High Prevalence of Diabetes in Bahrainis

Associations with ethnicity and raised plasma cholesterol

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OBJECTIVE — To determine prevalence of diabetes and associated risk factors in the population of Bahrain.

RESEARCH DESIGN AND METHODS — A cross-sectional study of 2,128 Bahrainis aged 40–69 years was conducted.

RESULTS — Age-standardized prevalence of diabetes was 25% in Jaafari Arabs, 48% in Sunni Arabs, and 23% in Iranians. In multivariate analyses, positive family history of diabetes, low educational status, waist girth, plasma cholesterol, and, in women, postmenopausal status were independently associated with diabetes. Adjusting for these factors did not account for the difference in prevalence between Jaafari and Sunni Arabs. There was no association between diabetes and parental consanguinity. Mean plasma cholesterol was 0.5 mmol/l higher in diabetic than in normoglycemic participants, 0.5 mmol/l higher in Sunni than in Jaafari Arabs, and, excluding diabetic individuals, 0.2 mmol/l higher in those with a positive family history of diabetes than in those with a negative family history. Although 28% of participants had BMI ≥30 kg/m^2, only 42% of these obese individuals rated themselves as overweight. In men, obesity was inversely related to physical activity at work. In women, obesity was associated with high parity and inversely associated with employment outside the home.

CONCLUSIONS — The high rates of diabetes in Bahrain and other Arabian Peninsula populations appear to be part of a familial syndrome that includes raised plasma cholesterol levels. Risk is related to ethnic origin but not to parental consanguinity. Despite the high rates of diabetes, obesity is still perceived as a desirable attribute in this population.

Type 2 diabetes is now a leading cause of adult morbidity in the Arabian Peninsula (1–6). Case-control studies of myocardial infarction suggest that a high proportion of cases of coronary heart disease in the region are attributable to the excess risk associated with diabetes (7–9). The only published survey data on prevalence of diabetes by World Health Organization (WHO) criteria in the Arabian Peninsula are from Oman, where prevalence was 14% in those aged 35–64 years (4), and Saudi Arabia, where prevalence was 34% in the age-group 41–59 years (10). The objectives of this study were to estimate the prevalence of diabetes and coronary heart disease in Bahrainis and to identify risk factors for these diseases. We report here the results of the survey of diabetes prevalence and related risk factors.

The indigenous populations of Bahrain and eastern Saudi Arabia are believed to be closely related. In early Islamic sources, the name Bahrain was used for the entire coastal region between Basra and Oman, and the name Majus was used for its inhabitants (11). The modern Bahraini population consists of three main ethnic groups: Jaafari Arabs, Sunni Arabs, and Iranians. Jaafari (also known as Baharnah) Arabs follow the Shiite branch of Islam and were the largest ethnic group in Bahrain before 1780 (12). Descriptions by early Arab geographers suggest that this group is descended from various Arabian tribes who migrated to Bahrain before the Islamic era, with some Persian admixture (11). Sunni Arabs are descended from two groups: the Huwalah and the Utub. The Huwalah, followers of the Shafii school of Islamic jurisprudence, were the second largest group in Bahrain before 1780 (12). Their ancestors originated in Arabia, migrated to the Iranian side of the Persian Gulf, then settled in Bahrain. The Utub migrated from central Arabia to the Persian Gulf coast in the 18th century and conquered Bahrain during 1782–1783. Iranians in Bahrain are predominantly Sunnis of Persian descent whose parents or grandparents migrated from Iran after 1921.

RESEARCH DESIGN AND METHODS

Sampling

Because an objective of the study was to estimate prevalence of coronary heart disease, men and women were sampled from different age-groups: 40–59 and 50–69 years, respectively. This method ensured that in a sample of 1,000 men and 1,000 women, the numbers of cases of coronary heart disease in each sex would be sufficient for comparison of prevalence rates with other populations. The population register of Bahrain is based on the 1991 national census and is updated when people move or die. In 1991, the population was 508,000, of whom 64% were Bahrainis and 36% were expatriates. From the register's list of men aged 40–59 years and women aged 50–69 years, a systematic sample was drawn within each region, block number, and sex. Residents who were not Bahraini citizens were excluded at this stage. Subjects with serious disability, recent psychiatric illness, terminal malignancy, or other advanced disease were ineligible but could not be excluded at this stage.

Fieldwork was conducted between June 1995 and February 1996. Initial invitations were sent by letter to 4,060 individuals, and the letters encouraged recipients to take part in the study, whatever their medical history might be. Nonresponders were reinvited, by letter or by a visit from the community nurses, at least once while the survey team remained in the

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area. Of those who were invited, 129 had died, 89 were away from Bahrain, 164 were established to be no longer residing at the address given, and 917 refused to take part. After receiving their invitation letters, 41 individuals were excluded because they were too ill or disabled to participate in the study. For 592 individuals, no reply was received, and it was not possible to establish whether they were still residing at the address given. Thus, 3,045–3,637 individuals were assumed to have received their invitation letters and to have been eligible. Of these, 2,128 attended the initial examination, giving a response rate of 59–70%. Estimates of diabetes prevalence are based on the 2,029 individuals who underwent blood sampling at the second examination.

Table 1—*Prevalence of IGT and diabetes by sex and 10-year age-group*

Age-group (years)	Normal glucose tolerance	IGT	Newly diagnosed diabetes	Previously diagnosed diabetes
Men				
40–49	404 (60)	111 (17)	71 (11)	82 (12)
50–59	276 (55)	80 (16)	46 (9)	104 (20)
Women				
50–59	207 (45)	89 (19)	49 (11)	113 (25)
60–69	148 (40)	83 (23)	45 (12)	94 (25)

Data are *n* (%). This table omits data for 22 men aged >60 years and for 5 women aged <50 years.

Data collection

Participants attended the field site between 7:30 and 10:30 A.M. At the initial visit, a questionnaire covering demographic items, medical history, and physical activity was administered in Arabic by an interviewer. Blood pressure in the right arm was measured twice using a mercury sphygmomanometer with participants in the sitting position after they had been sitting quietly for 5 min. Waist girth was measured with participants in the standing position and wearing only one layer of light clothing, using a tape 1 cm wide at a level halfway between the costal margin and the iliac crest. An approximate indicator of the waist level was obtained by asking the participants to bend sideways. For the second visit to the clinic, all participants who were not already identified as having diabetes were asked to fast overnight for at least 10 h. These participants underwent venous sampling in the fasting state and 2 h after drinking a specially made soft drink containing 75 g anhydrous dextrose equivalent dissolved in 300 g of water. A single nonfasting blood sample was taken from the participants whose diabetes was already diagnosed. Total cholesterol, HDL cholesterol, and triglyceride were measured on EDTA plasma using a Cobas Mira clinical analyzer and Unimate 7 diagnostic kits (Roche, Basel, Switzerland).

Data analysis

Ethnicity was assigned on the basis of district of residence and grandparents' countries of birth. The 11 districts of residence were grouped into three categories: Jaafari, Sunni, and mixed. From questionnaire items on grandparents' countries of birth, three categories were defined: Arab (all four grandparents born in Bahrain or Saudi Arabia), Iranian (at least one grandparent born in Iran), and other. These variables were combined to assign each of the 2,128 participants to one of four ethnic categories: Jaafari Arab (648), Sunni Arab (176), Iranian (306), and unclassified (998). Of those classified as Iranian, 80% were born in Bahrain, but 56% spoke Farsi as their first language. Of the unclassified group, 80% had all four grandparents born in Bahrain or Saudi Arabia; from other estimates of the composition of the Bahraini population, we estimate that this group contains approximately equal numbers of Jaafari and Sunni Arabs.

Education level was grouped into five categories: illiterate, literate with no formal schooling, primary school only, secondary school only, and higher education. Parity was scaled from 1 (nulliparous) to 5 (eight or more children). From questionnaire items on walking (excluding activity at work), cycling, and recreational activities, a leisure-time activity score was calculated as estimated additional energy expenditure in megajoules per day. Items concerning frequency of walking and sitting at work were combined to give an occupational activity score on a scale from 1 ("always sit, never walk") to 9 ("never sit, always walk"). Because only 56 women were employed outside the home, relationships with occupational activity score were analyzed for men only. Participants were asked to rate their weight in one of four categories: "underweight," "about the right weight," "a little overweight," or "very overweight." Impaired glucose tolerance (IGT) and diabetes were defined by WHO criteria (13). Hypertension was defined by systolic pressure ≥140 mmHg, diastolic pressure ≥90 mmHg, or current drug therapy for hypertension; these cutoff levels are based on current recommendations for the control of hypertension in type 2 diabetes (14).

The Stata 5.0 package (Stata, College Station, TX) was used for all statistical analyses. Plasma triglyceride values were log-transformed before analysis; geometric means for these variables were calculated. Associations with continuous dependent variables, such as BMI, were examined by least-squares regression. Associations with binary dependent variables, such as diabetes, were examined by logistic regression, and associations with dependent variables that were ordered categories were examined by ordered logit regression. In all these analyses, associations were adjusted for age.

RESULTS — Table 1 shows age-specific prevalence of IGT, newly diagnosed diabetes, and previously diagnosed diabetes, separated by sex. Comparison of prevalence rates between men and women can be made only for participants in the age-group 50–59 years, in which the total prevalence of diabetes was 29% in men and 35% in women (odds ratio [OR] for diabetes in women, 1.27; 95% CI, 0.96–1.66). Of the 615 diabetic participants, 204 (35%) had not had their diabetes diagnosed previously. With the age and sex distribution of the entire sample as standard population, directly standardized prevalence rates of diabetes by ethnic group (with 95% CI in parentheses) were 25% (22–28) in Jaafari Arabs, 48% (41–56) in Sunni Arabs, 23% (19–28) in Iranians, and 31% (29–34) in the unclassified group. Of the 329 diabetic participants who were hypertensive, 178 (54%) were not receiving antihypertensive therapy. Only 29 (19%) of the 150 diabetic participants who were on antihypertensive therapy had systolic blood pressure ≤130 mmHg and diastolic blood pressure ≤85 mmHg.

Tables 2 and 3 compare behavioral and clinical measurements by ethnic group. In comparison with Jaafari Arabs, the propor-

Table 2—*Comparison of risk factors in men by ethnic group*

	Jaafari Arab	Sunni Arab	Iranian	Unclassified	*P* value
n	380	117	169	579	—
Age (years)	50.1 ± 5.6	49.4 ± 5.6	49.9 ± 5.4	49.8 ± 6.0	—
No formal schooling (%)	29 (112/380)	10 (12/117)	18 (31/169)	19 (101/531)	<0.001
Active at work (walk > sit) (%)	46 (162/353)	37 (38/103)	43 (68/157)	40 (189/477)	NS
Active in leisure-time (%)*	19 (69/360)	28 (32/113)	34 (56/163)	21 (104/494)	<0.001
Height (cm)	165.9 ± 7.0	164.9 ± 7.9	166.5 ± 7.4	168.1 ± 7.0	<0.001
BMI (kg/m^2)	26.7 ± 4.7	28.9 ± 5.0	27.1 ± 4.3	27.2 ± 4.7	<0.001
Waist girth (cm)	94.2 ± 12.0	94.3 ± 11.1	93.7 ± 10.8	96.1 ± 12.3	0.04
Hypertension (%)	42 (160/379)	35 (41/116)	43 (72/169)	42 (243/578)	NS
Cholesterol (mmol/l)	5.06 ± 1.03	5.54 ± 1.16	5.30 ± 0.95	5.21 ± 1.06	<0.001
Triglyceride (mmol/l)†	1.38	1.58	1.49	1.49	NS
HDL cholesterol (mmol/l)	0.96 ± 0.27	0.98 ± 0.30	0.96 ± 0.26	0.98 ± 0.27	NS

Data are means ± SEM or % (*n*/total) unless otherwise indicated. *P* values are for differences among all four groups, controlling for age. *"Active in leisure time" refers to leisure-time energy expenditure >0.3 MJ/day. †Triglyceride levels are expressed as geometric means.

tion of Sunni Arab men whose leisure-time activity was equivalent to additional energy expenditure of >0.3 MJ/day (equivalent to walking daily for half an hour at 5 km/h) was higher, but the proportion of Sunni Arab men with high occupational activity scores was lower. Leisure-time activity scores were low in women from all ethnic groups. Mean BMI was higher in Sunni Arabs than in Jaafari Arabs or Iranians, but mean waist girth was similar in the three groups. After adjustments were made for age and sex, mean plasma cholesterol was 0.49 mmol/l (95% CI, 0.30–0.67) higher in Sunni Arabs than in Jaafari Arabs. This difference was reduced only slightly by adjusting for BMI and waist girth.

Table 4 compares cardiovascular risk factors among participants with normal glucose tolerance, IGT, and diabetes. An unexpected finding was that average plasma total cholesterol was higher in those with diabetes or IGT than in those with normal glucose tolerance. These differences in plasma cholesterol levels persisted after adjusting for age, BMI, and waist girth. The association of raised plasma total cholesterol with glucose intolerance was paralleled in men by an association of raised plasma HDL cholesterol with glucose tolerance, in contrast to the inverse relationship between HDL cholesterol and glucose intolerance usually observed in European populations.

Of the 2,019 participants, 632 (31%) reported a history of diabetes in a first-degree relative. After adjustments were made for age, sex, and ethnicity, positive family history of diabetes was associated with the participants' diabetes (OR, 2.7; 95% CI, 2.2–3.4). Prevalence of diabetes was the same in those who reported diabetes in their mother as in those who reported diabetes in their father. In comparison with nondiabetic participants with a negative family history of diabetes, nondiabetic participants with a positive family history of diabetes had higher average BMI (1.0 kg/m^2; 95% CI, 0.4–1.7) and higher average plasma cholesterol (0.17 mmol/l; 95% CI, 0.04–1.31 mmol/l) after adjustments were made for age and sex. The effect of family history of diabetes on plasma cholesterol remained statistically significant after adjusting for ethnic origin, waist girth, and BMI.

Of the 1,963 participants for whom information on parental consanguinity was available, 1,231 (63%) reported that their parents were unrelated, 305 (16%) reported that their parents were single first cousins,

Table 3—*Comparison of risk factors in women by ethnic group*

	Jaafari Arab	Sunni Arab	Iranian	Unclassified	*P* value
n	268	59	137	419	—
Age (years)	59.9 ± 5.3	59.9 ± 4.9	58.8 ± 5.2	59.5 ± 5.5	—
No formal schooling (%)	94 (252/268))	71 (42/59)	73 (100/137)	79 (308/388)	<0.001
Active in leisure time (%)*	0 (1/264)	2 (1/58)	1 (2/134)	2 (7/384)	NS
Height (cm)	152.5 ± 5.4	152.3 ± 5.1	154.7 ± 5.8	154.6 ± 5.8	<0.001
BMI (kg/m^2)	27.4 ± 5.7	30.9 ± 5.2	27.9 ± 4.9	27.7 ± 6.0	<0.001
Waist girth (cm)	95.2 ± 13.5	97.0 ± 11.4	95.1 ± 11.1	96.0 ± 13.9	NS
Hypertension (%)	58 (153/266)	76 (44/58)	43 (59/137)	54 (227/417)	<0.001
Cholesterol (mmol/l)	5.50 ± 1.17	5.99 ± 1.33	5.65 ± 1.01	5.59 ± 1.30	0.04
Triglyceride (mmol/l)†	1.28	1.47	1.35	1.34	NS
HDL cholesterol (mmol/l)	1.11 ± 0.33	1.21 ± 0.33	1.13 ± 0.27	1.11 ± 0.30	NS

Data are means ± SEM or % (*n*/total) unless otherwise indicated. *P* values are for difference between all four groups, controlling for age. *"Active in leisure time" refers to leisure-time energy expenditure >0.3 MJ/day. †Triglyceride levels are expressed as geometric means.

Table 4—*Cardiovascular risk factors by sex and glucose tolerance category*

	Men				Women			
	Normal glucose tolerance	IGT	Diabetic	*P* value	Normal glucose tolerance	IGT	Diabetic	*P* value
n	695	197	303	—	366	174	294	—
Age (years)	49.4 ± 5.8	50.0 ± 5.7	50.9 ± 5.6	—	59.3 ± 5.4	59.8 ± 5.3	59.8 ± 5.3	—
BMI (kg/m²)	26.5 ± 4.6	28.4 ± 4.9	28.0 ± 4.7	<0.001	26.4 ± 5.3	28.3 ± 5.7	29.4 ± 5.9	<0.001
Waist girth (cm)	93.1 ± 11.6	96.6 ± 11.8	98.1 ± 12.0	<0.001	93.0 ± 12.2	96.7 ± 12.1	98.5 ± 12.5	<0.001
Hypertension (%)	36 (251/694)	41 (80/196)	49 (149/302)	0.005	44 (161/362)	59 (102/173)	61 (180/294)	<0.001
Cholesterol (mmol/l)	5.04 ± 1.00	5.32 ± 0.99	5.52 ± 1.14	<0.001	5.32 ± 0.99	5.74 ± 1.52	5.87 ± 1.22	<0.001
Triglyceride (mmol/l)*	1.30	1.67	1.76	<0.001	1.13	1.36	1.59	<0.001
HDL cholesterol (mmol/l)	0.96 ± 0.26	0.96 ± 0.26	1.01 ± 0.31	0.05	1.12 ± 0.31	1.12 ± 0.33	1.12 ± 0.29	NS

Data are means ± SEM or % (*n*/total) unless otherwise indicated. *P* values are for difference between all three groups, controlling for age. *Triglyceride levels are expressed as geometric means.

211 (11%) reported that their parents were double first cousins, and 216 (11%) reported some other relationship between their parents. With offspring of unrelated parents considered as the baseline category, the age- and sex-adjusted OR for diabetes was 0.93 (95% CI, 0.67–1.30) in offspring of single first cousins and 1.04 (0.78–1.37) in offspring of double first cousins.

Table 5 shows separately for men and women the results of multiple logistic regression models with diabetes as the dependent variable. In men, Sunni Arab ethnicity, family history of diabetes, low educational status, waist girth, and plasma cholesterol were independently associated with diabetes. With the exception of educational status, these variables were associated with diabetes in women also. Measures of physical activity did not show any statistically significant relationships with diabetes in men or women, and there were no statistically significant interactions among the effects of ethnicity and other variables. In women, diabetes was associated with postmenopausal status. Analysis of diabetes prevalence by time since menopause showed a stepwise increase in prevalence between premenopausal women and women 0–2 years after menopause (from 27 to 43%, respectively) but no further increase in prevalence in women >2 years after menopause (Table 6). Diabetes had been diagnosed 0–2 years after menopause in 29 of the 121 postmenopausal women whose diabetes had been diagnosed before the survey. For comparison, diabetes had been diagnosed 1–3 years before menopause in only 14 of the women.

Table 7 shows the results of multiple regression analyses with BMI as the dependent variable, for men and women separately. In men BMI was related inversely to occupational activity score and cigarette smoking, and positively to Sunni Arab ethnicity. In women, BMI was related inversely to employment outside the home, and positively to Sunni Arab ethnicity, family history of diabetes, educational status, and parity. Leisure-time activity score did not show any statistically significant relationships with obesity in men or women.

Most of the men and women whose BMI was >30 kg/m² rated themselves as "about the right weight" or "underweight" (Table 8). To examine the determinants of self-rating as "overweight," the four categories shown in Table 8 were reduced to two categories: "overweight or very overweight" and "underweight or about the right weight." When associations with this binary variable were examined in a multiple logistic regression analysis with adjustments for age, sex, and BMI, self-rating as "overweight" was independently associated with Iranian origin (OR for Iranians versus Jaafari Arabs, 2.5; 95% CI, 1.7–3.7) and with educational status. With "illiterate" representing the baseline category, ORs for self-rating as "overweight" were 1.5 for "literate with no schooling," 1.8 for "primary school only," 2.8 for "secondary school only," and 3.5 for "higher education." These associations with self-rating as "overweight" were similar for men and women when analyzed separately.

CONCLUSIONS — In comparison with other surveys in the region that have used WHO criteria, age-specific prevalence of diabetes in Bahrainis is higher than in

Table 5—*Multiple logistic regression analyses with diabetes as dependent variable*

	Men		Women	
Variable	OR (95% CI)	*P* value	OR (95% CI)	*P* value
Age (years)	1.03 (1.01–1.07)	0.006	1.01 (0.98–1.04)	NS
Ethnic group (Jaafari Arab as baseline)				
Sunni Arab	1.77 (1.07–2.91)	0.03	3.31 (1.64–6.68)	<0.001
Iranian	0.84 (0.52–1.34)	NS	0.68 (0.40–1.17)	NS
Unclassified	1.07 (0.77–1.50)	NS	1.02 (0.79–1.70)	NS
Family history of diabetes (yes/no)	2.78 (2.07–3.74)	<0.001	2.68 (1.87–3.84)	<0.001
Educational status (scaled from 1 to 5)	0.87 (0.77–0.99)	0.03	1.73 (1.03–2.90)	0.04
Waist girth (cm)	1.027 (1.014–1.039)	<0.001	1.030 (1.016–1.043)	<0.001
Plasma cholesterol (mmol/l)	1.34 (1.18–1.53)	<0.001	1.27 (1.10–1.47)	<0.001

Table 6—***Relation of diabetes prevalence to years since menopause***

Years since menopause	Diabetes prevalence (%)	Cases/total (*n*)	OR (95% CI) (age-adjusted)
Premenopausal	27	30/112	1 (—)*
0–2 years	43	25/58	2.1 (1.1–4.2)
3–5 years	41	35/86	1.8 (1.0–3.2)
6–8 years	43	28/65	1.8 (0.9–3.5)
≥9 years	33	102/305	1.1 (0.6–1.8)

*Baseline value.

Oman in 1991 (4) and is similar to prevalence in eastern Saudi Arabia (10). The combined prevalence of IGT and diabetes varied from 40% in men aged 40–49 years to 60% in women aged 60–69 years. Given that the risk of cardiovascular disease begins to increase at levels of glycemia that are equivalent to IGT (15), this high prevalence indicates that the increased risk of cardiovascular disease associated with glucose intolerance is likely to account for a high proportion of cases of cardiovascular disease in the region. Although the response rate was less than 70%, nonresponse bias is unlikely to account for the high prevalence of diabetes. Even if prevalence of diagnosed diabetes is overestimated because individuals already identified as having diabetes were more likely than others to participate, this bias could not account for the high prevalence of undiagnosed diabetes and IGT in the participants.

The strong association of diabetes with positive family history suggests that genetic influences on diabetes risk are important in this population. As Sunni and Jaafari Bahrainis are descended from different Arabian tribes, and the difference in diabetes prevalence between these two ethnic groups was not accounted for by obesity or physical activity, it is possible that the ethnic difference in prevalence has a genetic basis. The lack of association between diabetes and parental consanguinity is not inconsistent with a genetic explanation for the high prevalence in Bahrainis, because association of a common disease with parental consanguinity is detectable only if the disease is caused by uncommon recessive alleles at multiple loci (16).

In populations of European descent, glucose intolerance is consistently associated with raised plasma triglyceride and with low HDL cholesterol levels but not with raised plasma total cholesterol levels (17,18). In contrast, glucose intolerance in Bahrainis is strongly associated with higher average plasma cholesterol levels, and this association is unexplained by adjusting for obesity. Plasma cholesterol levels were higher in Sunni Arabs—the group at highest risk of diabetes—than in the other two ethnic groups and higher in those with a positive family history of diabetes than in those with a negative family history, even when diabetic participants were excluded. This finding suggests that raised cholesterol levels may precede the development of glucose intolerance. An association of type 2 diabetes with raised cholesterol levels has been reported previously in Kuwait (19), where mean plasma total cholesterol was found to be 1.6 mmol/l higher, and mean plasma apolipoprotein (apo) B was found to be 46 mg/dl higher, in diabetic women aged <40 years than in control subjects. Thus, in contrast with European and South Asian populations, in which glucose intolerance generally occurs as part of a syndrome consisting of insulin resistance, raised triglyceride levels, and low HDL cholesterol levels, the underlying syndrome in populations of the Arabian Peninsula appears to comprise insulin resistance, raised total cholesterol levels, and raised apoB levels. This pattern resembles that of metabolic disturbances occurring in familial combined hyperlipidemia (20).

Our results suggest that the prevalence of diabetes in Bahraini women increases sharply around the time of menopause. Similar findings have been reported in Japanese-Americans (21). Our results are consistent with the results of longitudinal studies showing that glucose intolerance and insulin resistance increase as women pass through menopause (22). Some hormone replacement therapy preparations appear to improve insulin sensitivity (23), which suggests possibilities for reducing the risk of diabetes in older women.

As in Saudi Arabia (24,25), United Arab Emirates (3), and Kuwait (26,27), prevalence of obesity in Bahrain is high, especially in women. As in other populations (28,29), diabetes was associated more strongly with central obesity, measured by waist girth, than with BMI. Although the slope of the relationship between diabetes prevalence and obesity (increase of ~25% for every 10-cm increase in waist girth) was not steep in this cross-sectional survey, this may be an underestimate of the slope of the relationship between diabetes incidence and obesity if weight loss occurs after the development of diabetes. The only behavioral variable

Table 7—***Multiple regression analyses with BMI as dependent variable***

Variable	Regression coefficient (95% CI) (kg/m^2 per unit change in variable)	*P* value
Men		
Age (years)	−0.06 (−0.11 to −0.01)	0.01
Ethnic group (Jaafari Arab as baseline)		
Sunni Arab	2.48 (1.44 to 3.5)	<0.001
Iranian	0.37 (−0.52 to 1.26)	NS
Unclassified	0.60 (−0.06 to 1.26)	NS
Current smoking (cigarettes/day)	−0.03 (−0.05 to −0.01)	0.004
Occupational activity (scaled from 1 to 9)	−1.11 (−1.68 to −0.53)	<0.001
Women		
Age (years)	−0.15 (−0.22 to −0.08)	<0.001
Ethnic group (Jaafari Arab as baseline)		
Sunni Arab	2.83 (1.18 to 4.49)	0.001
Iranian	0.03 (−1.17 to 1.23)	NS
Unclassified	−0.02 (−0.95 to 0.91)	NS
Family history of diabetes	1.24 (0.37 to 2.12)	0.006
Educational status (scaled from 1 to 5)	1.31 (0.55 to 2.07)	0.001
Parity (scaled from 1 to 5)	0.61 (0.23 to 0.99)	0.002
Employment outside home (yes/no)	−2.63 (−4.25 to −1.00)	0.002

Table 8—*Self-rating of body weight by BMI category*

	BMI (kg/m²)							
	Men				Women			
	<20	20–24.9	25–29.9	≥30	<20	20–24.9	25–29.9	≥30
Self-rating								
Underweight	11 (21)	47 (13)	21 (4)	3 (1)	13 (25)	46 (19)	24 (9)	20 (4)
About the right weight	40 (77)	299 (83)	361 (76)	156 (52)	33 (63)	180 (76)	217 (78)	155 (55)
A little overweight	1 (2)	16 (4)	84 (18	107 (36)	4 (8)	10 (4)	34 (12)	74 (26)
Very overweight	0	0	9 (2)	33 (11)	2 (4)	0	2 (1)	31 (11)

Data are *n* (% total).

associated with obesity was lack of occupational activity: sedentary occupation for men and lack of employment outside the home for women. Although most studies suggest that activity equivalent to walking for at least half an hour a day affords some protection against obesity in otherwise sedentary individuals (30), no relationship between obesity and leisure-time activity could be demonstrated. Such a relationship may not have been found because average leisure-time activity levels were too low for an association to be detected, because responses to questionnaire items concerning leisure-time activity were inaccurate, or because higher energy expenditure during leisure-time activities such as walking is balanced by lower energy expenditure in tasks such as housework in this population.

Increases in dietary fat intake and decreases in intake of carbohydrate in Bahrain occurring since the 1970s are likely to have favored the development of obesity (31). Although temporary reductions in weight can be achieved by dietary restraint, long-term control of obesity appears to depend on maintaining higher energy expenditure through higher physical activity (32). In locations where most occupations are sedentary, walking is the easiest form of activity through which energy expenditure can be increased. In Bahrain, changes both in transport policy and in social attitudes would be necessary for walking to become an established activity. As in other populations that have undergone a recent transition from scarcity to affluence, most obese individuals in Bahrain did not rate themselves as overweight. Iranians in Bahrain were more likely than Arabs to rate themselves as overweight, even though both groups have shared in the general rise of living standards. Health promotion strategies that emphasize the adverse health consequences of obesity will have to take into account the apparent perception of obesity as a desirable attribute in Arab populations.

The risk of progression to renal failure in patients with diabetes can be reduced by treatment of hypertension and by the use of ACE inhibitors when albuminuria develops (14). In this survey, only half of the diabetic participants who were hypertensive were receiving antihypertensive therapy, although the denominator in this fraction may be overestimated because blood pressure was measured on only one occasion. Only 19% of those receiving therapy had systolic pressure ≤130 mmHg and diastolic pressure ≤85 mmHg in accordance with current recommendations for the control of hypertension in type 2 diabetes (14). Implementation of guidelines for the management of hypertension in diabetic individuals would be one feasible way to reduce morbidity from complications of diabetes in this population.

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