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PAPER

Obesity in a rural and an urban Palestinian West Bank population

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OBJECTIVE: To compare the prevalence of obesity, household food consumption patterns, physical activity patterns and smoking between a rural and an urban community in the Palestinian West Bank and to describe the associations of the latter factors with body mass index (BMI).
DESIGN: A population-based cross-sectional survey in a rural and an urban Palestinian West Bank community.
SUBJECTS: A total of 549 women and 387 men aged 30–65 y, excluding pregnant women.
MEASUREMENTS: Obesity was defined as BMI ≥ 30 kg/m^2.
RESULTS: The prevalence of obesity was 36.8 and 18.1% in rural women and men, respectively, compared with 49.1 and 30.6% in urban women and men, respectively. The mean difference (s.e) in BMI levels was 1.6 (0.52) kg/m^2 between urban and rural women and 0.9 (0.46) kg/m^2 in men. At the household level, the mean energy consumption from 25 selected food items was 13.8 MJ (3310 kcal)/consumption unit/day in the rural community compared to 14.5 MJ (3474 kcal)/consumption unit/day in the urban community ($P = 0.021$). BMI was positively associated with age in both men and women and with urban residence in women. BMI was negatively associated with smoking and physical activity in men and with educational level in women.
CONCLUSION: BMI was associated with urban residence in women after adjusting for age, smoking, education, physical activity and nutrition-related variables, suggesting that the differences in the conventional determinants of obesity could not fully explain the difference in the prevalence of obesity between the two communities. Among men, the measured determinants explained the rural–urban differences in BMI.
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Keywords: urban; rural; BMI; household; food consumption patterns

Introduction

The health impact and financial burdens of obesity have been well documented. Excess weight is associated with an increased incidence of cardiovascular disease (CVD), type 2 diabetes mellitus, hypertension, stroke, dyslipidemia, osteoarthritis, and some cancers.[1–4] Furthermore, obesity is believed to play a central role in the development of the 'metabolic syndrome', a term given to the clustering of CVD risk factors.[5] In financial terms, conservative estimates place the economic costs of obesity in developed countries at 2–7% of total health costs,[2] and it is anticipated that obesity-related diseases will increasingly compete with infectious diseases for health care resources in this century.[5]

The exact causes of obesity remain to be fully elucidated, but lack of physical activity and excessive energy intake are known to be major determinants.[6,7] As populations become more urbanized, and as lifestyles shift towards reduced physical activity and increased food consumption, the prevalence of obesity is expected to rise.

Obesity is becoming a common condition in the Eastern Mediterranean Region. Surveys from the United Arab Emirates, Saudi Arabia, Jordan, Egypt and Kuwait draw an alarming picture of prevalent obesity, which in turn could be an indicator for an increase in the occurrence of other chronic diseases in the region.[2,8–12] Although the urbanization trend has been documented in the region, along with its

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impact on morbidity and mortality profiles,[13–15] population-based data on the lifestyle factors associated with that phenomenon, such as patterns of food consumption, physical activity and smoking, are insufficient.

In the Palestinian West Bank, where 46.5% of the population now resides in urban areas,[16] two recent cross-sectional studies in the adult population of a rural and an urban community have found very high levels of obesity, especially among women.[17,18] The objectives of this study are to compare the prevalence of obesity, household food consumption patterns, physical activity patterns and smoking between the rural and urban communities as well as to describe the associations of the latter factors with body mass index (BMI).

Populations and methods

Two cross-sectional studies were conducted in an identical manner in an urban and a rural Palestinian population in the central West Bank. The rural study population resided in a prototypic central West Bank village, 15 km from the main city of Ramallah. The urban population resided in Old Ramallah, a well-defined urban community in the heart of the city of Ramallah, 16 km north of Jerusalem. The model protocol for diabetes and other noncommunicable diseases field survey by Dowse and Zimmet was followed,[19] and the study population and methods have been described in more detail in previous reports.[20,21]

Study populations

In each location, the survey was carried out in two phases. The first phase involved a complete enumeration of the households and inhabitants of the study site, with a household being defined as a group of people eating their main meals together. The surveys covered 368 rural and 569 urban households, representing 100 and 95% of all households in the respective locations. Using a structured questionnaire, data were collected from the female head of household on the demographic characteristics of each household member, including age, sex, education and employment. Data were also collected on the quantities consumed at the household level of 25 common foods using the list-recall method, which involves asking the participant to estimate from recall in as precise quantities as possible the consumption of certain foods over a period of time.[22] The food items in this study were selected to cover the most important contributors to energy consumption.

In the second phase of the survey, men and women aged 30–65 y from the households were invited individually to participate in a detailed health study. Five hundred rural and 492 urban men and women participated, representing response rates of 85 and 59%, respectively. The health study included anthropometric measurements (height, weight, and waist and hip circumferences) and completing a questionnaire on socio-demographic and lifestyle variables, including education, smoking, physical activity as well as a qualitative 24 h recall questionnaire.

Variables

Both household- and individual-level variables were used in the analysis. On the household level, quantities of 25 commonly consumed foods were recorded in the quantity units per time units individually preferred by the female head of household. Quantities were then converted to kilograms per consumption unit (CU) per year.[20] The number of consumption units in a household was calculated based on the number of household members, allowing for differences in energy requirements according to WHO in different age- and sex-groups, as described by Stene *et al*.[20] Energy and fat content values were taken from food composition tables for use in the Near East.[23,24] Total energy and total fat consumption were calculated by adding up the energy and fat contributions, respectively, of each of the foods on the list. Because households in the *rural* community usually make their own bread (using white, mixed, or wheat flour) while *urban* households rely on purchasing their bread supply, fat and energy contributions of bread were added on to the list of the 25 food items in the urban but not in the rural community.

On the individual level, the variables investigated were physical activity, smoking and education. For men, physical activity was based on occupation and rated as sedentary–light (eg office jobs, sales, retired, unemployed) or moderate–heavy (eg skilled and unskilled labor). The rating of the occupation-related physical activity was done by two of the authors (HFA-R and AH) independently, and discordant ratings were discussed until a consensus was reached. For women, physical activity was assessed based on self-reported engagement in any type of leisure time physical activity using a single question (*do you engage in physical exercise?*). Smoking was divided into two categories of current smokers and non-smokers. According to WHO guidelines, obesity for men and women was defined as BMI $\geq$ 30 kg/m^2.[25]

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences for Windows (SPSS) versions 8.0 and 11.0. Only persons for whom data were available from the first and second phases of the surveys were included in the analysis. Twenty-one pregnant women were also excluded from the analysis, so that data were analyzed for 470 rural and 466 urban men and women. Analyses were run separately for men (204 rural and 183 urban) and women (266 rural and 283 urban).

Obesity prevalence was adjusted to the age structure of the Palestinian population by direct standardization.[16] Associations between selected determinants of obesity and BMI were assessed using linear regression analysis, with BMI as

the continuous dependent variable. The linear regression coefficient was used as a measure of association. It can be interpreted as the increase (or decrease) in the dependent variable corresponding to a one-unit increase in the independent variable, with all the other variables in the model kept fixed.[20] Energy consumption, proportion of energy consumption from fat, and education were divided into tertiles to reduce the effect of outliers and account for possible non-linear relations, and age was divided into age groups (30–34, 35–44, 45–54, 55–65). Smoking was excluded from the analysis of associations among women because of the low frequency of smoking in that group. A linear mixed models analysis was run in order to check the potential effect of intra-family dependence.[26]

Results

The BMI levels of urban women and men were significantly higher than those of their rural counterparts (Table 1). The mean difference (s.e.) in BMI levels between urban and rural women was 1.6 (0.52) kg/m^2, while in men the difference was 0.9 (0.46) kg/m^2. Approximately half the urban women and a third of urban men were obese by WHO standards. When adjusted to the age structure of the

Table 1 Mean BMI levels (s.e.) and the prevalence of obesity (BMI $\geq$ 30) by sex in a rural and an urban Palestinian community

	n	*Mean BMI (s.e.)*	P[a]	*Percentage BMI* $\geq$ *30*	P[b]
Women					
Rural	266	28.6 (0.36)	0.002	36.8	0.004
Urban	283	30.3 (0.37)		49.1	
Men					
Rural	204	26.5 (0.32)	0.047	18.1	0.004
Urban	183	27.4 (0.33)		30.6	

[a]*P* (two-sided independent samples *t*-test).
[b]*P* (chi-square test).

Table 2 Selected determinants of obesity by location: nutrition-related variables (mean energy consumption (s.e.; MJ/CU/day), mean fat consumption (s.e.; g/CU/day), energy consumption from fat (s.e.; %), physical activity, smoking and education

	Rural	*Urban*	P
Nutrition-related variables[a]			
Mean energy consumption (s.e.; MJ/CU/day)	13.8 (0.17)	14.5 (0.24)	0.021[b]
Mean fat consumption (s.e.; g/CU/day)	108.4 (1.45)	132.5 (2.47)	$<$ 0.001[b]
Energy consumption from fat (%)	30.2 (0.35)	34.9 (0.39)	$<$ 0.001[c]
Physical activity			
Percentage of men (occupation-related)	n = 201	n = 183	
Sedentary–light	43.3	67.2	$<$ 0.001[c]
Moderate–heavy	56.7	32.8	
Percentage of women (leisure-time)	n = 265	n = 283	
None	55.5	60.1	0.28[c]
Some type of exercise	44.5	39.9	
Smoking			
Percentage of men	n = 203	n = 182	
Non-smokers	51.7	42.3	0.065[c]
Current smokers	48.3	57.7	
Percentage of women	n = 266	n = 281	
Non-smokers	96.6	82.2	$<$ 0.001[c]
Current smokers	3.4	17.8	
Education (y; s.e.)			
Men	9.4 (0.30)	8.8 (0.35)	0.22[b]
Women	4.4 (0.29)	7.0 (0.30)	$<$ 0.001[b]

[a]All figures based on a list of 25 frequently consumed foods at the household level. Number of household members is standardized as consumption units (CU; expected energy expenditure for men aged 18–30 y). Mean energy consumption is in MJ (MJ = 239 kcal).
[b]*P* (two-sided independent samples *t*-test).
[c]*P* (chi-square test).

Palestinian West Bank population, the prevalence of obesity was 35.0 and 18.2% in rural women and men, respectively compared to 46.3 and 29.1% in urban women and men, respectively.

Energy consumption, fat consumption and the proportion of energy derived from fat based on the list of 25 food items were significantly higher in the urban community (Table 2). The average energy consumption in the urban community was 14.5 MJ/CU/day (3474 kcal/CU/day) compared with 13.8 MJ/CU/day (3310 kcal/CU/day). A comparison of the average quantities of the 25 food items between the two communities showed that urban households reported a significantly higher consumption (in kg/CU/y) of vegetable oil, red meat, cold cuts, fish, eggs, dairy products, chickpeas, favabeans and rice (data not shown). On the other hand, the reported consumption of olive oil, vegetable fat, flour (white, wheat and mixed), and sugar was significantly higher in the rural community, and there was no significant difference in the reported consumption of salt.

Urban men were more likely to have sedentary–light occupations compared with rural men. The proportion of rural and urban women engaging in some type of exercise did not differ significantly. An analysis of the *type* of physical activity reported by women showed that the majority of rural women who do engage in some type of exercise report walking and/or engaging in some form of non-aerobic exercise (92%), compared to urban women who report engaging in both aerobic exercise (48%) as well as walking and/or non-aerobic exercise (52%). Smoking was much less prevalent among women than men, but urban women were significantly more likely to be smokers than rural women. A similar, though non-significant, trend was also seen in men.

Among men, 14.0% of the variation in BMI compared with 16.2% in woman could be accounted for by the variables in the model (Tables 3 and 4). The variables significantly associated with BMI after inclusion of all the variables in the model were older age in men and women, non-smoking and a low level of physical activity in men, and lower education and urban residence in women. The difference in BMI between the rural and urban location became insignificant in men after adjusting for other BMI determinants, but it remained highly significant in women after inclusion of all the variables in the model.

Table 3 Associations of body mass index with selected determinants of obesity in men[a,b]

	Linear regression coefficient (95% CI)[c]	
	Unadjusted	*Adjusted for all other factors in the model*
Age (y)		
55–65	Reference	Reference
45–54	0.64 (−0.71, 2.0)	0.74 (− 0.65, 2.14)
35–44	−0.85 (−2.02, 0.33)	−0.89 (−2.18, 0.41)
30–34	−1.99 (−3.33, −0.65)	−2.06 (−3.53, −0.60)
Location		
Rural	Reference	Reference
Urban	1.07 (0.23, 1.92)	0.86 (−0.032, 1.75)
Smoking		
Non-smoker	Reference	Reference
Current smoker	−1.73 (−2.57, −0.89)	−1.74 (−2.57, −0.90)
Education (y)		
High (≥12)	Reference	Reference
Moderate (7–11)	0.36 (−0.65, 1.36)	0.85 (−0.16, 1.86)
Low (1–6)	0.27 (−0.79, 1.34)	−0.27 (−1.47, 0.94)
Physical activity		
Sedentary–light	Reference	Reference
Moderate–heavy	−1.27 (−2.13, −0.42)	−1.18 (−2.08, −0.29)
Energy consumption (MJ)		
Low (<12.0)	Reference	Reference
Moderate (12.0–15.3)	−0.087 (−1.10, 0.93)	−0.063 (−1.05, 0.92)
High (≥15.3)	0.76 (−0.30, 1.81)	0.86 (−0.23, 1.94)
Energy consumption from fat (%)		
Low (<28.1)	Reference	Reference
Moderate (28.1–35.0)	0.16 (−0.89, 1.20)	0.58 (−0.46, 1.62)
High (≥35.0)	0.94 (−0.11, 1.98)	0.99 (−0.11, 2.09)

[a] $r^2 = 14.0\%$ in the linear regression analysis for men.
[b] One outlier was detected and excluded from this model.
[c] The estimated increase in the dependent variable (BMI) corresponding to a one-unit increase in the independent variable when the other factors in the model are kept fixed.

Table 4 Associations of body mass index with selected determinants of obesity in women[a,b]

	Linear regression coefficient (95% CI)[c]	
	Unadjusted	*Adjusted for all other factors in the model*
Age (y)		
55–65	Reference	Reference
45–54	−0.41 (−1.66, 0.84)	−0.028 (−1.30, 1.24)
35–44	−2.02 (−3.20, −0.84)	−1.26 (−2.61, 0.097)
30–34	−4.97 (−6.25, −3.69)	−3.78 (−5.32, −2.23)
Location		
Rural	Reference	Reference
Urban	1.63 (0.72, 2.54)	1.71 (0.75, 2.67)
Education (y)		
High (≥7)	Reference	Reference
Moderate (3–6)	2.03 (0.92, 3.14)	1.49 (0.34, 2.64)
Low (≤2)	2.73 (1.66, 3.80)	1.38 (0.003, 2.77)
Physical activity		
Exercise	Reference	Reference
No exercise	1.11 (0.18, 2.04)	0.62 (−0.26, 1.50)
Energy consumption (MJ)		
Low (<12.0)	Reference	Reference
Moderate(12.0–15.3)	−0.71 (−1.85, 0.42)	−0.72 (−1.80, 0.35)
High (>15.3)	1.25 (0.14, 2.36)	0.55 (−0.55, 1.65)
Energy consumption from fat (%)		
Low (<28.1)	Reference	Reference
Moderate (28.1–35.0)	0.49 (−0.63, 1.62)	1.060 (−0.008, 2.13)
High (≥35.0)	0.44 (−0.69, 1.57)	0.58 (−0.61, 1.76)

[a] $r^2 = 16.2\%$ in the linear regression analysis for women.
[b] Four outliers were detected and excluded from this model. Smoking was not entered into this analysis because of the small number of women who smoke.
[c] The estimated increase in the dependent variable (BMI) corresponding to a one-unit increase in the independent variable when the other factors in the model are kept fixed.

Discussion

Consistent with other regional studies, results from the two surveys in a rural and an urban Palestinian community show high prevalences of obesity, especially in the urban community and among women.[11,27] To our knowledge, no such information existed in the adult Palestinian West Bank population before those surveys. An understanding of the modifiable determinants of obesity is important for the design of effective preventive public health strategies to combat the rise in noncommunicable diseases associated with this condition, such as diabetes and cardiovascular disease.

Among women, even after including all variables in the model, urban residence remained an important determinant of obesity. This could suggest either that the data on nutrition and physical activity were too crude to allow for significant associations, or that other factors not included in the model are at work. The rural/urban location became statistically insignificant in the analysis of men, after including all variables in the model. This finding might be explained by greater similarities between rural and urban men than between rural and urban women. That is, rural men are more urbanized because of their work outside the home and exposure to urban lifestyles.

The validity of measures of physical activity and food consumption rely heavily on the cultural appropriateness of the methods used in data collection. It would be safe to say that, in the Palestinian context, this is virtually uncharted territory. Despite the crudeness of the variables used in our surveys to assess those important determinants of obesity, we have been able to show significant differences in nutrition-related variables between the two communities and to show significant associations between physical activity and BMI in men.

With regard to the list of 25 food items used to estimate quantities consumed by the household, the items included were common foods usually purchased in large quantities to cover the needs of household members and therefore relatively easy to recall and estimate. Although the list contained only 25 items and could thus have underestimated total energy intake, we believe that it covered a very high percentage of the total energy intake, including fat, for two reasons. First, the energy contributed by the 25 items in both communities was slightly higher than the expected energy requirement of an adult male and similar to the estimated energy available to Jordanian households.[20] Second, most of the items reported in the individual qualitative 24 h recall were covered by the list. One of the weaknesses of household

surveys is that food consumed outside the household is not accounted for. This limitation is likely to be more relevant for men rather than women in both communities, because of the meals taken outside the home on the job. However the effect would be similar between the two communities and may even be offset by the inflation in energy contributions due to food given to guests or wastage.

The associations of energy and fat consumption with BMI must be interpreted with caution, as the distribution of food *within* the household is not known and may depend on obesity levels or physical activity. The use of household level nutrition data to make individual associations with BMI masks intra-household variation and may violate the assumption of independence of observations.[28] However, results of the linear mixed models analysis show that the assumption of independence was upheld. In the Palestinian context, it was found both valid and easier to measure fat consumption at the household rather than individual level. This is because the largest source of fat is cooking fat/oil, and because the female head of household determines for the most part the food consumption patterns of household members, especially for the main meals, with the individual exerting less control over fat intake derived from cooked foods. Furthermore, some Palestinian eating practices make measurement of individual-level fat intake difficult, such as the traditional practice of dipping bread in olive oil. Thus, data are more to be regarded as contextual, although the percentage intake from fat, which is a ratio, may not be far from what is consumed at the individual level.

Physical activity was assessed in different ways for men and women. Although information was collected on the type, frequency and duration of leisure-time physical activity, we found this data difficult to use. Leisure-time physical activity is not a common concept in the Palestinian context, especially for rural women, where lack of sex-segregated facilities and cultural norms are prohibitive factors. Physical activity covering aspects other than leisure-time activities (such as walking to and from work for men or doing household chores for women) might be more appropriate in this context. For men, this problem was solved by using occupation-related physical activity. The negative association between BMI and physical activity assessed in this manner for men must be interpreted with caution, however. Occupation-based physical activity might be related to socio-economic status, with the moderate-heavy category representing poorer skilled and unskilled laborers, and it is known that BMI can be associated with socio-economic status.[29] Among women, occupation-related physical activity was judged to be inappropriate for two reasons. First, it is unlikely in the Palestinian context to find women involved in occupations involving heavy physical activity. Second, in our survey, approximately 80% of women in both communities were housewives and would thus have been placed in the same physical activity category. More sensitive instruments are needed to evaluate the physical activity of this largely sedentary group. Imprecise measurement of physical activity may lead to inadequate control for it, which in turn may lead to residual confounding.

Comparisons between the rural and urban communities show higher energy and fat consumption, a high proportion of energy consumption from fat, and lower levels of physical activity in the urban compared to the rural community. Of the nutrition-related variables however, none were significantly associated with BMI. Since data on food consumption were collected on the household level rather than from the individual, it is unlikely that under-reporting could explain the lack of association. Among men, the significant negative association of physical activity with obesity identifies a modifiable factor that can be targeted for prevention. The finding that smoking is negatively associated with BMI is expected.[30] The high prevalence of smoking among men should be targeted by prevention campaigns, because of the importance of smoking as a risk factor for CVD. Furthermore, anecdotal evidence suggests that, though still low, the prevalence of smoking among women is rising, a situation found in other countries of the region.[31]

In conclusion, more studies with finer instruments are needed for a deeper understanding of the determinants of obesity in the Palestinian context. However, it is clear that the high levels of obesity, high energy and fat consumption, low physical activity levels, and prevalent smoking in this population demand prompt public health action if the rise in noncommunicable diseases is to be contained in the resource-constrained Palestinian context.

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