Prevalence of overweight and obesity in diabetic and non-diabetic Saudis

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انتشار زيادة الوزن والسمنة بين السعوديين من السكّريين ومن غير السكّريين

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خلاصة: شملت هذه الدراسة 14 660 شخصاً. فتم فحص عينة من دم الصائم وعينة بعد ساعتين من إعطاء جمل من الغلوكوز لكل مشارك لتعيين مستوى سكر الدم لديه. وتم تصنيف المشاركين باعتبارهم سكريين أو غير سكريين، وكذلك باعتبارهم سمان (منسب كتلة الجسم أكبر من 30 كيلوغرام/متر مربع) أو زائدي الوزن (منسب كتلة الجسم 25 – 29.9 كيلوغرام/متر مربع) أو أسوياء (منسب كتلة الجسم أقل من 25 كيلوغرام/متر مربع). وتم حساب معدل انتشار السمنة في العينة كلها، وكذلك في السكّريين وغير السكّريين من الذكور والإناث كل على حدة. وأظهرت النتائج وجود السمنة وزيادة الوزن في 13.05% و27.23% من الذكور، وفي 20.26% و25.20% من الإناث على التوالي. وكان انتشار السمنة وزيادة الوزن أكثر ارتفاعاً بدرجة يعتد بها إحصائياً بين السكّريين عنها بين غير السكّريين. وفي كل منطقة من المناطق أبدى السكّريون معدل انتشار للسمنة أعلى بدرجة يعتد بها إحصائياً عنه بالنسبة لغير السكّريين. ولوحظت اختلافات متعددة بين المناطق. ويوصى بتوعية الجماهير في المملكة العربية السعودية حول السمنة وزيادة الوزن وكيفية تخفيضهما.

ABSTRACT A total of 14 660 individuals were included in the study. A fasting blood sample and 2-hour post-glucose load blood sample from each participant were analysed for blood sugar. Participants were classified as diabetic or non-diabetic and as either obese (BMI > 30 kg/m²), overweight (BMI 25–29.9 kg/m²) or normal (BMI < 25 kg/m²). The prevalence of obesity was calculated in the total sample and separately for diabetic and non-diabetic males and females. The results showed obesity and overweight in 13.05% and 27.23% of males and 20.26% and 25.20% of females respectively. The prevalence of both obesity and overweight were significantly higher among diabetics than non-diabetics. In each province, diabetics had a significantly higher prevalence of obesity than non-diabetics. Several interprovincial variations were seen. Public education on obesity and overweight and ways to decrease them are recommended in Saudi Arabia.

Prévalence de la surcharge pondérale et de l'obésité chez les Saoudiens diabétiques et non diabétiques

RESUME Au total, 14 660 personnes ont été incluses dans cette étude. Un prélèvement sanguin à jeun et un prélèvement sanguin deux heures après charge en glucose ont été analysés pour chaque participant afin de déterminer la glycémie. Les participants ont été classifiés en diabétiques ou non-diabétiques et en obèses (indice de masse corporelle > 30 kg/m²), ayant une surcharge pondérale (indice de masse corporelle 25-29,9 kg/m²), ou normaux (indice de masse corporelle < 25 kg/m²). La prévalence de l'obésité a été calculée dans l'échantillon total et séparément pour les hommes et femmes diabétiques et non diabétiques. Les résultats ont montré une obésité et une surcharge pondérale chez 13,05% et 27,23% des hommes et 20,26% et 25,20% des femmes respectivement. La prévalence de l'obésité ainsi que de la surcharge pondérale était considérablement plus élevée chez les diabétiques que chez les non-diabétiques. Dans chaque province, les diabétiques avaient une prévalence d'obésité considérablement plus élevée que les non-diabétiques. Plusieurs variations interprovinciales ont été observées. L'éducation du public sur l'obésité et la surcharge pondérale ainsi que des moyens de réduire ces deux affections sont recommandés en Arabie saoudite.

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Received: 07/03/99; accepted: 25/07/99

Introduction

Obesity is defined as "excessive deposition of fat in the body" [*1*]. It is the most common nutritional disorder in industrialized countries and is becoming increasingly prevalent in developing countries due to changing lifestyles [*2,3*].

The association of obesity with other serious conditions has been well recognized since ancient times when Hippocrates reported, "Sudden death is more common in those who are naturally fat than in the lean" [*4*]. Following several well designed studies, it has been established that obesity is associated with an increased prevalence of coronary artery disease, hypertension, diabetes mellitus, arteriosclerosis, arthritis, hyperlipidaemias, biliary track diseases, cancers, gout and several other disorders [*6–18*]. In addition, life expectancy is shown to be reduced in those who are obese or overweight.

Several etiological factors are involved in the development of obesity and, more recently, it has been established that obesity has a partial genetic basis; thus it has been classified as a multifactorial disorder [*19*]. Multifactorial disorders are polygenic, each gene having a small contribution in the presence of precipitating environmental factors, such as lifestyle, nutritional imbalance, physical inactivity, neuroendocrine disorders and the effect of certain drugs, Multifactorial disorders do not obey any specific Mendelian pattern of inheritance, but they concentrate in families [*19*].

The prevalence of obesity varies throughout the world [*2,3,5*]. Table 1 presents examples of the prevalence of obesity in males and females from different countries and different age groups. In addition, the prevalence of obesity varies in different pathological states [*12–18*]. One of the chronic states which goes hand-in-hand is diabetes mellitus [*12–18*]. These two states have been referred to as the odd couple; on the one hand, diabetic patients are often obese, while on the other, obese individuals frequently develop diabetes [*12*].

Table 1 **Prevalence of obesity in different age groups in different populations**

Age group (years)	Prevalence (%) of obesity	
	Men	Women
Australia		
25–34	4.0	5.7
35–44	6.2	7.5
45–54	10.2	22.0
55–64	9.6	12.5
25–64	7.0	7.0
South Africa		
15–24	3.6	4.6
25–34	13.2	10.5
35–44	14.3	15.6
45–54	20.9	23.8
55–64	19.8	31.7
15–64	14.7	18.0
United States of America		
20–24	7	7
25–34	10	12
35–44	12	16
45–54	16	18
55–64	14	21
20–64	12	15
United Kingdom		
20–24	3	5
25–34	6	6
35–44	8	8
45–54	8	12
55–46	9	14
20–64	8	9
Italy		
15–44	4.8	3.9
45–64	9.9	11.1

Source: [4]

To study the association between obesity and diabetes mellitus, we initiated this evaluation of the prevalence of obesity in diabetic and non-diabetic individuals living in different provinces of Saudi Arabia. The study was a part of a national programme for the study of diabetes mellitus.

Materials and methods

Throughout Saudi Arabia, 14 660 individuals (6162 males and 8498 females) (age range 14–70 years) were studied in a household screening survey. The country was divided into sectors; in randomly selected sectors, every 10th house on every 10th street was selected. The health centre in each area was visited and family details obtained. Only those families who volunteered after being contacted by telephone were included in the study. The refusal rate was < 5%. On a mutually agreed date, family members were asked to fast overnight. At an early morning visit, physical details (height, weight, age) were recorded. A blood sample was drawn from every family member older than 14 years. Each member was given a drink containing 75 g of glucose in 300 mL water and after exactly 2 hours a second blood sample was drawn. Both blood samples were used to estimate blood glucose immediately on a glucometer, which was regularly standardized, and on an autoanalyser (American Monitor Parallel) at King Khalid University Hospital in Riyadh.

Chi-squared analysis using 2 × 2 contingency tables was used to determine the significance of the difference in results of any two groups. $P < 0.05$ was considered statistically significant.

Results

Height and weight data were used to calculate the body mass index (BMI) for each individual [*20,21*]. The male and female data were separately analysed and the prevalence of overweight (BMI 25–29.9 kg/m^2) and obesity (BMI > 30 kg/m^2) were calculated. Of the males studied, 804 (13.05%) were obese and 1678 (27.23%) were overweight. Among the females, 1722 (20.26%) were obese and 2142 (25.20%) were overweight. The difference in the prevalence of obesity and overweight in the male and female samples was statistically significant ($\chi^2 = 130.5$, $P < 0.0001$).

Table 2 Prevalence of obesity and overweight in diabetic and non-diabetic Saudis

Sex	Diabetic					Non-diabetic				
	No. studied	Obese		Overweight		No. studied	Obese		Overweight	
		No.	%	No.	%		No	%	No.	%
Males[a]	711	147	20.68	263	36.99	5451	657	12.05	1412	25.90
Females[b]	708	278	39.27	210	29.66	7790	1444	18.54	1929	24.76
Total[c]	1419	425	29.95	473	33.33	13241	2101	15.87	3341	25.23

There was a statistically significant difference between the diabetics and non-diabetics
[a] $\chi^2 = 105.153$, $P < 0.0001$
[b] $\chi^2 = 221.927$, $P < 0.0001$
[c] $\chi^2 = 291.001$, $P < 0.0001$

Table 3 **Prevalence of obesity and overweight in the diabetic and non-diabetic Saudi population in different regions of Saudi Arabia**

Region	Sex	Diabetic					Non-diabetic				
		No. investigated	Obese		Over-weight		No. investigated	Obese		Over-weight	
			No.	%	No.	%		No.	%	No.	%
Central[a]	M	214	53	24.8	72	33.6	1633	243	14.9	485	29.7
	F	246	98	39.8	62	25.2	2278	519	22.8	641	28.1
Eastern[b]	M	19	4	21.0	8	42.1	210	25	11.9	41	19.5
	F	25	13	52.0	7	28.0	305	43	14.1	83	27.2
Northern[c]	M	107	27	25.2	40	37.3	1020	104	10.2	270	26.5
	F	100	45	45.0	28	28.0	1418	272	19.2	341	24.0
Southern[d]	M	182	21	11.5	69	37.9	1744	155	8.9	401	23.0
	F	189	67	35.4	58	30.7	2579	369	14.3	581	22.5
Western[e]	M	189	42	22.2	74	39.2	844	130	15.4	215	25.5
	F	148	55	37.2	55	37.2	1210	241	19.9	273	22.6

There was a statistically significant difference between the diabetics and non-diabetics
[a] *M: $\chi^2 = 19.239$, P = 0.0001; F: $\chi^2 = 36.468$, P = 0.0001*
[b] *M: $\chi^2 = 5.196$, P = 0.07; F: $\chi^2 = 25.769$, P = 0.0001*
[c] *M: $\chi^2 = 26.360$, P = 0.001; F: $\chi^2 = 55.470$, P = 0.0001*
[d] *M: $\chi^2 = 33.746$, P = 0.0001; F: $\chi^2 = 44.784$, P = 0.0001*
[e] *M: $\chi^2 = 23.954$, P = 0.0001; F: $\chi^2 = 79.769$, P = 0.0001*

The data of the fasting and 2-hour post-glucose load blood glucose were used to classify individuals as diabetic or non-diabetic according to WHO classification [*22,23*]. Only those with type 2 diabetes mellitus and non-diabetic individuals were included in the study. Male and female type 2 diabetics were separated and the prevalence of obesity and overweight were calculated for each group (Table 2 and Figure 1). In each case, overweight and obesity were significantly higher in diabetics than non-diabetics ($P < 0.001$). There were more overweight diabetic males than females, while obesity was more common in females in both groups ($P < 0.001$).

The population was grouped by province and overweight and obesity were calculated separately in non diabetic and

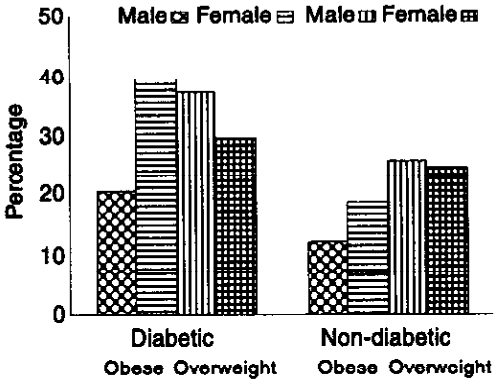

Figure 1 **Prevalence of obesity and overweight in diabetic and non-diabetic Saudis**

diabetic individuals. The results are presented in Table 3. There were significant differences in the prevalence of obesity and overweight in diabetic and non-diabetic individuals in the different provinces.

Discussion

The results of this study show that obesity can be regarded as a major health problem among the Saudi population. We found that in the overall population aged 14–70 years, 13.05% of males were obese and 20.26% of females. This value is higher than that reported in the UK, Australian, US and Italian populations (Table 1).

In an attempt to investigate whether obesity plays a role in diabetes, diabetics and non-diabetics were separately investigated. We found that both overweight and obese males and females were more often diabetics and the difference was statistically significant ($P < 0.001$). Such results were encountered in every region when data were analysed. This contributes to the notion that obesity may be one of the etiological factors in the development of diabetes mellitus. Diabetes mellitus has been reported to occur frequently in the Saudi population as shown in several recent studies [*24–29*].

Obesity has also been implicated as a risk factor for the development of cardiovascular disease, hypertension, cerebral and peripheral vascular disease, hyperlipidaemia, biliary tract disease, osteoarthritis, gout, cancer of the gastrointestinal tract, uterus and ovary, and diseases of the female reproductive tract, and has been linked to an increase in the mortality rate [*7–18*]. The risk increases with the extent of obesity and those with a BMI > 40 kg/m^2 are at highest risk. Conversely, the above-mentioned conditions have been shown to improve as obesity decreases [*30–32*].

It is evident that steps must be taken to decrease the prevalence of obesity in order to limit more serious conditions. Factors most closely associated with obesity include dietary habits, lifestyle, extent of physical activity and genetic susceptibility. On the whole, Saudi dietary habits are reasonably healthy, although consumption of sugar and dates is high. The major factor is probably sedentary lifestyle; physical activity is limited, most housework is done by home help and outdoor activities are scarce. In addition, hot climatic conditions 6–8 months per year restrict outdoor activities. Genetics may also play a role since obesity is multifactorial and tends to concentrate in Saudi families. Our study also revealed a higher prevalence of obese siblings if one or both parents were obese (El-Hazmi MAF et al., unpublished data).

Public education about obesity and its consequences is thus strongly recommended. Ways by which obesity and overweight can be controlled and prevented should be made known to the general public. Articles need to be written and published in the Arabic press, which are read by the general public. Education about obesity and diabetes mellitus could be incorporated in the school curriculum. Public lectures could be given on this important health condition, and television programmes, which are widely watched, should focus on this topic.

In the present study, we have illustrated the high prevalence of obesity among Saudis, and a significantly higher prevalence among those with diabetes compared with those without diabetes. It clearly highlights the need for prevention programmes.

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