OBESITY AMONG ADULT BAHRAINI POPULATION: IMPACT OF PHYSICAL ACTIVITY AND EDUCATIONAL LEVEL

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Background: In the populations of the Arabian Peninsula, obesity has emerged as the leading cause of morbidity and mortality over a 25-year period of swift socioeconomic progress. The objective of this study was to determine the body weight distribution, prevalence and risk factors for the overweight and obese in the native adult Bahraini population.

Subjects and Methods A cross-sectional national epidemiological community survey was conducted involving 2013 Bahraini subjects aged 40-69. The males were aged 40-59 years, with a mean age of 49 years, while the females were aged 50-69 years, with a mean age of 59. The sample was adjusted for gender, age, and area of residence distribution. A questionnaire describing the demographic, social, educational status and income status was completed. Measurements were made of height and weight, and body mass index (BMI) was calculated for each subject. WHO classification was used for defining overweight (BMI 25-29.9 kg/m^2) and obesity (BMI ≥30 kg/m^2) categories.

Results: The age-standardized prevalence rate among native Bahraini men and women was high. Approximately 32% of women and 25% of men were obese (BMI ≥30.0 kg/m^2). The prevalence of obesity was significantly higher among female subjects than males throughout all the age groups. Overweight and obesity were more prevalent among those with higher levels of education and people with high incomes. A significant relationship was found between obesity and education, physical inactivity and TV watching of 16 hours a week or more. Subjects' self-appraisal and their report of physicians' diagnosis of health disorders revealed a significantly higher prevalence of ill health among obese subjects. There was a progressive decrease of BMI for male and female subjects with age. Although 28% of participants (564) had body mass index ≥30 kg/m^2, only 42% (267) of these obese individuals rated themselves as overweight. In addition, obesity was inversely related to physical activity at work in men.

Conclusion: We conclude that the prevalence of obesity among the native middle-aged and elderly Bahraini population is high. We noted that the prevalence of obesity increased as the level of education increased, which reflects the perception of obesity being a sign of affluence among Bahraini population. There is a necessity to develop an action plan for controlling obesity and its metabolic consequences among the populations of the Arabian Gulf.

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Key Words: Obesity, risk factors, body mass index, physical activity.

Obesity represents a major threat to health and quality of life in Arabian populations.[1-4] Although obesity has strong genetic determinants, the increasing prevalence of obesity in populations around the world suggests that environmental factors are promoting or exacerbating the problem.[5]

The prevalence of obesity in Western populations varies greatly, but a weighed estimate suggests a prevalence between 15% and 20%.[6-9] There is a lot of data on the prevalence rates of obesity in the general population in Bahrain and other Arabian Peninsula states,[10-12] where the prevalence rate among adults is among the highest in the world.[13,14] Diabetes rates are increasing even more quickly in Arab countries.[15,16] The risks of type 2 diabetes mellitus in these countries tend to increase sharply. Obesity among Bahrainis greatly increases the risk for many serious and morbid conditions, including diabetes mellitus, hypertension, dyslipidemia, and coronary artery disease.[17] The prevalence trend of overweight and obesity has been increasing among adults Arabs, probably due to the effects of modernization, affluence, increased food consumption and the concomitant changes to sedentary lifestyles.[2]

Educational level and physical activity are inversely associated with the prevalence of obesity.[18,19] The objectives of this study were to estimate the prevalence of obesity, and to identify risk factors for obesity among Bahraini men and women aged 40 to 69 years.

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Subjects and Methods

The methods and sampling procedures performed in this study have been described in detail in an earlier study.[15] As one of the objectives of the project was to estimate the prevalence of coronary heart disease, men and women were sampled from two different age groups: 40-59 years and 50-69 years. From the national population register in Bahrain, a systematic sample of Bahraini citizens stratified by 5-year age groups was drawn from each residential area in Bahrain. An initial invitation was sent to 4060 individuals to participate in a screening survey for obesity and other lifestyle risk factors. Nonresponders were contacted again by a letter or a visit from a community nurse with the research team. Of the 4060 individuals invited, 382 were established not to be resident at the address given because they had moved, had died or were living abroad, 917 refused to participate and 41 were excluded on health grounds. For 592 individuals no reply was received. A subsample of 120 of these households was contacted during the survey to determine the reasons for non-participation. The reasons given were as follows: 77 (64%) were not interested in participating or too busy; 37 (31%) were not resident at the address given, travelling overseas or detained by security forces; and 6 (5%) were too ill to participate.

Applying these proportions to the remaining 470 households from whom no reply was received, we estimated that 3419 individuals received invitation letters and were eligible to participate. Of these, 2128 attended the initial examination, giving an estimated response rate of 70%. Of these 2128 participants, 85 subjects did not have anthropometric measurements and the variables required to assign the obesity category were not available, and 30 subjects were outside the age ranges originally defined for men and women. The analysis was, therefore, based on 2013 individuals.

Data Collection

Subjects were asked to attend the field site in the primary health care centers between 7.30 and 10.30 in the morning hours. At the first visit, a questionnaire covering demographic items, medical history and physical activity was administered in Arabic by a trained interviewer. The questionnaire was based on Rose et al. and the WHO Heart and Health Questionnaire,[20,21] and had been validated for use in Arab populations.[15] Weight (kg) and height (cm) were recorded with the subjects wearing light clothing and without shoes. Accurate balance scales were used, height was recorded to the nearest centimeter and weight to the nearest 0.1 kilogram. Height was measured at the start centimeter, rounding it up if midway, using a measuring rod. The subject was made to stand upright with the back against the stand, heels together and eyes directed forward so that the top of the tragus of the ear was horizontal with the inferior orbital margin, and the measuring plate lowered on to the scalp to give the correct level. The same person who recorded the height and weight in the same room recorded the waist and hip measurements. The subjects were asked to stand relaxed in a screened area. One layer of light clothing over underwear was acceptable. The observer knelt or sat at an appropriate height in front of the subject, who breathed quietly and normally. A dressmaker's measuring tape was used, taking care that it was applied horizontally. The waist was defined as the smallest girth between the costal margin and iliac crest, and the hip as the circumference at the level of the greater trochanters. Measurements were made to the nearest 0.5 centimeter and were repeated following both initial recordings. If there was a variation greater than 2 cm between duplicate readings then a third was taken and recorded alongside the second one.

Data Analysis

Quetelet's body mass index (BMI) was calculated for each subject, using the equation (weight [kg]/height [m^2]). Results were then grouped according to the following classification: body mass index category (kg/m^2), indicator variable was defined as 1, <20 kg/m^2 (underweight); 2, 20-24.9 kg/m^2 (normal weight); 3, 25-29.9 kg/m^2 (overweight); 4, ≥30 kg/m^2 (obese). Waist-hip ratio category indicator variable was defined as 1, <0.85; 2, 0.85-0.89; 3, 0.90-0.94; 4, 0.95-0.99; 5, 1.00-1.04; and 6, >1.04. Waist-height ratio category indicator variable was defined as 1, <0.45; 2, 0.45-0.50; 3, 0.50-0.55; 4, 0.55-0.60; 5, 0.60-0.65; and 6, >0.65).

A person was defined as diabetic if he/she were treated for diabetes or had a 2-hour glucose ≥11.1 mmol/L. Impaired glucose tolerance was defined as a 2-hour glucose of 7.8-11.0 mmol/L, according to the WHO 1985 criteria.[21] Physical activity was assessed by walking and cycling information and grouped according to the criteria. For the walking assessment, we created variable kilometer (km) walked on weekday; indicator variable was defined as walkkm = 5 x walkwk (walking/day in average week) + walkwe (walking in weekend). For cycling and cycling/week, indicator variable was defined as cyclekm = 5 x cyclewk (cycling/day in average week) + cyclewe (cycling in weekend).

Education level was grouped into five categories: illiterate, literate with no formal schooling, primary school only, secondary school only and higher education. 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 MJ/day. Items on 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). As 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

TABLE 1. *Prevalence of body mass index (BMI) category among Bahraini males and females by age group.*

Gender	Age group (years)	Underweight	Normal	Overweight	Obese
Male	40-44	8 (2.2)	102 (27.6)	154 (41.6)	106 (28.6)
	45-49	11 (3.6)	88 (29.6)	118 (39.6)	81 (27.2)
	50-54	14 (4.9)	106 (36.8)	103 (35.7)	65 (22.6)
	55-59	19 (9.0)	58 (27.3)	91 (42.9)	44 (20.8)
	Age adjusted	52 (4.5)	354 (30.3)	466 (39.9)	296 (25.3)
Female	50-54	7 (2.6)	70 (25.9)	83 (30.7)	110 (40.7)
	55-59	13 (6.5)	52 (26.3)	72 (36.4)	61 (30.8)
	60-64	11 (5.3)	63 (30.1)	67 (32.1)	68 (32.5)
	65-69	21 (12.5)	51 (30.3)	54 (32.2)	42 (25.0)
	Age adjusted	52 (6.2)	236 (27.9)	276 (32.7)	281 (33.2)

TABLE 2. *Characteristic values of variables among Bahraini men and women with and without obesity.**

	Non-obese	Obese	*P*-value**
Men (40-59 years)			
Number surveyed	872	296	
Age (year) (mean±SD)	50±5.7	49±5.7	<0.003
Systolic BP (mm Hg)	127±17.7	132±20.0	0
Diastolic BP (mm Hg)	80±11.2	84±12.1	0
Height (cm)	167.1±7.2	166.1±7.0	<0.03
Weight (kg)	70.3±10.4	92.2±11.3	0
Waist (cm)	91.1±9.4	106.3±11.4	0
Hip (cm)	95.5±9.3	107.5±11.5	0
WHR$^+$	0.95±0.07	0.99±0.08	0
Plasma cholesterol (mmol)	5.1±1.0	5.3±1.1	0
Women (50-69 years)			
Number surveyed	564	281	
Age (year) (mean±SD)	59±5.4	58±5.0	<0.002
Systolic BP (mm Hg)	135±22.0	138±22.0	0.124
Diastolic BP (mm Hg)	80±11.0	84±12.1	0
Height (cm)	153.4±5.9	154.5±5.3	<0.006
Weight (kg)	58.1±8.8	82.1±11.6	0
Waist (cm)	90.1±10.8	106.9±10.1	0
Hip (cm)	95.3±9.9	112.6±9.9	0
WHR$^+$	0.94±0.08	0.95±0.07	0.48
Plasma cholesterol (mmol)	5.5±1.1	5.6±1.4	0.264

*Obesity defined by body mass index (BMI≥30 kg/m^2), and non-obese (BMI <30 kg/m^2); **P-value based on t-test for difference between two means; $^+$WHR=waist hip ratio.

TABLE 3. *Distribution of body mass index (kg/m^2) by education level among men and women.*

Education level	BMI (kg/m^2) Mean±SD Men	Women
Cannot read or write	25.7±4.8	27.3±5.5
Read and write	26.5±4.6	28.5±5.8
Primary school	27.2±5.1	30.1±6.2
Secondary school	27.7±4.6	29.2±4.3
University degree	27.6±3.6	30.2±8.0
Master's degree	28.7±4.5	NA*
Doctorate degree or equivalent	27.6±3.6	NA
	Nptrend**	nptrend
	Z=5.30	Z=4.69
	P<0.00	P<0.00

*NA=not available among women in this sample; **nptrend=test for trend.

overweight" or "very overweight." The monthly income of the Bahraini population was grouped into four categories: < BD 250 ($660), BD 250-500 ($600-1320), BD 500-750 ($1320-2000), and BD >750 ($2000).

The Stata 5.0 package (Stata Co., Texas) was used for all statistical analyses. Plasma triglyceride values were log-transformed before analysis: geometric means for these variables are given in the tables. Associations with continuous dependent variables such as body mass index 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.

Plasma triglyceride values were log-transformed before analysis, and geometric means were given in the tables. LDL cholesterol was calculated from the Friedewald equation[22] in the 1591 participants who underwent glucose tolerance testing and whose plasma triglyceride did not exceed 4.5 mmol/L. This excludes 38 participants whose plasma triglyceride levels were greater than 4.5 mmol/L, and 410 participants with a history of diabetes who were not asked to fast for their blood test.

Results

The age-specific prevalence rates of obesity in men and women are presented in Table 1. The overall rate for obesity among Bahraini natives was 29%. The age-adjusted prevalence of obesity was higher among women (33.2%) than men (25.3%). The total rate of diabetes among the Bahraini population was 30%. Age- and sex-standardized prevalence of diabetes was 22% (95% CI, 19%-24%) in those with normal weight (BMI ≥20-24.9 kg/m^2) and 33% (95% CI, 27%-36%) in those who were obese (BMI ≥30 kg/m^2).

Table 1 also shows the distribution of number and percentage of sampled Bahrainis by sex, five-year-age groups and BMI category. The mean systolic and diastolic blood pressure, BMI, waist, plasma total cholesterol and WHR were higher in both obese men and women than in non-obese subjects (Table 2).

Table 3 compares participants by educational status: illiterate; can read and write only; primary school; secondary school; university degree; master's degree and doctorate degree. In both men and women, the mean BMI increased with higher education levels.

The distance walked per average weekday is presented in Table 4. The majority of people in Bahrain walk less than one kilometre on an average weekday. The men were more active than the women. Only 6% of women aged 50-59 years old were active, walking at least one km/day. In both men and women, a significant relationship was found between obesity and hours watching television, walking, and higher educational levels.

TABLE 4. *Proportion of Bahraini men and women walking distance/km on average week days.*

	Men		Women	
	40-49 years	50-59 years	50-59 years	60-69 years
No. of kilometer	No (%)	No (%)	No (%)	No (%)
<1 km	423 (64)	340 (68)	436 (93)	362 (95)
1-3 km	150 (22)	103 (21)	26 (6)	14 (4)
4 or more	94 (14)	57 (11)	5 (1)	2 (1)
Total	667 (100)	501 (100)	466 (100)	378 (100)

TABLE 5. *Multiple regression analyses with body mass index as dependent variable.*

Variable	Regression coefficient (kg m^{-2}/unit change in variable)	*P*-value	95% confidence interval
Men			
Age (years)	-0.06	0.01	-0.11 to -0.01
Hours watching television	-0.01	<0.002	-0.04 to -0.02
Walking (yes/no)	-0.09	<0.001	1.44 to 0.35
Cycling (yes/no)	-0.04	0.004	-0.02 to 1.26
Income (scaled from 1 to 4)	-0.01	NS	-0.95 to +0.91
Current smoking (cigarettes/day)	-0.03	0.004	-0.05 to -0.01
Occupational activity (scaled from 1 to 9)	-1.11	<0.001	-1.68 to -0.53
Educational status (scaled from 1 to 5)	2.13	<0.001	-1.68 to -0.53
Family history of diabetes	-1.11	0.005	0.21 to 1.67
Women			
Age (years)	-0.16	0.006	-0.07 to 1.33
Hours watching television	-0.13	<0.001	-0.02 to -0.03
Walking (yes/no)	0.42	NS	-0.01 to 2.33
Cycling (yes/no)	0.35	NS	-0.12 to 1.77
Income (scaled from 1 to 4)	-0.01	NS	-0.95 to +0.91
Current smoking (cigarettes/day)	-0.03	NS	-0.44 to +1.61
Occupational activity (scaled from 1 to 9)	-1.53	<0.002	-1.24 to -0.67
Educational status (scaled from 1 to 5)	1.55	<0.001	-1.78 to -0.64
Parity (scaled from 1 to 5)	0.22	0.003	0.14 to 0.96
Family history of diabetes	-1.19	0.001	-1.08 to -0.74
Employment outside home (yes/no)	-2.33	<0.001	-3.54 to -1.12

Table 5 shows the results of multiple regression analyses (likelihood analyses with co-efficient regression) with body mass index as a dependent variable for men and women separately. In men, body mass index was related inversely to hours watching television, sporting activity (walking and cycling), income, occupational activity score and cigarette smoking. In women, body mass index was related inversely to employment outside the home, hours watching television, occupational activity score, and family history of diabetes, educational status and parity. Sporting activity (walking and cycling) score did not show any statistically significant relationships with obesity in women.

Discussion

Our study shows that obesity is a major public health problem in both men and women and across age groups. The relationship was present in both men and women, although the magnitude of the association appears to be weaker in older age groups than in younger age groups. Surveys in Bahrain[10] and in other countries in the Arabian Peninsula,[11] which used the same criteria of BMI, show that the age-specific prevalence of obesity in Bahrainis is higher than that reported in Saudi adults.[12] However, rates in Bahrain are similar to the prevalence rates of obesity in Kuwait[11] and the United Arab Emirates.[3] The combined prevalence of overweight and obesity was 60% in men and 70% in women aged 50-59 years.

Obesity threatens to become the foremost cause of chronic disease in the world.[5] Being obese can induce multiple metabolic abnormalities that contribute to cardiovascular disease, diabetes mellitus, and other chronic disorders. Unfortunately, the prevalence of obesity is increasing both in the Western countries as well as in Arab populations. Reasons for the rising prevalence include urbanization of the world's population, increased availability of food supplies, and reduction of physical activity.[23] Although most obesity cases in the general population are of moderate type, this can still elicit several metabolic abnormalities that are precursors to increased morbidity and mortality from chronic noncommunicable diseases.[24]

The association of obesity with lack of physical activity, higher levels of education, and higher income levels indicates that lifestyle factors play an important role in the etiology of obesity among the Bahraini population. The pattern is in contrast with Western populations, where higher levels of education are associated with a higher prevalence of obesity.[18] This is consistent with the hypothesis that obesity is a consequence of affluence in the Arabian Peninsula region. Apart from the metabolic abnormalities, there are severe social and psychological consequences of obesity in Bahrain. Dietary fat intake increases along with decreases in intake of carbohydrates.[25] In Bahrain, most businesses and jobs are sedentary and walking is the obvious natural form of exercise through which activity output can be amplified. This would require changes both in transportation policy and in social attitudes.[26]

As expected in this population where obesity is common, the prevalence of hypertension (defined as systolic ≥160 mm Hg or diastolic ≥95 mm Hg) was high as well. Moreover, persons with BMI levels higher than 30 kg/m^2 (obese subjects) had higher blood pressure levels compared to persons with normal BMI range (BMI = 20-24.9 kg/m^2). There was a linear increase in the prevalence

of hypertension, with increasing BMI or waist-girth ratio. It is estimated that as much as one-third of all hypertension cases in the community may be attributable to obesity in populations where both hypertension and obesity are common.[17]

In Bahrainis, high rates of diabetes were associated with obesity but not with overweight. There was no relationship between obesity and plasma triglyceride levels after adjusting for glucose intolerance, while the association of diabetes persisted after adjusting for obesity. This is different from other populations in which obesity is independently associated with high rates of diabetes.[7]

We have previously reported that glucose intolerance is also associated with obesity.[15] Similar findings have been reported in other Arabian Peninsula populations.[3] This suggests that the obesity underlying the high prevalence of type 2 diabetes in the Arabian Peninsula may differ from the insulin resistance syndrome described in other populations.[27,28] Understanding the etiology of the high prevalence of obesity and diabetes in Arab populations may depend upon identifying underlying defects in metabolic syndromes.

In conclusion, the prevalence of overweight and obesity among the middle-aged and elderly Bahraini population is high. The prevalence of obesity was higher in educated subjects, which reflect that obesity may be a sign of affluence among the Bahraini population. There is a necessity to develop an action plan as well as a health strategy for controlling obesity and its consequences among Arabian Gulf populations.

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