

Diabetes mellitus, hypertension and obesity — common multifactorial disorders in Saudis

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SUMMARY Diabetes mellitus, hypertension and obesity are among the multifactorial disorders that occur at a higher prevalence in older age groups. Their prevalence is affected by both genetic and environmental factors. We investigated the distribution of diabetes mellitus, hypertension and obesity in Saudi males and females by conducting a household screening survey during the period 1992–1996 of the adult population (> 14 years) in five different areas of Saudi Arabia. Height, weight, age and other essential details were recorded and diastolic and systolic blood pressures measured. Glucose levels were measured in blood taken after fasting and 2 hours after a glucose load. The data were used to classify the individuals as diabetic, glucose intolerant and normal, using WHO criteria. The individuals were further classified as type 1 diabetes mellitus and type 2 diabetes mellitus. The overall prevalence of diabetes mellitus was 9.7% and 7.0%, obesity 13.05% and 20.26%, overweight 27.23% and 25.20%, and hypertension 5.39% and 3.65% in the adult male and female populations respectively. A significant increase was observed in the prevalence of diabetes, obesity and hypertension with age in both males and females. In addition, the prevalence of obesity and overweight was significantly higher in the individuals with diabetes mellitus.

Introduction

One of the most frequently encountered group of genetic disorders are those referred to as multifactorial disorders [1–3]. These disorders require genetic and environmental factors for their development and are generally polygenic, i.e. several different genetic loci each contribute partially to the disease development. The disorder occurs in the genetically susceptible individuals in the presence of the precipitating environmental factors [1–3]. Among the

adult-onset group of multifactorial disorders are diabetes mellitus, hypertension and obesity [1–3]. These disorders occur in almost all populations although at differing prevalence rates. These disorders can result in significant morbidity and mortality and hence extensive epidemiological studies have been devoted to determine their prevalence [4,5]. Apart from the prevalence of these disorders differing in different populations, further variations result from age and sex differences, nutritional habits, lifestyle and extent of physical activity [4–8].

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In Saudi Arabia, we conducted a nationwide study during the period 1992–1995 in an attempt to determine the prevalence of diabetes mellitus, obesity, overweight and hypertension in adult males and females and found the prevalence of all these disorders was high [9–11].

Here we review our findings and show that these disorders constitute some of the most common causes of chronic morbidity in the Saudi population.

Subjects and methods

The study group included 14 660 adult males and females > 14 years (males = 6162, females = 8498) living in different areas of Saudi Arabia, screened during a household screening programme to determine the prevalence of diabetes mellitus. Five areas of Saudi Arabia (Figure 1) were divided into different sectors and the sectors were randomly selected for screening. In the selected sector, every 10th street and every 10th house on the selected streets was enrolled in the study. Contact was made with the household members, the



Figure 1 Map of the five regions of Saudi Arabia designated for the study

purpose of the study was explained and a date was mutually agreed upon for the screening visit. Less than 5% of the families declined to join in the study.

On the day of the visit the adult family members (> 14 years) were requested to remain in a fasting state. An early morning visit was made and essential details were recorded about the family. A fasting blood sample was drawn in a heparinized tube by venepuncture. Height and weight were recorded and systolic and diastolic blood pressures were measured following a standardized procedure published earlier [11]. Fasting glucose level was estimated immediately in whole blood using a blood glucometer (Coulter-Wallace International, USA) using Answer™ blood glucose test strips impregnated with glucose oxidase/oxidase. The glucometer was regularly standardized against an autoanalyser (American Monitor Parallel) at the King Khalid University Hospital, Riyadh. Each adult was given an oral dose of 75 g glucose in 200–250 mL water and after exactly 2 hours a blood sample was taken and glucose was estimated using the Answer™ glucometer. The diagnosis of diabetes mellitus was based on World Health Organization (WHO) criteria using the fasting and 2-hour post-glucose load glucose levels [8, 12].

Height and weight data were used to calculate quetelet index or body mass index (BMI) using the formula: weight (kg)/height² (m²).

Results

Only adult Saudis (> 14 years) were included in the study. Using WHO criteria, the diabetic individuals were identified and the total prevalences of type I diabetes mellitus, type II diabetes mellitus and

Table 1 Prevalence of diabetes mellitus, impaired glucose tolerance, hypertension, overweight and obesity in Saudi Arabia according to region

Region	Prevalence (%)					
	Type 1 DM	Type 2 DM	IGT	Hypertension	Overweight	Obesity
<i>Northern</i>						
Male	0.15	4.64	0.50	7.07	27.51	11.62
Female	0.09	3.98	0.82	3.75	24.97	20.88
<i>North-western</i>						
Male	0.36	11.30	0.24	6.39	27.98	11.65
Female	0.46	6.61	0.41	4.55	24.15	21.80
<i>South-western</i>						
Male	0.20	4.08	0.36	4.00	24.40	9.14
Female	0.24	3.83	0.69	2.64	23.16	15.75
<i>Central</i>						
Male	0.21	5.40	0.64	3.68	30.32	16.03
Female	0.34	4.54	0.77	2.93	27.90	24.40
<i>Eastern</i>						
Male	0.44	4.37	4.53	17.47	21.40	12.66
Female	0.68	4.96	1.20	13.03	27.27	16.96
<i>All regions</i>						
Male	0.23	5.63	0.50	5.39	27.23	13.05
Female	0.30	4.53	0.72	3.65	25.20	20.26

DM = diabetes mellitus IGT = impaired glucose tolerance

impaired glucose tolerance (IGT) were calculated in the total males and females (Table 1). The individuals were grouped on the basis of the region to which they belonged and the prevalence of diabetes was calculated separately in each region (Table 1). In addition, further grouping was carried out on the basis of age and the prevalence of diabetes was calculated in each age group (Table 2).

Systolic and diastolic blood pressure values were used to classify the individuals as nonhypertensive or hypertensive (i.e. systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure > 90 mmHg). The overall prevalence of hypertension in the

total Saudi population and in the different regions is shown in Table 1. A significant difference in the prevalence of hypertension existed between the different regions of Saudi Arabia.

The individuals were classified as obese or overweight based on BMI. BMI < 25 kg/m² was considered normal, 25–29.9 kg/m² was overweight and ≥ 30 kg/m² was obese [13,14]. The prevalence of overweight and obesity was calculated in the total population screened and in the different regions (Table 1). The prevalence of obesity and overweight rose significantly with age in both males and females (Table 3).

Discussion

This study showed the high prevalence of diabetes mellitus, obesity and overweight in adult Saudi males and females. Our results showed that these multifactorial disorders

were present in all provinces of Saudi Arabia, although at considerably different prevalence rates. Type 2 diabetes mellitus occurred at the highest prevalence in males (11.30%) and females (6.61%) in the north-western regions. In almost every region the

Table 2 Prevalence of diabetes mellitus in male and female Saudi according to age group

Age group (years)	Prevalence (%)					
	Type I DM	Males Type II DM	IGT	Type I DM	Females Type II DM	IGT
14-20	0.311	0.380	0.035	0.320	0.987	0.420
30-44	0.365	7.012	0.876	0.265	5.030	1.552
45-59	-	21.061	1.567	-	22.090	2.285
>60	0.116	28.750	1.630	0.167	24.370	3.830

DM = diabetes mellitus

IGT = impaired glucose tolerance

Table 3 Prevalence of overweight and obesity in Saudis according to age group and sex

Age group (years)	No Investigated	Obesity ^a			Overweight ^a		
		No.	%	χ^2 (P-value)	No.	%	χ^2 (P-value)
14-19							
Males	2018	94	4.7	2.77	170	8.4 ^b	9.98
Females	2484	112	4.5	(> 0.1)	291	11.7 ^b	(< 0.01)
20-29							
Males	1073	98	9.1 ^b	10.93	230	21.4	2.77
Females	2325	306	13.2 ^b	(< 0.0001)	565	24.3	(0.096)
30-39							
Males	923	147	15.9 ^b	40.68	334	36.2 ^b	8.37
Females	1787	481	26.9 ^b	(< 0.0001)	547	30.6 ^b	(< 0.005)
40-49							
Males	816	157	19.2 ^b	63.5	315	38.6 ^b	16.34
Females	1111	400	36.0 ^b	(< 0.0001)	330	29.7 ^b	(< 0.0001)
≥ 50							
Males	1816	298	16.4 ^b	68.8	640	35.2	0.53
Females	1357	390	28.7 ^b	(< 0.0001)	472	34.8	(> 01)

^aThe chi-squared test for trend was highly significant ($P = 0.00$) for both obesity and overweight by age.

^bThe difference in the prevalence rates of obesity and overweight in the males and females of the same age group was statistically significant.

Increase in obesity and overweight with age in males and females was statistically significant.

prevalence in the males was significantly higher than the females and in both sexes the prevalence rose significantly with age.

Similarly, obesity and overweight occurred at a high prevalence in all regions, although the prevalence rates showed considerable variation. In each area, the prevalence of overweight was greater in males than females, while the prevalence of obesity was greater in females. There was a statistically significant difference between males and females. Interestingly, a very significant increase was observed in the prevalence of both obesity and overweight with age, where the number of obese females was almost twice that of obese males over 40 years of age.

In addition to genetic contributors to diabetes mellitus, overweight and obesity, several environmental factors favour the development of these disorders in the Saudis. These factors include the dietary habits (i.e. high consumption of carbohydrates and fats), lifestyle and lack of exercise (i.e. largely sedentary lifestyle, with very few people participating in any kind of sports or any other strenuous physical activity), climate (i.e. hot climate most of the year round which discourages outdoor physical activity and encourages an afternoon siesta after a heavy lunch) (El-Hazmi MAF et al., unpublished data). These and other factors may cause overweight and obesity, and it is well documented that obesity and overweight are one of the factors involved in the development of diabetes mellitus and hypertension [15-19].

The prevalence of hypertension was much lower than that reported in some other populations of the world [20]. Different populations belong to different races, have different habitats and dietary habits and have different risks for developing certain

disorders. For example, the Japanese, Koreans and Chinese are classified as high-risk populations for developing hypertension [21]. Nutritional studies have shown that low-risk populations have a low sodium intake compared with high-risk populations [22]. In addition, an increase in blood pressure also occurs with age and increase of BMI. Weight gain during adult life is an important risk factor for the development of hypertension [23] and the risk is greatest in those who gain weight during the third and fourth decades of life [24].

Saudi Arabia is amongst the low-risk populations for hypertension except for the population in the eastern provinces. A low prevalence of hypertension was also reported in a study in Medina conducted by Ahmed and Mahmoud [25]. The differences in the prevalence rates of obesity, overweight, diabetes mellitus and hypertension in the different regions of Saudi Arabia could be due to differences related to the genetic make-up of the populations, since the dietary habits, lifestyle and environmental factors do not differ considerably in the different regions [9-11].

This study has shown that multifactorial disorders, such as diabetes mellitus, obesity, overweight and hypertension, are frequently encountered in Saudis. Since by controlling the environmental factors, it is possible to slow down or inhibit the development of these disorders, steps are urgently required for the control and prevention of these common adult-onset multifactorial conditions. A comprehensive study to investigate the prevalence of diabetes mellitus in families and to determine the frequency of familial cases in different age groups is underway and will be published separately.

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Correction

Sociodemographic determinants of management behaviour of diabetic patients. Part 1. Behaviour of patients in relation to management of their disease by N.M. Kamel, Y.A. Badawy, N.A. El-Zeiny and I.A. Merdan. EMHJ Vol 5 No. 5 September 1999, pages 967-973.

On page 968 under Subjects and Methods, paragraph 1, lines 1-6 should read: A cross-sectional descriptive approach was used where the target population was the diabetic patients attending one randomly selected diabetic clinic of the Health Insurance Organization (HIO) in Alexandria.