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Brief Report**Trends in the prevalence of type 2 diabetes mellitus and obesity in the Arabian Gulf States: systematic review and meta-analysis**

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Brief Report**Trends in the prevalence of type 2 diabetes mellitus and obesity in the Arabian Gulf States: systematic review and meta-analysis****Abstract**

We report trends in type 2 diabetes mellitus and obesity in adults residing in the Arabian Gulf States. Among the Saudi population, the prevalence of diabetes increased from 10.6% in 1989 to 32.1% in 2009. Prevalence of the disease increased faster among Saudi men than women, with growth rates of 0.8% and 0.6% per year, respectively.

Brief Report

Trends in the prevalence of type 2 diabetes mellitus and obesity in the Arabian Gulf States: systematic review and meta-analysis

The prevalence of Type 2 Diabetes Mellitus (T2DM) has increased rapidly in Arabic countries over the past 30 years. According to the International Diabetes Federation (IDF), three of the Arabian Gulf countries have the highest prevalence of T2DM anywhere in the world (1). Obesity is one of the main factors affecting the prevalence of T2DM, which has also reached epidemic proportions in the Arabian Gulf States (2). However, exact figures relating to the increasing prevalence of these diseases have yet to be collected, compared and analysed for the region (3–5). We report how the prevalence of T2DM and obesity had changed over the last 30 years among adults residing in the Arabian Gulf States.

Methods

We conducted a comprehensive literature search for studies of T2DM and obesity using Medline and Embase. In addition, we reviewed the reference lists from retrieved articles in order to identify additional relevant papers. We included publications dating from 1st January 1979 to 31st December 2011 and focussed specifically on studies describing the prevalence of diabetes and obesity according to the WHO criteria, or the equivalent, explicit, blood glucose-level criteria for the diagnosis of diabetes. We included studies that considered both type 1 and type 2 diabetes, because T2DM accounts for over 90% of all diabetes cases (6).

Two reviewers (N. H. and R. M.) independently reviewed the title, the abstract, and the article. Discrepancies were resolved by consensus or determined by other reviewers (K. K. and S. de L.). Meta-analysis was performed to estimate pooled prevalence rates using a

random-effects model which gives an average estimate across studies weighted by sample size. In addition, we used meta-analysis to assess the prevalence trends by year for both sexes.

Results

A total of 34 papers (36 studies) met our inclusion criteria: 21 assessed the prevalence of T2DM, and 12 reported the prevalence of obesity, while a further 3 assessed the prevalence of both diabetes and obesity. The prevalence of diabetes varied between the countries. The current estimated prevalence of T2DM among the Arabian Gulf population ranged from 5.9% in the United Arab Emirates (7) to 32.1% in Saudi Arabia (8), while the recorded prevalence of obesity ranged from 20.3% in Saudi Arabia (9) to 56% in Kuwait (10). Details of individual prevalence studies are reported in appendix 1.

Although the overall estimate of the prevalence of T2DM was 14.9% we used a random-effects model to identify differences among the collected data. This heterogeneity arose from differences in the countries, and the year of publication. We could not apply the heterogeneity test to the obesity studies because there was too small a number of studies included and most of them were conducted in Saudi Arabia.

The prevalence of diabetes among the Saudi population increased over time from 12.4% in 1987 (11) to 27.7% in 2011 (12). Using a simple statistical analysis (t-test), it appeared that there was no significant difference in the prevalence of T2DM between genders. However, there was a significant difference in the rate of increase between males and females with T2DM. Our results showed that the prevalence of T2DM was estimated to increase by about 0.8% in males and 0.6% in females each year ($p < 0.0001$). There were

insufficient data on the prevalence of obesity in adults to observe a clear trend occurring over time (see Figure 1).

Discussion

Consistent with the findings of other studies is our observation that T2DM and obesity have a higher prevalence in Arabian Gulf States than most other countries. These findings fit with a non-systematic review of a smaller number of studies published between 1982 and 2004, which estimated that diabetes prevalence increased from 2.5% to 23.7%, for both genders and all age groups in Saudi Arabia (13). The prevalence estimate of T2DM among Saudi adults is similar to increases reported in Bangladesh and Iran (14, 15). We also found, however, that there is a steeper increase rate of prevalence of T2DM among men than among women, a finding which has previously not been detected in earlier studies.

The IDF reports that the prevalence of diabetes in Saudi Arabia for both sexes in 2012 was 23.38% (16). Our review estimates the prevalence to be higher, however, putting the figures at 25% for men and 31% for women (see Figure 1). These figures are likely to be more accurate estimates than the IDF's estimation because in the Middle East and North African regions over half of all cases of diabetes are undiagnosed (53%) (16).

Physical inactivity, poor eating habits, and increasingly sedentary lifestyles are probably responsible for the T2DM epidemic among Saudi citizens: for example, people now make greater use of cars than they used to in the country and tend to begin meetings with sweet tea and snacks (17). Obesity and being overweight are major factors contributing to the onset of T2DM (12). In this review, we found more limited evidence relating to the prevalence of obesity. Further research is needed to ascertain the prevalence of ongoing

trends in obesity and to identify any other factors that compound the risk of T2DM onset. The quality of T2DM management in Arabian Gulf states is ranked as “poor” (18). The Gulf States need to plan interventions to reverse this trend. Preventative interventions have been shown to reduce obesity and influence outcomes in terms of diabetes onset. Such interventions like the Diabetes Prevention Program (DPP) in the United States of America (19) and the national prevention program in Finland (20) have shown that T2DM can be prevented or delayed in persons at high risk of developing diabetes.

There have been previous systematic reviews of diabetes studies in the Arabian Gulf states, but none have focused on the difference in prevalence rates of T2DM according to gender (4, 5, 13). The limitations of these reviews are as follows: the majority of the studies reviewed did not distinguish between type 1 and type 2 diabetes, and the studies reviewed displayed heterogeneity of methods, sample size, and age range.

In conclusion, this systematic review reports an increase in the prevalence of T2DM and obesity among Arabian Gulf citizens, as well as identifying a higher prevalence rate among men than women. These trends require urgent intervention such as the implementation of prevention, health promotion, and improved diabetes management systems.

Acknowledgments

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References:

1: Guariguata L, Whiting DR, Hambleton I, Beagley J, Linnenkamp U, Shaw JE. Global estimates of diabetes prevalence in adults for 2013 and projections for 2035 for the IDF Diabetes Atlas. *Diabetes Res Clin Pract* 2014. 103 (2): 137-1492:

- 2: Caballero B. A nutrition paradox – underweight and obesity in developing countries. *N Engl J Med* 2005;352:1514–1516.
- 3: Ng SW, Zaghoul S, Ali HI, Harrison G, Popkin BM. The prevalence and trends of overweight, obesity and nutrition-related non-communicable diseases in the Arabian Gulf States. *Obes Rev* 2011;12:1–13.
- 4: Al-Hyas L, McKay A, Balasanthiran A, Majeed A. Prevalences of overweight, obesity, hyperglycaemia, hypertension and dyslipidaemia in the Gulf: Systematic review. *J R Soc Med Sh Rep* 2011;2:55
- 5: Al-Hyas L, McKay A, Majeed A. Prevalence of Type 2 Diabetes in the States of The Co-Operation Council for the Arab States of the Gulf: A Systematic Review. *PLoS One* 2012;7:e40948.
- 6: American Diabetes Association Standards of Medical Care in Diabetes–2010. *Diabetes Care* 2010;33(Suppl. 1):S11–S61.
- 7: El-Mugamer IT, Ali Zayat AS, Hossain MM, Pugh RN. Diabetes, obesity and hypertension in urban and rural people of Bedouin origin in the United Arab Emirates. *J Trop Med Hyg.*
- 8: Alqurashi KA, Aljabri KS, Bokhari SA. Prevalence of diabetes mellitus in a Saudi community. *Ann Saudi Med* 2011;31:19–23.
- 9: Al-Shammari SA, Khoja TA, Al-Maatouq MA. The prevalence of obesity among Saudi males in the Riyadh region. *Ann Saudi Med* 1996;16:269–273.
- 10: Al-Kandari YY. Prevalence of obesity in Kuwait and its relation to sociocultural variables. *Obes Rev* 2006;7:147–154.

- 11: Fatani H, Mira S, El-zubier A. Prevalence of diabetes mellitus in rural Saudi Arabia. *Diabetes Care* 1987;10:180–183.
- 12: Al-Daghri NM, Al-Attas OS, Alokail MS, Alkharfy KM, Yousef M, Sabico SL, Chrousos GP. Diabetes mellitus type 2 and other chronic non-communicable diseases in the central region, Saudi Arabia (Riyadh cohort 2): a decade of an epidemic. *BMC Med* 2011;20:9:76
- 13: Elhadd TA, Al-Amoudi AA, Alzahrani AS. Epidemiology, clinical and complications profile of diabetes in Saudi Arabia: a review. *Ann Saudi Med* 2007;27:241–250.
- 14: Saquib N, Saquib J, Ahmed T, Khanam MA, Cullen MR. Cardiovascular diseases and Type 2 Diabetes in Bangladesh: A systematic review and meta-analysis of studies between 1995 and 2010. *BMC Public Health* 2012;12:434.
- 15: Haghdooost AA, Rezazadeh-Kermani M, Sadghirad B, Baradaran HR. Prevalence of type 2 diabetes in the Islamic Republic of Iran: systematic review and meta-analysis. *East Mediterr Health J* 2009;15:591–599.
- 16: International Diabetes Federation. *IDF Diabetes Atlas*, 5th edn. Brussels, Belgium: International Diabetes Federation, 2012 Available from http://www.idf.org/sites/default/files/5E_IDFAtlasPoster_2012_EN.pdf. Accessed 4 July 2012.
- 17: Badran M, Laher, I, Type II Diabetes Mellitus in Arabic-Speaking Countries. *Int J Endocrinol* 2012;1–11.
- 18: Al-Hyas L, McKay A, Balasanthiran A, Majeed A. Quality of type 2 diabetes management in the states of the Co-operation Council for the Arab States of the Gulf: a systematic review. *PLoS One* 2011;8:e22186.

19: Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 2002;346:393–403.

20: Tuomilehto J, Lindström J, Eriksson JG, et al. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med* 2001;344:1343–1350.

Figure 1: Rise in the prevalence of diabetes among Saudi women and men 1980–2012