Prevalence and correlates of obesity and central obesity among Omani adults

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ABSTRACT

Objectives: Overweight, particularly obesity is a major risk factor for several important diseases, especially hypertension, coronary heart diseases and diabetes mellitus. Our aim is to determine the prevalence of obesity and central obesity among Omani adults aged ≥20 years, and to identify the socio-demographic and health variables that correlate to obesity and central obesity in a community based survey (National Health Survey, 2000).

Methods: A community based cross-sectional survey representing all parts of Oman was designed in the year 2000. A part of the survey was a door to door interviews including demographic data, weight, height, hip and waist measurements, blood pressure and fasting blood glucose and serum cholesterol for adults aged ≥20 years.

Results: The crude prevalence of overweight and obesity (body mass index >25 kg/m^2) was 47.9% for the whole sample, and 46.2% for males, 49.5% for females. The crude prevalence of central obesity (abnormal weight hips ratio) was 49.3% for the whole sample, 31.5% for males, and 64.6% for females. Obesity and central obesity were less prevalent among younger age groups and highly educated subjects. Both obesity and central obesity increased the odds of having diabetes, hypertension and hypercholesteremia.

Conclusion: The prevalence of obesity and central obesity is quietly high in Oman. Launching nutritional programs and promotional life style modification programs are recommended.

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The social advances in Oman since 1970 have been accompanied by cultural changes, reduction of communicable diseases, increasing life expectancy, change in nutritional habits and habitual physical activity and the increasing rate of non communicable diseases and its risk factors such as hypertension, diabetes, and smoking.[1] Overweight, particularly obesity is a major risk factor for several important diseases, especially hypertension, coronary heart diseases, dyslipidemia, diabetes mellitus (DM), and several cancers such as endometrial and breast cancer.[2-7] A relation to psychological problems has also been implied.[8] Obesity is also considered as a disease by itself.[9] It is important to determine the prevalence and the correlates of obesity as such information could help in public health intervention programs.

Our aim is to determine the prevalence of obesity and central obesity among Omani adults aged ≥20 years, and to identify the socio-demographic and health variables that correlate to obesity and central obesity in a community based survey as a part of National Health Survey (NHS), 2000.

Methods. ***Sample design and subjects.*** The sample for the survey was selected to be representative of the Nation as a whole. The survey adopted a multi-stage, stratified probability-sampling design. In the first stage, all the 10 regions of the Sultanate were chosen and the sample was distributed according to proportional allocation of the population size in each region. In each region, one or more willayates was

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randomly chosen according to the size of the population in each region. The total number of willayates selected was 16 out of 59 (27%). Then, each willayate was stratified into 2 strata; the first stratum was the willayate's centers representing the urban area and the second stratum was the villages or remote areas, which represent the rural areas. The ratio of urban to rural subjects was 2:1. The second stage was the random selection of enumeration areas (EAs) in each stratum. These EAs were the census enumeration areas, which were used during 1993 population census, and each EA approximately contains 80 households. The third stage was the selection of households in each EA. The maps of the selected EAs were updated and a complete listing of all Omani households in each EA was made to obtain the sampling frame, and then the households were systematically randomly selected. All subjects aged ≥20 years in the selected household were invited to participate in the survey. The total number of households selected was 1968 with 7011 subjects fulfilling the criteria of selection. The response rate varied from 83-91% according to the type of measurement or laboratory investigation completed. As regards to anthropometrical measurement, weight and height measurements were taken from 6430 subjects (91.7%), while waist and hip circumference measurement were taken from 6173 subjects (88%) as some males were shy to be waist and hip measured by female nurses especially in rural areas.

The questionnaire and measurements. The household health status questionnaire covers the demographic data, age, sex, marital status, educational status, and working status and includes self-reporting of DM, hypertension, and smoking habits. Measurements of blood pressure (BP), weight, height, waist and hip circumference were registered in the questionnaire. The World Health Organization (WHO) procedures were used for taking the measurements.[10] The questionnaire also included items for the results of laboratory investigations taken for fasting blood sugar, and serum cholesterol.

Specimens collection and analysis. Twenty-five teams consisting of a nurse took the measurements, a laboratory technician drawn the samples, a health educator interviewed the subjects, a health inspector transported the laboratory samples, and a field supervisor (statistician) supervised and reviewed the questionnaires during field operation. They were all trained on the methodology of the survey for 2 weeks. The eligible members in the selected households were asked to fast from one to 2 hours before midnight on the night before they were due a visit by the survey team. The following morning the eligible household members were interviewed, measurements were taken, and venous fasting blood samples were collected. Fasting blood samples for glucose were collected in sodium fluoride potassium oxalate tubes, labeled and transferred immediately with laboratory forms to the laboratory in the Willayate Hospital in cold boxes. Samples were immediately centrifuged, the plasma was separated and the fasting plasma glucose was determined by a glucose oxidase method[11] on the same day using Hitachi 911 automated clinical chemistry analyzers (Boehringer Mannheim). The same manufacturer supplied used reagents. The samples for estimation of cholesterol were collected in tubes containing lithium heparin anticoagulants transferred to the laboratory. Estimation of serum cholesterol was carried out by enzymatic colorimetric method[12] using Hitachi 911 automated clinical chemistry analyzer (Boehringer Mannheim).

Diagnostic criteria. The WHO criteria (1999) for diagnosis of hypertension, hypercholesterolemia, anthropometric measurement and glucose intolerance[13] were adopted.

1) Anthropometric measurements: a) Body mass index (BMI) = weight in kg/height^2 in cm^2. Subjects were considered underweight if their BMI was <18.5, normal if their BMI was 18.5-24.9; overweight if their BMI was 25.0-29.9; obese if their BMI was 30-39.9; and morbid obese if their BMI was ≥40.0. b) Waist hip ratio (WHR) - the cut-off point of abnormal WHR (central obesity) for female gender was considered ≥0.85, while it was considered ≥0.95 for male gender. Females with WHR ≥0.85 were considered central obese, while males with WHR ≥0.95 were considered central obese. The centiles for the WHR were also used in some tables.

2) Hypertension. Prevalence was estimated by adding the total subjects with self-reporting systolic or diastolic HTN (whether their BP was normal or not at the screening time) to the subjects with a mean of 2 readings of 140 mm Hg systolic BP or 90 mm Hg diastolic phase 5 BP or greater namely, either isolated systolic or diastolic hypertension.

3) Hypercholesterolemia. High total cholesterol: ≥ 5.2 mmol/1 or ≥ 200 mg/dl

4) Impaired fasting glycemia and diabetes mellitus. A) Impaired fasting glycemia (IFG) when fasting blood glucose ≥6.1-6.9 mmol/l. B) Diabetes mellitus: diabetes prevalence was estimated based on adding up the subjects with self-reporting of DM and subjects with fasting blood glucose ≥7.0 mmol/l C) Total impaired fasting glucose by adding A and B.

Data processing and analysis. Data entry was carried out using Epi Info version 6.[14] The process of preparation of data file was completed by July 2000. Data analysis was carried out using SPSS 5.0.[15] Group means were compared using analysis of variance (ANOVA) while the likelihood Chi squared test, or Chi square for linear by linear association examined the distribution of data. Step-wise logistic regression was conducted to test the most important associated factors with obesity and central obesity with calculation of the adjusted odds ratios (OR) for these factors. The independent variables used in the logistic models were either continuous or dichotomous (after recording some of them). A p value of <0.05 was considered statistically significant.

Results. **Table 1** shows the demographic and social characteristics of the study subjects. The sample was equally distributed by gender. The majority was of the age group 20-39 years (62.1%), 73% were living in urban areas, approximately 34% were illiterates, and 7 % of the sample were current smokers. Most of the sample were married (67%). Almost half of the families had 10 or more members due to the high fertility rate in Oman (TFR = 4.8, unpublished results of the NHS 2000). In **Table 2** shows the percentage of the subjects with obesity and central obesity according to certain characteristics. Overweight and obesity (BMI = 25+ kg/m^2), and central obesity (abnormal WHR) affects almost half of the sample (48%, 49%). Those of higher educational levels were significantly less likely to be obese or centrally obese. Those living in urban areas were more prone to be obese than those in rural areas. Non smokers were found to be less likely to be obese than current smokers. **Table 3** shows mean and proportions of some characteristics of the sample, distributed by age groups and gender. Diabetes mellitus was found among 11.2% of the overall sample, while hypertension was more prevalent 33.1%. Hypercholesterolemia was found among 40.6% of Omani adults. Chi squared test and ANOVA for comparison of means were used to test for any significant differences. In the youngest age group, there was a significant difference between both genders in most of the studied parameters. This almost disappeared in the middle age group to show again but with a lesser extent among the age group ≥60. While the mean systolic, BP was significantly higher among male subjects for those aged 20-39 years (123.79 in males versus 119.37 in females); the opposite was noticed in the eldest age group (aged ≥60). For diastolic BP males were found to have significantly higher mean in the youngest age group, but females aged ≥60 were found to have non-significantly higher mean than males. Females were found to have significantly higher BMI mean in the age group of 20-39 years and among those aged ≥60, while the WHR mean was significantly higher among males than females in the age group of 20-39 and 40-59 years. However, the prevalence of central obesity (abnormal WHR) was significantly higher among females in the 3 age groups due to the difference in the cut-off points of abnormal WHR among males and females (0.95, 0.85). From **Table 4**, it could be noticed that the prevalence of obesity and central obesity increased by age until reaching the age of 50 among males and then gradually decrease after that. The same pattern was not applied for females in case of central obesity. For the overall sample, females had significantly higher rates for both indicators in comparison with males and the difference was more evident for central obesity where its prevalence among females was almost double that of males. The risk of DM, hypertension and hypercholesteremia increased significantly among obese or centrally obese subjects (**Table 5**). The morbidity rates as well as the adjusted OR (for age, sex, education, residence, WHR) for them increased significantly among

Table 1 - Demographic and social characteristics of the study subjects.

Characteristics	n	(%)
Age groups (years)		
20-39	4353	(62.1)
40-59	1753	(25)
≥60	905	(12.9)
Total	**7011**	**(100)**
Sex		
Male	3506	(50)
Female	3505	(50)
Total	**7011**	**(100)**
Residence		
Urban	5143	(73.4)
Rural	1868	(26.4)
Total	**7011**	**(100)**
Education		
Illiterate	2333	(33.8)
<Secondary	2824	(40.9)
>Secondary	1753	(25.3)
Total	**6910**	**(100)**
Job		
Working	2778	(39.9)
Not working	4191	(60.1)
Total	**6969**	**(100)**
Marital status		
Married	4668	(66.7)
Not married	2327	(33.3)
Total	**6995**	**(100)**
Family size		
≤10 members	3696	(52.7)
>10 members	3315	(47.3)
Total	**7011**	**(100)**
Current smoking		
Yes	488	(7)
No	6515	(93)
Total	**7003**	**(100)**

Table 2 - Percentage of subjects with obesity and central obesity according to certain characteristics.

Characteristic	Obesity %	Central obesity %
Marital status		
Married	53.8	54.8
Not married	35.6*	37.5*
Education		
Illiterate	49.8	66.8
<Secondary	49.1	44.1
>Secondary	43.2*	32*
Work status		
Working	50.1	34.4*
Not working	46.5*	58.2
Place of residence		
Urban	50.5	48.8
Rural	40.8*	50.7
Family size		
≤10 members	48.6	49.1
>10 members	47.1	49.5
Current smoking		
Yes	47.1	31.4
No	40.3*	32.1
Total	**47.9**	**49.3**

*significant difference, p<0.05

Table 3 - Means and proportions of some characteristics of the sample distributed by age groups and gender.

Characteristics	Overall sample	Age groups 20-39 years Male	20-39 years Female	40-59 years Male	40-59 years Female	≥60 years Male	≥60 years Female
Diabetes status (N=5788)							
FBS mean (SD)	5.51 (2.28)	5.21 (1.65)	5.01* (1.48)	6.08 (2.67)	6.1 (3.08)	5.81 (2.44)	6.69* (3.81)
Normal fasting glucose (%)	(82.7)	(88.4)	(91.5)	(70.1)	(73.5)	(73.9)	(66.1)
Impaired fasting glucose (%)	(6.2)	(6.2)	(3.7)	(10)	(7.4)	(6.2)	(8.1)
Diabetes mellitus (%)	(11.2)	(5.4)	(4.8)	(19.9)	(19.1)	(19.9)	(25.8)
			p<0.05		p>0.05		p<0.05
Hypertension status (N=6414)							
Systolic BP mean (SD)	126.46 (16.33)	123.79 (12.07)	119.37* (12)	131.65 (16.30)	132.28 (18.09)	138.03 (19.1)	141.63* (21.46)
Diastolic BP mean (SD)	80.32 (10.07)	79.59 (8.85)	76.97* (9.04)	83.47 (9.82)	83.14 (10.73)	84.04 (10.81)	85.43 (11.73)
Normal BP (%)	(66.9)	(76.1)	(83.2)	(53.5)	(49.3)	(39.1)	(31.9)
Systolic or diastolic HTN (%)	(33.1)	(23.9)	(16.8)	(46.5)	(50.7)	(60.9)	(68.1)
			p<0.05		p>0.05		p<0.05
Cholesterol level (N=5850)							
Cholesterol mean (SD)	5.1 (1.18)	4.75 (1.09)	4.82 (1.07)	5.49 (1.18)	5.45 (1.2)	5.45 (1.12)	5.87* (1.12)
Normal (%)	(59.4)	(71.1)	(70.2)	(43.6)	(45.5)	(43.6)	(29.7)
High level (%)	(40.6)	(28.9)	(29.8)	(56.4)	(54.5)	(56.4)	(70.3)
			p>0.05		p>0.05		p<0.05
Body mass index (N=6430)							
BMI mean (SD)	25.52 (5.74)	24.79 (4.93)	25.38* (6.27)	26.66 (5.39)	27.11 (6.18)	24.31 (4.76)	25.2* (5.95)
Under/ normal weight (%)	(52.1)	(58)	(54)	(40.4)	(40.5)	(60)	(54.1)
Overweight/obese (%)	(47.9)	(42)	(46)	(59.6)	(59.5)	(40)	(45.9)
			p<0.05		p>0.05		p>0.05
WHR (N=6173)							
WHR mean (SD)	0.91 (0.15)	0.9 (0.12)	0.87* (0.13)	0.95 (0.14)	0.94* (0.17)	0.95 (0.18)	0.95 (0.13)
Normal WHR (%)	(50.7)	(76.6)	(46.5)	(54.6)	(17.6)	(60.6)	(14)
Abnormal WHR (%)	(49.3)	(23.4)	(53.5)	(45.4)	(82.2)	(39.4)	(86)
			p<0.05		p>0.05		p<0.05

*significant difference, p<0.05, BP - blood pressure, BMI - body mass index, WHR - waist, hips ratio, HTN - hypertension, FBS - fasting blood sugar

Table 4 - Prevalence of obesity and central obesity among Omani subjects by age and sex.

Age group (years)	Obesity Males Total	Obesity Males n of cases (%)	Obesity Females Total	Obesity Females n of cases (%)	Obesity Total Total	Obesity Total n of cases (%)	Central obesity Males Total	Central obesity Males n of cases (%)	Central obesity Females Total	Central obesity Females n of cases (%)	Central obesity Total Total	Central obesity Total n of cases (%)
20-29	**1248**	441 (35.3)	**1358**	528 (35.3)	**2606**	**969 (37.2)**	**1248**	441 (35.3)	**1358**	528 (35.3)	**2606**	**969 (37.2)**
30-39	**580**	327 (56.4)	**763**	447 (56.4)	**1343**	**774 (57.6)**	**580**	327 (56.4)	**763**	447 (56.4)	**1343**	**774 (57.6)**
40-49	**418**	268 (64.1)	**340**	225 (64.1)	**758**	**498 (65)**	**418**	268 (64.1)	**340**	225 (64.1)	**758**	**498 (65)**
50-59	**361**	196 (54.2)	**544**	301 (54.2)	**905**	**497 (54.9)**	**361**	196 (54.2)	**544**	301 (54.2)	**905**	**497 (54.9)**
>60	**467**	187 (40)	**351**	161 (40)	**818**	**348 (42.5)**	**467**	187 (40)	**351**	161 (40)	**818**	**348 (42.5)**
Total		**1419 (46.2)**		**1662 (46.2)**	**6430**	**3081 (47.9)**		**(46.2)**			**6430**	**3081**
		Chi square = 19.9* p=0.000*		Chi square = 30.6* p=0.000* Chi square = 7.268* p=0.007*		Chi square = 48.7* p=0.000*		Chi square = 114.68* p=0.000*		Chi square =385.57* p=0.000* Chi square =684.98* p=0.000**		Chi square =381.61* p=0.000*

*Chi square for linear association to show difference in rates by age.
†Likelihood of chi square to show difference in rates by sex.

both the overweight group (BMI = 25-<30kg/m^2) and the obese group (BMI=30+kg/m^2). The risk of diabetes starts for those >75th percentile of WHR (OR=1.84, 95% CI 1.18-2.87) versus those taken as the reference group namely <10th percentile, instead, while it starts for those >50th percentile for hypertension. (OR=1.62, 95%CI 1.26-2.09).

Discussion. Our study shows that overweight and obesity is prevalent among Omani population. There is apparently gradual weight gain after 30 years of age, which tends to decrease gradually after the age of 60. The decline in mean BMI in the oldest age group was consistent with other studies.[16-18] Both obesity and central obesity were more prevalent among females than males and the difference was evidently more in central obesity where the rate for females was double compared to males. Several studies of general obesity in the Kingdom of Saudi Arabia have indicated a significantly higher prevalence of obesity among females than among males.[19-21] These findings were not consistent with the findings in the Ontario population where the obesity among males tended to be more central, while obesity was more among females,[22] which could be explained by the increase in central body fat that occurs in males but not in females in the passage from adolescence to adulthood.[23,24] The explanation of why central obesity was higher among females in our study could be due to the high fertility rate and the high female illiteracy rates, which lead to lower female awareness to the importance of their physique. In addition, the relatively lower rates of alcoholism among men in Islamic culture in comparison with the western community, which could lead to liver enlargement or alcoholic cirrhosis could play a role in central obesity among men. The higher levels of obesity and central obesity among less educated subjects are consistent with the results of other studies.[22,25] Higher education may lead to healthier diet and more active life style especially among Omani adults. Those living in urban areas were more likely to be obese than those living in rural areas for both genders. This could be explained by the sedentary life style of those in urban areas. Urban residents were insignificantly less likely to be centrally obese than others, which could be explained by the tendency of urban subjects, especially females, to be more attractive in their appearance than rural subjects. It could be possible, if we would run this study after 10 years, to find that rural subjects would be linear than urban ones, a pattern similar to what is found in the industrialized world. The results of logistic regression showed that diabetes and hypertension, and hyperchlosterolemia were significantly associated with abnormal BMI and WHR among Omani adults. This was totally consistent with the findings of Negri et al[26] and others in their studies.[27] General obesity is usually associated with

Table 5 - Rates and odds ratio of diabetes mellitus, hypertension, and hypercholesteremia according to body mass index and different centile of waist, hip ratio among Omani subjects.

Measurement	n	Diabetes			Hypertension			Hypercholesteremia		
		%	OR	95% CI	%	OR	95% CI	%	OR	95% CI
Body mass index† (kg/m^2)										
>25	3349	7.8	1‡		26.7	1‡		34.2	1‡	
25-<30	1856	14.3	1.74	1.41 - 2.15	35.7	1.33	1.15 - 1.53	45.8	1.41	1.23 - 1.61
≥30	1225	16.2	2.04	1.61 - 2.58	47	2.36	2.02 - 2.77	50.3	1.63	1.39 -1.91
Total	**6430**	**11.2**			**3301**			**40.6**		
		Chi square = 70.8*, p=0.000*			Chi square = 172.4*, p=0.000*			Chi square = 106.2*, p=0.000*		
WHR centile										
<10th	625	5.2	1‡		17.6	1‡		24.1	1‡	
<25th	920	5.6	0.92	0.56 - 1.51	22.5	1.16	0.92 - 1.46	27	1.04	0.8 - 1.36
<50th	1545	8.3	1.04	0.67 - 1.62	27.1	1.08	0.84 - 1.4	37.8	1.4	1.1 - 1.78
<75th	1544	10.7	1.07	0.69 - 1.67	40.8	1.62	1.26 - 2.09	44.1	1.52	1.19 - 1.93
<90th	922	18.9	1.84	1.18 - 2.87	44.3	1.52	1.16 - 2	51.7	1.79	1.38 - 2.32
>90th	617	20.5	1.89	1.19 - 2.99	47.1	1.72	1.21 - 2.44	52.6	1.81	1.37 - 2.39
Total	**6173**	**11.2**			**33.1**			**40.6**		
		Chi square = 121.4*, p=0.000*			Chi square = 272.9*, p=0.000*			Chi square = 207.8*, p=0.000*		

*Chi square for linear by linear association to show difference in rates by body mass index grading and WHR centiles.
†reference category for the odds ratio, ‡ reference category.
OR - odds ratio adjusted for age, sex, level of education, place of residence (urban/rural), body mass index grades, WHR centile for the outcome morbidity of diabetes, hypertension or hypercholesteremia, CI - confidence intervals, WHR - waist, hips ratio, OR - odds ratio

insulin resistance. Approximately 50% of persons with hypertension can be considered to have insulin resistance and hyperinsulinemia. It appears likely that insulin resistance and hyperinsulinemia predispose to, rather than result from, hypertension. Insulin resistance is associated with abnormalities in lipoprotein metabolism, hypercoagulability, and endothelial function, which probably account partly for the increased cardiovascular risk among hypertensive patients.[28] Schmidt et al[29] reported that central obesity as measured by WHR was significantly associated with diabetes. An association between hypertension and central obesity has also been reported.[30] Central obesity is associated with a certain hemodynamic pattern characterized by high total peripheral resistance, low cardiac output and a vasoconstriction response to psychosocial stress, leading to cardiovascular disease and hypertension.[31]

The findings of the study show the magnitude of the problem of both obesity and central obesity among Omani adults. It also shows the demographic variables associated with obesity and central obesity aside from morbidity confounded. These findings suggest that there is a need to promote lifestyle changes to reduce the prevalence of obesity and central obesity and to prevent the occurrence of diabetes and hypertension among Omani subjects. Weight patterns in a population reflect both its dietary and physical activity habits. Improving community awareness towards decreased calories consumption and increased leisure time physical activity could start first in urban areas, as cultural evolution occurs at different rates in urban and rural areas.

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