Diabetes Mellitus in Saudi Arabia: Challenges and possible solutions

Conference Paper · November 2015

CITATIONS
0

READS
1,846

1 author:

Asirvatham Alwin Robert
Prince Sultan Military Medical City
126 PUBLICATIONS **1,414** CITATIONS

SEE PROFILE

Send Orders for Reprints to reprints@benthamscience.ae

Current Diabetes Reviews, **2016,** *12,* **1-6**

Type 2 Diabetes Mellitus in Saudi Arabia: Major Challenges and Possible Solutions

Asirvatham Alwin Robert, Mohamed Abdulaziz Al Dawish, Rim Braham, Maha Ali Musallam, Ayman Abdullah Al Hayek and Nasser Hazza Al Kahtany

Department of Endocrinology and Diabetes, Diabetes Treatment Center, Prince Sultan Military Medical City, Riyadh, Saudi Arabia.

A. Alwin Robert

Abstract: The World Health Organization has ranked Saudi Arabia as having the second highest rate of diabetes in the Middle East (7th highest in the world) with an estimated population of 7 million living with diabetes and more than 3 million with pre-diabetes. This presents a pressing public health problem. Several challenges in diabetes management need to be tackled in Saudi Arabia, including the growing prevalence (chiefly among children and young adults), micro-and macrovascular complications, lifestyle changes, late diagnosis, poor awareness and high treatment costs. Over the last two decades, the Saudi population saw an increase in the expenses in healthcare and treatment of diabetes by by more than 500%. In 2014, the health care budget was 180 billion (Saudi Riyal) of which 17 billion was spent on all Saudis, with an approximate 25 billion on the entire Saudi diabetic population. This implies that the direct expense of diabetes is costing Saudi Arabia around 13.9% of the total health expenditure. Therefore, unless a comprehensive epidemic control program/multidisciplinary approach is stringently enforced, the diabetes mellitus burden on Saudi Arabia will probably increase to very serious levels. It is crucial to implement improved health and health-related quality of life of to those with diabetes, thus minimizing the social and personal expenses for diabetes care in Saudi Arabia. In this study we discuss the significant and major threats posed by diabetes mellitus to the Saudi population and recommend essential possible solutions to delay/prevent this formidable issue.

Keywords: Type 2 diabetes, Epidemiology, Diabetes complication, Self-Management, Healthcare, Saudi Arabia.

INTRODUCTION

Diabetes Mellitus (DM) has been dubbed the 21st century's prime healthcare challenge across the globe, by the World Health Organization (WHO) and the International Diabetes Federation (IDF). Diabetes related complications and mortality also generate social and economic challenges that seriously impact the lives of individuals, families, businesses, and the entire society [1]. It also places a heavy burden on individuals and health care systems worldwide. In 2011, diabetes related deaths were around 4.6 million globally and a minimum of US$ 465 billion was utilized in healthcare expenditures, an equivalent of 11% of the total healthcare expenditure in adults [2]. A recent study from Saudi Arabia revealed that out of the allocated 180 billion Riyals (for health care in Saudi Arabia), 17 billion Riyals cover all Saudis, and approximately 25 billion for the entire diabetes population in the country [3]. Diabetes thus directly costs around 13.9% of the total health expenditure in Saudi Arabia. If the undiagnosed population is included in the treatment pool, the cost would soar to 27 billion Riyals. Assuming that individuals with glucose intolerance (pre-diabetes) progressed at the current rate, the total cost would sky rocket to 43 billion Riyals. The projection post the 2014 Saudi census estimates the total population of the country to be about 20 million Saudis and 9.5 million non-Saudis. Hence, these estimates incurred to treat diabetes would be 25, 39.8, and 63.4 billion Riyals for the total population if it is assumed that the non-Saudis and Saudis experience the same disease patterns [3]. Significantly it must be noted that over the last two decades, healthcare expenditures incurred by those with diabetes rose by more than 500%. In 2010, on average, those suffering with diabetes have borne medical healthcare expenditures ten times more ($3,686 vs. $380, 21% of the total healthcare budget) than those without diabetes [4, 5]. Therefore, it becomes imperative to improve the health and related quality of life outcomes, thereby decreasing the social and personal costs of the diabetes-inflicted population. Also, in Saudi Arabia, diabetes has reached crisis levels. Such a situation cannot afford any further delay in action. Besides, the human despair and distress caused by diabetes are intolerable and indefensible. If ignored, the rise in the diabetes rates, in the future, in Saudi Arabia could reach proportions similar to the ethnic populations like the Pima Indians, among whom nearly 50% of the adult population are diabetic [6]. Therefore, it is crucial for Saudi Arabia to have credible data on the trends in DM prevalence and its likely projections in the future. These data are highly essential to ensure proper health policy planning and resource distribution for the prevention and control of DM. This review reports the important and major demands made by DM

*Address correspondence to this author at the Department of Endocrinology and Diabetes, Diabetes Treatment Center, Prince Sultan Military Medical City, P.O. Box 7897, Riyadh 11159, Saudi Arabia; Tel: +966 5 020 48 321; Fax: +966 1 291 2224; E-mails: aalwinrobert@gmail.com, maldawish@psmmc.med.sa

1573-3998/16 $58.00+.00

among the Saudi population and suggests critical and promising solutions to delay/prevent this devastating health issue.

METHODS

With the help of a senior researcher a literature search was done in the archives of the National Library of Medicine/PubMed as well as the Ovid Medline databases. General search engines were also employed and non-peer reviewed professional and specialist guidelines and workshops on diabetes mellitus websites only in English and Arabic were accessed. We selected the articles were by reviewing their titles and abstracts along with the additional references from the lists mentioned in selected articles.

1. MAJOR CHALLENGES

1.1. Rising Prevalence of Diabetes and Pre-diabetes

Sustained monitoring of the frequency and occurrence of diabetes are major issues challenging the Saudi health care division. According to the WHO, Regional Office for the Eastern Mediterranean, six out of the ten countries having the highest prevalence of diabetes in the world are in the Middle East: Bahrain, Kuwait, Lebanon, Oman, Saudi Arabia and the United Arab Emirates [7]. In 2011, the IDF statistics for type 2 diabetes mellitus (T2DM) revealed an estimated 9.1% from the Middle Eastern North African (MENA) populations with the disease (32.8 million). Assuming that this trend continues, the IDF projection is that by 2030, the diabetes population in the MENA region will nearly double, touching 59.7 million [2, 8]. Diabetes prevalence in Saudi Arabia has reached alarming proportions. More than 25% of the adult population has diabetes, a proportion that is predicted to more than double by 2030. In fact, half the population above 30 years of age is prone to diabetes [9].

The high prevalence of diabetes in Saudi Arabia has been clearly shown to represent a major clinical and public health problem. According to prior findings of Saudi studies, the lowest prevalence of diabetes was 2.5 % among 1387 males surveyed in Al-Kharj area (in 1982); the highest prevalence (30%) was observed in patients surveyed at a primary care clinic (in June 2009) [10]. Another study reported that Saudi Arabia was right at the top in terms of overall prevalence with 17,817 cases per 100,000 people (in 2013), more than twice the report of China's 6,480 per 100,000 and that of the United States of 6,630 per 100,000 [11]. A recent publication (in 2014) revealed that abnormal glucose metabolism has reached epidemic proportions, with more than half the Saudi population age ≥30 years being diagnosed as either diabetic (25.4%) or pre-diabetic (25.5%) [12]. Also, 40.3% of the diabetic patients were blissfully unaware of their disease - and this is one of the highest ever reported percentages on a global scale [12]. A majority of the studies reviewed revealed that the prevalence of diabetes was increasing with age among the Saudi community, more prevalent among the males than females. The most recent study (in 2015) reported that the diabetes had increased ten-fold over the past four decades in the Saudi community. Also, the prevalence of diabetes was high in the 30-39 age group (between 12-20% i.e. almost 1 million people) [9].

1.2. Rising Prevalence Among Youth

Based on the latest statistics released by the National Information Center at the Ministry of Interior and by the Saudi Press Agency, around 67% of the Saudi population is younger than 30 years of age while at least 80% are below 40 years. Till very lately, T2DM was typically understood as a disease striking the middle-aged and elderly populations. Although it still remains true that this age-group is at a higher risk than the younger adults, mounting evidence reveals that the onset of the disease in those below 30 years is becoming increasingly common. Also, in the past, type 1 diabetes was the predominant type occurring in children; but for the last 20 years (mainly the year after 2000), T2DM, recognized by its different etiology, is forging into the lead, emerging with a new entity called '*double diabetes'* [13-15]. The International Diabetes Federation has issued a stringent warning that unless health habits are immediately modified 50% of the Saudis will be diabetic by 2030. Also, 3 million (18%) Saudi children are overweight or obese, forming a category most susceptible for diabetes [16].

While type 1 diabetes continues to be the most prevalent form of the disease in children globally, it is possible that T2DM will be the leading form within ten years, in many countries [17]. Among the Japanese children, it has already become more common than type 1 diabetes, accounting for 80% of the childhood diabetes [17]. In Saudi Arabia, the onset age of T2DM is normally low; also, now this type of diabetes is being identified more frequently in children. The earlier studies from Saudi Arabia reported that many young adults are being diagnosed with this destructive disease [10]; therefore, it has been recommended that every Saudi above 30 years or more should be screened for both T2DM and pre-diabetes to comprise the disease. The American Association of Clinical Endocrinologists has also suggested that high-risk adults undergo annual screening from age 30 onwards [18].

1.3. Lifestyle Related Risk Factors

The main factors driving this epidemic are the demographic changes with longer life expectancy and lifestyle changes resulting from rapid urbanization and industrialization [4]. Several researches have revealed that a healthy lifestyle can significantly reduce the risk of T2DM, and/or delay its onset in the genetically susceptible groups [9,19]. Further, diabetes can be more effectively controlled when patients intentionally choose to maintain healthy lifestyles. The most significant risk factors linked with T2DM, apart from a family history of diabetes, includes physical inactivity and obesity [19,20]. Also, among the Saudi population, the consumption of vegetables and fruits is infrequent with greater preference for meat and heavy carbohydrates, primarily dates, in their main diet. Considered in the context of the country's current wave of westernization, such dietary imbalance has progressively deteriorated to include high carbonated drinks and processed food [4].

Over the last four decades, Saudi Arabia has experienced rapid economic growth accompanied by a remarkable increase in the standards of living and implementation of a 'Westernized' lifestyle, characterized by unhealthy dietary choices, and limited physical activity [19]. The increased

prevalence of T2DM was also observed during the same period, which is a spin-off from the striking lifestyle changes, besides the genetic predisposition of the Saudis to diabetes, and their high predominance of consanguineous marriages [19]. Significantly, it must be noted that several recent reports have documented a strong association between increased per capita income and economic development on the drastic rise in diabetes prevalence [4-5]. There is an evidence that urbanization and economic development in emerging economies, such as China, have also led to a drastic decline in overall and occupational physical activity. In West Africa, urbanization have enabled physical inactivity and diabetes is a major health concern [4-5]. The great benefits of weight loss and physical activity strongly imply that lifestyle modification should be the first decision taken to prevent or delay diabetes. The goals recommended include moderate weight loss (5–10% of body weight) and modest physical activity (30 min daily) [21, 22].

1.4. Obesity

Obesity and overweight, which are directly connected with lifestyle, largely increase the risk of developing T2DM in Saudi Arabia. Both are modifiable risk factors for diabetes [19-23]. One of the studies in Saudi Arabia reported that almost 50% of the children in the Eastern province sample showed a BMI above the 85th percentile. This made it amply clear that Saudi children started to gain weight between 5 and 9 years of age, by which time 21% of children were overweight and 21% were obese. Unfortunately, their weight gain continued to increase into the adolescent years [24].

The Global Burden of Disease study (2010) demonstrated that high BMI was the major risk factor for the disability-adjusted life years in Saudi Arabia. Prior studies in Saudi Arabia too reveal an increasing tendency in the prevalence of obesity. Data recorded from the late 1980s through the mid-1990s show an average 20% prevalence of obesity, ranging from a low of 13.1% among men to a high of nearly 26.6% among the women. However, all prevalence assessments from 1995 onwards are higher than 35% [24-26].

A higher occurrence of obesity in diabetics is a well-recognized fact, with 80% to 90% of those diagnosed with T2DM being obese [10]. Prior studies in Saudi Arabia also imply an increasing trend in the frequency of obesity. Also, when the prevalence of obesity among the diabetic patients was studied in various provinces of Saudi Arabia, the results from these studies revealed significantly higher prevalence overweight and obesity rates among the diabetics than non-diabetics, with relatively higher rates observed among the female diabetic patients [26,27,28].

1.5. Delayed Diagnosis

From the research it is evident that T2DM often develops over many years and the individual may be asymptomatic until complications surface. This implies that often many chances are often lost for the treatment and control of diabetes and prevention of the debilitating complications. If the high-risk individuals are identified early, appropriate intervention measures including dietary changes and increased physical activity can be taken, thus helping to prevent, or at least delay, the onset of diabetes [29, 30]. Studies also revealed that the diagnosis of DM by a physician was usually delayed, with a median delay of greater than two years. In fact, some remained undiagnosed for more than seven years. The great number of undiagnosed diabetes threatens to result in an increased frequency of diabetes-related complications, as any delay in diagnosis and treatment gives scope for complications to occur, and will culminate in greater healthcare expenses in the future [31]. The IDF has stated that presently there is a high percentage of individuals with undiagnosed diabetes in Saudi Arabia [29].

As diabetes is a relatively asymptomatic disease and also because of the poor awareness regarding it among the Saudi population, delayed diagnosis of the disease is often the case, by several years sometimes. Thus, many patients could already have developed vascular complications when they are diagnosed with diabetes. It is therefore strongly recommended that opportunistic screening be performed by the health care providers, in the government and nongovernment sectors, for the non-diabetic subjects who report for a medical checkup.

2. POSSIBLE SOLUTIONS

2.1. Delay or Prevention

As the rates of prevalence and incidence of T2DM are rather high among the Saudi population, the prevention/delay of diabetes is highly essential [9]. WHO propounds that 80% of T2DM is preventable by simple cost-effective strategies. Also, several research works in Saudi clearly demonstrate that lifestyle changes, with respect to a healthy diet, increased physical activity, weight loss and non-smoking can lower the risk of developing T2DM. They can also be effective in preventing or delaying this disease [19, 32,33].

The present estimates in Saudi Arabia revealed that with the present burden of pre-diabetes, very soon there will be a large number of individuals with diabetes. However, there is also the high possibility of being able to reverse this trend by making wiser choices regarding lifestyles and medications. Several studies reported that by prescribing metformin (the most common prescription medication for diabetes in Saudi Arabia) for pre-diabetic individuals, the T2DM can be decreased / prevented [3, 34, 35]. In its consensus statement, issued by the American Diabetes Association (ADA), it has recommended the early detection and prevention treatment in high-risk individuals [36]. The ADA recommends that individuals having both IFG and IGT and one additional risk factor (age <60 years, BMI $\geq$35 kg/m^2, family history of diabetes in a first-degree relative, elevated triglycerides, reduced HDL cholesterol, or A1C >6.0%) should be considered for metformin treatment besides lifestyle modification [35,36].

2.2. Education and Awareness

Diabetes can be successfully managed, not merely with medicines and medical treatments. Awareness and education regarding the nature of this condition and how to manage it are equally important steps. Today, there is clear evidence from several studies on the effects of diabetes education on the overall improvement in diabetic care, including a decrease in hospitalizations [17, 30,37]. A trial research group

on diabetes control and complications identified a significant correlation between glycemic control and a decrease in the diabetic-related complications through intensive education programs. Hence, it is evident that the education of diabetes care plays an important role in the prevention and treatment of the disease-related complications and disabilities [38].

Recent research studies revealed that the less educated individuals face higher risks, possibly because of their poor awareness levels regarding the disease and the factors causing it. Therefore, more emphasis should be placed on conducting health education and media campaigns focusing upon the less educated sectors of the population to facilitate an increased awareness of the risk factors of diabetes. Expenses associated with diabetes over a lifetime could be decreased by 8% if those with T2DM were given access to adequate patient education [16]. Also, most often health education is imparted mainly in the primary health care centers, and less often in the government hospitals. Further, diabetes patients are more open to accepting health education than the non-diabetic ones visiting the health facilities [16]. A correct understanding of diabetes, its risk factors and complications will significantly impact treatment outcomes. In fact, when people with diabetes are educated about the disease their HbA1c levels and associated complications have been known to decrease. An education program for Saudi nationals revealed improved glycemic control irrespective of gender, age and educational level [39]. In yet another study in Saudi Arabia a six-month diabetes education program produced noteworthy enhancement of the patients' dietary plan, physical exercise, self-monitoring of blood glucose (SMBG), HbA1c, faithful adherence to medication and depression [30].

It is important to note here that the IDF has estimated that around 183 million people are quite unaware that they suffer from diabetes. Interestingly, even some policy makers at international and national levels, have very poor awareness regarding the public health and clinical importance of diabetes [9]. In a recent research from Saudi Arabia it was found that nearly 40.3% of diabetic patients had been unaware that they had DM [40]. Another study from Saudi Arabia revealed that the intensive education training given by a professional healthcare team was an effective method which reinforced the need for applying such educational programs as a mandatory requirement for metabolic control in diabetic patients [41]. Further, in one report the average diabetes knowledge score among the Saudi population was 67.4%, whereas the scores for general knowledge about this disease, risk factors, symptoms and complications were 71.1, and 47.7%, respectively. Also, the males were nearly twice as more likely to be knowledgeable regarding the disease than were the females [42]. Nearly two-thirds of the patients believed that diabetes was a curable disease. Further, the study revealed the grave ignorance of diabetes-related secondary complications. Only 19.1% of the participants knew about the nature of this disease from the healthcare professionals. This is a clear indicator that greater efforts are called for to educate the general population on diabetes and the complications associated with it [42].

2.3. Self-care Management

The Veterans Health Administration (VHA) and the American Diabetes Association (ADA) has emphasized the significance of self-management skills in diabetes care. The patients' ability to understand and perform their individual treatment protocols is crucial to the control of DM. Self-management must be promoted by the treating institution which needs to develop a statement of short-term and long-term goals to suit each patient's individual needs. These goals should include the patient's medication use, nutrition plan, lifestyle, requirement monitoring, annual comprehensive dilated eye examination, and podiatry care [43,44]. The management plan should be given in writing with patient input as well as from the family and health care team. Self-management education of diabetes and the continued diabetes support must necessarily be central constituents of the management plan [45].

2.4. Collective Action

As the impact of diabetes is felt society as a whole the solutions and responses must necessarily be multi-sectoral and coordinated [46]. As the difficulty precipitated by diabetes continues to increase, the need for more combined and efficient efforts to enhance the health and well-being of Saudis becomes a vital requirement. Organized public responses and research studies have concurred with the same. The IDF also calls for participation by governments, businesses, the United Nations and international bodies, civil society, health professionals, researchers, philanthropic organizations and the general public to cooperate in a coordinated movement to overcome diabetes and the related non-communicable diseases [46]. Although public and private organizations across Saudi have put in great effort to positively impact the spiraling diabetes crisis, it is evident that much more needs to be done to raise the level of action in the country and around it [46]. Using a committed network of stakeholders, the interventions need to be tailored to suit the country's needs culturally, as well as engage all the sectors of society to create an immediate and sustainable impact on the whole population. Also, multidisciplinary care teams including nurses, clinicians, dietitians, psychologists, physiotherapists and health educators may offer more intensive counseling and thus raise the motivation levels of the individuals to persevere and reach the goals.

2.5. Comprehensive Evaluation

Strong evidence is available that a comprehensive and organized evaluation of patients with diabetes during each clinic visit will give long-term benefits and even prevent this dreaded disease. The American Diabetes Association [47] recently recommended that a full and thorough medical evaluation must be done during the initial visit to identify and classify the diabetes related complications, as well as review the earlier treatment and risk factor control in individuals with established diabetes. Also, assistance was to be given to formulate a management plan and the foundation for continuing care. Emphasis on the components of comprehensive care will enable the health care team to favorably manage such patients. Therefore, in this study we advocated application of the ADA 2015 guidelines for all Saudi dia-

betic clinics to delay/prevent the disease and its complications [47].

2.6. Research

Exhaustive researches on diabetes over the years have greatly enhanced our understanding of the pathophysiology and effect of the disease, as well as introduced several advanced and improved therapies. Implementing the outcome of this research has resulted in the reductions of chronic complications and mortality in people with diabetes; however, literature related to diabetes in Saudi Arabia is quite limited. While most of the literature and studies have paid attention to the prevalence of diabetes throughout the region, there has been less focus on other areas of the research such as the aspects of diabetes education and self-care management [9]. Therefore, it is imperative for innovative research, associated evidence-based care and prevention to plan for appropriate management programs. The primary prevention tactics need to be effectively implemented to control the soaring costs of diabetes-related health care and for suitable allotment of health resources for this distressing disease.

CONCLUSION

Diabetes prevalence seems to be growing higher in the Saudi population, posing a significant public health issue in the country. It is also a considerable challenge for all the health care providers and the health care system in the country. Most often diabetes can be prevented or delayed. Early diagnosis and sound management can enable people with diabetes to live longer, healthier and more productively. Health systems too can cut down on expenses if complications such as kidney failure, blindness and amputations can be avoided. Also, education and awareness are undeniably indispensable to achieve high self-management standards, an essential requirement for good diabetic control. Likewise, immediate implementation of a national prevention program to check diabetes and deal with the modifiable risk factors at the community level, centering on the high-risk groups, is the need of the hour. Also, if the correct policies, are implemented, coupled with commitment, investment and persistence, it is well within our reach to make a major change in handling diabetes for the present and future generations of Saudi Arabia and the other Gulf countries.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

ACKNOWLEDGEMENTS

Declared none.

REFERENCES

[1] McAdam Marx C. Economic implications of type 2 diabetes management. Am J Manag Care 2013; 19(8 Suppl): S143-8.

[2] International Diabetes Federation: Diabetes Atlas 5th edition. Brussels, Belgium: 2012. http: //www.idf.org/diabetesatlas

[3] Mokdad AH, Tuffaha M, Hanlon M, *et al*. (2015) Cost of Diabetes in the Kingdom of Saudi Arabia. 2014; J Diabetes Metab 6: 575. doi: 10.4172/2155-6156.1000575.

[4] Sherif S, Sumpio BE. Economic development and diabetes prevalence in MENA countries: Egypt and Saudi Arabia comparison. World J Diabetes. 2015; 6: 304-11.

[5] Alhowaish AK. Economic costs of diabetes in Saudi Arabia. J Family Community Med.2013; 20(1): 1-7.

[6] Alzaid A. Diabetes: a tale of two cultures. Br J Diabetes Vasc Dis. 2012; 12: 57.

[7] World Health Organization Regional Office for the Eastern Mediterranean, 2015 http: //www.emro.who.int/health-topics/diabetes/index.html

[8] Badran M, Laher I.Type II Diabetes Mellitus in Arabic-Speaking Countries. Int J Endocrinol. 2012; 2012: 902873.

[9] Al Dawish MA, Robert AA, Braham R, *et al*. Diabetes Mellitus in Saudi Arabia: A Review of the Recent Literature. Curr Diabetes Rev. 2015 Jul 23. DOI: 10.2174/1573399811666150724095130.

[10] Alqurashi KA, Aljabri KS, Bokhari SA. Prevalence of diabetes mellitus in a Saudi community. Ann Saudi Med. 2011; 31(1): 19-23.

[11] Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2015; 386(9995): 743-800.

[12] Al-Rubeaan K, Al-Manaa HA, Khoja TA, *et al.* Epidemiology of abnormal glucose metabolism in a country facing its epidemic: SAUDI-DM study SAUDI-DM. J Diabetes. 2015; 7(5): 622-32.

[13] Pozzilli P, Buzzetti R. A new expression of diabetes: double diabetes. Trends Endocrinol Metab 2007; 18(2): 52-7.

[14] Alberti G, Zimmet P, Shaw J, *et al.* Type 2 diabetes in the young: the evolving epidemic: the international diabetes federation consensus workshop. Diabetes Care. 2004; 27(7): 1798-811.

[15] Al-Rubeaan K. National surveillance for type 1, type 2 diabetes and prediabetes among children and adolescents: a population-based study (SAUDI-DM). J Epidemiol Community Health. 2015; 69(11): 1045-51. doi: 10.1136/jech-2015-205710.

[16] Diabetes the hidden pandemic and its impact on the Middle East and Northern Africa. Middle East and Northern Africa (MENA) Diabetes Leadership Forum, Dubai, 12–13 December 2010.

[17] Type 2 Diabetes Practical Targets and Treatments, Asian-Pacific Type 2 Diabetes Policy Group. World Health Organization, 2005.

[18] American Association of Clinical Endocrinologists. 2009.

[19] Midhet FM, Al-Mohaimeed AA, Sharaf FK. Lifestyle related risk factors of type 2 diabetes mellitus in Saudi Arabia. Saudi Med J 2010; 31(7): 768-74.

[20] Al-Mutairi RL, Bawazir AA, Ahmed AE, Jradi H. Health Beliefs Related to Diabetes Mellitus Prevention among Adolescents in Saudi Arabia. Sultan Qaboos Univ Med J. 2015; 15(3): e398-404.

[21] Laditka SB, Laditka JN. Active life expectancy of Americans with diabetes: risks of heart disease, obesity, and inactivity. Diabetes Res Clin Pract 2015; 107(1): 37-45.

[22] Colberg SR, Sigal RJ, Fernhall B, *et al*. Exercise and type 2 diabetes: the American College of Sports Medicine and the American Diabetes Association: joint position statement. Diabetes Care 2010; 33(12): e147-67.

[23] Bass R, Eneli I. Severe childhood obesity: an under-recognised and growing health problem. Postgrad Med J 2015.

[24] Al-Dossary SS, Sarkis PE, Hassan A, Ezz El Regal M, Fouda AE. Obesity in Saudi children: a dangerous reality. East Mediterr Health J. 2010; 16(9): 1003-8.

[25] Al-Othaimeen AI, Al-Nozha M, Osman AK. Obesity: an emerging problem in Saudi Arabia. Analysis of data from the National Nutrition Survey. East Mediterr Health J 2007; 13(2): 441-8.

[26] Memish ZA, El Bcheraoui C, Tuffaha M, *et al*. Obesity and associated factors--Kingdom of Saudi Arabia. Prev Chronic Dis. 2014; 11: E174. doi: 10.5888/pcd11.140236

[27] el-Hazmi MA, Warsy AS. Prevalence of overweight and obesity in diabetic and non-diabetic Saudis. East Mediterr Health J. 2000; 6(2-3): 276-82.

[28] Mugharbel KM, Al-Mansouri MA. Prevalence of obesity among type 2 diabetic patients in Al-khobar primary health care centers. J Family Community Med. 2003; 10(2): 49-53.

[29] Global Diabetes Plan 2011-2012, International Diabetes Federation. https: //www.idf.org/sites/default/files/Global_Diabetes_Plan_Final.pdf.

[30] Al Hayek AA, Robert AA, Al Dawish MA, Zamzami MM, Sam AE, Alzaid AA. Impact of an education program on patient anxiety, depression, glycemic control, and adherence to self-care and

medication in Type 2 diabetes. J Family Community Med. 2013; 20(2): 77-82.

[31] Samuels TA, Cohen D, Brancati FL, Coresh J, Kao WH. Delayed diagnosis of incident type 2 diabetes mellitus in the ARIC study. Am J Manag Care. 2006; 12(12): 717-24.

[32] Majeed A, El-Sayed AA, Khoja T, Alshamsan R, Millett C, Rawaf S. Diabetes in the Middle-East and North Africa: an update. Diabetes Res Clin Pract 2014; 103(2): 218-22.

[33] Sidawi B, Al-Hariri MT. The impact of built environment on diabetic patients: the case of Eastern Province, Kingdom of Saudi Arabia. Glob J Health Sci 2012; 4(4): 126-38.

[34] Alhreashy FA, Mobierek AF. Prescription Practice for Diabetes Management among a Female Population in Primary Health Care. Int J Family Med. 2014; 2014: 103853. doi: 10.1155/2014/103853

[35] Rhee MK, Herrick K, Ziemer DC, *et al*. Many Americans have prediabetes and should be considered for metformin therapy. Diabetes Care. 2010; 33(1): 49-54.

[36] Nathan DM, Davidson MB, DeFronzo RA, *et al*. Impaired fasting glucose and impaired glucose tolerance: implications for care. Diabetes Care. 2007; 30(3): 753-9.

[37] Jamal A, Khan SA, AlHumud A, *et al.* Association of Online Health Information-Seeking Behavior and Self-Care Activities Among Type 2 Diabetic Patients in Saudi Arabia. J Med Internet Res. 2015; 17(8): e196.

[38] The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. The Diabetes Control and Complications Trial Research Group. N Engl J Med. 1993; 329(14): 977-86.

[39] Uddin I, Ahmad TJ, Kurkuman AR, Iftikhar R. Diabetes education: its effects on glycemic control. Ann Saudi Med. 2001; 21(1-2): 120-2.

[40] Al-Rubeaan K, Al-Manaa H, Khoja T, *et al*. The Saudi Abnormal Glucose Metabolism and Diabetes Impact Study (SAUDI-DM). Ann Saudi Med 2014; 34(6): 465-75.

[41] Al-Shahrani AM, Hassan A, Al-Rubeaan KA, Al Sharqawi AH, Ahmad NA. Effects of diabetes education program on metabolic control among Saudi type 2 diabetic patients. Pak J Med Sci. 2012; 28(5): 925-930

[42] Mohieldein A.H, Alzohairy M.A, Hasan M. Awareness of diabetes mellitus among Saudi non-diabetic population in Al-Qassim region, Saudi Arabia. Journal of Diabetes and Endocrinology. 2011; 2 (2), pp. 14-19.

[43] West JD, Goldberg KL. Diabetes self-care knowledge among ooutpatients at a Veterans affairs medical center. Am J Health Syst Pharm. 2002; 59(9): 849-52.

[44] Sabbah KOA, Al-Shehri AA. Practice and perception of self - management among diabetics in Taif, KSA: Impact of demographic factors. Int J Med Sci Public Health. 2014; 3(3): 277-284.

[45] American Diabetes A. (3) Initial evaluation and diabetes management planning. Diabetes Care 2015; 38 Suppl: S17-9.

[46] A call to action on diabetes. International Diabetes Federation, November 2010. https: //www.idf.org/webdata/Call-to-Action-on-Diabetes.pdf.

[47] American Diabetes Association. Initial evaluation and diabetes management planning. Sec. 3. In Standards of Medical Care in Diabetes 2015. Diabetes Care 2015; 38 (Suppl. 1): S17–S19.

Received: November 28, 2015 Revised: January 18, 2016 Accepted: January 23, 2016