

Diabetes mellitus as a health problem in Saudi Arabia

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السكري، كمشكلة صحية في المملكة العربية السعودية

محسن علي فارس الحازمي وأرجمند سلطان وارسى وعبد الرحمن السويلم وعبد المحسن السويلم ورياض سليمان

خلاصة : فحص 25 337 مواطناً سعودياً [11 713 (46.2%) من الذكور و13 624 من الإناث (53.8%)] لكشف السكري واختلال تحمل الغلوكوز بينهم وفقاً لمعايير التشخيص في منظمة الصحة العالمية. وتبين أن معدل انتشار السكري المعتمد على الإنسولين 0.23% والسكري غير المعتمد على الإنسولين 5.63% واختلال تحمل الغلوكوز 0.60%. أما لدى السعوديات فقد كانت معدلات انتشار السكري المعتمد على الإنسولين 0.30% والسكري غير المعتمد على الإنسولين 4.53% واختلال تحمل الغلوكوز 0.72% مع وجود اختلافات بين المناطق. وبعد سن الستين، ارتفع معدل انتشار السكري غير المعتمد على الإنسولين إلى 28.82% بين الذكور وإلى 24.92% بين الإناث، بينما ارتفع معدل اختلال تحمل الغلوكوز إلى 1.60% عند الذكور و3.56% عند الإناث.

ABSTRACT A total of 25 337 Saudis [11 713 males (46.2%) and 13 624 females (53.8%)] were screened for diabetes mellitus and impaired glucose tolerance using WHO criteria for diagnosis. The prevalence of insulin-dependent diabetes mellitus, non-insulin-dependent diabetes mellitus and impaired glucose tolerance in the total Saudi male population was 0.23%, 5.63% and 0.50% respectively, and in the total Saudi female population was 0.30%, 4.53% and 0.72% respectively. Differences were observed in the prevalence of diabetes mellitus and impaired glucose tolerance between the provinces. Non-insulin-dependent diabetes mellitus increased to 28.82% and 24.92% in males and females respectively over the age of 60 years, while impaired glucose tolerance increased to 1.60% and 3.56%.

Le diabète sucré en tant que problème de santé en Arabie saoudite

RESUME Un nombre total de 25 337 saoudiens [11 713 hommes (46,2%) et 13 624 femmes (53,8%)] ont été examinés pour la recherche du diabète sucré et de l'abaissement de la tolérance au glucose en utilisant les critères de l'OMS pour le diagnostic. La prévalence du diabète insulino-dépendant, non-insulino-dépendant et de l'abaissement de la tolérance au glucose dans la population totale des hommes saoudiens était respectivement de 0,23%, 5,63% et 0,50% et dans la population totale des femmes saoudiennes de 0,30%, 4,53% et 0,72% respectivement. Des différences ont été observées dans la prévalence du diabète sucré et de l'abaissement de la tolérance au glucose entre les provinces. La prévalence du diabète sucré non-insulino-dépendant a augmenté, atteignant 28,82% et 24,92% chez les hommes et les femmes de plus de 60 ans respectivement, et celle de l'abaissement de la tolérance au glucose a atteint 1,60% et 3,56% respectivement.

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Introduction

Diabetes mellitus is by far the most common metabolic disorder, its prevalence varying widely worldwide and ranging from as low as <1% to >50% [1-6]. It is due to insulin deficiency or inefficiency, which results in a state of hyperglycaemia [7]. Insulin-dependent diabetes mellitus (IDDM) and non-insulin-dependent diabetes mellitus (NIDDM) are the two primary types and are the most widely distributed [8-9]. Factors involved in influencing the prevalence of diabetes mellitus include socioeconomic status, age, sex, genetic susceptibility, lifestyle and other environmental factors. It has been shown that the prevalence of diabetes is constantly on the rise and this is believed to result from urbanization and socioeconomic developments, which are associated with rapid changes in lifestyle [3-6]. In developing countries, the prevalence of diabetes is increasing, where there are, as estimated by the World Health Organization (WHO), around 70 million people suffering from diabetes mellitus [10]. Thus, it is essential that every country attempts to assess the magnitude of the problem and takes steps to control and prevent diabetes mellitus and provide appropriate care.

Saudi Arabia, a country of over 12 million people, is a rapidly developing country. During the past two to three decades the tremendous surge in socioeconomic growth has considerably influenced the lifestyle of the people. The few epidemiological studies that were conducted during the 1980s showed a relatively high prevalence of diabetes mellitus [11-14] and studies carried out in the 1990s showed an even higher prevalence of diabetes mellitus in the Saudis [15,16]. In fact, when one compares recent results [16] with those of a study reported in 1982 [11] in Riyadh, one finds

that there has been a significant increase in the prevalence of diabetes mellitus.

We conducted this study at the national level to determine the prevalence of diabetes mellitus in the Saudi population and to assess the magnitude of the problem in the different provinces of Saudi Arabia.

Subjects and methods

The study was conducted throughout the five main provinces of Saudi Arabia, i.e. the North-western, South-western, Northern, Eastern and Central provinces. The sample size to be collected from each province depended on the population structure of each region. The screening was carried out as a household screening programme. In each province, several areas were randomly selected and divided into sectors, and streets and houses were selected for the screening programme at regularly determined intervals. On contacting the selected family, the details of the study were explained and their cooperation was requested. Over 95% of the families contacted agreed to be included in the study; those who refused (<5%) were generally those with no male family member available in the house at the time of the visit. These were replaced by other randomly selected families from the same locality.

Each family was instructed to remain in a fasting state on a mutually agreed day for the visit. An early morning visit was made, the essential information on the family was documented and a sample of urine was requested and analysed using a dipstick (Combur 8). A fasting blood sample was taken by venepuncture from each member of the family over the age of 2 years. Blood glucose was estimated immediately using an Answer™ blood glucose meter (Coulter-Wallace International Distribution, USA)

and the Answer™ test strips impregnated with glucose oxidase/peroxidase. The glucometer was regularly standardized against an autoanalyser (American Monitor "Parallel"). Each adult individual was given orally a load of 75 g glucose in 200–300 ml of distilled water. Children were given 1.75 g glucose/kg body weight in water, up to a maximum of 75 g. A 2-hour postprandial blood sample was taken and analysed immediately using the glucometer.

The diagnosis of diabetic state was based on WHO criteria [17,18] and was as follows:

- Diabetes mellitus: fasting venous blood glucose level ≥ 6.7 mmol/l (≥ 120 mg/dl) and a 2-hour post-glucose load ≥ 10.0 mmol/l (≥ 180 mg/dl) in venous blood or ≥ 11.1 mmol/l if capillary blood was used.
- Impaired glucose tolerance (IGT): normal fasting blood glucose level (< 6.7 mmol/l), increasing to 6.7–10 mmol/l (120–180 mg/dl) 2 hours following the oral glucose load.
- All previously diagnosed patients on insulin or oral hyperglycaemics or diet therapy.

Differentiation between IDDM and NIDDM was made on the basis of age of onset and mode of treatment. For people with IDDM the disease presented at a young age (< 25 years) and they required continuous use of insulin following diagnosis to maintain their glucose level in the normal range. Maturity onset diabetes of the young also presented at < 25 years and control was achieved by either hypoglycaemic drugs or dietary intervention.

The results obtained in different provinces and by sex were compared using chi-squared (χ^2) analysis on 2×2 contingency tables; $P < 0.05$ was considered statistically significant.

Results

The total number of individuals screened in different provinces was 25 337 and included 11 713 (46.2%) males and 13 624 (53.8%) females. The numbers screened in each province by age and sex are presented in Table 1. The age range was from 2 years to 77 years. By age, 9917 (39.1%) were children below 14 years (boys = 4919, 19.4% of the total; girls = 4998, 19.7% of the total), and the rest (15 394, 60.75%) were adolescents and adults over 14 years of age. This age distribution matches that of the whole population of Saudi Arabia. Further grouping in those over 14 years was done according to age as shown in Table 1.

The overall prevalence of IDDM, NIDDM and IGT in the total population was 0.23%, 5.63% and 0.50% respectively in the Saudi males, and 0.30%, 4.53% and 0.72% respectively in the Saudi females. The prevalence of IDDM, NIDDM and IGT in the male and female population in different provinces is presented in Table 2. Differences in prevalence were found in the different provinces; the highest prevalence of IDDM occurred in the Eastern province and the highest prevalence of NIDDM was seen in the North-western province. NIDDM was more prevalent in males compared to females in all provinces, except the Eastern province. IGT was more prevalent in females in all provinces.

IDDM was identified in 68 people of the total 25 337; this gave an approximate rate of 2.7 IDDM cases/1000 Saudis, except in the Eastern province where the rate was approximately 6/1000 of the screened population.

Regarding the prevalence of NIDDM and IGT by age, a significant increase in the prevalence was observed with age, both in the total male and female populations and

Table 1 Number of individuals screened in the different provinces of Saudi Arabia

Province by sex	Total number investigated	Age group (years)				
		<14	14-29	30-44	45-60	>60
<i>Males</i>						
Central	3759	1694	1006	477	343	239
South-western	3869	1692	1005	505	386	281
North western	1646	607	400	234	216	189
Eastern	458	199	116	57	41	45
Northern	1981	727	573	259	239	183
Total	11 713	4919	3100	1532	1225	937
<i>Females</i>						
Central	4383	1610	1443	773	369	188
South-western	4518	1804	1399	755	369	191
North-western	1951	633	649	376	211	82
Eastern	585	219	180	89	56	41
Northern	2187	732	709	401	229	116
Total	13 624	4998	4380	2394	1234	618
<i>Both sexes</i>						
Central	8142	3304	2449	1250	712	427
South-western	8387	3496	2404	1200	755	472
North-western	3597	1240	1049	610	427	271
Eastern	1043	418	296	146	97	86
Northern	4168	1459	1282	660	468	299
Total	25 337	9917	7480	3926	2459	1555

the same trend was observed in each province (with few exceptions) as presented in Table 3.

The overall prevalence of NIDDM in the Saudi population was 0.12% and 0.79% in those below the age of 14 years and those aged 14-29 years respectively; it increased to 28.82% and 24.92% in males and females respectively in those over the age of 60 years. This increase was statistically significant ($P < 0.0001$). In general, the prevalence of NIDDM tended to be higher in males than in females in the majority of age

groups. Interestingly, in two provinces the prevalence of NIDDM decreased in females over the age of 60 years, compared with the prevalence in those aged 45-60 years.

The prevalence of impaired glucose tolerance was higher in females compared with males of the same age group, in the majority of age groups (Table 4). The prevalence of IGT increased with age in both the male and female groups in each province and in the total population.

Thirteen cases were classified as suffering from maturity onset diabetes of the

Table 2 Prevalence (%) of IDDM, NIDDM and IGT in Saudis by sex in different provinces of Saudi Arabia

Province	Males						Females						Both sexes					
	%	No.	Investigated	IDDM	NIDDM	IGT	%	No.	Investigated	IDDM	NIDDM	IGT	%	No.	Investigated	IDDM	NIDDM	IGT
Central			3759	8	203	24	0.34	4383	15	199	34	0.77	8142	23	402	0.28	4.94	58
South-western			3869	8	158	14	0.24	4518	11	173	31	0.69	8387	19	331	0.23	3.95	45
North-western			1646	6	186	4	0.24	1951	9	129	8	0.41	3597	15	315	0.42	8.76	12
Eastern			458	2	20	7	1.53	585	4	29	7	1.20	1043	6	49	0.57	4.70	14
Northern			1981	3	92	10	0.50	2187	2	87	18	0.82	4168	5	179	0.12	4.29	28
Total			11 713	27	658	59	0.50	13 624	41	617	98	0.72	25 337	68	1276	0.27	5.04	157

IDDM = insulin-dependent diabetes mellitus
 NIDDM = non-insulin-dependent diabetes mellitus
 IGT = impaired glucose tolerance

Table 3 Prevalence (%) of NIDDM by age in different provinces of Saudi Arabia

Province by sex	Age group (years)									
	<14		14-29		30-44		45-60		>60	
	No.	%	No.	%	No.	%	No.	%	No.	%
<i>Males</i>										
Central	2	0.12	8	0.79	33	6.54	84	24.50	76	31.80
South-western	6	0.35	5	0.50	23	5.13	60	15.50	64	22.77
North-western	-	-	1	1.00	33	14.10	73	33.80	79	41.79
Eastern	-	-	1	0.86	1	1.75	6	14.63	12	22.67
Northern	-	-	2	0.35	15	5.79	36	15.06	39	21.30
Total	8	0.16	17	0.55	105	6.85	259	21.14	270	28.82
<i>Females</i>										
Central			13	0.00	51	6.54	83	22.60	52	27.65
South-western	3	0.17	15	1.07	38	5.03	66	17.88	51	26.70
North-western	1	0.16	8	1.23	38	10.10	59	27.96	23	28.00
Eastern	-	-	2	1.12	3	3.34	16	28.54	8	19.50
Northern	-	-	4	0.56	16	4.01	47	20.52	20	17.24
Total	4	0.08	42	0.96	146	6.10	271	21.96	154	24.92
<i>Both sexes</i>										
Central	2	0.06	21	0.86	84	6.72	167	23.45	128	29.98
South-western	9	0.26	20	0.83	61	4.84	126	16.69	115	24.36
North-western	1	0.08	9	0.86	71	11.64	132	30.90	102	37.64
Eastern	-	-	3	1.01	4	2.74	22	22.68	20	23.26
Northern	-	-	6	0.47	31	4.70	83	17.74	59	19.73
Total	12	0.12	59	0.79	251	6.39	530	21.55	424	27.40

NIDDM = non-insulin-dependent diabetes mellitus

young (MODY). This gave the overall prevalence of MODY as 0.0513% in the Saudis, i.e. in 1/2000 Saudis.

Discussion

This study was conducted on 25 337 Saudi individuals and showed that diabetes mellitus and IGT occurred in all provinces of Saudi Arabia and the type of diabetes most prevalent in the Saudis was NIDDM. Inter-

estingly, the prevalence of NIDDM was higher among males compared with females, a trend generally observed in developing countries [19], although exceptions were encountered in some provinces. Other studies from Saudi Arabia have shown a similar trend [12,15]. In industrialized countries, on the other hand, the reverse is generally the case and females have a higher prevalence of NIDDM than their male counterparts. These differences between industrialized and developing countries are

Table 4 Prevalence (%) of IGT by age in different provinces of Saudi Arabia

Province by sex	Age group (years)									
	<14		14-29		30-44		45-60		>60	
	No.	%	No.	%	No.	%	No.	%	No.	%
<i>Males</i>										
Central	7	0.41	-	-	6	0.19	7	2.06	4	1.67
South-western	3	0.18	-	-	5	1.12	2	1.52	4	1.42
North-western	1	0.13	-	-	1	0.43	-	-	2	1.06
Eastern	1	0.50	1	0.86	1	1.75	2	4.88	2	4.44
Northern	1	0.13	-	-	1	0.39	5	2.09	3	1.64
Total	13	0.26	1	0.03	14	0.91	16	1.30	15	1.60
<i>Females</i>										
Central	3	0.18	6	1.42	12	0.16	8	2.17	5	2.65
South-western	6	0.33	3	0.21	5	0.66	8	2.17	9	4.7
North-western	-	-	-	-	4	1.1	2	0.95	2	2.4
Eastern	2	0.91	2	1.12	-	-	1	1.78	2	4.88
Northern	1	0.13	4	0.56	-	-	9	3.93	4	4.45
Total	12	0.24	15	0.34	21	0.88	28	2.27	22	3.56
<i>Both sexes</i>										
Central	10	0.30	6	0.24	18	1.44	15	2.1	9	2.1
South-western	9	0.26	3	0.12	10	0.79	10	1.32	13	2.75
North-western	1	0.08	-	-	5	0.82	2	0.47	4	1.48
Eastern	3	0.72	3	1.01	1	0.68	3	3.09	4	4.65
Northern	2	0.14	4	0.31	1	0.15	14	3.0	7	2.34
Total	25	0.25	16	0.21	35	0.89	44	1.79	37	2.38

IGT = impaired glucose tolerance

possibly a result of differences in the life-styles of the male and female population.

The increase in the prevalence of diabetes mellitus with age is expected and has been observed in all studies reported on other populations. However, the increase in prevalence in those aged 45 years and above was very significant in the Saudi population and places Saudi Arabia among the countries of world classified as high prevalence countries [1]. This group includes Omani Arabs, urban Dravidians in Madras, Asian Indians, Malays in Singapore, black women in the United States

of America (USA), Asian Indians who have migrated to South Africa, Creole and Chinese populations, the urban Micronesians of Kiribati and most of the Hispanic populations of the USA [1]. In this group of populations the prevalence varies between 11% and 20%. Interestingly, differences in the prevalence of NIDDM were observed within the Saudi population, although the prevalence in those over 30 years of age was greater than 14% in each province.

These results confirm the earlier suggestions that diabetes mellitus is a health problem in the adult population of Saudi

Arabia. The possible etiological factors involved in the high prevalence of diabetes mellitus in the Saudis include:

- *High prevalence of obesity.* Our studies have shown that overweight and obesity are common in both males and females, particularly females [20].
- *Dietary habits.* The Saudi diet includes a high intake of carbohydrates in the form of bread, dates, sugar, potatoes, etc. and is believed to be one of the major factors involved in obesity (El-Hazmi et al., in press).
- *Lack of exercise.* The climatic conditions and the life pattern in Saudi Arabia affect the extent of physical activity carried out daily, particularly by older people. Less than 5% of the population questioned were in the habit of performing any form of physical exercise (El-Hazmi et al., in press).
- *Genetic factors.* The role of genetic predisposing factors is well established for diabetes mellitus. The finding that diabetes mellitus accumulates in Saudi families confirms that genetics has a significant role to play in the etiology of diabetes (El-Hazmi et al., in press).

In addition, there may be other factors, including viral infections and specific foods, which may further contribute to the development of diabetes mellitus in the Saudi population.

One study reported in 1982 on Saudi males [11] could be compared with the results of the present study. There has been a significant increase in the prevalence of NIDDM since 1982, when 6% of males had NIDDM compared with 18.22% of males above the age of 30 years in our study in the Central province. This confirms that the prevalence of NIDDM is on the rise and there is an urgent need to adopt control and prevention programmes in Saudi Arabia. As

a first step, it is necessary to educate the public and improve awareness about diabetes mellitus. This is essential, as from our personal observations during the screening programme, it was obvious that awareness of diabetes mellitus was lacking in the majority of the older people. This results in two major problems. First, no specific attention is given to avoid weight gain or to lose excess weight and secondly, there is poor compliance with treatment, as observed by a very high prevalence (> 90%) of hyperglycaemia in the known cases of diabetes.

We feel that the first and most important step to achieve control and prevention of diabetes mellitus in the Saudi population is to promote and improve public education and increase public awareness about the condition in the population of Saudi Arabia. This can be achieved in several ways, such as publication of small booklets in Arabic in layman terms for the education of the general public, discussions and lectures on television, articles in newspapers, inclusion of information about diabetes mellitus in school curricula, and public lectures. The role of primary health care centres in achieving the goal of improving awareness in patients and their families cannot be underestimated. Doctors and nurses can play a major role in educating their patients by emphasizing the importance of dietary intervention, exercise, weight control and compliance with drug therapy. Lectures, patient-doctor meetings and discussions could be arranged at these centres to improve awareness. In three areas of Saudi Arabia, diabetic centres have been established and similar centres in all areas are necessary, as it is often difficult for patients to travel far. Special efforts are necessary in the villages and rural areas where education and awareness is limited, particularly in the older generation. These steps to-

wards control and prevention cannot be neglected if the serious sequelae of diabetes mellitus are to be avoided.

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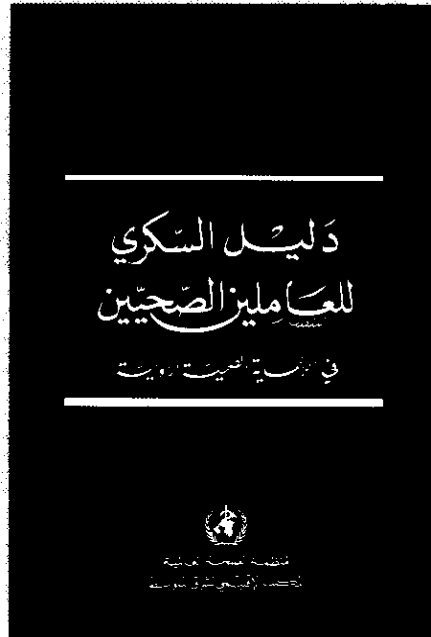
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القرءاء المستهدفون

الأطباء والعاملون الصحيون في مراكز السكري والرعاية الصحية الأولية.

أسباب تأليف هذا الدليل

يستهدف هذا الدليل توفير المعالجة الجيدة للسكريين وضمان توافر المتطلبات اللازمة لرعايتهم رعاية صحية مناسبة. والمكتب الإقليمي إذ يقدم الطبعة العربية الأولى لهذا الدليل، ليكون في متناول النظم الصحية في بلدان الإقليم، يأمل أن يحقق الغاية المرجوة منه، كأداة تثقيفية للعاملين الصحيين وأن يساهم في رفع مستوى الخدمات الصحية المتاحة للسكريين.



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