ABSTRACT

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| Title of Document: | FACTORS ASSOCIATED WITH COMPLIANCE TO DIABETES SELF-CARE BEHAVIORS AND GLYCEMIC CONTROL AMONG KUWAITI PEOPLE WITH TYPE 2 DIABETES |
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In this cross-sectional study, diabetes self-care behaviors, diabetes knowledge, attitude and satisfaction, dietary and lifestyle modifications, and barriers to diabetes self-care behaviors and diabetes self-management were assessed by a questionnaire. Biochemical and anthropometric measurements were extracted from patients' medical records. Data collection through multi-stage stratified random sampling was obtained from eight primary healthcare centers in the Capital Region of Kuwait. The overall prevalence of poor glycemic control (HbA1c $\geq$ 7%) among Kuwaiti type 2 diabetic patients was 78.8%. About 76% of patients were non-compliant and 24% were compliant to glycemic control. Fasting plasma glucose was the strongest discriminating variable that classified patients as compliant and non-compliant to glycemic control. About 59.3% of patients were classified as "poor" adherence to diabetes self-care behaviors. Diet had the strongest association with diabetes self-care behaviors scores ($X^2 = 234.3$, $P < 0.05$).

FACTORS ASSOCIATED WITH COMPLIANCE TO DIABETES SELF-CARE
BEHAVIORS AND GLYCEMIC CONTROL AMONG KUWAITI PEOPLE WITH
TYPE 2 DIABETES


By


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# Dedication

I dedicate this thesis to my mother, who gave me her endless love, encouragement,

and support every step of the way during my graduate education.

# Acknowledgements

# Table of Contents

# List of Tables

# List of Figures

# List of Appendices

Appendix A. Survey on Self-Management of Type 2 Diabetes in Kuwait (Arabic Version)

Appendix B:  Survey on Self-Management of Type 2 Diabetes in Kuwait (English Version)

Appendix C: Table of Biochemical Parameters for Type 2 Diabetic Patients

# Chapter 1: Introduction

Diabetes mellitus is now recognized as the disease "epidemic" of the 21st century affecting millions of people worldwide. According to the World Health Organization (WHO) and the International Diabetes Federation (IDF), diabetes has become the primary global health-care challenge. In the Middle East, this health-care challenge is becoming a serious problem, especially in the Arabian Gulf region [1]. Over the past 20 years, the overall prevalence and incidence of diabetes in the Arabian Gulf has been increasing dramatically. Type 2 diabetes (T2DM) has recently become one of the leading causes of disability, especially in developing countries undergoing rapid economic transition [1]. The State of Kuwait, with a population of 2.2 million, is located in the northwestern corner of the Arabian Gulf. Type 2 diabetes is a major clinical and public health concern in Kuwait [2]. The last prevalence study of T2DM in Kuwait was done in 1998 and reported to be 14.7% [3]. Multiple factors including socioeconomic changes, culture and westernization, changes in dietary habits, sedentary lifestyle, obesity, and smoking are all factors associated with increase in diabetes prevalence. It is currently expected that the prevalence and incidence of T2DM among Kuwaitis is higher than it was in the past decade and it will continue to rise in the future.

Obesity has been shown to be a major health problem and is associated with wide range of co-morbid conditions including diabetes mellitus, coronary heart disease, gall bladder disease, hypertension, osteoarthritis, and cancer [2]. Obesity is highly prevalent and is increasing in Kuwait as well as in other Gulf States [4]. In addition, T2DM is more common in overweight people and the prevalence of diabetes is increasing in parallel with obesity [4]. One study found that obesity and physical inactivity was more often found in Kuwaiti adults with diabetes [5]. About one third of adult Kuwaitis were found to be obese (BMI ≥ 30) [6]. Parental history of

T2DM, high diastolic blood pressure and elevated serum triglycerides were found to be significantly associated risk factors for the development of T2DM [2,6].

Type 2 diabetes is a disease in which impaired insulin sensitivity often coexists with a cluster of cardiovascular risk factors, and about twice as many patients with T2DM also have hypertension (HTN) compared to individuals without T2DM [4]. A study carried out in the Hawalli health district in Kuwait showed that HTN was present in 40%, hypercholesterolemia in 23%, obesity in 47%, and overweight in 42% of diabetic subjects [4]. In addition, high cholesterol and high triglycerides were common in patients with T2DM. All these factors predispose diabetic patients to increased risks of atherosclerosis and premature death as a consequence of cardiovascular disease (CVD) [2].

Diabetes management requires a comprehensive approach including continuing medical care and patient education in order to prevent short-term and long-term complications. Glycemic control is the main treatment goal for diabetes care. Glycemic control is a medical term that means to maintain blood glucose levels within normal range in people with diabetes. A person with "tight" or "perfect" glycemic control would have blood glucose levels as close to a non-diabetic person as possible. However, this may not always be the case in people with diabetes. Therefore, a person is considered to have an "adequate" or "good" glycemic control if there is a long-term control of average blood glucose within normal range. Glycemic control can be assessed based on controlling two measurements; fasting plasma glucose (FPG) and glycosylated hemoglobin (HbA1c). Blood glucose (random or fasting) provides a measurement of glucose level at the moment the sample is collected. On the other hand, HbA1c is a proxy measure of the average blood glucose levels over the previous two to three months. For that reason, HbA1c is

known to be the best indicator for long-term glycemic control in people with diabetes [7]. It serves as a useful tool for healthcare providers to determine whether patients are compliant with the treatments they are advised to follow to better manage their diabetes.  In general, studies indicate that people with lower education levels, higher BMIs, longer duration of diabetes, have prolonged use of intensive treatment (including medication and/or insulin) have the highest proportion of poor glycemic control [8]. Therefore, incorporating intensive lifestyle interventions can lead to favorable changes in biochemical parameters including FPG, %HbA1c, and lipid profile, which may help prevent the occurrence of diabetes-related complications.

Diabetes management begins with patient education by healthcare professionals including physicians, nurses, dietitians, pharmacists, and exercise specialists who together can make a significant contribution to care and self-management. In addition, patients must be able to maintain a correct balance between different elements of a comprehensive treatment in order to achieve adequate glycemic control [9]. Diabetes self-care behaviors are essential for patients to practice and maintain on a daily basis in order to improve their health. They are made up of four components: 1) Oral Hypoglycemic Agents (OHA) medication and/or insulin use, 2) following a meal plan, 3) regular exercise and physical activity, and 4) self-monitoring blood glucose (SMBG). These behaviors impose daily demands on diabetic patients' and successful performance of these behaviors is likely to be influenced by their sense of competence [10]. Patients' adherence to diabetes self-care behaviors plays a major role in improving their overall quality of life. It often represents a great challenge for patients as well as for healthcare professionals.

**Statement of the Problem**

Although all medical services are freely available to Kuwaitis by the government, T2DM remains a serious clinical and public health problem. While the disease is increasingly becoming recognized in Kuwait, little is known about the prevalence of poor glycemic control and its associated factors among Kuwaiti type 2 diabetic patients. In addition, limited studies have evaluated diabetes self-management and its effect on glycemic control among the Kuwaiti population. No study has investigated the role of diabetes self-care behaviors on glycemic control among Kuwaiti people with diabetes, as well as examining their diet and lifestyles, knowledge and attitudes towards their disease. Moreover, limited studies have determined compliance to glycemic control and adherence to self-care behaviors. Furthermore, barriers to adherence to self-care behaviors and barriers to diabetes self-management have not been determined. No study has investigated the differences in the quality of diabetes care between Kuwaiti diabetic patients attending the general family clinics and the specialized clinics at the PHCs.

**Rationale of the Study**

Although the importance of glycemic control is well established, it is often not achieved. Based on previous literature, there are various factors associated with glycemic control. Contribution of poor glycemic control is due to the paucity of information available to patients about the importance of compliance to glycemic control and adherence to diabetes self-care behaviors and to healthcare providers about patients' barriers to compliance to glycemic control and practicing diabetes self-care behaviors. No study has examined the extent of compliance to glycemic control and adherence to self-care behaviors among Kuwaiti people with diabetes. The current information about the effects of diabetes self-care behaviors on glycemic control has not

been investigated among Kuwaiti diabetic patients. For that reason, this thesis attempts to provide a holistic overview on patients' compliance to glycemic control and adherence to diabetes self-care behaviors and the assessment of their associated factors. Our research is considered the first study to compare diabetes self-care behaviors and glycemic control between the general family clinics and the specialized diabetic clinics at the PHCs in Kuwait.

**Objectives**

The objectives of this research study are as follows:

1. To determine the proportion of poor glycemic control (HbA1c > 7%) among Kuwaiti type 2 diabetic patients attending the PHCs.

2. To examine the factors associated with poor glycemic control among Kuwaiti people with T2DM.

3. To investigate the effects of diabetes self-care behaviors, dietary and lifestyle modifications, general diabetes knowledge, and general attitude and satisfaction on glycemic control.

4. To compare the proportions of glycemic control and diabetes self-care behaviors between Kuwaiti type 2 diabetic patients attending the general family clinics and the specialized diabetic clinics.

5. To determine the factors associated with compliance to glycemic control and diabetes self-care behaviors among Kuwaiti people with T2DM.

6. To identify the barriers on adherence to diabetes self-care behaviors and diabetes self-management among Kuwaiti type 2 diabetic patients.

**Research Questions**

1. What is the prevalence of poor glycemic control (HbA1c > 7%) among Kuwaiti people with T2DM living in the Capital Region?

2. What are the effects of diabetes self-care behaviors, dietary and lifestyle modifications, general diabetes knowledge, and general attitude and satisfaction on glycemic control among Kuwaiti type 2 diabetic patients?

3. What are the determinants of compliance to glycemic control and diabetes self-care behaviors (medication/insulin, diet, exercise, SMBG) among Kuwaiti people with T2DM?

4. What are the potential barriers to complying with self-care behaviors and diabetes self-management in Kuwaiti people with T2DM?

5. Is there a difference in the percentage of glycemic control between Kuwaiti T2DM patients who visit the general family clinics and those who visit the specialized diabetic clinics at the Capital Region?

# Chapter 2: Literature Review

## 2.1 An Overview of Type 2 diabetes

Diabetes mellitus is a chronic metabolic disorder in which a person has high blood glucose, either the body does not produce enough insulin or the cells do not respond to the insulin that is produced. Insulin, which is a hormone produced by β-cells of the pancreas, facilitates glucose uptake from the bloodstream into the body cells (i.e., muscles) mainly for energy. Usually, the pancreas produces the right amount of insulin to accommodate the quantity of glucose in the bloodstream. However, in the case of people with diabetes, the pancreas produces little or no insulin or the cells do not respond normally to the insulin being produced. This condition is known as insulin resistance, which is a decrease in sensitivity or responsiveness to insulin, mainly in tissue, muscle, and adipose cells [11]. Consequently, excess glucose is built up in the blood instead of going into cells leading to conditions known as glucose intolerance (inability to metabolize glucose) and hyperglycemia (elevated blood glucose). There are three main types of diabetes: type 1 diabetes, type 2 diabetes, and gestational diabetes. Our research focused on Kuwaiti adults with type 2 diabetes.

Type 2 diabetes (T2DM) is when the body loses the ability to produce and/or utilize insulin properly, and it is sometimes combined with an absolute insulin deficiency. It is often called "adult-onset" diabetes representing 90-95% of all cases of diabetes and it is related to an individual's lifestyle habits that include poor diet and physical inactivity (lack of exercise). However, the underlying cause is still unknown, although genetic and environmental factors (i.e., obesity, physical inactivity) are important risk factors [12]. In most cases, T2DM results from a combination of insulin resistance and β-cell failure. Initially when there is a rise in blood

glucose, there is a compensatory increase in insulin secretion to maintain normal glucose concentrations. However, insulin production gradually decreases as the disease progresses. Hyperglycemia is first demonstrated as an elevation of postprandial (after meal) blood glucose caused by insulin resistance at the cellular level and is followed by an elevation in fasting glucose concentrations. As insulin secretion decreases, glucose production in the liver increases, causing the rise in preprandial (fasting) blood glucose levels [11]. Type 2 diabetes has serious complications if not managed properly. Poor diabetes management can lead to progressive complications including cardiovascular disease (CVD), retinopathy (blindness), nephropathy (kidney failure), neuropathy (nerve disorders), and amputation of extremities due to circulation problems as well as other chronic conditions. These complications may lead to massive personal, financial, and societal costs [1].

The diagnostic criteria and clinical testing of diabetes can either be evaluated by glycosylated hemoglobin (HbA1c), fasting plasma glucose (FPG), or 2-hour Oral Glucose Tolerance Test (OGGT), which identifies people with either impaired fasting glucose (IFG) or impaired glucose tolerance (IGT) placing people at increased risk for the development of diabetes and CVD [13]. Both the World Health Organization (WHO) and the American Diabetes Association (ADA) agree that normal fasting plasma glucose (FPG) should be less than 6.1 mmol/l, while the Oral Glucose Tolerance Test (OGGT) should be less than 7.8 mmol/l. The new diagnostic cut point for FPG is ≥126 mg/dl (7.0 mmol/l) and diagnostic 2-hour OGGT plasma glucose value is ≥ 200 mg/dl (11.1 mmol/l) [13]. In addition, a glycated hemoglobin also called a glycosylated hemoglobin (HbA1c) test, was introduced as an important tool for diagnosis and follow-up of diabetes. However, since there are currently no specific guidelines for people in the Middle East on diabetes management, the Ministries of Health in the gulf countries are adopting

the diabetes management and treatment guidelines currently recommended by the American Diabetes Association. Therefore, this research study followed the current ADA guidelines for Kuwaiti T2DM patients.

As a screening test, %HbA1c is easier for both patients and clinicians to use as a diagnostic tool for diabetes because the blood sample can be drawn at the time of the patient's visit to the hospital. Unlike FPG testing and the OGGT, HbA1c testing does not require overnight fasting because it measures the average blood glucose levels for a period of two to three months. An HbA1c level of approximately 5% indicates the absence of diabetes, and according to the revised evidence-based guidelines, an HbA1c score of 5.7% to 6.4% indicates pre-diabetes as well as IFG and IGT levels, and an HbA1c level of 6.5% or higher indicates the presence of diabetes. The most recent ADA recommendations state that: i) for optimal diabetic control, the target for most people with diabetes is an HbA1c level no greater than 7%, ii) preprandial (before meal) plasma glucose should be within a range of 70-130 mg/dl (3.8-7.2 mmol/l) and iii) peak postprandial (after meal) plasma glucose should be kept below 180 mg/dl (10 mmol/l) [13].

## 2.2 Type 2 Diabetes in Kuwait

Economic growth has slowed down in Kuwait and in most of the Arabian Gulf countries after the Gulf war. As a response to the delayed economic growth, governments have pursued development efforts aimed at liberalizing their economics and generating faster growth. This socio-economic progress has brought benefits to many people in the gulf region, such as improved access to health care, education, and safe drinking water. However, this development has negatively transformed lifestyles, eating habits, traditional, societal, and family structures in

the region [14]. After the Gulf War, the health status of the Kuwaiti population changed dramatically as a result of modernization and technology. Kuwait's socioeconomic developments have a negative impact on chronic diseases including CVD risk factors and the increased incidence and prevalence of diabetes among the population. Prior to the discovery of oil, manual labor such as sailing, fishing, and pearl-diving protected against these problems [15]. As a result of increased oil-revenue, a dynamic pattern of migration movement from international countries had a great impact on the food practices in Kuwait and in many Arab countries. According to one research study, food consumption patterns have drastically changed in some Arab countries as a result of a sudden increase in income from oil revenue. It is believed that the food subsidy policy has resulted in adversely affecting the food habits in the Arabian Gulf States by encouraging the excess intake of fat, sugar, rice, wheat flour and meat. Results showed that sociocultural factors have noticeable influence on food consumption patterns. Moreover, mass media, especially televised food advertisements, play an important role in changing peoples' perceptions of their dietary habits [16]. Changes in nutrition, decrease in physical activity, and obesity are all major factors contributing to the dramatic rise of T2DM cases in Kuwait and the Arabian Gulf Region.

The prevalence of diabetes is on the rise in Kuwait. One prevalence study examined patients attending two hospital-based diabetic units in Kuwait. The study compared the number of patients and the number of people in each health region. Both locations were similar in the distribution and age structure of the population as well as in socioeconomic factors and degree of obesity. A total of 3,222 Kuwaiti registered patients were collected from both clinics. The mean age of the patients was $53 \pm 13.9$ years, and 73.8% were in the age group of 45 to 64 years. In addition, the mean duration of diabetes was 7.8 years and 70% of the patients had diabetes for 9 years or less. BMI was higher in women than men in this age group [17]. The mean BMI in

women and men was $31.8 \pm 6.3$ kg/m$^2$ and $28.5 \pm 6.3$ kg/m$^2$, respectively.  Among the diabetic women, 57.7% were obese (BM > 30 kg/m$^2$) and 30.2% were overweight (BMI 25–30 kg/m$^2$), compared to 33.6% obese and 44.3% overweight among diabetic men. The main treatment given to the majority of patients (63.2%) was medication (OHA), while 23.7% were on a diet regimen, and only 13.1% were on insulin therapy [17].  Moreover, a prevalence study showed that family history was associated with increased prevalence of diabetes among Kuwaiti adults. The result reported that 63% of diabetic subjects had a positive family history of diabetes from first-degree relatives. This could be due to the increased rate of the common pattern of first cousin marriages, which was as high as 60% in this particular study [18].  Another prevalence study had consistent results about Kuwaiti people with T2DM. The study investigated the prevalence rates of T2DM among Kuwaiti people aged 20 and older in two governorates. A total of 3,003 participants (63% females) were interviewed and examined by the research team. Patients were asked about their ages, education, levels of physical activity, parental history of diabetes, and presence of hypertension. Physical examination included height, weight, and measurements of blood pressure and FPG. The overall prevalence of T2DM in that study was 14.8%. Diabetic subjects presented at a relatively young age with prevalence rate in the age group of 20 to 39 was 5.7% and in the age group of 40 to 59 was 18.3%.The mean FPG was $11.58 \pm 3.81$ mmol/l for participants with diabetes, which was significantly higher than that reported for participants without diabetes. Obesity was a significant risk factor ($P < 0.001$). Hypertension was also significantly associated with T2DM as well as impaired glucose tolerance ($P < 0.001$). In addition, there was a strong association between T2DM and family history of diabetes and the presence of HTN [3]. The prevalence of abnormal glucose tolerance is continuing to rise, which may lead to serious impact on morbidity and mortality among the Kuwaiti population.

2.3 Therapy for Type 2 Diabetes

It is important to understand the pathophysiology of T2DM in order to determine appropriate management strategies. There are four intrinsic defects in individuals with T2DM: 1) insulin resistance in muscle and adipose tissue, 2) decreased insulin production by pancreatic beta cells, 3) increased production of glucose by the liver, and 4) decreased glucagon-like peptide-1 (GLP-1) levels [19], which is produced by the proglucagon gene in L-cells of the small intestine. In response to nutrients, GLP-1 stimulates glucose-dependent insulin release from the pancreatic islets, slows gastric emptying, inhibits inappropriate glucagon release, stimulates β-cell proliferation and differentiation, and improves satiety [20]. The ADA and the European Association for the Study of Diabetes (EASD) have published consensus guidelines for the management of hyperglycemia in people with T2DM. Diabetes management should begin by lifestyle modification, which should always be included along with exercise and weight loss, then the addition of some type of drug therapy in order to reach or maintain an HbA1c goal of < 7% [19]. The overall objective is to achieve and maintain glycemic control and to change interventions when therapeutic goals are not being met [13]. As a start, individuals who have pre-diabetes or have already developed diabetes should receive individualized Medical Nutrition Therapy (MNT) as needed to achieve treatment goals and preferably a registered dietitian should provide these. Medical Nutrition Therapy is an integral component of diabetes prevention, management, and self-management education. Clinical trials of MNT have reported decreases in HbA1C at 3–6 months ranging from 0.25 to 2.9% with higher reductions seen in T2DM of shorter duration. Multiple studies have demonstrated sustained improvements in HbA1C at 12 months and longer when a registered dietitian provided follow-up visits ranging from monthly to three sessions per year. Physical activity and behavior modifications are important components

of weight loss programs and are very helpful to weight loss maintenance. In overweight and obese insulin-resistant individuals, modest weight loss has been shown to reduce insulin resistance. Thus, weight loss is recommended for all overweight or obese individuals who have or are at risk for diabetes [13]. Several short-term studies have demonstrated the benefits of intensive lifestyle modification of patients with IGT with moderate weight loss (5% body weight), as well as improved measures of glycemia and lipemia, and reduced blood pressure. Current ADA guidelines recommend individuals with IGT and IFG lose 5% to 10% of their body weight and increase their physical activity to at least 150 minutes of moderate exercise per week to delay the onset of T2DM [19]. Resistance training should also be encouraged three times per week in people with T2DM where there are no contraindications. Regular exercise has been shown to improve blood glucose control, reduce cardiovascular risk factors, contribute to weight loss, and improve overall well being. Glycosylated hemoglobin has shown to be reduced by an average of 0.66% in people with T2DM with structured exercise interventions in duration of at least 8 weeks, even with no significant change in BMI. Look AHEAD (Action for Health in Diabetes) is a large clinical trial was designed to determine whether long-term weight loss would improve glycemia and prevent cardiovascular events in subjects with T2DM. The results of the trial have shown that after one year of the intensive lifestyle intervention, there was an average of 8.6% weight loss, significant reduction of HbA1c, and reduction in several CVD risk factors [13]. Furthermore, the ADA and EASD guidelines recommend the use of Metformin (a glucose-lowering agent by decreasing hepatic glucose production) for initial pharmacotherapy in addition to promoting lifestyle modifications. HbA1c should be monitored every 3 months until the target goal is reached and then at every 6 months. If HbA1c goal is not reached or when metformin alone is not sufficient, insulin and glucose-lowering agents (enhancing insulin secretion)

including sulfonylurea and/or thiazolidinediones (TZD) should be added within 2 to 3 months and be included as part of intensive therapy [19].

2.4 Importance of Glycemic control

Glycemic control is fundamental to the management of diabetes. Many people with diabetes do not achieve adequate glycemic control. The main reason is that glycemia is not properly assessed by patients and their health care professionals. The main challenge of modern diabetes management is how to achieve glycemic control [21]. There are two primary techniques for healthcare providers as well as patients to assess the effectiveness of management plan on glycemic control: plasma glucose or HbA1c, and patient self-monitoring of blood glucose (SMBG).

**Glycosylated Hemoglobin (HbA1c)**

Glycosylated hemoglobin (HbA1c) is known to reflect average glycemia for up to 3 months and has strong predictive value for diabetes complications. Therefore, testing should be performed routinely in all patients with diabetes at initial assessment and then as a part of continuing care. The frequency of HbA1c testing should be dependent on the individual's glycemic status, the treatment regimen used, and the judgment of the clinician. The ADA recommends that HbA1c test should be performed at least twice a year in patients who are having a stable glycemic control and are meeting the treatment goals. Patients who are not meeting glycemic goals or have changed their therapy should perform the HbA1c test four times a year [13]. It is important to maintain glycemia under tight control, which means to keep blood glucose level close to normal (nondiabetic) as possible. Ideally, blood glucose levels before meals should be between 70 and 130 mg/dl (3.8-7.2 mmol/l), and less than 180 mg/dl (< 10

mmol/l) two hours before starting a meal, with HbA1c level less than 7% [13]. Adequate glycemic control is essential in preventing microvascular complications associated with T2DM. Observational analyses from the United Kingdom Prospective Diabetes Study (UKPDS) trial showed reductions in mortality and other diabetes-related complications, including cardiovascular complications. For instance, a 1% decrease in HbA1c was associated with a 14% reduction in the incidence of Myocardial Infarction (MI) [19]. Epidemiological analyses of the Diabetes Control and Complications Trial (DCCT) and the UKPDS demonstrate a curvilinear relationship between HbA1c and microvascular complications. It is suggested that on a population level, the greatest number of complications will be prevented by taking patients from "very poor" control to "fair" or to "good" control. These analyses also suggest that further lowering of HbA1c from 7% to 6% is associated with further reduction in the risk of microvascular complications [13]. Furthermore, reductions in HbA1c have been shown to decrease medical costs and health care utilization. One study [22] followed individuals enrolled in a Minnesota Health Plan to determine the effect of baseline HbA1c, CVD, and depression in predicting subsequent health care costs among those with diabetes. In their 3-year analysis, the authors found that for every 1% rise in HbA1c levels, there was an associated increase in costs for patients with diabetes. These costs were significantly higher in diabetic patients who had higher HbA1c levels as well as associated heart disease, HTN, both heart disease and HTN, and depression. Diabetic patients with heart disease or HTN had significantly higher 3-year costs than patients without diabetes or either of those conditions [19].

**Self-Monitoring Blood Glucose (SMBG)**

Self-monitoring blood glucose (SMBG) is an essential component of diabetes self-care in obtaining glycemic control. There has been a great controversy on whether self-monitoring of

blood glucose is appropriate for patients with T2DM. Studies suggest that the use of glucometers can be useful in providing information on a person's blood glucose patterns over time. On the other hand, other studies show that the frequency of SMBG has no beneficial effect on glycemic control. Moreover, it has never been clearly demonstrated that lifestyle changes especially better adherence to dietary recommendations and exercise advice might be promoted by SMBG [23]. Therefore, the role and importance of SMBG in patients who are not using insulin remains to be less clear.

Several randomized clinical trials have addressed the question of whether SMBG reduces HbA1c and has an impact on glycemic control [24]. One out of the five randomized clinical trials was able to detect a 0.5% HbA1c difference between the intervention and control groups, but SMBG was associated with modest HbA1c reduction in patients treated with OHA and were poorly controlled [25]. Furthermore, the Fremantle Diabetes Study (FDS) is an observational study that used cross-sectional and longitudinal data to determine whether SMBG is associated with better glycemic control in T2DM. Patients were classified as adherent SMBG users if they were 1) treated with OHA medication and/or insulin and performed SMBG one or more times per day or 2) managed by diet and undertook any SMBG. Results showed that there was no significant difference between SMBG users and SMBG nonusers, either overall or within diabetes treatment groups (diet, OHAs, and insulin with or without OHAs) [25].

SMBG allows patients to evaluate their individual response to therapy and assess whether glycemic targets are being achieved, as well as it is useful in preventing hypoglycemia, adjusting medications, MNT, and physical activity [26]. SMBG is an important measure because unlike other parameters (i.e., serum cholesterol concentration) it changes continuously by 10-folds in

people with diabetes compared to a 2 to 4 fold change in non-diabetics. Diabetic patients who use SMBG are able to know their own status as well as allowing them to be independent in self-care; SMBG is a tool that provides easier communication to patients with their physicians [21]. Based on a survey of diabetic UK members, a study was carried out on participants with T2DM to determine their views on the usefulness of SMBG in the management of diabetes. Interviewers asked patients to specify the benefits they gained from SMBG and how these benefits were achieved. Results showed that 80% of respondents reported high satisfaction with SMBG, and reported feeling more "in control" of their diabetes. The most frequent use of SMBG was to make adjustments to food intake or confirm a hyperglycemic episode. The study also indicated that there was a difference in gender response to SMBG, where women were significantly more likely to report feelings of guilt or self-chastisement with abnormal or out-of-range readings [27].

The frequency and timing of SMBG is highly individualized and it should be determined by the patients' particular needs and goals [13]. People with T2DM should self-monitor their blood glucose anywhere from 1 to 2 times per day to once every few hours. It is recommended for patients to check not only in the morning fasting condition, but at various times of day to be aware on whether their blood glucose levels are much higher or lower than normal (i.e., at bedtime). In addition, it is recommended for people with pre-diabetes or mild T2DM to self-monitor their postprandial (after meal) glycemia [21]. The Fremantle Diabetes Study found that 70% of patients performed SMBG with a median of four tests per week. In addition, patients with shorter diabetes duration, who were attending diabetes education, diabetic clinics, or medical specialists, who were taking insulin with or without OHA, and who were reporting hypoglycemic events were more likely to use SMBG [25].

However, many diabetic people are reluctant to use SMBG because of significant barriers such as pain, patient denial or discouragement from health care professional, and cost [21]. A longitudinal study of 18 type 2 diabetic patients revealed that patients decreased the use of SMBG over time as a result of lack of encouragement from health care professionals. In addition, there was a lack of perceived interest from patients in meter readings indicating that self-monitoring was not worth continuing. Moreover, some participants found that readings are difficult to interpret and were uncertain on how to respond to high readings. Lack of education about the appropriate response to readings could be a part of the reason patients tended not to act on self-monitoring results [26].

2.5 Factors Associated with Glycemic Control

Glycemic control by lowering blood glucose to normal range remains the primary therapeutic objective for diabetes management and prevention of target organ damage and other diabetes-related complications. Although it is known that glycemic control improves macrovascular outcomes, not much is known about factors that influence control. In clinical practice, normal glycemia is difficult to obtain on a long-term basis because of the complexity of glycemic control in T2DM. Both patients and healthcare providers may contribute to poor glycemic control [8]. Studies suggest that there are many factors associated with glycemic control. In the past decade, there has been increasing attention to the role that lifestyle behaviors play a role in glycemic control. Most studies have focused only on the effects of specific diabetes self-management behaviors on glycemic control. Other studies have demonstrated the effects of general health behaviors on HbA1c levels focused on a single lifestyle behavior, such as exercise or weight control [28]. One study in a health maintenance organization found that age, BMI, and

emotional distress were significantly related to glycemic control [29]. Another study was conducted in Jordan to determine factors associated with glycemic control among Jordanian patients with T2DM. A systemic random sample of 917 patients was selected from all patients with T2DM over a period of six months. Anthropometric measurements including weight, height, and waist circumference were measured, as well as all available last readings of HbA1c, fasting blood glucose measurements, and lipid profile were taken from patients' medical records. Results showed that diabetes was more likely to be poorly controlled among those with increased duration of diabetes, low level of education, higher BMI, hypercholesterolemia, hypertriglyceridemia, and elevated LDL-C. Patients on combination of OHA and insulin had the highest level (92.5%) of poor glycemic control. In addition, poor glycemic control was more common among patients who did not follow dietary regimens, did not practice any physical activity, did not adhere to medication regimen, and did not regularly perform home glucose monitoring. Moreover, about 81.4% of patients did not follow diabetic meal plans as recommended by the dietitians, and 67.9% did not participate in physical exercise. Only 38.1% of patients tested their blood glucose at home, and 91.1% of patients reported having family support for their diabetes and its management. The results of this research suggested that 65.1% of patients had poor glycemic control (HbA1c > 7%) [8]. In Saudi Arabia, only 27% of patients reached target level of glycemic control [30].

Moreover, demographics, clinical conditions, and treatment have an influence on glycemic control. Studies have suggested that minority groups (i.e., African Americans, Hispanics, American Indians, Pacific Islanders) and adults who have had diabetes for a long time, who have co-morbidities, or who use insulin or multiple oral agents have high HbA1c levels. However, there is not enough evidence regarding the explanatory effects of these

predictors on glycemic control [28]. Using the Third National Health and Nutrition Examination Survey (NHANES III), a study on racial and ethnic differences in glycemic control found that Black women, Mexican-American men, those treated with insulin or OHA medications, and patients over 60 years of age had poorer glycemic control [31].

A cross-sectional survey was using random selection carried out on older adults aged 65 years and older with T2DM from three ethnic communities: African American, Native American, and White. HbA1c levels were measured and compared across ethnic groups and personal characteristics as well as personal and health characteristics were used to evaluate the potential predictors of glycemic control. The overall results showed that 36.4% had HbA1c $\geq$ 7% where Native Americans and African American men had the highest, while African-American women and White men had the lowest proportion of poor glycemic control. In addition to ethnicity, living arrangements, use of diabetes medications, having a diabetes-related healthcare visits in the past year, and duration of diabetes were significantly associated with glycemic control (those with HbA1c > 7% compared to those with HbA1c < 7%) [32]. Furthermore, a longitudinal study was carried out to determine demographic, health status, treatment, access/quality of care, and behavioral factors associated with poor glycemic control in patients with T2DM in low-income minority San Diego population. The sample included 573 patients with a racial/ethnic mix of 53% Hispanic, 7% Black, 18% Asian, 20% White, and 2% other. In general, results showed that parents who were uninsured, had diabetes for longer periods of time, used insulin or multiple oral agents or had high cholesterol and higher HbA1c values over time, and younger subjects were indicators of poor glycemic control. Moreover, patients who were uninsured had a 5.2% increase in HbA1c level. Among these patients, individuals who had diabetes over 10 years had a 15.2% higher HbA1c level compared to those who had diabetes less

than one year. Similarly, patients who had diabetes 6 to10 years and 1 to 5 years had significantly higher HbA1c values compared to those with diabetes less than one year. Patients who required insulin had a 22.4% higher HbA1c and those who were on more than one oral medication had a 12.0% higher HbA1c compared those who used only one or no medications [31].

There has been little investigation of the predictive factors of glycemic control in midlife and older age. A study was conducted on 379 middle-aged adults with 51 to 64 years and 430 older adults with ≥ 65 years diagnosed with T2DM. The results in this study showed distinctive patterns of glycemic control for middle-aged and older adults. Glycemic control was significantly associated with age, race/ethnicity, number of chronic diseases, duration of diabetes, treatment modality (diet only, oral medication, or insulin only or in combination with other regimens), and lifestyle. Age was negatively associated with HbA1c values, while sex, education, and marital status were not significantly associated with HbA1c. Age and race/ethnicity explained 4.6% of the variance in HbA1c levels. Duration of diabetes and number of chronic diseases explained 7.6% of the variance in HbA1c levels. Independent of demographic factors, participants who reported having more chronic diseases or a longer duration of diabetes had higher HbA1c levels than those who reported having few chronic diseases or a shorter duration of diabetes. Treatment modality explained 14.1% of the variance in HbA1c levels. Participants who were treated with diet only or with oral medications had lower HbA1c levels compared to participants who used insulin only. Independent of demographic characteristics and clinical conditions, treatment modality explained an additional 2.5% of the variance significantly by lifestyle behaviors. In other words, an increase of one healthy behavior was associated with a decrease in HbA1c levels of more than 1%. Overall, this study was able to

determine that there are distinct patterns of glycemic control for middle-aged and older adults and confirm a long-term beneficial effect of general lifestyle behaviors on glycemic control (HbA1c), beyond what it is accounted for by demographic factors, clinical conditions, and treatment modality, especially in middle-aged adults [28].

2.6 Diabetes Self-Care Behaviors

Diabetes Management programs that incorporate group patient education, nutrition consultation, and clinical care have been shown to be effective in patients with diabetes (Chiu et al., 2010). As referred by several studies, self-care behaviors were defined as the activities diabetic patients perform to manage their health in terms of following a healthy eating plan (i.e., diabetic diet), exercise, self-glucose monitoring, and diabetes medication and/or insulin intake [7,9,10,33]. Self-care behaviors are essential for type 2 diabetic patients to maintain and improve their health; at the same time it represents a challenge for patients as well as health professionals [9].

A descriptive correlational study [9] was carried out to analyze self-care behaviors and their relationship with health indicators including HbA1c, cholesterol, triglycerides, BMI, waist circumference, and body fat percentage in a sample of 98 Mexican adults (ages 30-55 years) with T2DM. The results found a significant relationship between self-care behaviors and HbA1c ($r_s =$ -0.379, $p < 0.001$) indicating that better self-care corresponds to lower HbA1c (better glycemic control), significant negative correlation between self-care and triglyceride levels ($r_s = -0.208$, $p = 0.040$), BMI ($r_s = -0.248$, $p = 0.014$), and self-care and body fat percentage ($r_s = -0.221$, $p = 0.029$). With respect to describing the influence of age, schooling, gender and previous understanding about diabetes on self-care and health indicators, the most predictive model

revealed that only gender ($p < 0.05$) moderated the relation between self-care and health indicators. With explained variances of 9-41%, significant influence was found for HbA1c, BMI, and body fat only. In another multivariate model, self-care behaviors (i.e., diet, exercise, monitoring and medication) were adjusted as independent variables and health indicators as dependent variables. Diet was the most predictive health indicator from all self-care dimensions, moderated by gender ($p < 0.001$) and understanding of diabetes ($p < 0.04$). In terms of determining self-care differences according to gender, age, education, and occupation, significant differences were found for exercise and according to gender only, where men engaged in more exercise than women ($p = 0.003$) [9].

2.7 Patient Knowledge about Diabetes

Modern treatment of diabetes does not only require pharmacologic therapy but also health education by physicians and other health care providers. Diabetes education has changed the health belief, compliance, and metabolic control of patients [34]. Diabetes Self-Management Education (DSME) is the foundation of care for all people with diabetes and is essential in order to improve patient outcomes. DSME is the ongoing process of facilitating the knowledge, skills, and ability necessary for diabetes self-care. The overall objectives of DSME are to support informed decision-making, self-care behaviors, problem-solving and active collaboration with the health care team and to improve clinical outcomes, health status, and patients' quality of life [35]. The goals of diabetes education are to optimize metabolic control, prevent acute and chronic complications, and to optimize the quality of life. There are significant knowledge and skill deficits in 50% to 80% of individuals with diabetes, and ideal glycemic control ($HbA_{1c} < 7.0\%$) is achieved in less than half of people with T2DM [36]. Studies have shown that many

diabetic patients do not know whether they had a recent HbA1c test or what the value means [37]. Therefore, it is essential to have planned educational programs that are integrated into the patients' structured care in order to improve diabetes care [38]. The first step in the process of education is to identify the educational needs of all patients with diabetes [37].

Knowledge of one's actual and target health outcomes (i.e., HbA1c values) is a requirement for effective patient involvement in diabetes management. A cross-sectional survey investigated the relationship between knowledge of recent HbA1c values and the understanding of diabetes care and self-management. The sample was on 686 U.S. adults with T2DM surveyed about their diabetes-related knowledge, attitudes, and service use. Participants were surveyed in a Veterans Affairs (VA), medical center, an academic center (AMC), and three inner-city health systems. All participants had recorded HbA1c values within the six-month period prior to taking the survey. The research study examined associations between patient characteristics, health care provider communication, and health system type with their knowledge of their last HbA1c values. The study also assessed whether knowledge of HbA1c was associated with key diabetes self-care behaviors. From patients' responses to the survey, 66% reported that they did not know their last HbA1c value and only 25% accurately reported their most recent HbA1c value. Moreover, 56% of respondents who knew their HbA1c gave accurate assessments of their diabetes control compared with 45% of those who did not know their HbA1c. Results also showed that more years of formal education and healthcare provider thoroughness of communication with patients were associated with knowledge of recent HbA1c values. Respondents who knew their last HbA1c value had higher odds of accurately assessing their diabetes control (adjusted odds ratio 1.59, 95% CI 1.05-2.42). Similarly, knowing a person's HbA1c was associated with higher scores on the measure of reported diabetes care understanding

($\beta$ = 0.17, P < 0.001). There was significantly lower percentages of Latinos (8%) accurately reported their last HbA1c than respondent of other ethnicities. In addition, most of the respondents with less than a high school education (7%), income $\leq$ $10,000 (13%), and who received care at the VA (14%) or inner city health systems (16%), were not able to accurately report their most recent HbA1c value [37].

Using the Michigan Diabetes Knowledge Test (DKT), a cross-sectional survey of 5,114 Kuwaiti adults with T2DM revealed that participants, who were older and with lower educational levels, limited family income, negative family history of diabetes or were smokers, had significantly lower knowledge scores [38]. In addition, scores were lower in those who had shorter disease duration and fewer complications, were taking insulin, had less frequent insulin injections, performed less glucose monitoring, and had lower HbA1c levels. Moreover, the results of the study showed that education, family income, glucose monitoring and presence of complications were independent determinants of total and general knowledge score, whereas the presence of complications was a significant determinant of total knowledge ($P$ < 0.001). The overall knowledge levels and determinants of poor knowledge showed that only 58.9 $\pm$ 22.1% were able to correctly answer the questions related to total DKT, while 61$\pm$ 22.1% did on the general knowledge subscale and 54.7 $\pm$ 22.7% on the insulin knowledge subscale. Furthermore, knowledge deficits were apparent in T2DM patients in the questions related to diet and self-care, such as questions related to the nutrient composition of low-fat milk, effect of unsweetened juice on glucose level, peak timing of intermediate-acting insulin, and signs of ketoacidosis. As for the most common questions that were incorrectly answered in the DKT questionnaire, 71.7% answered that corn was high in fat, 43.7% answered that unsweetened fruit juice had no effect on blood glucose, 40% answered that they would take the usual breakfast insulin dose at lunch time

if they forgot to take it at breakfast, 38% answered that intermediate-acting insulin (NPH or Lente) would cause insulin reactions in 1 to 3 hours where the correct peak last for 6 to 12 hours, 34% answered that sweating is a sign of ketoacidosis where vomiting is the correct answer, and 54.5% either incorrectly answered or did not know their HbA1c [38].

2.8 Attitude and Barriers on Adherence to Diabetes Self-Management

The role of diabetes educators is essential in helping diabetic patients acquire the knowledge and skills necessary to manage their disease on a daily basis. However, knowledge alone will not lead to improved clinical outcomes and the resulting long-term outcome of improved health behavior change. Therefore, it is important to identify the influences including lack of social support, community resources, and environmental and economic factors that can create barriers to adherence to diabetes self-care behaviors. The extent of compliance to the recommendations from physicians or dietitians is challenging for many patients as they find self-care behaviors hard to change and maintain for long periods. Non-compliance can worsen the quality of life and add to the cost of medical care. Understanding the barriers to adherence can help physicians plan and implement more intensive interventions to assist patients in achieving beneficial lifestyle changes [15].

A cross-sectional study on 309 type 2 diabetic patients examined the relationships of diabetes-specific treatment barriers and self-efficacy with self-care behaviors. The study found that perceived barriers to carrying out self-care behaviors were associated with worse diet and exercise behavior [10]. Moreover, results showed that people with higher education tested their blood glucose more frequently ($r = 0.16$, $P = 0.01$). In addition, insulin adjustment was more common among persons who had a longer duration of diabetes ($r = 0.20$, $P = 0.009$), and diet

adjustment was higher among young people (r = 0.16, *P* = 0.03). Moreover, skipping medications was less common among Whites and higher among those with more diabetes complications (r = -0.16, *P* = 0.02). Self-efficacy, which was defined as a judgment of one's own capacity to monitor, plan, and carry out diabetes activities in daily life (i.e. self-care behaviors). In this particular study, self-efficacy explained 4 to 10% of the variance in diabetes self-care behaviors beyond that accounted for by patient characteristics about health beliefs about barriers [10].

Another cross-sectional study identified factors that influence diabetes adherence based on personal factors such as type and duration of diabetes, illness, and other health conditions and psychosocial factors [33]. The sample consisted of 253 patients who had measured their HbA1c within three months prior to responding to the questionnaire. The questionnaire entitled "Self-Care Behavior Survey for Patients with Diabetes" comprised of 141 questions in seven domains. Following a meal plan had the highest correlation with HbA1c as compared with the other self-care behaviors. As for the barriers to diabetes management, cost was the most significant barrier to the four diabetes self-care behaviors and associated with higher HbA1c levels. Similarly, "depression interference" was another barrier associated with higher HbA1c levels for three self-care behaviors. Patients who indicated that T2DM is a very serious disease were significantly more likely to have higher HbA1c. On the other hand, patients who were married, higher adherence-satisfaction with medication, and higher adherence-satisfaction with testing blood glucose were associated with lower HbA1c levels [33].

Diet and exercise modification are important components for treatment of T2DM. According to the Finnish Diabetes Prevention Study, the risk of T2DM can be reduced significantly through intensive lifestyle intervention. However, non-adherence to diet and

exercise are most frequently reported as barriers to diabetes self-management in many research studies. A cross-sectional study was conducted to assess the effectiveness of dietary and lifestyle advice and determine the perception and attitudes of Omani adults (n = 98) with T2DM management. Metabolic parameters, dietary intake, and exercise levels were evaluated in 2005 and then re-evaluated in 2008. All patients received nutrition and lifestyle counseling based on education about diabetes, diet and nutrition, weight management, and exercise. Strong emphasis was placed on diabetes education (i.e., what diabetes is, importance of blood glucose control, possible complications, importance of regular exercise). In terms of attitudes toward diabetes management, 9.6% strongly agreed "diet is sufficient for improving blood glucose," 55.8% strongly agreed "exercise improves blood sugar," and 15.4% strongly agreed "taking traditional herbs improves blood sugar levels." The study also found that more than 10% of the patients do not believe that diabetes or diabetes-related complications would affect their quality of life [39].

2.9 The Healthcare System in Kuwait

The health care system in Kuwait has improved greatly over the past decades [40]. Kuwait is divided into six health districts/regions: Capital, Hawalli, Ahmadi, Jahra, Farwaniya, and Mubarek Al-kabeer. Each health region is considered as an independent administrative unit. It is responsible for all executive affairs in the area according to the responsibilities assigned to it in terms of specialized health services as well as administrative, financial, and engineering services. The main duties of each region include: 1) implementing an action plan of the ministry to ensure provision of health services to the residents in the area; 2) offering different levels and types of health care; 3) implementing training for medical, technical and administrative cadres; and 4) establishing and implementing a comprehensive computerized system of health information in the area [40].

The Ministry of Health (MOH), which is located in the Capital region, is the major government entity that is responsible for health service delivery as well as planning, financing, resource allocation, regulation, monitoring, and evaluation. MOH offers an extensive network of public hospitals, health centers, physicians, and nurses. The healthcare system in Kuwait provides primary, secondary and tertiary healthcare and emergency medical services free-of-charge to Kuwaiti citizens. There are 72 primary health centers spread across all the six regions. Primary healthcare is delivered through a series of health centers, with general or family health clinics, maternal and child care clinics, diabetic clinics, dental clinics, and preventive care clinics, school health services, ambulance services, and police health services [40]. As a small country, access to health care with the necessary resources available is widespread in Kuwait. There are several neighborhood areas that are distributed within each health region. In each area, there is a healthcare center and it is usually beside the grocery store of that area.

Although the Kuwaiti government has made large efforts, not much progress has been reported on diabetes management. Poor compliance with monitoring and treatment recommendations, poor patient participation, limited doctor-patient feedback, and lack of access to medical supplies and devices are all factors that delay the improvement of diabetes management. Routine screening procedures, monitoring diabetes control, and detecting common diabetes complications are still not implemented at the primary care infrastructure. Therefore, there is a strong need for trained and experienced diabetologists, nutritionists/dietitians, diabetes nurse educators, and other health-care providers [12] to improve the quality of care on diabetes management in the Kuwaiti population.

# Chapter 3: Materials and Methods

Primary healthcare in Kuwait is delivered through a series of health centers where the government provides approximately 97% of the services. In each center, the services offered include general practitioner services and childcare, family medicine, maternity care, diabetes patient care, dentistry, preventive medical care, nursing care, and pharmaceuticals. Residents of Kuwaiti nationality generally receive free medical services while expatriates are required to pay for their treatment and drugs [40]. The Capital Region has the highest number of diabetic patients (about 38,471 patients) registered at the Primary Healthcare Centers (PHCs) compared to the other health regions. For that reason, this research determined the prevalence of poor glycemic control among Kuwaiti patients with T2DM attending the PHCs in the Capital Region.

## 3.1 Subjects

The study involved Kuwaiti type 2 diabetic adults visiting the PHCs in the Capital Region. Data was obtained through a structured questionnaire that was used to briefly interview patients at their visit to the clinic. Other measures were also extracted from medical records of patients receiving care during that day. No blood samples or any other invasive procedures were performed in this research study. As a first step, approval was obtained from the ethical committee at the Kuwait Institute for Medical Specialization (KIMS) for data collection at all the PHCs in the Capital Region. Approval from the Institutional Review Board (IRB) at the University of Maryland, College Park (UMDCP) was also granted before conducting the study. The field duration of data collection was approximately 5 months.

- o The **inclusion criteria** of subjects are as follows:
  - ▪ Subjects with T2DM

- Kuwaiti Nationality

- Adults age +20 years

o The **exclusion criteria** of subjects are as follows:

- Subjects with type 1 diabetes

- Subjects with Gestational Diabetes

- Subjects with complicated diseases not related to diabetes (i.e., liver failure, cancer)

3.2 Study Design

A cross-sectional study was conducted through a multi-stage stratified random sampling of the PHCs in the Capital Region. Data was obtained using a questionnaire to assess patients' responses about their diabetes self-care behaviors, solicit their general knowledge and attitudes, their dietary and lifestyle modifications, and determine potential barriers to adherence self-care behaviors and barriers to adherence to diabetes self-management (*Appendices A & B*). Moreover, data collection including biochemical parameters was extracted from patients' medical records, and the most recent anthropometric measurements were obtained from either the patients' log notebooks or from their medical records (*Appendix C*).

**Questionnaire Design**

A questionnaire was used to assess patients' diabetes self-care behaviors, general diabetes knowledge, general attitude and satisfaction, dietary and lifestyle modifications, barriers to adherence to self-care behaviors, and barriers to adherence to overall diabetes self-management. The questionnaire is entitled "Survey on Self-Management of Type 2 Diabetes in Kuwait." In addition, the questionnaire was developed based on the research literature related to diabetes self-management [8,10,15,33,38,41].

The first part of the questionnaire included information about personal characteristics (age, weight, height, sex, marital status, education level, occupation, income, smoking status) and diabetes-related characteristics (duration and family history of diabetes). The second part of the questionnaire was made up of questions related to six domains: 1) Diabetes Self-Care Behaviors, 2) Dietary and Lifestyle Modifications, 3) General Attitude and Satisfaction 4) General Diabetes Knowledge, 5) Barriers to Diabetes Self-care Behaviors, and 6) Barriers to Diabetes Self- Management.

The first part is related to questions about the type of diabetes treatment, frequency of medication/insulin regimen, whether patient has been placed on a special diet, frequency of exercise, frequency of testing blood glucose at home, and the presence of diabetes-related complications. The second part is specific to dietary and lifestyle modifications. Questions are related to patients' general appetites, frequency of meals and snacks they consume during the day, type of food/meal planning methods, if they are on any diet restrictions from their physicians or dietitians, if there was any weight change within the past year, minutes exercised per week, and the average number of hours they sleep at night. The third part is made up of questions to evaluate patients' general attitudes and satisfaction toward diabetes management, as well as questions on specific barriers to self-care behaviors by using the 5-point Likert-Scale (Strongly Agree, Agree, Somewhat Agree, Disagree, and Strongly Disagree). Questions on barriers to self-care behaviors were specific to Kuwaiti people to ask on whether they have difficulty following their treatment regimen have frequent social gatherings, influenced by environmental factors (i.e., lack of time, and weather conditions), difficulty reducing blood glucose at high readings, and stress and depression. The fourth part relates to questions about

patients' general knowledge about diabetes based on true/false questions. Patients are asked if a statement is true, false, or to choose that they don't know the answer to the statement. The last part is a question based on patients' personal experiences where they would rank the barriers that they consider as the most influential to the least influential in terms of negative impact to their diabetes management. The reasons provided where they would rank based on their experience with T2DM are: 1) non-adherence to medication, 2) non-adherence to the diet recommended, 3) non-adherence to clinic appointments and periodic check-ups, 4) lack of exercise/physical activity, 5) family and social circumstances, and 6) stress from work. The last question is optional for patients to answer if they have any other comments on whether they are experiencing other barriers to diabetes self-management in their lives besides the reasons mentioned in the questionnaire (*Appendices A & B*).

**Validity**

Validity is the extent to which the research findings truly represent the phenomenon that is under study. To test the validity of the questionnaire, researchers, statisticians, medical doctors, and dietitians were consulted in the process of designing the questionnaire. Since Arabic is the first language among Kuwaiti people, the questionnaire was initially designed in Arabic and then translated into English language. Family practitioners and dietitians validated the Arabic version of the questionnaire. After that, a pilot study was conducted on 20 Kuwaiti type 2 diabetic patients at two of the PHCs in the Capital Region, of which one of them was from a specialized outpatient clinic and the other was a general family outpatient clinic. The pilot study was useful to determine the clarity of the questionnaire as regards to the phrasing of the questions, estimated time of filling the questionnaire, and to test the analytic procedure and overall response of the patients. Initially, the average time patients took in completing the

interview questionnaire in the pilot study was 20-30 minutes. Therefore, the questionnaire was revised (up to 9 versions) after the pilot study. Some questions were removed and combined to reduce the time for patients to answer the questions in the survey, mainly in the domains related to general diabetes knowledge, general attitude and satisfaction, and barriers to self-care behaviors. Other questions (i.e., sociodemographic characteristics) were modified and re-ordered based on the suggestions received from family practitioners and dietitians while validating the questionnaire. Overall, the pilot study revealed that the questionnaire was appropriate and suitable for diabetic patients to use.

**Reliability**

Reliability is the consistency of the measurement, or the degree to which an instrument measures what is supposed to measure each time it is used under the same condition. In other words, it is the repeatability of the measurement. The reliability was estimated through Internal Consistency. The reliability has an Internal Consistency of estimation by grouping questions in a questionnaire that measure the same concept, which are the five domains in our questionnaire. Correlation values were computed by using Cronbach's Alpha among the questions in the questionnaire. Cronbach's Alpha among the 5-point Likert-scale questions was found to be 0.6.

**Biochemical Investigations**

Since patients' updated medical records are inconsistent in most of the clinics, the most recent available record based on the last date patients are asked to get a blood test was recorded from the files. Therefore, the most recent biochemical parameters were extracted from patients' medical records. These include Fasting Plasma Glucose (mmol/l) for assessing short-term glycemic control, and lipid profile including Triglycerides (mmol/l), Total Cholesterol (mmol/l),

HDL-C (mmol/l), and LDL-C (mmol/l) for determining the presence of diabetic dyslipidemia. Moreover, as a proxy for measuring long-term glycemic control, the most recent Glycosylated Hemoglobin (%HbA1c) readings was also recorded to assess patients' overall compliance to diabetes self-care behaviors (*Appendix C*). Since there is no current standard developed in the Middle East and the Arabian Gulf region, the current Standards of Medical Care in Diabetes, which is recently developed by the American Diabetes Association, was used as a reference in assessing glycemic control as well as diabetic dyslipidemia [42]. The normal level for FPG was set at < 7 mmol/L, while the target HbA1c for non-pregnant adults was < 7% [13,42]. In addition, triglycerides should be < 150 mg/dl (<1.7 mmol/l), LDL-C should be < 100 mg/dl (< 2.6 mmol/l), HDL-C should be > 40 mg/dl (>1.1 mmol) in men and > 50 mg/dl (> 1.4 mmol/l) in women, and total cholesterol should be < 5.2 mmol/l [42].

**Anthropometric Measurements**

Measurements including weight (kg) and height (cm) were extracted from patients' medical records or from the log notebooks that they bring with them at their visits to the clinic. A trained nurse in the clinic took these measurements when they were not available in the medical records. Body Mass Index (BMI = $kg/m^2$) will be calculated using these two measurements. The cutoffs for BMI was based on the World Health Organization (WHO) criteria, where overweight is defined as a BMI ≥ 25 $kg/m^2$, and obesity is defined as a BMI ≥ 30 $kg/m^2$ [43].

3.3 Sampling Procedure

There are a total of 21 PHCs in the Capital Region of Kuwait. Two clinics are temporarily closed for reconstruction and two others clinics receive visits from less than 1% of Kuwaiti patients. For that reason, these four clinics are excluded and the remaining 17 PHCs

were considered in this research study. Within the remaining 17 PHCs, six are specialized diabetic clinics and eleven are the general family clinics. Both types of clinics do receive diabetic patients. However, the specialized diabetic clinics have a different setup for diabetic patients including a room where a machine is placed for eye examination, fundus cameras, doctors, nurses, and dietitians who counsel only diabetic patients. In addition, the medical doctors are general practitioners who specialize in only counseling diabetic patients on a daily basis. However, in the general family clinics there is a rotation between the family practitioners, where each doctor is assigned to counsel diabetic patients on certain day(s) of the week and the rotation varies from clinic to clinic. From the given set up, if we would like to consider the two types of clinics as groups or strata, then the clinics were randomly be selected within each stratum (as sampling units). Hence, the numbers of sampled clinics included in the study were determined. Due to limitations in time and budget, we did not consider all the patients in the selected number of clinics. A second stage of random sampling was considered to select Kuwaiti type 2 diabetic patients from each of the selected clinics (i.e., eight clinics). Therefore, a total sample size ($n$) of patients was selected according to the number of clinics being selected. Furthermore, there are important terminologies that needed to be defined in the sampling procedure of this study.

- *Population*: All Kuwaiti type 2 diabetic patients filed at PHCs at the Capital district of Kuwait.
- *Sampling Unit*: The PHCs within the Capital district of Kuwait.
- *Element*: An individual Kuwaiti Type 2 diabetic patient.
- *Sampling Frame*: A list of all the clinics that are in the population of interest.

Suppose the population of $N$ units (here the units are clinics and the variable of interest y is the HbA1c Glycosylated Hemoglobin) is partitioned into $L$ strata with $N_i$ units in the i-th stratum such as $\sum N_i = N$. Let the total sample size be $n$ divided into $n_1,....,n_L$ with $n_i$ units from the i-th stratum and $c_i$ = cost of sampling per unit from the i-th stratum, then the total cost of sampling is $C = c_0 + \Sigma\, c_i n_i$ , where $c_0$ is a fixed overhead cost. Based on Theorem 5.6 on sampling [44], we may choose the optimum allocation scheme (i.e., choose the $n_i$'s) either (1) to minimize the variance $(V)$ of the estimate of the population mean for a specified total cost $(C)$, or (2) to minimize $C$ for specified $V$. Both schemes lead to the same solution for allocation. The formulas are given in the above references for $n_i/n$ and $n$. In this study, L= 2 and if we select scheme (2), then this leads to the following solution for allocation [44]:

$$\frac{n_1}{n} = \frac{(N_1 S_1/\sqrt{c_1})}{B} \quad \text{and} \quad \frac{n_2}{n} = \frac{(N_2 S_2/\sqrt{c_2})}{B},$$

where $B = \dfrac{N_1 S_1}{\sqrt{c_1}} + \dfrac{N_2 S_2}{\sqrt{c_2}}$ , and the total sample size is given by

$$n = \frac{[N_1 S_1 \sqrt{c_1} + N_2 S_2 \sqrt{c_2}]\mathrm{x}[\frac{N_1 S_1}{\sqrt{c_1}} + \frac{N_2 S_2}{\sqrt{c_2}}]}{D},$$

where $D = VN^2 + [N_1 S_1^2 + N_2 S_2^2]$

For the problem in hand, we have L=2, $N_1$=6, and $N_2$=11. The numbers of Kuwaiti type 2 diabetic patients registered in the specialized diabetic clinics and in the general family clinics are

listed in **Table 3.1** and **Table 3.2** below. These numbers were obtained from the persons' in charge or Head Chairs of the clinics based on personal visits for each PHCs.

*Table 3.1*: Number of Kuwaiti Type 2 Diabetic Patients in Specialized Diabetic Clinics

| Clinic Name | Location | Number of Patients |
|---|---|---|
| Abdul Al Rahman Abdul Al Mogni | Faiha | 1,457 |
| Al Sager Health Speciality Center | Adaliya | 1,204 |
| Shaikhah Al Ibrahim Health Center | Nuzha | 1,721 |
| Rawda Health Center | Rawda | 1,964 |
| Qairwan Health Center | Qairwan | 1,162 |
| Al Ahqaqee Health Center | Daiya | 1,470 |

*Table 3.2*: Number of Kuwaiti Type 2 Diabetic Patients in General Family Clinics

| Clinic Name | Location | Number of Patients |
|---|---|---|
| Abdalla Yousif Al Abdul Hadi Clinic | Yarmouk | 1,105 |
| Abdulla Sharifa Al Mahari | Khaldiya | 1,062 |
| Bader Al Nifisi Health Center | Abdullah Al Salem | 536 |
| Al-Homaydi Health Center | Shwaikh | 376 |
| Jassim Al Wazzan Health Center | Mansoriyah | 455 |
| Dasma Health Center | Dasma | 587 |
| Khaled Saleh Algoneem Center | Quadisiya | 163 |
| Muneera Al Ayar Health Center | Keifan | 883 |
| Qurtuba Health Center | Qurtuba | 1,493 |
| Fatuh Salman Al Sabah Health Center | Shamiyah | 725 |
| Surra Health Center | Surra | 1,495 |

Also, we were able to obtain from the Department of Information Systems at Ministry of Health (DISMH) the initial estimates of means and standard deviations of HbA1c variable for clinics in both groups. These estimates are $\bar{X}_1 = 8.531$, $S_1 = 1.7842$ for specialized diabetic clinics (1,054 patients), and $\bar{X}_2 = 7.964$, $S_2 = 1.7691$ for general family clinics (751 patients). The pooled estimate of the variance $S_p^2 = 3.16$ was used for the estimate of $V$ in the formula for $n$. If

we assume that the market cost of collecting one questionnaire in Kuwait is KD 1.0, then $c_1 =$ KD 1054 and $c_2 =$ KD 751. Accordingly, we have for optimal allocation $\frac{n_1}{n} = 0.33$, $\frac{n_2}{n} = 0.67$ and hence n = 8.5 (from 8 to 9 clinics). Therefore, eight clinics was selected; three from the specialized diabetic clinics (33% of 8) and five from the general family clinics (67% of 8).

**Power Analysis**

A priori power analysis was calculated using SAS software version 9.2, with a 95% confidence level and a power of 0.80. As the main parameter in measuring long-term glycemic control, %HbA1c was tested as the variable of interest for the PHCs. The mean and standard deviation of %HbA1c for both specialized diabetic and general family clinics was obtained from the DISMH. Estimates of the mean difference of 0.567 and pooled standard deviation of 1.8 were entered into the software for sample calculation. Results showed that in order to detect a mean difference as small as 0.567 at $\alpha = 0.05$, a sample size of 320 type 2 diabetic patients are needed in order to achieve a power of 0.8 (80%). However, if the sample size is increased to 426, the power of the test will increase to 0.9 (90%).

Finally, the total sample size (n = 447) was distributed proportionally according to the number of patients in the eight selected clinics. Out of the eight clinics, three specialized diabetic clinics and five general family clinics were selected. The areas of which the randomly selected specialized clinics along with the number of patients collected from each clinic are: Adaliya (n = 76), Rawda (n = 69), and Dai'aya (n = 109). The areas of which the randomly selected general family clinics along with the number of patients collected from each clinic are: Yarmouk (n = 43), Khaldiya (n = 56), Dasma (n = 26), Keifan (n = 41), and Quadsiyah (n = 27).

3.4 Statistical Analysis

Descriptive and inferential statistical analyses were used in the study. Continuous variables were presented as means (SD). Categorical variables were presented using frequencies and percentages. Descriptive statistics were used for the sociodemographic and diabetes-related characteristics, biochemical parameters, and diabetes self-management variables. In addition, chi-square tests were used to determine the associations and significance between categorical variables in the questionnaire. Independent samples t-test was used to determine mean differences in biochemical parameters and diabetes self-management scores according to the types of clinics. Analysis of Variance (ANOVA) was used to compare the differences in means for quantitative variables of interest for three and more groups. Tukey HSD test was used for post-hoc pairwise comparisons. Pearson correlation coefficients were used to examine the associations between continuous variables. Stepwise multiple linear regression analyses were used to identify the most significant predictors of glycemic control using patients' latest HbA1c in 2011. Predictors that are significant at $p < 0.05$ were included in the final multiple linear regression model. Nonparametric k-related samples tests were used to categorize the influence of barriers to diabetes self-management based on their mean ranks. Discriminant analysis was used to build a predictive model for group membership (compliant versus non-compliant) with respect to glycemic control. Adherence to diabetes self-care behaviors was analyzed through decision tree classification using the Chi-squared Automatic Interaction Detection (CHAID) method. Overall, a significance level was set at $p \leq 0.05$ and analyses were performed using Statistical Packages SPSS (version 18 and version 20).

# Chapter 4: Results

## Paper #1: Prevalence of poor glycemic control among type 2 diabetic patients at the Primary Healthcare Centers in Kuwait

**Abstract**

*Background:* Type 2 diabetes (T2DM) is a major health problem in Kuwait. Despite its growing prevalence, limited information is known about the effect of diabetes self-management on glycemic control and its associated factors among Kuwaiti people with T2DM.

*Objectives:* The purpose of this study is to determine the percentage of poor glycemic control and its associated factors among Kuwaiti type 2 diabetic patients at Primary Healthcare Centers (PHCs), and to examine the influences of self-care behaviors, dietary and lifestyle modifications, general diabetes knowledge, and general attitude and satisfaction with glycemic control.

*Design:* A cross-sectional survey involved Kuwaiti adults with T2DM (n = 447) at eight PHCs. A questionnaire was used to collect information on sociodemographic and diabetes-related characteristics, self-care behaviors, dietary and lifestyle modifications, general diabetes knowledge, and general attitude and satisfaction. Biochemical and anthropometric measurements were extracted from patients' medical records. A score system was developed for diabetic patients based on the domains in the questionnaire. The prevalence of poor glycemic control was evaluated by following the current American Diabetes Association (ADA) criteria.

*Results:* The overall prevalence of poor glycemic control (HbA1c ≥ 7%) among Kuwaiti type 2 diabetic patients was 78.8%. Proportion of poor glycemic control was higher among patients with a longer duration of diabetes, positive family histories of diabetes, and who are on oral hypoglycemic agent (OHA) medications. Stepwise multiple regression analyses showed that HbA1c in 2010, Fasting Plasma Glucose (FPG), Total Cholesterol (TC), general diabetes

knowledge scores, and Triglycerides (TGs) explained a significant amount of variance ($Adj\ R^2 =$ 0.541, $F = 42.030$, $p = 0.000$) in glycemic control (HbA1c levels in 2011). Comparison of mean diabetes self-management scores showed that most diabetic patients had "poor" self-care behaviors and dietary and lifestyle modifications scores of 59.3% and 64%, respectively. However, most diabetic patients were considered to have "good" general diabetes knowledge and general attitudes and satisfaction scores of 52.8% and 70.5%, respectively. Diabetic patients with poor glycemic control had significantly lower general diabetes knowledge and lower general attitude and satisfaction scores than patients with good glycemic control.

*Conclusion:* The prevalence of poor glycemic control among type 2 diabetic Kuwaitis is relatively high, which reflects the need for more national studies to assess and develop interventions for improving glycemic control among diabetic patients at the PHCs in Kuwait.

**<u>Introduction</u>**

Type 2 diabetes (T2DM) is a serious clinical and public health concern in Kuwait. The last prevalence study of T2DM in Kuwait was done in 1998 and reported to be 14.7% [3]. However, it is currently expected that the prevalence rate of T2DM among Kuwaitis is higher than it was in the past decade. In the Arabian Gulf region, the prevalence of T2DM in adult populations was reported as 23.7% in the Kingdom of Saudi Arabia, 20.1% in the United Arab Emirates, and 15.4% in Bahrain [45,46]. Multiple factors including socioeconomic changes, culture and westernization, changes in dietary habits, sedentary lifestyle, obesity, and smoking are all factors associated with an increase in diabetes prevalence.

Many people with diabetes do not achieve adequate glycemic control, which makes it a great challenge for patients as well as healthcare professionals [21]. Glycemic control is a medical term that means to maintain blood glucose levels within a normal range in people with

diabetes. Blood glucose (random or fasting) provides a measurement of glucose level at the moment the blood sample is collected to determine patients' short-term glycemic control. On the other hand, glycosylated hemoglobin (%HbA1c) provides a measure of the average blood glucose levels during the previous two to three months. It is considered as the best indicator for patients' long-term glycemic control [7]. Large clinical trials have shown that strict glycemic control correlates with reduction in the macrovascular and microvascular complications of diabetes [8]. For that reason, glycemic control remains to be the primary therapeutic target for diabetes management and prevention of target organ damage and other diabetes-related complications [19].

The current target HbA1c goal recommended by the American Diabetes Association (ADA) is < 7.0%, whereas the HbA1c goal of the American Association of Clinical Endocrinologists (AACE)/American College of Endocrinology (ACE) is ≤ 6.5% [47]. Optimal glycemic control is difficult to achieve and maintain on a long-term basis among type 2 diabetic patients. Studies suggest that there are various factors associated with poor glycemic control. Diabetes self-management has shown to make a significant contribution on patients' overall health and quality of life. Diabetes self-care behaviors including medication/insulin, dietary intake, exercise or physical activity, and self-monitoring of blood glucose (SMBG) are important in achieving adequate glycemic control. Furthermore, patients' knowledge and attitude on diabetes self-management have shown to affect their glycemic control. Several studies have indicated that diabetic patients with a lack of knowledge and negative attitudes on diabetes self-management were more likely to have poor glycemic control [8,38]. Therefore, recognizing the determinants of poor glycemic control may contribute to a clearer understanding on improving patients' care and reducing complications associated with diabetes.

Despite the significant awareness of increased diabetes prevalence in Kuwait, the rate of poor glycemic control and its associated factors among Kuwaiti type 2 diabetic patients has not been determined. In addition, the impact of diabetes self-management on glycemic control has not been clearly established and not been investigated among Kuwaiti people with diabetes. For that reason, the objectives of this study are: to determine the prevalence of poor glycemic control among Kuwaiti type 2 diabetic patients attending the Primary Healthcare Centers (PHCs), to identify the factors associated with poor glycemic control among Kuwaiti people with T2DM, and to investigate the influences of diabetes self-care behaviors, dietary and lifestyle modifications, general diabetes knowledge, and general attitude and satisfaction on glycemic control.

## Subjects and methods

*Study population*

A cross-sectional study was conducted to assess the prevalence of poor glycemic control and its associated factors at the PHCs in Kuwait. At each PHC, there are various healthcare services offered including diabetes patient care. Kuwaiti citizens nationality generally receive free medical services while expatriates are required to pay for their treatment and drugs. Our study sample consisted of 447 Kuwaiti adults aged 20 years and older with T2DM. Data were collected by a structured questionnaire and by medical record extraction from patients' files at eight PHCs in the Capital Region of Kuwait. Protocols were approved by the Kuwait Institute of Medical Specialization and by the Institutional Review Board at the University of Maryland, College Park. All patients were given informed consent to participate in the study.

*Questionnaire Design*

A questionnaire was designed to obtain information on sociodemographic and diabetes-related characteristics, and to determine the factors associated with poor glycemic control based on four domains: diabetes self-care behaviors, dietary and lifestyle modifications, general diabetes knowledge, and general attitude and satisfaction. The questionnaire was designed in Arabic and was validated by five primary healthcare physicians and dietitians. The questionnaire was further pretested on a sample of 20 patients at two PHCs to determine its validity. Overall, the questionnaire was appropriate and suitable for diabetic patients to use.

*Study Variables*

Several variables of interest were obtained onto the questionnaire. Sociodemographic characteristics included weight, height, age, sex, social status, education level, occupation, family income, and smoking status. Diabetes-related characteristics included duration of diabetes, family history of diabetes, and presence of diabetes-related complications. Diabetes self-care behaviors variables are related to medication/insulin, dietary intake, exercise/physical activity, and SMBG. Dietary and lifestyle modifications variables are related to meals and snacks, meal-planning methods, diet restrictions, minutes of exercise, and average hours of sleep. General diabetes knowledge variables are related to health consequences from diabetes, definition of %HbA1c, food intake control while on medication/insulin, and inclusion of foods in a diabetic diet. General attitude and satisfaction variables are related to patients' current diet, motivation by healthcare provider, coming to appointments, and consultation and advice received by healthcare providers at the clinic.

*Biochemical and Anthropometric Measures*

The diagnosis of T2DM was based on the current American Diabetes Association (ADA) criteria. Glycosylated hemoglobin was used in assessing long-term glycemic control. ADA guidelines recommend a target HbA1c < 7% for non-pregnant diabetic adults. Total cholesterol (TC) was considered high if ≥ 5.2 mmol/l. Low density lipoprotein cholesterol (LDL-C) was considered high when > 2.6 mmol/l. High density lipoprotein (HDL-C) was considered low when < 1.0 mmol/l for males and < 1.3 for females. Hypertriglyceridemia (TGs) was identified if > 1.7 mmol/l. Body Mass Index (BMI) was calculated as the ratio of weight (kilograms) to the square of height (meters). BMI was categorized according to World Health Organization (WHO) criteria as normal if BMI < 25 kg/m$^2$, overweight if BMI 25-29.9 kg/m$^2$, and obese if BMI > 30 kg/m$^2$.

*Diabetes Self-Management Scores*

Diabetes self-management scores were measured based on diabetes self-care behaviors, dietary and lifestyle modifications, general diabetes knowledge, and general attitude and satisfaction domains. Each domain is made up of questions with categorical answer choices. Patients' scores were evaluated based on the choices they selected in answering the questions.

Regarding the first domain, diabetes self-care behaviors scores were developed based on five questions with a maximum of one point for each question. Questions on self-care behaviors included: type of diabetes treatment, frequency of medication/insulin intake, if placed on a special diet, frequency of exercise per week, and frequency of SMBG per week. Possible scores for each question are zero, half, or one point. A score of zero points indicates that patients' do not practice a self-care behavior. A score of a half point indicates that patients' may practice a self-care behavior but not on a regular basis. A score of one point indicates that patients' practice

a self-care behavior regularly according to advice given by a physician or dietitian. The points for all the questions were added to obtain the total self-care behaviors score with a maximum of five points. Total diabetes self-care behaviors scores are classified as "good" if the score is 4-5 points, "fair" if score is 3 points, and "poor" if score is 1-2 points.

For the second domain, dietary and lifestyle modification scores were developed based on five questions with a maximum of one point for each question. Questions on dietary and lifestyle modifications included: frequency of meals and snacks intake, meal-planning method, if placed on diet restrictions, minutes of exercise per week, and average hours of sleep everyday. Possible scores are zero or one point for questions related to meals and snacks, meal-planning method, and diet restrictions. Possible scores for questions on minutes of exercise per week and average hours of sleep every day are zero, half, and one point. A score of zero points indicates that patients' do not follow any meal-planning method, are not on any diet restrictions or do not exercise, their average meals and snacks intake is less than three meals a day, and their average hours of sleep is less than 6 hours daily. The points for all the questions were added up to obtain the total dietary and lifestyle modifications score with a maximum of five points. Total dietary and lifestyle modification scores are classified as "good" if score is 4-5 points, "fair" if score is 3 points, and "poor" if score is 1-2 points.

For the third domain, general diabetes knowledge scores were developed based on four questions with a maximum of one point for each question. Each statement was based on true, false, or don't know answer choices. Patients who correctly answered "true" or "false" to each statement received 1 point, and those who answered, "don't know" to the statements received no points. All of the points were added up to obtain the total general diabetes knowledge score with

a maximum of four points. Total general diabetes knowledge scores are classified as "good" if score is 3-4 points, "fair" if score is 2 points, and "poor" if score is 1 point.

Finally for the last domain, patients' general attitude and satisfaction scores were developed based on four questions. Each statement is rated on a five-point Likert-scale (1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree, and 5 = strongly agree). The questions did not require reverse scoring since the statements are positively worded. Based on patients' scale answers to the questions, the numbers for the statements were added together and then divided by the number of questions/statements to obtain the total general attitude and satisfaction score with a maximum of five points. Total general attitude and satisfaction scores are classified as "positive" if score is 4-5 points, "neutral" if score is 3 points, and "negative" if score is 1-2 points.

*Statistical Analysis*

Descriptive and inferential statistics were used in the analysis. Data were presented as means ± standard deviations (SD) and frequencies and percentages for categorical variables. Chi-square test was used to determine associations between diabetes-related characteristics and glycemic control. Pearson (*r*) correlation was used to determine associations between biochemical variables. Factors associated with poor glycemic control were assessed by using one-way analysis of variance (ANOVA) to determine differences in mean HbA1c of more than two groups. Tukey HSD test was used for post-hoc pairwise comparisons. Stepwise multiple regression analyses were conducted to develop a model that identified the most significant predictors of glycemic control. Diabetes self-management scores were considered as non-normally distributed variables and analyzed using non-parametric tests. Mann-Whitney U-test was used for comparing mean total scores of two groups and the Kruskal-Wallis test was used

for comparing mean total scores of more than two groups. Analyses were performed using Statistical Package for Social Sciences (SPSS), version 18. A p-value ≤ 0.05 was considered statistically significant.

**Results**

*Sociodemographic Characteristics*

This study included a total of 447 Kuwaiti participants (203 men and 243 women) with T2DM aged between 23 and 92 years with a mean (SD) of 55.7 (± 9.95) years. Weight (kg) ranged from 39 to 176 kg with a mean (SD) of 82.9 (±18.4) kg, and height (cm) ranged from 137 to 197 cm with a mean (SD) of 163.8 (±10.24) cm. The mean (SD) BMI for Kuwaiti type 2 diabetic adults was 31.0 (±6.62) kg/m$^2$. The mean (SD) BMI for Kuwaiti diabetic males and females were 30.3 (±6.3) and 31.6 (±6.8), respectively. Most patients were married 358 (80.6%) and had an education up to high school or 2 years diploma 190 (42.7%). In addition, about 27% were university graduates and only 2.7% had a higher (MS or PhD) degree. The majority of patients (45.2%) reported to have a monthly family income between 700 and 1200 Kuwaiti dinars (1 KD = 3.6 US dollars), and more than half of the patients (60.8%) were either not employed or retired. Only 14.2% were current smokers, while most of the patients were nonsmokers (76.7%).

*Diabetes-Related Characteristics*

Most patients (47.9%) had diabetes of more than 8 years. About 87% of patients reported to have a positive family history of diabetes from either first-degree (i.e., parents and siblings) or second-degree relatives (i.e., grandparents, uncles/aunts, and cousins) or from both. Almost half of the patients (49.1%) have diabetes-related complications, where eye and nerve diseases were

50

most frequently reported, with 26.1% and 28.6%, respectively. About 12.8% of patients were reported to have other problems including hypertension, hypercholesterolemia, hypoglycemia, stroke, arthritis and joint pain, osteoporosis, asthma, and gastrointestinal, liver, and sexual problems. Diabetes-related characteristics of Kuwaiti type 2 diabetic patients are shown in **Table 4.1**.

Chi-square test showed that duration of diabetes was significantly associated with the type of diabetes treatment ($p = 0.012$), medication regimen ($p = 0.000$), frequency of medication intake ($p = 0.001$), and diabetes-related complications ($p = 0.000$). Patients with longer durations of diabetes were more likely to be placed on intensive therapy. About 82.3% of patients placed on both medication and insulin and 81.8% of patients placed on insulin only have diabetes of more than 8 years. In addition, frequency of medication/insulin intake was found to increase with longer durations of diabetes. About 53.2% of patients who take their medications/insulin three or more times daily have diabetes of more than 8 years. Furthermore, about 58.7% of patients with diabetes-related complications had diabetes for more than 8 years. Patients with a family history from first-degree relatives were more likely to have diabetes-related complications ($p = 0.000$). About 50.9% of patients with first-degree relatives and 30.7% with both first-degree and second-degree relatives reported to have diabetes-related complications.

*Biochemical Parameters*

**Table 4.2** shows the biochemical parameters of Kuwaiti type 2 diabetic patients according to the current ADA criteria. Overall, most diabetic patients did not achieve good short-term or long-term glycemic control. About 70.2% of patients had fasting plasma glucose (FPG) $\geq$ 7 mmol/l and 78.8% had glycosylated hemoglobin (HbA1c) $\geq$ 7%. On the other hand, most patients did achieve the recommended levels of lipid profile. About 74.3% had Total Cholesterol

(TC) < 5.2 mmol/l, 56.3% had Triglycerides (TGs) < 1.7 mmol/l, and 47.7% had LDL < 2.6 mmol/l. However, most patients did not achieve the recommended levels of HDL, where 57.3% of males had HDL < 1.0 mmol/l and 65% of females had HDL < 1.3 mmol/l.

Pearson ($r$) correlation showed a weak but significant positive correlation between FPG and TGs ($r = 0.295$, $p = 0.000$), FPG and TC ($r = 0.243$, $p = 0.000$), and a weak but significant negative correlation between FPG and HDL ($r = -0.115$, $p = 0.025$). For the relationship between short-term and long-term glycemic control, there was a moderate but significant positive correlation between FPG and HbA1c ($r = 0.470$, $p = 0.000$). As for the lipid profile, there was a weak but significant negative correlation between TGs and HDL ($r = -0.117$, $p = 0.022$), and a moderate but significant positive correlation between TC and LDL ($r = 0.540$, $p = 0.000$).

*Diabetes-Related Characteristics and Glycemic Control*

**Table 4.3** shows the proportion of patients with poor glycemic control according to anthropometric and diabetes-related characteristics. Diabetes was significantly less controlled among patients with longer durations of diabetes, positive family histories from first-degree relatives, and patients who are taking OHA medications only. However, BMI was not found to be significantly associated with poor glycemic control, despite high percentages of overweight and obesity among Kuwaiti type 2 diabetic adults, with 34.6% and 52.9%, respectively. In addition, patients with diabetes-related complications had significantly higher BMI ($X^2 = 14.27$; $p = 0.014$). About 35.5% of overweight and 53.2% of obese patients reported to have diabetes-related complications.

*Factors Associated with Poor Glycemic Control*

Using the one-way ANOVA test, duration of diabetes was found to have a significant

effect on glycemic control with $p < 0.05$ level for the four conditions: 1 year or less, 2-4 years, 5-7 years, and 8 or more years (F-test = 7.255, $p$ = 0.000). Post-hoc comparisons using the Tukey HSD test indicated that there was a significant mean difference in %HbA1c for duration of diabetes of 2-4 years (M = 7.65, SD = 1.37) and 8 or more years (M = 8.87, SD = 1.98). In addition, there was a significant mean difference in %HbA1c for duration of diabetes of 5-7 years (M = 8.00, SD = 1.40) and 8 or more years. Moreover, family history was found to have a significant effect on glycemic control for the five conditions: first-degree relatives, second-degree relatives, both first- and second- degree relatives, no family history, and don't know (F-test = 3.021, $p$ = 0.018). Post-hoc comparisons using the Tukey HSD test showed that there was only a significant mean difference in %HbA1c for patients with second-degree relatives (M = 7.52, SD = 1.51) and patients who don't know their family history of diabetes (M = 9.50, SD = 2.33). Furthermore, medication regimen was the only self-care behavior that had a significant effect on glycemic control with $p < 0.05$ level for the three conditions: OHA medications only, both medication and insulin, and insulin only (F-test = 13.10, $p$ = 0.000). Post-hoc comparisons using the Tukey HSD test denoted that there was significant mean difference in %HbA1c for patients on OHA medications only (M = 8.15, SD = 1.65) and the other two conditions: both medication and insulin (M = 9.58, SD = 2.19), and insulin only (M = 9.11 SD = 1.98). However, no significant difference in mean %HbA1c was found among patients on both medication and insulin and on insulin only. No significant differences in mean HbA1c were found for other self-care behaviors.

*Predictors of Glycemic Control*

Stepwise multiple regression analyses were conducted to identify the predictors of glycemic control (i.e., HbA1c). The independent variables included are age, sex, height, weight,

BMI, smoking status, duration of diabetes, frequency of medication, special diet, hours of exercise, SMBG, FPG, TGs, TC, HDL, LDL, VLDL, latest HbA1c in 2010, self-care behaviors scores, dietary and lifestyle modifications scores, general diabetes knowledge scores, and general attitude and satisfaction scores. We found that only latest HbA1c in 2010, FPG, TC, general diabetes knowledge score, and TGs were highly significant in the regression model. All other variables were excluded from the model and were not found significant in predicting glycemic control. After checking the assumptions of the adopted model, we observed that the residual plots were slightly away from normality but the model remained to be robust since our sample size is considered adequate. We also found that homogeneity of variance assumption was strongly violated. Thus, a log transformation method was performed to correct the problem. The independent variables were again entered into the model with the log transformation of the dependent variable $\log_e$ (latest HbA1c in 2011). The regression model demonstrated that $\text{Log}_e$ (HbA1c in 2010), $\log_e$ (FPG), TC, general diabetes knowledge scores, and TGs explained a significant amount of the variance in latest HbA1c levels in 2011 (*Adj $R^2$* = 0.541, *F* = 42.030, *p* = 0.000). As shown in **Table 4.4**, the "best-fit" model can be written by the following regression equation:

$$\log\widehat{Y} = 0.644 \, (\log \text{HbA1c } 2010) \, + 0.248 \, (\log \text{FPG}) \, - \, 0.183 \, (\text{Total Cholesterol})$$
$$- \, 0.162 \, (\text{Knowledge Score}) - 0.126 \, (\text{Triglycerides}) \, + \, 4.268$$

Based on the partial and semi-partial (part) correlation values, the latest HbA1c in 2010 and FPG are the most significant variables in explaining the variations in glycemic control. On the other hand, TG is the least important variable where its deletion would not make a significant change in the regression model.

*Diabetes Self-Management Scores and Glycemic Control*

In general, the mean (SD) diabetes self-care behavior scores was 2.63 ± 0.88; the mean (SD) dietary and lifestyle modifications score was 2.26 ± 1.06; the mean (SD) general diabetes knowledge score was 2.54 ± 1.01, and the mean (SD) general attitude and satisfaction score was 4.16 ± 0.71. Most diabetic patients had "poor" self-care behaviors and dietary and lifestyle modifications scores with 59.3% and 64%, respectively. On the other hand, most diabetic patients had "good" general diabetes knowledge and general attitude and satisfaction scores with 52.8% and 70.5%, respectively. **Table 4.5** shows the diabetes self-management scores among Kuwaiti patients.

Comparison of mean diabetes self-management scores according to sociodemographic and diabetes-related characteristics and glycemic control are shown in **Table 4.6.** Regarding sociodemographic characteristics, patients with older age, who are divorced or widowed, and those with lower education and limited family income had significantly lower diabetes self-care behaviors, dietary and lifestyle modifications, and general diabetes knowledge scores. In addition, male patients had significantly lower diabetes self-care behavior scores than females. No differences were found between gender and the other domain scores. For diabetes-related characteristics, patients who don't know their family history of diabetes had significantly lower diabetes self-care behaviors, dietary and lifestyle modifications, and general knowledge scores, and patients with a family history from both first-degree and second-degree relatives had significantly lower general attitude and satisfaction scores. Patients with diabetes-related complications had significantly lower general diabetes knowledge and general attitude and satisfaction scores than patients without complications. Similarly, the general diabetes knowledge and general attitude and satisfaction scores were significantly lower in patients with

poor glycemic control than in patients with good glycemic control. Diabetes self-care behaviors and dietary and lifestyle modifications scores were not significantly different for diabetes-related complications and glycemic control.

**Discussion**

We found that the proportion of Kuwaiti type 2 diabetic patients with poor glycemic control (HbA1c > 7%) among Kuwaiti type 2 diabetic patients was 78.8%, while only 21.2% had good glycemic control (HbA1c < 7%). Our results were very similar to other studies conducted in Arab countries. A three-year retrospective study in Oman showed that 77.2% of patients had poor glycemic control, while only 22.8% had good glycemic control [48]. In Jordan, the percentage of HbA1c > 7% was present in 65.5% of type 2 diabetic patients [8]. In Bahrain, about 88.8% of patients had uncontrolled diabetes with HbA1c > 7% [49]. In Saudi Arabia, only 27% of patients had target levels of glycemic control [30]. A reason for such high prevalence of poor glycemic control among Kuwaitis may perhaps reflect the inadequate services provided, such as insufficient efforts on patients' education and motivation from healthcare providers, and lack of facilities for HbA1c measurement and availability of certain diabetes medications at the PHCs setting. Another possible reason may due to the absence of uniform guidelines in assessing glycemic control for physicians to follow when treating patients, and that some clinics at the PHCs use more lenient standards of control that may permit higher levels of glycemia among diabetic patients. An alternative explanation may be due to lack of understanding on the importance of glycemic control and diabetes self-management among patients, physicians, or both.

We found that diabetes-related characteristics including duration of diabetes, family history, and medication regimen were significantly associated with poor glycemic control. This

finding is consistent with other studies [8,45,50-52]. We found that the proportion of poor glycemic control increases with longer duration of diabetes. About half (53.2%) of Kuwaiti adults with duration of diabetes of 8 or more years had poor glycemic control with highest mean HbA1c compared to shorter durations (< 8 years). This can be explained by the progressive nature of deterioration in the β-cells of the pancreas over time in people with diabetes. Studies have shown that β-cell function continues to decline at different stages of the disease process [52], especially during the five to ten years after diagnosis of diabetes that lead to decrease in insulin secretion [45]. In addition, increased fat mass and visceral adiposity over time could affect insulin sensitivity and cause insulin resistance. Poor glycemic control with longer duration of diabetes could also be explained by the increased amount of carbohydrates attached to the HbA1c as the disease progresses [45]. Moreover, the extent of compliance to self-care behaviors can be challenging for many diabetic patients as some may find glycemic control difficult to maintain for long periods.

Moreover, we found that an intensive medication/insulin regimen is significantly associated with poor glycemic control. As in other studies, patients with poor glycemic control and with longer duration of diabetes were more likely to be prescribed with higher dose of OHA medications or insulin or a combination of OHA medications and insulin. Patients treated by insulin or combination therapy require more aggressive treatment to control their disease, while patients with milder disease are more easily controlled by diet or OHA medications [50]. We found that patients who were on combination therapy had significantly higher mean HbA1c than patients who were taking OHA medications only. We also found that patients being placed on combination therapy had significantly higher mean HbA1c than those who take insulin only. Given the high percentage of poor glycemic control, insulin therapy is underutilized among

diabetic patients at the PHCs with only 7%. This could be explained by their phobia of using needles when taking insulin, which makes some physicians reluctant to change their medication regimen to insulin therapy. Patterns of disease burden, disease complexity, comorbidity, disease outcomes, experiences of healthcare providers, and resource utilization are different between primary care and tertiary care settings [45].

There are conflicting results from previous studies on the relationship of sociodemographic variables, BMI, and glycemic control. We did not find significant associations between age and gender and poor glycemic control, which are consistent with some studies [8,45,50]. In addition, we did not find significant associations between education level, marital status, and smoking status and glycemic control, which are consistent with another previous study [28]. Moreover, the contribution of overweight and obesity on glycemic control based on their BMI was not significant, despite the high prevalence of obesity among the general Kuwaiti population, with 36% of male and 47.9% of female adults [53]. The prevalence of overweight and obesity was even higher for both sexes among Kuwaiti type 2 diabetic patients. We found that female diabetics had a significantly ($X^2 = 8.813$, $p = 0.012$) higher percentage of obesity than male diabetics, with 60.9% and 39.1%, respectively. We also found that obesity was more prevalent among middle-aged than older-aged diabetic patients, with 33.6% in 41-50 years, 37.6% in 51-60 years, 19.9% in 61-70 years and 4.4% in >70 years. Our result is also consistent with a previous study conducted in Saudi Arabia, where obesity was more prevalent among the younger diabetic population < 50 years (41%) than in the older diabetic population > 50 years (31%) [54].

There are various predictors of glycemic control that have been identified in preceding studies. In our study, multivariate analyses using stepwise regression showed that TC and TGs

are significant predictors of glycemic control (HbA1c in 2011), which is consistent with another study that found similar results [50]. More than half of Kuwaiti diabetic patients did achieve target levels of TC and TGs (74.3% and 56.3%, respectively), while half (52.3%) did not achieve the target level of LDL. Although high TC, LDL, and TG are indicators of diabetic dyslipidemia, such pattern was not evident in our study, probably because the patients had also been treated with lipid-lowering medications (i.e., statins). We also found that $Log_e$ (HbA1c in 2010) and $log_e$ (FPG) are significant predictors of HbA1c in 2011, which are useful for identifying the pattern of long-term glycemic control among diabetic patients.

We performed an analysis looking at diabetes self-management scores including diabetes self-care behaviors, dietary and lifestyle modifications, general diabetes knowledge, and general attitude and satisfaction. We found the main sociodemographic factors affecting diabetes self-care behaviors, dietary and lifestyle modifications, and general diabetes knowledge are patients with old age, lower education level, and limited family income. This finding is consistent with another study on diabetes knowledge among patients [38]. This may be explained by the fact that old age is seen as a barrier to diabetes education while younger patients may have higher degrees of motivation and adaptability toward their disease through practicing self-care behaviors and making changes to their diet and lifestyle [38]. Moreover, we found that more than half of diabetic patients were considered to have "poor" diabetes self-care behaviors scores with males having significantly lower scores than females. A possible explanation may relate to the Arab culture where Kuwaiti males have more obligations toward their family and society causing them to experience more stress than females, which can affect their adherence to practicing diabetes self-care behaviors. As for diabetes-related characteristics, we found that low general attitude and satisfaction scores are related to patients' positive family history of diabetes, probably

59

because they feel that their genetic predisposition serves as a barrier on their ability to self-manage their disease. In addition, our result on general diabetes knowledge and poor glycemic control was consistent with another study that found similar results [38]. We found that half of diabetic patients were considered to have "good" diabetes knowledge based on our classification of scores. Nevertheless, the association between diabetes knowledge and poor glycemic control might explain that Kuwaiti people with T2DM obtain knowledge about their disease based on the experience they gained over their long duration of diabetes and its complications rather than from any formal educational programs, which are limited in Kuwait. We also found that more than half of diabetic patients were considered to have "positive" attitude and satisfaction based on our classification of scores. This finding is consistent with another study on patients' satisfaction with PHC services in Kuwait [55], which found that the overall satisfaction score of patients was high. We would expect such high scores among Kuwaitis since they receive free health care and their needs are generally being met by the services provided, but not necessary for achieving good glycemic control.

Strengths of this study include its focus on providing an overview on factors associated with glycemic control among Kuwaiti people with T2DM. In addition, our study is one of the first to determine the prevalence of poor glycemic control among Kuwait type 2 diabetic patients attending the PHCs. Moreover, we uniquely developed scores for diabetes self-care behaviors, dietary and lifestyle modifications, general diabetes knowledge, and general attitude and satisfaction as domains to assess glycemic control among Kuwaiti type 2 diabetic patients. However, this study has two limitations. The first is that the information obtained was based on self-reported data from the patients themselves, which may be limited by recall bias. In addition, we did not make comparison of HbA1c measurements at patients' first visit, at 6-months and 12-

months follow-up due to lack of organization and missing information in their medical records at the clinics.

**Conclusion**

In conclusion, the prevalence of poor glycemic control is alarmingly high among Kuwaiti type 2 diabetic patients attending the PHCs in the Capital Region. From identifying the problem, there is a strong need to develop interventions in improving glycemic control among Kuwaiti diabetic patients. Therefore, periodic monitoring of HbA1c levels among diabetic patients should be emphasized by physicians and be available to be measured in the laboratories at the PHCs. In addition, educational programs at are needed to emphasize lifestyle modifications, adherence to self-care behaviors, adequate diabetes knowledge, and positive attitude in order to achieve good glycemic control.

**Table 4.1. Diabetes-related characteristics of Kuwaiti patients**

| Variables | *n* (%) |
|---|---|
| Duration of Diabetes (year) | |
| ≤ 1 | 59 (13.2) |
| 2-4 | 82 (18.3) |
| 5-7 | 92 (20.6) |
| ≥8 | 214 (47.9) |
| | |
| Family History of Diabetes | |
| First-degree Relatives | 253 (56.9) |
| Second-degree Relatives | 33 (7.4) |
| Both | 101 (22.7) |
| No Family History | 41 (9.2) |
| Don't Know | 17 (3.8) |
| | |
| Diabetes-Related Complications | |
| Eye Disease | 116 (26.1) |
| Heart Disease | 44 (9.9) |
| Foot Gangrene/Amputation | 5 (1.1) |
| Nerve Disease | 127 (28.6) |
| Diabetic Coma | 21 (4.7) |
| Kidney Disease | 24 (5.4) |
| Others | 57 (12.8) |

[1] Data presented as percentages (%).

# Table 4.2. Biochemical parameters of Kuwaiti diabetic patients

| Variables | Mean ± SD | n (%) |
|---|---|---|
| FPG (mmol/l) | 8.98 ± 3.12 | |
| < 7 | | 129 (29.8) |
| ≥ 7 | | 292 (70.2) |
| | | |
| TG (mmol/l) | 1.96 ± 1.35 | |
| < 1.7 | | 231 (56.3) |
| ≥ 1.7 | | 179 (43.7) |
| | | |
| TC (mmol/l) | 4.49 ± 1.36 | |
| < 5.2 | | 312 (74.3) |
| ≥ 5.2 | | 108 (25.7) |
| | | |
| HDL (mmol/l) - men | 0.97 ± 0.27 | |
| < 1.0 | | 102 (57.3) |
| ≥ 1.0 | | 76 (42.3) |
| | | |
| HDL (mmol/l) - women | 1.23 ± 0.45 | |
| < 1.3 | | 139 (65.0) |
| ≥ 1.3 | | 75 (35.0) |
| | | |
| LDL (mmol/l) | 2.78 ± 1.2 | |
| < 2.6 | | 184 (47.7) |
| ≥ 2.6 | | 202 (52.3) |
| | | |
| HbA1c (%) | 8.40 ± 1.83 | |
| < 7 | | 54 (21.2) |
| ≥ 7 | | 201 (78.8) |

[1] Data are means ± SD.
[2] Data presented as percentages (%).
[3] FPG, Fasting Plasma Glucose; TG, Triglycerides; TC, Total Cholesterol; HDL, High Density Lipoprotein; LDL, Low Density Lipoprotein; HbA1c, Glycosylated Hemoglobin.

**Table 4.3. Proportion of Kuwaiti patients with poor glycemic control according to anthropometric and diabetes-related characteristics**

| Variables | Total | n (%) | $X^2$ | P |
|---|---|---|---|---|
| Body Mass Index (kg/m$^2$) | | | 8.051 | 0.153 |
|   Normal | 31 | 25 (12.7) | | |
|   Overweight | 93 | 70 (35.5) | | |
|   Obese (class I) | 64 | 53 (26.9) | | |
|   Obese (class II) | 34 | 30 (15.2) | | |
|   Morbidly Obese | 27 | 19 (9.6) | | |
| Duration of Diabetes (years) | | | 14.878 | 0.002* |
|   $\leq 1$ | 36 | 25 (12.4) | | |
|   2-4 | 47 | 29 (14.4) | | |
|   5-7 | 48 | 40 (19.9) | | |
|   $\geq 8$ | 124 | 107 (53.2) | | |
| Family History | | | 13.244 | 0.010* |
|   First-degree relatives | 149 | 122 (61.0) | | |
|   Second-degree relatives | 19 | 10 (5.0) | | |
|   Both | 54 | 39 (19.5) | | |
|   No family history | 24 | 21 (10.5) | | |
|   Don't know | 8 | 8 (4.0) | | |
| Medication Regimen | | | 11.822 | 0.003* |
|   OHA only | 200 | 149 (74.9) | | |
|   OHA + Insulin | 38 | 36 (18.1) | | |
|   Insulin Only | 14 | 14 (7.0) | | |

[1] Data presented as percentages (%).
[2] $X^2$; Chi-square test.
[3] Statistically significant at ($P < 0.05$)*.

**Table 4.4. Predictors of glycemic control using stepwise multiple regression analyses**

| Variables | $\beta$ | *t-value* | *P* | Partial ($r_{12.3.4.5}$) | Part ($r_{1(2.3.4.5)}$) |
|---|---|---|---|---|---|
| $\text{Log}_e$ (HbA1c 2010) | 0.644 | 10.925 | 0.000* | 0.643 | 0.561 |
| $\text{Log}_e$ (FPG) | 0.248 | 4.209 | 0.000* | 0.308 | 0.216 |
| Total Cholesterol | -0.183 | -3.328 | 0.001* | -0.248 | -0.171 |
| Knowledge Scores | -0.162 | -3.132 | 0.002* | -0.234 | -0.161 |
| Triglycerides | -0.126 | -2.347 | 0.020* | -0.178 | -0.121 |

[1] Dependent Variable; $\text{Log}_e$ (HbA1c 2011)
[2] FPG, Fasting Plasma Glucose; HbA1c, Glycosylated Hemoglobin; $\beta$; Standardized Coefficients; $r_{12.3.4.5}$; Partial Correlation; $r_{1(2.3.4.5)}$; Part Correlation.
[3] Statistically significant at ($P < 0.05$)*.

**Table 4.5. Diabetes self-management scores of Kuwaiti patients**

| Total Scores | Mean ± SD | n (%) |
|---|---|---|
| Diabetes Self-care Behaviors | 2.63 ± 0.88 | |
| Good | | 51 (11.4) |
| Fair | | 131 (29.3) |
| Poor | | 265 (59.3) |
| | | |
| Dietary & Lifestyle Modifications | 2.26 ± 1.06 | |
| Good | | 59 (13.2) |
| Fair | | 102 (28.8) |
| Poor | | 286 (64.0) |
| | | |
| General Diabetes Knowledge | 2.54 ± 1.01 | |
| Good | | 236 (52.8) |
| Fair | | 142 (31.8) |
| Poor | | 69 (15.4) |
| | | |
| General Attitude & Satisfaction | 4.16 ± 0.71 | |
| Positive | | 315 (70.5) |
| Neutral | | 111 (24.8) |
| Negative | | 21 (4.7) |

[1] Data presented as numbers and percentages *n* (%).

**Table 4.6. Mean diabetes self-management scores according to sociodemographic and diabetes-related characteristics and glycemic control**

| | Diabetes Self-Care Behaviors | | Dietary and Lifestyle | | General Diabetes Knowledge | | General Attitude and Satisfaction | |
|---|---|---|---|---|---|---|---|---|
| | Mean ± SD | P | Mean ± SD | P | Mean ± SD | P | Mean ± SD | P |
| Age (years) | | 0.009* | | 0.000* | | 0.000* | | 0.599 |
| ≤ 40 | 2.79 ± 1.05 | | 2.53 ± 1.23 | | 2.75 ± 0.97 | | 4.33 ± 0.57 | |
| 41-50 | 2.83 ± 0.93 | | 2.59 ± 1.08 | | 2.89 ± 0.98 | | 4.21 ± 0.68 | |
| 51-60 | 2.64 ± 0.83 | | 2.25 ± 1.09 | | 2.45 ± 0.96 | | 4.17 ± 0.73 | |
| 61-70 | 2.50 ± 0.91 | | 2.03 ± 0.89 | | 2.40 ± 0.99 | | 4.05 ± 0.69 | |
| > 70 | 2.24 ± 0.74 | | 1.48 ± 0.69 | | 2.29 ± 1.23 | | 4.23 ± 0.67 | |
| Gender | | 0.010* | | 0.178 | | 0.184 | | 0.844 |
| Male | 2.75 ± 0.88 | | 2.31 ± 1.09 | | 2.54 ± 0.96 | | 4.11 ± 0.74 | |
| Female | 2.54 ± 0.89 | | 2.23 ± 1.05 | | 2.54 ± 1.04 | | 4.21 ± 0.66 | |
| Marital Status | | 0.000* | | 0.005* | | 0.021* | | 0.098 |
| Single | 2.19 ± 0.92 | | 2.31 ± 1.08 | | 2.24 ± 0.99 | | 4.30 ± 0.79 | |
| Married | 2.74 ± 0.87 | | 2.32 ± 1.09 | | 2.66 ± 0.98 | | 4.20 ± 0.68 | |
| Divorced | 2.33 ± 0.97 | | 2.17 ± 1.13 | | 2.09 ± 0.95 | | 3.98 ± 0.67 | |
| Widowed | 2.12 ± 0.75 | | 1.82 ± 0.81 | | 2.11 ± 0.98 | | 3.88 ± 0.84 | |
| Education Level | | 0.000* | | 0.000* | | 0.000* | | 0.009* |
| Middle School | 2.32 ± 0.90 | | 1.85 ± 0.89 | | 1.94 ± 0.94 | | 4.10 ± 0.69 | |
| High School | 2.73 ± 0.88 | | 2.34 ± 1.12 | | 2.67 ± 0.92 | | 4.13 ± 0.73 | |
| University | 2.73 ± 0.81 | | 2.52 ± 1.00 | | 2.87 ± 0.96 | | 4.32 ± 0.62 | |
| Higher | 3.50 ± 0.72 | | 2.55 ± 1.42 | | 3.30 ± 0.67 | | 3.75 ± 0.91 | |
| Income (Kuwaiti Dinars) | | 0.000* | | 0.000* | | 0.000* | | 0.793 |
| < 700 KD | 2.41 ± 0.88 | | 1.98 ± 0.98 | | 2.11 ± 1.08 | | 4.14 ± 0.75 | |
| 700-1200 KD | 2.66 ± 0.89 | | 2.21 ± 1.08 | | 2.70 ± 0.97 | | 4.20 ± 0.67 | |
| 1200-2500 KD | 2.72 ± 0.88 | | 2.54 ± 1.06 | | 2.60 ± 0.90 | | 4.15 ± 0.68 | |
| >2500 KD | 3.21 ± 0.77 | | 2.63 ± 1.04 | | 3.05 ± 0.97 | | 4.04 ± 0.92 | |
| Family History | | 0.053* | | 0.000* | | 0.002* | | 0.003* |
| First-degree | 2.63 ± 0.84 | | 2.14 ± 0.99 | | 2.65 ± 1.02 | | 4.22 ± 0.68 | |
| Second-degree | 2.37 ± 0.91 | | 2.27 ± 0.96 | | 2.55 ± 0.89 | | 4.32 ± 0.62 | |
| Both | 2.76 ± 0.98 | | 2.76 ± 1.16 | | 2.61 ± 0.94 | | 3.95 ± 0.78 | |
| No Family History | 2.69 ± 0.92 | | 2.14 ± 1.06 | | 2.24 ± 0.93 | | 4.18 ± 0.62 | |
| Don't Know | 2.13 ± 0.74 | | 1.50 ± 0.84 | | 1.63 ± 1.03 | | 4.33 ± 0.64 | |
| Diabetes-Related Complications | | 0.369 | | 0.610 | | 0.000* | | 0.000* |
| No | 2.68 ± 0.93 | | 2.29 ± 1.10 | | 2.76 ± 0.99 | | 4.37 ± 0.61 | |
| Yes | 2.56 ± 0.83 | | 2.21 ± 1.10 | | 2.33 ± 0.98 | | 3.94 ± 0.74 | |
| Glycemic Control | | 0.872 | | 0.579 | | 0.020* | | 0.047* |
| HbA1c < 7% | 2.68 ± 0.90 | | 2.45 ± 1.12 | | 2.79 ± 1.01 | | 4.34 ± 0.61 | |
| HbA1c ≥ 7% | 2.64 ± 0.87 | | 2.30 ± 1.08 | | 2.44 ± 1.05 | | 4.14 ± 0.71 | |

[1] Data means ± SD.

[2] Mann-Whitney U-test was used for comparing two groups; Kruskal-Wallis test for comparing more than two groups.

[3] Statistically significant at ($P < 0.05$)*.
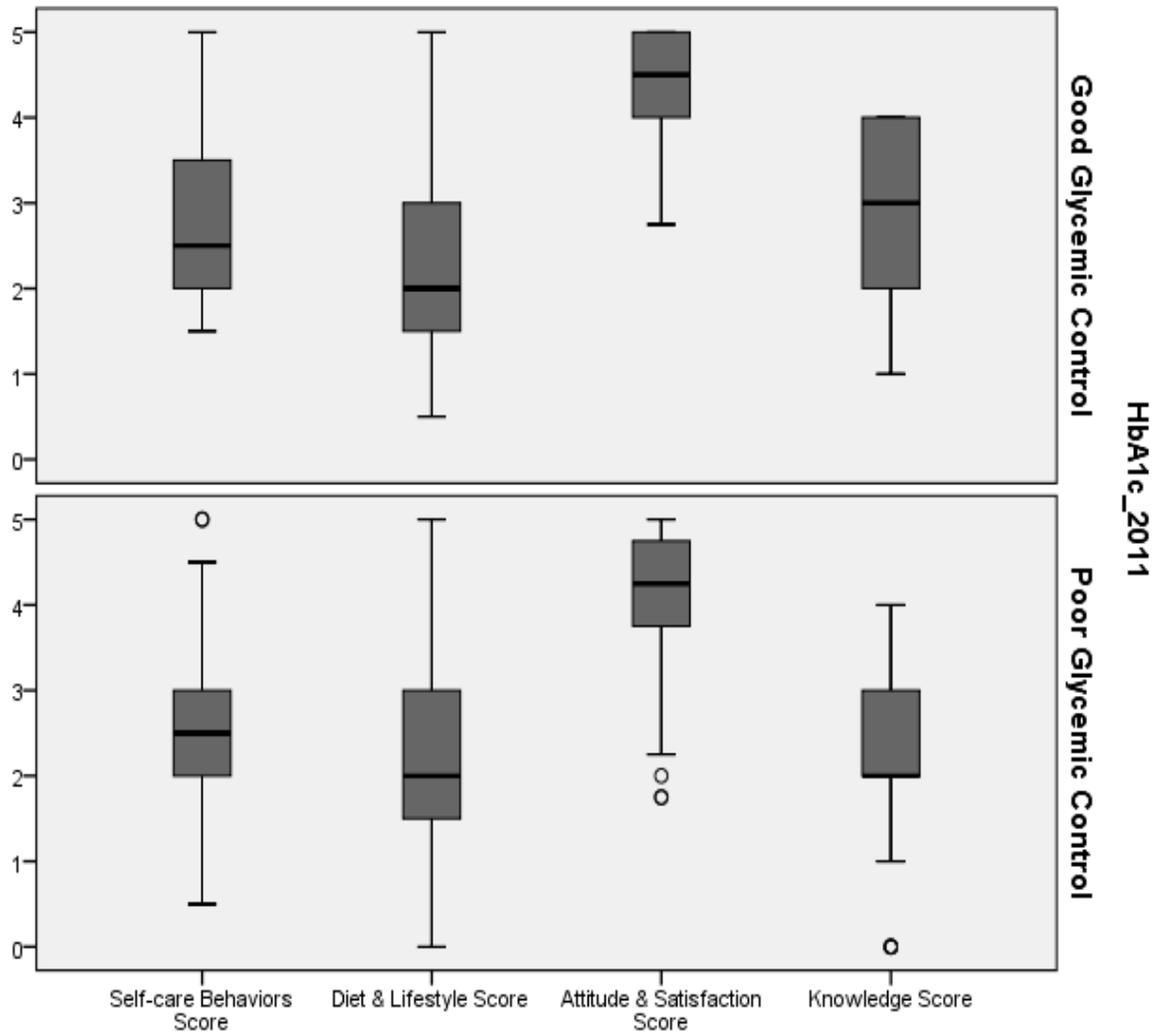
**Figure 4.1** Boxplot of diabetes self-management scores according to glycemic control

# Paper #2: Factors determining compliance to glycemic control and diabetes self-care behaviors among type 2 diabetic patients at the general family and specialized diabetic clinics in Kuwait

## Abstract

*Background:* Compliance is a major constituent in patients' self-care and health. Limited information is known about the factors determining compliance to glycemic control and diabetes self-care behaviors. In addition, barriers to self-care behaviors and diabetes self-management have not been investigated among Kuwaiti people with T2DM.

*Objectives:* The purpose of this study is to compare the percentages of glycemic control and self-care behaviors according to the types of clinics, to determine the factors associated with compliance to glycemic control and diabetes self-care behaviors, and to identify the barriers on adherence to diabetes self-care behaviors and diabetes self-management among Kuwaiti type 2 diabetic patients.

*Design:* A cross-sectional study involved Kuwaiti adults with T2DM (n = 447) at eight PHCs. Data was collected from five general family clinics and three specialized diabetic clinics. A questionnaire was used to collect information on sociodemographic and diabetes-related characteristics, diabetes self-care behaviors, dietary and lifestyle modifications, general diabetes knowledge, general attitude and satisfaction, barriers to diabetes self-care behaviors, and barriers to diabetes self-management. Biochemical and anthropometric measurements were extracted from patients' medical records. A score system was made for diabetic patients based on the domains in the questionnaire. Proposed definition for patients' compliance to glycemic control was also developed. Adherence to diabetes self-care behaviors was evaluated by decision tree classification.

*Results:* Patients at the specialized diabetic clinics had a significantly higher percentage (86.1%) of poor glycemic control than at the general family clinics (68.3%), with mean HbA1c of 8.73 (± 1.84) and 7.94 (± 1.72), respectively. In addition, FPG, duration of diabetes, knowledge scores, and weight change were significant determinants of compliance to glycemic control ($P < 0.05$). Fasting plasma glucose was the most powerful discriminating variable that classified patients as compliant and non-compliant to glycemic control. About 76% of patients were non-compliant while only 24% were compliant to glycemic control. More than half (59.3%) of patients were classified as "poor" adherence to diabetes self-care behaviors. Diet had the strongest association with diabetes self-care behaviors scores ($X^2 = 234.3$, $P < 0.05$). Proportions of patients' perceptions on barriers to physical exercise, self-monitoring of blood glucose at home, and stress and depression were significantly different between the types of clinics ($P < 0.05$). Most patients ranked "non-adherence to the recommended diet" as the most influential and "stress from work" as the least influential barriers to diabetes self-management.

*Conclusion:* Non-compliance to glycemic control and self-care behaviors is high among Kuwaiti T2DM patients. Development of effective behavioral strategies is needed to promote better compliance and improve quality of life.

**Introduction**

Diabetes self-management has been shown to make a significant contribution on patients' overall quality of life. Although the importance of glycemic control is well established, it is often not achieved [33]. Self-care behaviors, which are defined as the activities diabetic patients perform to manage their own health, are important in achieving good glycemic control [7,9,10,33]. They are essential for patients to practice and maintain on a daily basis in order to improve their health. Diabetes self-care behaviors are made up of four components: 1) intake of

Oral Hypoglycemic Agents (OHA) medication and/or insulin, 2) following a healthy diet plan, 3) engaging in regular exercise or physical activity, and 4) self-monitoring of blood glucose (SMBG). These behaviors impose daily demands on diabetic patients' and successful performance of these behaviors is likely to be influenced by their sense of competence [10].

Many people find compliance (adherence) to recommendations by physicians or dietitians difficult to incorporate into their lives. Compliance to self-care behaviors are defined as the extent to which patients carry out the set of daily activities recommended to them by a healthcare professional as a means for managing their diabetes [56]. Adherence to the recommendations from physicians or dietitians is challenging for many patients, as they find self-care behaviors difficult to change and maintain for long periods. It also represents a great challenge for healthcare professionals when treating patients, especially among individuals with diabetes-related complications as a consequence of poor glycemic control. Non-adherence to self-care behaviors can worsen the quality of life in people with diabetes and add to the costs of healthcare [15].

There is a strong recognition that diabetes self-care behaviors have great impact on glycemic control. Factors that influence diabetes adherence such as type and duration of diabetes, illness, and other health conditions and psychosocial factors contribute to poor diabetes self-care [33]. In addition, social and environmental factors including community resources, social support, economic issues, and barriers to adherence make it difficult for patients to follow their treatment program [56]. Therefore, it is important to identify the barriers on adherence to self-care behaviors and diabetes self-management. Understanding these barriers can help healthcare professionals plan and implement more intensive interventions to assist patients in practicing self-care behaviors over long-term periods in order to achieve adequate glycemic control.

Despite the substantial improvements of healthcare in Kuwait, no study has examined the extent of compliance to glycemic control and adherence to self-care behaviors among Kuwaiti people with diabetes. In addition, no study has identified the potential barriers Kuwaiti diabetic patients often encounter with adherence to self-care behaviors and diabetes self-management. For that reason, the objectives of this study are to compare the proportions of glycemic control and diabetes self-care behaviors of patients attending the general family clinics and the specialized diabetic clinics, to determine the factors associated with compliance to glycemic control and diabetes self-care behaviors, and to identify the barriers on adherence to diabetes self-care behaviors and diabetes self-management among Kuwaiti type 2 diabetic patients.

**Subjects and methods**

*Study Setting*

A cross-sectional study was conducted at eight Primary Healthcare Centers (PHCs) in the Capital Region of Kuwait. At each PHC, there are various healthcare services provided including diabetes patient care. Residents of Kuwaiti nationality generally receive free medical services while expatriates are required to pay for their treatment and drugs. The PHCs are made up of two types: general family clinics and specialized diabetic clinics. Both types of clinics do receive diabetic patients but are different in their arrangements. At the general family clinics, there is a rotation between the family practitioners, where each doctor is assigned to counsel diabetic patients on certain day(s) of the week and the rotation varies from clinic to clinic. However, the specialized diabetic clinics have a different setup for diabetic patients including a room where a machine is placed for eye examination, fundus cameras, doctors, nurses, and dietitians who counsel only diabetic patients. In addition, the medical doctors are general practitioners who

specialize in only counseling diabetic patients on a daily basis. Data was collected from five general family clinics and three specialized diabetic clinics at the Capital Region.

*Study population*

Our study sample consisted of 447 Kuwaiti adults aged 20 years and older with T2DM. Data were collected by a structured questionnaire and by medical record extraction from patients' files. Protocols were approved by the Kuwait Institute of Medical Specialization and by the Institutional Review Board at the University of Maryland, College Park. All patients were given informed consent to participate in the study.

*Questionnaire Design*

We developed a questionnaire based on the research literature related to diabetes self-management (Adsani et al., 2009, Al Jasem et al., 2001, Daly et al., 2009, Jumah et al., 2009, Khattab et al., 2010, Serour et al., 2007). Our questionnaire is composed of 41 questions in the following domains: (1) Diabetes Self-care Behaviors; (2) Dietary and Lifestyle Modifications; (3) General Diabetes Knowledge; (4) General Attitude and Satisfaction; (5) Barriers to Diabetes Self-Care Behaviors; and (6) Barriers to Diabetes Self-Management.

*Questionnaire Structure*

The questionnaire is based on several components. The first part relates to the sociodemographic and diabetes-related characteristics. Sociodemographic variables included weight, height, age, sex, social status, education level, occupation, family income, and smoking status. Diabetes-related variables included duration of diabetes, family history of diabetes, and presence of diabetes-related complications. The second part relates to the diabetes self-care behaviors domain. Diabetes self-care behaviors variables included medication/insulin intake,

dietary intake, exercise/physical activity, and SMBG. The third part relates to the dietary and lifestyle modifications domain. Dietary and lifestyle modifications variables included meals and snacks, meal-planning methods, diet restrictions, minutes of exercise, and average hours of sleep. The fourth part relates to the general attitude and satisfaction and the barriers to self-care behaviors domains using the 5-point Likert-Scale (Strongly Agree, Agree, Somewhat Agree, Disagree, and Strongly Disagree). General attitude and satisfaction variables included patients' current diet, motivation by healthcare providers, coming to appointments, and consultation and advice received by healthcare providers at the clinic. Barriers to diabetes self-care behaviors variables included difficulty following treatment regimen, frequent social gatherings, environmental factors, stress and depression, and difficulty reducing blood glucose at high readings. The fifth part relates to the general diabetes knowledge domain based on true and false questions. General diabetes knowledge variables included health consequences from diabetes, definition of %HbA1c, food intake control while on medication/insulin, and inclusion of foods in a diabetic diet. The last part is a question that relates to the barriers to overall diabetes self-management. Patients were asked to rank the barriers they consider as the most influential to the least influential in terms of negative impact to their diabetes management. Patients had to rank the following barriers: 1) non-adherence to medications/insulin, 2) non-adherence to the recommended diet, 3) non-adherence to clinic appointments and periodic check-ups, 4) lack of exercise and physical activity, 5) family and social circumstances, and 6) stress from work.

*Validity and Reliability*

The questionnaire is designed in Arabic since it is the native language spoken by Kuwaiti people. Content validity for the instrument was obtained by soliciting the judgments of experts related to diabetes management, including primary healthcare physicians and dietitians at the

PHCs. The questionnaire was further pretested on a sample of 20 patients at one general family clinic and one specialized diabetic clinic to determine its clarity as regards to the phrasing of the questions and to test the overall response of the patients. For reliability, the Cronbach's alpha coefficient was calculated for 9 items of the questionnaire that used the 5-point Likert scale. Five questions on barriers to diabetes self-care behaviors were negatively worded, which required reverse scoring. Cronbach's alpha was found to be 0.6. Overall, the questionnaire was appropriate and suitable for diabetic patients to use.

*Diabetes Self-Management Scores*

Diabetes self-management scores were measured based on diabetes self-care behaviors, dietary and lifestyle modifications, general diabetes knowledge, and general attitude and satisfaction domains. Each domain is made up of questions with categorical answer choices. Patients' scores were evaluated based on the choices they selected in answering the questions.

Regarding the first domain, diabetes self-care behaviors scores were developed based on five questions with a maximum of one point for each question. Questions on self-care behaviors included: type of diabetes treatment, frequency of medication/insulin intake, if placed on a special diet, frequency of exercise per week, and frequency of SMBG per week. Possible scores for each question are zero, half, or one point. A score of zero points indicates that patients' do not practice a self-care behavior. A score of a half point indicates that patients' may practice a self-care behavior but not on a regular basis. A score of one point indicates that patients' practice a self-care behavior regularly according to advice given by a physician or dietitian. The points for all the questions were added to obtain the total self-care behaviors score with a maximum of five points. Total diabetes self-care behaviors scores are classified as "good" if the score is 4-5 points, "fair" if score is 3 points, and "poor" if score is 1-2 points.

For the second domain, dietary and lifestyle modification scores were developed based on five questions with a maximum of one point for each question. Questions on dietary and lifestyle modifications included: frequency of meals and snacks intake, meal-planning method, if placed on diet restrictions, minutes of exercise per week, and average hours of sleep everyday. Possible scores are zero or one point for questions related to meals and snacks, meal-planning method, and diet restrictions. Possible scores for questions on minutes of exercise per week and average hours of sleep every day are zero, half, and one point. A score of zero points indicates that patients' do not follow any meal-planning method, are not on any diet restrictions or do not exercise, their average meals and snacks intake is less than three meals a day, and their average hours of sleep is less than 6 hours daily. The points for all the questions were added up to obtain the total dietary and lifestyle modifications score with a maximum of five points. Total dietary and lifestyle modification scores are classified as "good" if score is 4-5 points, "fair" if score is 3 points, and "poor" if score is 1-2 points.

For the third domain, general diabetes knowledge scores were developed based on four questions with a maximum of one point for each question. Each statement was based on true, false, or don't know answer choices. Patients who correctly answered "true" or "false" to each statement received 1 point, and those who answered, "don't know" to the statements received no points. All of the points were added up to obtain the total general diabetes knowledge score with a maximum of four points. Total general diabetes knowledge scores are classified as "good" if score is 3-4 points, "fair" if score is 2 points, and "poor" if score is 1 point.

Finally for the last domain, patients' general attitude and satisfaction scores were developed based on four questions. Each statement is rated on a five-point Likert-scale (1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree, and 5 = strongly agree). The

questions did not require reverse scoring since the statements are positively worded. Based on patients' scale answers to the questions, the numbers for the statements were added together and then divided by the number of questions/statements to obtain the total general attitude and satisfaction score with a maximum of five points. Total general attitude and satisfaction scores are classified as "positive" if score is 4-5 points, "neutral" if score is 3 points, and "negative" if score is 1-2 points.

*Biochemical and Anthropometric Measures*

The diagnosis of T2DM was based on the current American Diabetes Association (ADA) criteria. Glycosylated hemoglobin was used in assessing long-term glycemic control. ADA guidelines recommend a target HbA1c < 7% for non-pregnant diabetic adults. Total cholesterol (TC) was considered high if $\geq$ 5.2 mmol/l. Low density lipoprotein cholesterol (LDL-C) was considered high when > 2.6 mmol/l. High density lipoprotein (HDL-C) was considered low if < 1.0 mmol/l for males and < 1.3 for females. Hypertriglyceridemia (TGs) was identified if > 1.7 mmol/l. Body Mass Index (BMI) was calculated as the ratio of weight (kilograms) to the square of height (meters). BMI was categorized according to World Health Organization (WHO) criteria as normal if BMI < 25 kg/m$^2$, overweight if BMI 25-29.9 kg/m$^2$, and obese if BMI > 30 kg/m$^2$.

*Compliance to Glycemic control*

We developed a criterion that measures patients' compliance with respect to glycemic control and diabetes self-care behaviors. In our sampled data, we defined compliance to glycemic control based on patients' latest HbA1c in 2011, as well as the difference of their HbA1c measure that was obtained from the latest HbA1c in 2010. As a proposed definition of

compliance to glycemic control, patients are considered compliant if their latest HbA1c in 2011 is < 7% or the difference of the HbA1c measure is >1 SD of the HbA1c in 2010 and 2011.

*Statistical Analysis*

Descriptive and inferential statistics were used in the analysis. Data were presented as means ± standard deviations (SD) and frequencies and percentages for categorical variables. A chi-square test was used to determine differences in sociodemographic and diabetes-related characteristics, and barriers to diabetes self-care behaviors according to the types of clinics. Independent samples t-test was used to determine mean differences in biochemical parameters as well as diabetes self-management scores between patients attending the general family clinics and the specialized diabetic clinics. Nonparametric k-related samples tests were used to categorize the influence of barriers to diabetes self-management based on their mean ranks. Discriminant analysis was used to develop a predictive model for group membership (compliant versus non-compliant) with respect to glycemic control. Adherence to diabetes self-care behaviors was analyzed through decision tree classification using the Chi-squared Automatic Interaction Detection (CHAID) method. Analyses were performed using Statistical Package for Social Sciences (SPSS), version 20. A p-value ≤ 0.05 was considered statistically significant.

**Results**

*Sociodemographic Characteristics*

Our study included a total of 447 Kuwaiti participants with T2DM attending the general family clinics and the specialized diabetic clinics at the PHCs. About 193 (43.2%) of Kuwaiti type 2 diabetic patients (86 men and 107 women) were from the general family clinics aged between 31 and 92 with a mean (SD) of 56.6 (± 10.02) years. Weight (kg) ranged from 48 to 147

kg with a mean (SD) of 81.4 (±17.8) kg, and height (cm) ranged from 140 to 190 cm with a mean (SD) of 163.2 (±9.50) cm. The mean (SD) BMI for Kuwaiti type 2 diabetic adults at the general family clinics was 30.6 (±6.62) kg/m$^2$. Most of the patients are married 157 (81.8%) and had an education up to high school or 2 years diploma 83 (43.5%). The majority of patients 110 (46.2%) reported to have a family income between 700 and 1200 Kuwaiti dinars (1 KD = 3.6 US dollars), and more than half of the patients (63%) were either not employed or retired. Only 14.7% were current smokers, while most of the patients were nonsmokers (78.9%).

About 254 (56.8%) Kuwaiti type 2 diabetic patients (117 men and 136 women) were from the specialized diabetic clinics aged between 23 and 87 years with a mean (SD) of 55.0 (± 9.86) years. Weight (kg) ranged from 39 to 176 kg with a mean (SD) of 84.2 (±18.8) kg, and height (cm) ranged from 137 to 197 cm with a mean (SD) of 164.2 (±10.8) cm. The mean (SD) BMI for Kuwaiti type 2 diabetic adults at the specialized diabetic clinics was 31.3 (±6.62) kg/m$^2$. Most of the patients are married 201 (79.8%) and had an education up to high school or 2 years diploma 107 (42.1%). The majority of patients 81 (43.1%) reported to have a family income between 700 and 1200 Kuwaiti dinars (1 KD = 3.6 US dollars), and more than half of the patients (59.1%) were either not employed or retired. Only 13.8% were current smokers, while most of the patients were nonsmokers (75.1%).

*Diabetes-Related Characteristics*

Most patients at the general family clinics (48.7%) had durations of diabetes of more than 8 years. About 54.2% of patients reported to have a positive family history of diabetes from first-degree relatives (i.e., parents and siblings) and about 42.2% of patients have diabetes-related complications, where nerve and eye diseases were most frequently reported, with 26.6% and 22.9%, respectively. At the specialized diabetic clinics, about 47.2% of diabetic patients had

diabetes more than 8 years. Most patients (58.9%) reported to have a positive family history from first-degree relatives (i.e., parents and siblings) and more than half of patients (54.4%) have diabetes-related complications, where nerve and eye diseases were most frequently reported, with 30.2% and 28.6%, respectively.

Table 4.7 shows the characteristics of Kuwaiti diabetic patients according to the types of clinics. In general, no significant differences in proportions were found for the sociodemographic characteristics between Kuwaiti diabetic patients attending the general family clinics and the specialized diabetic clinics ($P > 0.05$). As for diabetes-related characteristics, chi-square test showed that patients at the specialized diabetic clinics had significantly higher percentage of diabetes-related complications than patients at the general family clinics ($X^2 = 6.466$, $p = 0.013$). In addition, patients at the specialized diabetic clinics had a higher incidence of diabetic coma than patients at the general family clinics ($X^2 = 10.211$, $p = 0.001$). Patients at the specialized diabetic clinics also had higher incidence of having other problems from diabetes (i.e., hypertension, hypercholesterolemia, hypoglycemia, stroke, arthritis and joint pain, osteoporosis, asthma, and gastrointestinal, liver, and sexual problems) than patients at the general family clinics ($X^2 = 6.134$, $p = 0.015$). Diabetes-related complications including eye disease, nerve disease, heart disease, kidney disease, and gangrene were higher at the specialized diabetic clinics than the general family clinics but not statistically significant ($P > 0.05$). No significant differences were found for duration of diabetes and family history between the general family clinics and the specialized diabetic clinics ($P > 0.05$).

*Biochemical Parameters*

Table 4.8 shows the biochemical parameters of Kuwaiti type 2 diabetic patients according to the types of clinics. Overall, most diabetic patients at both types of clinics did not

achieve good short-term and long-term glycemic control. Patients at the specialized diabetic clinics had significantly higher mean FPG of 9.33 (± 3.27) than at the general family clinics with mean FPG of 8.52 (± 2.84) ($p$ = 0.009). For the latest glycosylated hemoglobin reading in 2011, patients at the specialized diabetic clinics had significantly higher mean %HbA1c of 8.73 (± 1.84) than the general family clinics with mean %HbA1c of 7.94 (± 1.72) ($p$ = 0.000). In addition, patients at the specialized diabetic clinics had significantly higher percentage of poor glycemic control than at the general family clinics, with HbA1c of 86.1% and 68.3%, respectively. However, no significant mean differences were found for latest glycosylated hemoglobin reading in 2010. As for the lipid profile, significant differences in mean TC and mean LDL-C were found between the types of clinic. Patients at the specialized diabetic clinics had significantly higher TC with a mean of 4.61 (± 1.36) than the general family clinics with a mean of 4.34 (± 1.35) ($p$ = 0.048). In addition, patients at the specialized diabetic clinics had significantly higher LDL-C with a mean of 2.89 (± 1.40) than the general family clinics with a mean of 2.63 (± 0.83) ($p$ = 0.030). No significant mean differences were found for HDL-C and TGs between the two types of clinics.

*Diabetes Self-Management Scores*

**Table 4.9** represents the diabetes self-management scores of Kuwaiti type 2 diabetic patients according to the types of clinics. Dietary and lifestyle modifications scores were significantly lower at the specialized diabetic clinics than at the general family clinics, with mean scores of 2.15 (± 1.06) and 2.39 (± 1.04), respectively ($p$ = 0.018). General diabetes knowledge scores were significantly lower at the specialized diabetic clinics than at general diabetes knowledge scores, with mean scores of 2.35 (± 1.01) and 2.79 (± 0.97), respectively ($p$ = 0.000). General attitude and satisfaction scores were significantly lower at the specialized diabetic

clinics than at the general family clinics, with mean scores of 4.02 (± 0.75) and 4.34 (± 0.60), respectively ($p$ = 0.000). However, no significant mean differences between the two types of clinics were found between diabetes self-care behaviors scores.

*Compliance to Glycemic Control*

   **Table 4.10** represents the model obtained from discriminant analysis of compliance to glycemic control among Kuwaiti diabetic patients. The independent variables entered into discriminant analysis are BMI, duration of diabetes, family history, medication regimen, special diet, exercise per week, SMBG, diabetes-related complications, meal planning type, diet restrictions, weight change, hours of exercise, hours of sleep, self-care behaviors scores, dietary and lifestyle modifications scores, general diabetes knowledge scores, general attitude and satisfaction scores and FPG. The discriminant analysis model obtained correctly classified 76.4% of patients being compliant versus non-compliant to glycemic control (Eigen value = 0.239, Wilks' Lambda = 0.807, canonical correlation = 0.439, significance = 0.000). Significant differences between groups were observed for FPG, duration of diabetes, knowledge scores, and weight change ($P < 0.05$). As indicated by the discriminant loading values, we found that FPG is the strongest discriminating variable that determines compliant and non-compliant to glycemic control.  Based on the canonical discriminant function coefficients, the "best-fit" model can be written by the following discriminant function equation:

$$D = 1.679 \, (FPG) + \, 0.1321(\text{Duration of Diabetes})$$

$$- \, 0.333(\text{Knowledge Score}) - 0.255 \, (\text{Weight Change}) \, + \, 0.798$$

*Adherence to Diabetes Self-care Behaviors*

Overall, about 77% of Kuwaiti type 2 diabetic patients at the PHCs follow medications/insulin intake as their only diabetes treatment. About 78.5% of patients are on OHA medications only, while 14.2% of patients are on both OHA medications and insulin, and 7.5% are on insulin only. Almost half of patients (45.6%) take their medications/insulin three or more times a day at all meals (41.6%). About 41.8% of patients are placed on a special diet from either a physician, dietitian, or self-arranged, while the majority (58.3%) do not follow any dietary regimen. In addition, about one-third (30.3%) of patients self-arrange their dietary intake without seeking advice from a physician or dietitian. Only 39.8% of patients engage in exercise or physical activity during the week while more than half (62.2%) do not participate in any physical exercise. About 43.5% of patients do not SMBG while 23.6% SMBG at home only when feeling diabetes symptoms. **Figure 4.2** shows the percentages of diabetes self-care behaviors according to the types of clinics. When we compared the proportions of practicing self-care behaviors between the two types of clinics, we found that patients not following a special diet was significantly higher at the specialized diabetic clinics than at the general family clinics, with 64.4% and 50.3%, respectively ($X^2 = 11.371$, $p = 0.010$). Proportions of not practicing the other self-care behaviors were higher at the specialized diabetic clinics than at the general family clinics but were not statistically significant. **Figure 4.3** shows the decision tree classification for adherence to diabetes self-care behaviors. The dependent variable is diabetes self-care behaviors score, also classified as level of adherence (good, fair, poor). The independent variables are medication regimen, following a meal plan (diet), SMBG at home, and exercise or physical activity. More than half (59.3%) of patients had "poor" diabetes self-care behaviors scores. In addition, following a meal plan was the strongest predictor that had interaction with diabetes

self-care behaviors score, followed by SMBG at home, and exercise or physical activity ($P <$ 0.05). Medication regimen was not shown in the decision tree classification because it did not have a significant association with respect to diabetes self-care behaviors scores. Moreover, about 27.3% of patients who follow a meal plan, 41% who SMBG at home, and 63.8% who engage in exercise or physical activity have "good" diabetes self-care behaviors scores (adherent). However, about 86.9% of patients who do not follow a meal plan, and 99.2% who do not SMBG at home have "poor" diabetes self-care behaviors scores (non-adherent).

*Barriers to Diabetes Self-care Behaviors*

**Table 4.11** shows the barriers to diabetes self-care behaviors among Kuwaiti patients at the general family clinics and the specialized diabetic clinics. A total of 14.5% of patients at the PHCs reported that they strongly believed that "treatment regimen for diabetes (i.e., medication or diet) is hard to follow" and a total of 54.8% strongly believed that "frequent food gatherings with family and friends affect dietary intake and make it difficult to control blood sugar levels." Moreover, a total of 46.9% strongly believed that "the surrounding environment (i.e., weather, lack of time) does not encourage exercising regularly" and a total of 33.6% strongly believed that "stress and depression prevents them from managing diabetes," while only a total of 8.8% strongly believed that "when self-monitoring blood sugar at home, reducing blood sugar levels at high readings is difficult." Significant differences in perceptions for "surrounding environment" were found between the specialized diabetic clinics and the general family clinics, with 48.6% and 44.6%, respectively, strongly agreed ($p = 0.045$). In addition, significant differences in perceptions for "stress and depression" were found between the specialized diabetic clinics and the general family clinics, with 39.0% and 26.6%, respectively, strongly agreed ($p = 0.008$). Significant differences in perceptions were also found for "reduce blood sugar levels at high

readings" were found between the specialized diabetic clinics and the general family clinics, with 22.9% and 14.4%, respectively, strongly disagreed ($p = 0.011$). However, no significant differences in perceptions were found between the general family clinics and the specialized diabetic clinics for "treatment regimen" and "food gatherings."

*Barriers to Diabetes Self-Management*

We considered possible factors for what Kuwaiti patients would experience as barriers to diabetes self-management. The question is ranked from 1 to 6 corresponding from the most influential to least influential barrier. The ranks of barriers to diabetes self-management were analyzed as non-parametric k-related samples using Friedman test $(X^2 = 345.642, df = 5)$ and were highly significant ($p = 0.000$). **Table 4.12** represents the mean ranks of the six barriers where the most influential barrier is "non-adherence to the recommended diets" followed by "non-adherence to medications/insulin," "lack of exercise and physical activity," "family and social circumstances," "non-adherence to clinic appointments and periodic check-ups," and the least influential barrier is "stress from work."

**Discussion**

The main findings of our study were based on the differences in the characteristics, biochemical parameters, diabetes self-management scores, and the barriers to diabetes self-care behaviors between Kuwaiti diabetic patients attending the general family clinics and the specialized diabetic clinics. In general, the sociodemographic characteristics were similar between Kuwaiti diabetic patients attending both types of clinics. However, we found that patients at the specialized diabetic clinics had significantly higher incidences of diabetes-related complications (i.e., diabetic coma, other problems) than at the general family clinics. We also

found that patients at the specialized diabetic clinics had higher lipid values (i.e., TC and LDL-C) than patients at the general family clinics ($P < 0.05$). Most importantly, higher proportions of poor short-term (i.e., FPG) and long-term glycemic control (i.e., latest HbA1c in 2011) were significantly higher at the specialized diabetic clinics than at the general family clinics. We also found that 76% of Kuwaiti type 2 diabetic patients were non-compliant to glycemic control. All these factors could be due to the difference in implementation of the recommended clinical standards by healthcare providers at the PHC setting. One study evaluated the impact of the Kuwait Diabetes Care Program (KDCP) on the quality of diabetes care at the PHCs, where the specialized diabetic clinics were mainly investigated. The study did demonstrate some improvement in implementation of standards but the majority of the clinical standards for diabetes care were not optimally achieved [57]. Moreover, the administrative management, availability of healthcare providers, and delivery of diabetes care may contributed to the differences that we found at both types of PHC settings. For instance, the specialized diabetic clinics are organized in terms of structure and scheduling of appointments and regular follow-ups with patients. However, the general family clinics are more flexible in that healthcare providers are more available to follow-up with patients since they can visit the clinic anytime with and without an appointment. Therefore, patients are more monitored and treated when they experience diabetes symptoms (i.e., hyperglycemia, hypoglycemia) at the general family clinics. In addition, we observed the availability of HbA1c meters at the general family clinics but not at any of the specialized diabetic clinics, which allows physicians to closely monitor patients' glycemic control.

Moreover, diabetes self-management scores including dietary and lifestyle modifications, general diabetes knowledge, and general attitude and satisfaction scores were significantly lower

at the specialized diabetic clinics than at the general family clinics ($P < 0.05$). This could be due to the differences in the patient load between the types of clinics. Based on the information we received from the Heads of the PHCs, the numbers of diabetic patients registered at the specialized diabetic clinics are higher than the numbers at the general family clinics. As a consequence, there is a higher patient load at the specialized diabetic clinics than at the general family clinics. This may compromise the quality of diabetes care by preventing effective communication between healthcare providers and diabetic patients. Our findings support a study that identified factors affecting patients' satisfaction on the quality of care services they receive at the PHCs. The majority of patients (87%) responded that the time for communication with their healthcare provider was not enough. About 79% reported that they would go to the emergency room of the hospitals if needed instead of going to the PHCs. Most patients responded negatively to the quality of the communication relationship they have with their healthcare providers [58]. As a result, patients may not acquire enough knowledge about how to manage their disease through practicing diabetes self-care behaviors as well as not incorporating recommended dietary and lifestyle modifications. Furthermore, another study found that patients' education activities were available in few of the clinics investigated, which indicates limited availability of educational programs at the specialized diabetic clinics. The study also showed that shortages of physicians and lack of dietitians, diabetic nurses, social workers, and secretaries were observed at the specialized diabetic clinics [57].

Furthermore, we observed significantly higher percentages of patients at the specialized diabetic clinics, where the patients experienced more barriers to physical exercise and stress and depression than at the general family clinics ($P < 0.05$). Moreover, about 59.3% of patients were classified as not adherent to diabetes self-care behaviors, which indicate poor diabetes self-

management among Kuwaitis at the PHCs. Therefore, it is crucial for Kuwaiti diabetic patients to understand the importance of compliance to diabetes treatments given by healthcare providers. Based on patients' ranking of barriers to diabetes self-management, we found that "non-adherence to the recommended diet" was the most influential barrier and "stress from work" was the least influential barrier to diabetes self-management among Kuwaitis at the PHCs. Our finding on "non-adherence to the recommended diet" as the primary barrier to diabetes self-management is consistent with another previous study [8,39]. The reason that most Kuwaiti diabetic patients reported "stress from work" being a barrier with the least impact on their diabetes self-management could be because more than half of the patients in our study either do not work or are currently retired.

Strengths of this study include its focus on providing a holistic overview on compliance to glycemic control and adherence to diabetes self-care behaviors. In addition, our study is the first to compare diabetes self-care behaviors and glycemic control between patients attending the general family clinics and the specialized diabetic clinics at the PHCs. Moreover, we developed proposed definition compliance to glycemic control among diabetic patients that can be used as a reference in future studies. We also uniquely presented factors that are associated with adherence to diabetes self-care behaviors through decision tree classification. However, our study has some limitations. First, the information obtained was based on self-reported data from the patients themselves, which may be limited to recall bias. Second, we did not take into account self-efficacy, social support, and healthcare provider-patient relationship when assessing compliance. Last, we did not re-evaluate patients' compliance since our study design is cross-sectional.

**Conclusion**

In conclusion, the proportions of non-compliance to glycemic control and self-care behaviors are high among Kuwaiti T2DM patients at both PHC settings. The role of diabetes educators is essential in helping patients acquire the knowledge and skills necessary to manage their disease. Patient education through increasing diabetes knowledge, building positive attitudes, monitoring patients' compliance to glycemic control and adherence to self-care behaviors should be implemented by healthcare providers. In addition, awareness on the importance of compliance to glycemic control and diabetes self-care behaviors is strongly needed among Kuwaiti diabetic patients, which can only be achieved through providing more educational programs. Effective behavioral strategies on overcoming barriers to diabetes self-management should also be developed and tailored toward patients' needs in order to promote better compliance and improve quality of diabetes care among Kuwaiti people receive at the PHCs.

# Table 4.7. Characteristics of Kuwaiti patients according to the types of clinics

| Characteristics | Types of Clinic | | $X^2$ | $P$ |
| --- | --- | --- | --- | --- |
| | **General Family** *n* (%) | **Specialized Diabetic** *n* (%) | | |
| Age (years) | | | 9.083 | 0.059* |
| ≤ 40 | 5 (2.6%) | 16 (6.3%) | | |
| 41-50 | 54 (28%) | 57 (22.4%) | | |
| 51-60 | 74 (38.3%) | 117 (46.1%) | | |
| 61-70 | 43 (22.3%) | 52 (20.5%) | | |
| > 70 | 17 (8.8) | 12 (4.7%) | | |
| Sex | | | 0.125 | 0.774 |
| Male | 86 (44.6%) | 117 (46.2%) | | |
| Female | 107 (55.4%) | 136 (53.8%) | | |
| Marital Status | | | 4.582 | 0.205 |
| Single | 5 (2.6%) | 17 (6.7%) | | |
| Married | 157 (81.8%) | 201 (79.8%) | | |
| Divorced | 12 (6.3%) | 11 (4.4%) | | |
| Widowed | 18 (9.4%) | 23 (9.1%) | | |
| Education Level | | | 1.854 | 0.603 |
| Middle School or lower | 47 (24.6%) | 76 (29.9%) | | |
| High School/2 years College | 83 (43.5%) | 107 (42.1%) | | |
| University/4 years College | 56 (29.3%) | 64 (25.2%) | | |
| Higher (MS/Ph.D.) | 5 (2.6%) | 7 (2.8%) | | |
| Income (Kuwaiti Dinars) | | | 2.607 | 0.456 |
| < 700 KD | 53 (22.3%) | 40 (21.6%) | | |
| 700-1200 KD | 110 (46.2%) | 81 (43.8%) | | |
| 1200-2500 KD | 60 (25.2%) | 57 (30.8%) | | |
| >2500 KD | 15 (6.3%) | 7 (3.8%) | | |
| Body Mass Index (kg/m$^2$) | | | 0.778 | 0.678 |
| Normal | 34 (17.6%) | 37 (14.6%) | | |
| Overweight | 64 (33.2%) | 86 (33.9%) | | |
| Obese | 95 (49.2%) | 131 (51.6%) | | |
| Duration of Diabetes (years) | | | 1.895 | 0.594 |
| ≤ 1 | 29 (15%) | 30 (11.8%) | | |
| 2-4 | 31 (16.1%) | 51 (20.1%) | | |
| 5-7 | 39 (20.2%) | 53 (20.9%) | | |
| ≥ 8 | 94 (48.7%) | 120 (47.2%) | | |
| Diabetes-Related Complications | | | 6.466 | 0.013* |
| No | 111 (57.8%) | 115 (45.6%) | | |
| Yes | 82 (42.2%) | 137 (54.4%) | | |

[1] Data presented as numbers and percentages *n* (%).
[2] Using Chi-square test. Significantly different between groups at ($P$ < 0.05)*.

**Table 4.8. Biochemical parameters of Kuwaiti diabetic patients according to the types of clinics**

| Parameters | Type of Clinics | | *t-test* | *P* |
|---|---|---|---|---|
| | General Family Means ± SD | Specialized Diabetic Means ± SD | | |
| FPG (mmol/l) | 8.52 ± 2.84 | 9.33 ± 3.27 | 2.613 | 0.009* |
| TGs (mmol/l) | 2.02 ± 1.45 | 1.92 ± 1.27 | - 0.735 | 0.463 |
| TC (mmol/l) | 4.34 ± 1.35 | 4.61 ± 1.36 | 1.982 | 0.048* |
| HDL-C (mmol/l) | 1.11 ± 0.47 | 1.11 ± 0.34 | 0.140 | 0.889 |
| LDL-C (mmol/l) | 2.63 ± 0.83 | 2.89 ± 1.40 | 2.172 | 0.030* |
| HbA1c in 2011 (%) | 7.94 ± 1.72 | 8.73 ± 1.84 | 3.683 | 0.000* |
| HbA1c in 2010 (%) | 8.18 ± 1.80 | 8.40 ± 1.62 | 1.060 | 0.290 |

[1] Data are means ± SD.
[2] Using independent samples-*t test*. Significantly different between groups at ($P < 0.05$)*.
[3] FPG, Fasting Plasma Glucose; TG, Triglycerides; TC, Total Cholesterol; HDL, High Density Lipoprotein; LDL, Low Density Lipoprotein; HbA1c, Glycosylated Hemoglobin.

**Table 4.9. Diabetes self-management scores of Kuwaiti diabetic patients according to the types of clinics**

| Scores | Type of Clinics | | t-test | P |
| --- | --- | --- | --- | --- |
| | General Family Means ± SD | Specialized Diabetic Means ± SD | | |
| Diabetes Self-care Behaviors | 2.69 ± 0.87 | 2.59 ± 0.89 | -1.109 | 0.268 |
| Dietary and Lifestyle Modifications | 2.39 ± 1.04 | 2.15 ± 1.06 | -2.237 | 0.018* |
| General Diabetes Knowledge | 2.79 ± 0.97 | 2.35 ± 1.01 | -4.571 | 0.000* |
| General Attitude and Satisfaction | 4.34 ± 0.60 | 4.02 ± 0.75 | -4.745 | 0.000* |

[1] Data are means ± SD.
[2] Using independent samples-*t test*. Significantly different between groups at ($P < 0.05$)*.

**Table 4.10. Discriminant analysis of compliance to glycemic control among Kuwaiti diabetic patients**

| Independent Variables | Wilks' Lambda | F-test | P | Discriminant Loadings | Canonical Discriminant Function Coefficients |
|---|---|---|---|---|---|
| FPG | 0.889 | 32.54 | 0.000* | 0.722 | 1.679 |
| Duration of Diabetes | 0.973 | 7.302 | 0.007* | 0.342 | 0.321 |
| Knowledge Score | 0.977 | 6.125 | 0.014* | -0.313 | -0.333 |
| Weight Change | 0.981 | 5.078 | 0.025* | -0.285 | -0.255 |

Eigen Value = 0.239
Canonical Correlation = 0.439
Overall Wilks' Lambda = 0.807
Significance = 0.000
76.4% of cases correctly classified as compliant vs. non-compliant.

[1] FPG, Fasting Plasma Glucose.
[2] Statistically significant at ($P < 0.05$)*.

**Table 4.11. Barriers to adherence to self-care behaviors among Kuwaiti patients at the general family clinics and the specialized diabetic clinics**

| Barriers | Clinic Type | Strongly Agree | Agree | Somewhat Agree | Disagree | Strongly Disagree | P |
|---|---|---|---|---|---|---|---|
| Difficulty following treatment regimen | G | 27 (14.1%) | 34 (17.7%) | 34 (17.7%) | 83 (43.2%) | 14 (7.3%) | 0.122 |
| | S | 38 (15.0%) | 63 (24.8%) | 52 (20.5%) | 80 (31.5%) | 21 (8.3%) | |
| Food gatherings with family and friends | G | 107 (55.4%) | 26 (13.5%) | 22 (11.4%) | 29 (15.0%) | 9 (4.7%) | 0.705 |
| | S | 138 (54.3%) | 44 (17.3%) | 26 (10.2%) | 31 (12.2%) | 15 (5.9%) | |
| Surrounding environment | G | 86 (44.6%) | 48 (24.9%) | 27 (14.0%) | 28 (14.5%) | 4 (2.1%) | 0.045* |
| | S | 123 (48.6%) | 79 (31.2%) | 27 (10.0%) | 17 (6.7%) | 7 (2.8%) | |
| Stress and Depression | G | 51 (26.6%) | 38 (19.8%) | 35 (18.2%) | 58 (30.2%) | 10 (5.2%) | 0.008* |
| | S | 99 (39.0%) | 58 (22.8%) | 43 (16.9%) | 44 (17.3%) | 10 (3.9%) | |
| Difficulty to reduce sugar levels at high readings | G | 10 (5.2%) | 18 (9.4%) | 35 (18.2%) | 85 (44.3%) | 44 (22.9%) | 0.011* |
| | S | 29 (11.6%) | 36 (14.4%) | 53 (21.2%) | 96 (38.4%) | 36 (14.4%) | |

[1] Data presented as numbers and percentages *n* (%).
[2] *G:* general family clinics; *S:* specialized diabetic clinics.
[3] Using *Chi-square test*. Significantly different between groups at ($P < 0.05$)*.

**Table 4.12. Mean ranks of barriers to diabetes self-management at the PHCs**

| Barriers | Mean Rank | Degree of Influence |
|---|---|---|
| Non-adherence to recommended diet | 2.54 | Most Influential |
| Non-adherence to medications/insulin | 3.07 | |
| Lack of exercise and physical activity | 3.37 | |
| Family and social circumstances | 3.54 | |
| Non-adherence to clinic appointments and periodic check-up | 3.67 | |
| Stress from work | 4.81 | Least Influential |

[1] Data presented as mean ranks.
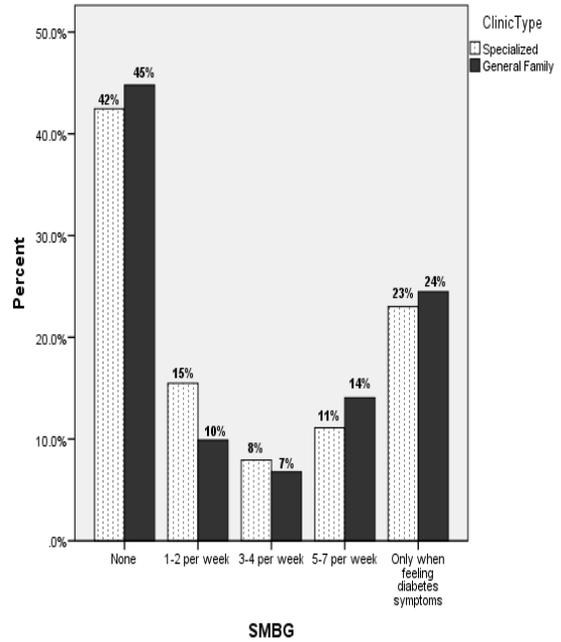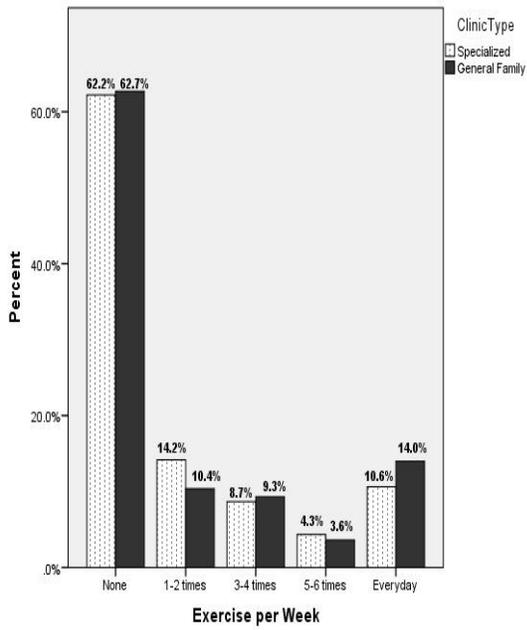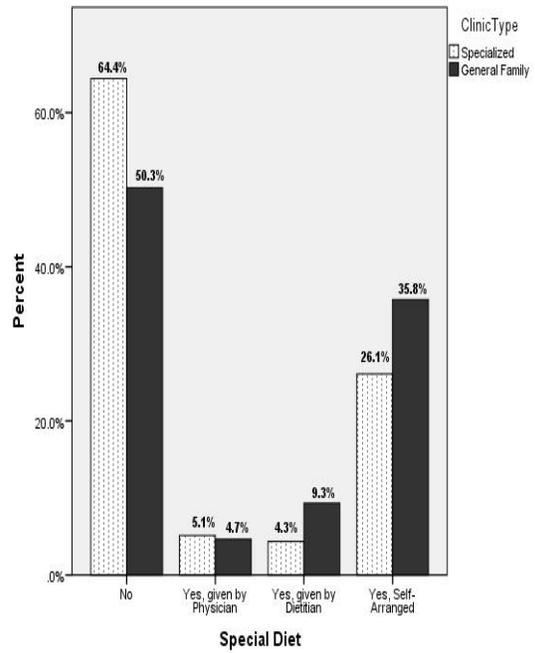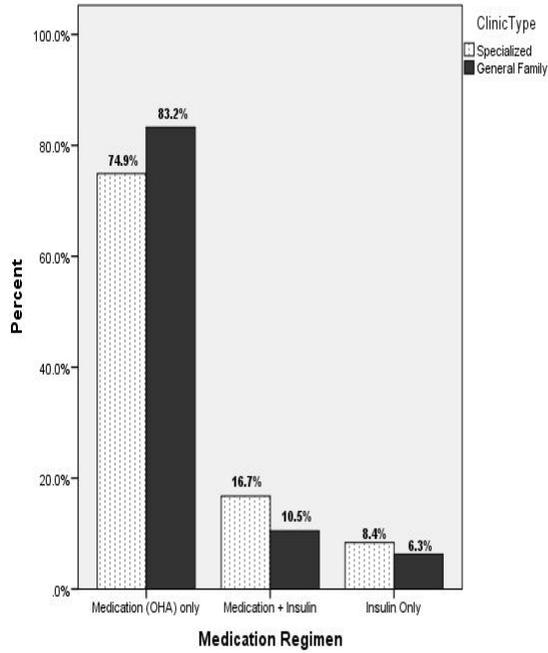
**Figure 4.2** Percentages of diabetes self-care behaviors according to clinic type
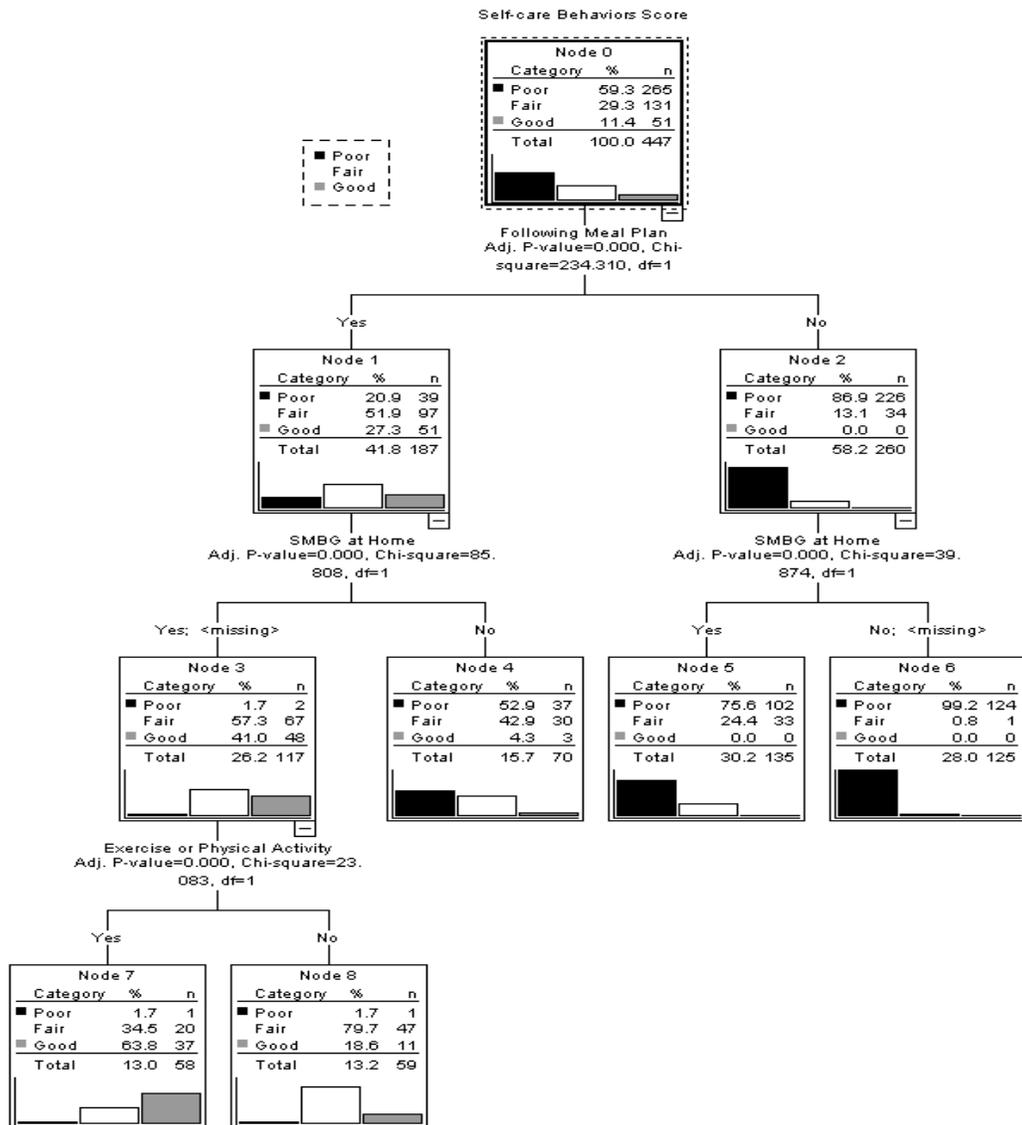
**Figure 4.3** Decision tree classification for adherence to diabetes self-care behaviors
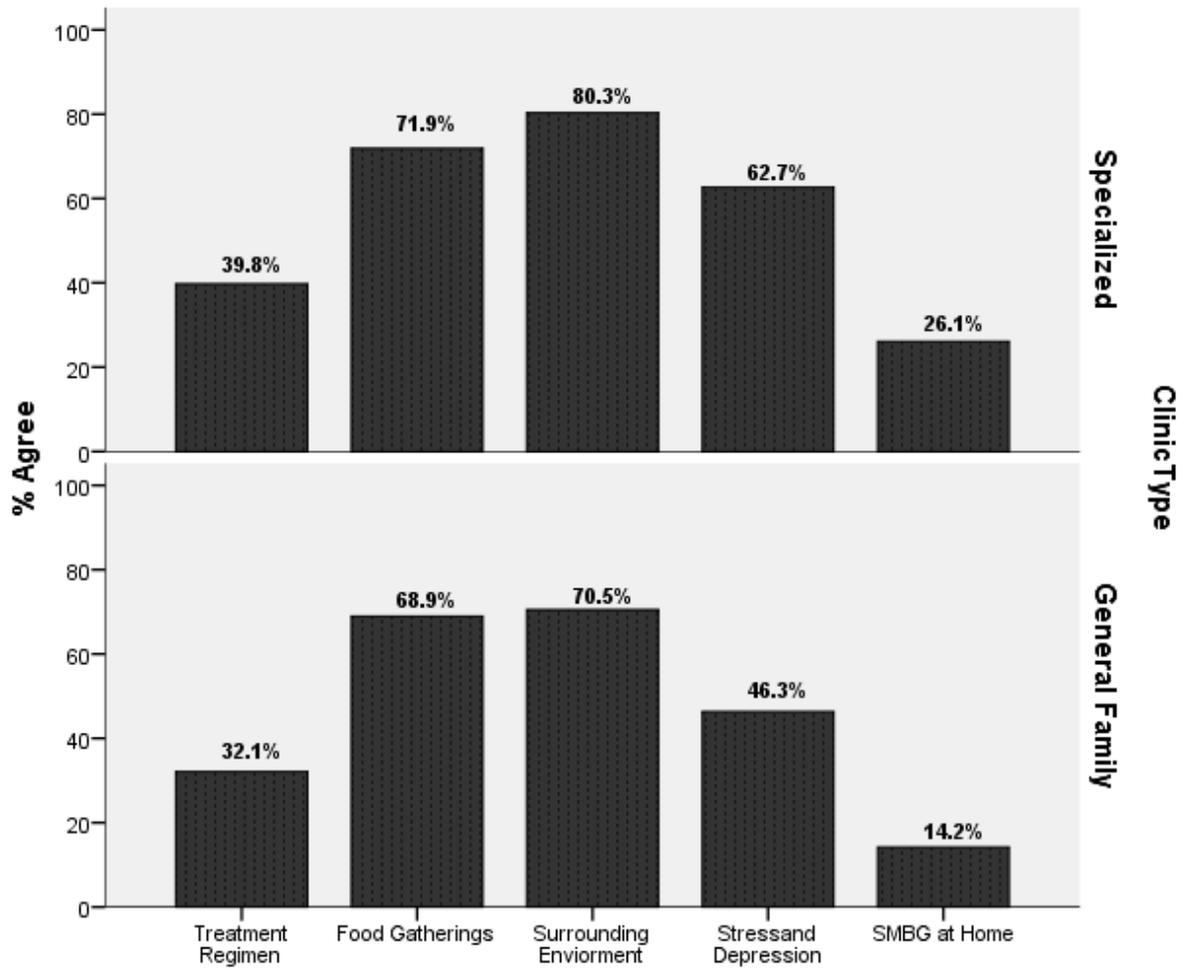
**Figure 4.4** Percentages of Kuwaiti patients agree on barriers to diabetes self-care behaviors according to clinic type

# Chapter 5: Summary and Conclusions

**Summary**

Diabetes is a major global public health problem. The growing prevalence of diabetes and the emergence of its complications cause early morbidity and mortality and the rising burden on health care systems. The prevalence of diabetes has been increasing and is becoming a serious clinical and public health concern in Kuwait. Kuwait is a small developing country where the prevalence of T2DM is increasing drastically and it presents at a young age among Kuwaiti individuals greater or equal to 20 years of age. Some of the factors that contribute to such high prevalence in glucose intolerance are genetics, poor diet, lack of physical activity, and obesity. Diabetes is associated with major risk factors including hypertension, coronary heart disease, myocardial infarction, stroke and other co-morbidities.

Type 2 diabetes is the result of a combined defect in insulin resistance, beta-cell dysfunction, and hepatic glucose dysfunction. Complications of neuropathy, retinopathy, nephropathy, and cardiovascular disease are commonly found in diabetic people with poor glycemic control. Therefore, self-care behaviors including carefully managing diet, physical activity and exercise, SMBG, and taking medications and/or using some form of insulin are essential components of diabetes self-management. Implementing diabetes self-care behaviors is the key to achieving good glycemic control leading to a longer and healthier life. Diabetes self-management requires commitment from the patient in order to prevent the occurrence of diabetes-related complications, which create more burdens on health-care costs. Summaries of answering our research questions are as follows:

**Research Question #1:** What is the prevalence of poor glycemic control (HbA1c > 7%) among Kuwaiti people with T2DM living in the Capital Region?

**Findings:** The proportion of poor glycemic control (HbA1c > 7%) among Kuwaiti type 2 diabetic patients was 78.8%, while only 21.2% had good glycemic control (HbA1c < 7%).

**Conclusion:** The prevalence of poor glycemic control among type 2 diabetic Kuwaitis at the PHCs is relatively high. This reflects the need for more national studies to assess and develop interventions for improving glycemic control among diabetic patients at the PHCs in Kuwait.

**Research Question #2:** What are the effects of diabetes self-care behaviors, dietary and lifestyle modifications, general diabetes knowledge, and general attitude and satisfaction on glycemic control among Kuwaiti type 2 diabetic patients?

**Findings:** Kuwaiti type 2 diabetic patients with poor glycemic control had significantly lower general diabetes knowledge and lower general attitude and satisfaction scores than patients with good glycemic control ($P < 0.05$). Self-care behaviors and dietary and lifestyle modifications scores were not significantly different in patients with poor glycemic control.

**Conclusion:** Practicing self-care behaviors, lifestyle modifications, having adequate diabetes knowledge, and developing positive attitudes must be emphasized in order to achieve good glycemic control.

**Research Question #3:** What are the determinants of compliance to glycemic control and diabetes self-care behaviors (medication/insulin, diet, exercise, SMBG) among Kuwaiti people with T2DM?

**Findings:** Based on the discriminant analysis model, significant differences between groups were observed for FPG, duration of diabetes, knowledge scores, and weight change ($P < 0.05$).

100

We found that FPG is the most powerful discriminating variable that classifies diabetic patients as being compliant versus non-compliant to glycemic control. For adherence to diabetes self-care behaviors, we found that more than half (59.3%) of patients were classified "poor" adherence to diabetes self-care behaviors. From the decision tree classification, diet was the strongest predictor that had association with diabetes self-care behaviors scores (adherence).

**Conclusion:** More emphasis on dietary and lifestyle modifications is needed from healthcare providers as well as continuous monitoring of patients' compliance to glycemic control and diabetes self-care behaviors.

**Research Question #4:** What are the potential barriers to complying with diabetes with self-care behaviors and diabetes self-management in Kuwaiti people with T2DM?

**Findings:** We took into account possible factors Kuwaiti patients would experience as barriers to diabetes self-care behaviors and overall diabetes self-management. For barriers to diabetes self-care behaviors, we found that the percentages of patients' perceptions to barriers "surrounding environment," "stress and depression," and "difficulty to reduce blood sugar levels at high readings" were significantly higher by patients at the specialized diabetic clinics than at the general family clinics ($P < 0.05$). As for barriers to diabetes self-management, most patients ranked "non-adherence to the recommended diet" as the most influential and "stress from work" as the least influential barriers.

**Conclusion:** Effective behavioral strategies on overcoming barriers should be developed and tailored towards individual needs. Healthcare providers (i.e., family practitioners, dietitians) should discuss these strategies when counseling diabetic patients.

**Research Question #5:** Is there a difference in the percentage of glycemic control between Kuwaiti T2DM patients who visit the general family clinics and those who visit the specialized clinics at the Capital Region?

**Findings:** Most Kuwaiti type 2 diabetic patients did not achieve good short-term and long-term glycemic control at both types of clinics. We found a significant difference in the proportion of glycemic control between the types of clinics. Patients at the specialized diabetic clinics had a significantly higher percentage of poor glycemic control than at the general family clinics, with HbA1c of 86.1% and 68.3%, respectively. In addition, patients at the specialized diabetic clinics had a significantly higher mean %HbA1c of 8.73 (± 1.84) than the general family clinics with a mean %HbA1c of 7.94 (± 1.72) ($p = 0.000$).

**Conclusion:** Substantial improvements are needed on the quality of diabetes care Kuwaiti patients are receiving at the PHCs, especially at the specialized diabetic clinics where high patient load and shortage of healthcare providers are identified.

**Recommendations**

There is a strong necessity for improving the quality of diabetes care among Kuwaiti people with diabetes attending the Primary Healthcare Centers across all health sectors in Kuwait. Therefore, the findings in this research suggest the following:

1. There is a high prevalence of poor glycemic control among Kuwaiti type 2 diabetic patients. More efforts are needed from healthcare providers on patients' education and motivation as well as to emphasize the importance of achieving adequate glycemic control through incorporating healthy lifestyle changes including diabetes self-care behaviors.

2. Develop guidelines and standards in assessing glycemic control when treating diabetic patients in Kuwait. Healthcare providers including physicians, dietitians, and nurses should agree on an international reference that is appropriate to Kuwaiti people with diabetes and should uniformly be followed at all the PHCs.

3. Facilities for measuring HbA1c to assess glycemic control should be provided in each laboratory of the clinic at the PHCs, instead of patients' blood samples being sent to hospitals where misplacement of lab results may occur. Providing the assay needed for routine HbA1c testing at the clinics will be more efficient for diabetic patients as well as healthcare providers for determining their compliance to glycemic control.

4. More trained healthcare providers including physicians, dietitians, and diabetic nurses need to be recruited at the PHCs, especially at the specialized diabetic clinics where higher patient load is determined.

5. Develop effective communication skills when counseling diabetic patients. Rather than only focusing on providing services, patient education through increasing diabetes knowledge, building positive attitudes, monitoring patients' compliance to glycemic control, encouraging adherence to self-care behaviors as well as dietary and lifestyle modifications should be emphasized to diabetic patients at every appointment.

6. Develop effective behavioral strategies (i.e., consider social and cultural habits) to overcome barriers to diabetes self-care behaviors and diabetes self-management among Kuwaiti people with diabetes. Healthcare providers, especially family practitioners and dietitians should discuss barriers when counseling patients and solutions should be tailored toward individual needs.

7. Develop culturally appropriate health education programs for Kuwaiti people with diabetes. Patient education by healthcare providers on diabetes self-management and awareness on the importance of compliance to glycemic control and diabetes self-care behaviors is strongly needed.

**Implications and Future Research**

Compliance to glycemic control and self-care behaviors is a major problem in people with diabetes, especially among individuals with or at risk of developing diabetes-related complications. Therefore, cultural demographics and individual characteristics need to be seriously addressed to avoid many patients suffering from unnecessary further morbidity and premature mortality as a result of complications from diabetes. In addition, more investigation is needed from physicians, nurses, and dietitians about the social and cultural habits of Kuwaiti T2DM patients, and in the methods used for developing solutions to overcome these potential barriers when counseling patients. Healthcare professionals need to make more effort to motivate patients to incorporate these self-care behaviors throughout their lives. In addition, there is an increased need for the development of culturally appropriate health education programs for Kuwaiti people with diabetes, especially those individuals at risk of developing diabetes-related complications. Solutions need to be implemented in improving the practices of diabetes management at all the PHCs across the six regions as well as throughout the healthcare system in the State of Kuwait.

This cross-sectional study was able to provide an overview on the quality of diabetes care Kuwaiti patients receive at the PHCs in the Capital Region. Our research was one of the first studies to assess the factors associated with compliance to glycemic control and diabetes self-care behaviors among Kuwaiti adults with T2DM. In addition, this research was able to

contribute new knowledge about the degree of adherence to the instructions Kuwaiti patients are advised to follow by healthcare professionals at their visit to the clinic. We initiated a proposed definition of compliance to glycemic control that can further be developed and implemented in future research. In addition, we presented a unique method in assessing patients' adherence to diabetes self-care behaviors through using decision tree classification for categorical variables.

Since our research is a cross-sectional study design, causal relationships in the factors associated with glycemic control and self-care behaviors cannot be established. Therefore, longitudinal studies are needed in Kuwait to determine causal relationships between factors associated with glycemic control over time, as well as measuring patients' long-term compliance to diabetes self-care behaviors in order to have a better assessment of overall diabetes self-management. In addition, studies are needed to determine the factors associated with glycemic control at different levels of the healthcare system in Kuwait (i.e., primary care, secondary care, and tertiary care). Moreover, more studies are needed for developing a measurement or criteria in assessing compliance to glycemic control and diabetes self-care behaviors. Lastly, more studies are needed in identifying the barriers to self-care behaviors and diabetes self-management that is culturally specific in order to overcome these barriers and improve healthcare in Kuwait.

# Appendices

**Appendix A**
**Survey on Self-Management of Type 2 Diabetes in Kuwait**
**(Arabic Version)**

# دراسة عن الإدارة الذاتية لداء السكري من النوع الثاني في دولة الكويت

يعتبر داء السكري من الأمراض الأكثر انتشارا في مجتمعنا وخطورة الصحة العامة بدولة الكويت. والهدف من هذا الاستبيان هو تقييم سلوكيات **مرضى السكري من النوع 2** من خلال الرعاية الذاتية، ومعرفة النظام الغذائي وتعديل نمط الحياة، وبعض معوقات الامتثال للإدارة الذاتية لمرض السكري. يرجى وضع علامة (√) في الخانة الأنسب لحالتك.

اسم المستوصف/ المركز ـــــــــــــ رقم الملف أو البطاقة المدنية ـــــــــــــ

## أولا: بيانات شخصية

1. العمر : ـــــــــــ 2. الطول (سم):ـــــــــــ 3. الوزن (كلغ) : ـــــــــــ

4. الجنس : □ ذكر □ أنثى

5. الحالة الاجتماعية: □ أعزب □ متزوج □ مطلق □ أرمل

6. مستوى التعليم : □ متوسطة وأقل □ ثانوي/ معهد □ جامعة □ ماجستير أو دكتوراه

7. المهنة : □ إداري □ مديرإدارة أوأعلى □ فني/ مهني □ لا يعمل أو متقاعد

8. الدخل الشهري: □أقل من700 دينار □ 700ـ1200 دينار □ 1200ـ2500 دينار □ أكثر من 2500 دينار

9. حالة التدخين : □غير مدخن □ مدخن □ مدخن سابقا وتركت التدخين منذ ـــــــ(اذكر المدة)

10. زمن الإصابة بداء السكري (النوع 2) : □1 سنة وأقل □2ـ4 سنوات □ 5ـ7 سنوات □ 8 سنوات أو أكثر

11. التاريخ العائلي للمرض: □ لدي أقارب من الدرجة الأولى مصابين بداء السكري (الآباء الأخوان الأبناء)
□ لدي أقارب من الدرجة الثانية مصابين بداء السكري (الأجداد الأعمام/الأخوال وأبناءهم)
□ لا يوجد مصابين غيري
□ لا أعلم

## ثانيا: يرجى الإفادة عما يلي

12. ما هو علاجك لمرض السكري؟ □ حمية (نظام غذائي) فقط □ أدوية علاجية فقط □ حمية + أدوية علاجية

13. ما نوع أدويتك العلاجية؟ □ أقراص دوائية فقط □ أقراص دوائية + أبرالأنسولين □ أبر الأنسولين فقط

14. كم مرة **في اليوم** تأخذ الدواء الخاص بك؟ □ ولامرة □ مرة واحدة في اليوم □ مرتين في اليوم □ ثلاثة أو أكثر في اليوم

15. مع أي من الوجبات اليومية تتناول دوائك؟ (يمكن التأشير على أكثر من وجبة) □ الإفطار □ الغداء □ العشاء

16. هل أنت على نظام غذائي خاص (أو حمية)؟ □ لا □ نعم باشراف الطبيب □ نعم باشراف أخصائي التغذية □ نعم باجتهاد شخصي

17. كم مرة **في الأسبوع** تمارس الرياضة البدنية ؟

□ ولا مرة  □ 1 2 مرة  □ 3 4 مرات  □ 5 6 مرات  □ يوميا

18. كم مرة تقوم باختبار نسبة السكر في الدم في المنزل؟

□ ولامرة  □ 1 2 مرة في الأسبوع  □ 3 4 مرة في الأسبوع

□ 5 7 مرة في الأسبوع  □ فقط عندما أشعر بأعراض مرض السكري

19. هل لديك أي مضاعفات أو أمراض ذات الصلة بمرض السكري ؟ (اختر كل ما ينطبق)

□ لايوجد  □ امراض العيون  □ امراض القلب  □ الغرغرينا ( بتر أطراف الأعضاء)

□ الأمراض العصبية  □ غيبوبة داء السكري  □ أمراض الكلى  □ أخرى حدد _____

20. كيف تصف شهيتك؟  □ مفتوحة جدا  □جيدة  □ معتدلة  □ ضعيفة

21. كم عدد الوجبات **الرئيسية والخفيفة** التي تأكلها في اليوم؟

□ 1 2 وجبة  □ 3 وجبة  □4 5 وجبة  □ 6 وجبة أو أكثر

22. ما هو نوع الحمية الغذائية التي تستخدمها؟

□ لايوجد  □ احتساب السعرات الحرارية  □ نظام البدائل

□ احتساب الكربوهيدرات  □ أخرى يرجى تحديدها _____

23. ماهو النظام الغذائي المحدد لك من قبل الطبيب أو أخصائي التغذية ؟

□لايوجد  □ قليل السعرات الحرارية  □ قليل الكولسترول  □ قليل الدهون

□ قليل الأملاح  □ قليل البروتين  □ غني بالألياف  □ أخرى حدد _____

24. منذ متى تتبع النظام الغذائي في رقم (22) أعلاه والموصى لك به من قبل الطبيب أو أخصائي التغذية ؟

□لا أتبع  □ أقل من 3 أشهر  □ 3 6 أشهر  □ أكثرمن 6 شهرإلى سنة  □ أكثر من سنة

25. هل تغير وزنك خلال **السنة الماضية؟**

□ لم يطرأ أي تغيير  □ زيادة بالوزن بعدد _____كيلو  □ انخفاض بالوزن بعدد _____كيلو

26. كم ساعة تمارس الرياضة في **الأسبوع؟**

□ لا أمارس  □ من 30 دقيقة إلى أقل من ساعة  □ 1 2 ساعات  □ 3 4 ساعات  □ 5 ساعات أو أكثر

27. في المتوسط كم ساعة تنام في اليوم ؟

□أقل من 6 ساعات  □ 6 8 ساعات  □ أكثر من 8 ساعات

**ثالثا: يرجى وضع علامة ( √) في الخانة الأقرب لوضعك أمام كل عبارة ممايلي**

| أعترض تماما | أعترض | أوافق إلى حد ما | أوافق | أوافق تماما | العبـــــــارة |
|---|---|---|---|---|---|
|  |  |  |  |  | 28. نظامي الغذائي يساعدني على تحقيق نسبة السكر الطبيعية (أقل من 7) في الدم |
|  |  |  |  |  | 29. يحفزني ذوي الاختصاص بالعيادة على المحافظة على نسبة السكر الطبيعية (أقل من 7) في الدم |
|  |  |  |  |  | 30. من الصعب إتباع علاج مرض السكري (الدواء أو النظام الغذائي) بانتظام |
|  |  |  |  |  | 31. الارتباطات العائلية والاجتماعية (الولائم) تؤثر على التغذية و ضبط مستوى السكر بالدم |

| أعترض تماما | أعترض | أوافق إلى حد ما | أوافق | أوافق تماما | العبـــــــــارة |
|---|---|---|---|---|---|
| | | | | | 32. الظروف المحيطة (الطقس، ضيق الوقت،...) لاتشجع على ممارسة الرياضة بانتظام |
| | | | | | 33. الشعور بالتوتر والاكتئاب يمنعني من التحكم بمرض السكري |
| | | | | | 34. عندما أقوم بالفحص الذاتي بالمنزل أجد صعوبة بتخفيض نسبة السكر بالدم عندما تكون القراءة عالية |
| | | | | | 35. ألتزم دائما بمواعيد مراجعتي لعيادة السكري |
| | | | | | 36. أنا راض عن الاستشارة والعلاج الذي أتلقاه من المختصين في عيادة السكري |

**رابعا: برأيك هل العبارات التالية صحيحة أم خاطئة؟**

37. الشخص المصاب بداء السكري لديه فرصة أكبر للإصابة بمشاكل صحية أخرى من الشخص الذي ليس لديه مرض السكري
□ صح          □ خطأ          □ لا أعرف

38. ليس من الضروري التحكم في كمية الطعام الذي نتناوله طالما نأخذ أدوية السكري
□ صح          □ خطأ          □ لا أعرف

39. الهيموغلوبين الغليكوزيلاتي (الهيموجلوبين A1C) هو اختبار الدم الذي يبين متوسط مستوى السكر في الدم خلال 2 3 أشهر الماضية
□ صح          □ خطأ          □ لا أعرف

40. النظام الغذائي لمريض السكر يجب ألا يحتوي على النشويات (الخبز، الرز ، البقوليات، الفواكهة، المعجنات الخ..)
□ صح          □ خطأ          □ لا أعرف

**خامسا: من خلال تجربتك الشخصية، ماهو ترتيبك للأسباب التالية من حيث تأثيرها السلبي على إدارة مرض السكري، بحيث تعطي الرقم (1) للسبب الأكثر تأثيرا، والرقم (2) للذي يليه وهكذا إلى الرقم (6) أقلهم تأثيرا.**

□ قلة الرياضة          □ عدم إتباع نظام غذائي          □ عدم الالتزام بمواعيد العيادة والفحص الدوري
□ ضغط العمل          □ عدم الالتزام بالدواء          □ الظروف العائلية والاجتماعية

**وأخيرا إذا كان لديك أي ملاحظات أخري حول معوقات إدارة مرض السكري ، يرجى ذكرها أدناه.**

_____

_____

**نشكر لكم تعاونكم ،،،**

**Appendix B**
**Survey on Self-Management of Type 2 Diabetes in Kuwait**
**(English Version)**

# Survey on Self-Management of Type 2 Diabetes in Kuwait

Type 2 diabetes mellitus is a prevalent and a serious public health concern in the State of Kuwait. The purpose of this survey is to assess the patients' self-care behaviors, knowledge and general attitude about diabetes, dietary and lifestyle modifications, and some of the potential barriers on adherence to self-diabetes management. Please place (√) in appropriate box for your status.

Name of Health Center/Clinic: _____          File or Civil ID # _____

## Part A: Personal Information

1. Age: _____          2. Height (cm):_____          3. Weight (kg): _____

4. Sex:          □ Male          □ Female

5. Marital Status:     □ Single          □ Married     □ Divorced          □ Widowed

6. Education Level:     □ Middle School or lower          □ High School/2yrs college
                       □ University/4 yrs college          □ Higher (MS /Ph.D)

7. Income:          □ < 700 KD     □ 700 – 1200 KD          □ 1200-2500 KD          □ >2500 KD

8. Occupation:     □ Administrator          □ Technician
                   □ Manager or Higher          □ does not work /retired

9. Smoking Status:
   □ Nonsmoker     □ Current Smoker     □ Former smokers and quit since ____(state the period)

10. Duration of diabetes since
    □ ≤ 1 year          □ 2-4 years          □ 5-7 years          □ > 8 years

11. Family History of Diabetes:
        □ First-degree relatives (parents - Siblings - children)
        □ Second-degree relatives (grandparents - aunts / uncles & their children)
        □ No family History
        □ Don't Know

## Part B: Please answer the following questions

12. Specify your Diabetes Treatment
    □ Diet only  □ Medication/Insulin Only   □ Medication/Insulin + Diet  □ Diet + Exercise

13. What type of medication regimen are you taking?
    □ Medication (OHA) only          □ Medication + Insulin          □ Insulin Only

14. How many times do you take your medicine/insulin per day?
    □ Never          □ Once a day          □ Two times a day          □ Three or more a day

15. With which meals are you taking your medication/insulin?
    □ Breakfast          □ Lunch          □ Dinner

16. **Are you on special diet?**
    □ No      □ Yes, given by physician      □ Yes, given by dietitian      □ Yes, self-arranged

17. **How often do you exercise or do physical activity <u>per week</u>?**
    □ None      □ 1-2 times week      □ 3-4 times week      □ 5-6 times week      □ Daily

18. **How frequently do you test your blood glucose at home?**
    □ None            □ 1-2 per week      □ 3-4 per week            □ 5-7 per week
    □ Only when feeling diabetes symptoms

19. **Do you have any diabetes-related complications? (select all that apply)**
    □ None            □ Eye Disease      □ Heart Disease      □ Foot Gangrene/Amputation
    □ Nerve Disease   □ Diabetic Coma    □ Kidney Disease     □ Others specify _____

20. **How would you describe your appetite?**
    □ Very Good       □ Good            □ Fair                □ Poor

21. **How many meals and snacks do you eat during the day?**
    □ 1-2 meals            □ 3  meals            □ 4-5  meals      □ 6 meals or more

22. **What type of food/meal planning method do you use?**
    □ None            □ Calorie Counting   □ Exchange Lists      □ Carbohydrate Counting
    □ Other (please specify)_____

23. **What other diet restrictions have you been told by your dietitian or physician to follow?**
    □ None                 □ Low calorie    □ Low cholesterol    □ Low fat
    □ Low salt/sodium      □ Low protein   □ High fiber          □ Other specify_____

24. **How long have you been following the meal plan in Q22 above recommended by your dietitian?**
    □ None      □ less than 3 months    □ 3-6 months   □ more than 6 months up to a year
    □ more than one  year

25.  **Has your weight changed in the past year?**
    □ No change       □ Gained weight _____kg            □ Lost weight_____kg

26. **How many minutes do you exercise <u>per week</u>?**
    □ None                 □ 30 min to 1 hour      □ 1-2 hrs            □ 3-4 hrs       □ 5 hrs or more

27. **How many hours do you sleep on average every night?**
    □ less than 6 hours       □ 6-8 hours            □ more than 8 hours

<u>Part C: Please place (√) in the box closest to your situation in front of each statement</u>

| Statement | Strongly Agree | Agree | Somewhat agree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| 28.  My current diet is helpful in achieving normal (less than 7 mmol/l) blood sugar levels. | | | | | |
| 29. My healthcare provider at the clinic motivates me in maintaining normal (less than 7 mmol/l) blood sugar levels. | | | | | |

| Statement | Strongly Agree | Agree | Somewhat agree | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 30. My treatment regimen for diabetes (i.e. medication or diet) is hard to follow. | | | | | |
| 31. High frequency of food gatherings with family and friends affects my diet and makes it difficult to control my blood sugar levels. | | | | | |
| 32. The surrounding environment (i.e. weather, lack of time, etc…) does not encourage me to exercise regularly. | | | | | |
| 33. Feeling stressed and depressed prevent me from managing my diabetes. | | | | | |
| 34. When I self-monitor my blood sugar at home, I find it difficult to reduce my blood sugar level at high readings. | | | | | |
| 35. I always keep up with my appointments at the diabetic clinic. | | | | | |
| 36. I am satisfied with the consultation and advice I receive at the diabetic clinic. | | | | | |

**Part D: Do you consider the following statements true or false?**

37. **A person with diabetes has a greater chance of having other health problems than a person who does not have diabetes.**
      □ True            □ False            □ I don't know

38. **It is not necessary to control the amount of food I eat when taking diabetes medication or insulin.**
      □ True            □ False            □ I don't know

39. **Glycosylated hemoglobin (hemoglobin A1c) is a blood test that shows the average blood glucose level during the past 2-3 months.**
      □ True            □ False            □ I don't know

40. **A person following a diabetic diet should not eat foods like toast/bread/rice/legumes/fruits/pastries etc…**
      □ True            □ False            □ I don't know

**Part E: Through your personal experience, what is your ranking for the following reasons in terms of their negative impact on the management of diabetes? Choose number (1) for the reason that you consider as the most influential, up to number (6) for the reason that you consider as the least influential.**

□ Non-adherence to clinic appointments & periodic check-up    □ Family & Social circumstances
□ Non-adherence to the recommended diet    □ Non-adherence to medications/insulin
□ Lack of exercise/physical activity    □ Stress from work

**Finally, if you have any other comments about the barriers to your diabetes management, please specify.**

_____

_____

# THANK YOU

**Appendix C**
**Table of Biochemical Parameters for Type 2 Diabetic Patients**

*Clinic Name:* _____          *Location:* _____

| File or Civil ID# | Year: Date | FPG (mmol/l) | TGs (mmol/l) | TC (mmol/l) | HDL-C (mmol/l) | LDL-C (mmol/l) | %HbA1c (Most Recent) | %HbA1c (1st Reading) | %HbA1c (2nd Reading) | %HbA1c (3nd Reading) |
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