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PAPER

Obesity and selected co-morbidities in an urban Palestinian population

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OBJECTIVE: To assess the prevalence of obesity and central obesity in an urban Palestinian population and their associations with selected co-morbidities, including diabetes, hypertension and dyslipidaemia.
DESIGN: A population-based cross-sectional survey in an urban Palestinian community.
SUBJECTS: Men and women aged 30–65 y residing in the urban community, excluding pregnant women.
MEASUREMENTS: According to WHO guidelines, obesity for men and women was defined as BMI $\geq$ 30 kg m^{-2}, while pre-obesity was defined as BMI 25–29.9 kg m^{-2}. Central obesity was defined as a waist-to-hip ratio (WHR) of $>$ 0.90 in men and $>$ 0.85 in women.
RESULTS: The prevalence of obesity in this population was high at 41% (49% and 30% in women and men, respectively). Central obesity was more prevalent among men (59% compared to 25% in women). After adjusting for the effects of age, sex, smoking and each other, obesity and central obesity were found to be significantly associated with diabetes, low HDL-cholesterol and elevated triglycerides in separate logistic regression analyses. Central obesity was also significantly associated with hypertension (OR 2.26, 95% CI 1.30–3.91).
CONCLUSION: Obesity and central obesity are prevalent in the urban Palestinian population. Their associations with diabetes, hypertension, and dyslipidaemia point to a potential rise in cardiovascular disease (CVD). An understanding of the reasons behind the high prevalence of obesity is essential for its prevention as well as for the prevention of the morbidities to which it may lead.
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Introduction

In addition to its association with a variety of morbidities, such as gallbladder disease, osteoarthritis, and certain types of cancer, obesity also has a well-established association with cardiovascular disease (CVD) and its risk factors.[1,2] A number of metabolic abnormalities that lead to CVD are associated with obesity, including dyslipidaemia, raised blood pressure, insulin resistance and glucose intolerance, and abnormalities in the coagulation system.[3] This collection of factors is known as the metabolic syndrome.[4] Central obesity has also been found to be an independent contributor to CVD at a given level of obesity and is included in the WHO working definition of the metabolic syndrome.[4,5]

The exact mechanisms whereby obesity predisposes to this collection of risk factors are not yet fully understood. What is known, however, is that the prevalence of obesity has been increasing worldwide due, in large part, to rising urbanization, increased availability of food, and decrease in physical activity.[3]

In the Eastern Mediterranean Region (EMR), economic development has precipitated profound social and demographic changes over the past two decades.[6] Food availability and consumption have increased rapidly in many countries, and lifestyles have become more sedentary, as growing urbanization lessens the need for physical labour.[7,8] Surveys from the region indicate alarmingly high prevalences of obesity, especially in urban areas and among women.[9–13]

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In the Palestinian West Bank, a recent survey conducted in a rural community found the prevalence of obesity to be 42.1% in women and 19.5% in men when age-standardized to the WHO 'world' standard population.[14] In view of the fact that 46.5% of the Palestinian West Bank population now lives in urban areas, it is important to obtain data on the prevalence of obesity and its co-morbidities there.[15] The objectives of the present study are to determine the prevalence of obesity in an urban Palestinian community and to assess its associations with selected co-morbidities, including diabetes, hypertension and dyslipidaemia.

Methods

The population surveyed in this study resides in a well-defined, predominantly Muslim, urban community in the heart of Ramallah, which is a major city located in the centre of the West Bank, 16 km north of Jerusalem.

A household census was first conducted to identify eligible subjects. Eligibility was based on age (30–65 y), residence within the survey area for at least 6 months prior to the beginning of the study, physical ability to participate, and mental ability to comprehend and consent to survey procedures.

Characteristics of the study population are summarized in Table 1. Based on the inclusion criteria, and after exclusion of seven pregnant women, a total of 485 individuals (295 women and 190 men) participated in the study, representing an overall response rate of 59.2% (71% in women and 47% in men).

The model protocol by Dowse and Zimmet was followed.[16] Survey procedures included anthropometric measurements (height, weight, and waist and hip circumferences), fasting capillary blood glucose (FBS) measurement, an oral glucose tolerance test (OGTT), blood pressure measurement, blood lipids tests, and completing a questionnaire on socio-demographic and smoking information. The study population and methods have been described in more detail in a previous report.[17]

According to WHO guidelines, obesity for men and women was defined as BMI $\geq 30\,\text{kg m}^{-2}$, while pre-obesity was defined as BMI $25-29.9\,\text{kg m}^{-2}$.[18] Central obesity was defined as a waist-to-hip ratio (WHR) >0.90 for men and >0.85 for women.[4] Diabetes was determined by the results of the OGTT using venous plasma or by reporting a physician's diagnosis prior to the survey. The diagnostic values for the OGTT, according to WHO guidelines of 1985, were >11.1 mmol/l at 2 h after glucose load.[19] Persons with previously diagnosed diabetes who were on oral hypoglycemic agents or insulin injections were excluded from the OGTT.[16] Hypertension was defined as blood pressure $\geq 140/90$ mmHg or a physician's diagnosis of hypertension prior to the survey. Venous serum samples were used to determine levels of blood lipids. The cut-off for determining raised triglycerides was ≥ 1.70 mmol/l, and low HDL-cholesterol was defined as <0.90 mmol/l in men and <1.0 mmol/l in women.[4]

Table 1 Characteristics of the study population

	Males	*Females*
n	190	295
Age (y) (s.d.)[a]	42.7 (9.6)	45.3 (10.5)
Years of education (s.d.)[b]	8.9 (4.8)	7.1 (5.1)
Currently smoking (%)[c]	58.7	18.1

[a] P (independent-samples) t-test) = 0.006.
[b] P (independent-samples t-test) < 0.001.
[c] P (χ^2 test) < 0.001.

Data analysis

Statistical analysis was conducted using the Statistical Package for the Social Sciences for Windows (SPSSWIN), version 8.0. The prevalence of obesity was presented both as a raw percentage and adjusted for confounding by age and sex. Adjustment was made to the age and sex structures of the Palestinian population[15] as well as to the age structure of the WHO 'world' population by direct standardization.[20] The associations of BMI and WHR with age-group were assessed by analysis of variance (ANOVA), and the χ^2 test was used to test the difference between prevalence values (Tables 2 and 3). Descriptive bivariate analysis between the metabolic factors as continuous variables and levels of BMI (normal, pre-obese and obese) was performed using multiple regression analysis, including age as a categorical variable (Table 4). In logistic regression analyses controlling for potential confounding by age, sex and smoking, associations were assessed between (a) obesity and (b) central obesity as categorical independent variables and, taken one by one, diabetes, hypertension and dyslipidaemia as dependent variables (Table 5). Potentially significant interactions between independent variables were examined by inclusion of their product terms in each model. In the model with diabetes as the dependent variable, the interaction between age and obesity was significant, so age-specific odds ratios are presented. The P-value 0.05 was used as a cut-off level for significance.

Table 2 Mean BMI and the prevalence of pre-obesity (BMI 25–29.9) and obesity (BMI ≥ 30) by sex and age

Age group	*n*	*BMI Mean (s.e.)*	*Pre-obese BMI 25–29.9 % (n)*	*Obese BMI ≥ 30 % (n)*
Male				
30–34	44	25.6 (0.52)	45.5 (20)	11.4 (5)
35–44	80	27.4 (0.47)	45.0 (36)	28.8 (23)
45–54	39	28.3 (0.68)	33.3 (13)	43.6 (17)
55–65	27	28.8 (1.08)	29.6 (8)	44.4 (12)
30–65	190	27.4 (0.32)	40.5 (77)	30.0 (57)
Female				
30–34	61	28.0 (0.83)	42.6 (26)	27.9 (17)
35–44	83	29.5 (0.58)	30.1 (25)	48.2 (40)
45–54	78	31.3 (0.68)	37.2 (29)	53.8 (42)
55–65	73	31.9 (0.74)	26.0 (19)	61.6 (45)
30–65	295	30.2 (0.36)	33.6 (99)	48.8 (144)

Table 3 Mean waist-to-hip ratio (WHR) and the prevalence of abdominal obesity (WHR > 0.90 in men and > 0.85 in women) by sex and age

	Males			*Females*		
Age group	n	*WHR mean (s.e.)*	*WHR ≥ 0.90 %(n)*	n	*WHR mean (s.e.)*	*WHR ≥ 0.85 %(n)*
30–34	44	0.88 (0.0082)	40.9 (18)	61	0.77 (0.0067)	3.3 (2)
35–44	80	0.91 (0.0068)	56.3 (45)	83	0.80 (0.0065)	13.3 (11)
45–54	39	0.94 (0.011)	76.9 (30)	78	0.82 (0.0062)	30.8 (24)
55–65	27	0.95 (0.015)	70.4 (19)	73	0.86 (0.0077)	52.1 (38)
30–65	190	0.92 (0.0049)	58.9 (112)	295	0.81 (0.0038)	25.4 (75)

Table 4 Mean risk factor values and their standard errors (s.e.) in normal-weight (BMI < 25), pre-obese (BMI 25–29.9) and obese (BMI ≥ 30) males and females

		BMI			
	Metabolic factor	*Normal*	*Pre-obese*	*Obese*	*P-value*[a]
Males	Systolic BP (mmHg)	115.4 (1.86)	124.3 (2.09)	132.1 (2.28)	< 0.001
	WHR	0.85 (0.0058)	0.92 (0.0058)	0.97 (0.007)	< 0.001
	FBS (mmol/l)	4.11 (0.20)	4.22 (0.13)	4.86 (0.36)	0.124
	2 h-glucose (mmol/l)[b]	4.67 (0.16)	4.84 (0.19)	5.42 (0.26)	0.048
	Cholesterol (mmol/l)	4.49 (0.12)	5.10 (0.13)	5.56 (0.25)	< 0.001
	HDL-chol (mmol/l)	0.89 (0.038)	0.74 (0.030)	0.77 (0.035)	0.002
	LDL-chol (mmol/l)	3.15 (0.12)	3.77 (0.13)	3.99 (0.16)	< 0.001
	TG (mmol/l)	1.21 (0.10)	1.85 (0.20)	3.0 (0.56)	0.001
Females	Systolic BP (mmHg)	111.4 (2.52)	118.5 (2.06)	125.9 (1.67)	0.003
	WHR	0.76 (0.0067)	0.80 (0.0064)	0.84 (0.0049)	< 0.001
	FBS (mmol/l)[b]	4.75 (0.27)	4.70 (0.15)	5.64 (0.22)	0.052
	2 h-glucose (mmol/l)[b]	5.08 (0.19)	5.73 (0.24)	6.37 (0.22)	0.006
	Cholesterol (mmol/l)	4.88 (0.16)	5.17 (0.12)	5.32 (0.12)	0.580
	HDL-chol (mmol/l)	1.15 (0.049)	0.95 (0.027)	0.90 (0.024)	< 0.001
	LDL-chol (mmol/l)	3.32 (0.16)	3.71 (0.12)	3.80 (0.084)	0.392
	TG (mmol/l)	0.95 (0.074)	1.41 (0.087)	2.07 (0.23)	0.002

[a]*P*-value obtained from multivariate regression analysis of each metabolic factor on the three levels of obesity and age (30–34, 35–44, 45–54, 55–65).
[b]FBS values include all subjects regardless of their diabetes status, while 2 h-glucose levels exclude persons with previously diagnosed diabetes.

Results

The mean BMI and the prevalence of pre-obesity and obesity by age and sex are presented in Table 2. The age-specific and overall BMI averages were significantly higher in females than in males. The difference in the prevalence of obesity, but not pre-obesity, was significant between the sexes ($P < 0.001$ and $P = 0.12$, respectively). The crude prevalence of obesity for both sexes was 41.4% (95% CI 37.0–45.8). The point prevalence rose to 43.3% (95% CI 38.9–47.7) when adjusted to the age structure of the WHO 'world' population and dropped to 38.1% (95% CI 33.8–42.4) when adjusted to age and sex structures of the Palestinian population. In total, 70.5% of men and 82.4% of women had a BMI ≥ 25. There was a significant positive association between BMI and age in both sexes ($P = 0.007$ in males and $P < 0.001$ in females). Similarly, the prevalence of obesity increased steadily with age in both sexes, reaching a high of 61.6% in the 55–65 age-group of women. The mean WHR was significantly higher among males than females ($P < 0.001$), and the prevalence of central obesity among males (58.9%) was more than double that in females (Table 3).

Table 5 Age-, sex- and smoking-adjusted odds ratios of hypertension, diabetes and dyslipdaemia for overall obesity (BMI ≥ 30) and central obesity (WHR ≥ 0.85 in females and WHR ≥ 0.90 in males)

	Overall obesity OR (95% CI)[a]	P-value	*Central obesity OR (95% CI)*[a]	P-value
Hypertension	1.53 (0.92, 2.54)	0.10	2.26 (1.30, 3.91)	0.0036
Diabetes[b]			2.11 (1.07, 4.18)	0.031
Age 30–44	1.60 (0.44–5.82)	0.48		
Age 45–54	12.68 (2.78–57.84)	0.001		
Age 55–65	0.88 (0.35–2.24)	0.79		
Low HDL-chol	2.22 (1.42, 3.47)	0.0005	2.14 (1.31, 3.49)	0.0022
Hypertrigly-ceridaemia	2.04 (1.30, 3.18)	0.0018	4.13 (2.55, 6.68)	< 0.001

[a]Age groups used in the logistic regression model (30–44, 45–54, 55–65).
[b]Odds ratios for the interaction of obesity with age. The odds ratio for each age group reflects the effect of obesity *within* that group.

The bivariate associations between various metabolic factors and levels of BMI are presented in Table 4. A significant positive association was seen in both sexes between BMI levels and systolic blood pressure, WHR, 2 h-glucose, and triglycerides, after adjusting for age, and a significant negative association with HDL-cholesterol was also seen in both sexes. The association of FBS with BMI levels did not reach the level of significance in either sex, while total and LDL-cholesterol were significantly associated with BMI only in men. The association was not confounded by central obesity, as it was tested in a regression analysis after stratification into tertiles of WHR.

When age, sex and smoking were adjusted for in logistic regression analyses for each metabolic factor, obesity and central obesity were significantly associated with low HDL-cholesterol and hypertriglyceridaemia, in the presence of each other in the model (Table 5). Both types of obesity were also associated with diabetes, but there was a significant interaction between obesity and age, such that obesity was only significantly associated with diabetes in the 45–54 age group. The odds ratios presented in Table 5 reflect the association of obesity with diabetes *within* each age group. Central obesity, but not obesity, was also significantly associated with hypertension.

Discussion

Population-based data on the anthropometric measurements of Palestinian adults have been lacking until recently. A community-based rural survey found the age-adjusted prevalence of obesity to be 42.1 and 19.5% among women and men, respectively.[14] The study concluded that the prevalence of obesity was high for a rural population and that it pointed to an emerging trend of CVD morbidity and mortality. The present study provides for the first time community-based data on obesity in an adult urban Palestinian population, which show, as expected, that the prevalence of obesity there is even higher.

A high response rate is important for minimizing selection bias. In this survey, intensive efforts were made to encourage participation, including recruitment of local field workers and securing the approval and support of local community leaders. Approximately 62% of families with eligible individuals participated in the survey. Response among men was problematic however (47%), in part due to the time demand of the survey protocol (approximately 2 h), which conflicted with work schedules. Among women, the response was higher (71%), since most were not employed in the formal sector. Another reason cited for non-response was the availability of a number of health facilities in this urban centre, thus reducing the interest in obtaining a health assessment through the survey. Though probably of varying quality, health services are accessible to all income levels, because of the mix of private and government providers and insurance types. Thus it may be reasonable to assume that the study participants were not only persons of lower income who were unable to access health services.

An examination of the demographic characteristics of non-responders is essential, in order to anticipate the direction of the potential bias associated with low response. The age, sex, education and SES levels of responders and non-responders were compared, and no significant differences were found. The findings of this study can thus be generalized to urban communities similar to the survey site in the center of the West Bank, especially in middle-to-lower income communities.

Because of the excess of females and due to the fact that the study population was slightly older than the Palestinian population, sex and age adjustments were applied, resulting in a drop of the point prevalence of obesity from 41.4 to 38.1%. The prevalence of obesity among women in this study was high, where approximately 50% of women and 30.0% of men had a BMI $\geq$ 30. Since health risks associated with increasing BMI are graded and begin at a BMI $<$ 25,[18] the high prevalence of BMI $\geq$ 25 in this population is especially alarming. Although direct comparisons are difficult because of differences in the study populations' age groups, these findings seem to fall within the range of obesity prevalences found by other studies in the EMR, including Kuwait, Saudi Arabia and Jordan.[10,11,13]

Both obesity and fat distribution are known to be associated with CVD and its risk factors.[1,21] Because of its cross-sectional design, this study is not able to show causality, as exposure and effect are measured simultaneously. It is possible that subjects who had been diagnosed with diabetes or hypertension prior to the survey had changed their lifestyles, including their body weight, in response to their condition. However, the significant associations of obesity and central obesity with diabetes, low HDL-cholesterol and elevated triglycerides after controlling for age, sex and smoking, are consistent with the findings of prospective studies.[22] The effect of age on the association between BMI and morbidity has been debated.[23] In an analysis of cross-sectional data from the Third National Health and Nutrition Examination Survey (NHANES III) in the United States, it was observed that the relationship of obesity with the comorbidities studied (including diabetes) was generally strongest among the younger age groups.[23] The interaction of obesity with age found in this study in relation to diabetes requires further investigation.

Conclusion

The prevalence of obesity and central obesity in urban Palestinian men and women is high, and it is associated with dyslipidaemia, hypertension and diabetes. Chronic diseases pose a considerable burden of morbidity and premature mortality, and their financial toll can be daunting, especially for health systems with limited resources, making prevention the strategy of choice. In the Palestinian setting, future research should focus on elucidating the causes of overweight and obesity, including changing nutritional habits, physical activity patterns and cultural attitudes, as a first step towards prevention.

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