013). Unlike perceived adherence scores, no associations were observed between education status and actual intake of nutrients. High intakes of fat (r=.332, p=.021), saturated fat (r=.352, p=.014) and sodium (r=.294, p=.043) were associated with higher A1C values.

4.53 Perceived Adherence vs. Actual Adherence

A summary of associations was generated between individual components of the perceived adherence questionnaire and actual intake data obtained from three-day food record. Higher perceived adherence scores for consumption of the recommended number of servings of fruits and vegetables was associated with higher dietary intake of carbohydrate (r=.415, p=.003), fibre (r=.541, p=.000) and sugar (r=.505, p=.000). Perceived frequency of low GI food consumption was positively correlated with fibre intake (r=.334, p=.021). Perceived adherence to consumption of high sugar foods (ie. infrequent consumption) corresponded to high intake of saturated fat (r=.334, p=.020). Notably, high perceived adherence to consumption of fibre rich foods was associated with high intakes of fibre (r=.487, p=.000) and sugar (r=.315, p=.029). Perceptions towards adherence to carbohydrate spacing recommendations and omega 3 fat intakes were not associated with any of the nutrient intakes recorded in the three-day food records. However a perception of including high fat foods for more number of days/week correlated with higher intakes of fat (r=.356, p=.013) and saturated fat (r=.312, p=.031).

Another correlation analysis was done between perceived adherence and actual adherence after adjustment to an average over 7 days. A significant

negative association existed between fibre and sugar intake (r = -0.449, p=.001). Also higher perceived frequency of including fruits and vegetables was associated with increased usage of canola, walnut, olive or flax oil (r= .336, p=0.02). No other significant associations were found.

4.6 Food Acceptability

Personal and cultural acceptability of foods in the recommended diet are summarised in Tables 4.10, 4.11 and in Figures 4.3-4.5. Sixty percent of participants reported being "very likely" to consume foods that were recommended for diabetes compared with 6.3% who reported it "very unlikely". About 21% said they chose to buy foods that are part of recommended diet every time they shop and 37.5% buy them often while 4.2% do not buy them at all. About 60% percent of participants continued to relish the foods recommended since their diagnosis; however 14.6% expressed that their enjoyment to eat recommended foods had decreased (Fig. 4.3). A tendency to eat non-recommended foods on five to seven days a week was expressed by 21% of participants while more than 50% of them tended to eat non-recommended foods on two days of a week or less (Fig. 4.5a). Half of the participants responded "not applicable" to a question about ethnic heritage as a factor in their dietary patterns. From the half who reported that ethnicity was a factor, 8.3 % consumed foods that were not part of their ethnic heritage every day, but the remaining of the respondents consumed foods from their ethnic heritage at least one day per week (Fig. 4.5b). One fifth of participants believe the situation to eat non-ethnic foods had occurred only after being diagnosed with diabetes.

From the recommendations made by their health care team, over 90% of participants reported being aware of beneficial foods or foods to be avoided to help improve and maintain glycemic control. Yet approximately 58% of participants were unaware of GI values of foods they eat (Table 4.11).

Table 4.10: Summary of responses to the food acceptability questionnaire (n=48).

Food acceptability items	**N**	**Frequency, %**
Likelihood of eating recommended foods regularly:		
Very Unlikely	3	6.3
Neutral	13	27.1
Very Likely	32	66.7
Frequency of buying recommended foods:		
Never	0	0.0
Seldom	2	4.2
Usually	18	37.5
Often	18	37.5
Always	10	20.8
Consumption of locally produced foods:		
Yes	37	77.1
No	1	2.1
Not aware	10	20.8
Consumption of ethnic foods changed since diagnosis:		
Yes	10	20.8
No	18	37.5
Don’t know	1	2.1
Not applicable	18	37.5

Figure 4.3 Change in enjoyment to eat recommended foods since diagnosis of diabetes

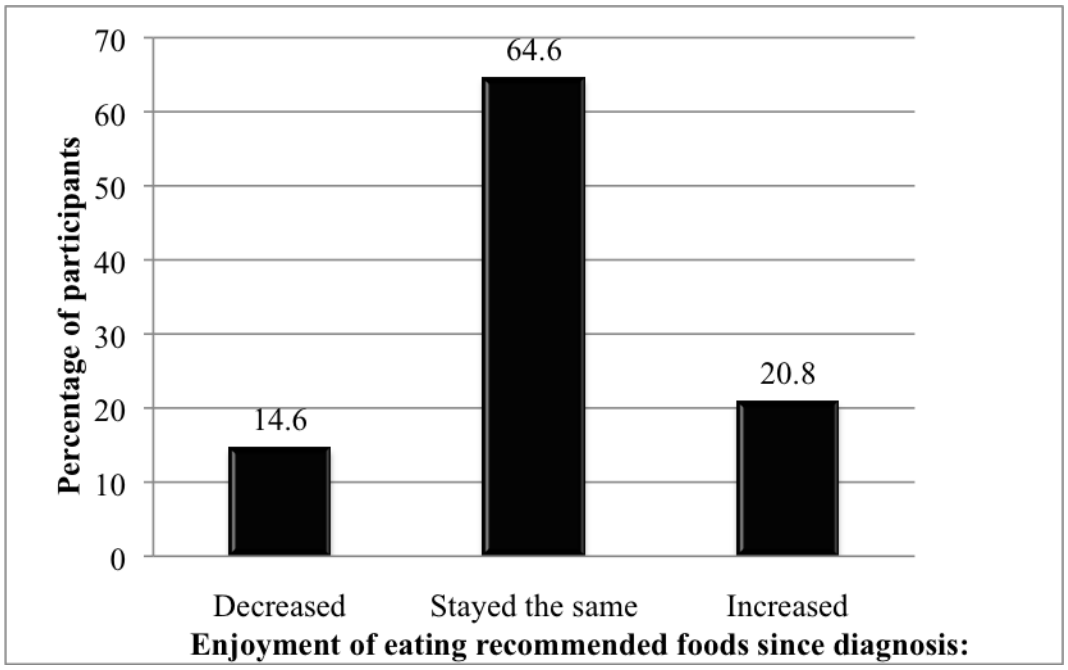


Figure 4.4 Change in frequency of eating away from home since diagnosis of diabetes

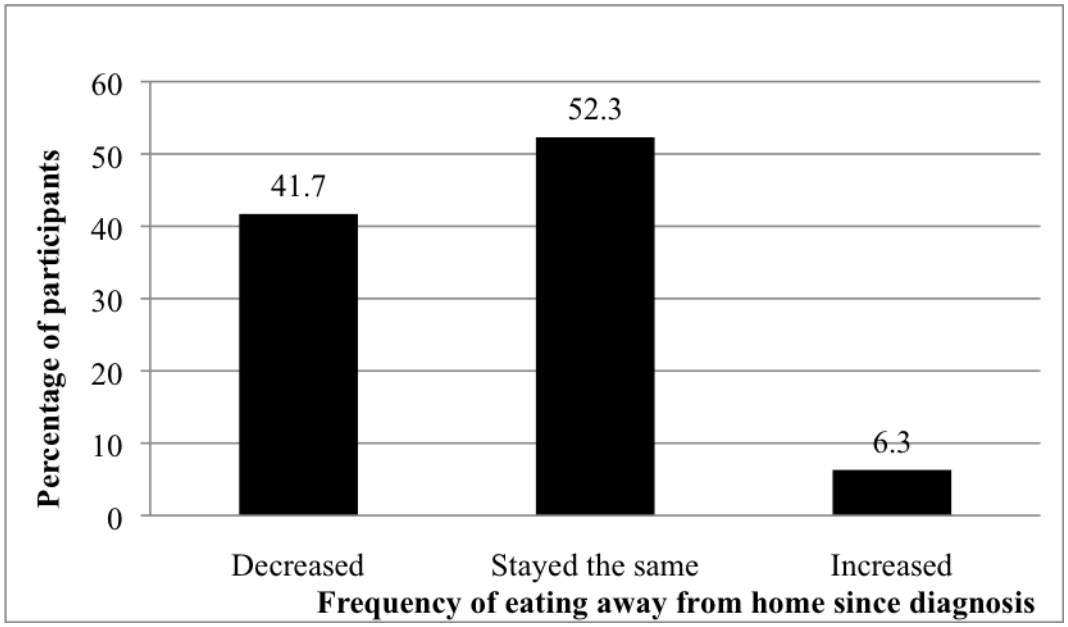


Figure 4.5a: Frequency (days/week) that participants report specific food consumption behaviours and attitudes from the Food Acceptability Questionnaire (n=48)

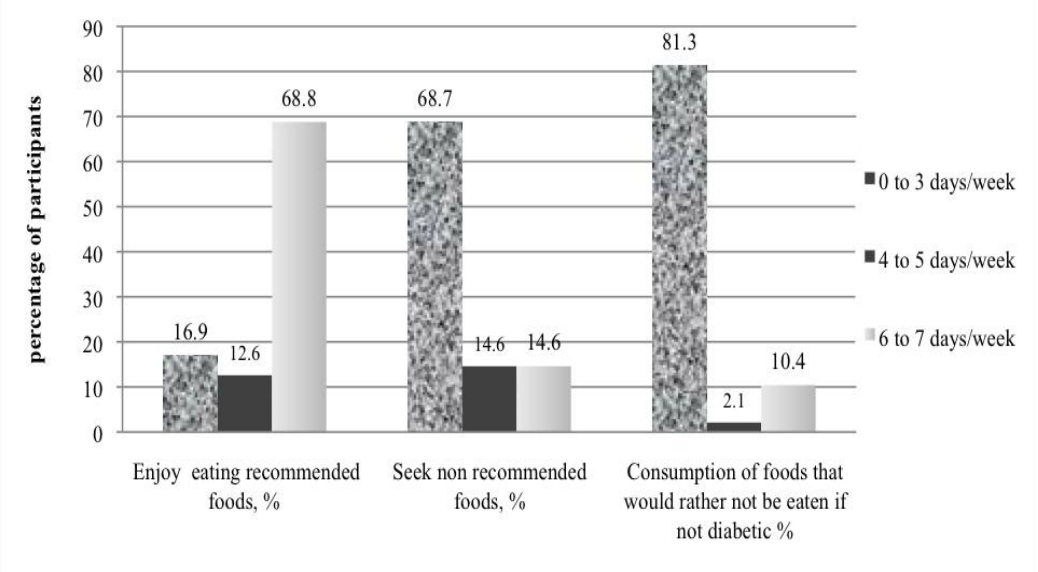


Figure 4.5b: Frequency (days/week) that participants report specific food consumption behaviours and attitudes from the Food Acceptability Questionnaire (n=48)

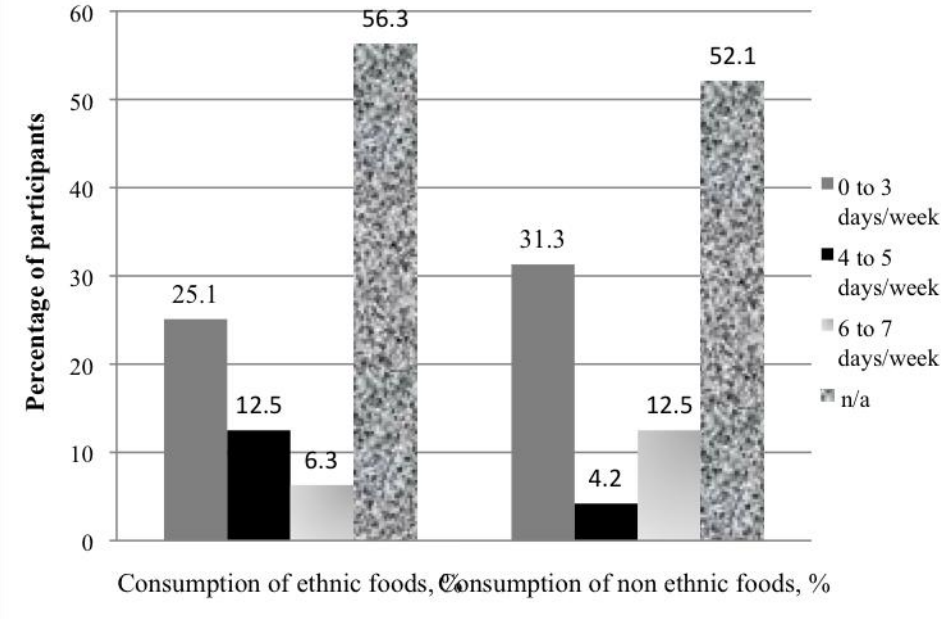


Table 4.11: Participants' awareness about basic concepts of a diabetes diet[1]

	Aware, %	Not aware, %
Beneficial foods	91.7	8.3
Foods to avoid	95.8	4.2
Frequency of meals	93.8	6.3
Snack foods	85.4	14.6
Foods on sick day	60.4	39.6
Glycemic index of foods	58.3	41.7
Foods that are satiating	70.8	29.2

[1] n=48

4.7 Correlations

4.7.1. Food Acceptability vs. Perceived Adherence

The perceived adherence score was higher among participants who chose to buy recommended foods more frequently ($r = .585$, $p < .005$). Likewise the extent to which participants enjoyed consuming recommended foods was also associated with a higher perceived adherence score ($r = .446$, $p < .005$). Lower perceived adherence scores were observed when participants chose to consume non recommended foods more often ($r = -.315$, $p < .05$). The frequency of consumption of foods from ethnic and non-ethnic heritage showed no significant associations with perceived adherence scores.

4.7.2. Food Acceptability vs. Actual Adherence

Participants who reported choosing to buy foods that were part of their recommended diet more frequently had higher intakes of carbohydrate ($r = .367$, $p < .05$), fibre ($r = .407$, $p < .005$) and sugar ($r = .359$, $p < .05$). Similarly, higher intakes of calories, protein, carbohydrate, fibre and sugar were observed when participants reported more enjoyment of eating the recommended foods. An

increase in the frequency of choosing non-recommended foods was correlated with an increased consumption of calories (r=.301, p<.05), fat (r=.402, p<.005), saturated fat (r=.300, p<.05), MUFA (r=.326, p<.05) and PUFA (r=.326, p<.05). A positive association between frequency of consumption of foods from ethnic heritage with protein intake (r=.298, p<0.05) and that of non-ethnic heritage foods with saturated fat intake (r=.298, p<0.05) was noted

4.8 Multivariate analysis

4.8.1. Association Between Dietary Adherence and A1c

Multivariate analysis was conducted to assess the relationship between glycemic control (as assessed by A1c) and dietary adherence, both perceived (Table.4.12) and actual adherence (Table 4.13). The analysis was performed adjusting for variables including age, gender, BMI, income, duration of diabetes, diabetes treatment and physical activity. A higher perceived adherence score was significantly and inversely associated with a lower A1c value (β = -.038, p = 0.039). The perceived adherence score explained 30% (R^2 = 0.308) of the variance in A1c values. The actual adherence score showed no associations with glycemic control (β = -.032, p = 0.86). However this variable showed a negative association with A1c (r = -.310, p = 0.03) when a simple Pearson correlation analysis was performed.

Table 4.12: Multiple linear regression to examine the association between perceived adherence score and A1c (n=48)

Model		Standardized Coefficients		
		Beta	t	p-value
1	(Constant)		4.914	.000
	Perceived adherence score	-.358	-2.160	.039
	Age	-.055	-.331	.743
	BMI	-.211	-1.282	.210
	Duration	-.203	-1.039	.307
	Treatment	.308	1.520	.139
	Physical activity	-.262	-1.526	.138
	Gender	-.238	-1.312	.200
	Income	-.035	-.199	.843

Table 4.13: Multiple linear regression to examine the association between actual adherence score and A1c (n=48).

Model		Standardized Coefficients		
		Beta	t	p-value
1	(Constant)		4.001	.000
	Actual adherence score	-.035	-.167	.868
	Age	-.091	-.490	.628
	BMI	-.129	-.741	.464
	Duration	-.254	-1.154	.258
	Treatment	.325	1.481	.149
	Physical activity	-.317	-1.552	.131
	Gender	-.230	-1.142	.262
	Income	-.005	-.027	.979

4.8.2. Food acceptability vs. A1c

Table 4.14: Results of multiple linear regression examining the association between the food acceptability score and A1c (n=48)

Model		Standardized Coefficients		
		Beta	t	p-value
1	(Constant)		3.277	.003
	Food acceptability score	-.346	-2.229	0.34
	Duration of diabetes	-.336	-1.535	.137
	Diabetes treatment	.355	1.880	.071
	Physical activity	-.084	-.523	.605
	Gender	-.224	-1.441	.161
	Age	.276	1.678	.105
	BMI	.075	.498	.622
	Ethnicity	-.276	-1.385	.177
	Income	-.113	-.700	.490

Table 4.15: Results of multiple linear regression examining the association between individual factors of food acceptability and A1c (n=48)

Model		Standardized Coefficients		
		Beta	t	p-value
1	(Constant)		7.211	.000
	Likely to eat RF[1]	.095	.567	.575
	Unlikely to eat RF[1]	.265	1.706	.098
	Choose to buy RF[1]	-.471	-2.965	.006
	Enjoy eating RF[1] (↑)	-.090	-.588	.561
	Enjoy eating RF[1] (↓)	.023	.171	.865
	Frequency eating away (↑)	.144	.914	.368
	Frequency eating away (↓)	-.031	-.222	.826
	Days enjoy eating RF[1]	.088	.605	.550
	Days not enjoy eating RF[1]	.280	2.087	.045
	Diabetes duration	-.027	-.173	.864
	Diabetes treatment	.282	1.771	.087
	Physical activity	.043	.317	.753

a. Dependent variable: A1c; [1] RF(Recommended Foods)

Table 4.14 shows the results from multivariate linear regression analysis describing the association between food acceptability and glycemic control (A1c). The R^2 of the overall model was 0.46 indicating that 46% of the variance observed in A1c was accounted for by the independent variables used to measure food acceptability. As explained in the methods section, an overall food acceptability score was calculated by combining the number of days of buying and cooking foods recommended for a diabetes-appropriate diet with participants' reported enjoyment experienced eating the recommended foods. The food acceptability

score was inversely associated with A1C (β = -.081, p = 0.034). Therefore, the results imply that as the Food Acceptability score increased, a decline in A1c was predicted. In other words, higher levels of food acceptability are associated with improved A1c, and a 1-unit increase in the food acceptability score is associated with a 0.08% reduction in A1c.

Further analyses were used to identify the components of the food acceptability score which showed the greatest influence on A1c values. The results of this analysis are presented in Table 4.15. Along with the components of the food acceptability score, duration of diabetes, diabetes treatment and physical activity were included in the model. The R^2 of the model was 0.562. There was a negative association between the frequency of choosing recommended foods (p = 0.006) and A1c. This indicates that if the frequency of choosing the recommended foods increases by one day/week, their A1c values decrease by 1% (β = -1.046). Also, the frequency of seeking non-recommended foods was positively associated with A1c (p = 0.045). This indicates that if the frequency of seeking non-recommended foods increases by one day/week, the A1c also increases by 0.14% (β = 0.142). Stated another way, the higher the number of days that people chose to eat non-recommended foods, the higher their A1c. After controlling for age, gender and BMI, the frequency of choosing recommended foods was still negatively associated with A1c (β = -1.185, p = 0.012), while seeking non-recommended foods was no longer associated with A1c.

Chapter 5 Discussion

The incidence and prevalence of diabetes is increasing in North America and worldwide. Nutrition therapy forms the major treatment for diabetes along with medication. It helps to minimise long and short term complications and to maintain healthy body weight. However, in general, people with diabetes exhibit difficulties in making appropriate dietary modifications leading to poor glycemic control. A team of researchers aim to develop and implement practical interventions for people with Type 2 diabetes in Alberta; this project is called Physical Activity and Nutrition for Diabetes in Alberta (PANDA). In order for an intervention to be effective it is essential first to understand the existing nutritional issues in that particular population and identify the factors that are found to be associated with dietary behaviour. Therefore the main purpose of this study was to assess the nutrient intake of people with diabetes in Alberta, specifically the Edmonton area. We also aimed to determine the association between dietary intake and food acceptability. Furthermore this study assessed the associations between socio- demographic variables, dietary adherence, food acceptability and A1c.

5.1 Perceived Dietary Adherence

In our study dietary adherence was measured both objectively using 3-day food record and subjectively using perceived dietary adherence questionnaire. Using the questionnaire our objective was to measure participant's perception of their dietary adherence. Based on the diet that participants consider being right

for their diabetes, trying to avoid high sugar and high fat foods and including low GI foods was reported less frequently by participants. Participants reported including recommended numbers of servings of fruits and vegetables and high fibre foods more frequently (4-6 days/ week). These results suggest that avoidance of nutrients such as sugar and fat appears to be a notable issue among diabetes patients. Inclusion of low GI foods was also identified to be limited among diabetes patients. Results from perceived adherence questionnaire correspond to actual intake data. Participants who felt that they do not adhere to the dietary recommendation by reporting to include high sugar and high fat frequently, consumed more fat rich foods. Comparison between perceived and actual adherence data showed that participants who perceived that they follow the dietary recommendations did focus on their dietary intake. Participants who perceived that they follow recommendations for fruit and vegetable intake also chose oils such as canola, walnut, olive or flax oil for cooking purposes which is consistent with nutrition therapy guidelines. Similarly high fibre intake was noted in the diet of those who perceive that they include high fibre foods frequently.

5.2 Actual Dietary Adherence

Several studies have recognised the benefits of diet on diabetes including reductions in A1c, plasma glucose and triglycerides values, increase in HDL cholesterol, improved insulin resistance, reduced risk for CHD and weight loss (Jenkins et al., 2008; Jenkins et al., 2011; McAuley et al., 2005). One of the primary objectives of our study was to describe the nutrient intake and compare it to current nutrient recommendations outlined by CDA. The mean macronutrient

intakes of participants compared against the CDA's 2008 nutrient recommendations indicated that on average, adherence of the study population to dietary recommendations was good except for saturated fat. However, when individual participant's total energy intake and ten other nutrients were combined (protein, carbohydrate, sugar, fibre, fat, saturated fat, PUFA, MUFA, cholesterol and sodium) none of the participants were able to meet all 11 recommendations. Less than 5% were able to meet at least 8 of 11 recommendations. Although mean nutrient intake of respondents appeared to be satisfactory they were able to meet a few of the recommendations but not all. This suggests that most of the participants found it difficult to follow all of the nutrient recommendations. Similar results were observed in a study completed by (Barclay et al., 2006) to assess the macronutrient intake of older Australian individuals with diabetes. In this study 219 individuals with diabetes were recruited and four-day weighed food record was used to collect dietary intake. Only very few subjects with diabetes (4.3%) were able to meet all of the macronutrient intake recommendations.

Sixty to seventy percent of participants met the recommendations for macronutrient intake including carbohydrate (66.7%), protein (70.8%), fibre (58.3%), and fat (70.8%), and sixty two percent met the recommendations for cholesterol intake. These findings are similar to those reported in other studies (Rivellese et al., 2007, The Diabetes and Nutrition Study Group of the Spanish Diabetes Association- GSEDNu, 2005). In contrast, more than 70% of our participants exceeded the recommendations for saturated fat, MUFA, sugar and sodium intake. The reasons underlying these excess intakes likely reflect the food

choices made by participants. For example, high fat dairy products, such as cream added to coffee, and red meat were major sources of saturated fat. On the other hand, red meat was also a source of MUFA and protein intake. High sodium content was the result of regular consumption of breakfast cereal which was also the main source of fibre. Foods including canned vegetables, soups, sauces, salad dressings, processed meats and cheeses also contributed to dietary sodium intake.

The mean percentage of energy contributed by protein, carbohydrate and fibre was within the recommended limits. In several other studies that measured dietary adherence of individuals with diabetes, adequate carbohydrate and protein intake was noted (Rivellese et al., 2007; Thanopoulou et al., 2004); however inadequate consumption of fibre by individuals with diabetes has been widely reported (Eilat-Adar et al., 2008; Toeller et al., 1997). Mean intake of total saturated fat and sodium was higher than the CDA recommendation (SF: <10% of TE and sodium: <2300 mg/day) and is consistent with previously reported studies (Eilat-Adar et al., 2008; Rivellese et al., 2007; Toeller et al., 1997). These findings from our study suggests that participants might have placed more emphasis on attaining dietary fibre at the expense of other nutrients such as saturated fat and sodium. Diets rich in saturated fat increase LDL cholesterol, which increases the risk for CVD (Hu et al., 2010; Lichtenstein et al., 2006). The Oslo Diet-Heart Study which included 412 men aged between 30 to 64 years showed that saturated fat of <9% and total fat intake between 35-40% of total energy decreased the events of CVD (Leren, 1970).

Participants who did not take any dietary supplements consumed significantly less vitamin A, vitamin D and calcium ($p<0.00$) than who included supplements along with their diet. CDA recommends intake of 50 IU of vitamin D per day for people aged over 50 years but does not recommend routine supplementation for other micronutrients (CDA, 2008). Although the CDA encourages individuals with diabetes to meet the recommendations through a well balanced diet, participants of our study were not able to meet the micronutrient recommendations through diet. Therefore additional importance should be given to educate participants about food selections that would help them to meet their micronutrient needs.

5.2.1 Dietary adherence versus socio-demographic and anthropometric variables

This study showed no associations between gender and both perceived and actual adherence. This might be because of the low number of males participating in this study. The significant associations between age and consumption of various nutrients indicated increased consumption of total calories, carbohydrate, fat and sodium among younger adults with diabetes. The higher calories were attributable to the higher carbohydrate and fat consumption. These results were similar to a study in which it was found that younger adults reported lower consumption of fruits and vegetables and a higher amount of calories from fat than older adults (Nelson, 2002). Some other studies have also reported an association between age and adherence (Montague, 2002, Travis, 1997, Uchenna et al., 2010). Emotion and schedule had a negative impact on dietary adherence for younger adults in a study by Travis, (Travis, 1997). It is possible that younger

adults in our study might face time constraints which might have caused them to choose convenient foods that are rich in fat. However, a study by Al-Kaabi et al., found no association between age and dietary compliance of T2D (Al-Kaabi et al., 2008).

No clear associations were found between BMI and actual dietary adherence but the perceived adherence score was positively associated with waist circumference (WC). The reason may be that the more obese or overweight participants felt that they tried harder to follow their recommended diet. On the other hand, participants with higher WC consumed more fat, MUFA and sodium. Participants with high WC who did not taken any measures to modify their diet pattern are likely to have inappropriate diet quality therefore diet high in fat and sodium. Overall by looking at the association between perceived and actual adherence to WC it suggests that participants those who are obese or overweight might be willing to make modifications to dietary patterns. In other words, they may perceive themselves to have better dietary adherence but they have difficulty in managing their fat and sodium intake.

Duration of diabetes and cholesterol intake was found to be positively associated in our study. A study by Yim et al., demonstrated a positive association between fat intake and duration of diabetes in Korean T2D patients (Yim et al, 2011). Increase in fat intake by 0.3 % of total energy per one year of diabetes duration was observed in their study. Also, total cholesterol intake was positively associated with total fat ($r=.571$, $p<0.00$) and saturated fat intake ($r=.566$, $p<0.00$) in our study, therefore as duration of diabetes increases individuals with diabetes

should be advised to pay more attention to manage their fat, saturated fat and cholesterol intake along with other nutrients.

5.2.2 Dietary adherence and A1c

Maintaining adequate glycemic control helps to reduce or delay the onset of complications associated with diabetes (Stratton et al., 2000; Khaw et al., 2004). To determine the association between dietary adherence and A1c was one of the objectives of our study. In this study both actual and perceived adherence to the CDA guidelines (CDA, 2008) was negatively associated with A1C. Higher intakes of fat, saturated fat and sodium were associated with poor glycemic control. Higher fat (Harding et al., 2001) and saturated fat (Boeing et al., 2000) consumption and higher A1c is similar to the results observed in other studies. Results from simple correlation analyses indicate the association between healthier food habits and better glycemic control. However when potential confounding factors such as physical activity and medication were adjusted, the actual adherence score was not associated with A1c. The association between actual nutrient intake and A1c may be imprecise due to insufficient nutrient intake data as nearly half of the participants did not completed the food record.

5.3 Food acceptability

Patients' acceptability of prescribed changes in dietary pattern is a primary area of concern but it is not well studied. Acceptability of different diets such as low fat vegan diet or high carbohydrate diet have been evaluated in intervention studies in order to improve the adherence (Barnard et al., 2000; Coyne et al., 1995; Fuller et al., 2011; Holm et al., 2008) but not many studies have evaluated

the acceptability of a diabetes diet and its association with dietary adherence. Lack of dietary adherence is commonly reported among diabetes patients and factors such as time, cost, social setting, emotion and several other factors identified through various studies contribute to poor adherence among diabetes patients (Galasso et al., 2005; Glasgow et al., 1986; Schlundt et al., 1994; Vijan et al., 2005). There might also be an association between food acceptability and dietary adherence in diabetes patients; therefore we evaluated the personal and cultural acceptability of current dietary recommendations to identify any links with adherence.

Results from our study show that people had a good level of acceptability of the recommended diet when considering dimensions like the likelihood of eating recommended foods, choosing to buy recommended foods and enjoyment eating recommended foods. About fifteen percent of our participants reported that their enjoyment of eating recommended foods had increased after they had been diagnosed with diabetes and about 65% of participants reported that their enjoyment of foods and dietary intake was same before and after their diagnosis of diabetes. These results were not expected. Possible reasons for increased enjoyment could be due participants not having to make major modifications to the dietary pattern that they followed earlier. It is possible that they liked any minor modifications they made, and therefore they now enjoy their diet more. Other reasons such as increased consciousness about their health could have motivated them to follow the recommended diet and enjoy their meals.

It is interesting to note that many participants reported a reduced frequency of eating away from home, and this may reflect a positive lifestyle change to them. Importantly, participants who completed this study had an A1c that was not considered high (indicating that they were generally in good glycemic control) and that their intake of carbohydrate, fibre, protein and fat, on average, were within the recommended limits. A decrease in the frequency of eating away from home reported by our participants could also be interpreted that the recommended diet plan has limited them from dining out because our questionnaire did not address the exact reasons for either decrease or increase in frequency of eating away from home. Eating away from home was reported to be one of the major factors that influenced adherence (Schlundt et al., 1994). Adherence to dietary recommendations for diabetes, which is reported to be difficult and complex by diabetes patients, may be improved if an emphasis on dietary acceptability is made while menu planning and providing dietary counselling to wisely plan and choose foods while eating outside and to create awareness among restaurateurs about the needs of individuals with diabetes to include special menus that are low in fat, sodium and higher in fibre.

Dietary adherence helps in optimising glycemic control (Aas et al., 2005; Goldhaber-Fieber et al., 2003; Mayer-Davis et al., 2004). This is another reason to measure the association between food acceptability and dietary adherence in our study. Results from our study indicate that participants' adherence to recommended foods was related to their level of food acceptability with diet, that is, better adherence was observed in participants who reported higher dietary

acceptability. T2D patients in the study by Vijan et al. had mentioned not liking the foods in the diet plan to be a reason for not following the dietary recommendations (Vijan et al., 2005).

In terms of cultural acceptability, a mixed pattern of ethnic and non-ethnic food consumption was most frequent for the respondents (45% of the sample) for whom this item was applicable. Three-quarters reported occasional consumption of foods (3 or fewer days of the week) from non-ethnic food groups. Fewer than 15% of participants perceived that they had to very frequently eat different foods after their diagnosis of diabetes but 25% indicted they sometimes ate different foods after their diagnosis. These data may suggest a lack of consideration of cultural food preferences in diet planning. In a study by Lawton et al., where they assessed food and eating practices of Indians and Pakistanis with T2D, respondents reported consuming traditional foods for at least one meal of the day whether or not those foods were recommended. Moreover, consuming traditional foods made them feel satisfied (Lawton et al., 2008). When culturally appropriate foods were not included in the diet plan, a tendency to consume high carbohydrate and high sugar foods was observed among participants in our study and on the contrary side high fibre intake was also noted. Consumption of high fibre may be due to partial adoption of the recommended diet plan by consuming more fruits and vegetables or due to the consumption of fibre-rich cereals or supplements. Prescribing foods that do not belong to ones cultural background may diminish ones adherence to recommended diet plan (James, 2004). James examined the nutrition related attitude of African American and found that since most of the

foods did not represent what they usually ate they did not did not want to follow the diet plan although they were aware of the fact that some of their traditional foods might be unhealthy. Also they believed the food guide or the recommended diet plan included only part of the culturally based foods, and it mostly reflected the diet of the dominant culture (James, 2004).

Participants who reported higher acceptability to the recommended diet had lower A1c values. The association observed in our study between food acceptability, dietary adherence and A1c indicates that planning more acceptable diets could increase the compatibility of the recommended diet with adherence, and therefore improve glycemic control. Jimenez showed in his study that Mexican obese adults achieved a significant reduction in their A1c in the duration of 6 weeks when they were prescribed with more a flexible, low GI, culture-based diet (Jimenez-Cruz et al., 2003).

In this study we found no significant associations between socio-demographic factors such as age, gender, income, ethnicity and education level and diet acceptability. Relevant results were observed in the study by Coyne et al (Coyne et al., 1995) where they assessed the association between dietary satisfaction of a modified protein eating pattern and adherence. In this study they assessed the association between diet satisfaction and adherence among participants from 3 different diet groups; usual-protein group, low-protein group and very low protein group receiving monthly dietary counselling for 26 months. Dietary satisfaction was measured at baseline and at 6 months, an annual visit and at final visits. In this study demographic factors showed no consistent association

with diet satisfaction. However gender was found to be associated with diet satisfaction, with men in the very low protein group reporting less satisfaction during the final visit compared to baseline visit.

5.4 References

Aas, A., Bergstad, I., Thorsby, P., Johannesen, Ø., Solberg, M., & Birkeland, K. (2005). An intensified lifestyle intervention programme may be superior to insulin treatment in poorly controlled type 2 diabetic patients on oral hypoglycaemic agents: Results of a feasibility study. Diabetic Medicine, 22(3), 316-322.

Al-Kaabi, J., Al-Maskari, F., Saadi, H., Afandi, B., Parkar, H., & Nagelkerke, N. (2008). Assessment of dietary practice among diabetic patients in the United Arab Emirates. The Review of Diabetic Studies, 5(2), 110-115.

Barclay, A. W., Brand-Miller, J. C., & 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.

Barnard, N., Scialli, A. R., Bertron, P., Hurlock, D., & Edmonds, K. (2000). Acceptability of a therapeutic low-fat, vegan diet in premenopausal women. Journal of Nutrition Education, 32(6), 314-319.

Boeing, H., Weisgerber, U. M., Jeckel, A., Rose, H. J., & Kroke, A. (2000). Association between glycated hemoglobin and diet and other lifestyle factors in a nondiabetic population: Cross-sectional evaluation of data from the Potsdam cohort of the European prospective investigation into cancer and nutrition study. The American Journal of Clinical Nutrition, 71(5), 1115-1112.

Canadian Diabetes Association (CDA). (2008). Clinical Practice Guidelines for the prevention and management of diabetes in Canada. Canadian Journal of Diabetes, 32, S1-S201.

Coyne, T., Olson, M., Bradham, K., Garcon, M., Gregory, P., & Scherch, L. (1995). Dietary satisfaction correlated with adherence in the modification of diet in renal disease study. Journal of the American Dietetic Association, 95(11), 1301-1306.

Eilat-Adar, S., Xu, J., Zephier, E., O'Leary, V., Howard, B. V., & Resnick, H. E. (2008). Adherence to dietary recommendations for saturated fat, fiber, and sodium is low in American Indians and other US adults with diabetes. Journal of Nutrition, 138(9), 1699-1704.

Fuller, N. R., Lau, N. S., Denyer, G., Simpson, A. E., Gerofi, J., Wu, M., et al. (2011). A 12-week, randomised, controlled trial to examine the acceptability of the Korean diet and its effectiveness on weight and metabolic parameters in an Australian overweight and obese population. Obesity Research &Clinical Practice (In press).

Galasso, P., Amend, A., Melkus, G. D., & Nelson, G. T. (2005). Barriers to medical nutrition therapy in black women with type 2 diabetes mellitus. The Diabetes Educator, 31(5), 719-725.

Glasgow, R. E., McCaul, K. D., & Schafer, L. C. (1986). Barriers to regimen adherence among persons with insulin-dependent diabetes. Journal of Behavioral Medicine, 9(1), 65-77.

Goldhaber-Fiebert, J. D., Goldhaber-Fiebert, S. N., Tristán, M. L., & Nathan, D. M. (2003). Randomized controlled community-based nutrition and exercise intervention improves glycemia and cardiovascular risk factors in type 2 diabetic patients in rural Costa Rica. Diabetes Care, 26(1), 24-29.

Harding, A. H., Sargeant, L. A., Welch, A., Oakes, S., Luben, R. N., Bingham, S., et al. (2001). Fat consumption and HbA1c levels: The EPIC-Norfolk study. Diabetes Care, 24(11), 1911-1916.

Holm, L., Hoff, A., Erichsen, L., Møhl, M., Toubro, S., & Astrup, A. (2008). Social and cultural acceptability of fat reduced diets among Danish overweight subjects: High-protein versus high-carbohydrate diets. Food Quality and Preference, 19(1), 43-50.

Hu, F. B., Patty, W., Qi S., Ronald, M. K., et al. (2010) Saturated fat, carbohydrate and cardiovascular disease. American Journal of Clinical Nutrition, 91,502–509.

James, D. (2004). Factors influencing food choices, dietary intake, and nutrition-related attitudes among African Americans: Application of a culturally sensitive model. Ethnicity and Health, 9(4), 349-367.

Jenkins, D. J. A., Kendall, C. W. C., McKeown-Eyssen, G., Josse, R. G., Silverberg, J., Booth, G. L., et al. (2008). Effect of a low–glycemic index or a high–cereal fiber diet on type 2 diabetes. The Journal of the American Medical Association, 300(23), 2742-2753.

Jimenez-Cruz, A., Bacardi-Gascon, M., Turnbull, W. H., Rosales-Garay, P., & Severino-Lugo, I. (2003). A flexible, low-glycemic index Mexican-style diet in overweight and obese subjects with type 2 diabetes improves metabolic parameters during a 6-week treatment period. Diabetes Care, 26(7), 1967-1970.

Khaw, K. T., Wareham, N., Bingham, S., Luben, R., Welch, A., & Day, N. (2004). Association of hemoglobin A1c with cardiovascular disease and mortality in adults: The European prospective investigation into cancer in Norfolk. Annals of Internal Medicine, 141(6), 413-420.

Lawton, J., Ahmad, N., Hanna, L., Douglas, M., Bains, H., & Hallowell, N. (2008). 'We should change ourselves, but we can't': Accounts of food and eating practices amongst British Pakistanis and Indians with type 2 diabetes. Ethnicity & Health, 13(4), 305-319.

Leren P. (1970). The Oslo Diet-Heart Study: eleven-year report. Circulation, 42, 935–942

Lichtenstein A.H., Appel L.J., Brands, M., et al. (2006). Diet and lifestyle recommendations revision 2006: a scientific statement from the American Heart Association Nutrition Committee. Circulation, 114, 82–96.

Mayer-Davis, E. J., D'Antonio, A. M., Smith, S. M., Kirkner, G., Levin Martin, S., Parra-Medina, D., et al. (2004). Pounds off with empowerment (POWER): A clinical trial of weight management strategies for black and white adults with diabetes who live in medically underserved rural communities. American Journal of Public Health, 94(10), 1736-1742.

McAuley, K., Hopkins, C., Smith, K., McLay, R., Williams, S., Taylor, R., et al. (2005). Comparison of high-fat and high-protein diets with a high-carbohydrate diet in insulin-resistant obese women. Diabetologia, 48(1), 8-16.

Montague, M. (2002). Psychosocial and functional outcomes in African Americans with diabetes mellitus. Journal of the Association of Black Nursing Faculty in Higher Education. 13(5), 103-109.

Nelson, K. M., Reiber, G., & Boyko, E. J. (2002). Diet and exercise among adults with type 2 diabetes. Diabetes Care, 25(10), 1722-1728.

Rivellese, A., Boemi, M., Cavalot, F., Costagliola, L., De Feo, P., Miccoli, R., et al. (2007). Dietary habits in type II diabetes mellitus: How is adherence to dietary recommendations? European Journal of Clinical Nutrition, 62(5), 660-664.

Schlundt, D. G., Rea, M. R., Kline, S. S., & Pichert, J. W. (1994). Situational obstacles to dietary adherence for adults with diabetes. Journal of the American Dietetic Association, 94(8), 874-879.

Stratton, I. M., Adler, A. I., Neil, H. A. W., Matthews, D. R., Manley, S. E., Cull, C. A., et al. (2000). Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): Prospective observational study. British Medical Journal, 321(7258), 405-412.

Thanopoulou, A., Karamanos, B., Angelico, F., Assaad-Khalil, S., Barbato, A., Ben, M. D., et al. (2004). Nutritional habits of subjects with type 2 diabetes mellitus in the Mediterranean basin: Comparison with the non-diabetic population and the dietary recommendations. multi-centre study of the Mediterranean group for the study of diabetes (MGSD). Diabetologia, 47(3), 367-376.

Toeller, M., Buyken, A., Heitkamp, G., Milne, R., Klischan, A., & Gries, F. A. (1997). Repeatability of three-day dietary records in the EURODIAB IDDM complications study. European Journal of Clinical Nutrition, 51(2), 74-80.

Travis, T. (1997). Patient perceptions of factors that affect adherence to dietary regimens for diabetes mellitus. The Diabetes Educator, 23(2), 152-156.

Uchenna, O., Ijeoma, E., Pauline, E., & Sylvester, O (2010). Contributory factors to diabetes dietary regimen non adherence in adults with diabetes. World Academy of Science, Engineering and Technology, 69, 734-741.

Vijan, S., Stuart, N., Fitzgerald, J., Ronis, D., Hayward, R., Slater, S., et al. (2005). Barriers to following dietary recommendations in type 2 diabetes. Diabetic Medicine, 22(1), 32-38.

Yim, J. E., Kim, Y. S., Cho, M. R., & Choue, R. (2011). Ratio of fat to energy intake independently associated with the duration of diabetes and total cholesterol levels in type 2 diabetes. Nutrition Research and Practice, 5(2), 157-162.

Chapter 6 Conclusion and Future research

6.1 Conclusion

From the results obtained we conclude that

- While generally following the recommended diet plan and Eating Well with Canada's Food Guide, participants perceived that they frequently included high fat and high sugar foods.
- On average, the recommendations for saturated fat and sodium were exceeded, and higher intakes were associated with higher A1c, which identifies a potential point of nutritional intervention among the diabetes population.
- People who were educated had better adherence and younger participants consumed more calories, carbohydrate, saturated fat and sodium.
- Participants who more frequently buy and enjoy eating recommended foods had higher dietary adherence.
- Participants who often seek non recommended foods consumed high calories, fat, saturated fat and PUFA.
- Participants who had higher acceptability scores for their recommended diet had better glycemic control.

6.2 Study Limitations

- Participants of this study were recruited through posters, advertisements on television, in newspapers and through newspaper articles. This would have attracted self motivated participants who would be more willing to manage their disease.
- Approximately 40% of the participants dropped out of the study by not completing their food record; therefore the dietary adherence results might have been different from the participants who completed the study.
- According to the 2006 census, 6.3% of the population of Edmonton self-identified as Chinese, and 5.3% identified themselves as were South Asians, black, Arabic or South East Asian. The proportion of ethnic participants in the present study was low, thus our study does not provide much insight into the role that food acceptability, specific to different cultures, may play in promoting dietary adherence.

6.3 Future applications

- Higher than recommended consumption of foods high in saturated fat and sodium was identified as the major nutritional issue in our study. Therefore it is recommended that future interventions target particularly on fat and sodium. This would help in lowering the complications that are associated with diabetes.
- Findings from this study can be applied to the dietary intervention study of PANDA project. As the results of this study showed that the intake of saturated fat and sodium are higher than dietary recommendations, future

intervention studies could encourage participants to modify the types of foods chosen to include low fat dairy products and lean cuts of meats to reduce the amount of saturated fats and to select foods such as breakfast cereals and salad dressings that contain low amounts of sodium. They should also limit intake of high sodium foods such as cheese and canned soups. Some of these recommendations may require extra nutrition education in order for people to change their food choices.

- Increasing the sample size in future studies with a more ethnically diverse population would help to better understand cultural acceptability of recommended foods.
- Although previous studies have been conducted to learn about the barriers to dietary adherence among different ethnic groups our study is unique in that both dietary intake and acceptability of the diet were measured in the same participants. Thus we are able to compare actual intake with peoples' impressions of food acceptability. Information on enjoyment of foods, frequency of consumption of ethnic and non-ethnic foods were collected in our study, however specific questions to understand whether or not the inclusion of ethnic or non-ethnic foods was desirable to the participants, or whether participants had changed their pattern of consumption of non-ethnic foods before and after diagnosis of diabetes was not addressed. Therefore future studies should address these issues to clearly understand the role that cultural acceptability of dietary recommendations may play in influencing adherence

- An association between food acceptability and glycemic control was observed in this study. Food acceptability can be studied further to see whether factors such as availability and accessibility of culturally appropriate foods have an effect on food acceptability and dietary adherence.

APPENDIX A: Recruitment poster

PANDA Physical Activity & Nutrition for	Physical Activity and Nutrition for Diabetes in Alberta (PANDA): Cross-sectional study

DO YOU HAVE DIABETES?

Researchers at the University of Alberta are doing a study to find out about you and your diabetic diet
If you:

- ***Have type 2 diabetes***
- ***Are 18 years and above***
- **Do not have severe digestive disorders (colitis, irritable bowel etc.)**

We invite you to participate in our study:

Study Coordinators

Denise Maxwell & Gayathiri Durairaj

Contact us at: Phone: (780)-248-1501 and leave a message
Email: pandaresearch@med.ualberta.

For more information, please visit our PANDA website:
http://www.ales.ualberta.ca/afns/PANDA.cfm

APPENDIX B: Information Sheet

Title of Project

Cross-sectional study of dietary intake, time use, and perceived food availability, acceptability, and accessibility for people with Type 2 diabetes.

Principle Investigator:
Dr. Cathy Chan 780-492-7742
Cathy.Chan@ualberta.ca
Co-investigators
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Rhonda.Bell@ualberta.ca
Dr. Sean Cash 608-262-5498 scash@ualberta.ca
Dr. Sven Anders 780-492-5453
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Purpose

The purpose of this study is to assess your dietary intake and to find out what helps or stops people with Type 2 diabetes from following a diabetic diet. We are doing this study for 2 reasons. First, we will use this information to help us develop a new nutrition program that will be part of a larger study called Physical Activity for Nutrition and Diabetes in Alberta (PANDA). The second reason is that we think we will use some of the same questionnaires and methods in the PANDA project and in this project. Therefore we need you to try them out. We will also ask you questions about methods that you will use (e.g. How easy was it for you to collect grocery and food receipts for 28 days?). The goal of PANDA is to create diet and physical activity programs that are easy to follow and simple to understand, and the current study is one step toward this goal.

Background

The number of people with type 2 diabetes is increasing steadily in Canada. Diet is considered one of the major treatments to help control blood sugar levels. Though various dietary guidelines have been developed many people seem to find it difficult to follow the diet that is best for treating diabetes. We need to find the reasons that either help or stop people with Type 2 diabetes from staying with their diet.

Procedure

- If you agree to participate in the study you will be asked to come to HNRU (Human Nutrition Research Unit) located at Agricultural, Food and Nutritional science department of University of Alberta and to complete the questionnaires about your food purchases, the foods you eat, and the cost of foods you purchase.

- You will also be asked some questions about your age, ethnicity, income level and other general information.

- Completing the questionnaire might take approximately 45 minutes.

- During a meeting with the study coordinator, you will be asked to have your Hemoglobin A1C level (a test that measures your long term blood sugar control) measured and to have height, weight, waist and hip circumference measured.

- For the Hemoglobin A1C measurement, you will need to prick your finger using a clean lancet (i.e. just like when you do your blood sugar check at home).

- The study coordinators will explain how to fill out a 3 day food record, an activity recall, and information about collecting and saving your grocery receipts and restaurant receipts.

- You will be asked to return records and receipts to us by mail in pre-paid envelops that will be given to you.

Confidentiality

Only people associated with the research study (Investigators and the study coordinators) will have access to your records. Records from the study are confidential and will be securely stored in locked filing cabinets for five years, after which they will be destroyed. Your records will be listed according to your identification number rather than your name. Published reports resulting from this study will be summarized as group findings. We will not identify you in our report. We will not give your name or phone number to anyone or use them for any other purpose apart from the study. Other participants may know that you took part in the study, but they will never see your questionnaires or study information.

Risks and Benefits

There are no known risks for participating in this study. It will take time for you to fill out the questionnaire, collect grocery receipts, and keep your dietary and time records. You may get a sore finger from the finger prick blood sample taken to determine your HbA1c. This should be minor because the test is the same as the finger prick that you do to test your blood glucose.

If you wish, you can receive information about your diet compared with Canada's Food Guide and diabetes recommendations and some information about the cost of your food from the study coordinators. The study coordinators will do their best to answer any questions that you have about diabetes research and related questionnaires.

Participation in this survey will help the researchers to better understand many factors that could either help or stop people with Type 2 diabetes from following a diet that is recommended to treat this disease.

Withdrawal from the study

Participation in the study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time.

We will be calling you by telephone to ask you some questions about grocery shopping, preparing food, and other things.

This will happen once during the week of _____.

If you have any concerns about your rights to participate as a subject in this study, you may contact the University of Alberta Health Research Ethics Board at780-492-0302.

APPENDIX C: Consent form

Title of Project: Cross-sectional study of dietary intake, time use, and perceived food availability, acceptability, and accessibility for people with Type 2 diabetes.

Principal Investigator: Dr. Cathy Chan	Phone Number(s):780-492-9939
Co – Investigators(s)	Phone Number(s):
Dr. Rhonda Bell	780-492-7742
Dr. Sean Cash	608-262-5498
Dr. Sven Anders	780-492-5453

	Yes	No
Do you understand that you have been asked to be in a research study?	☐	☐
Have you read and received a copy of the attached Information Sheet?	☐	☐
Do you understand the benefits/risks involved in taking part in this research study?	☐	
Have you had an opportunity to ask questions and discuss this study?	☐	☐
Do you understand that you are free to withdraw from the study at any time, without having to give a reason?	☐	☐
Has the issue of confidentiality been explained to you?	☐	☐
Do you understand who will have the access to your PANDA study records?	☐	☐

Who explained this study to you?_____

I agree to take part in this study YES ☐ No ☐

Signature of the participant_____

Printed name of the participant_____

I believe that the person signing this form understands what is involved in the study and voluntarily
agrees to participate.

Signature of Investigator or
Designee_____Date_____

APPENDIX D: Anthropometric Assessment

Date: _____

Measurement	1	2	3	Average
Height (cm)				
				ft
Weight (kg)				
				lb
Waist circumference(cm)				
Hip circumference(cm)				

BMI: _____ Waist-Hip ratio: _____

HbA1C: _____

APPENDIX E: 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 F: 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 G: 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 H: 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 I: 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

APPENDIX J: Food Acceptability Questionnaire

Please circle the appropriate response

Food acceptability refers to foods that are personally and culturally acceptable to you. For example, are the foods recommended in a diet for Type 2 diabetes those that you want to eat?

1. In thinking about the foods that are part of a diet that you follow for your diabetes, how likely is it that you will regularly eat these foods?

Very unlikely Neutral Very likely

2. When choosing to buy foods that you prepare at home, how often do you choose foods that are part of a diet that you follow for your diabetes?

Never Seldom Usually Often Always

3. When you choose foods that are **NOT** part of your recommended diet, what are the main 3 reasons for this?

Reason 1_____

_____

Reason 2_____

_____

Reason 3_____

_____

4. Since you were first diagnosed with diabetes, has your enjoyment of foods that are part of your recommended diet:

Decreased Stayed about the same Increased

5. Since you were first diagnosed with diabetes, has the frequency of eating food away from home:

Decreased Stayed about the same Increased

6. How many days out of the week do you enjoy the foods that are part of your recommended diet?

0 1 2 3 4 5 6 7

7. How many days of the week do you find yourself seeking out foods that are **NOT** part of your recommended diet?

0 1 2 3 4 5 6 7

8. How many days of the week do you eat foods that are part of your ethnic heritage?

0 1 2 3 4 5 6 7 N/A

9. How many days of the week do you eat foods that are **NOT** part of your ethnic heritage?

0 1 2 3 4 5 6 7 N/A

10. Has this changed since you were diagnosed with diabetes?

Yes No Don't know N/A

11. How many days of the week do you eat foods that are part of your recommended diet that you would rather not eat?

0 1 2 3 4 5 6 7

12. Do you eat foods that are produced locally (i.e. grown or produced in Alberta)?

Yes No Don't know

13. Do you believe those foods produced locally in Alberta are more diabetes friendly than those from elsewhere?

Yes Neutral No Don't know

14. Provide a list of the foods that you eat that are part of your diet for treating your diabetes and that are produced locally. Be as specific as possible.

Information about Your Recommended Diet

15. From the information you have received about your diabetes diet, is it clear to you:

What kinds of foods will be most beneficial for you?	Yes	No
What kinds of foods to avoid?	Yes	No
How often you should eat?	Yes	No
Which foods to keep handy for snacks?	Yes	No
Which foods are helpful on a sick day?	Yes	No
The glycemic index of foods that you eat	Yes	No
Foods which fill you up	Yes	No

APPENDIX K: 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 <u>on a regular basis</u>? 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 L: 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 M: Food-related Time Use Questionnaire For Diabetics and Household Members

Instructions:
Please answer all questions. If your answer is zero, please answer like this:
Hours__0___Minutes__0___

If your answer is 1 ½ hours, please answer like this:
Hours__1___Minutes__30___

If you don't know the answer, please answer like this:
Don't know___X_____

*For the purpose of this study**, household** is defined as those living in the **same household** and **eating together regularly***

Food from home
The following questions apply to meals and snacks PREPARED AT HOME. This includes meals prepared and eaten at home, and food PREPARED at home and eaten away from home, such as sandwiches and salads that you have prepared to take for lunch at work.

1. How much time (total) do you **typically** spend preparing meals for you and/or your household in ONE DAY?
Hours_____ Minutes_____

2. How much time (total) do other household members **typically** spend preparing meals for you and/or your household in ONE DAY?
Hours_____ Minutes_____ Not Applicable_____

3. Do you have different meals/snacks than the rest of your household due to your diabetic needs?
Yes No Not applicable

4. If yes, how much LESS or MORE time (total) (circle appropriate response) does it **typically** take to **prepare** your meals/snacks in ONE DAY?
Hours_____ Minutes_____Don't know_____

5. Were your meal preparation activities in the last seven days typical?
Yes No

If not, briefly explain what was different:_____

6. How much time (total) do you spend eating meals and snacks in ONE DAY?
Hours_____Minutes_____

7. On a typical day, compared to other members of your household, is the time you spend eating

Less Same More Not sure Not Applicable

8. If different from your household, by how much in ONE DAY?
Hours_____Minutes_____

9. Do you feel that you have enough time to prepare and enjoy meals and snacks appropriate for your diabetes?
Yes No

10. How many people eat regularly in your home?
Number of children (under 18 years of age)_____ Number of adults_____

Food away from home:
The following questions apply to meals and snacks PURCHASED AWAY FROM HOME. This includes restaurant meals, take-out meals and convenience store snacks. DO NOT include food PREPARED at home and consumed away from home (such as sandwiches and salads that you have prepared to take for lunch at work).

1. In the past SEVEN DAYS how often have you eaten meals/snacks away from home?

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

2. In the past SEVEN DAYS, how much time (total) have you spent at restaurants/diners/etc., including commuting time? (if applicable)

Hours_____Minutes_____

3. In the past SEVEN DAYS how often have you eaten meals/snacks away from home with members of your household?

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

4. In the past SEVEN DAYS, how much time (total) have you spent at restaurants/diners/etc. with members of your household, including commuting time? (if applicable)

Hours_____Minutes_____

5. Do you feel that constraints make it impossible for you to enjoy meals and snacks away from home appropriate for your diabetes?

Yes No

6. Do you feel that constraints make it impossible for you to enjoy meals and snacks away from home appropriate for your diabetes with members of your household?
Yes No Not Applicable

Time use for non-food related activities:

On a **typical workday**, how much time do you spend on the following?
For example, if you usually spend 3 ½ hours watching TV, you would write 3 hours and 30 minutes.
Place a check mark under N/A if not applicable.

Activity	**Hours**	**Minutes**	**N/A**
Part-time work (including volunteer)			
Full-time work (including volunteer)			
Watching TV/ Using a computer (other than at work)			
Reading			
Relaxing			
Exercise/working out			
Time with children (homework)			
Time with children (sports) *Do not include activities already mentioned in Exercise/working out*			
Time with children (playing games)			
Other activity (specify)			
Other activity (specify)			

On a **typical weekend day**, how much time do you spend on the following?
For example, if you usually spend 3 ½ hours watching TV, you would write 3 hours and 30 minutes.
Place a check mark under N/A if not applicable

Activity	**Hours**	**Minutes**	**N/A**
Part-time work (including volunteer)			
Full-time work (including volunteer)			
Watching TV / Using a computer (other than at work)			
Reading			
Relaxing			
Exercise/working out			
Time with children (homework)			
Time with children (sports) *Do not include activities already mentioned in Exercise/working out*			
Time with children (playing games)			
Other activity (specify)			

THREE-DAY

DIETARY INTAKE RECORD

Participant ID:_____

Phone Number: _____

Date of Birth: _____ _____ _____
(Day) (Month) (Year)

Record Dates: _____ _____
(Day) (Month) (Day) (Month)
(Month) (Day) (Month)

University of Alberta
Department of Agricultural, Food and Nutritional Science

NSTRUCTIONS FOR RECORDING DAILY FOOD INTAKE

The purpose of collecting this information is to know what you eat and drink during a three-day period. It is important to record ALL foods and beverages – whether it is a full course meal at home or a quick can of pop at school/work.

The Three-Day Dietary Intake Record has a separate section for every day (see Day 1, Day 2, Day 3 on top each page). Each day is broken up into 6 eating times:

1. Morning meal
2. Midmorning snack
3. Midday meal
4. Afternoon snack
5. Evening meal
6. Evening snack

It is a good idea to carry your Dietary Intake Record book with you and record your entries as soon after eating as possible. Foods and beverages consumed away from home – at a friend's house, at the mall, at a restaurant- are just as important as those eaten at home. Please include the following information on your food record:

FOOD AND BEVERAGE ITEMS Column: Enter all foods and beverages consumed at the meal or snack time. Please record the specific type of food (for example: *WHOLE WHEAT* bread, *FROSTED FLAKES* cereal). In the same column, record all toppings or items added at the time of eating (for example: sugar, syrup, jam, butter, mayonnaise, gravy, milk, salt, etc.). For combination foods, please include detailed information on each item. For example: If you had a tuna sandwich, you would list the following foods and include detailed information for each of them: white bread, mayonnaise, celery, solid white tuna, salt.

DESCRIPTION OF ITEM Column: For every food or beverage item listed, include the following (if applicable):

Brand: *MIRACLE WHIP* mayonnaise, *PIZZA HUT DEEP DISH* pizza, *OR*cookie
Type of flavour: *BLUEBERRY* muffins, *STRAWBERRY* yogurt
Method of cooking: *FRIED, BAKED, BBQ'D, HOMEMADE*
All other relevant information included on food label: *LOW FAT,* ranch fat free salad dressing, *28% M.F. (MILK FAT*) cheddar cheese, *LEAN* Ground Beef , For fruits and vegetables specify the varieties if possible e.g. "Granny smith" apple and other information's such as frozen, canned sweetened/unsweetened, sliced etc

AMOUNT Column**:** Specify number and units of measure of food or beverage item and the amount of any topping or items added.. E.g. 2 cups, 1 Teaspoon. Use appropriate unil of measures necessary e.g. "cup", "grams", "piece", "ounce", "number", size of fruit (small, medium, large), "teaspoon", or "tablespoon. Use measuring cups and spoons whenever possible. Homemade foods - attach the recipe to the additional information sheet and mention the portion you had eaten E.g. 1/5th of a batch of stew.Restaurants: Include as much information as possible. Make sure you include the name of the restaurant, name of the dish and the options that you have chosen. Please attach the food labels of processed foods if possible and ensure that you have entered "label attached"

Fill in the blanks on the bottom of each record. Please list any vitamin or mineral supplements and/or herbal products taken, including quantities and detailed label information along with the Drug Identification number (DIN), if possible. Indicate the time of your meal or snack and where it was eaten (for example: at home, at a restaurant, in class). If you ate more than one snack between two meals, please indicate the time of each snack. If you did not eat a meal or snack, please place a check mark (✓) in the space provided on the bottom of the page, so that we do not think you forgot to record it.

Daily check: in the evening, after you have recorded everything for the day. Also check that the blanks are completed on the bottom of the page.

Dietary record should reflect the way you usually eat. Please do not change your normal eating habits for the 3 days you are recording your food intake. Your honesty is crucial to the success of this research study.

Thank you for your participation and cooperation with this study. If you have any questions please contact:
panadaresearch@med.ualberta.ca

Sample Meal

Food and Beverage Items	**DESCRIPTION OF ITEM**	**AMOUNT**
Enter all foods and beverages consumed. For combination foods, please include detailed information on each item.	Include a detailed description of each food and drink item consumed including: - Brand name - Flavour - Method of cooking - All other relevant information on food/drink label	Enter number of units and units of measure: for example: cup, grams, ounce, piece, teaspoon, tablespoon
Spaghetti with tomato/meat sauce:		
Pasta	Whole wheat Spaghetti, cooked	2 Cup
Tomato sauce	Hunt's canned sauce, roasted garlic flavour	1 Cup
Meat balls	Made with extra lean ground beef	5 Number (1 oz/ball)
Parmesan cheese, grated	Kraft, 30% Milk Fat (M.F.)	1 Tablespoon
Garlic Bread:		
Italian Bread	Toasted	3 Piece (large slice)
Garlic Butter		3 Teaspoon
Caesar salad:		
Lettuce	Romaine	1 Cup
Croutons	Safeway brand, garlic flavor	2 Tablespoon
Bacon bits	Simulated flavour, No Name Brand	2 Tablespoon
Caesar salad dressing	Kraft, Fat free	2 Tablespoon
Milk	1%	1 Cup
Tiramisu	Sarah Lee	1 Slice
Coffee	Brewed, Black	1 Cup

Vitamin or herbal Supplements or taken:_____

Fill in blanks: Time of meal/snack: 6:00 pm **Location meal/snack was consumed:** at home

Please CHECK (✓) if you did not eat or drink at this meal or snack time:_____

Sample Meal

Food and Beverage Items	**DESCRIPTION OF ITEM**	**AMOUNT**
Enter all foods and beverages consumed. For combination foods, please include detailed information on each item.	Include a detailed description of each food and drink item consumed including: - Brand name - Flavour - Method of cooking - All other relevant information on food/drink label	Enter number of units and units of measure: for example: cup, grams, ounce, piece, teaspoon, tablespoon
Strawberry - Kiwi Juice	Sunrype 100% fruit juice	½ Cup (125 ml)
Bacon	Maple leaf regular	1 piece
Whole wheat bread:	Toasted, homemade (recipe attached)	2 Piece (small slice)
Margarine	Becel, polyunsaturated salt reduced spread	3 teaspoon
Peanut butter	Compliments, 100% natural crunchy	2 teaspoon (10 ml)
Jam	Blueberry haven, blueberry, no sugar	3 teaspoon
Granola bar	Nature valley, sweet and salty, gluten free, Almond (Label attached)	1 Bar
Apple	Granny smith	1 medium size

Vitamin/Mineral Supplements or Herbal Products taken: Ferrous sulphate 300mg Safeway 1 tablet DIN:00346918

Fill in blanks: Time of meal/snack: 6:00 pm **Location meal/snack was consumed:** at home

Please CHECK (✓) if you did not eat or drink at this meal or snack time:

Day 1 - Morning Meal

Food and Beverage Items	**DESCRIPTION OF ITEM**	**AMOUNT**
Enter all foods and beverages consumed. For combination foods, please include detailed information on each item.	Include a detailed description of each food and drink item consumed including: - Brand name - Flavour - Method of cooking - All other relevant information on food/drink label	Enter number of units and units of measure: for example: cup, grams, ounce, piece, teaspoon, tablespoon

Vitamin/Mineral Supplements or Herbal Productstaken:_____

Fill in blanks: Time of meal/snack:_____ Location meal/snack was consumed:_____

Please CHECK (✓) if you did not eat or drink at this meal or snack time:_____

Day 1 - Mid-Morning Snack

Food and Beverage Items	**DESCRIPTION OF ITEM**	**AMOUNT**
Enter all foods and beverages consumed. For combination foods, please include detailed information on each item.	Include a detailed description of each food and drink item consumed including: - Brand name - Flavour - Method of cooking - All other relevant information on food/drink label	Enter number of units and units of measure: for example: cup, grams, ounce, piece, teaspoon, tablespoon

Vitamin/Mineral Supplements or Herbal Productstaken:_____

Fill in blanks: Time of meal/snack:_____ Location meal/snack was consumed:_____

Please CHECK (✓) if you did not eat or drink at this meal or snack time:_____

Day 1 - Midday Meal

Food and Beverage Items	DESCRIPTION OF ITEM	AMOUNT
Enter all foods and beverages consumed. For combination foods, please include detailed information on each item.	Include a detailed description of each food and drink item consumed including: - Brand name - Flavour - Method of cooking - All other relevant information on food/drink label	Enter number of units and units of measure: for example: cup, grams, ounce, piece, teaspoon, tablespoon

Vitamin/Mineral Supplements or Herbal Productstaken:_____

Fill in blanks: Time of meal/snack:_____ Location meal/snack was consumed:_____

Please CHECK (✓) if you did not eat or drink at this meal or snack time:_____

Day 1 - Afternoon Snack

Food and Beverage Items	**DESCRIPTION OF ITEM**	**AMOUNT**
Enter all foods and beverages consumed. For combination foods, please include detailed information on each item.	Include a detailed description of each food and drink item consumed including: - Brand name - Flavour - Method of cooking - All other relevant information on food/drink label	Enter number of units and units of measure: for example: cup, grams, ounce, piece, teaspoon, tablespoon

Vitamin/Mineral Supplements or Herbal Productstaken:_____

Fill in blanks: Time of meal/snack:_____ Location meal/snack was consumed:_____

Please CHECK (✓) if you did not eat or drink at this meal or snack time:_____

Day 1 - Evening Meal

Food and Beverage Items	**DESCRIPTION OF ITEM**	**AMOUNT**
Enter all foods and beverages consumed. For combination foods, please include detailed information on each item.	Include a detailed description of each food and drink item consumed including: - Brand name - Flavour - Method of cooking - All other relevant information on food/drink label	Enter number of units and units of measure: for example: cup, grams, ounce, piece, teaspoon, tablespoon

Vitamin/Mineral Supplements or Herbal Productstaken:_____

Fill in blanks: Time of meal/snack:_____ Location meal/snack was consumed:_____

Please CHECK (✓) if you did not eat or drink at this meal or snack time:_____

Day 1 - Evening Snack

Food and Beverage Items	**DESCRIPTION OF ITEM**	**AMOUNT**
Enter all foods and beverages consumed. For combination foods, please include detailed information on each item.	Include a detailed description of each food and drink item consumed including: - Brand name - Flavour - Method of cooking - All other relevant information on food/drink label	Enter number of units and units of measure: for example: cup, grams, ounce, piece, teaspoon, tablespoon

Vitamin/Mineral Supplements or Herbal Productstaken:_____

Fill in blanks: Time of meal/snack:_____ Location meal/snack was consumed:_____

Please CHECK (✓) if you did not eat or drink at this meal or snack time:_____

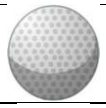
ADDITIONAL INFORMATION

(For example: recipes or food/drink label information)

Appendix O: Serving size sheet

APRON SERVING SIZES FOR 24 HOUR FOOD RECALL

MILK PRODUCTS		
1 serving	**Equals**	**Equals**
1 oz/30g cheese	4 dice	
1 cup/250mL ice cream	baseball	
1 cup/250mL milk or other beverage	Fist	
½ cup/100 g yogurt ¾ cup/175 g yogurt	Purchased as multi-pack Purchased as individual	
GRAIN PRODUCTS		
1 serving	**Equals**	**Equals**
1 slice of bread	CD case	
½ -1 bagel	Hockey puck	
1 medium pancake	CD	
Vegetables and Fruit		
1 serving	**Equals**	**Equals**
½ cup/125 mL fresh, frozen, canned	Light bulb	
1 medium sized	Tennis ball	
1 cup/250 mL salad, raw, leafy	Softball	
2 Tbsp/30 mL dried fruit	Large egg	
1 small baked potato	Computer mouse	
1 cup/250mL juice	Fist	

MEAT AND ALTERNATIVES		
1 serving	**Equals**	**Equals**
3oz/90 g meat, chicken, cooked	Deck of cards	
3 oz/90 g fish, cooked	Cheque book	
½ cup/250 mL beans, lentils	Light bulb	
2 Tbsp/30 mL peanut butter	Golf ball	
2 Tbsp/30 mL nuts/seeds	1 oz shot glass	

FATS AND OILS		
1 serving	**Equals**	**Equals**
1 tsp/5 mL butter, margarine	1 dice or tip of your thumb	
2 Tbsp/30 mL dressing	Ping pong ball	

Adapted from Storey & Taylor Serving Sizes (2005) and Alberta Milk.

Appendix P: Measurements

Height and weight

The device used for measurements was a wall mounted digital height scale, or standiometer, which was available for use at the HNRU. Participants were measured in light clothing without shoes. Hats and hairpieces were removed. This scale must be calibrated by ensuring that the headpiece reads the same as the distance from the bottom of the standiometer to the floor (measured by staff at the HNRU) when at the lowest possible point on the scale. Press the + or – keys until it reads this.

Weight was also measured at the HNRU on a digital scale, in light clothing without shoes. No calibration was necessary, as this scale is calibrated periodically by staff at the HNRU.

Heights and weights were taken three times, and the average of the readings was recorded.

Waist and hip

Standard measuring tape was used to measure waist and hip. Proper protocol was used. Measurements were taken only after three consecutive practice measurements revealed the same result.

APPENDIX Q: Food Processor Standard Operating Procedures

1. Setting Up a New Participant

1. **Person ⟶ New**
2. **First Name:** Participant ID (ex. E0016-01-1 or C0078-01-1)
3. **Last Name:** (blank)
4. **Age, Height, Current Weight**: 1
5. **User Code**: (blank)
6. Click **Next⟶ Finish**
7. Change Date and Day
    - Change the date to represent the day in which foods were consumed. In other words, the date should be entered as the day before the date the 24 hr recall was taken (ex. If recall was performed on August 15, 2009, then the date entered will be August 14, 2009).
    - Date should be time stamped with the reported trimester using the corresponding letter:
        1st Trimester: A
        2nd Trimester: B
        3rd Trimester: C
        12 wk Postpartum: E
    - To change date and insert time stamp:
        a) Right click on **Date⟶ Modify item**
        b) Enter the correct date in the format of month/day/year (ex. Day 1 **(8/14/09)**)
        c) Change day to the time stamp (ex. **B** (8/14/09))

2. Entering a Follow up Visit

If a participant is has returned for a subsequent visit, their new day will be add to their previous day(s) already saved. This is performed by opening their file from the external drive:

1. Ensure external hard drive is plugged into computer and power source
2. **File ⟶ Open from file⟶ Look in:** Free Agent Drive
3. Click on appropriate folder ⟶ **Open**
    - Choose from either Calgary Food Processor or Edmonton Food Processor)
4. Click on appropriate file ⟶ **Open**
    - File name corresponds to Participant ID
5. Add new day by: **Edit⟶ Add Day**
6. Change Date and Day
    - Change the date to represent the day in which foods were consumed. In other words, the date should be entered as the day before the date the 24 hr

recall was taken (ex. If recall was performed on August 15, 2009, then the date entered will be August 14, 2009).

- Date should be time stamped with the reported trimester using the corresponding letter:

  1st Trimester: A
  2nd Trimester: B
  3rd Trimester: C
  12 wk Postpartum: E

- To change date and insert time stamp:

d) Right click on **Date⟶ Modify item**
e) Enter the correct date in the format of month/day/year (ex. Day 1**(8/14/09)**)
f) Change day to the time stamp (ex. **B** (8/14/09))

3. Choosing from the Database

Tip before you start:
When choosing a food from the database, read the entire description of the food item. Descriptions that are cut off can be expanded by simply moving the cursor over the food selection. This will give you information about the food item as well as choosing the appropriate serving size.

1. Foods should be chosen, when possible, from the **Health Canada Database** (Canadian Nutrient File (CNF)).
   - It is important to choose a CNF first because all other foods reported in the Food Processor reflect foods found in the USA. Canadian and American foods different in nutrient content. CNF food items will also have a more complete nutrient profile than manufacturers' foods.
   - Health Canada foods can be easily identified because they are in capital letters. The "Supplier" (rightmost column) will say Health Canada.
   - Your search can be specified to only these foods by typing in the search field your food item followed by *Health Canada*

IMPORTANT NOTES:

- Common foods, as well as, many other foods **can be found** in the Health Canada Database.
- ***You must be persistent in your search***.
- If you cannot not find the food you are looking for, try:
- Searching for the food item under a different name. In other words, sometimes foods are classified under a name that differs from the one in which you are searching. (ex. The CNF uses roll instead of bun)
  i. Check the spelling of your food. The CNF uses the British spelling of some foods. (ex. yog**ou**rt instead of yog**u**rt)

ii. Make sure your food item is singular.

2. Use the **APrON Food Processor Default List** for common foods, (i.e. skim milk or commercial whole wheat bread) or food with little description (i.e. store bought chocolate chip cookie)
    - ***This list was created to ensure consistency and reliability in data entry data entry process.*** Most foods have been chosen from the CNF, but you will find one or two from the USDA database.
    - The *ESHA* Code can be type directly in search field
    - If you feel a food item should be added to the list, record the food item name, Food Processor description, and ESHA code. Give this information to the project coordinator so they can add it to the master list.

3. If you have done an exhaustive search, and the food item cannot be found in the Health Canada Database, choose the closest match from the USDA database.
    - These foods will be in lower case and will have USDA in the "Supplier" column

4. The Brand Name/Manufacturer foods should be chosen only when the best match is not in the Health Canada or USDA database. This is because these foods may not have as many nutrients listed and reflect American food products.

Note:

- If choosing between multiple brand name foods, compare the number of nutrients listed for each item and choose the food item with the greatest number of nutrients listed. This can be done by:

  Single click on food item → **Preview** → **Nutrients**
- If there is no information for a nutrient in a food, that nutrient value is left blank

4. Entering Food Items

Tip before you start:
Enter food into the Food Processor in the same order in which they appear on the 24 hour recall. This will make it easier to check over entries and make changes if necessary.

1. In the **Search For**: window, type in the name of the food item for which you are looking. Click **Search**.
    - Enter food items in the singular form. Using plurals decreases the number of food choices provided. (Example: Enter Strawberry and **not** strawberries or cracker **not** crackers)
    - The more specific you are, the more narrow your search will be (less results). This can be good help find the food item you are looking for more quickly, however, if you make the search too narrow or you may

include words not used by the Food Processor causing the item you are looking for to be eliminated from your search.

2. The results from your search will appear, in the **Select Recipe or Ingredient** pop up window.
3. Scroll through the results until you find an appropriate match or best match.

Remember:

- To read the full description of the food item
- That you can preview and food item nutrient content before you select it by:

Single click on food item → **Preview** → **Nutrients**

4. If you need to refine your search, you can do so by typing in your new search in the pop up window **Search For**: window and clicking **Search.**
5. To select the desired food time, double clicking on the item or click the food item once and click **Open**
6. A new pop up window will appear called **Modify Foodlist Item**. This is where you will enter in the amounts of food eaten.

5. Entering the Food Amounts

1. In the **Quantity** window, enter the amount of food that was eaten (this will be the number only, not the unit)
2. In the **Measure** window, enter the unit
3. Click **OK**
5. If the measurement provided in the recall is not listed as one of the choices, check the **APrON Food Processor Default List** to see if the conversion is listed. If the conversion is not listed, use the website www.thecaloriecounter.com for measurement conversions.
6. If the measure was taken in comparison to the food models (FM), see Food Model Equivalents chart, Appendix 1, for the equivalent measurement and units.
7. Be cautious using the *each*, *serving* and *slice* measures.
    i. *Each* does not always mean the same thing. It can mean each cracker, each serving of crackers (e.g. 4 crackers) or each box of crackers. However, most often you will know what *each* refers to by reading the entire food description.
    ii. Serving does not necessarily refer to a Canadian Food Guide serving. This is especially true of brand name foods. *Serving* **should not** be used as a food measure.
    iii. Using the *slice* measurement should be done so cautiously. If it does not indicate in the food description what constitutes a slice, it should not be used as a measurement.

Exception: APrON uses *slice* for one standard slice of bread.

6. Entering a Food Labels

If no match is found in any of the databases, food items can be searched through the manufacturer or restaurant's website or by contacting them directly by telephone or e-mail. If nutrition information is found it may be entered into the Food Processor database using the steps below:

1. Click on **Ingredient→ New**
2. Type in food name (including brand name/restaurant), **Quantity** and **Measure**
3. Click **New**
4. Type in all nutrient values provided into white boxes. If nutrient value is not listed, leave box empty (DO NOT put in zero).
5. Click **Finish**
6. Click **Save** and close the window
7. You may now search for the food item in the database by using the **Search For:** window.

Note: This food label is now saved into the food item database in the Food Processor software on the computer you are using. You can search for this food item again even if entering in other data under another Participant ID. Unfortunately, however, it is only saved to the computer you are using. You can not access this for label when using Food Processor on another computer (even if opening a participant file from memory stick)

7. Entering a Recipe

If a recipe for a food item is provided it may be entered into Food Processor by using the steps below.

1. Click **Recipe/Formula→ New**
2. Type in recipe **Name** and number of **Servings**. If number of servings is unknown, type in 1.
3. Click **Finish**
4. Enter in each ingredient and amount the same way you would enter food items.
5. Click **File→ Save**
6. Close window and return to **Person**.
7. Recipe can now be search for in the database

- On the occasion that a food is known to be homemade but no recipe is given and it is not in the database, a search for a common recipe can be made and entered into the Food Processor. This recipe will then become the default recipe for that food item and a note about the recipe should be given to the Research Coordinator so it can be added to the **APrON Food Processor Default List.**

Note: This recipe is now saved into the food item database in the Food Processor software on the computer you are using. You can search for this recipe again even if entering in other data under a**nother Participant ID. Unfortunately, however, it is only

saved to the computer you are using. You can not access this for recipe when using Food Processor on another computer (even if opening a participant file from memory stick).

8. Saving the Data

It is important that you save your data often (every 5 – 10 minutes) to ensure that you do not lose data should something occur.

1. Save to the external hard drive:
    i. **File ▸ Save to file**
    ii. **Save in:** Free Agent Drive
    iii. Choose the appropriate folder (either Calgary Food Processor or Edmonton Food Processor)
    iv. **File** name is participant ID

2. Save to memory stick
    i. **File ▸ Save to file**
    ii. **Save in:** STORE N GO
    iii. Choose the appropriate folder (either Calgary Food Processor or Edmonton Food Processor)
    iv. **File** name is participant ID

Appendix 1 – Food Model Equivalents

Item	**Size**
F/V	
Banana	Whole, 170g/6oz – medium
Apple	Whole, 6oz/170g/7 cm dia
Corn	120mL/4 fl oz
Carrots	120mL/4 fl oz
OJ	120mL/4 fl oz
Potato, baked	Whole, 6oz/175 g before baking
Grains	
Macaroni	120mL
Muffin	42g/1.5oz/6cm dia
Bagel	Whole, 85g/3oz/9cm dia
Rice	120mL
Pancake	1oz/27g/10cm dia
Chips, Tortilla	15-20, 0.57g/20g
Meat & Alt	
Chicken	3oz/85g
Roast beef	3oz/85g
Pork chop	3oz/85g w/o bone
Turkey, luncheon	1oz/30g/11cm dia
Fish Sticks	4, 1oz/28g
Dairy	
Milk	240mL
Cheese	1oz/30g

Yogurt	
Combination	
Lasagna	7.5cm x 10cm
Pizza	14cm sector, 1/8 of 36cm (14") dia
Chicken stir fry	240mL, 3oz/85g chicken
Other	
Ice cream	1 scoop, 120mL
Cake	5 x 5 x 4.5cm
Cookie	5cm dia
Brownie	5cm square
French Fries	120mL
Bowl	holds 1 C liquid

Appendix R Results from SPSS:

Pearson correlation perceived vs actual

		CALORIES	PROT	CARB	FIBRE	SUGAR
CFG	Pearson Correlation	.321*	.381**	.596**	.387**	.201
	Sig. (2-tailed)	.028	.008	.000	.007	.176
	N	47	47	47	47	47
DAQ2	Pearson Correlation	.248	.279	.500**	.358*	.087
	Sig. (2-tailed)	.092	.057	.000	.013	.563
	N	47	47	47	47	47
DAQ3	Pearson Correlation	.224	.415**	.541**	.505**	.202
	Sig. (2-tailed)	.126	.003	.000	.000	.169
	N	48	48	48	48	48
DAQ4	Pearson Correlation	.142	.153	.334*	.056	.074
	Sig. (2-tailed)	.336	.300	.021	.703	.616
	N	48	48	48	48	48
DAQ5	Pearson Correlation	.031	-.044	-.215	-.009	.104
	Sig. (2-tailed)	.833	.766	.142	.949	.480
	N	48	48	48	48	48
DAQ6	Pearson Correlation	.264	.230	.487**	.315*	.193
	Sig. (2-tailed)	.070	.116	.000	.029	.188
	N	48	48	48	48	48
DAQ7	Pearson Correlation	.088	.053	.138	.020	-.035
	Sig. (2-tailed)	.553	.722	.348	.894	.812
	N	48	48	48	48	48
DAQ8	Pearson Correlation	.056	-.006	.050	-.127	.028
	Sig. (2-tailed)	.703	.966	.734	.388	.849
	N	48	48	48	48	48
DAQ9	Pearson Correlation	.209	.211	.281	.183	.174
	Sig. (2-tailed)	.154	.150	.053	.212	.236
	N	48	48	48	48	48
DAQ10	Pearson Correlation	.019	-.049	-.158	-.125	.204
	Sig. (2-tailed)	.899	.743	.284	.397	.163
	N	48	48	48	48	48

Pearson correlation perceived vs actual

		FAT	SAT	MUFA	PUFA	Cholesterol	sodium
DAQ1	Pearson Correlation	-.102	-.016	.041	-.113	-.103	-.070
	Sig. (2-tailed)	.496	.913	.787	.449	.489	.638
	N	47	47	47	47	47	47
DAQ2	Pearson Correlation	-.126	-.023	.029	-.090	-.105	-.119
	Sig. (2-tailed)	.400	.879	.845	.546	.481	.424
	N	47	47	47	47	47	47
DAQ3	Pearson Correlation	-.115	.058	.096	-.084	.031	-.020
	Sig. (2-tailed)	.435	.693	.515	.569	.834	.891
	N	48	48	48	48	48	48
DAQ4	Pearson Correlation	-.092	.053	.002	-.001	-.138	-.098
	Sig. (2-tailed)	.534	.723	.990	.995	.348	.506
	N	48	48	48	48	48	48
DAQ5	Pearson Correlation	.334*	.125	.017	.111	.226	.239
	Sig. (2-tailed)	.020	.396	.907	.453	.123	.102
	N	48	48	48	48	48	48
DAQ6	Pearson Correlation	-.016	.080	.005	-.074	.132	.005
	Sig. (2-tailed)	.911	.590	.972	.615	.371	.971
	N	48	48	48	48	48	48
DAQ7	Pearson Correlation	-.207	-.186	-.038	-.226	-.134	-.174
	Sig. (2-tailed)	.157	.205	.796	.123	.363	.237
	N	48	48	48	48	48	48
DAQ8	Pearson Correlation	-.060	.063	.101	-.090	-.134	.021
	Sig. (2-tailed)	.688	.672	.493	.545	.363	.889
	N	48	48	48	48	48	48
DAQ9	Pearson Correlation	-.047	.164	.159	.099	.019	.081
	Sig. (2-tailed)	.753	.267	.280	.504	.899	.586
	N	48	48	48	48	48	48
DAQ10	Pearson Correlation	.312*	.163	.175	.100	.238	.356*
	Sig. (2-tailed)	.031	.268	.236	.498	.103	.013
	N	48	48	48	48	48	48

Food acceptability vs. actual adherence

		Actual adh.score	F_Acp 2	F_Acp 6	F_Acp7	F_Acp 8	F_Acp9	F_Acp 11
CALORIES	Pearson Correlation	.237	.134	.301*	.130	.129	.343*	.351*
	Sig. (2-tailed)	.106	.365	.040	.377	.381	.021	.015
	N	48	48	47	48	48	45	47
PROT	Pearson Correlation	.304*	.276	.165	.298*	.267	.083	.414**
	Sig. (2-tailed)	.036	.057	.269	.039	.067	.586	.004
	N	48	48	47	48	48	45	47
CARB	Pearson Correlation	.323*	.367*	.109	-.092	-.120	.406**	.450**
	Sig. (2-tailed)	.025	.010	.467	.532	.416	.006	.001
	N	48	48	47	48	48	45	47
FIBRE	Pearson Correlation	.496**	.467**	.163	.018	-.070	.309*	.390**
	Sig. (2-tailed)	.000	.001	.274	.905	.637	.039	.007
	N	48	48	47	48	48	45	47
SUGAR	Pearson Correlation	.305*	.359*	.119	-.107	-.141	.358*	.424**
	Sig. (2-tailed)	.035	.012	.424	.469	.338	.016	.003
	N	48	48	47	48	48	45	47
FAT	Pearson Correlation	.029	-.173	.402**	.191	.212	.237	.086
	Sig. (2-tailed)	.846	.239	.005	.194	.148	.117	.566
	N	48	48	47	48	48	45	47
SAT	Pearson Correlation	-.044	-.224	.300*	.175	.289*	.159	.081
	Sig. (2-tailed)	.769	.125	.041	.234	.046	.297	.587
	N	48	48	47	48	48	45	47
MUFA	Pearson Correlation	.094	-.167	.326*	.065	.049	.205	.111
	Sig. (2-tailed)	.524	.256	.025	.659	.743	.177	.456
	N	48	48	47	48	48	45	47
PUFA	Pearson Correlation	.126	-.094	.362*	.029	.036	.166	-.056
	Sig. (2-tailed)	.392	.526	.013	.845	.810	.277	.708
	N	48	48	47	48	48	45	47
CHOLESTROL	Pearson Correlation	-.058	-.079	.086	-.038	.016	.197	-.118
	Sig. (2-tailed)	.697	.592	.566	.796	.914	.195	.431
	N	48	48	47	48	48	45	47
DIEARYADHERENCESCORE	Pearson Correlation	1	.588**	-.138	.012	-.005	.197	.389**
	Sig. (2-tailed)		.000	.356	.936	.973	.194	.007
	N	48	48	47	48	48	45	47

Food acceptability vs. Perceived adherence

		PERDIETARYADHERENCE SCORE
Facp2	Pearson Correlation	.585**
	Sig. (2-tailed)	.000
	N	80
Facp6	Pearson Correlation	.446**
	Sig. (2-tailed)	.000
	N	79
Facp7	Pearson Correlation	-.315**
	Sig. (2-tailed)	.005
	N	79
Facp8	Pearson Correlation	.035
	Sig. (2-tailed)	.755
	N	80
Facp9	Pearson Correlation	-.011
	Sig. (2-tailed)	.925
	N	77
Facp11	Pearson Correlation	.112
	Sig. (2-tailed)	.337
	N	75
Facp15a	Pearson Correlation	.151
	Sig. (2-tailed)	.190
	N	77
Facp15b	Pearson Correlation	.072
	Sig. (2-tailed)	.532
	N	78
Facp15c	Pearson Correlation	-.094
	Sig. (2-tailed)	.410
	N	79
Facp15d	Pearson Correlation	.136
	Sig. (2-tailed)	.233
	N	79
Facp15e	Pearson Correlation	-.048
	Sig. (2-tailed)	.676
	N	79
Facp15f	Pearson Correlation	.147
	Sig. (2-tailed)	.202
	N	77
Facp15g	Pearson Correlation	.145
	Sig. (2-tailed)	.203
	N	79

Perceived adherence vs. Actual adherence (7 days)

		P_FV	P_GI	P_SUGAR	P_FIBRE	P_CARBSPAC	P_OMEGA3	P_FLAX	P_FAT
F_FV_7	Pearson Correlation	.129	-.093	.142	-.034	.018	.054	.336*	-.015
	Sig. (2-tailed)	.382	.528	.337	.821	.903	.713	.020	.917
	N	48	48	48	48	48	48	48	48
F_GI7	Pearson Correlation	-.038	.114	.037	.060	-.041	.017	.181	-.133
	Sig. (2-tailed)	.799	.440	.801	.687	.784	.908	.219	.369
	N	48	48	48	48	48	48	48	48
F_SUGAR7	Pearson Correlation	-.050	-.017	.103	.070	-.013	-.016	.155	-.169
	Sig. (2-tailed)	.736	.910	.485	.638	.928	.917	.292	.251
	N	48	48	48	48	48	48	48	48
F_FIBRE7	Pearson Correlation	.309*	.251	.449**	-.208	.157	.199	.284	.030
	Sig. (2-tailed)	.032	.085	.001	.156	.287	.174	.050	.842
	N	48	48	48	48	48	48	48	48
F_CARBSPAC7	Pearson Correlation	.038	-.137	.047	-.126	.034	.046	-.047	.263
	Sig. (2-tailed)	.797	.354	.750	.392	.818	.755	.753	.071
	N	48	48	48	48	48	48	48	48
F_OMEGA37	Pearson Correlation	.046	.155	-.008	-.031	.056	-.029	.213	-.064
	Sig. (2-tailed)	.756	.293	.957	.833	.707	.847	.146	.666
	N	48	48	48	48	48	48	48	48
F_FLAX7	Pearson Correlation	.127	.038	.119	.015	.087	.302*	.198	.135
	Sig. (2-tailed)	.389	.795	.419	.920	.555	.037	.177	.362
	N	48	48	48	48	48	48	48	48
F_FAT7	Pearson Correlation	.091	-.139	-.027	-.084	.065	-.083	-.151	-.029
	Sig. (2-tailed)	.537	.346	.855	.571	.662	.577	.305	.845
	N	48	48	48	48	48	48	48	48