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National Prevalence of Obesity

Prevalence of obesity and associated socioeconomic factors among Tunisian women from different living environments

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Summary

Adult Tunisian women aged 20–59 (national random sample, $n = 1849$), were assessed with respect to environmental and socioeconomic factors associated with obesity (body mass index ≥ 30 kg m^{-2}) and abdominal obesity (waist circumference ≥ 88 cm). At the national level, prevalence of obesity and abdominal obesity were, respectively, 22.6% and 29.2%, but varied markedly (both $P < 0.0001$) among living environments classified as big cities (30.2% and 36.6%), other cities (25.9% and 32.4%), rural clustered (19.4% and 24.8%) and rural dispersed (9.5% and 16.5%). Adjusted prevalences of both types of obesity increased with age, parity and economic level of the household, while educationally, the risk was greatest in women with intermediate schooling. Differences between the four environments were accounted for by socioeconomic factors, mostly household wealth, except for most rural environment; socio-cultural factors were possibly influential. Observed differences between rural areas confirmed that finer measures of urbanization are necessary for the drivers of obesity prevalence at the national level. Obesity was still more prevalent in wealthy than in poor women, but given the high prevalence in all the environments, actions are needed at the national level before highly prevalent obesity extends into those of lower socioeconomic status and thereby increases health inequities.

Keywords: Obesity, socioeconomic factors, urban, women.

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Introduction

Since the 1990s, the prevalence of obesity has been increasing rapidly worldwide and obesity is becoming an acute threat to public health (1) not only in the industrialized world but also in developing countries (2). Some parts of the developing world, such as the Middle East and North Africa, have obesity prevalence rates in women that are sometimes higher than those of industrialized countries (3–8). This increase, which has been termed an epidemic (1,9), is embedded in a larger nutritional transition characterized by changes in lifestyle and in diet (10,11) in a context of rapid economic development. In most developing societies, urbanization has been shown to be a major factor associated with high prevalences of obesity (10,12,13), although there is no real consensus on what defines an urban environment (14). Also, past studies have shown that, in contrast to developed societies where prevalence of obesity is higher in the lowest social class, the higher the socioeconomic status (SES), the greater the prevalence of obesity in the developing world. However, in developing countries, obesity can no longer be considered solely a disease of the highest SES groups, especially in women, who in these environments have higher obesity

rates than men (12). A key issue is to define optimal strategies for prevention and to avoid fuelling inequities in health. It is therefore important to assess the relationship between SES and environmental issues, e.g. the degree of urbanization in relation to obesity prevalence as part of this analysis and policy development (10).

In Tunisia, a middle-income developing North African country (97 out of 173 on the Human Development Index ranking in 2000), a national nutrition survey conducted in 1996/97 showed a very high prevalence rate of obesity in adult women (22.6%), whereas in men it was much lower (6.8%) (15); the percentage of obese women had almost doubled in 10 years (from 11.2% in 1985) (16). The presently described survey characterized environments in terms of four degrees of urbanization or collective living, and it therefore offered an opportunity to assess urbanization in a more discriminating way than simply by urban/rural differences (14) and allowed an assessment of different socioeconomic factors that might contribute to the epidemic.

Methods

Sampling

The target population comprised non-pregnant and non-lactating Tunisian women aged 20–59. Analyses used a subset of Tunisia's 1996/97 national nutrition survey data (15,17), which featured a random stratified two-stage clustered sample: stratification was according to the 23 governorates and urban/rural environments as defined by the Tunisian National Institute of Statistics. In each stratum, at the first sampling stage, primary units (referred to as census districts) were selected with a probability based on the census district's size and with 300 districts in all. At the second stage, in each district, six households were randomly selected and all members were included in the sample.

Measurements

Anthropometric indices

Measurements were made according to standardized procedures. Height and waist circumference (WC) were measured to the nearest millimetre and weight was measured with 100 g accuracy. Following WHO recommendations (1), weight for height was assessed by body mass index (BMI) = weight × height^{-2} (kg m^{-2}), BMI ≥ 25 kg m^{-2} defined overweight, BMI ≥ 30 kg m^{-2} defined overall obesity; WC ≥ 88 cm was used to assess abdominal obesity.

Living environment was coded according to the four-category classification of the Tunisian National Institute of Statistics: urban «big cities» (>100 000 inhabitants), urban «other cities» (≤100 000 inhabitants), «rural clustered»: grouped habitat (population > 80 households), «rural dispersed»: areas featuring dispersed habitat or grouped in small villages. This was considered as a decreasing gradient of urbanization (14). A binary urban vs. rural coding was also used in some analyses.

Socioeconomic variables

Data on age, parity, matrimonial status, level of education and professional occupation were collected (see Table 1). A household economic level proxy was computed by an integrated analysis of a number of variables pertaining to type of housing, house ownership, domestic equipment, sanitation and appliances. The first principal component, displaying a gradient of household 'wealth', was used as a proxy for economic level (18). Households were grouped in 'low', 'medium' and 'high' levels according to tertiles of this index (Table 1).

Data management and statistical analysis

Data entry and control was performed using ISSA software (19), and data management was performed with the SAS system v8.2 for Windows (20). For statistical analyses, SAS and Stata 9 (21) procedures specific to survey data were used. The first type error rate was set at 0.05 in analyses, which all took into account the characteristics of the sampling plan (22).

Preliminary comparisons of the four living environments were performed using *F*-tests for interval variables and chi-square tests for categorical variables. Logistic regressions (23) were used for binary response variables (BMI ≥ 30 kg m^{-2} and WC ≥ 88 cm) and general linear models (24) for interval response variables (BMI and WC): crude estimates of associations between each socioeconomic determinant and the response variable were obtained by univariate models. Then effect modification of living environment was tested for each determinant by a regression model featuring an interaction term. Adjusted estimates of associations were derived from multivariate models including all socioeconomic factors; prevalence odds ratios (OR) for dichotomous response variables and differences in means for continuous response variables are given vs. a reference category.

The extent to which socioeconomic factors could mediate differences between the living environments for BMI and WC was assessed using a hierarchical approach (25). In the first model, the only regressor was living environment. Then socioeconomic factors were added sequentially. At each step, by comparing previous and current OR, the change in the association was assessed: it measured the extent to which the difference between living environments could be attributed to the variable(s) just entered. The final model estimated the residual association, i.e. the differences between environments that could not be accounted for by the socioeconomic variables taken into account in the study.

Table 1 Tunisian women 20–59 years ($n = 1849$): socioeconomic and anthropometric data by living environment

	Urban				Rural				National		Big cities vs. other cities	Rural clustered vs. dispersed	Urban vs. rural	All four habitats
	Big cities		Other cities		Clustered		Dispersed							
	n	Mean (s.e.) or %*	*n*	Mean (s.e.) or %*	*n*	Mean (s.e.) or %*	*n*	Mean (s.e.) or %*	*n*	Mean (s.e.) or %*	*P*-value†	*P*-value†	*P*-value†	*P*-value†
Socioeconomic variables														
Age (years)	422	36.6 (0.5)	733	36.7 (0.4)	205	34.2 (0.6)	489	35.2 (0.6)	1849	36.1 (0.3)	0.87	0.25	0.0006	0.005
Parity	408		721		201		483		1813		0.34	0.11	0.0001	0.0001
0		30.1%		30.2%		38.7%		38.6%		33.0%				
1–4		47.4%		33.2%		28.9%		20.1%		30.9%				
5+		32.5%		36.6%		32.4%		41.3%		36.1%				
Married	422	66.4%	733	66.1%	205	61.9%	489	61.3%	1849	64.7%	0.94	0.93	0.14	0.53
Schooling	419		709		203		483		1814		0.062	<0.0001	<0.0001	<0.0001
None		27.8%		36.5%		44.9%		67.6%		42.2%				
Primary		42.6%		36.7%		39.1%		28.1%		36.6%				
Secondary and over		29.6%		26.8%		16.0%		4.3%		21.2%				
Professional occupation	420	13.9%	729	16.3%	205	10.7%	488	6.1%	1842	12.5%	0.33	0.17	0.0002	0.0098
Household economic level	401		711		203		483		1798		0.0001	<0.0001	<0.0001	<0.0001
Low		3.9%		7.9%		21.6%		83.0%		26.7%				
Medium		26.5%		44.8%		58.8%		15.5%		33.2%				
High		69.6%		47.3%		19.6%		1.5%		40.1%				
Anthropometry														
Height (cm)	417	156.9 (0.4)	726	157.6 (0.3)	204	157.1 (0.7)	489	156.5 (0.3)	1836	157.0 (0.2)	0.11	0.41	0.33	0.067
Weight (kg)	416	66.7 (1.0)	727	65.8 (0.7)	205	61.8 (1.1)	489	58.6 (0.8)	1837	63.9 (0.5)	0.44	0.035	<0.0001	<0.0001
BMI (kg m^{-2})	416	27.1 (0.4)	726	26.5 (0.3)	204	25.2 (0.5)	489	23.9 (0.3)	1835	25.9 (0.2)	0.19	0.034	<0.0001	<0.0001
BMI ≥ 25 kg m^{-2}	416	61.4%	726	56.3%	204	43.4%	489	36.2%	1835	51.7%	0.18	0.19	<0.0001	<0.0001
BMI ≥ 30 kg m^{-2}	416	30.2%	726	25.9%	204	19.4%	489	9.5%	1835	22.6%	0.16	0.003	<0.0001	<0.0001
Waist circumference (cm)	412	83.3 (0.7)	664	81.9 (0.7)	197	79.1 (1.3)	465	75.7 (0.6)	1738	80.6 (0.4)	0.15	0.027	<0.0001	<0.0001
Waist circumference ≥ 88 cm	412	36.6%	664	32.4%	197	24.8%	465	16.5%	1738	29.2%	0.25	0.058	0.0001	<0.0001

*For continuous variables: mean and standard error of the mean. For categorical variables: percentages (standard errors not given for readability). All estimates are design based.
†F-test for continuous variables, chi-square test for categorical variables (design-based tests).
BMI, body mass index.

Ethics

All applicable institutional and governmental regulations concerning the ethical use of human volunteers were respected during this study. The survey was authorized by the Tunisian health authorities and the National Institute of Statistics. All women included in the study gave their free and informed consent.

Results

Subjects

Of 1800 households selected, 1736 were actually surveyed, i.e. a household response rate of 96.4%. The overall individual response rate for adult women was 93%. Thus, a total of 1849 women were included.

Socioeconomic factors (Table 1)

Mean age was 36.1 (s.e. 0.3) years. Two-thirds of the women were married, with no differences in marriage rates between environments. At the national level, 42.2% of the women had no formal schooling, and the level of schooling decreased with the level of urbanization ($P < 0.001$), with the exception of big vs. other cities ($P = 0.062$). Overall, only 12.5% of the women worked outside the home and this was more common in urban households ($P = 0.0002$). There was a marked decreasing gradient of household economic status ($P < 0.0001$) from the big cities to the rural dispersed environment; differences were also observed between the two urban environments ($P = 0.0001$) and even more marked between the two rural environments ($P < 0.0001$).

Anthropometry (Table 1)

The overall mean BMI was 25.9 (s.e. 0.2) kg m^{-2}; it decreased with the level of urbanization though there was no difference between the two urban environments ($P = 0.19$). Overall prevalence of obesity was 22.6% with a decreasing trend from big cities to rural dispersed environments (from 30.2% to 9.5%, $P < 0.0001$); urban and rural environments featured contrasted prevalences (OR = 2.8, CI 2.0–3.8) as did the two rural environments (OR = 2.3, CI 1.3–4.0), whereas the two urban environments (OR = 1.2, CI 0.9–1.7) did not. The national prevalence of abdominal obesity was 29.2%, with a contrast between urban and rural environments (OR = 2.3, CI 1.7–3.0) and also between the rural environments (OR = 1.7, CI 1.0–2.8) but not between the two urban categories.

Factors associated with BMI and WC

Figures 1 and 2 show a significant interaction between living environment and the age category; mean BMI and WC increased sharply for older women in all living environments except for the rural dispersed area, for which the increase was much lower; similar interactions with living environment were found for parity and matrimonial status but this was confounded by the effect of age. No significant interaction was observed for either overall or abdominal obesity. Since the age × living environment interaction did not inverse the relationship of age with anthropometric status but only altered its strength, and only for BMI and WC interval variables, it was not included in the multivariate models. For other socio-demographic variables, only a mild modifying effect of the living environment on the relationship between professional occupation and obesity

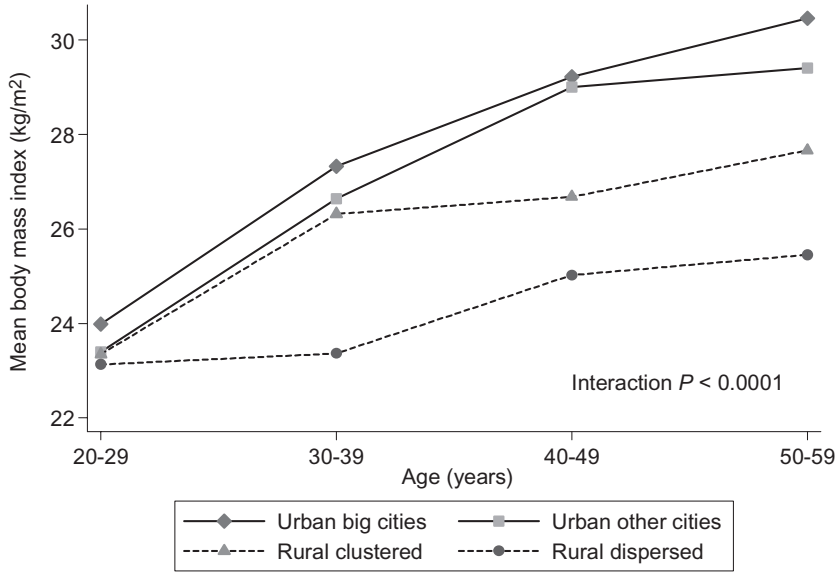

Figure 1 Tunisian women 20–59 years: mean BMI (kg m^{-2}) by living environment and age category.

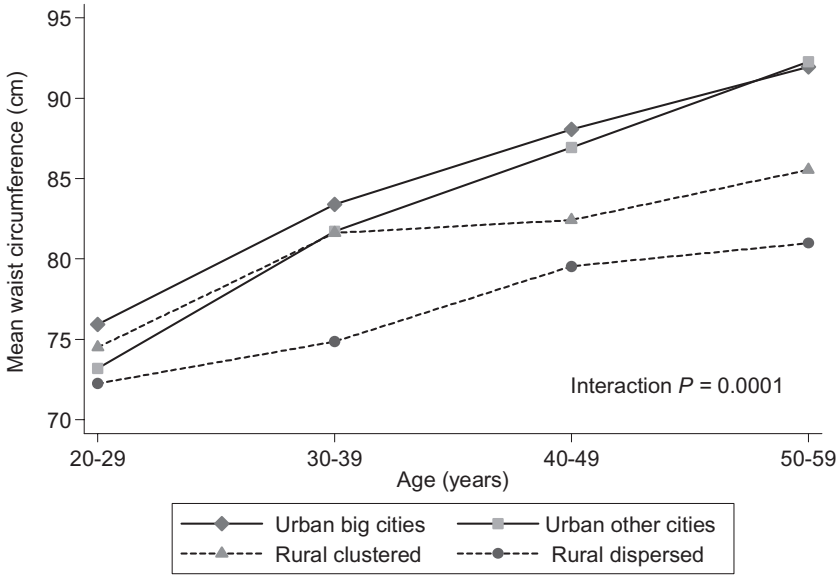

Figure 2 Tunisian women 20–59 years: mean WC (cm) by living environment and age category.

was observed ($P = 0.019$) as only women in the rural dispersed environment who were not professionally active were less obese. However, as the effect was deemed relatively mild compared with the main effects, it was not included in the multivariate models either.

Concerning obesity, unadjusted estimates of relationships with socioeconomic factors are shown in Table 2: there was a marked gradient of increasing prevalence of obesity with age (from 8.7% to 37.2%, $P < 0.0001$), parity (9.5% to 33.5%, $P < 0.0001$), household economic index (10.2% to 30.2%, $P < 0.0001$). Married women featured a higher prevalence of obesity than single women and so did those with a higher level of education compared with the other levels. After adjustment, matrimonial status and professional occupation were not linked to obesity; the largest OR were still observed for age and economic level of household, as these associations remained relatively unchanged. Adjusted association with schooling was still significant ($P = 0.0064$) though not linear, as only women with primary education featured a higher prevalence than those with no schooling (OR = 1.9, CI 1.2–2.8). Results for BMI were analogous, indicating that in specific socioeconomic categories, increased prevalence of obesity did result from a global shift of the BMI distribution.

For abdominal obesity (Table 2), the results for adjusted associations were generally analogous to those observed for obesity.

Variables mediating the effect of the living environments on BMI and WC

Results of the hierarchical analysis are presented in Table 3. Concerning obesity in model 1, the urban environment was homogeneous, but not the rural one. In model 2, adjustment for age, parity and matrimonial status did not alter much the associations. In model 3, adjustment for schooling only slightly reduced the differences between environments. In model 4, adding professional occupation had no straightforward effect. In model 5, adjustment for the economic level had a drastic effect, as the OR were much closer to 1 and the *P*-value of the contrast between all four habitats as well as urban vs. rural were closer to 0.05. The *P*-value for the contrast between 'big cities vs. other cities vs. rural clustered' was 0.93 (data not shown). Thus, only the rural dispersed environment still differentiated itself from the others. As for abdominal obesity, results were quite similar and even more marked: adding adjustment for economic level of the household in model 5 resulted in sharply reduced contrasts in prevalence between all four habitats (*P*-value = 0.094) and also between rural clustered and dispersed categories (*P*-value = 0.10).

Discussion

The results of the present study showed that one woman out of five was obese and about one out of three featured abdominal obesity. This high prevalence of abdominal obesity compared with overall obesity deserves to be noted, as the original WHO cut-offs for WC in women were chosen from a study in the Netherlands where the WC of 88 cm corresponds to a BMI of 30 (26). Such a difference has been also observed in Moroccan women (27). This is an issue which several authors have highlighted as a symptom of adults who put on weight but who were malnourished as children – a widespread problem in North Africa 30–50 years ago when this population was growing up (28,29). The different living environments (or levels of urbanicity) displayed markedly different prevalence rates of overall

Table 2 Tunisian women 20–59 years: association of socioeconomic factors with body mass index (kg m^{-2}), obesity (BMI ≥ 30 kg m^{-2}) and abdominal obesity (WC ≥ 88 cm)

	Body mass index (kg m^{-2}) (n = 1713)						Body mass index ≥ 30 kg m^{-2} (n = 1713)					Waist circumference ≥ 88 cm (n = 1636)					
	Raw*				Adjusted†		Raw*			Adjusted†		Raw*				Adjusted†	
	n	Mean (s.e)	Diff.‡	CI§	Diff.‡	CI§	%	OR¶	CI§	OR¶	CI§	n	%	OR¶	CI§	OR¶	CI§
Age (years)			$P < 0.0001$		$P < 0.0001$			$P < 0.0001$		$P = 0.0001$				$P < 0.0001$		$P < 0.0001$	
20–29	485	23.3 (0.3)	0	–	0	–	8.7	1	–	1	–	457	9.0	1	–	1	–
30–39	505	26.2 (0.3)	+2.9	2.1–3.6	+1.7	0.9–2.5	24.1	3.3	2.1–5.2	2.4	1.4–4.0	485	30.1	4.3	2.8–6.7	3.0	1.7–5.2
40–49	423	27.7 (0.3)	+4.4	3.6–5.4	+3.5	2.4–4.5	32.9	5.1	3.2–8.2	3.9	2.1–7.5	404	43.4	7.7	4.9–12.2	5.4	2.8–10.3
50–59	300	28.7 (0.4)	+5.3	4.5–6.2	+4.6	3.5–5.8	37.2	6.2	3.9–10.0	4.9	2.5–9.8	290	56.4	13.0	8.1–21.0	9.2	4.5–18.9
Parity			$P < 0.0001$		$P = 0.040$			$P < 0.0001$		$P = 0.015$				$P < 0.0001$		$P = 0.028$	
0	493	23.3 (0.3)	0	–	0	–	9.5	1	–	1	–	471	10.5	1	–	1	–
1–4	475	26.6 (0.3)	+3.3	2.5–4.1	+1.4	0.3–2.5	22.6	2.8	1.8–4.4	1.7	0.9–3.3	455	29.9	3.6	2.3–5.6	1.7	1.0–3.1
5+	745	27.6 (0.2)	+4.3	3.6–5.1	+1.4	0.2–2.7	33.5	4.8	3.1–7.4	2.5	1.3–4.9	710	45.8	7.2	4.8–10.9	2.4	1.2–4.6
Matrimonial status			$P < 0.0001$		$P = 0.70$			$P < 0.0001$		$P = 0.18$				$P = 0.007$		$P = 0.64$	
Other	563	23.7 (0.3)	0	–	0	–	12.8	1	–	1	–	537	14.8	1	–	1	–
Married	1150	27.0 (0.2)	+3.3	2.6–4.0	+0.2	–0.8–1.1	27.6	2.6	1.9–3.6	0.8	0.5–1.1	1099	37.4	3.4	2.5–4.7	0.9	0.6–1.4
Schooling			$P = 0.0032$		$P = 0.0001$			$P = 0.038$		$P = 0.0064$				$P = 0.0064$		$P = 0.094$	
None	846	25.9 (0.3)	0	–	0	–	21.6	1	–	1	–	806	32.6	1	–	1	–
Primary	584	26.4 (0.3)	+0.5	–0.2–1.3	+1.6	0.8–2.4	25.8	1.3	0.9–1.7	1.9	1.3–2.8	558	29.8	0.9	0.7–1.2	1.5	1.0–2.2
Secondary and over	283	24.8 (0.4)	–1.1	–2.0–0.2	+0.3	–0.7–1.2	17.4	0.8	0.5–1.1	1.3	0.8–2.2	272	21.8	0.6	0.4–0.8	1.3	0.8–2.2
Professional occupation			$P = 0.0046$		$P = 0.095$			$P = 0.050$		$P = 0.13$				$P = 0.029$		$P = 0.18$	
Yes	192	24.7 (0.5)	0	–	0	–	15.8	1		1	–	178	21.2	1	–	1	–
No	1521	26.0 (0.2)	+1.3	0.4–2.2	+0.8	–0.1–1.6	23.2	1.6	1.0–2.6	1.5	0.9–2.6	1458	30.4	1.6	1.1–2.5	1.4	0.8–2.4
Household economic level			$P < 0.0001$		$P < 0.0001$			$P < 0.0001$		$P < 0.0001$				$P < 0.0001$		$P < 0.0001$	
Low	516	24.0 (0.3)	0	–	0	–	10.2	1	–	1	–	490	17.1	1	–	1	–
Medium	598	25.8 (0.3)	+1.8	1.0–2.6	+1.4	0.6–2.2	22.4	2.5	1.7–3.7	2.4	1.6–3.6	564	30.2	2.1	1.5–3.0	2.1	1.4–3.0
High	599	27.1 (0.3)	+3.1	2.2–3.9	+2.6	1.7–3.5	30.2	3.8	2.6–5.6	3.5	2.3–5.5	582	36.6	2.8	2.0–4.0	2.7	1.8–4.1

*Univariate logistic regression or general linear model (regressor is as stated in column 1).

†Multivariate general linear or logistic regression model, regressors are age, parity, matrimonial status, schooling, professional occupation, household economic index.

‡Difference between mean BMI of category and mean BMI of reference category.

§0.95 confidence interval for estimate.

¶Prevalence odds ratio of category vs. reference category.

Table 3 Tunisian women 20–59 years: mediating variables of association between living environment, obesity and abdominal obesity; hierarchical regression models

Model*	Body mass index ≥ 30 kg m^{-2} (n = 1713)								Waist circumference ≥88 cm (n = 1636)							
	Odds ratios† (CI)				P-values‡				Odds ratios† (CI)				P-values‡			
	Big cities	Other cities	Rural clustered	Rural dispersed	Urban big cities vs. other	Rural clustered vs. dispersed	Urban vs. Rural	All 4 habitats	Big cities	Other cities	Rural clustered	Rural dispersed	Urban big cities vs. other	Rural clustered vs. dispersed	Urban vs Rural	All 4 habitats
1 Living environment	4.2 2.6–6.7	3.6 2.3–5.6	2.5 1.4–4.4	1	0.38	0.0022	<0.0001	<0.0001	3.0 2.0–4.5	2.5 1.7–3.6	1.7 1.0–2.9	1	0.29	0.051	<0.0001	<0.0001
2 Living environment, age, parity, matrimonial status	4.4 2.7–7.2	3.8 2.4–5.9	3.0 1.7–5.4	1	0.38	0.0002	<0.0001	<0.0001	3.3 2.1–5.1	2.6 1.8–3.8	2.1 1.2–3.7	1	0.27	0.0089	<0.0001	<0.0001
3 Living environment, age, parity, matrimonial status, schooling	3.7 2.2–6.2	3.3 2.1–5.3	2.8 1.6–4.9	1	0.52	0.0005	<0.0001	<0.0001	2.9 1.8–4.6	2.4 1.6–3.5	2.0 1.2–3.5	1	0.34	0.0129	<0.0001	<0.0001
4 Living environment, age, parity, matrimonial status, schooling, professional occupation	3.7 2.2–6.3	3.4 2.1–5.5	2.8 1.6–5.0	1	0.59	0.0005	<0.0001	<0.0001	2.9 1.8–4.7	2.4 1.7–3.6	2.0 1.2–3.6	1	0.37	0.0125	<0.0001	<0.0001
5 Living environment, age, parity, matrimonial status, schooling, professional occupation, economic level of household	2.4 1.3–4.6	2.4 1.3–4.4	2.2 1.1–4.1	1	0.94	0.015	0.051	0.031	2.1 1.1–3.8	1.8 1.1–3.0	1.6 0.9–2.9	1	0.52	0.10	0.0817	0.094

*Logistic regression model: response is binary variable body mass index ≥30 kg m^{-2} or waist circumference ≥88 cm, regressors as listed in column 2.
†Prevalence odds ratio of living environment category vs. rural dispersed (odds ratios are adjusted for all others variables in model).
‡Contrasts for habitat categories in relevant logistic regression model: design-based adjusted Wald chi-square tests.

and abdominal obesity: e.g. about a-third of the women from the most urbanized environments were obese, while the rural dispersed environment (i.e. the most remote and culturally traditional rural areas) featured the lowest prevalence of obesity (~10%); even this latter level was nevertheless already close to the prevalence of obesity at the national level in a high-income country like France at the time of the survey. As for abdominal obesity, the contrast within urban and within rural environments was less marked but still existed. On the whole, these results revealed different situations regarding obesity according to the type of environment, beyond the usual urban vs. rural comparison (14).

Regarding socioeconomic factors associated with obesity, the increasing prevalence of both types of obesity with economic level is in agreement with the causal model previously built for Tunisia (16), where in the context of a middle-income country, increased ability to purchase food is thought to increase energy intake. Thus, in each of the four living environments studied, including the largest cities, obesity still seemed to be more a disease of rich people than of the poor. This result is quite different from results obtained in Brazil, another middle income country where an independent and increasing association of female obesity with economic status was found in 1996 only in rural areas (10) and in less developed regions (30). However, it should be stressed that in Tunisia the prevalence of obesity in women in household with low and medium economic levels (10–20% respectively) is already far from negligible. Regarding education, the non-linearity of the relationship between the level of schooling and obesity was all the more marked when adjusted for other factors, most likely owing to the confounding effect of age, as in the Tunisian context older women combine high prevalence of obesity and no schooling. In observations made among Brazilian women, the prevalence of obesity markedly decreased with the level of education, independently of income, which is coherent with the hypothesis that more educated women have different perceptions of obesity and a better knowledge of dietary and behaviour-related determinants of obesity. Interpreting the non-linear relationship observed among Tunisian women is not straightforward. Complex interactions between household wealth, educational level and anthropometric status could be involved and may blur the interpretation of adjustment on household wealth.

As for the differences between environments regarding obesity, the economic level of the household appeared to be a major mediating factor especially of differences between the rural clustered and urban environments. Nevertheless, and all the more so for overall obesity, even in the more complete model, differences between the rural dispersed environment and the other three were not completely accounted for. Measurement issues may be involved: the proxy of economic level of the household might not take into account some specific items that are relevant for the assessment of household wealth in more rural settings. Hypotheses regarding the influence of distal socioeconomic factors on proximal factors of anthropometric status such as dietary intake and physical activity in the different environments, and on which the hierarchical analyses are based, may also be debatable. Socio-cultural factors that influence behaviours associated with anthropometric status may be also involved, though their influence may be limited by the living environment or the SES. Indeed the traditional social representation of the female body in Arab-Muslim countries tends to value corpulence and overweight (3,5,31). Nevertheless, information collected from focus groups of Tunisian women from different environments showed that representations of body image could differ between living environments as overweight was more valued in rural than in urban environments (data not shown). In the latter, preference for a slimmer norm, closer to that in Western societies, was recently shown especially in women with a higher SES (32). In future studies, it could be of interest to assess – in women who relatively recently migrated to a urban environment – whether the combination of traditional representations and living in an environment that is more obesity-prone results in an even higher prevalence of obesity than among those who were urbanized earlier. This would be all the more relevant if one wishes to monitor the evolution of the prevalence of obesity in women from lower SES households in a context of growing urbanization.

Conclusion

In Tunisia, beyond the urban vs. rural contrast, observed differences between rural areas confirmed that finer measures of urbanicity are relevant for prevalence studies at the national level. Obesity remained more a rich than a poor woman's disease, but given its relatively high prevalence in all living environments, actions are needed at the national level before obesity also extends massively to low SES population groups and increases inequities in health.

Conflict of Interest Statement

No conflict of interest was declared.

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