THE EFFECT OF DIABETIC CONTINUING EDUCATION PROGRAMME ON THE HEALTH CARE PROVIDER'S KNOWLEDGE, ATTITUDE AND PRACTICE, ANDON DIABETIC PATIENTS OUTCOMES IN MUKALLA CITY,YEMEN

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By

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DEDICATION

To my mother, I ask Allah to guide her, My wives Am Abdullah Belqess and Am Mohammed Alanood, my children; Mohammed, Abdul Rhman, Ala'a and Ammah and my brothers and my sister.

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LIST OF ABBREVIATIONS

ACC	Al-noor charity clinic
ACE	Angiotensin-converting enzyme
ACP	Alberta college of pharmacy
ADA	American diabetes association
ARBs	Angiotensin receptor blockers
ASDKT	Arabic short diabetes knowledge test
BG	Blood glucose
BMI	Body mass index
BP	Blood pressure
CDA	Canadian diabetes association
CDC	Center for Disease Control
CDE	Certified diabetic educator
CE	Continuing education
CHD	Coronary heart disease
CHW	Community health workers
CME	Continuing medical education
CVD	Cerebral vascular diseases
DAS	Diabetes attitudes scale
DBKT	Diabetes basic knowledge test
DBP	Diastolic blood pressure
DCCT	Diabetes Control and Complications Trial
DKA	Diabetic ketoacidosis

DKT	Diabetes knowledge test
DM	Diabetes mellitus
DM CE	Diabetes mellitus continuing education
DSA-3	Diabetes attitudes scale third version
DSRT	Diabetes self report tool
FBS	Fasting blood sugar
GDM	Gestational diabetes
GPs	General practitioners
HbA1C	A glycosylated heamoglobin
HCPs	Health care professionals
HDL	High density lipoprotein
HHS	Hyperosmolar hyperglycemic syndrome
IDDM	Insulin dependent diabetes
IDF	International diabetes federation
IFG	Impaired fasting glucose
IGT	Impaired glucose tolerance
JDRFI	Juvenile diabetes research foundation international,
KAP	Knowledge attitude practice
LDL	Low density lipoprotein
LEP	Limited English proficient
Mg/dl	Milligram per deciliter
NCM	Nurse case manger
NIDDM	Non-insulin dependent diabetes
NSD	Nurse Specialized in Diabetes
PCPs	Primary care physicians

PDRY	People’s Democratic Republic of Yemen
PVD	Pulmonary vascular diseases
ROY	Republic of Yemen
SBP	Systolic blood pressure
SD	Standard deviation
SDM	Staged diabetes management
SPSS	Statistical Package for the Social Sciences
T1D	Type 1 diabetes
T2D	Type 2 diabetes
TG	Triglyceride
TG	Triglyceride
TGI	Total glucose intolerance
UK	Untitled kingdom
UKPDS	United kingdom prospective diabetes study
US	Untied state
USA	United state america
WHO	World health organization

KESAN PROGRAM PENDIDIKAN BERTERUSAN DIABETES TERHADAP PERGAMAL, SIKAP DAN AMALAN PENGAMAL PENJAGAAN KESIHATAN DAN KESANNYA TERHADAP HASIL DIABETES PESAKITDI BANDAR MUKALLA, YAMAN

ABSTRAK

Diabetes mellitus merupakan salah satu suatu masalah kesihatan awam utama dunia yang dikaitkan dengan peningkatan morbiditi, mortaliti (kematian), penggunaan dan kos penjagaan kesihatan. Di antara tahun 1986 dan 1990, prevalens diabetes di Yaman adalah lebih kurang 4.7%. Dalam tahun 2004, prevalens diabetes jenis II di Yaman telah dilaporkan sekitar 4.6% dengan lebih tinggi (7.6%) dikalangan lelaki berbanding wanita (2%). Kajian ini dijalankan di bandar Mukalla, Hadramout, Yaman untuk menilai kesan program pendidikan berterusan (CE) terhadap pengetahuan, sikap dan amalan (KAP) dalam kalangan pengamal penjagaan kesihatan (HCPs) di Yaman. Kajian juga menilai sama ada CE, HCPs dapat meningkatkan hasil klinikal diabetes pesakit diabetes jenis 2 (kawalan glisemik, tekanan darah, berat, profil lipid, serum kreatinin dan urea darah).

Kajian ini melibatkan dua fasa. Fasa I kajian melihat impak CE diabetes terhadap pengetahuan, sikap dan amalan penjagaan diabetes dalam kalangan HCPs. Dalam Fasa II, kajian menerokai kesan program CE dalam kalangan HCPs terhadap hasil diabetes pesakit. Bagi fasa I, seramai 73 orang HCPs menerima intervensi CE. Pengetahuan, sikap dan amalan dinilai menggunakan soal selidik yang telah divalidasi. Hasil daripada fasa I menunjukkan bahawa kebanyakkan HCPs mempunyai pengetahuan am yang baik tentang diabetes dan pengurusannya sebelum mereka menghadiri program CE. Penilaian skor atau markah pengetahuan am dalam kalangan HCPs menunjukkan beberapa penambah baikan, walau bagaimanapun

peningkatannya tidak signifikan (p=0.31). Keputusan kajian ini mendapati bahawa HCPs mempunyai pengetahuan yang baik dalam pemantauan tanda-tanda, gejala dan parameter makmal. Penilaian skor pengetahuan terhadap matlamat pengurusan diabetes dalam kalangan HCPs mendapati penambah baikan yang signifikan (p=0.024) dalam skor pengetahuan. Keputusan laporan kajian ini menunjukkan bahawa nilai makmal dianggap sebagai amat penting dalam rawatan pesakit diabetes. Kajian juga mendapati bahawa tiada perbezaan yang signifikan dalam skor amalan selepas program CE diabetes dalam kalangan HCPs. Di samping itu, kajian ini juga mendapati bahawa HCPs mempunyai sikap yang positif terhadap diabetes. Doktor mempunyai sikap yang lebih tinggi terhadap diabetes berbanding dengan HCPs lain (ahli farmasi dan jururawat) sementara jururawat menunjukkan sikap yang terendah dalam kalangan HCPs.

Bagi fasa II, satu rekabentuk sebelum dan selepas ujian digunakan untuk menilai kesan CE oleh HCPs terhadap penjagaan diabetes dan hasil pesakit. Seramai 92 orang pesakit diabetes jenis 2 menerima penjagaan daripada HCPs yang telah menghadiri program CE (Fasa I). Hasil pesakit diukur sebelum dan selepas 1, 3 dan 6 bulan HCPs menghadiri program CE. Keputusan fasa II menunjukkan bahawa hasil pesakit diabetes (paras gula darah, tekanan darah, profil lipid dan fungsi ginjal / renal) yang diurus oleh HCPs selepas menghadiri program CE adalah lebih baik berbanding sebelum CE.

Kesimpulannya, program CE dalam diabetes dikalangan HCPs memainkan peranan penting dalam peningkatan hasil klinikal pesakit diabetes.

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ABSTRACT

Diabetes mellitus is one of the worldwide major public health concerns which associated with increased morbidity, mortality, health care utilization and costs. Between 1986 and 1990, the prevalence of diabetes in Yemen was about 4.7%. In 2004 the prevalence of diabetes type II in Yemen was reported at 4.6% which was higher in man (7.4%) compared to female (2%). This study was conducted in Mukalla city, Hadramout, Yemen to assess the impact of continuing education (CE) program on Health Care Professionals (HCPs) knowledge, attitude and practice in Yemen. In addition, the study explores whether HCPs CE intervention would improve the clinical outcomes of type 2 diabetes patients (glycemic control, blood pressure, weight, lipid profiles, serum creatinine and blood urea).

This study consisted of two phases. Phase I of the study was looking at the impact of diabetes CE on knowledge, attitude and practice of diabetes care among HCPs. In the phase II, the study was exploring the effect of HCPs continuing education programme on patient diabetic's outcome. In phase I, a total of 73 HCPs received continuing education (CE) intervention. Knowledge attitude and practice (KAP) was assessed using a validated questionnaire. The result from phase I showed that majority of the HCPs has a good general knowledge on diabetes and its managements prior to the CE program. Evaluation of the general knowledge score of the HCPs found some improvement in the knowledge score, however the improvement was not significant ($p=0.31$). The result of this study found that HCPs has good knowledge on monitoring the sign, symptoms and laboratory parameters.

Evaluation of the knowledge score on Goal of Diabetes Management of HCPs found significant (p=0.024) improvement in the knowledge score. The results indicated that the lab values were rated as the most important in the goal for the treatment of diabetes patients. The study also found no significant difference in practice score after CE program among HCPs. In addition, this study also found that the HCPs have positive attitudes toward diabetes. Doctors have higher attitudes toward diabetes than others HCPs groups (pharmacist and nurses), where nurses showed lowest attitude among HCPs groups.

For phase II, one pre/post test design was used to evaluate the impact of HCPs CE on patient outcomes. A total of 92 patients with type 2 diabetes patient received care from HCPs who have attended the CE in Phase I. The patient outcomes were measured before the HCPs received CE and at 1, 3 and 6 months after the HCPs received CE. The result of phase II indicated that diabetic patient's clinical outcomes (blood sugar levels, blood pressure, lipid profile and renal functions) were better following managements by HCPs after they have completed a CE programme compared to baseline.

In conclusion, health care professionals' continuing education (CE) program in diabetes and its management plays an important role in the improvement of patient clinical outcomes.

CHAPTER ONE: INTRODUCTION

1.1 Background

Diabetes mellitus is a major public health concern and a condition that leads to increased morbidity, mortality, health care utilization and costs (American Diabetes Association, 2010; Norris et al., 2002). Complications related to diabetes have been documented, ranging from acute complications such as hypo/hyperglycaemia to chronic and serious complications such as those related to micro and macrovascular complications. These chronic and serious complications include heart attacks, blindness, kidney failure, stroke and others (DCCT,1993; Keller et al., 1993; Campbell et al., 1995; Ohkubo et al., 1995; Uusitupa et al., 1996; Renders et al., 2001; Umpierrez et al., 2002; Bate &Jerums, 2003; Gaede et al., 2003; Niaz et al., 2005; Sperl-Hillen & O'Connor, 2005;).

The diabetic epidemic is a global problem and is not limited to the developed countries. It has been estimated that there are about 366 million diabetic patients worldwide and the majority of them are sufferring from diabetes type 2 (Whiting et al., 2011). It has been postulated that the number of diabetic patients worldwide in the year 2030 could increase to 552 million.

Yemen is currently undergoing rapid development and is not excluded from the rapid increase in the incidences of diabetes (Gunaid &Assabri, 2008). Between 1986 and 1990, the prevalence of diabetes in Yemen was about 4.7% (Gunaid et al., 1997). In the year 2000, the prevalence of diabetes in the whole of Yemen had increased to 6.57% (Gunid, 2002). Furthermore, in the year 2004, the total prevalence of type II diabetes mellitus in the urban cities of Yemen was about 4.6% (7.4% of males and

2% of females). Moreover, the prevalence of impaired glucose tolerance (IGT) and impaired fasting glucose (IFG) were found to be 2% and 2.2%, respectively (Al Habori et al., 2004). In 2008, Gunaid and Assabri (2008) reported that the incidence of diabetes in Yemen has increased to 10.4%.

All health care professionals, including neurologists, pharmacists, nutritionists, health educators, nurses and other specialists, play significant roles in diabetes management (Wagner et al., 2001). The improvement noted in patient knowledge on diabetes and its management has been shown to depend on the instructions received from health care professionals (Drass et al., 1989). Several studies have reported that the effectiveness of diabetes education would be optimised if the health care professionals have a good knowledge of diabetes and good communications skills (Franz et al., 2003; Knowler et al., 2003; Trento et al., 2003; Balcou et al., 2008).

Unfortunately, some studies have reported that health care professionals (pharmacists, nurses and physicians) have insufficient knowledge and limited skills, which hamper in recognising the disease process (Uding et al., 2002; Chen et al., 2004). Therefore, a continuing education (CE) program and a certificated diabetic educator (CDE) program should be created to assist health care providers in updating their knowledge and skills in diabetes care.

Study carried out by Chen et al., (2004) have evaluated that the knowledge of pharmacists on diabetes and they found that improvement in the pharmacists' knowledge was very small, from 50% at baseline to 57.2% after the intervention program. Chen et al., (2004) concluded that the pharmacists' knowledge was still inadequate and suggested that pharmacists should undergo additional training on diabetes and its management to improve their competency.

Studies have also reported that nurses' knowledge on diabetes is also inadequate. Three of these studies assessed the nurses' knowledge using the DKT. These studies found that the nurses' level of knolwedge was between 66 % and 77 % of the total correct answer (Moriarty & Stephens, 1990; El-Deirawi & Zuraikat, 2001; Drass et al., 1998). Therefore, Drass et al. (1998) suggested that additional diabetes education programs are needed for all professional nurses to increase their knowledge and skills in diabetes.

According to O'Brien et al., (2009), in 32 studies it was suggested that continuing education programmes and workshops could improve health care professionals' practices. An education intervention programme for health care professionals plays an important role in the management of diseases, patients and their lives as well as their health problems. Health care professionals' education programme has been shown to improve the quality of care of diabetes patients and yield the best results in clinical outcomes (Lewin et al.,2001; Van Zyl and Rheeder et al.,2004; Thom et al., 2006; Chehade et al., 2010; Sequist et al., 2010; Speril-Hillen et al., 2010).

Studies have also shown that health care professionals' education with or without diabetes patients education could prevent or delay complications of diabetes (Deeb et.al.,1988). Several studies have reported that improved glycemic control, reduction in cholesterol and the control of blood pressure (BP) could reduce complications and improve outcomes (Klein et al., 1984; Nathan et al., 1986; Ohkubo et. al., 1995; DCCT 1993; Campbell et al., 1995; Uusitupa et al., 1996; Renders et al., 2001; Gaede et al., 2003; Sperl-Hillen & O'Connor, 2005).

In this study, we attempt to describe and assess the effect of HCPs professionals' CE programme on the clinical outcomes in type 2 diabetes patients. The HCPs that

attended the CE in Section One of the research were involved directly in the management of patients in Diabetic Clinic, Mukkala City. The patients' outcome parameters were monitored before and after the intervention given by the HCPs after the CE programme. This makes it possible to assess the effect of the CE to the patient diabetes outcome.

1.2 Problem statements

Diabetes is one of the commonest and costly chronic diseases, with 366 million people currently diagnosed globally (Whiting et al., 2011). Developing countries are projected to experience a tremendous increase in the number of diabetic cases, from 84 million to 228 million by 2025. Therefore, by the year 2026, over 75% of all the people with diabetes are expected to be in the developing countries, compared to 62% in 1995(King et al., 1998). By the year 2030, approximately 388 million diabetic patients are expected worldwide (CDC, 2005). The increase in the prevalence of diabetes in the develop countries such as Middle East and North Africa due to obesity rate (Hossan et al., 2007).

According to the (Sicree et al., 2010), six countries in the Middle East were rated in the top 10 countries in the word with the highest prevalence of diabetes. These 6 countries were the United Arab Emirates, which has the second highest diabetes rate in the world, followed by Bahrain, Egypt, Kuwait, Oman and the Kingdom of Saudi Arabia. As for Yemen, being one of the countries currently undergoing rapid development, it is faced with the challenge of an increasing number of diabetic patients (Wild et al., 2004). (Al-Habori et al., 2004) reported that the total prevalence of type II DM was recorded at about 4.6% (7.4% in males and 2% in females).

The increase in the prevalence of diabetes globally needs some kind of intervention that could be useful in retarding the progression of this disease. One of the steps that has been shown to be useful is improving the level of knowledge on the disease and its management among health care providers and patients (Fedderson & Lockwood, 1994; Amos et al., 1997; Moghissi & Hirsch, 2005; Haas, 2006). For health care providers, a systematic and recognised program such as the certified diabetes educator (CDE) program is very important to ensure that the information provided by health care providers is consistent. If the diabetes education effort is effective, the severity of the condition could be seriously lowered (Schwedes et al., 2002).

According to Plake et al. (2003), pharmacists' knowledge on diabetes is still poor; therefore, they need additional training regarding diabetes diagnosis and its management. The diabetes attitudes scale (DAS) is a well-validated instrument, which has been widely used to successfully measure attitudes of physicians and nurses, but there is a little information on pharmacists' attitudes (Chen et al., 2004).

Numerous studies have shown a lack of knowledge on diabetes among nurses. Many researchers, who conducted repetitive studies utilizing the diabetes basic knowledge test (DBKT), found that nurses still had inadequate knowledge on diabetes care (Drass et al., 1989; El-Deirawi & Zuraikat, 2001; Wright, 2008). Therefore, there is a need to improve nurses' knowledge on diabetes care, since nurses are the largest group of health care professionals who spend the longest time with diabetic patients.

Additionally, there is very little data on the level of knowledge and awareness on diabetes in developing countries such as Yemen. Such data is extremely important in the planning of public health policies, with specific reference to its national implementation. Studies have shown that the prevalence of diabetes in Yemen is

increasing, while education about diabetes is still not established (Al-Habori et al., 2004; Almikhlafy et al., 2008). In most countries, health care providers adopt a standard guideline for diagnosing and managing diabetic patients; however, the existence of such guidelines is still not widely available in Yemen. Therefore, the information on the level of knowledge, attitude and practice of health care providers on diabetes and its management is useful for policy makers in Yemen to develop a model that could be adopted by the practitioners in the whole country.

Health care professionals' education programmes are essential for improvements in glycemic control, blood pressure, weight loss and lipid levels. At the present time, no studies have been found, which evaluate whether health care professional education interventions have any effect on clinical outcomes in T2DM in Yemen. Therefore, this present study aims to answer the following question: what effect would a health care professional's diabetes education programme have on clinical outcomes including fasting blood glucose, blood pressure, weight, renal and lipid profiles of type 2 diabetes patients?

1.3 The rationale of study

Diabetes is a chronic disease, which affects the lives of millions of people all over the world. Studies have shown that education interventions are designed to improve glycemic control, patient knowledge, self-care behaviours, and blood pressure control, as well as to reduce lipid levels and prevent or delay diabetes complications (Susan et al., 2002; Ismail et al., 2005; Madonna, 2008).

Many studies reported that the health care professionals' diabetes education programmes improve glycemic control by reducing HbA1C and fasting blood sugar, controlling blood pressure and reducing cholesterol. They could also reduce

complications of the progress of the disease (Klein et al.. 1984; Nathan et al., 1986; DCCT, 1993; Ohkubo et al., 1995; Campbell et al., 1996; Uusitupa et al., 1996; Norris et al., 2001; Renders et al., 2001; Gaede et al., 2003; Parchman et al., 2003; Steed et al., 2003; Sperl-Hillen & O'Connor, 2005). Presently, there are no studies on whether the care providers' education interventions have any effects on blood glucose level and metabolic risk factor in T2DM in Yemen.

1.4 Significance of the study

This study explored the level of knowledge, attitude and practice in diabetes care among health care providers in Mukalla, Yemen. The study also looked at the outcome of diabetes treatment before and after the intervention (in the form of diabetes education) by health care providers.

This study will provide the basic information on the level of knowledge, attitude and practice in diabetes care among doctors, pharmacists and nurses. This information could be used to assist the relevant authority in designing specific educational programs to enhance the level of knowledge and skills of health care providers in diabetes and its management.

The finding of the study could also be relevant for health care societies such as the Pharmaceutical Association, Medical Association and Nursing Association. They could use the information obtained from this study to design specific programs or educational programs tailored for their profession's need to improve diabetes care.

The results of the present intervention could provide evidence for improving glycemic control in the population studied. This could be used to aid health care providers and programme directors in the design and the delivery of standardised and

effective care in the area of diabetes control and management.

This study could also assist physicians and nursing practitioners by increasing their professional knowledge regarding the effectiveness of education intervention on blood glucose level, blood pressure, weight and renal assessment of patients with type 2 diabetes. If this type of intervention has effect on clinical outcomes of the patient with T2DM, then the strategy could be adopted by the health care professionals to assist their patients.

1.5 Hypotheses of the study

Hypothesis 1: The current level of knowledge and attitude among health care professionals is still inadequate.

Hypothesis 2: There will be a significant effect of education intervention (i.e., presentation) on the knowledge of health care professionals.

Hypothesis 3: There will be significant differences between health care professionals (pharmacists, doctors and nurses) for the knowledge diabetes scores.

Hypothesis 4: There will be a significant effect of our education intervention (i.e., presentation) on the perception of health care professional.

Hypothesis 5: There will be significant differences between health care professionals (pharmacists, doctors and nurses) on practice scores.

Hypothesis 6: There will be a significant effect of education intervention (i.e., presentation) on the attitude of health care professionals.

Hypothesis 7: There will be significant differences among the health care

professionals (pharmacists, doctors and nurses) toward diabetes attitudes subscales.

Hypothesis 8: There will be effect of health care professionals' intervention on clinical outcomes; fasting blood sugar, blood pressure, weigh, lipid profiles (i.e. total cholesterol, LDL cholesterol, HDL cholesterol and TG) and renal profiles(i.e. serum blood urea and serum creatinine) at baseline, before the intervention programme, at one month after and at six months after the intervention.

1.6 Study objectives

1.6.1 Main objective

At present, there is no available data on the level of knowledge, attitude and practice (KAP) in diabetes care in Mukalla city, Yemen. In view of this, the main objective of this study was to assess the current level of KAP in diabetes care among health care providers, namely doctors, pharmacists and nurses in Mukalla city, Yemen. In addition, the study also evaluated the improvement in a KAP intervention program in diabetes care among health care professionals in Mukalla city.

In addition, this study was to evaluate the effect of health care professionals' intervention on clinical outcomes in type 2 diabetes patients in Mukalla City, Yemen.

1.6.2 Specific objectives

1. To assess the level of health care professional's knowledge on symptoms, treatment, complications and life style modifications.

2. To evaluate the attitude of health care providers with regards to training of diabetes, complications and the monitoring of blood glucose.

3. To determine the practice of health care professionals in the diagnosis, investigation and treatment of diabetes.

4. To assess the improvement of health care provider s' KAP after a CE programme.

5. To determine the effects of health care professionals' intervention on clinical outcomes in type 2 diabetes patients at baseline, before the intervention programme, at one month, three and six months after the intervention.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter provides a review of the literature related to the knowledge, attitude and practice in diabetes care among health care providers. To facilitate the discussion, the chapter is divided into nine major sections. The first section provides a background review of Yemen, the second provides the diabetes in Yemen, and the third gives the diabetes risk factor in Yemen.The fourth give global prevalence of diabetes. The fifth gives the general diabetes information. The sixth provides the knowledge, in diabetes care among health care providers; the seventh provides a review of attitude in diabetes care among health care providers, while the eighth section gives a review of practice in diabetes care among health care providers. The ninth section provides diabetes education programs and its effect on KAP among health care professionals. The tenth section reviews the effectiveness of health care professionals'intervention on patientsoutcomes.

2.2 The health care system and education in the republic of Yemen

Prior to 1990, the Republic of Yemen (ROY) was divided into two: North Yemen, which was known as the Yemen Arab Republic (YAR), and South Yemen, which was the People´s Democratic Republic of Yemen (PDRY). In May 1990, both South and North Yemen was amalgamated and became the Republic of Yemen. With the unification, all the management of government was carried out from the capital of Yemen, Sana'a. Sana'a also governs the health care system, which includes facilities, policy, and manpower as well as drugs supply. There is no recent data on the health care facilities in Yemen; however, the latest data available was for the year 2004.

There were 42 government hospitals (93 private), 470 polyclinics (341 private), 626 health centers (115 private), 2,185 primary health care units, 380 maternity and child health centers, 1,768 private pharmacies, and 4,799 physicians (329 dentists and 974 specialists) to provide services to 22.2 million inhabitants. In 2007, a report from the U.S. government and United Nations showed that the population of Yemen was composed of 46 % under 15 years old, while 51 % of the population was between 15 and 64 years old and less than 3 % was 65 and older. The data also showed that the universities offering medical, pharmaceutical, dental, nursing and other health-related programs were limited. In the year 2011, the total number of universities offering health-related programs in Yemen was only 5, namely Sana'a University, Aden University, Hadramout University, Thomar University and one private institution, the Science and Technology University. The limited number of educational institutions offering health care-related programs was unable to provide an adequate supply of manpower to meet the health care providers to patient ratio set by WHO.

2.3 Diabetes in Yemen

2.3.1 Diabetes prevalence and its complications in Yemen

The knowledge of diabetes epidemiology among Yemenis is yet to be properly established (Almikhlafy et al., 2008). A recent cross sectional study carried out by Almikhlafy et al., (2008), aimed to determine the prevalence of diabetes mellitus among Yemeni physicians in Sana'a city Yemen, and to find the relationship between gat chewing and diabetes mellitus. The sample size of this study was 332 physicians. Data was collected by a questionnaire consisting of basic demographic, socio-economic, medical and drug history. However, the questionnaire did not

mention where the pilot study was done, which may contribute to the validity of the findings. In addition, fasting blood samples were taken to measure glucose levels. The prevalence of diabetes among Yemeni physicians was about 10% and there was no relationship between gat chewing and diabetes mellitus. However, the study does not represent the typical problems in Yemen as the sample size was small and it was carried out only in three government hospitals in Sana'a city. A earlier study was conducted in the capital city, Sana'a, among 1080 Yemeni people by Guniad et al., (1997). The author found the crude prevalence of known diabetes to be 6.57%, while the age-standardized prevalence for the age ranging between 30–64 years was 9.75%. In addition, it was discovered that history of diabetes was found in 33.7% of IDDM patients: 30% for non-obese NIDDM patients, 39.2% for obese NIDDM patients and 33% for the whole number of subjects studied.

Al-Habori et al. (2004) carried out a cross sectional study in Sana'a city, Yemen among 498 adults with ages ranging from 25–65 years. They examined the prevalence of diabetes mellitus and impaired glucose tolerance (IGT), as well as identified the metabolic abnormalities and risk factors associated with these conditions. All residents who were ≥25 years were screened for type II Diabetes Mellitus and impaired glucose tolerance (IGT) as well as impaired fasting glucose (IFG). The result of the study revealed that the prevalence of diabetes was 4.6 %, impaired glucose tolerance (IGT) was 2% and impaired fasting glucose (IFG) represented 2.2%. In addition, the authors found that 80% of the type II diabetics were over 40 years old, 35% had hyperlipidemia, 22% were hypertensive and 18% were obese, whereas 60% of IGT subjects had hyperlipidemia and 20% were obese. One of the problems of this study was the small sample size, which may increase Type II error. Another study was carried out among 1080 adults by Gunaid in

Sana'a city (Gunaid, 2002). Gunaid found that the demographics of Yeminis were similar to those reported by Al-Habori etal,(2004) where the majority of Yemeni people above 25 years have higher risk of developing diabetes. However, Gunaid's study found that the crude prevalence of known diabetes was 6.57%. Both studies established that diabetes mellitus was more prevalent in males than in females.

Another recent study carried out in Sana'a city by Gunid and Assarbi (2008) aimed to explore the prevalence of diabetes mellitus and abnormal glucose tolerance as well as other cardiovascular risk factors. The sample of this study was 250 adults aged ≥ 35 years in a semirural area near Sana'a, the capital of Yemen. Medical history and clinical data collected included BP, weight and BMI. Whole blood glucose concentration and 2 hours after oral glucose load were taken to screen diabetes mellitus and abnormal glucose tolerance as well as other cardiovascular risk factors. The findings of this study were that the crude prevalence of diabetes type 2 was 10.4%, while the age-standardized prevalence for those aged over 35 years was 6.3%. Moreover, the age-standardized rate of either impaired fasting glucose or impaired glucose tolerance was 9.0%, and the age-standardized prevalence of hypertension was 14.2% (Gunaid and Assabri, 2008).

Al-Khawlani et al. (2010) conducted another study in Sana'a, among 311 type 2 diabetes patients above 25 years old. The authors explored the prevalence of macrovascular complications and their association with glycemic control, as well as other risk factors in patients with type 2 diabetes mellitus. Physicians collected the data related to history, BP, BMI, symptom of peripheral vascular diseases (PVD), coronary heart diseases (CHD) and history of cardiovascular diseases (CVD). FBG was determined using WHO standard protocols (WHO, 1999). They found that

53.4% of subjects had hypertension, 34.1% were overweight, 8.7% were obese and 87.9% had poor glycemic control (HbA1c $\geq$ 7%). In addition, it was reported that 25.4% of diabetes patients with type 2 had symptoms of macrovascular complications, PVD (9.1%), CHD (17.8%) and CVD (5.8%). This study showed that risk factors for CHD were age and, hypertension, while risk factors for PVD were male sex, age, duration of diabetes and smoking.

Studies have reported that diabetes and its complications are the major public health concern in Yemen. Data in 2004 demonstrated that the prevalence of diabetes retinopathy among diabetic patients in Yemen was 55% (Bamashmus et al., 2009). Hypertension is another common illness associated with diabetic patients in Yemen, where 55% of patients have hypertension. The prevalence of retinopathy and neuropathy complications among Yemeni diabetic patients with hypertension have been reported to be 38.5 % and 54.3 %, respectively. In addition to that, the prevalence of peripheral neuropathy has been reported to be about 89.4%. For macrovascular complications, ischemic heart disease is the most common at 28.8% followed by peripheral vascular disease (13.5 %) and stroke (8.7%). On the other hand, in diabetic patients without hypertension, the prevalence of complications are slightly lower. The prevalence of retinopathy in non-hypertensive diabetic patients is 20.4%, neuropathy 32.8 % and peripheral neuropathy 74.1 %. A similar trend were observed in the macrovascular complications of non-hypertensive diabetic patients where ischemic heart disease is 12.9 %, peripheral vascular disease 10.6 % and stoke 5.9 % (Al-Khawlani et al., 2009). Another recent study in the city of Sana'a, Yemen, by Al-Khawlani et al. (2010) found that the prevalence of coronary heart disease was 17.8%, peripheral vascular disease 9.1% and cerebrovascular disease 5.8%. This sudden drop in the prevalence of diabetes-related complications may represent the

variations in the population of the study.

2.3.2 Diabetes Risk Factor in Yemen

There are several factors have been identified as the risk factors for diabetes. There are three studies conducted in Yemen to explore the specific risk factors contributed to the recent increase in diabetes incidents. A study by Al-Habori et al. (2004) reported a high incidence of diabetes in Sana'a city. The study was conducted among 498 adults (≥25 years of age) and found that 80% of the type II diabetics have an age above 40 years old. The prevalence of obesity (BMI≥30 kg/m2) was higher among the normal glucose tolerant (78%), and 35% were hyperlipidemia. Study by Guniad and Assabri (2008) found that being over 55 years old and having a waist circumference ≥ 102 cm for men and ≥ 88 cm for women have higher risk to total glucose intolerance (TGI). In addition, the family history was also identified as a risk factor for diabetes mellitus. A more recent study in Sana'a city by Almikhlafy et al. (2008) found that age, physical inactivity and smoking significantly increased the risk factor of diabetes among Yemeni physicians.

2.4 Global prevalence of diabetes

Globally, the estimated prevalence of diabetes in the year 2000 was between 147 and 154 million people (King et al., 1998). In 2001, the prevalence of diabetics worldwide was estimated at about 150 million and this is expected to increase to 220 million by 2010 and to 300 million by 2025 (King et al., 1998; Zimmet et al., 2001). Developing countries are expected to experience an increase in the number of diabetes from 84 million to 228 million in the same time frame. Based on the above estimation, 75% of all the total number of diabetes in 2006 was expected to come from the developing countries, compared to 62% in 1995 (King et al., 1998).

According to the IDF (2009), it was reported that six countries in the Middle East were rated in the top 10 countries in the world with the highest diabetes prevalence. The 6 countries included the United Arab Emirates, which has the second highest diabetes rate in the world, followed by Bahrain, Egypt, Kuwait, Oman and the Kingdom of Saudi Arabia. Yemen, being one of the countries currently undergoing rapid development, is faced with the challenges of increasing number of diabetic patients. Al-Habori et al. (2004) reported that the total prevalence of T2D was estimated at about 4.6% (7.4% in males and 2% in females).

Several studies have reported on the prevalence of diabetes in some countries of the Middle East, including: the Kingdom of Bahrain, 25.5% (Farouq et al.,1996); Kingdom of Saudi Arabia, 23.7% (Mohieldein et al., 2011; Al-Norzha et al., 2004); Lebanon, 21%; Kuwait, 14.8% (Abdella et al, 1998); Jordan, 13.4% (Ajlouni et al., 1998); Egypt, 13.1% (Herman et al., 1995); Oman, 7 to 13% (Al-Lawati et al., 2002). With these percentages, the expected number of diabetes in the Middle East alone could contribute to a significant percentage of the total global number of diabetic patients.

2.5 General diabetes information

2.5.1 Etiology and classification

Diabetes is classified based on its etiology, namely diabetes type I (T1D), diabetes type II (T2D), gestational diabetes (GDM) and other specific types of diabetes (e.g. genetic defects in insulin action, diseases of the exocrine pancreas (cystic fibrosis), and drug- or chemical-induced e.g.in the treatment of HIV/AIDS or after organ transplantation. Other specific types of diabetes, e.g. genetic defects in β-cell function; several types are due to monogenetic defect in β-cell function. These types

of diabetes are developed at an early age and characterized by sudden onset of hyperglycaemia. Genetic defects in β-cell function are referred to as maturity onset diabetes of the young (MODY) (ADA, 2010). Type I diabetes (T1D) is more common in children and adolescents. The main cause is linked to the autoimmune-mediated destruction of pancreatic B-cells, resulting in the reduction or absence of insulin secretion. T1D accounts for about 10% of all diabetic patients and requires daily injections of insulin. T1D patients are more prone to develope ketoacidosis and other symptoms such as polydipsia, excess urination, fatigue, blurred vision and rapid weight loss (CDC, 2005; ADA, 2010).

T2D is also known as non-insulin dependent diabetes mellitus (NIDDM) and occurs predominantly in adults above forty years old who are obese and have a family history of diabetes. T2D accounts for approximately 90% of diabetic cases (ADA, 2008). There are various risk factors associated with T2D and most patients have several of these risk factors prior to the onset of diabetes. These risk factors include pregnancy, obesity, hypertension, inactive lifestyles and family history (CDC, 2005). Treatment of T2D generally includes dietary modifications, weight reduction, physical activity and a combination of several oral medications (CDC, 2005; ADA, 2008).

Gestational diabetes mellitus (GDM), on the other hand, occurs only during pregnancy. Obesity and a family history of diabetes are common factors contributing to the development of gestational diabetes (CDC, 2005). Other risk factors for GDM are raised fasting blood glucose or random blood glucose levels and glycosuria (Hanna & Peters, 2002). Women diagnosed with gestational diabetes are more likely (5% to 10 %) to develop T2D (CDC, 2005). Those who are at risk of gestational

diabetes should be tested as soon as possible. If gestational diabetes is not found at initial screening, the women should be retested after 24 weeks of gestation (ADA, 2008). Gestational diabetes must be treated during pregnancy to avoid complications to the infant.

Treatment of gestational diabetes generally includes close blood glucose monitoring, which can be done by physicians, nurses or the patient herself. Women with GDM should be encouraged to participate in physical activity and dietary modification. Finally, insulin can be recommended when diet and exercises fail to maintain fasting blood glucose level ≤150mg/dl (5.8 mmol/l) (Chan et al.,2004).

2.5.2 Diabetes complications

Diabetes is a serious public health disease leading to high morbidity and mortality. It is associated with various serious complications and could lead to death if not properly treated. According to the CDC (2007), most of the complications from diabetes are associated with the poor control of T2D. The major goals of diabetes management are therefore to achieve euglycaemia and prevent the development of complications. There are two types of complications in diabetes: acute and chronic. The acute complications of diabetes are hypoglycaemia, diabetic ketoacidosis (DKA) and hyperglycaemia. Diabetic ketoacidosis (DKA) is more common in T1D, while hyperglycaemia occurs in type 2 diabetes. On the other hand, chronic complications (long-term complications) are not directly related to blood sugar level, but are linked to changes in the histopathology of macro and microvasculature. The prevalence of microvascular and macrovascular complicationsare usually associated with the duration of diabetes and blood sugar control. Microvascular complications are more common in T1D, while macrovascular complications are more prevalent in T2D,

which contributes to the main cause of morbidity and mortality in T2D. The presence of microvascular complications such as retinopathy, nephropathy and others may run undetected even before the diagnosis is made (Bate & Jerums, 2003). Several studies have documented that a good control of blood sugar, reduction in cholesterol and blood pressure control could reduce complications and improve outcomes in both types of diabetes (DCCT, 1993; Ohkubo et al., 1995; Campbell et al., 1995; Uusitupa et al., 1996; Renders et al., 2001; Bate & Jerums, 2003; Gaede et al., 2003; Sperl-Hillen & O'Connor, 2005).

2.5.2.1 Acute complications

This mainly occurs in T1D, which often affects young diabetic patients. The clinical manifestations of diabetic ketoacidosis (DKA) are related to insulin deficiency with hyperglycaemia (blood glucose level ≥ 200 mg/dL), lipolysis, increased production of ketone bodies and acidosis (pH≤ 7.3). Some other participating factors found to worsen DKA include infections, hypercatabolism secondary to acute illness, inadequate diabetes knowledge, non-compliance to therapy and inadequate glucose monitoring (Keller et al., 1993; Umpierrez et al., 2004; Niaz et al., 2005;). Prevention of DKA is very important and could be done by improving patient adherence to diabetes education, adequate self-care and compliance to insulin and self-monitoring of blood glucose level. In general, the treatment of DKA involves adequate hydration therapy, insulin infusion therapy and electrolyte replacements.

Hyperosmolar hyperglycaemic syndrome (HHS) is clinically characterised by an elevated blood glucose (> 600 mg/dL), elevated serum osmolality (>320 mOsm/kg) and the absence of ketoacidosis (Kitabchi & Fisher, 2008). HSS usually occurs in elderly patients who refuse to drink adequate amount of fluid and hence, leads to

severe dehydration. Treatment of HHS should be initiated by reversing the dehydration with large volume fluid replacement, close monitoring of blood glucose level and insulin therapy may sometimes be needed (Umpierrez et al., 2004)

2.5.2.2 Long-term complications

The long-term complications of diabetes are usually associated with the prolonged fluctuation in blood glucose level, as well as changes in the lipid profile. Chronic complications can be divided into two types, namely macro and microvascular diseases. Macrovascular diseases refer to heart and peripheral vascular diseases, as well as cerebrovascular diseases (Wilson et al, 1998; Laing et al, 2001; Paterson et al, 2007). Microvascular diseases include blindness (retinopathy), kidney disease (nephropathy), nerve damage (neuropathy) and infections that lead to gangrene and amputation (Ohkubo et al, 1995; Feire et al., 2002)

Macrovascular complications of diabetes include coronary heart disease (CHD), stroke and peripheral arterial diseases (Avogaro et al., 2007). Coronary heart diseases and stroke are the major complications leading to morbidity and mortality in diabetes (Stamler et al., 1993; Wilson, 1998; Beckman et al., 2002; Beckman et al., 2007; Buse et al., 2007). In addition, myocardial ischemia arises from coronary atherosclerosis and is also common in diabetes (Wingard et al., 1993). Subsequently, myocardial infarctions could also lead to heart failure (Haffner et al., 1998; Paterson et al., 2007). Moreover, cerebrovascular disease is more commonly found in T1D (Laing et al., 2003).

Studies have shown that intensive glycemic control in type I diabetes through the lowering of HbA1C is associated with a reduction in all cardiovascular diseases and a decrease in myocardial infarction and stroke (Nathan et al., 2005; Paterson et al.,

2007). By contrast, intensive blood glucose control in type 2 diabetes does not improve macrovascular complications, but it has been reported that the control of hypertension in T2D improves macrovascular complications (UKPDS, 1998; Turner et al.,1998). Studies have reported that the control of blood pressure in diabetic patients could be achieved with ACE inhibitors or angiotensin receptor blockers (ARBs) (Beckman et al., 2002; Lindholm et al., 2002). Moreover, there is an additional benefit in the use of ACE inhibitors and ARBs in diabetic patients because both are useful for arresting the progression of diabetic microvascular kidney disease.

Another approach in the prevention of macrovascular complication of diabetes is by controlling lipid concentrations. Several studies have reported a reduction in triglycerides and LDL cholesterol concentrations and increased HDL cholesterol using lipid lowering agents, particularly statins, which are very useful in reducing these complications (Beckman et al., 2002; Colhoun et al., 2004; Buse et al., 2007).

Retinopathy, nephropathy and neuropathy are the main presentations of microvascular complications in diabetes. Diabetic retinopathy is one of the major microvascular complications of diabetes and is more common in type I diabetes (Keenan et al, 2007). It occurs early, within 7 years before the diagnosis of type 2 diabetes (Fong et al, 2003). According to a study carried out by Bamashmus et al. (2009) in Sana'a, Yemen, among diabetes patients, the prevalence of diabetic retinopathy was 55%, blindness 16% and cataract and glaucoma 34.3% and 8.6%, respectively. Some recommendations to reduce the progression of diabetes retinopathy include tight glycemic control, control of blood pressure and regular dilated eye examination at least annually (ADA, 2008).

Diabetic nephropathy is indicated by the presence of proteinuria above 500 mg in 24 hours or the presence of microalbuminuria in the urine (target albumin excretion of 30 to 299 mg/24 hours). Diabetes nephropathy has been implicated as the major cause of renal failure and represents the majority of dialysis patients in the world. Treatment is based on the prevention of progression. Like the other microvascular complications, it can be prevented or reduced by tight glycemic control (DCCT, 1993; Adler et al., 2003; Gross et al., 2005). Studies have demonstrated that treatment with angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs) reduces the risk of diabetic nephropathy (Gross et al., 2005). A good control of blood pressure in diabetes patients reduces the progression of microalbuminuria, especially with the use of ACE and ARBs (Gross et al., 2005; ADA, 2008).

Diabetic neuropathy is defined as a loss of pain sensation in the lower extremities and subsequently, can lead to peripheral nerve dysfunction, increased infection and joint dysfunction (ADA, 2007). Peripheral neuropathy in diabetes has many forms, such as sensory, multifocal and autonomic neuropathies. Amputation usually arises after foot ulceration, which refers to diabetic neuropathy (Boulton et a.l, 2005). Neurological dysfunction refers to diabetic autonomic neuropathy and its clinical manifestations are gastroparesis, constipation, diarrhoea, bladder dysfunction, erectile dysfunction, tachycardia, silent ischemia and sudden cardiac death (Boulton et al., 2005; ADA, 2007). The primary goal of treatment is to relieve the symptoms and prevent the progression of neuropathy, which could be achieved by controlling the blood glucose level. Diabetic patients should be educated more regarding diabetes self-care (ADA, 2007). To date, there is no specific medication for treating diabetic neuropathy, but some drugs are recommended to treat the symptoms of

diabetic neuropathy. These include metoclopramide for gastroparesis and amitriptyline, imiprimine, paroxetine and citalopram which have been recommended to relieve pain (Fowler, 2008).

2.6 Knowledge of diabetes among health care professionals

The studies on health care providers' knowledge on diabetes is more difficult to obtain since there are only a few studies on the topic throughout the world. Most studies evaluate patient knowledge on diabetes rather than the knowledge of health care providers. Moreover, the studies on health care knowledge are usually more specific, such as on diabetic nutrition or exercise (Tay et al., 2007)

2.6.1 General knowledge on diabetes among health care professionals

Previous studies on the level of health care providers' knowledge on diabetes have shown a great variation in their results. Most studies have found that health care providers have low knowledge on diabetes care (O'Brien, 2003; Chen et al., 2004; Tay et al., 2007; Derr et al., 2007; Torres et al., 2010). In addition, most reports do not address the effect of knowledge on patient outcome, which is one of the objectives of the current study. El-Deirawi and Zuraikat (2001) conducted a non-experimental descriptive design among registered nurses in Western Pennsylvania. The study aimed to assess the registered nurses' actual and perceived knowledge on diabetes in a community hospital and care home. The study used the Diabetes Basic Knowledge Test (DBKT) questionnaire and Diabetes Self Report Tool (DSRT) developed and validated by Drass et al. (1989). This questionnaire was specifically developed to study nurses' knowledge on diabetes. The DBKT consisted of 45 questions, while the DSRT contained 22 statements. The questionnaire was sent to 169 nurses working in a hospital and 60 nurses in a nursing home. The number of