UNIVERSITI PUTRA MALAYSIA

ASSOCIATION OF DIETARY PATTERNS WITH SOCIO-DEMOGRAPHIC, LIFESTYLE, WEIGHT STATUS AND BIOCHEMICAL PROFILES AMONG TYPE 2 DIABETES MELLITUS PATIENTS IN A SPECIAL MEDICAL CENTER, TEHRAN IRAN

NASRIN DARANI ZAD

FPSK(M) 2012 49

ASSOCIATION OF DIETARY PATTERNS WITH SOCIO-DEMOGRAPHIC, LIFESTYLE, WEIGHT STATUS AND BIOCHEMICAL PROFILES AMONG TYPE 2 DIABETES MELLITUS PATIENTS IN A SPECIAL MEDICAL CENTER, TEHRAN IRAN

By

NASRIN DARANI ZAD

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Master of Science

JULY 2012

Specially dedicated to

My mother, my father the most beloved persons in my life, for their love, understanding, endless patience and encouragement when it was most needed.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirements for the degree of Master of Science

ASSOCIATION OF DIETARY PATTERNS WITH SOCIO-DEMOGRAPHIC, LIFESTYLE, WEIGHT STATUS AND BIOCHEMICAL PROFILES AMONG TYPE 2 DIABETES MELLITUS PATIENTS IN A SPECIAL MEDICAL CENTER, TEHRAN IRAN

By

NASRIN DARANI ZAD

JULY 2012

Chairman: Rokiah bt Mohd Yusof, PhD

Faculty: Medicine and Health Sciences

A cross-sectional study was conducted to determine the dietary patterns and their association with socio-demography, lifestyle, weight status and biochemical profiles among type 2 diabetes mellitus subjects and to determine the significant predictors of dietary patterns. Three hundred subjects aged 30 years and above with type 2 diabetes mellitus were selected for this study. Height, weight, and waist circumference were measured and body mass index and waist hip ratio calculated. Biochemical profiles were investigated from past medical history records including glycosylated hemoglobin, fasting blood glucose, postprandial blood glucose, triglycerides, total cholesterol, low and high density lipoprotein cholesterol. For each subject, a physical activity level in weekly metabolic equivalent hours were calculated using International Physical Activity Questionnaire. To measure the

dietary intake of the subjects, a semi-quantitative food frequency questionnaire consisting 105 food items was used. The subjects were interviewed on how often they had consumed each of the food items throughout the preceding month to the study period. The frequency intake per day was obtained from the amount of food that was intake each day. The portion sizes of food were estimated to gram with using household measurements. Total energy intake was calculated by summing up energy intake from all foods. Because of the large number of the food items relative to the number of participants, each food was assigned item into 1 of 23 defined food groups. The basis for placing a food item in a certain food group was the similarity of nutrients. Some food items were considered individually as a food group because their nutrient profiles were unique (e.g., eggs, and tea). Three factors (dietary patterns) were identified using factor analysis. Factor 1 was characterized by higher intake of fruit, fish, poultry, low fat dairy, green leafy vegetables, tomato, yellow vegetables, other vegetables, and olive oil and was labeled as vegetables and poultry dietary pattern, Factor 2 was labeled as western dietary pattern which was heavily loaded with legumes, sweets, egg, fish, high fat dairy product, French fries, potatoes, pizza, yellow vegetables. Factor 3 was labeled as mixed dietary pattern with high intake of refined grain, fruits, nuts, tea, whole grains, red meat and olive. Using the multivariate regression model, the factors which contribute significantly to vegetable and poultry dietary pattern in diabetic patients were waist circumference (b=-0.022, p=0.000), low physical activity (b= -0.377, p=0.01), male (b= -0.295, p=0.01), total energy (b=0.001, p=0.000), and body mass index (b= -0.032, p=0.02). The significant factors accounted in the western dietary pattern as moderate physical activity (b= 0.773, p=0.000), male (b=0.436, p=0.001), total cholesterol (b= 0.003, p=0.008), total energy (b=0.000, p=0.001), non-smoker (b= 0.621, p=0.002),

uneducated (b= -0.371, p=0.02), single (b= -0.775, p=0.005), fasting blood glucose (b=0.002, p=0.013). In addition, the results, related to mixed dietary pattern, showed that family history of diabetes mellitus (b=0.349, p=0.003), total energy (b=0.001, p=0.000) and high density lipoprotein cholesterol (b=0.01, p=0.002), moderate physical activity (b=-0.39, p=0.03), waist circumference (b=-0.02, p=0.001), body mass index (b=0.03, p=0.01) as well as low density lipoprotein cholesterol (b=-0.003, p=0.04) were significantly associated with mixed dietary pattern. As a conclusion, these findings showed that dietary patterns are influenced by interrelated factors such as socio-cultural, demographic, and lifestyle, which may be important for designing public health nutrition policy and preventive nutrition intervention programs to tackle further diabetes complications among Iranians.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PERKAITAN ANTARA CORAK DIET DENGAN SOSIO-DEMOGRAFI, GAYA HIDUP, STATUS BERAT BADAN DAN PROFIL BIOKIMIA DALAM KALANGAN PESAKIT DIABETES MELLITUS JENIS 2 DI PUSAT PERUBATAN KHAS, TEHRAN, IRAN

Oleh

NASRIN DARANI ZAD

JULAI 2012

Pengerusi: Profesor Madya Rokiah binti Mohd Yusof, PhD

Fakulti: Perubatan dan Sains Kesihatan

Satu kajian keratan rentas telah dijalankan untuk menentukan corak diet dan perkaitan dengan sosio-demografi, gayahidup, status antropometri badan dan profil biokimia dalam kalangan subjek diabetes mellitus jenis 2, dan juga untuk menentukan petunjuk signifikan corak diet. Tiga ratus subjek diabetes mellitus berumur 30 tahun dan keatas telah dipilih. Tinggi, berat badan dan lilitan pinggang telah diukur dan indeks jisim tubuh dan nisbah pinggang-pinggul telah dikira. Profil biokimia telah dikaji menerusi rekod sejarah perubatan, termasuk paras hemoglobin glikosilat, glukosa darah berpuasa, glukosa darah selepas makan, trigliserida, jumlah kolesterol dan kolesterol lipoprotein ketumpatan rendah dan tinggi. Bagi setiap

subjek, tahap aktiviti fizikal dalam bentuk jam setara metabolik mingguan telah diukur menggunakan Soal Selidik Aktiviti Fizikal Antarabangsa. Bagi mengukur pengambilan diet subjek, soal selidik kekerapan pengambilan makanan separa-kuantitatif termasuk 105 jenis makanan telah digunakan. Subjek telah ditemuduga untuk kekerapan pengambilan makanan yang mereka makan bagi setiap jenis makanan daripada sebulan sebelumnya sehingga tempoh kajian. Kekerapan pengambilan setiap hari telah diperolehi bagi setiap jenis makanan. Saiz hidangan makanan telah dianggar kepada gram menggunakan sukatan isirumah. Jumlah pengambilan tenaga telah dikira dengan menjumlahkan pengambilan tenaga daripada semua makanan. Oleh kerana jumlah bilangan makanan yang banyak relatif kepada bilangan subjek, setiap makanan telah diagihkan kedalam 1-23 kumpulan makanan tertentu. Asas bagi meletakkan makanan kedalam kumpulan tertentu adalah mengikut persamaan nutrien di dalamnya. Terdapat juga makanan yang diletakkan secara individu sebagai kumpulan disebabkan profil nutriennya adalah unik (sebagai contoh: telur dan teh). Tiga faktor (corak diet) telah dikenalpasti melalui analisis faktor. Faktor 1, yang dilabelkan sebagai corak diet sayur-sayuran dan ayam-itek yang bercirikan pengambilan tinggi buah-buahan, ikan, ayam, produk tenusu rendah lemak, sayur-sayuran berdaun hijau, tomato, sayur-sayuran kuning, lain-lain sayur, dan minyak zaitun. Faktor 2, yang dilabelkan sebagai corak diet ala barat yang terdiri daripada kekacang, gula-gula, telur, ikan, produk tenusu tinggi lemak, kentang goreng, kentang, pizza dan sayur-sayuran kuning. Faktor 3 dilabelkan sebagai corak diet campuran, yang terdiri daripada bijian halus, buah-buahan, kacang, teh, bijian penuh, daging merah dan zaitun. Menggunakan model *regression multivariate*, faktor yang menyumbang secara signifikan kepada corak diet sayur-sayuran dan ayam-itek dalam kalangan pesakit diabetik adalah lilitan pinggang (b=-0.022,

p=0.000), aktiviti fizikal rendah (b=-0.377, p=0.01), lelaki (b=-0.295, p=0.01), jumlah tenaga (b=0.001, p=0.000), dan indeks jisim tubuh (b=-0.032, p=0.02). Faktor yang menyumbang secara signifikan dalam corak diet barat adalah aktiviti fizikal sederhana (b=0.773, p=0.000), lelaki (b=0.436, p=0.001), jumlah kolesterol (b=0.003, p=0.008), jumlah tenaga (b=0.000, p=0.001), tidak merokok (b=0.621, p=0.002), tidak berpelajaran (b=-0.371, p=0.02), tidak berkahwin (b=-0.775, p=0.005) dan paras glukosa darah berpuasa (b=0.002, p=0.013). Hasil kajian seterusnya juga berkait dengan corak diet campuran, menunjukkan bahawa sejarah keluarga diabetes mellitus (b=0.349, p=0.003), jumlah tenaga (b=0.001, p=0.000), kolesterol lipoprotein ketumpatan tinggi (b=0.01, p=0.002), aktiviti fizikal sederhana (b=-0.39, p=0.03), lilitan pinggang (b=-0.02, p=0.001), indeks jisim tubuh (b=0.03, p=0.01), dan kolesterol lipoprotein ketumpatan rendah (b=-0.003, p=0.04) mempunyai perkaitan yang signifikan dengan corak diet campuran. Sebagai rumusan, kajian ini menunjukkan bahawa corak diet dipengaruhi oleh faktor-faktor sosio-budaya, demografi dan faktor gayahidup yang saling berkaitan, dan penting untuk merancang polisi pemakanan kesihatan awam dan program intervensi pemakanan bagi membendung komplikasi diabetes seterusnya dalam kalangan penduduk Iran.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank my compassionate supervisor, Dr Rokiah Mohd Yusof who always guides me through all ups and downs, joyful and hopeless moments during my research. I truly appreciate her support, concerns, time and sincerity I received during my study.

I would like to thank my co-supervisors, Dr. Rosita Jamaluddin and Dr. Fariba Mohseni, for their advices and insightful comments, which guide me through the proper direction. I am indebted for their knowledge and helpful contributions on this thesis.

I would like to express my deepest gratitude to my beloved mother, my supportive father,and my fiancé, Ali Hamedani who are always there for me. This thesis would not have been possible without their love and understanding. I would like to dedicate this thesis to my parents, for their patients, unconditional love and generosity during my whole life. My special thanks to all my friends for their impressive help in my thesis. I want to thank all the patients for providing valuable feedback in this study.

Finally, thanks God for giving me another opportunity to know myself by living in Malaysia.

I certify that a Thesis Examination Committee has met on 7.13.2012 to conduct the finale examination of Nasrin Darani Zad on her thesis entitled "Association of Dietary Patterns with Socio-demography, Lifestyle, Weight Status and Biochemical Profiles among Type 2 Diabetes Mellitus Patients in a Special Medical Center, Tehran Iran" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998.The Committee recommends that the candidate be awarded the master of science.
Members of the Thesis Examination Committee were as follows:

Mohd Sokhini bin Abd Mutalib, PhD
Associate Professor
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Chairman)

Dr. Zaitun bt Yassin, PhD
Associate Professor
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Internal Examiner)

Dr. Mary Huang Soo Lee, PhD
Associate Professor
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Internal Examiner)

Dr. Poh Bee Koon, PhD
Professor
Faculty of Health Sciences
University Kebangsaan Malaysia
(External Examiner)

_____

SIEW HENG FONG, PhD
Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:22 October 2012

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirements for the degree of Master of Science. Members of the Supervisory Committee were as follows:

Rokiah Mohd Yusof, PhD

Associate Professor

Faculty of Medicine and Health Sciences

Universiti Putra Malaysia

(Chairman)

Rosita Jamaluddin, PhD

Faculty of Medicine and Health Sciences

Universiti Putra Malaysia

(Member)

Fariba Mohseni, PhD

Associate Professor

Faculty of Medicine and Health Sciences

AJA Medical University of Tehran

(Member)

BUJANG BIH KIM HUAT, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malays

Date:

DECLARATION

I declare that the thesis is my original work expect for quotations and citations which have been duly acknowledged. I also, declare that it has not been previously, and is not concurrently, submitted for any other degree at University Putra Malaysia or at any other institutions.

NASRIN DARANI ZAD

Date: 13.July.2012

TABLE OF CONTENTS

Table **LIST OF TABLES** **Page**

LIST OF FIGURES

LIST OF ABBREVIATIONS

ADA	American Diabetes Association
BMI	Body Mass Index
DGAI	Dietary Guidelines for the Americans adherence Index
DM	Diabetes Mellitus
FBG	Fasting Blood Glucose
GDM	Gestational diabetes mellitus
GI	Glycemic index
HbA1c	Glycated Hemoglobin
HDL-C	High-Density Lipoprotein Cholesterol
IFG	Impaired Fasting Glycemia
IGT	Impaired Glucose Tolerance
IPAQ	International Physical Activity Questionnaire
LDL-C	Low-Density Lipoprotein Cholesterol
MET	Metabolic Equivalent
PPBG	Postprandial Blood Glucose
Q	Quintile
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
T2DM	Type 2 Diabetes Mellitus
TC	Total Cholesterol
TG	Triglyceride
VO_2 max	Maximal oxygen consumption
WC	Waist Circumference
WHO	World Health Organization
WHR	Waist Hip Ratio

CHAPTER 1

INTRODUCTION

1.1 Background

The term diabetes mellitus (DM) describes a metabolic disorder that is characterized by chronic hyperglycemia with disturbances of carbohydrate, protein and fat metabolism resulting from defects in insulin secretion, insulin action, or both (ADA, 2006). Diabetes mellitus may present symptoms such as thirst, polyuria, weight loss and blurring of vision. In its most severe form, ketoacidosis or a non ketotic hyperosmolar state may develop and lead to stupor, coma and in the absence of effective treatment, death (Craig et al., 2009).

The incidence of DM is increasing worldwide (Tuomilehto et al., 2001). As DM affects around 171 million people worldwide, it is predicted by the World Health Organization (WHO) that this number will have more than doubled to 366 million by 2030 (Wild, 2004). DM results in about 3.2 million deaths per annually. According to WHO (2006), DM increases the risk of heart disease and stroke. It has been reported that 50 % of diabetic patients die of cardiovascular disease. Type 2 diabetes mellitus (T2DM) is becoming an epidemic in the world. The worldwide prevalence of T2DM was 2.8% with an expected increase to 4.4% by the year 2030 (Wild et al., 2004). In the coming decade, one of the world's greatest increases in the absolute burden of diabetes is expected to be in the Middle East. The prevalence of T2DM ranges from 1.2% to 14.6% in Asia and 4.6% to 40% in the Middle East (Marjani

and Mojerloo, 2011). Modernization has resulted in increased rates of diabetes, primarily because of a decrease in physical activity and an increasing consumption of high caloric diets in these nations. Iran is a Middle East country which experienced a socioeconomic transition coupled with westernization in diet and lifestyle. People both in urban and rural areas are increasingly suffering from chronic disease related to their diets.

There is a considerable imbalance in food consumption with low nutrient density in food consumption among the Iranian population (Ghassemi et al.,2002). An Iranian study was reported approximately 2 million adults have DM, ranging from a prevalence of 1.3% in rural areas and increase to 14.5% in the large cities of Iran (Azizi et al., 2003); Azizi revealed that the prevalence of diabetes is 8.7% in Tehran, the capital city of Iran. The peak prevalence was observed among individuals aged 55–64 years, whereas the greatest total number of diabetic individuals was among the 45–54 years age-group (Esteghamati et al., 2008). Early detection and appropriate management of diabetes is essential to reduce diabetes complications and major mortality.

1.2 Complication of Diabetes Mellitus

The effects of DM include long-term damage, dysfunction and failure of various organs. The long-term effects of DM include progressive development of specific complications. Diabetic complications can be categorized broadly as microvascular or macrovascular complications. Microvascular complications include nephropathy (kidney disease), neuropathy (nerve damage), and vision disorders (e.g., glaucoma,

retinopathy cataract, and corneal disease). Macrovascular complications include cerebrovascular disease, coronary heart disease, and peripheral vascular disease which can lead to ulcers, gangrene, and amputation (Williams et al., 2002). Dietary intervention, physical activity, weight management and cessation of smoking are all necessary for good glycemic control, the prevention of both microvascular and macrovascular complication (ADA, 2005).

1.3 Problem Statement

Diabetes causes disability and premature death in both developing and newly developed countries have significantly increased. Chronic complications are the major outcome of T2DM progress, which reduce the quality of life of patients, incur heavy burdens to the health care system, and increase diabetic mortality (Liu et al., 2010). In Isfahan, big city of Iran, the rate of complications among approximately 4000 T2DM patients was reported to be ischemic heart disease (34%), hypertension (50%), congestive heart failure (12%), retinopathy (44%), cataract (5%), bacteriuria (27%), nephropathy (19%), neuropathy (27%), depression (60%), diabetic foot (2.5%), hypercholesterolaemia (37%), and hypertriglyceridaemia (37%) (Azizi et al., 2003).

Type 2 diabetes mellitus is a well-known disease in which diet plays an important role in etiology and management. The goals of diet control are to improve quality of life, nutritional status as well as to prevent the chronic complications of diabetes. Appropriate dietary practice are a basic and integral part treating diabetes mellitus and may reduce the development of disease complications by improving risk

factor profiles (Al-Kaabi et al.,2008). Diabetic people are routinely advised to adopt a healthful diet; dietary changes include modifications in food habits and meal patterns on a lifelong basis (Yannakoulia, 2006).

Until now, numerous studies on the association between diet and diabetes have been reported. Diet is a complex exposure variable, various approaches are required to examine the relationship between diet and disease. The traditional approach to investigating diet-disease associations focuses on single dietary components, such as single nutrients or foods. Most of the studies focusing on nutrients or single food/food group intake. For instance, whole-grain intake appears to reduce blood glucose, fasting insulin among insulin-resistant subjects (Pereiraet al., 2002). However, individuals eat combinations of foods as meals instead of consuming single nutrients or foods, making it difficult to interpret the effects of dietary factors.

Therefore, the recent researches has focused more on dietary pattern approach to investigate the relationship between disease and diet, rather than disease and individual food or nutrient factors (Lee et al., 2011). Favorable results of dietary pattern approaches have been seen in previous studies, for example, the healthy type dietary pattern rich in vegetable and fish, which is similar to the Mediterranean diet, and Dietary Approach to Stop Hypertension (DASH) was suggested to improve life prognosis in diabetic patients (Limuro et al.,2012). However, there have been few studies that have examined the dietary patterns among patients with diabetes mellitus (Lim et al., 2011). Furthermore, the epidemiology studies showed that, dietary patterns were influenced by biological, nutritional, socioeconomic, and demographic characteristics (Kant, 2004; Yi Park et al., 2005). Within several populations,

researchers have identified different dietary patterns that are attributable to varying social and cultural backgrounds. The differences in dietary patterns of societies are the result of different socio-demographic characteristics and lifestyle of patients that affect the choice of foods and diet. Therefore, many countries have tried to identify their own dietary patterns to determine their relationship with chronic disease, because culture and unique dietary patterns are factors that can influence the incidence of chronic disease (Odegaard et al., 2011)

However, diet, a lifestyle behavior, has been reported as a management domain with very low compliance among diabetics (mirmiran et al.,2007). People with diabetes generally report better nutrition awareness, but this does not consistently translate into healthy eating behaviors. Results from cross-sectional studies indicated low adherence to the dietary recommendations for macronutrient intake and fruit and vegetable consumption (Thanopoulou et al., 2004). In Iran, Veghari et al., (2007) reported diabetic patients do not have an effective knowledge about their diet and blood glucose controlling methods. Thus, there is a need to study and more practical dietary strategies are necessary. This study would provide information for planning dietary menu for diabetes mellitus. The purpose of this study was to identify dietary patterns among adults with T2DM and explore the associations of the dietary patterns with lifestyle, weight status, and biochemical blood profiles for management of the disease in order to prevent from further complications. Our findings may provide useful data for the development of practical dietary guidelines for diabetes management or treatment in Asian populations.

1.4 Research Questions

This research hopes to answer the following questions:

i. What are the socio-demography, lifestyles, weight status, and biochemical profiles of diabetic subjects?

ii. What are the dietary patterns among diabetic subjects in the Special Medical Center, Tehran, Iran?

iii. Are there any associations between socio-demography, lifestyle, weight status, and biochemical profiles, with dietary patterns?

1.5 Objectives

1.5.1 General Objective:

To determine dietary patterns and their association with socio-demographic, lifestyle, weight status, and biochemical profiles among patients with T2DM in a Special Medical Center in Tehran, Iran.

1.5.2 Specific Objectives

- To determine the socio-demographic characteristics and related health factors including age, gender, marital status, educational level, occupation, monthly income, duration of T2DM, family history of DM, hypertension, and treatment of DM among subjects with T2DM.
- To determine the lifestyle factors such as smoking and physical activity. Smoking status was assessed as current smoker, non-smoker or ex-smoker. Physical activity

level was measured by International Physical Activity Questionnaire (IPAQ, short form) and categorized into 3 levels as low, moderate or high physical activity.

- To determine BMI, waist circumference (WC), and waist hip ratio (WHR) of subjects with T2DM.
- To assess glycosylated hemoglobin **(**HbA1c), fasting blood glucose (FBG), postprandial blood glucose (PPBG), lipid profiles [total cholesterol (TC), triglycerides (TG), low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C)] of subjects with T2DM from most recent medical record.
- To determine the dietary patterns, total energy intake and energy intake from macronutrients of subjects with T2DM through food frequency questionnaire (FFQ).
- To determine the association of dietary patterns with socio-demography, lifestyle, weight status, and biochemical profiles of subjects with T2DM.

1.6 Null Hypothesis

H01: There is no significant association between socio-demographic characteristics and dietary patterns.

H02: There is no significant association between lifestyle factors and dietary patterns.

H03: There is no significant association between weight status and dietary patterns.

H04: There is no significant association between biochemical profiles and dietary patterns

1.7 Conceptual Framework

The purpose of the present study was to determine the dietary patterns among T2DM subjects and its association with socio-demography, lifestyle, weight status, and biochemical profiles. Some studies reported that socio- demographic characteristics and lifestyle factors were associated with dietary pattern (Lenz, 2009; Rezazadeh et al., 2010). Besides, dietary pattern was also found to be correlated with weight status (Newby et al., 2004) and lipid profiles (Lim et al., 2011**).**

As shown in Figure 1.1, the outcome was influenced by socio-demography, related health factors, lifestyle, weight status and, biochemical profiles. In this conceptual model, dietary patterns as dependent variables influenced by 4 independent variables, socio-demographic characteristics were defined as age, gender, marital status, educational level, occupation, monthly income, related health factors are defined as family history of DM, hypertension, and treatment of DM. Lifestyle factors were defined as physical activity and smoking. Anthropometric measurements included body mass index (BMI), waist circumference (WC) and waist to hip ratio (WHR). Finally, biochemical profiles included the glycosylated hemoglobin (HbA1c), fasting blood glucose (FBG), postprandial blood glucose (PPBG), total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C).

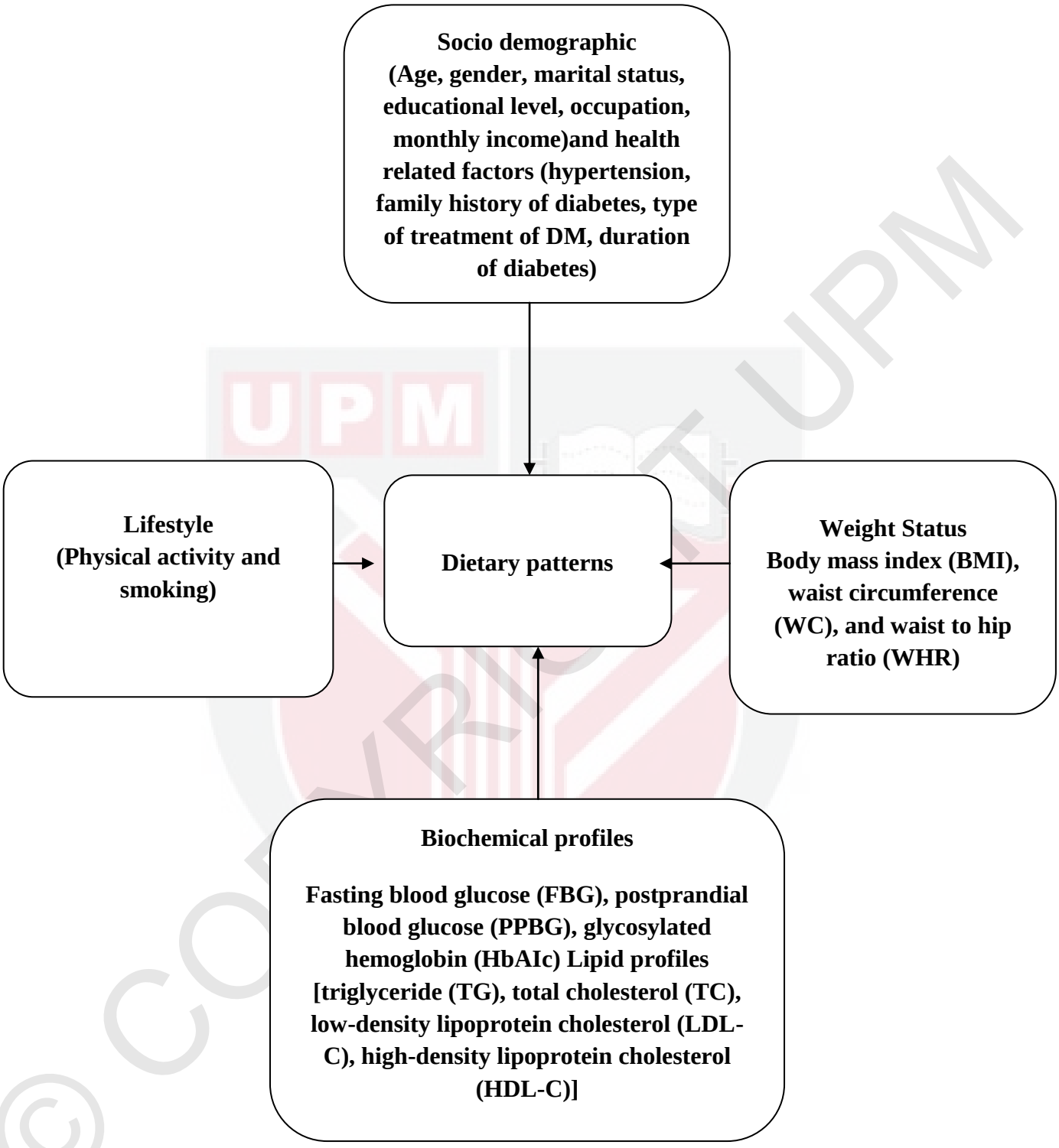

Figure 1.1 Conceptual Framework

1.8 Significance of the Study

This present study recognized dietary patterns among diabetic patients. Dietary pattern analysis provides patterns of food consumption among diabetic subjects; which has been shown to be useful, because it goes beyond nutrients and examines the effect of overall diet. A dietary pattern approach reflects individual's dietary behaviors and therefore can provide more detailed information about nutritional etiology of diabetes mellitus.

Analyzing dietary pattern can provide insights into possibilities for dietary changes and also may help facilitate the translation of findings into dietary recommendation. It can also enhance our conceptual understanding of diabetic patients dietary practice, and provide guidance for nutrition education. Information obtained from food consumption patterns, and associated with socio-demography, lifestyle, weight status and biochemical profiles which would be useful to nutritionists for monitoring diabetic patients' food consumption trends, identification of nutritional at risk groups, targeting for public health nutrition interventions programs and it could be very useful in establishing practical dietary guidelines for diabetics. Briefly, understanding dietary exposure should precede planning of public health nutrition policy and designing of preventive nutrition intervention to tackle from further diabetes complication, among Iranians.

REFERENCES

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*, 110-115.

American Diabetes Association. (2003). Physical activity/exercise and diabetes mellitus. *Diabetes Care, 26*, S73-S77.

American Diabetes Association. (2005). Standards of Medical Care in Diabetes. *Diabetes Care, 28*, S4-S36.

American Diabetes Association. (2006). Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care, 29*, S43-S48.

American Diabetes Association. (2010). Standards of Medical Care in Diabetes-2010. *Diabetes Care, 33*. S11-S61.

Anderson, J. W., Randles, K. M., Kendall, C. W. C., & Jenkins, D. J. A. (2004). Carbohydrate and fiber recommendations for individuals with diabetes: a quantitative assessment and meta-analysis of the evidence. *American college of nutrition, 23*, 5-17.

Appel, L. J., Moore, T. J., Obarzanek, E., Vollmer, W. M., Svetkey, L. P., Sacks, F. M., et al. (1997). A clinical trial of the effects of dietary patterns on blood pressure. *New England Journal of Medicine, 336*, 1117-1124.

Aranceta, J., Pe´rez-Rodrigo, C., L Ribas, L., & Serra-Majem, L. l. (2003). Socio-demographic and lifestyle determinants of food patterns in Spanish children and adolescents: the enKid study. *European Journal of Clinical Nutrition, 57*, S40–S44.

Azimi-Nezhad, M., Ghayour-Mobarhan, M., Parizadeh, M. R., Safarian, M., Esmaeili, H., Parizadeh, S. M. J., et al. (2008). Prevalence of type 2 diabetes mellitus in Iran and its relationship with gender, urbanisation, education, marital status and occupation. *Singapore Medical Journal, 49*, 571-576.

Azizi, F., Guoya, M., Vazirian, P., Dolatshati, P., & Habbibian, S. (2003). Screening for type 2 diabetes in the Iranian national programme: a preliminary report. *Eastern Mediterranean Health Journal, 9*, 1122-1127.

Bantle, J. P., Wylie-Rosett, J., Albright, A. L., Apovian, C. M., Clark, N. G., Franz, M. J., et al. (2008). Nutrition Recommendations and Interventions for Diabetes. *Diabetes care, 31*, S61-S78.

Barclay, A. W., Petocz, P., McMillan-Price, J., Flood, V. M., Prvan, T., Mitchell, P., et al. (2008). Glycemic index, glycemic load, and chronic disease risk—a meta-analysis of observational studies. *The American journal of clinical nutrition, 87*, 627-637.

Bazzano, L. A., Thompson, A. M., Tees, M. T., Nguyen, C. H., & Winham, D. M. (2011). Non-soy legume consumption lowers cholesterol levels: a meta-analysis of randomized controlled trials. *Nutritional, metabolism and cardiovascular disease, 21*, 94-103.

Bener, A., & Zirie, M. (2007). Lipids, lipoprotein (a) profile and HbA1c among Arabian Type 2 diabetic patients. *Biomedical Research* (pp97-102).

Bodhe, C., Jankar.D, Bhutada, T., Patwardhan, M., & Patwardhan, V. (2012). HbA1c: Predictor of Dyslipidemia and Atherogenicity in Diabetes Mellitus. *International Journal of Basic Medical Sciences and Pharmacy (IJBMSP)2*, 25-27.

Bonen, A., Dohm, G. L., & van Loon, L. J. (2006). Lipid Metabolism, Exercise and insulin action. *Essays in Biochemistry, 42*, 47-59.

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

Brouns, F., . Bjorck, I,. Frayn,K. N,. Gibbs, A. L,.Lang,V,.Slama,G,.Wolever,T.M.S. (2005). Glycaemic index methodology. *Nutrition Research Review, 18*, 145–117.

Brunner, E. J., Mosdol, A., Witte, D. R., Martikainen, P., Stafford, M., Shipley.M.J., et al. (2008). Dietary patterns and 15-y risks of major coronary events, diabetes, and mortality. *American journal clinic nutrition, 87*, 1414-1421.

Cai, H., Zheng, W., Xiang, Y. B., Xu, W. H., Yang, G., Li, H., et al. (2007). Dietary patterns and their correlates among middle-aged and elderly Chinese men: a report from the Shanghai Men's Health Study. *British Journal of Nutrition, 98*, 1006-1013.

Canga, N., De Irala, J., Vara, E., Duaso, M. I., Ferrer, A., & Martínez-González, M. A. (2000). Intervention study for smoking cessation in diabetic patients. *Diabetes Care, 23*, 1455-1460.

Cattell, R. B. (1996). The scree test for the number of factors. *Multivariate Behavioral Research, 1*, 245-276.

Cernea, S., Hancu, N., & Raz, I. (2003). Diet and coronary heart disease in diabetes. *Acta diabetologica, 40*, 389-400.

Chandalia, M., Garg, A., Lutjohann, D., Bergmann, V. K., Grundy, S. M., & Brinkley, L. J. (2000). Beneficial effects of high dietary fiber intake in patients with type 2 diabetes mellitus. *New England Journal of Medicine, 342*, 1392-1398.

Cho, E., Manson, J. E., Stampfer, M. J., Solomon, C. G., Colditz, G. A., Speizer, F. E., et al. (2002). A prospective study of obesity and risk of coronary heart disease among diabetic women. *Diabetes Care, 25*, 1142-1148.

Choi, H. K., Willett, W. C., Stampfer, M. J., Rimm, E., & Hu, F. B. (2005). Dairy consumption and risk of type 2 diabetes mellitus in men: a prospective study. *Archives of Internal Medicine, 165*, 997-1003.

Chrysohoou, C., Panagiotakos, D. B., Pitsavos, C., Das, U. N., & Stefanadis.C. (2004). Adherence to the Mediterranean diet attenuates inflammation and coagulation process in healthy adults: The ATTICA Study. *Journal of The American College Of Cardiology, 44*(152-158).

Coulston, A. M., Hollenbeck, C. B., Swislocki, A. L., & Reaven, G. M. (1987). Effect of source of dietary carbohydrate on plasma glucose and insulin responses to mixed meals in subjects with NIDDM. *Diabetes Care, 10*, 395–400.

Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., et al. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine and Science in Sports and Exercise*, 1381-139535.

Craig, M. E., Hattersley, A., & Donaghue, K. C. (2009). Definition, epidemiology and classification of diabetes in children and adolescents. *Pediatric Diabetes, 10*, 3-12.

Cunha, D. B., Rodrigues de Almeida, R. M. V., Sichieri, R., & Pereira, R. A. (2010). Association of dietary patterns with BMI and waist circumference in a low-income neighbourhood in Brazil. *British Journal of Nutrition, 104*, 908-913.

A foun :Biostatistics .2005 .W .W ,Danieldation for analysis in the health sciences. 8th. New york: John Wiley and Sons.

Davies, M. J., Judd, J. T., Baer, D. J., Clevidence, B. A., Paul, D. R., Edwards, A. J., et al. (2003). Black tea consumption reduces total and LDL cholesterol in mildly hypercholesterolemic adults. *The Journal of Nutrition, 133*, 3298S-3302S.

DeFronzo, R. A.. (2004). Pathogenesis of type 2 diabetes mellitus. *Medical Clinics North America, 88*, 787–835.

Deshmukh-Taskar, P. R., O'Neil, C. E., Nicklas, T. A., Yang, S. J., Liu, Y., Gustat, J., et al. (2009). Dietary patterns associated with metabolic syndrome, sociodemographic and lifestyle factors in young adults: the Bogalusa Heart Study. *Public Health Nutrition, 12*, 2493-2503.

Djouss´e, L., Gaziano, J. M., Buring, J. E., & Lee, L. M. (2009). Egg consumption and risk of type 2 diabetes in men and women. *Diabetes Care, 32*, 295-300.

Dugee , O., Khor, G. L., Lye, M. S., Luvsannyam, L., Janchiv.O, Jamyan.B, et al. (2009). Association of major dietary patterns with obesity risk among Mongolian men and women. *Asia Pacific Journal Clinic Nutrition, 18*, 433-440.

Dynesen, A., Haraldsdottir, J., L, H., & Astrup, A. (2003). Sociodemographic differences in dietary habits described by food frequency questions--results from Denmark. *European Journal of Clinical Nutrition, 57*, 1586-1597.

Egede, L. E., & Zheng, D. (2002). Modifiable Cardiovascular Risk Factors in Adults With Diabetes. *Archives of Internal Medicine , 162*, 427-443.

Esmaillzadeh, A., & Azadbakht, L. (2008). Major dietary patterns in relation to general obesity and central adiposity among Iranian women. *The Journal of nutrition, 138*, 358-363.

Esmaillzadeh, A., Kimiagar, M., Mehrabi, Y., Azadbakht, L., Hu, F. B., & Willett, W. C. (2007). Dietary patterns, insulin resistance, and prevalence of the metabolic syndrome in women. *The American Journal of Clinical Nutrition, 85*, 910-918.

Esposito K, M. R., Ciotola M . (2004). Effect of a Mediterranean-style diet on endothelial dysfunction and markers of vascular inflammation in the metabolic syndrome: a randomized trial. *Journal Of The American Medical Association, 292*, 1440-1446.

Esteghamati, A., Gouya, M. M., Abbasi, M., Delavari, A., Alikhani, S., Alaedini, F., et al. (2008). Prevalence of diabetes and impaired fasting Glucose in the adult population of Iran. *Diabetes Care, 31*, 96-98.

Estruch, R., Gonzalez, M., Corella, D., Salvado, S. J., Gutierrez, R. V., Covas, M., et al. (2006). Effects of a Mediterranean-style diet on cardiovascular risk factors: a randomized trial. *Annals of Internal Medicine, 13*, 1-11.

Ford, E., & Mokdad, A. (2001). Fruit and vegetable consumption and diabetes mellitus incidence among U.S. adults. *Preventive Medicine, 32*, 33-39.

Fumeron, F., Lamri, A., Abi Khalil, C., Jaziri R, Porchay-Baldérelli, I., Lantieri, O., et al. (2011). Dairy consumption and the incidence of hyperglycemia and the metabolic syndrome: results from a French prospective study, Data from the Epidemiological Study on the Insulin Resistance Syndrome (DESIR). *Diabetes Care, 34*, 813-817.

Fung, T. T., Rimm, E. B., Spiegelman, D., Rifai, N., Tofler, G. H., Willett, W. C., et al. (2001). Association between dietary patterns and plasma biomarkers of obesity and cardiovascular disease risk. *The American journal of clinical nutrition, 73*, 61-67.

Fung, T. T., Schulze, M., Manson, J. A. E., Willett, W. C., & Hu, F. B. (2004). Dietary patterns, meat intake, and the risk of type 2 diabetes in women. *Archives of Internal Medicine, 164*, 2233-2240.

Ganji, V., Kafai, M. R., & McCarthy, E. (2009). Serum leptin concentrations are not related to dietary patterns but are related to sex, age, body mass index, serum triacylglycerol, serum insulin, and plasma glucose in the US population. *Nutrition & Metabolism*.

Ghassemi, H., Harrison, G., & Mohammad, K. (2002). An accelerated nutrition transition in Iran. *Public Health Nutrition, 5*, 149-155.

Goldberg, I. J. (2000). Clinical review 124: Diabetic dyslipidemia: causes and consequences. *The Journal of Clinical Endocrinology And Metabolism, 86*, 965-971.

GREEN, C., BLANCHARD, J. F., YOUNG, T. K., & GRIFFITH, J. (2003). The Epidemiology of Diabetes in the Manitoba-Registered First Nation Population. *Diabetes Care, 26*, 1993-1998.

Hair, J., J.F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. 2006. Multivariate data analysis (6th Ed.), Pearson-Prentice Hall, Upper Saddle River.

1.1.1 Halton, T. L., Willett, W. C., Liu, S., Manson, J. E., Stampfer, M. J., & Hu, F. B. (2006). Potato and french fry consumption and risk of type 2 diabetes in women. *The American Journal of Clinical Nutrition, 83, 284-290.*

Hamer, M., & Mishra, G. D. (2010). Dietary patterns and cardiovascular risk markers in the UK Low Income Diet and Nutrition Survey. *Nutrition, Metabolism & Cardiovascular Diseases, 20*, 491-497.

Heidemann, C., Hoffmann, K., Spranger, J., Klipstein-Grobusch, K., Möhlig, M., Pfeiffer, A. F. H., et al. (2005). A dietary pattern protective against type 2 diabetes in the european prospective investigation into cancer and nutrition (EPIC)—potsdam study cohort. *Diabetologia 48*, 1126-1134.

Henson, R. K., & Roberts, J. K. (2006). Use of exploratory factor analysis in published research:Common errors and some comment on improved practice. . *Educational and Psychological Measurement, 66*, 393-416.

Hodge, A. M., English, D. R., O'Dea, K., & Giles, G. G. (2007). Dietary patterns and diabetes incidence in the Melbourne Collaborative Cohort Study. *American journal of epidemiology*, *165*, 603-610.

Hu, F. B. (2002). Dietary pattern analysis: a new direction in nutritional epidemiology. *Current Opinion in Lipidology, 13*(1), 3-0.

Hu, F. B., Rimm, E. B., Stampfer, M. J., Ascherio, A., Spiegelman, D., & Willett, W. C. (2000). Prospective study of major dietary patterns and risk of coronary heart disease in men. *The American Journal of Clinical Nutrition, 72*, 912-921.

Iimuro, S., Yoshimura, Y., Umegaki, H., Sakurai, T., Araki, A., Ohashi, Y., et al. (2012). Dietary pattern and mortality in Japanese elderly patients with type 2 diabetes mellitus: Does avegetable- and fish-rich diet improve mortality? *Geriatrics and Gerontology International 12*, 59-67.

International Physical Activity Questionnaire (accessed at http://www.ipaq.ki.se/on February 2006

Jacobs, D. R., & Steffen, L. M. (2003). Nutrients, foods, and dietary patterns as exposures in research: a framework for food synergy. *The American Journal of Clinical Nutrition, 78*(3), 508S-513S.

Jenkins, D. J., Kendall, C. W., Marchie, A. L., Jenkins, A. L., Augustin, L. S., Ludwig, D. S., et al. (2003). Type 2 diabetes and the vegetarian diet. *American Journal Clinic Nutrition, 78*, 610S-616S.

Jenkins, D. J., Wolever, T. M., Jenkins A.L, Josse, R. G., & Wong, G. S. (1984). The glycaemic response to carbohydrate foods. *The lancet 324*, 388-391.

Jinlin, F., Binyou, W., & Terry, C. (2007). A new approach to the study of diet and risk of type 2 diabetes. *Journal of Postgraduate Medicine, 53*, 139-143.

Kadowaki, T., & Yamauchi, T. (2005). Adiponectin and adiponectin receptors. *Endocrine Reviews, 26*, 439-451.

Kant, A. K. (2004). Dietary patterns and health outcomes. *Journal of the American Dietetic Association, 104*, 615-635.

Kerver, J. M., Yang, E. J., Bianchi, L., & Song, W. O. (2003). Dietary patterns associated with risk factors for cardiovascular disease in healthy US adults. *The American Journal Of Clinical Nutrition, 78*, 1103-1110.

Kesse-Guyot, E., Bertrais, S., Peneau, S., Estaquio, C., Dauche, t. L., Vergnaud, A. C., et al. (2009). Dietary patterns and their sociodemographic and behavioural correlates in French middle-aged adults from the SU.VI.MAX cohort. *European Journal Of Clinical Nutrition, 63*, 521-528.

Kesse, E., Clavel-Chapelon, F., & Boutron-Ruault, M. C. (2006). Dietary patterns and risk of colorectal tumors: a cohort of French women of the National Education System (E3N). *American Journal of Epidemioogyl, 164*, 1085-1093.

Kriaučionienė, V., Petkevičienė, J., & Klumbienė, J. (2008). Dietary patterns and their association with sociodemographic factors in Lithuanian adult population. *Medicina (Kaunas), 44*, 799-804.

Krishnan, S., Rosenberg, L., Singer, M., Hu, F. B., Djousse´, L., Cupples, L. A., et al. (2007). Glycemic Index, Glycemic Load, and Cereal Fiber Intake and Risk of Type 2 Diabetes in US Black Wome. *Archives of Internal Medicine, 167*, 2304-2309.

Lazarevic, G., Antic, S., Cvetkovic, T., Vlahovic, P., Tasic, I., & Stefanovic, V. (2006). A physical activity programme and its effects on insulin resistance and oxidative defense in obese male patients with type 2 diabetes mellitus. *Diabetes Metab, 32*, 583-590.

Le, T. D., Bae, S., Ed Hsu, C., Singh, K. P., Blair, S. N., & Shang, N. (2008). Effects Of cardiorespiratory fitness on serum ferritin concentration and incidence of type 2 diabetes: evidence from the aerobics center longitudinal study (ACLS). the *Review of Diabetic Studies, 5*, 245-252.

Lee, C. M. Y., Huxley, R. R., Wildman, R. P., & Woodward, M. (2008). Indices of abdominal obesity are better discriminators of cardiovascular risk factors than BMI: a meta-analysis. *Journal of The Clinical Epidemiology, 61*, 646-653.

Lee, J. E., Kim, J. H., Son, S. J., Ahn, Y., Lee, J., Park, C., et al. (2011). Dietary pattern classifications with nutrient intake and health-risk factors in Korean men. *Nutrition, 27*, 26-33.

Lenz, A., Olinto, M. T. A., Dias-da-Costa, J. S., Alves, A. L., Balbinotti, M., Pattussi, M. P., et al. (2009). Socioeconomic, demographic and lifestyle factors associated with dietary patterns of women living in Southern Brazil. *Cadernos de Saúde Pública, 25*, 1297-1306.

Lim, J. H., Lee, Y. S., Chang, H. C., Moon, M. K., & Song, Y. (2011). Association between Dietary Patterns and Blood Lipid Profiles in Korean Adults with Type 2 Diabetes. *Journal Korean Medical Science, 26*, 1201-1208.

Liu, Z., Fu, C., Wang, W., & Xu, B. (2010). Prevalence of chronic complications of type 2 diabetes mellitus in outpatients - a cross-sectional hospital based survey in urban China *Health and Quality of Life Outcomes, 8*, 1-9.

Malone, M. (2005). Medications associated with weight gain. *The Annals of Pharmacotherapy 39, 2046-2055*.

Mantzoros, C. S., Li, T., Manson, J. A. E., Meigs, J. B., & Hu, F. B. (2005). Circulating adiponectin levels are associated with better glycemic control, more favorable lipid profile, and reduced inflammation in women with type 2 diabetes. *Journal of Clinical Endocrinology & Metabolism, 90*, 4542-4548.

Marjani, A., & Mojerloo, M. (2011). The metabolic syndrome in type 2 diabetic subjects in Gorgan, Iran. *Journal of the Pakistan Medical Association ,61*, 458-461.

Marlett, J. A., McBurney, M. I., & Slavin, J. L. (2002). Position of the American dietetic association: health implications of dietary fiber. *Journal of the American Dietetic Association,102*, 993-1000.

Marsola, F. K., Rinaldi, A. E. M., Siqueira, M., McLellan, K. C. P., Corrente, J. E., & Burini, R. C. (2011). Association of dietary patterns with metabolic syndrome components in low-income, free-living Brazilian adults. *International Journal of Nutrition and Metabolism, 3*, 31-38.

Martınez-Gonza´lez, M. A., Fuente-Arrillaga, C. d. l., Nunez-Cordoba, J. M., Basterra-Gortari, F. J., Beunza, J. J., Vazquez, Z., et al. (2008). Adherence to Mediterranean diet and risk of developing diabetes: prospective cohort study. *British Medical Journal, 336*, 1348-1351.

Marwick, T. H., Hordern, M. D., Miller, T., Chyun, D. A., Bertoni, A. G., Blumenthal, R. S., et al. (2009). Council on clinical cardiology, American heart association exercise, et al. exercise training for type 2 diabetes mellitus: impact on cardiovascular risk: a scientific statement from the American heart association. *Circulation, 25*, 3244-3262.

Maskarinec, G., Novotny, R., & Tasaki, K. (2000). Dietary patterns are associated with body mass index in multiethnic women. *The Journal of Nutrition, 130*, 3068-3072.

McNaughton, S. A., Ball, K., Mishra, G. D., & Crawford, D. A. (2008). Dietary patterns of adolescents and risk of obesity and hypertension. *Journal of Nutrition, 138*, 364-370.

McNaughton, S. A., Mishra, G. D., & Brunner, E. J. (2008). Dietary patterns, insulin resistance, and incidence of type 2 diabetes in the Whitehall II Study. *Diabetes Care, 31*, 1343-1348.

McNaughton, S. A., Mishra, G. D., Stephen, A. M., & Wadsworth, M. E. (2007). Dietary patterns throughout adult life are associated with body mass index, waist circumference, blood pressure, and red cell folate. *The Journal of Nutrition Epidemiology* (0022-3166), 99-105.

Meyer, K. A., Kushi, L. H., Jacobs, D. R., Slavin, J., Sellers, T. A., & Folsom, A. R. (2000). Carbohydrates, dietary fiber, and incident type 2 diabetes in older women. *The American Journal of Clinical Nutrition, 71*, 921_930.

Millett, C., Gray, J., Saxena, S., Netuveli, G., & Majeed, A. (2007). Impact of a pay-for-performance incentive on support for smoking cessation and on smoking prevalence among people with diabetes. *Canadian Medical Association Journal, 176*, 1705-1710.

Mirmiran, P., Azadbakht, L., & Azizi, F. (2007). Dietary behaviour of Tehranian adolescents does not accord with their nutritional knowledge. *Public Health Nutrition:, 10*, 897-901.

Mirmiran, P., Hosseini-Esfahani, F., Jessri, M., Mahan, L. K., Shiva, N., & Azizi, F. (2011). Does Dietary Intake by Tehranian Adults Align with the 2005 Dietary Guidelines for Americans? Observations from the Tehran Lipid and Glucose Study. *Journal of Health, Population, and Nutrition, 29*, 39-52.

Mishra, G. D., McNaughton, S. A., Bramwell, G. D., & Wadsworth, M. E. (2006). Longitudinal changes in dietary patterns during adult life. *British journal of nutrition, 96*, 735-744.

Moeller, S. M., Reedy, J., Millen, A. E., Dixon, L. B., Newby, P., Tucker, K. L., et al. (2007). Dietary patterns: challenges and opportunities in dietary patterns research an Experimental Biology workshop. *Journal of the American Dietetic Association, 107*, 1233-1239.

Montonen, J., Knekt, P., Härkänen, T., Järvinen, R., Heliövaara, M., Aromaa, A., et al. (2005). Dietary patterns and the incidence of type 2 diabetes. *American Journal of Epidemiology, 161*, 219-227.

Mullie, P., Clarys, P., Hulens, M., & Vansant, G. (2010). Dietary patterns and socioeconomic position. *European Journal of Clinical Nutrition, 64*, 231-238.

Nanri, A., Mizoue, T., Yoshida, D., Takahashi, R., & Takayanagi, R. (2008). Dietary patterns and A1C in Japanese men and women. *Diabetes Care, 31*, 1568-1573.

Naska, A., Fouskakis, D., Oikonomou, E., Almeida, M. D. V., Berg, M. A., Gedrich, K., et al. (2006). Dietary patterns and their socio-demographic determinants in 10 European countries: data from the DAFNE databank. *European Journal of Clinical Nutrition, 60*, 181-190.

Nayak, S., Maiya, A., & Hande, M. (2005). Influence of aerobic treadmill exercise on blood glucose homeostasis in noninsulin dependent diabetes mellitus patients. *Indian Journal of Clinical Biochemistry, 20*, 47-51.

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

Newby, P., Muller, D., Hallfrisch, J., Andres, R., & Tucker, K. L. (2004b). Food patterns measured by factor analysis and anthropometric changes in adults. *The American Journal of Clinical Nutrition, 80*, 504-513.

Newby, P. K., Muller, D., & Tucker, K. L. (2004b). Associations of empirically derived eating patterns with plasma lipid biomarkers: a comparison of factor and cluster analysis methods. *The American Journal of Clinical Nutrition 80*, 759-767.

Nitzke, S., Freeland-Graves, J., & Association., A. D. (2007). Position of the American Dietetic Association: total diet approach to communicating food and nutrition information. *Journal of the American Dietetic Association, 107*, 1224-1232.

Norris, S. L., Zhang, X., Avenell, A., Gregg, E., Brown, T. J., Schmid, C. H., et al. (2005). Long-term non-pharmacologic weight loss interventions for adults with type 2 diabetes. *Cochrane Database* of *Systematic Reviews*.

Odegaard, A. O., Puay Koh, W., Butler, L. M., Duval, S., Gross, M. D., Yu, M. C., et al. (2011). Dietary Patterns and Incident Type 2 Diabetes in Chinese Men and Women. *Diabetes Care 34*, 880-885.

Okubo, H., Sasaki, S., Murakami, K., Kim, M., Takahashi, Y., Hosoi, Y., et al. (2007). Three major dietary patterns are all independently related to the risk of obesity among 3760 Japanese women aged 18–20 years. *International Journal of Obesity, 32*, 541-549.

Paek, K. W., Chun, K. H., & Lee, S. J. (2011). A Factor of Fasting Blood Glucose and Dietary Patterns in Korean Adults Using Data From the 2007, 2008 and 2009 Korea National Health and Nutrition Examination Survey. *Journal of Preventive Medicine and Public Health, 44*, 93-100.

Pala, V., Sieri, S., Masala, G., Palli, D., Panico, S., Vineis, P., et al. (2006). Associations between dietary pattern and lifestyle, anthropometry and other health indicators in the elderly participants of the EPIC-Italy cohort. *Nutrition, Metabolism and Cardiovascular Diseases, 16*, 186-201.

Panagiotakos, D. B., Dimakopoulou, K., Katsouyanni, K., Bellander, T., Grau, M., Koenig, W., et al. (2009). Mediterranean diet and inflammatory response in myocardial infarction survivors. *International Journal of Epidemiology, 38*, 856-866.

Panagiotakos, D. B., Tzima, N., Pitsavos, C., Chrysohoou, C., Papakonstantinou, E., Zampelas, A., et al. (2005). The relationship between dietary habits, blood glucose and insulin levels among people without cardiovascular disease and type 2 diabetes; the ATTICA study. *The Review of Diabetic Studies, 2*, 208-215.

Paniagua, J. A., Gallego de la Sacristana, A., Sa´nchez, E., Vidal-Puig, A., Berral, F. J., Escribano, A., et al. (2007). A MUFA-Rich Diet Improves Posprandial Glucose, Lipid and GLP-1 Responses in Insulin-Resistant Subjects. *The American Journal of Clinical Nutrition, 26*, 434-444.

Patel, P. S., Sharp, S. J., Luben, R. N., Khaw, K. T., Bingham, S. A., Wareham, N. J., et al. (2009). Association between type of dietary fish and seafood intake and the risk of incident type 2 diabetes: the European prospective investigation of cancer (EPIC)-Norfolk cohort study. *Diabetes Care, 32*, 1857-1863.

Pereira, M. A., Jacobs, J., Pins, J. J., Raatz, S. K., Gross, M. D., & Slavin, J. L. (2002). Effect of whole grains on insulin sensitivity in overweight hyperinsulinemic adults. *The American Journal of Clinical Nutrition, 75*, 848e-855.

Pi-Sunyer, F. X. (2005). Weight loss in type 2 diabetic patients. *Diabetes care, 28*, 1526-1527.

Pischon, T., Girman, C. J., Hotamisligil, G. S., Rifai, N., Hu, F. B., & Rimm, E. B. (2004). Plasma adiponectin levels and risk of myocardial infarction in men. *The Journal of The American Medical Association, 291*, 1730-1737.

Pitsavos, C., Panagiotakos, D., Weinem, M., & Stefanadis, C. (2006). Diet, exercise and the metabolic syndrome. *Review of diabetic studies, 3*, 118-126.

Plotnikof, R. C. (2004). Physical activity in the management of diabetes: population-based perspectives and strategy. *Canadian Journal of Diabetes, 30*, 52-62.

Popkin, B. M. (1999). Urbanization, lifestyle changes and the nutrition transition. *World Development, 27*, 1905-1916.

Popkin, B. M. (2002). Part II. What is unique about the experience in lower-and middle-income less-industrialised countries compared with the very-high income industrialised countries? *Public Health Nutrition, 5*, 205-214.

Popkin, B. M. (2006). Global nutrition dynamics: the world is shifting rapidly toward a diet linked with noncommunicable diseases. *The American Journal of Clinical Nutrition, 84*, 289.

Rezazadeh, A., Rashidkhani, B., & Omidvar, N. (2010). Association of major dietary patterns with socioeconomic and lifestyle factors of adult women living in Tehran, Iran. *Nutrition, 26*, 337-341.

Sadakane, A., Tsutsumi, A., Gotoh, T., Ishikawa, S., Ojima, T., Kario, K., et al. (2008). Dietary Patterns and Levels of Blood Pressure and Serum Lipidsin a Japanese Population. *Journal of Epidemiology, 18*, 58-67.

Sadeghi, M., Roohafza, H., Shirani, S., Poormoghadas, M., Roya Kelishadi, R., Baghaii, A., et al. (2007). Diabetes and Associated Cardiovascular Risk Factors in Iran:The Isfahan Healthy Heart Programme. *Annals, Academy of Medicine, Singapore*, *36*, 175-180.

Samaha, F. F. (2005). Effect of very high-fat diets on body weight, lipoproteins, and glycemic status in the obese. *Current Atherosclerosis Reports , 7*, 412-420.

Sánchez-Villegas, A., Delgado-Rodríguez, M., Martínez-González, M. Á., & De Irala-Estevez, J. (2003). Gender, age, socio-demographic and lifestyle factors associated with major dietary patterns in the Spanish Project SUN (Seguimiento Universidad de Navarra). *European Journal of Clinical Nutrition, 57*, 285-292.

Schröder, H., Marrugat, J., Vila, J., Covas, M. I., & Elosua, R. (2004). Adherence to the traditional Mediterranean diet is inversely associated with body mass index and obesity in a Spanish population. *The Journal of nutrition, 134*, 3355.

Schulze, M. B., Hoffmann, K., Kroke, A., & Boeing, H. (2003). An approach to construct simplified measures of dietary patterns from exploratory factor analysis. *British Journal of Nutrition, 89*, 409-418.

Schulze, M. B., Liu, S., Rimm, E. B., Manson, J. E., Willett, W. C., & Hu, F. B. (2004). Glycemic index, glycemic load, and dietary fiber intake and incidence of type 2 diabetes in younger and middle-aged women. *The American Journal of Clinical Nutrition, 80*, 348-356.

Sheard, N. F., Clark, N. G., Brand-Miller, J. C., Franz, M. J., Pi-Sunyer, F. X., Mayer-Davis, E., et al. (2004). Dietary carbohydrate (amount and type) in the prevention and management of diabetes. *Diabetes Care, 27*, 2266-2271.

Sichieri, R. (2002). Dietary patterns and their associations with obesity in the Brazilian city of Rio de Janeiro. *Obesity Research, 10*, 42-48.

Sodjinou, R., V, A., Fayomi, B., & Delisle, H. (2009). Dietary patterns of urban adults in Benin: relationship with overall diet quality and socio-demographic characteristics. *European Journal of Clinical Nutrition, 63*, 222-228.

Stevens, J., & Ahn, K. (2002). Dietary fiber intake and glycemic index and incidence of diabetes in African-American and white adults. *Diabetes Care, 25*(10), 1721-1715.

Tabachnick, B. G., Fidell, L.S.1996. Using Multivariate Statistic. New York.: Harper Collins.

Thanopoulou A, Karamanos B, Angelico F, Assaad-Khalil S, & A, B. (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*, 367-376.

Thomas, N., Alder, E., & Leese, G. (2004). Barriers to physical activity in patients with diabetes. *Postgraduate Medical Journal, 80*, 287-291.

Togo, P., Osler, M., Sørensen, T. I. A., & Heitmann, B. (2001). Food intake patterns and body mass index in observational studies. *International Journal of Obesity, 25*, 1741-1751.

Tuomilehto, J., Lindström, J., Eriksson, J. G., Valle, T. T., Hämäläinen, H., Ilanne-Parikka, P., et al. (2001). Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *New England Journal of Medicine, 344*, 1343-1350.

Van Dam, R. M., Grievink, L., Ocké, M. C., & Feskens, E. J. M. (2003). Patterns of food consumption and risk factors for cardiovascular disease in the general Dutch population. *The American Journal of Clinical Nutrition, 77*, 1156-1163.

Van Dam, R. M., Rimm, E. B., Willett, W. C., Stampfer, M. J., & Hu, F. B. (2002). Dietary patterns and risk for type 2 diabetes mellitus in US men. *Annals of Internal Medicine, 136*, 201-209.

Vaz Carneiro, A. (2004). Coronary heart disease in diabetes mellitus: risk factors and epidemiology. *Revista Portuguesa de Cardiologia 23*, 1359-1366.

Veghari, G., Sedaghat, M., Joshaghani, H., Hoseini, S. A., Niknezad, F., Angizeh, A., et al. (2010). Association between socio-demographic factors and diabetes mellitus in the north of Iran: A population-based study. *International Journal of Diabetes Mellitus, 2*, 154-157.

Waxman, S., Nesto, R. W., Ruderman, N. B., & Devlin, J. T. (2000). The Health Professional's Guide To Diabetes And Exercise. American Diabetes Association; Alexandria, VA: pp155-162.

Weggemans, R. M., Zock, P. L., & Katan, M. B. (2001). Dietary cholesterol from eggs increases the ratio of total cholesterol to high-density lipoprotein cholesterol in humans: a meta-analysis. *American Journal Clinic Nutrition, 73*, 885-891.

Whitney, E. N. Cataldo,C.B, Debruyne,L,K.2001. Carbohydrates in nutrition for health and health care, pp.32-47. Peter Marshal Publisher.

World Health Organisation. (2004). Appropriate body mass index for Asian populations and its implications for policy and intervention strategies. *Lncet, 363*, 157-163.

World Health Organisation. Waist Circumference and Waist-Hip Ratio,Report of a WHO Expert Consultation;Geneva, 2008.

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*, 1047-1053.

Williams, D. E., Prevost, A. T., Whichelow, M. J., Cox, B. D., Day, N. E., & Wareham, N. J. (2000). A cross-sectional study of dietary patterns with glucose intolerance and other features of the metabolic syndrome. *British Journal of Nutrition, 83*, 257-266.

Williams, R., Gaal, V. L., & Lucioni, C. (2002). Assessing the impact of complications on the costs of Type II diabetes. *Diabetologia, 45*, S13-S17.

Wirfalt, E., Hedblad, B., Gullberg, B., Mattisson, L., Andren , C., Rosander, U., et al. (2001). Food patterns and components of the metabolic syndrome in men and women: a cross-sectional study within the Malmo Diet and Cancer cohort. *American Journal of Epidemiology, 154*, 1150-1159.

Yang, E. j., Chung, H. k., Kim, W. Y., Kerver, J. M., & Song, W. O. (2002). Carbohydrate intake is associated with diet quality and risk factors for cardiovascular disease in U.S. adults: NHANES III. *Journal of the American College of Nutrition, 22*, 71-79.

Yannakoulia, M. (2006). Eating Behavior among Type 2 Diabetic Patients: A Poorly Recognized Aspect in a Poorly Controlled Disease. *The Review of Diabetic Studies, 3*, 11-16.

Yeh, G. Y., Eisenberg, D. M., Kaptchuk, T. J., & Phillips, R. S. (2003). Systematic Review of Herbs and Dietary Supplements for Glycemic Control in Diabetes. *Diabetes Care, 26*, 1277-1294.

Yekta , Z., Pourali, R., Aghassi, M. R., Ashragh, N., Ravanyar, L., & Rahim Pour , M. Y. (2011). Assessment of Self-Care Practice and Its Associated Factors among Diabetic Patients in Urban Area of Urmia, Northwest of Iran. *Journal of Research in Health Sciences,11*, 33-38.

Yi Park, S., Murphy, S. P., Wilkens, L. R., Yamamoto, J. F., Sharma, S., Hankin, J. H., et al. (2005). Dietary Patterns Using the Food Guide Pyramid Groups Are Associated with Sociodemographic and Lifestyle Factors: The Multiethnic Cohort Study. *Journal Nutrition., 135*, 843-849.