**Name of Journal: *World Journal of Diabetes***

**ESPS Manuscript NO: 23772**

**Manuscript Type: Review**

**Diabetes epidemic sweeping the Arab world**

Abuyassin B *et al.* Type-2 diabetes mellitus in the Arab world

**Bisher Abuyassin, Ismail Laher**

**Bisher Abuyassin, Ismail Laher,** Department of Pharmacology and Therapeutics, Faculty of Medicine, University of British Columbia, Vancouver, British Columbia V6T 1Z3, Canada

**Author contributions:** Abuyassin B conducted the literature search and prepared the manuscript, Laher I reviewed and edited the manuscript.

**Conflict-of-interest** **statement:** Authors have no financial conflicts of interest related to this work.

**Open-Access:** This article is an open-access article which was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

**Correspondence to: Dr.** **Ismail Laher**, Department of Pharmacology and Therapeutics, Faculty of Medicine, University of British Columbia, 2176 Health Science Mall, Medical Block C, Vancouver, British Columbia V6T 1Z3, Canada. [ilaher@mail.ubc.ca](mailto:ilaher@mail.ubc.ca)

**Telephone:** +1-604-8225882

**Fax:** +1-604-8226012

**Received:** December 16, 2015

**Peer-review started:** December 18, 2015

**First decision:** January 18, 2016

**Revised:** January 27, 2016

**Accepted:** February 16, 2016

**Article in press:**

**Published online:**

**Abstract**

The prevalence of type-2 diabetes mellitus (T2DM) has increased dramatically during the last 2 decades, a fact driven by the increased prevalence of obesity, the primary risk factor for T2DM. The figures for diabetes in the Arab world are particularly startling as the number of people with diabetes is projected to increase by 96.2% by 2035. Genetic risk factors may play a crucial role in this uncontrolled raise in the prevalence of T2DM in the Middle Eastern region. However, factors such as obesity, rapid urbanization and lack of exercise are other key determinants of this rapid increase in the rate of T2DM in the Arab world. The unavailability of an effective program to defeat T2DM has serious consequences on the increasing rise of this disease, where available data indicates an unusually high prevalence of T2DM in Arabian children less than 18 years old. Living with T2DM is problematic as well, since T2DM has become the 5th leading cause of disability, which was ranked 10th as recently as 1990. Giving the current status of T2DM in the Arab world, a collaborative international effort is needed for fighting further spread of this disease.

**Key words**: Diabetes; Arab world; Epidemiology; Etiology; Risk factors and complication

**© The Author(s) 2016.** Published by Baishideng Publishing Group Inc. All rights reserved.

**Core tip:** The Middle Eastern and North African region has the second highest rate of increases in diabetes anywhere in the world. We comprehensively review type-2 diabetes mellitus (T2DM) in adults and children from 22 Arab speaking countries by reviewing data published from 1980 to 2015; this allowed us to have a better view of the trends in the dramatic increases of T2DM impacting the Arabic region. We also discuss the etiology of this uncontrolled medical crisis and the most commonly reported complications in these Arab speaking countries. Finally, we highlight a number of crucial data that appear to be unavailable but which may be essential for a more comprehensive understanding of the diabetes epidemic sweeping the Arabian region.

Abuyassin B, Laher I. Diabetes epidemic sweeping the Arab world. *World J Diabetes* 2016; In press

**RESEARCH METHODS**

We undertook a search of the medical literature using the PubMed, Embase and Ovid databases for articles published in English language between 1980 and 2015, and included the following keywords: diabetes, Arab world, epidemiology, etiology, risk factors and complication, or their corresponding MeSH term synonyms. Among 22 Arabic countries, a total of 2347 papers were identified and screened by title and/or abstract (Figure 1). To ensure that we included the highest number of epidemiological studies from each country, we did not set any limitations on the study design in our exclusion criteria. However, animal or genetic studies, studies not relevant to T2DM, studies on the effects of treatment, and non-primary data such as review articles or adherence studies were excluded (Figure 2). A total of 85 studies were added in the article and were reviewed in full. Among these, 3 studies were concerning Arab immigrants in different countries not listed in Figure 1, and 1 study (not PubMed indexed) was obtained from the references of other paper.

**INTRODUCTION**

Diabetes mellitus affects more than 382 million people around the world, of whom 90% are diagnosed with type-2 diabetes mellitus (T2DM)[1]. The prevalence of T2DM has increased dramatically during the last 2 decades[1]. The Arab world is not immune from this epidemic in the prevalence of T2DM. In fact, the Middle Eastern and North African region has the second highest rate of increase in diabetes globally, with the number of people with diabetes is projected to increase by 96.2% in 2035[1]. Having T2DM increases the burden for both patients and their caregivers, and of particular concern for Arab governments is the large economic burden of diabetes in terms of cost of treatment, management of complications, disability and loss of productivity[2-4]. The factors associated with T2DM seem more pronounced in the Arab world. Although genetic risk factors can’t be ruled out in the context of T2DM in the Arab world, factors such as obesity, rapid urbanization and lack of exercise are key determinants of the rapid increase of the rate of T2DM among the Arab world[5].

The unavailability of an effective program to contain the dramatic rise in T2DM in the Arab world has led to a serious development in the disease’s course, where current data indicates that T2DM can’t be ruled out in children less than 18 years old. Children diagnosed with T2DM come from all countries in the Arab world and obesity is a hallmark feature in this age group[6,7].

This review will initially address the epidemiology of T2DM in the Arab world, followed by the etiology of the disease, complication and risk factors of T2DM, and finally will discuss some suggestions related to of research on T2DM in the Arab world.

**EPIDEMIOLOGY**

***Adults***

Based on the International Diabetes Federation (IDF) estimates from 2013[1], three countries from the Arabic world are among the top 10 countries worldwide for the prevalence of T2DM; these countries are Saudi Arabia, Kuwait and Qatar. The data obtained from each country in the Arabic world reports variation regarding prevalence of T2DM. However, differences in reported prevalence of T2DM within each country can be attributed to the study design, population and diagnostic methods used to obtain these data. The data clearly confirms that the prevalence of T2DM has increased dramatically during the past two decades. For example, studies from Saudi Arabia in the 80’s indicated that prevalence of T2DM was between 2.4%-4.3%[8,9], while recent a study in Saudi Arabia indicated a dramatic increase in the rate of T2DM with an estimated prevalence of 25.4%[10]. This pattern of massive increases in the rate of T2DM is similar for Iraq, Oman and other countries within the Arabic world (Table 1).

***Children and adolescents***

Due to the recent recognition of T2DM during childhood, limited data are available worldwide. This unusual age-related disease has become a focus of attention for medical organizations around the world. A recent analysis showed a significant increase of 30.5% in the prevalence of T2DM among children and adolescents aged 10-19 years old in United States from 2001 to 2009[11]. The international society for pediatric and adolescents diabetes has published comprehensive guidelines for screening, diagnosis and treatment of T2DM in children and adolescents[12].

Not surprisingly, data from the Arab world show similar figures for childhood T2DM. Perhaps more worrying is that recent data from Saudi Arabia reports an age-specific prevalence of 1 per 1000 for T2DM in children less than 18 years old[7], which was similar to the highest prevalence found in specific groups (American Indian and African American) in United States[12]. Additional findings on childhood T2DM are summarized in Table 2.

**RISK FACTORS**

A number of risk factors could account for the uncontrolled rise in T2DM in the Arab world, with genetic factors likely to play an important role. However, a number of modifiable risk factors such as obesity, rapid urbanization and its associated changes in dietary habits and lack of physical activity are also important determinants in the etiology of T2DM. Other considerations such as multiple pregnancies and a lack of health education may be unique challenges in the diabetes epidemic in the Arab world.

***Obesity***

Obesity represent a large component in the pathogenesis of T2DM[13], and is by far the primary risk factor for the increased prevalence of T2DM globally[14]. Obesity not only worsens the prognosis of T2DM, but obese diabetics suffer higher rates of microvascular complications and mortality[15-18]. Obesity-related T2DM has been investigated in several countries in the Arab world. In Saudi Arabia, a study of 14252 diabetic patients reported that more than half of the obese diabetics had poor glycemic control[19]. Additionally, the first national health survey in Kuwait indicates that 48% obese males and 77% obese females were also diabetics[20], confirming a significant association between obesity and diabetes [odds ratio (OR) of 2.87] in the Kuwaiti population. In Oman and Qatar, 60.1% and 59.7% of the diabetic patients were obese respectively[21,22]. The average body mass index (BMI) in Palestinian and Lebanese diabetics was 33.7 kg/m2 and 30.8 kg/m2 respectively[23,24]. Nevertheless, obesity is significantly associated with diabetes even in some Arab countries such as Sudan and Tunisia where the prevalence of diabetes can be described as relatively low - the relative risk of developing T2DM was 1.74 (95%CI: 1.32-2.28) in obese Sudanese subjects and the OR of having T2DM was 1.61 (95%CI: 1.34-1.93) in obese Tunisians[25,26].

A recent analysis of 46 Muslim countries (where Muslims represent > 50% of the population) estimated the prevalence of overweight subjects reported that in the Eastern Mediterranean region, females were more likely to be overweight than males (42.1% *vs* 33%)[27]. Interestingly, those living in Arab countries were 2.92 (95%CI: 2.86-2.97) times more likely to be overweight compared to those living in non-Arab Muslim countries.

***Rapid urbanization***

Urbanizing of many rural areas within the Arab world carries with it many advantages in term of access to improved medical services, access to education and other “modern” conveniences. There are significant differences in the rate of T2DM between rural and urban communities. For example, an early study in Saudi Arabia found that the prevalence of T2DM in urban communities was 12% and 14% in males and females respectively, which was nearly double the prevalence of T2DM in males and females residing rural areas (7% and 7.7% for males and females respectively)[28]. Another study in Oman indicated that urban residence was significantly associated with T2DM (OR = 1.7, 95%CI: 1.4–2.1), with the prevalence of T2DM was 17.7% and 10.5 in urban and rural areas respectively[21]. Moreover, a systematic review of the prevalence of T2DM in North Africa found that the prevalence of T2DM ranged from 2.6% in rural Sudan to 20.0% in urban Egypt[29].

***Dietary habits***

The Mediterranean diet is considered to be one of the healthiest food options available, as it contains a variety of fruits, vegetables, grains and olive oil. In fact, several studies have shown significant reduction in the rate of T2DM with the Mediterranean diet[30,31]. However, one is unlikely to obtain the health benefits of the Mediterranean diet without proper adherence, which may be a common habit in most of the Eastern Mediterranean countries. In a comparative risk assessment analysis, data from the United Food and Agricultural Organization was used to estimate the dietary intake of 20 countries in the Middle East and North Africa[32]. These estimates were used to provide a country specific estimates of cardio-metabolic disease mortality secondary to 15 different dietary and metabolic risk factors. This analysis shows that there is suboptimal intake of the “protective” diets (*e.g*., fruits, vegetables and sea food), and greater consumption of “harmful’ diets (*e.g*., processed meat and trans fatty acids). These results were reflected in the cardio-metabolic disease mortality rate, where non-optimal BMI was the second leading metabolic risk factor for cardio-metabolic disease mortality, accounting for 21% of all cardio-metabolic mortality risk factors, followed by high fasting blood glucose (> 5.3 mmol/L) which accounted for 17% of all cardio-metabolic disease deaths.

***Sedentary life style***

Numerous studies confirm that physical activity reduces the incidence and/or severity of T2DM[33-35]. Six years of leading an active life coupled with a healthy diet can reduce the incidence of T2DM by 43% in subjects with impaired glucose tolerance followed for 20 years[36]. Another meta-analysis shows that exercise training reduces glycosylated haemoglobin (HbA1c) by 0.66% in type-2 diabetic patients, a percentage that should substantially reduce the complications of T2DM[37]. Not surprisingly, a sedentary life style is one of the most important modifiable risk factors in the Arab world, specifically when comparing the prevalence of highly active subjects in the Arab world with the global data. Among 52746 subject from 20 countries included to study the prevalence of physical activity, 8 countries reported that more than 50% of the population are highly active based on the international physical activity questionnaire[38]. Saudi Arabia, which was the only country from the Arab world that was included in their analysis, is reported to have 26.2% of their population as being highly active. More recent data came from a study over 10 Eastern Mediterranean countries indicating that the highest level of physically active adolescents were in the Emirates (23.9%), while the lowest was in Egypt (9.2%), giving an overall prevalence of physically active adolescents in the Eastern Mediterranean countries of 19%[39].

***Other factors***

Several factors can explain the unrestrained raise in the rate of T2DM in the Arabian area. Some are attributed to the Eastern cultural heritage from a hundred of years ago, such as multiple pregnancies and cultural barriers for women’s physical activity. However, despite no changes in the traditional risk factors for T2DM in Arabian area, there is an alarming increase in the prevalence of diabetes, particularly within the last two decades - suggesting that recent lifestyle changes may have greater effect on this crisis. The global change impacts the Arab nations even more dramatically than elsewhere: temperatures that are already scorching on a regular basis are now increased (higher temperatures for longer periods), even more increases in polluted and dusty air. These conditions combine to further discourage many people - regardless of age or gender - from any kind of outdoor activity. The situation is made even worse by the political instability in many of these countries, which affects access to healthy food and medical care.

**COMPLICATIONS**

According to the World Health Organization (WHO), diabetes is the 8th leading cause of death in the world[40]. Data published specifically from the Arab world shows a similar trend to that available globally. A recent analysis indicates that diabetes represents the 5th leading cause of death in the Arab world in 2010, compared to it being the 11th leading cause of death in 1990[41]. Living with T2DM is troublesome as well, as diabetes is the 5th leading cause for the disability-adjusted life years in high income Arabic countries in 2010, compared to it being ranked as the 10th reason in twenty years earlier[41]. The studies summarized in Table 3 summarize the most recent data on the prevalence of common complications (retinopathy, nephropathy, neuropathy and peripheral vascular diseases) in diabetic patients from the Arab world.

**FUTURE DIRECTIONS**

The high prevalence of T2DM in Arab nations offers an opportunity to better understand the disease and its treatment. Unfortunately, current research in the Arab nations does not match the level of this health crisis in the area. Large portions of critical data information are unavailable in many countries from the Arab world. For instance, predicting the prevalence of T2DM statistically could crucial in formulating a strategic plan for combating the disease, which requires comprehensive knowledge about its current burden, for which data is available only from Tunisia and Saudi Arabia. The Tunisian study revealed that the prevalence of T2DM in Tunisia will reach 26.6% in 2027[42]. Moreover, it predicts that a 20% reduction in obesity and smoking will yield in a 3.3% reduction in T2DM by 2027. On the other hand, the Saudi study indicates that the prevalence of T2DM in Saudi Arabia could reach 44.1% in 2022, a figure which differs significantly from IDF estimates[43].

It would be important to apply the recommendations on physical activity discussed at conference on Healthy Lifestyles and Non-Communicable Diseases in the Arab World and the Middle East, also called the “Riyadh declaration”[44]. To successfully implement the recommendations of the Riyadh declaration, novel research is needed to determine the social determinants for developing diabetes in the Arab world. For instance, a population based longitudinal cohort of 5124 diabetes-free participants in United States revealed that people residing neighborhoods with fewer opportunities for physical activity have nearly double the risk of developing T2DM[45].

Considering the epidemic nature of obesity and T2DM in the Arab world, studies on the ethnic-specific obesity cut-off points for the risk of diabetes are certainly necessary for peoples of the Arab and North African populations. For example, the risk of diabetes increases with BMI values greater than 25 kg/m2 for South Asians, at 27 kg/m2 for African-Caribbeans and at 30 kg/m2 for Europeans[46].

**CONCLUSION**

The data obtained from the Arabic world indicates that there is an uncontrolled rise in the prevalence of T2DM over the last two decades, in particular within the Gulf cooperation countries. For example, the prevalence of T2DM in early 80’ was estimated 2.4%[8], and then increased to 12% in the late 90’s[28], while recent data from Saudi Arabia shows that the prevalence of T2DM reached 25.4% in 2014. Given that obesity is a major risk factor for developing T2DM, obesity is associated with T2DM in Arab countries even where the prevalence of T2DM is relatively low. In addition, other factors such as rapid urbanization, unhealthy dietary habits and the lack of physical activity are key determinants of T2DM in the area. With this uncontrolled rise in the rate of T2DM in the Arab world, T2DM has now become the 5th leading cause of death in the Arab world. To better estimate the size of this crisis, studies aimed at predicting the rate of T2DM in the future are urgently needed. However, the vast majority of Arabian countries do not provide this important information. In order to succefuly contain the uncontrolled rise of T2DM in the Arabian region, one should take advantage of the research conducted in other communities facing similar patterns in the increasing rates of diabetes. For example, genetic studies, ethnic-specific obesity cut-off points for the risk of diabetes studies and community studies to assess the appropriateness of the neighborhoods for physical activity may bring about increased awareness on the epidemic of diabetes sweeping the region—and so help in creating national/regional strategies to successfully limit the widespread firestorm of T2DM ravaging the Arabic region.

**REFERENCES**

1 **International Diabetes Federation**. IDF Diabetes Atlas, 6th edition. Brussels, Belgium: International Diabetes Federation, 2013. Available from: URL: http://www.idf.org/diabetesatlas

2 **American Diabetes Association**. Economic costs of diabetes in the U.S. In 2007. *Diabetes Care* 2008; **31**: 596-615 [PMID: 18308683 DOI: 10.2337/dc08-9017]

3 **World Health Organization**. The World Health Statistics, 2008. Available from: URL: http://www.who.int/whosis/whostat/2008/en/index.ht

4 **Al-Maskari F**, El-Sadig M, Nagelkerke N. Assessment of the direct medical costs of diabetes mellitus and its complications in the United Arab Emirates. *BMC Public Health* 2010; **10**: 679 [PMID: 21059202 DOI: 10.1186/1471-2458-10-679]

5 **Badran M**, Laher I. Type II Diabetes Mellitus in Arabic-Speaking Countries. *Int J Endocrinol* 2012; **2012**: 902873 [PMID: 22851968 DOI: 10.1155/2012/902873]

6 **Moussa MA**, Alsaeid M, Abdella N, Refai TM, Al-Sheikh N, Gomez JE. Prevalence of type 2 diabetes mellitus among Kuwaiti children and adolescents. *Med Princ Pract* 2008; **17**: 270-275 [PMID: 18523392 DOI: 10.1159/000129604]

7 **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**: 1045-1051 [PMID: 26085648 DOI: 10.1136/jech-2015-205710]

8 **Bacchus RA**, Bell JL, Madkour M, Kilshaw B. The prevalence of diabetes mellitus in male Saudi Arabs. *Diabetologia* 1982; **23**: 330-332 [PMID: 7141167]

9 **Fatani HH**, Mira SA, el-Zubier AG. Prevalence of diabetes mellitus in rural Saudi Arabia. *Diabetes Care* 1987; **10**: 180-183 [PMID: 3582078]

10 **Al-Rubeaan K**, Al-Manaa HA, Khoja TA, Ahmad NA, Al-Sharqawi AH, Siddiqui K, Alnaqeb D, Aburisheh KH, Youssef AM, Al-Batel A, Alotaibi MS, Al-Gamdi AA. Epidemiology of abnormal glucose metabolism in a country facing its epidemic: SAUDI-DM study. *J Diabetes* 2015; **7**: 622-632 [PMID: 25266306 DOI: 10.1111/1753-0407]

11 **Dabelea D**, Mayer-Davis EJ, Saydah S, Imperatore G, Linder B, Divers J, Bell R, Badaru A, Talton JW, Crume T, Liese AD, Merchant AT, Lawrence JM, Reynolds K, Dolan L, Liu LL, Hamman RF. Prevalence of type 1 and type 2 diabetes among children and adolescents from 2001 to 2009. *JAMA* 2014; **311**: 1778-1786 [PMID: 24794371 DOI: 10.1001/jama.2014.3201]

12 **Zeitler P**, Fu J, Tandon N, Nadeau K, Urakami T, Barrett T, Maahs D. ISPAD Clinical Practice Consensus Guidelines 2014. Type 2 diabetes in the child and adolescent. *Pediatr Diabetes* 2014; **15** Suppl 20: 26-46 [PMID: 25182306 DOI: 10.1111/pedi.12179]

13 **Abuyassin B**, Laher I. Obesity-linked diabetes in the Arab world: a review. *East Mediterr Health J* 2015; **21**: 420-439 [PMID: 26370001]

14 **Sigal RJ**, Kenny GP, Wasserman DH, Castaneda-Sceppa C. Physical activity/exercise and type 2 diabetes. *Diabetes Care* 2004; **27**: 2518-2539 [PMID: 15451933]

15 **Bonora E**, Targher G, Formentini G, Calcaterra F, Lombardi S, Marini F, Zenari L, Saggiani F, Poli M, Perbellini S, Raffaelli A, Gemma L, Santi L, Bonadonna RC, Muggeo M. The Metabolic Syndrome is an independent predictor of cardiovascular disease in Type 2 diabetic subjects. Prospective data from the Verona Diabetes Complications Study. *Diabet Med* 2004; **21**: 52-58 [PMID: 14706054]

16 **Masuo K**, Rakugi H, Ogihara T, Esler MD, Lambert GW. Cardiovascular and renal complications of type 2 diabetes in obesity: role of sympathetic nerve activity and insulin resistance. *Curr Diabetes Rev* 2010; **6**: 58-67 [PMID: 20034369]

17 **Tobias DK**, Pan A, Jackson CL, O'Reilly EJ, Ding EL, Willett WC, Manson JE, Hu FB. Body-mass index and mortality among adults with incident type 2 diabetes. *N Engl J Med* 2014; **370**: 233-244 [PMID: 24428469 DOI: 10.1056/NEJMoa1304501]

18 **Logue J**, Walker JJ, Leese G, Lindsay R, McKnight J, Morris A, Philip S, Wild S, Sattar N. Association between BMI measured within a year after diagnosis of type 2 diabetes and mortality. *Diabetes Care* 2013; **36**: 887-893 [PMID: 23139375 DOI: 10.2337/dc12-0944]

19 **Al-Shahrani A**, Al-Khaldi Y. Obesity among diabetic and hypertensive patients in Aseer region, Saudi Arabia. *Saudi J Obes* 2013; **1**: 14-17 [DOI: 10.4103/2347-2618.119470]

20 **Alarouj M**, Bennakhi A, Alnesef Y, Sharifi M, Elkum N. Diabetes and associated cardiovascular risk factors in the State of Kuwait: the first national survey. *Int J Clin Pract* 2013; **67**: 89-96 [PMID: 23241053 DOI: 10.1111/ijcp.12064]

21 **Al-Moosa S**, Allin S, Jemiai N, Al-Lawati J, Mossialos E. Diabetes and urbanization in the Omani population: an analysis of national survey data. *Popul Health Metr* 2006; **4**: 5 [PMID: 16635266]

22 **Bener A**, Zirie M, Janahi IM, Al-Hamaq AO, Musallam M, Wareham NJ. Prevalence of diagnosed and undiagnosed diabetes mellitus and its risk factors in a population-based study of Qatar. *Diabetes Res Clin Pract* 2009; **84**: 99-106 [PMID: 19261345 DOI: 10.1016/j.diabres.2009.02.003]

23 **Abdul-Rahim HF**, Husseini A, Giacaman R, Jervell J, Bjertness E. Diabetes mellitus in an urban Palestinian population: prevalence and associated factors. *East Mediterr Health J* 2001; **7**: 67-78 [PMID: 12596954]

24 **Naja F**, Hwalla N, Itani L, Salem M, Azar ST, Zeidan MN, Nasreddine L. Dietary patterns and odds of Type 2 diabetes in Beirut, Lebanon: a case-control study. *Nutr Metab* (Lond) 2012; **9**: 111 [PMID: 23270372 DOI: 10.1186/1743-7075-9-111]

25 **Elbagir MN**, Eltom MA, Elmahadi EM, Kadam IM, Berne C. A population-based study of the prevalence of diabetes and impaired glucose tolerance in adults in northern Sudan. *Diabetes Care* 1996; **19**: 1126-1128 [PMID: 8886561]

26 **Bouguerra R**, Alberti H, Salem LB, Rayana CB, Atti JE, Gaigi S, Slama CB, Zouari B, Alberti K. The global diabetes pandemic: the Tunisian experience. *Eur J Clin Nutr* 2007; **61**: 160-165 [PMID: 16900086]

27 **Kahan D**. Prevalence and correlates of adult overweight in the Muslim world: analysis of 46 countries. *Clin Obes* 2015; **5**: 87-98 [PMID: 25755091]

28 **Al-Nuaim AR**. Prevalence of glucose intolerance in urban and rural communities in Saudi Arabia. *Diabet Med* 1997; **14**: 595-602 [PMID: 9223399]

29 **Bos M**, Agyemang C. Prevalence and complications of diabetes mellitus in Northern Africa, a systematic review. *BMC Public Health* 2013; **13**: 387 [PMID: 23617762 DOI: 10.1186/1471-2458-13-387]

30 **Martínez-González MA**, de la Fuente-Arrillaga C, Nunez-Cordoba JM, Basterra-Gortari FJ, Beunza JJ, Vazquez Z, Benito S, Tortosa A, Bes-Rastrollo M. Adherence to Mediterranean diet and risk of developing diabetes: prospective cohort study. *BMJ* 2008; **336**: 1348-1351 [PMID: 18511765 DOI: 10.1136/bmj.39561.501007.BE]

31 **Salas-Salvadó J**, Bulló M, Babio N, Martínez-González MÁ, Ibarrola-Jurado N, Basora J, Estruch R, Covas MI, Corella D, Arós F, Ruiz-Gutiérrez V, Ros E. Reduction in the incidence of type 2 diabetes with the Mediterranean diet: results of the PREDIMED-Reus nutrition intervention randomized trial. *Diabetes Care* 2011; **34**: 14-19 [PMID: 20929998 DOI: 10.2337/dc10-1288]

32 **Afshin A**, Micha R, Khatibzadeh S, Fahimi S, Shi P, Powles J, Singh G, Yakoob MY, Abdollahi M, Al-Hooti S, Farzadfar F, Houshiar-Rad A, Hwalla N, Koksal E, Musaiger A, Pekcan G, Sibai AM, Zaghloul S, Danaei G, Ezzati M, Mozaffarian D. The impact of dietary habits and metabolic risk factors on cardiovascular and diabetes mortality in countries of the Middle East and North Africa in 2010: a comparative risk assessment analysis. *BMJ Open* 2015; **5**: e006385 [PMID: 25995236 DOI: 10.1136/bmjopen-2014-006385]

33 **Sigal RJ**, Armstrong MJ, Colby P, Kenny GP, Plotnikoff RC, Reichert SM, Riddell MC. Physical activity and diabetes. *Can J Diabetes* 2013; **37** Suppl 1: S40-S44 [PMID: 24070962 DOI: 10.1016/j.jcjd.2013.01.018]

34 **LaMonte MJ**, Blair SN, Church TS. Physical activity and diabetes prevention. *J Appl Physiol* (1985) 2005; **99**: 1205-1213 [PMID: 16103523]

35 **Sigal RJ**, Kenny GP, Wasserman DH, Castaneda-Sceppa C, White RD. Physical activity/exercise and type 2 diabetes: a consensus statement from the American Diabetes Association. *Diabetes Care* 2006; **29**: 1433-1438 [PMID: 16732040]

36 **Li G**, Zhang P, Wang J, Gregg EW, Yang W, Gong Q, Li H, Li H, Jiang Y, An Y, Shuai Y, Zhang B, Zhang J, Thompson TJ, Gerzoff RB, Roglic G, Hu Y, Bennett PH. The long-term effect of lifestyle interventions to prevent diabetes in the China Da Qing Diabetes Prevention Study: a 20-year follow-up study. *Lancet* 2008; **371**: 1783-1789 [PMID: 18502303 DOI: 10.1016/S0140-6736(08)60766-7]

37 **Boulé NG**, Haddad E, Kenny GP, Wells GA, Sigal RJ. Effects of exercise on glycemic control and body mass in type 2 diabetes mellitus: a meta-analysis of controlled clinical trials. *JAMA* 2001; **286**: 1218-1227 [PMID: 11559268]

38 **Bauman A**, Bull F, Chey T, Craig CL, Ainsworth BE, Sallis JF, Bowles HR, Hagstromer M, Sjostrom M, Pratt M. The International Prevalence Study on Physical Activity: results from 20 countries. *Int J Behav Nutr Phys Act* 2009; **6**: 21 [PMID: 19335883 DOI: 10.1186/1479-5868-6-21]

39 **Al Subhi LK**, Bose S, Al Ani MF. Prevalence of physically active and sedentary adolescents in 10 Eastern Mediterranean countries and its relation with age, sex, and body mass index. *J Phys Act Health* 2015; **12**: 257-265 [PMID: 24763105 DOI: 10.1123/jpah.2013-0134]

40 **World Health Organization**, fact sheet No. 310, updated May 2014. Available from: URL: http://www.who.int/mediacentre/factsheets/fs310/en

41 **Mokdad AH**, Jaber S, Aziz MI, AlBuhairan F, AlGhaithi A, AlHamad NM, Al-Hooti SN, Al-Jasari A, AlMazroa MA, AlQasmi AM, Alsowaidi S, Asad M, Atkinson C, Badawi A, Bakfalouni T, Barkia A, Biryukov S, El Bcheraoui C, Daoud F, Forouzanfar MH, Gonzalez-Medina D, Hamadeh RR, Hsairi M, Hussein SS, Karam N, Khalifa SE, Khoja TA, Lami F, Leach-Kemon K, Memish ZA, Mokdad AA, Naghavi M, Nasher J, Qasem MB, Shuaib M, Al Thani AA, Al Thani MH, Zamakhshary M, Lopez AD, Murray CJ. The state of health in the Arab world, 1990-2010: an analysis of the burden of diseases, injuries, and risk factors. *Lancet* 2014; **383**: 309-320 [PMID: 24452042 DOI: 10.1016/S0140-6736(13)62189-3]

42 **Saidi O**, O'Flaherty M, Mansour NB, Aissi W, Lassoued O, Capewell S, Critchley JA, Malouche D, Romdhane HB. Forecasting Tunisian type 2 diabetes prevalence to 2027: validation of a simple model. *BMC Public Health* 2015; **15**: 104 [PMID: 25885910 DOI: 10.1186/s12889-015-1416-z]

43 **Al-Quwaidhi AJ**, Pearce MS, Sobngwi E, Critchley JA, O'Flaherty M. Comparison of type 2 diabetes prevalence estimates in Saudi Arabia from a validated Markov model against the International Diabetes Federation and other modelling studies. *Diabetes Res Clin Pract* 2014; **103**: 496-503 [PMID: 24447810 DOI: 10.1016/j.diabres.2013.12.036]

44 **Bull F**, Dvorak J. Tackling chronic disease through increased physical activity in the Arab World and the Middle East: challenge and opportunity. *Br J Sports Med* 2013; **47**: 600-602 [PMID: 23624465 DOI: 10.1136/bjsports-2012-092109]

45 **Christine PJ**, Auchincloss AH, Bertoni AG, Carnethon MR, Sánchez BN, Moore K, Adar SD, Horwich TB, Watson KE, Diez Roux AV. Longitudinal Associations Between Neighborhood Physical and Social Environments and Incident Type 2 Diabetes Mellitus: The Multi-Ethnic Study of Atherosclerosis (MESA). *JAMA Intern Med* 2015; **175**: 1311-1320 [PMID: 26121402 DOI: 10.1001/jamainternmed.2015.2691]

46 **Tillin T**, Sattar N, Godsland IF, Hughes AD, Chaturvedi N, Forouhi NG. Ethnicity-specific obesity cut-points in the development of Type 2 diabetes - a prospective study including three ethnic groups in the United Kingdom. *Diabet Med* 2015; **32**: 226-234 [PMID: 25186015 DOI: 10.1111/dme.12576]

47 **Rahman Al-Nuaim A**. Effect of overweight and obesity on glucose intolerance and dyslipidemia in Saudi Arabia, epidemiological study. *Diabetes Res Clin Pract* 1997; **36**: 181-191 [PMID: 9237785]

48 **el-Hazmi MA**, Warsy AS. Prevalence of overweight and obesity in diabetic and non-diabetic Saudis. *East Mediterr Health J* 2000; **6**: 276-282 [PMID: 11556013]

49 **Al-Nozha MM**, Al-Maatouq MA, Al-Mazrou YY, Al-Harthi SS, Arafah MR, Khalil MZ, Khan NB, Al-Khadra A, Al-Marzouki K, Nouh MS, Abdullah M, Attas O, Al-Shahid MS, Al-Mobeireek A. Diabetes mellitus in Saudi Arabia. *Saudi Med J* 2004; **25**: 1603-1610 [PMID: 15573186]

50 **Almajwal AM**, Al-Baghli NA, Batterham MJ, Williams PG, Al-Turki KA, Al-Ghamdi AJ. Performance of body mass index in predicting diabetes and hypertension in the Eastern Province of Saudi Arabia. *Ann Saudi Med* 2009; **29**: 437-445 [PMID: 19847080 DOI: 10.4103/0256-4947.57165]

51 **Al-Rubeaan K**, Al-Manaa H, Khoja T, Ahmad N, Al-Sharqawi A, Siddiqui K, AlNaqeb D, Aburisheh K, Youssef A, Al-Batil A, Al-Otaibi M, Ghamdi AA. The Saudi Abnormal Glucose Metabolism and Diabetes Impact Study (SAUDI-DM). *Ann Saudi Med* 2014; **34**: 465-475 [PMID: 25971818 DOI: 10.5144/0256-4947.2014.465]

52 **El Bcheraoui C**, Basulaiman M, Tuffaha M, Daoud F, Robinson M, Jaber S, Mikhitarian S, Memish ZA, Al Saeedi M, AlMazroa MA, Mokdad AH. Status of the diabetes epidemic in the Kingdom of Saudi Arabia, 2013. *Int J Public Health* 2014; **59**: 1011-1021 [PMID: 25292457 DOI: 10.1007/s00038-014-0612-4]

53 **Abdella N**, Khogali M, al-Ali S, Gumaa K, Bajaj J. Known type 2 diabetes mellitus among the Kuwaiti population. A prevalence study. *Acta Diabetol* 1996; **33**: 145-149 [PMID: 8870817]

54 **Al Khalaf MM**, Eid MM, Najjar HA, Alhajry KM, Doi SA, Thalib L. Screening for diabetes in Kuwait and evaluation of risk scores. *East Mediterr Health J* 2010; **16**: 725-731 [PMID: 20799528]

55 **Al Zurba FI**, Al Garf A. Prevalence of diabetes mellitus among Bahrainis attending primary health care centres. *East Mediterr Health J* 1996; **2**: 274-282

56 **Malik M**, Bakir A, Saab BA, King H. Glucose intolerance and associated factors in the multi-ethnic population of the United Arab Emirates: results of a national survey. *Diabetes Res Clin Pract* 2005; **69**: 188-195 [PMID: 16005369]

57 **Saadi H**, Carruthers SG, Nagelkerke N, Al-Maskari F, Afandi B, Reed R, Lukic M, Nicholls MG, Kazam E, Algawi K, Al-Kaabi J, Leduc C, Sabri S, El-Sadig M, Elkhumaidi S, Agarwal M, Benedict S. Prevalence of diabetes mellitus and its complications in a population-based sample in Al Ain, United Arab Emirates. *Diabetes Res Clin Pract* 2007; **78**: 369-377 [PMID: 17532085]

58 **Mansour AA**, Al-Jazairi MI. Predictors of incident diabetes mellitus in Basrah, Iraq. *Ann Nutr Metab* 2007; **51**: 277-280 [PMID: 17622787]

59 **Mansour AA**, Al-Maliky AA, Kasem B, Jabar A, Mosbeh KA. Prevalence of diagnosed and undiagnosed diabetes mellitus in adults aged 19 years and older in Basrah, Iraq. *Diabetes Metab Syndr Obes* 2014; **7**: 139-144 [PMID: 24833912 DOI: 10.2147/DMSO.S59652]

60 **Al-Lawati JA**, Panduranga P, Al-Shaikh HA, Morsi M, Mohsin N, Khandekar RB, Al-Lawati HJ, Bayoumi RA. Epidemiology of Diabetes Mellitus in Oman: Results from two decades of research. *Sultan Qaboos Univ Med J* 2015; **15**: e226-e233 [PMID: 26052456]

61 **Musaiger A**, Shahbeek N. The relationship between obesity and prevalence of chronic diseases in the Arab women. *J Hum Ecol Special Issue* 2005; **13**: 97-100

62 **Al-Habori M**, Al-Mamari M, Al-Meeri A. Type II Diabetes Mellitus and impaired glucose tolerance in Yemen: prevalence, associated metabolic changes and risk factors. *Diabetes Res Clin Pract* 2004; **65**: 275-281 [PMID: 15331208]

63 **Gunaid AA**, Assabri AM. Prevalence of type 2 diabetes and other cardiovascular risk factors in a semirural area in Yemen. *East Mediterr Health J* 2008; **14**: 42-56 [PMID: 18557451]

64 **Ajlouni K**, Khader YS, Batieha A, Ajlouni H, El-Khateeb M. An increase in prevalence of diabetes mellitus in Jordan over 10 years. *J Diabetes Complications* 2008; **22**: 317-324 [PMID: 18413210 DOI: 10.1016/j.jdiacomp.2007.01.004]

65 **Albache N**, Al Ali R, Rastam S, Fouad FM, Mzayek F, Maziak W. Epidemiology of Type 2 diabetes mellitus in Aleppo, Syria. *J Diabetes* 2010; **2**: 85-91 [PMID: 20923489 DOI: 10.1111/j.1753-0407.2009.00063]

66 **Hirbli KI**, Jambeine MA, Slim HB, Barakat WM, Habis RJ, Francis ZM. Prevalence of diabetes in greater Beirut. *Diabetes Care* 2005; **28**: 1262 [PMID: 15855610]

67 **Herman WH**, Aubert RE, Engelgau MM, Thompson TJ, Ali MA, Sous ES, Hegazy M, Badran A, Kenny SJ, Gunter EW, Malarcher AM, Brechner RJ, Wetterhall SF, DeStefano F, Smith PJ, Habib M, abd el Shakour S, Ibrahim AS, el Behairy EM. Diabetes mellitus in Egypt: glycaemic control and microvascular and neuropathic complications. *Diabet Med* 1998; **15**: 1045-1051 [PMID: 9868980]

68 **Abolfotouh MA**, Soliman LA, Mansour E, Farghaly M, El-Dawaiaty AA. Central obesity among adults in Egypt: prevalence and associated morbidity. *East Mediterr Health J* 2008; **14**: 57-68 [PMID: 18557452]

69 **Noor SK**, Bushara SO, Sulaiman AA, Elmadhoun WM, Ahmed MH. Undiagnosed diabetes mellitus in rural communities in Sudan: prevalence and risk factors. *East Mediterr Health J* 2015; **21**: 164-170 [PMID: 26074216]

70 **Ben Romdhane H**, Ben Ali S, Aissi W, Traissac P, Aounallah-Skhiri H, Bougatef S, Maire B, Delpeuch F, Achour N. Prevalence of diabetes in Northern African countries: the case of Tunisia. *BMC Public Health* 2014; **14**: 86 [PMID: 24472619 DOI: 10.1186/1471-2458-14-86]

71 **Kadiki OA**, Roaeid RB. Prevalence of diabetes mellitus and impaired glucose tolerance in Benghazi Libya. *Diabetes Metab* 2001; **27**: 647-654 [PMID: 11852372]

72 **Rguibi M**, Belahsen R. Prevalence and associated risk factors of undiagnosed diabetes among adult Moroccan Sahraoui women. *Public Health Nutr* 2006; **9**: 722-727 [PMID: 16925877]

73 **Jaber LA**, Brown MB, Hammad A, Nowak SN, Zhu Q, Ghafoor A, Herman WH. Epidemiology of diabetes among Arab Americans. *Diabetes Care* 2003; **26**: 308-313 [PMID: 12547854]

74 **Rissel C**, Lesjak M, Ward J. Cardiovascular risk factors among Arabic-speaking patients attending Arabic-speaking general practitioners in Sydney, Australia: opportunities for intervention. *Ethn Health* 1998; **3**: 213-222 [PMID: 9798119]

75 **Thow AM**, Waters AM. AIHW 2005. Diabetes in culturally and linguistically diverse Australians. Cat. No. CVD 30. Canberra: Australian Institute of Health and Welfare, 2005

76 **Punnose J**, Agarwal MM, Bin-Uthman S. Type 2 diabetes mellitus among children and adolescents in Al-Ain: a case series. *East Mediterr Health J* 2005; **11**: 788-797 [PMID: 16700395]

77 **Al-Agha A**, Ocheltree A, Shata N. Prevalence of hyperinsulinism, type 2 diabetes mellitus and metabolic syndrome among Saudi overweight and obese pediatric patients. *Minerva Pediatr* 2012; **64**: 623-631 [PMID: 23108324]

78 **Ali BA**, Abdallah ST, Abdallah AM, Hussein MM. The Frequency of Type 2 Diabetes Mellitus among Diabetic Children in El Minia Governorate, Egypt. *Sultan Qaboos Univ Med J* 2013; **13**: 399-403 [PMID: 23984025]

79 **Osman H**, Elsadek N, Abdullah M. Type 2 diabetes in Sudanese children and adolescents. *Sudan J Paediatr* 2013; **13**: 17-23

80 **Ehtisham S**, Barrett TG, Shaw NJ. Type 2 diabetes mellitus in UK children--an emerging problem. *Diabet Med* 2000; **17**: 867-871 [PMID: 11168330]

81 **Al-Rubeaan K**, Abu El-Asrar AM, Youssef AM, Subhani SN, Ahmad NA, Al-Sharqawi AH, Alguwaihes A, Alotaibi MS, Al-Ghamdi A, Ibrahim HM. Diabetic retinopathy and its risk factors in a society with a type 2 diabetes epidemic: a Saudi National Diabetes Registry-based study. *Acta Ophthalmol* 2015; **93**: e140-e147 [PMID: 25270515 DOI: 10.1111/aos.12532]

82 **Hajar S**, Al Hazmi A, Wasli M, Mousa A, Rabiu M. Prevalence and causes of blindness and diabetic retinopathy in Southern Saudi Arabia. *Saudi Med J* 2015; **36**: 449-455 [PMID: 25828282 DOI: 10.15537/smj.2015.4.10371]

83 **Al-Rubeaan K**, Youssef AM, Subhani SN, Ahmad NA, Al-Sharqawi AH, Al-Mutlaq HM, David SK, AlNaqeb D. Diabetic nephropathy and its risk factors in a society with a type 2 diabetes epidemic: a Saudi National Diabetes Registry-based study. *PLoS One* 2014; **9**: e88956 [PMID: 24586457 DOI: 10.1371/journal.pone.0088956]

84 **Al-Rubeaan K**, Al Derwish M, Ouizi S, Youssef AM, Subhani SN, Ibrahim HM, Alamri BN. Diabetic foot complications and their risk factors from a large retrospective cohort study. *PLoS One* 2015; **10**: e0124446 [PMID: 25946144 DOI: 10.1371/journal.pone.0124446]

85 **Wang DD**, Bakhotmah BA, Hu FB, Alzahrani HA. Prevalence and correlates of diabetic peripheral neuropathy in a Saudi Arabic population: a cross-sectional study. *PLoS One* 2014; **9**: e106935 [PMID: 25184511 DOI: 10.1371/journal.pone.0106935]

86 **Al-Adsani AM**. Risk factors for diabetic retinopathy in Kuwaiti type 2 diabetic patients. *Saudi Med J* 2007; **28**: 579-583 [PMID: 17457481]

87 **Al-Maskari F**, El-Sadig M. Prevalence of diabetic retinopathy in the United Arab Emirates: a cross-sectional survey. *BMC Ophthalmol* 2007; **7**: 11 [PMID: 17572909]

88 **Al-Salman RA**, Al-Basri HA, Al-Sayyad AS, Hearnshaw HM. Prevalence and risk factors of albuminuria in Type 2 diabetes in Bahrain. *J Endocrinol Invest* 2009; **32**: 746-751 [PMID: 20009501]

89 **Al-Mahroos F**, Al-Roomi K. Diabetic neuropathy, foot ulceration, peripheral vascular disease and potential risk factors among patients with diabetes in Bahrain: a nationwide primary care diabetes clinic-based study. *Ann Saudi Med* 2007; **27**: 25-31 [PMID: 17277500]

90 **Bener A**, Al-Laftah F, Al-Hamaq AO, Daghash M, Abdullatef WK. A study of diabetes complications in an endogamous population: an emerging public health burden. *Diabetes Metab Syndr* 2014; **8**: 108-114 [PMID: 24907176 DOI: 10.1016/j.dsx.2014.04.005]

91 **Elshafei M**, Gamra H, Khandekar R, Al Hashimi M, Pai A, Ahmed MF. Prevalence and determinants of diabetic retinopathy among persons ≥ 40 years of age with diabetes in Qatar: a community-based survey. *Eur J Ophthalmol* 2011; **21**: 39-47 [PMID: 20602322]

92 **Khandekar R**, Al Lawatii J, Mohammed AJ, Al Raisi A. Diabetic retinopathy in Oman: a hospital based study. *Br J Ophthalmol* 2003; **87**: 1061-1064 [PMID: 12928265]

93 **Khandekar RB**, Tirumurthy S, Al-Harby S, Moorthy NS, Amir I. Diabetic retinopathy and ocular co-morbidities among persons with diabetes at Sumail Hospital of Oman. *Diabetes Technol Ther* 2009; **11**: 675-679 [PMID: 19821761 DOI: 10.1089/dia.2009.0032]

94 **Al-Lawati JA**, N Barakat M, Al-Zakwani I, Elsayed MK, Al-Maskari M, M Al-Lawati N, Mohammed AJ. Control of risk factors for cardiovascular disease among adults with previously diagnosed type 2 diabetes mellitus: a descriptive study from a middle eastern arab population. *Open Cardiovasc Med J* 2012; **6**: 133-140 [PMID: 23166566 DOI: 10.2174/1874192401206010133]

95 **Alrawahi AH**, Rizvi SG, Al-Riyami D, Al-Anqoodi Z. Prevalence and risk factors of diabetic nephropathy in omani type 2 diabetics in Al-dakhiliyah region. *Oman Med J* 2012; **27**: 212-216 [PMID: 22811770 DOI: 10.5001/omj.2012.48]

96 **Al-Akily SA**, Bamashmus MA, Gunaid AA. Causes of visual impairment and blindness among Yemenis with diabetes: a hospital-based study. *East Mediterr Health J* 2011; **17**: 831-837 [PMID: 22276490]

97 **Bamashmus MA**, Gunaid AA, Khandekar RB. Diabetic retinopathy, visual impairment and ocular status among patients with diabetes mellitus in Yemen: a hospital-based study. *Indian J Ophthalmol* 2009; **57**: 293-298 [PMID: 19574698 DOI: 10.4103/0301-4738.53055]

98 **Gunaid AA**, El Khally FM, Hassan NA, Mukhtar el D. Demographic and clinical features of diabetes mellitus in 1095 Yemeni patients. *Ann Saudi Med* 1997; **17**: 402-409 [PMID: 17353590]

99 **Al-Khawlani A**, Atef ZA, Al-Ansi A. Macrovascular complications and their associated risk factors in type 2 diabetic patients in Sana'a city, Yemen. *East Mediterr Health J* 2010; **16**: 851-858 [PMID: 21469567]

100 **Rabiu MM**, Al Bdour MD, Abu Ameerh MA, Jadoon MZ. Prevalence of blindness and diabetic retinopathy in northern Jordan. *Eur J Ophthalmol* 2015; **25**: 320-327 [PMID: 25684158 DOI: 10.5301/ejo.5000557]

101 **Al-Bdour MD**, Al-Till MI, Abu Samra KM. Risk Factors for Diabetic Retinopathy among Jordanian Diabetics. *Middle East Afr J Ophthalmol* 2008; **15**: 77-80 [PMID: 21346842 DOI: 10.4103/0974-9233.51997]

102 **Al-Till MI**, Al-Bdour MD, Ajlouni KM. Prevalence of blindness and visual impairment among Jordanian diabetics. *Eur J Ophthalmol* 2005; **15**: 62-68 [PMID: 15751241]

103 **Jbour AS**, Jarrah NS, Radaideh AM, Shegem NS, Bader IM, Batieha AM, Ajlouni KM. Prevalence and predictors of diabetic foot syndrome in type 2 diabetes mellitus in Jordan. *Saudi Med J* 2003; **24**: 761-764 [PMID: 12883610]

104 **Macky TA**, Khater N, Al-Zamil MA, El Fishawy H, Soliman MM. Epidemiology of diabetic retinopathy in Egypt: a hospital-based study. *Ophthalmic Res* 2011; **45**: 73-78 [PMID: 20714195 DOI: 10.1159/000314876]

105 **Assaad-Khalil SH**, Zaki A, Abdel Rehim A, Megallaa MH, Gaber N, Gamal H, Rohoma KH. Prevalence of diabetic foot disorders and related risk factors among Egyptian subjects with diabetes. *Prim Care Diabetes* 2015; **9**: 297-303 [PMID: 25543864 DOI: 10.1016/j.pcd.2014.10.010]

106 **Kahloun R**, Jelliti B, Zaouali S, Attia S, Ben Yahia S, Resnikoff S, Khairallah M. Prevalence and causes of visual impairment in diabetic patients in Tunisia, North Africa. *Eye* (Lond) 2014; **28**: 986-991 [PMID: 24924439 DOI: 10.1038/eye.2014.131]

107 **Elhwuegi AS**, Darez AA, Langa AM, Bashaga NA. Cross-sectional pilot study about the health status of diabetic patients in city of Misurata, Libya. *Afr Health Sci* 2012; **12**: 81-86 [PMID: 23066426]

**P-Reviewer:** Gómez-Sáez JM, Papazoglou D, Tziomalos K

**S-Editor:** Ji FF **L-Editor: E-Editor:**

**Table 1 Prevalence of type-2 diabetes mellitus in adult Arab population**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Ref. | Country | Year | Sample size | Main findings | Diagnostic technique |
| Bacchus *et al*[8] | Saudi Arabia | 1982 | 1385 | Prevalence of diabetes: 2.4% | WHO criteria |
| Fatani *et al*[9] | Saudi Arabia | 1987 | 5222 | Prevalence of diabetes: 4.3% | Random capillary blood glucose |
| AlNuaim *et al*[28] | Saudi Arabia | 1997 | 13177 | Prevalence of diabetes in urban males and females: 12%, 14%  Prevalence of diabetes in rural males and females: 7%, 7.7% | Random plasma glucose |
| AlNuaim *et al*[47] | Saudi Arabia | 1997 | 2059 | Prevalence of T2DM in obese males: 26.0%  Prevalence of T2DM in non-obese males: 8.6% (*P* < 0.001)  Prevalence of T2DM in obese females: 23.5%  Prevalence of T2DM in non-obese females: 4.4% (*P* < 0.0001) | OGTT |
| ElHazmi *et al*[48] | Saudi Arabia | 2000 | 14660 | Prevalence of obesity in males: 13.05%  Prevalence of obesity in females: 20.26%  Prevalence of obesity in diabetics: 29.98%  Prevalence of obesity in non-diabetics: 15.87% (*P* < 0.0001) | FBG |
| AlNozha *et al*[49] | Saudi Arabia | 2004 | 16917 | Prevalence of diabetes: 23.7% | FPG |
| Ali *et al*[50] | Saudi Arabia | 2009 | 195,851 | Prevalence of diabetes: 17.2% | FBG |
| AlRubeaan *et al*[10] | Saudi Arabia | 2014 | 18,034 | Prevalence of diabetes: 25.4% | FPG |
| AlRubeaan *et al*[51] | Saudi Arabia | 2014 | 53370 | Prevalence of abnormal glucose metabolism: 34.5% | FPG |
| El Bcheraoui *et al*[52] | Saudi Arabia | 2014 | 10735 | Prevalence of diabetes: 13.4% | FPG |
| Abdella *et al*[53] | Kuwait | 1996 | 8336 | Prevalence of diabetes: 7.6% | Medical chart review |
| AlKhalaf *et al*[54] | Kuwait | 2010 | 560 | Prevalence of diabetes: 21.4% | FBG |
| Alarouj *et al*[20] | Kuwait | 2013 | 1970 | Prevalence of diabetes: 17.9% | FPG |
| Farouq *et al*[55] | Bahrain | 1996 | 498 | Prevalence of diabetes: 25.5% | FPG |
| Malik *et al*[56] | UAE | 2005 | 5758 | Prevalence of T2DM: 20.2% | FPG |
| Saadi *et al*[57] | UAE | 2007 | 2455 | Prevalence of diagnosed T2DM: 10.5%  Prevalence of undiagnosed T2DM: 6.6% | FBG |
| Mansour *et al*[58] | Iraq | 2007 | 13730 | Incidence of T2DM: 6.8% | FPG |
| Mansour *et al*[59] | Iraq | 2014 | 5445 | Prevalence of T2DM: 19.7% | FPG |
| AlMoosa *et al*[21] | Oman | 2006 | 5840 | Prevalence of T2DM: 11.6% | FPG |
| Al-Lawati *et al*[60] | Oman | 2015 | NA | Age-adjusted prevalence of T2DM: 10.4% to 21.1% | FPG and OGTT |
| Musaiger *et al*[61] | Qatar | 2005 | 535 | Prevalence of T2DM among obese females ≥ 50 years: 51.4% | Self-reported diabetes |
| Bener *et al*[22] | Qatar | 2009 | 1117 | Prevalence of T2DM: 16.7% | FBG and OGTT |
| AlHabori *et al*[62] | Yemen | 2004 | 498 | Prevalence of T2DM: 7.4% | FPG |
| Gunaid *et al*[63] | Yemen | 2008 | 250 | Prevalence of T2DM: 10.4% | FPG and OGTT |
| Abdul-Rahim *et al*[23] | Palestine | 2001 | 302 | Prevalence of T2DM: 12% | OGTT |
| Ajlouni *et al*[64] | Jordan | 2008 | 1121 | Prevalence of T2DM: 17.4% | FPG |
| Albache *et al*[65] | Syria | 2010 | 806 | Prevalence of T2DM: 15.6% | FPG |
| Hirbli *et al*[66] | Lebanon | 2005 | 3000 | Prevalence of T2DM: 15.6% | FPG |
| Herman *et al*[67] | Egypt | 1998 | 1451 | Prevalence of T2DM: 9.3% | OGTT |
| Abolfotouh *et al*[68] | Egypt | 2008 | 1800 | Prevalence of T2DM: 3.7% | FBG |
| Elbagir *et al*[25] | Sudan | 1996 | 1284 | Prevalence of T2DM: 3.4% | OGTT |
| Noor *et al*[69] | Sudan | 2015 | 1111 | Prevalence of T2DM: 1.3%  Prevalence of undiagnosed T2DM: 2.6% | FBG |
| Bouguerra *et al*[26] | Tunisia | 2007 | 3729 | Prevalence of T2DM: 9.9% | FPG |
| Ben Romdhane *et al*[70] | Tunisia | 2014 | 7700 | Prevalence of T2DM: 15.1% | FPG |
| Kadiki *et al*[71] | Libya | 2001 | 868 | Prevalence of T2DM: 14.1% | OGTT |
| Rguibi *et al*[72] | Morocco | 2006 | 249 | Prevalence of undiagnosed T2DM: 6.4% | FPG |
| Bos *et al*[29] | North Africa | 2013 | NA | Prevalence of diabetes: range from 2.6% in rural Sudan to 20.0% in urban Egypt  Prevalence of diabetes significantly higher in urban than rural areas  Significantly higher prevalence of overweight/obesity in females than males in Algeria, Egypt, Morocco, Tunisia and Sudan | NA |
| Jaber *et al*[73] | United States (Arab-Americans) | 2003 | 542 | Prevalence of T2DM in males: 22.0%  Prevalence T2DM in females: 18.0% | OGTT |
| Rissel *et al*[74] | Australia (Arab immigrants) | 1998 | 528 | Prevalence of overweight or obesity in males: 73%  Prevalence of overweight or obesity in females: 36% | NA |
| Thow *et al*[75] | Australia (people born in Middle East and North Africa) | 2005 | NA | Highest prevalence and incidence of T2DM  Second highest ratio of hospitalization and mortality  Standard prevalence ratio for diabetes among Arabic-speaking subjects significantly 3.6 times higher than English-only speaking subjects | NA |

WHO: World Health Organization; OGTT: Oral glucose tolerance test; FBG: Fasting blood glucose; FPG: Fasting plasma glucose; UAE: United Arab Emirates; NA: Data not available; T2DM: Type-2 diabetes mellitus.

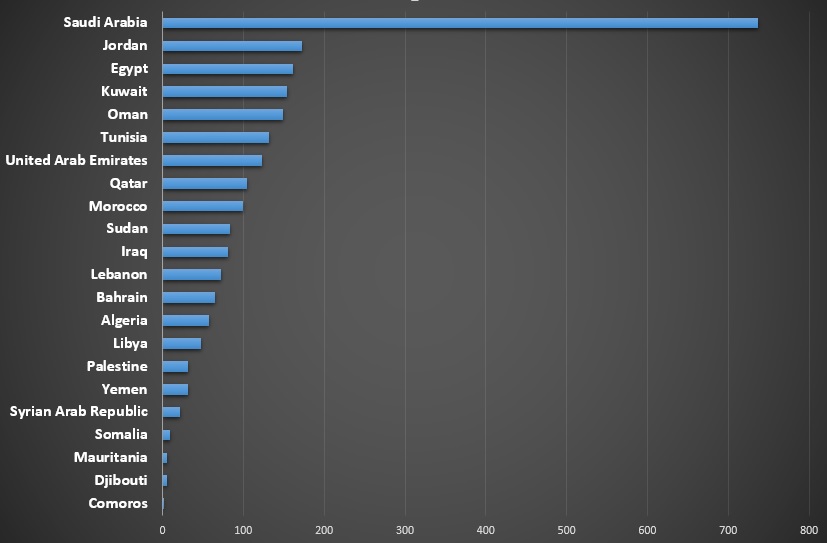
**Table 2 Prevalence of type-2 diabetes mellitus in Arab podiatric and children**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Ref. | Country | Year | Sample size | Main findings | Diagnostic technique | Notes |
| Punnose *et al*[76] | UAE | 2005 | 96 | 11 children diagnosed with T2DM  9/11 children were Arab origin  8/11 children were overweight or obese  10/11 children were female | FPG | (8-18 years old)  Case series |
| Moussa *et al*[6] | Kuwait | 2008 | 128918 | T2DM found in 45 children  Prevalence of T2DM in male children: 47.3/10,000  Prevalence of T2DM in female children: 26.3/10000 (*P* = 0.05) | NA | (6-18 years old)  Medical record review |
| Al-Agha *et al*[77] | Saudi Arabia | 2012 | 387 | Prevalence of T2DM: 9.04% | NA | (2-18 years old)  Retrospective cross-sectional study |
| AlRubeaan *et al*[7] | Saudi Arabia | 2015 | 23523 | Age adjusted Prevalence of T2DM: 1/1000 | FPG | ≤ 18 years |
| Ali *et al*[78] | Egypt | 2013 | 210 | 28 out of 210 children with diabetes diagnosed with T2DM  64.3% of T2DM children were female (*P* = 0.04) | fasting serum C-peptide levels | (1-18 years old) |
| Osman *et al*[79] | Sudan | 2013 | 958 | 38/985 children identified with T2DM  32/38 of cases were from tribes of Arab origin | NA | (11-18 years old)  Retrospective cross sectional |
| Ehtisham *et al*[80] | United Kingdom | 2000 | 8 | First 8 cases reported with T2DM in United Kingdom  All cases were overweight and originated from India, Pakistan and Arab countries | NA | (9-16 years old)  Retrospective cross sectional |

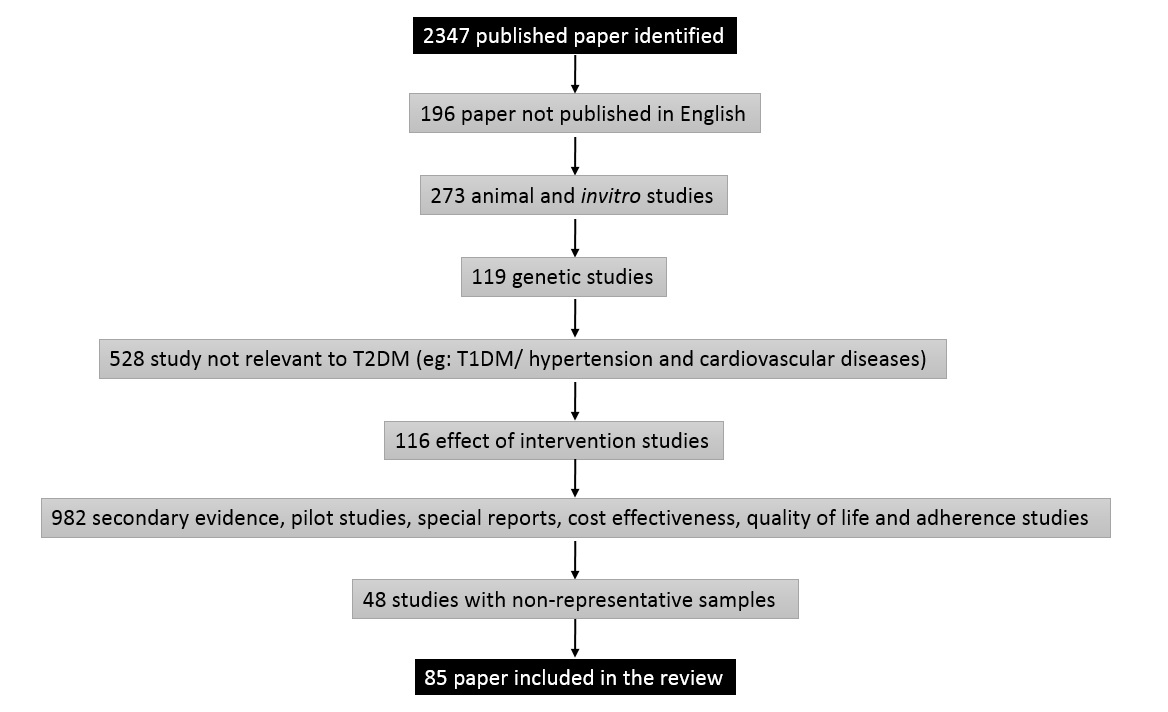
UAE: United Arab Emirates; FPG: Fasting plasma glucose; NA: Data not available; T2DM: Type-2 diabetes mellitus.

**Table 3 Diabetes complications in the Arab world**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Country | Year | Sample size | Prevalence of complication | Ref. |
| Saudi Arabia | 2015 | 50464 | Retinopathy: 19.7% | [81] |
| 2015 | 3800 | Blindness: 33% | [82] |
| 2014 | 54670 | Nephropathy: 10.8% | [83] |
| 2015 | 62681 | Diabetic foot: 3.3%  Foot ulcer: 2.05  Gangrene: 0.19%  Amputation: 1.06% | [84] |
| 2014 | 552 | Peripheral neuropathy: 19.9% | [85] |
| Kuwait | 2007 | 165 | Retinopathy: 40% | [86] |
| Emirates | 2007 | 513 | Retinopathy: 19% | [87] |
| 2007 | 2455 | Retinopathy: 54.2%  Nephropathy: 40.8%  Neuropathy: 34.7  Peripheral vascular disease: 11.1% | [57] |
| Bahrain | 2009 | 712 | Microalbuminuria: 27.9% | [88] |
| 2007 | 1477 | Neuropathy: 36.6%  Foot ulcer: 5.9%  Peripheral vascular disease: 11.8% | [89] |
| Qatar | 2011 | 540 | Retinopathy: 23.5% | [90] |
| 2014 | 1633 | Retinopathy: 12.5%  Nephropathy: 12.4%  Neuropathy: 9.5% | [91] |
| Oman | 2003 | 2249 | Retinopathy: 14.9% | [92] |
| 2009 | 418 | Retinopathy: 7.9% | [93] |
| 2012 | 2551 | Microalbuminuria: 37%  Nephropathy: 5% | [94] |
| 2012 | 699 | Nephropathy: 42.5% | [95] |
| Yemen | 2011 | 694 | Blindness: 15.7% | [96] |
| 2009 | 350 | Retinopathy: 55% | [97] |
| 1997 | 1095 | Peripheral neuropathy: 40.7% | [98] |
| 2010 | 311 | Peripheral vascular disease: 9.1% | [99] |
| Jordan | 2015 | 3638 | Blindness: 1.3%  Severe visual impairment: 1.82%  Correctable visual impairment: 9.49% | [100] |
| 2008 | 986 | Retinopathy: 64.1% | [101] |
| 2005 | 986 | Blindness: 7.4% | [102] |
| 2003 | 1142 | Microalbuminuria: 33%  Ulceration: 4%  Amputation: 5% | [103] |
| Egypt | 2011 | 1325 | Retinopathy: 20.5% | [104] |
| 2015 | 2000 | Neuropathy: 29.3%  Peripheral vascular disease: 11% | [105] |
| 1998 | 4600 | Retinopathy: 42%  Blindness: 5%  Nephropathy: 7%  Neuropathy: 22%  Foot ulcer: 1% | [67] |
| Tunisia | 2014 | 2320 | Retinopathy: 26.3% | [106] |
| Libya | 2012 | 260 | Retinopathy: 16.2%  Nephropathy: 1.5%  Neuropathy: 11.2% | [107] |



**Figure 1 Number of studies reviewed by title and/or abstract for each Arabic country.**



**Figure 2 Research scheme and exclusion criteria.** T2DM: Type-2 diabetes mellitus; T1DM: Type-1 diabetes mellitus.