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ORIGINAL PAPERS

Association between socioeconomic status and adiposity in urban Cameroon

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Background As the relation between socioeconomic status (SES) and obesity may depend on the stage of development of a country, this relation is assessed in adults from urban Cameroon.

Methods A sample comprising 1530 women and 1301 men aged 25 years and above, from 1897 households in the Biyem-Assi health area in the capital of Cameroon, Yaoundé, were interviewed about their household amenities, occupation, and education. Weight, height, and waist circumference were measured and subjects were classified as obese if their BMI $\geqslant 30$ kg/m^2 or overweight if BMI was between 25.0 and 29.9 kg/m^2. Abdominal obesity was defined by a waist circumference $\geqslant$80 cm in women and $\geqslant$94 cm in men.

Results Of the sample studied 33% of women and 30% of men were overweight ($P < 0.08$), whereas 22% of women and 7% of men were obese ($P < 0.001$). Abdominal obesity was present in 67% of women and 18% of men ($P < 0.001$). After adjusting for age, leisure time physical activity, alcohol consumption, and tobacco smoking, the prevalence of overweight + obesity, obesity, and abdominal obesity increased with quartiles of household amenities in both genders and with occupational level in men.

Conclusion SES is positively associated with adiposity in urban Cameroon after adjusting for confounding factors.

Keywords Socioeconomic status, overweight, obesity, abdominal obesity, developing countries

Introduction

Excess weight has been identified as an important risk factor for many diseases including hypertension, diabetes, CVD, and rheumatologic problems.[1,2] The World Health Organisation has declared that obesity is an epidemic on a global scale,[3] posing a major threat to human health and well-being.

Over the past few decades, several advances have been made in our understanding of the factors that contribute to obesity,[4–8] including the identification of some genetic polymorphisms[6–8] and the potential role of metabolic factors such as variations in energy expenditure and in patterns of fuel utilization. However, the link between socioeconomic status (SES) and obesity has been controversial as it is highly dependent upon the stage of industrial development of a country or region.[9,10]

In developed countries, there is evidence of a consistent, strong inverse association between different measures of SES, including education level and income, and the risk of obesity in women, whereas obesity in men is characterized by a weaker and more variable association with SES.[9,11] However, there is much less research on socioeconomic determinants of obesity in developing countries and the data available are mainly from Latin America and Asia.[12–15] Although the review of the modest published literature on this topic points to a general positive association between SES and obesity in both men and women that may not be true for all developing societies. Also, most of the studies available do not take into account the variables which could be confounders in the relation between adiposity and SES.

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The primary goal of this study is to examine relationships between SES and anthropometric parameters, taking into account other risks factors for obesity, in an urban population in Cameroon.

Research design and methods

This study is part of the Cameroon Non-Communicable Diseases Poverty Study, funded by the World Health Organisation and conducted during 12 months (from January to December 2000) within an urban area of Cameroon. Its aims were to investigate the relations between the burden of diseases, specific causes, and poverty.

Study site and study population

The Biyem-Assi health area of Biyem-Assi health district was chosen as the study site. Biyem-Assi is an urban area of Yaoundé, the capital city of Cameroon. Its inhabitants are mainly civil servants, businessmen, and students. Before the study, a household census was conducted in the health district. The sampling frame was all households of Cameroonian subjects who had been resident in the health area for at least one year. All inhabitants aged 25 years and over were selected for participation in the study. Pregnant women and subjects suffering from chronic illnesses were excluded. A map of the health area was drawn and divided into eight zones; each zone was further subdivided into blocks. An identification number was attributed to each household in each block. Two weeks prior to the survey each household received a leaflet explaining the purpose of the survey. All available mass media (newspapers, local broadcast by radio in French and English and in local languages, announcements in churches and cultural groups) were used to inform the population about the aims and period of the study.

Methods

A pilot study was undertaken to test the survey forms and procedures and these were adapted as necessary. All participants were interviewed and examined between 8 a.m. and 9 p.m. by nurses trained and certified for this study. They responded to a questionnaire on their socio-demographic characteristics. Information on household amenities[16] and annual family income was obtained from the head of each household. Body weight and height were measured with the subjects wearing light clothes, and waist circumference was measured midway between the lowest rib and the iliac crest. The Sub-Saharan Africa Activity Questionnaire (SSAAQ),[17] was used to assess the leisure time physical activity during the past month. Frequency and duration were computed for each reported activity, and the energy expenditure was calculated using Ainsworth *et al.*'s compendium.[18,19] Energy expenditure related to leisure time physical activity was calculated by multiplying the ratio of the exercise to resting metabolic rate (MET, Metabolic equivalent) score by the number of hours spent in each activity. There were guidelines for survey workers, explaining how to administer the questionnaire and measure all the parameters.

A total of 2700 households with 3484 subjects were selected to participate in the study. The number of eligible subjects per household varied from 1 to 6. Overall 2622 households were surveyed, comprising 1671 women and 1378 men; the response rate of individuals was 87.5%. The main reasons for non-response were absence of subjects after three visits of the survey team, and refusal to participate in the study. Due to such missing and inconsistent data, 1530 women and 1301 men were included in these analyses.

Definitions

Overweight, obesity and abdominal obesity: Body mass index (BMI) was calculated for all subjects and the World Health Organisation criteria[3] was used: normal weight ($18.5 \leqslant \text{BMI} < 25\ \text{kg/m}^2$), overweight ($25 \leqslant \text{BMI} < 30\ \text{kg/m}^2$), or obese ($\text{BMI} \geqslant 30\ \text{kg/m}^2$). Abdominal obesity was defined[3] using waist ⩾94 cm for men and ⩾80 cm for women.

Household amenities and income: For each amenity available in the household (Table 1) a score based on the HNP/Poverty Thematic Group of the World Bank[16] was given and their sum was the household amenities score. From the total household score, we calculated sex-specific quartiles and defined four wealth classes, from poorest (first quartile) to richest (fourth quartile). Each individual in the household was given the same household score. Annual family income was available for only 644 households. The Pearson correlation coefficient between household amenities and available annual family income was 0.51, $P < 0.001$.

Occupation: Three categories of occupations (low, middle, and high) were defined based on the public service classification of occupations (respectively, civil servants categories C, B, and A). Subjects working for private firms or for themselves were consensually allocated to these categories based on their profession and income. Housewives were attributed the occupation category of the head of household.

Education: The type of last educational institution attended was used, assigning four categories: none (attended no educational institution), primary (1–7 years of education), secondary (8–14 years of education), and university (>14 years of education).

Leisure time physical activity: From the total MET of each subject, we calculated sex-specific quartiles and defined four classes of physical activity.

Smoking: The classification used was non-smoker (has never smoked + ex-smoker) and smokers (current smokers).

Alcohol consumption: Took into account the consumption of beer, wine, spirits, and traditional spirits. The number of grams of pure alcohol in 100 cl of each of the following alcoholic drinks was taken to be: 3.17 g for beer; 9.07 g for wine; 27.39 g for spirits, including traditional spirits. The daily consumption of pure alcohol was divided into four categories: 0 g = non-drinkers, <5, 5–30, and >30 g/day.

Statistical methods

Analyses used the 'svy' statistical module for complex sample data from the STATA® 8.0 Software with the primary sample unit being the household; $P < 0.05$ was taken to indicate statistical significance. The maximum design effect was for BMI in women, equal to 1.10. The prevalence of overweight, obesity, and abdominal obesity were standardized according to the urban Cameroonian 2000 population[20] distribution. Data were stratified by sex and results are presented as means [standard deviation (SD)], median (25th to 75th percentile) or percentages. The logistic regression model was used in univariate analysis to

Table 1 Summary of amenities and scores used in the analyses, and percentage of household with each amenity: Cameroon Study[16]

Household amenities	Percentage of households with the amenity (%)	Household amenity score
Electricity	99.8	0.170
Television	81.6	0.264
Bicycle	2.8	−0.073
Car	23.7	0.323
Gas or electric portable stove	34.5	0.171
Radio	72.9	0.077
Refrigerator	65.4	0.303
Motorcycle	4.3	0.068
Gas or electric oven	18.7	0.309
Domestic worker not related to household head	6.8	0.020
Principal type of flooring		
Dirt, earth	2.2	−0.137
Wood, plank	0.1	−0.099
Cement	56.1	0.105
Tile	1.6	0.354
Other type of flooring	40.0	0.260
Bucket latrine	30.4	0.074
Principal household source of water		
Piped drinking water in residence	92.9	0.348
Well with a hand pump	0.9	−0.100
River, canal, or surface water	0.00	−0.114
Water piped into the yard	6.1	0.174
Rain water	0.03	−0.091
Bottled water	0.07	−0.031
Own flush toilet	75.8	0.354
Number per sleeping room	–	$-0.006 \times (\text{number} - 1.920)/1.220$

estimate the odds ratios between adiposity and possible confounding risk factors (age classes, leisure time physical activity quartiles, tobacco smoking, and alcohol consumption). Also, the logistic regression model was used in multivariate analyses to quantify the association between socioeconomic indicators and adiposity after adjusting for other risk factors of obesity.

Ethical issues

Approvals for this study were obtained from the National Ethical Committee of the Ministry of Health, the Minister of Health, and local administrative and traditional authorities prior to starting the study. Informed consent was obtained from all the study participants.

Results

Characteristics of the study population

There was no statistically significant difference ($P = 0.2$) between the mean age of women: 38.4 (SD = 10.3) years and men: 39.0 (10.9) years (Table 2). Women had higher mean BMI (26.7 vs 24.7 kg/m^2; $P < 0.001$) and waist circumference (84.8 vs 83.6 cm; $P < 0.003$) than men. While the median leisure time physical activity was not significantly different between the genders (11.6 MET/day for women vs 10.4 MET/day for men; $P = 0.3$), more men had a high occupational level (21.5% vs 11.9%), a university education (26.7% vs 17.3%), smoked (7.9% vs 2.8%), and more drank alcohol (37.5% vs 28.6%; Table 2).

Prevalence of overweight, obesity, and abdominal obesity

The age standardized prevalence of overweight was 32.9% for women and 29.8% for men ($P < 0.08$), whereas 22.3% of women and 7.0% of men were obese ($P < 0.001$). Abdominal obesity was present in 66.7% of the women and 18.2% of the men ($P < 0.001$).

Univariate analyses

The prevalences of the overweight, obesity, and abdominal obesity factors increased with age in both genders (Table 3). Quartiles of leisure time physical activity were negatively associated with overweight and obesity in men and with abdominal obesity in women. There was no significant association between educational level and markers of adiposity in either gender. Alcohol consumption was positively associated with overweight in women and with abdominal obesity in men.

The age adjusted prevalences of overweight and obesity (BMI $\geqslant$ 25 kg/m^2) increased significantly in women only with quartiles of household amenities (P for trend <0.002), while it increased in men with quartiles of both household amenities (P for trend <0.001) and occupational level (P for trend <0.001; Figure 1). The same trend was seen with the prevalence of abdominal obesity. Also, in men, the prevalences of overweight and obesity and of abdominal obesity were two times higher in the fourth quartile of the household amenities score than in the first quartile.

Alcohol consumption increased with education in both genders. Amenities were negatively associated with smoking in women. Subjects in middle occupational class were the fewer smokers. Mean METS of leisure time physical activity were significantly different according to educational level in men while there was a negative association between the METS of leisure time physical activity and household amenities in both genders ($r = -0.11$, $P < 0.001$ for women and $r = -0.12$, $P < 0.001$ for men).

Multivariate analyses

After adjusting for age classes, quartiles of leisure time physical activity, alcohol consumption, and smoking, the prevalences of obesity and abdominal obesity were higher in the third (odds ratios, 2.0, 95% CI: 1.3–3.0 and 1.3, 1.0–1.8) and fourth (1.8, 1.2–2.8 and 1.7, 1.2–2.4) quartiles of household amenities compared with the first quartile in women. In men, the odds ratios of overweight + obesity, obesity, and abdominal obesity were higher in the third (1.6, 1.1–2.3; 2.1, 1.1–4.2; and 3.3, 1.8–5.8, respectively) and fourth (odds ratios, 2.3, 1.6–3.2; 2.4, 1.5–6.0; and 4.1, 2.3–7.3, respectively) quartiles of household amenities compared with the first quartile (Table 4). Also, in men, after adjusting for confounding variables, the odds of

Table 2 Characteristics of the study population by sex in urban Cameroonians aged ⩾25 years

Characteristics	Women	Men	*P*
Clinical[a]			
n	1530	1301	
Age (years)	38.4 (10.3)	39.0 (10.9)	0.2
Body mass index (kg/m^2)	26.7 (4.8)	24.7 (3.3)	<0.001
Classification of BMI			<0.001
18.5 ⩽ BMI < 25 kg/m^2	43.8	62.2	
25 ⩽ BMI < 30 kg/m^2	34.6	30.4	
BMI ⩾ 30 kg/m^2	21.6	7.3	
Waist circumference (cm)	84.8 (12)	83.6 (10)	0.003
Classification of waist			<0.001
Waist < 80 cm (W) 94 cm (M)	33.7	82.5	
Waist ⩾ 80 cm (W) 94 cm (M)	66.3	17.5	
Leisure time physical activity (MET/day)[b]	11.6 (7.0–15.5)	10.4 (6.1–15.9)	0.3
Socio-demographic[c]			
Occupational level (%)			<0.001
Low	37	29	
Middle	51	50	
High	12	21	
Educational level (%)			<0.001
None	13	10	
Primary	23	19	
Secondary	46	44	
University	18	27	
Alcohol consumption (%)			<0.001
Non-drinkers	71	63	
<5 g/day	13	10	
5–30 g/day	11	14	
>30 g/day	5	13	
Tobacco smoking (%)			<0.001
Non-smokers	96.4	91.0	
Ex-smokers	0.6	1.0	
Current smokers	3.0	8.0	

Education levels are primary 1–7 years, secondary 8–14 years, and university >14 years of school.

[a] Data are mean (SD), median.

[b] (25th to 75th percentile) or percentages.

[c] Data are percentages.

overweight + obesity (1.6, 1.2–2.3), obesity (3.8, 1.8–7.8), and abdominal obesity (2.2, 1.3–3.6) were significantly higher for those in the high compared with the low occupational level.

Discussion

The aim of this study was to describe the association between socioeconomic indicators and adiposity in an urban Cameroonian population after adjusting for the main confounding factors. Household amenities were the most important socioeconomic indicator for overweight, obesity and abdominal obesity in both genders. Occupational level was positively associated with obesity and abdominal obesity only in men, while there was no association between any marker of adiposity and educational level.

The household amenities score developed by the World Bank[16] is probably a better indicator of poverty than family income in developing countries. Family income was difficult to obtain in our study, due to suspicion and fear of responders as to the use of these data. Most families in Cameroon have various sources of income, and the exact amount of income varies from month to month. The main occupation was used to define the occupational level, although wages are not always related with occupation. The proposed World Health Organization definition of abdominal obesity[3] was used, as there is not yet a specific definition for African populations. This definition uses a higher cut point for waist circumference for men than for women, and is probably not suitable in our population where the mean waist circumference of women is greater than that of men. This may explain the higher prevalence of abdominal obesity in women compared to men.

There seems to be a positive relationship between SES and BMI in urban Cameroon. In the present study, obesity increased with household amenities in women and was positively associated with household amenities and occupation in men even after adjusting for age, physical activity, education, alcohol, and smoking. A positive SES to adiposity relation is consistent with findings in some[21–23] but not in all developing countries.[12] Kruger *et al.*[24] found in univariate analysis a positive association between income and BMI and no association between BMI and educational level in women from South Africa. BMI related more to education than to wealth, in urban Tanzania.[21] However, for almost all of these studies, when adjustments were made for age and other studied SES factors,[12,24] the relation was no longer statistically significant.[12,21,24] In contrast, BMI is inversely and significantly related to almost all socioeconomic indicators in developed countries.[25–28]

A higher BMI in individuals with lower SES in developed countries has been shown to be related to restricted knowledge and access to healthy foods and to safe exercise, less interest in weight control, discrimination against socioeconomic advancement, and cultural standards of physical effectiveness.[9,25] Cultural factors and health beliefs differ in Cameroon, and probably in Sub-Saharan Africa, where undernutrition and opulence co-exist, food availability remains a daily challenge and overweight is subsequently perceived as a sign of wealth.[29] Moreover, being obese is still a deeply rooted status symbol in some developing countries, and it will be a challenge for health services to try to change that health belief. Also, prevention programmes warning the population about harmful effects of weight gain on health are still rare.

Socioeconomic inequalities in health have been attributed to a number of different mechanisms, including unhealthy behaviours, inadequate access to health care, nutritional inadequacies and other inequalities in material circumstances, and psychological stress.[30,31] Socioeconomic indicators usually describe different aspects of socioeconomic position. Education indicates skills required for acquiring social, psychosocial, and economic resources; occupation measures

Table 3 Odds ratios (95% CIs) between overweight, obesity, and abdominal obesity and studied risk factors by sex in urban Cameroonians aged ⩾25 years

Dependent variables	Women			Men		
	Overweight + Obesity	Obesity	Abdominal obesity	Overweight + Obesity	Obesity	Abdominal obesity
Age classes in years						
25–34	1	1	1	1	1	1
35–44	2.0 (1.5–2.5)	3.5 (2.5–4.9)	2.5 (1.9–3.2)	3.1 (2.3–4.2)	5.1 (2.6–10.0)	5.5 (3.4–8.9)
45–54	2.7 (2.0–3.8)	5.9 (4.0–8.8)	3.2 (2.2–4.5)	4.5 (3.3–6.1)	12.0 (6.3–22.7)	12.3 (7.6–19.8)
55+	1.7 (1.1–2.6)	3.2 (1.8–5.4)	3.7 (2.2–6.2)	2.7 (1.8–4.1)	5.4 (2.4–12.4)	12.4 (7.2–21.4)
*P**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Quartiles of leisure time physical activities						
First quartile	1	1	1	1	1	1
Second quartile	1.13 (0.84–1.50)	1.4 (1.0–2.1)	0.7 (0.5–0.9)	1.3 (0.9–1.8)	1.4 (0.8–2.5)	1.2 (0.8–1.8)
Third quartile	1.10 (0.83–1.48)	1.31 (0.89–1.93)	0.9 (0.6–1.2)	0.9 (0.6–1.2)	0.9 (0.5–1.8)	0.9 (0.6–1.4)
Fourth quartile	1.11 (0.84–1.50)	1.32 (0.90–1.94)	0.7 (0.5–0.9)	0.7 (0.5–0.9)	0.5 (0.2–0.9)	0.7 (0.5–1.1)
*P**	0.8	0.3	0.04	0.003	0.01	0.09
Tobacco smoking						
Non-smokers	1	1	1	1	1	1
Smokers	0.6 (0.3–1.1)	1.4 (1.0–1.9)	0.8 (0.4–1.5)	0.7 (0.5–1.3)	1.0 (0.6–1.6)	0.9 (0.5–1.5)
*P**	0.08	0.03	0.5	0.2	1.0	0.6
Alcohol consumption						
Non-drinker	1	1	1	1	1	1
<5 g/day	1.7 (1.2–2.4)	1.7 (1.2–2.6)	1.1 (0.8–1.5)	0.8 (0.5–1.2)	0.8 (0.4–1.7)	1.1 (0.6–1.8)
5–30 g/day	1.3 (0.9–1.8)	1.3 (0.8–2.0)	1.3 (0.9–1.9)	1.1 (0.8–1.6)	0.9 (0.5–1.7)	1.3 (0.9–2.0)
>30 g/day	0.8 (0.4–1.3)	1.1 (0.6–1.9)	1.2 (0.7–1.8)	1.4 (1.0–1.9)	1.3 (0.7–2.5)	2.1 (1.4–3.0)
*P**	0.006	0.06	0.5	0.1	0.6	0.004

* *P* for difference.

prestige, responsibility, physical activity, and work exposure; income reflects spending power, diet, and medical care.[11,32] The socioeconomic indicator associated with adiposity is mainly income in developing countries and education in developed countries.[9]

In our study, educational level was not significantly related to adiposity, even in univariate analyses. Being educated in Cameroon is not necessarily associated with a better remuneration in the job market. In fact, those involved in economic or commercial activities are mainly the less educated but the most financially rewarded. With the expected increase in the standard of living in Cameroon, an adequate food supply will be available even for the poorest subjects in the society, and adoption of unhealthy behaviour related to eating habits and energy expenditure patterns will be one of the major determinants for obesity.

Neither eating behaviour nor energy intake was taken into account when adjusting for confounding variables in the present study. Due to economic problems in Cameroon, energy intake is probably positively associated with income, and also to household amenities. In developing countries, income has been found to be positively associated with intake of fat and animal-protein.[33] Although adjusting for energy intake may have permitted the assessment of the real effect of wealth and occupation on markers of adiposity, it could, to some extent, be an over adjustment if the relation between these socioeconomic indicators and obesity is partly mediated by the accessibility to food.

Monteiro *et al.*,[15] in a cross-sectional study including 148 579 non-pregnant women from 37 developing countries with gross national product varying from US $190 to 44 440 per capita, identified a cut point from which there was a shift of the effects of income on obesity, with a positive association between BMI and income <US $2500 and a negative association >US $2500. It is likely that economic growth in Cameroon will be associated with an increase in the prevalence of obesity, particularly in the poorest populations.

Civil servants, businessmen, and students were the major inhabitants of the Biyem-Assi quarter and this will be true of most cities in Cameroon. Moreover, their socioeconomic and lifestyle characteristics are not so different from those of other main urban cities in Cameroon, even if these different social classes are not represented in the same proportion in all of the cities. Therefore, even if there are limitations in the generalizability of the results to the urban part of Cameroon, we believe that these limitations are minor.

In conclusion, in the subjects studied, there was a complex relationship between SES and adiposity: a positive association between household amenities (in both genders) and occupational level (in men), and no association with educational

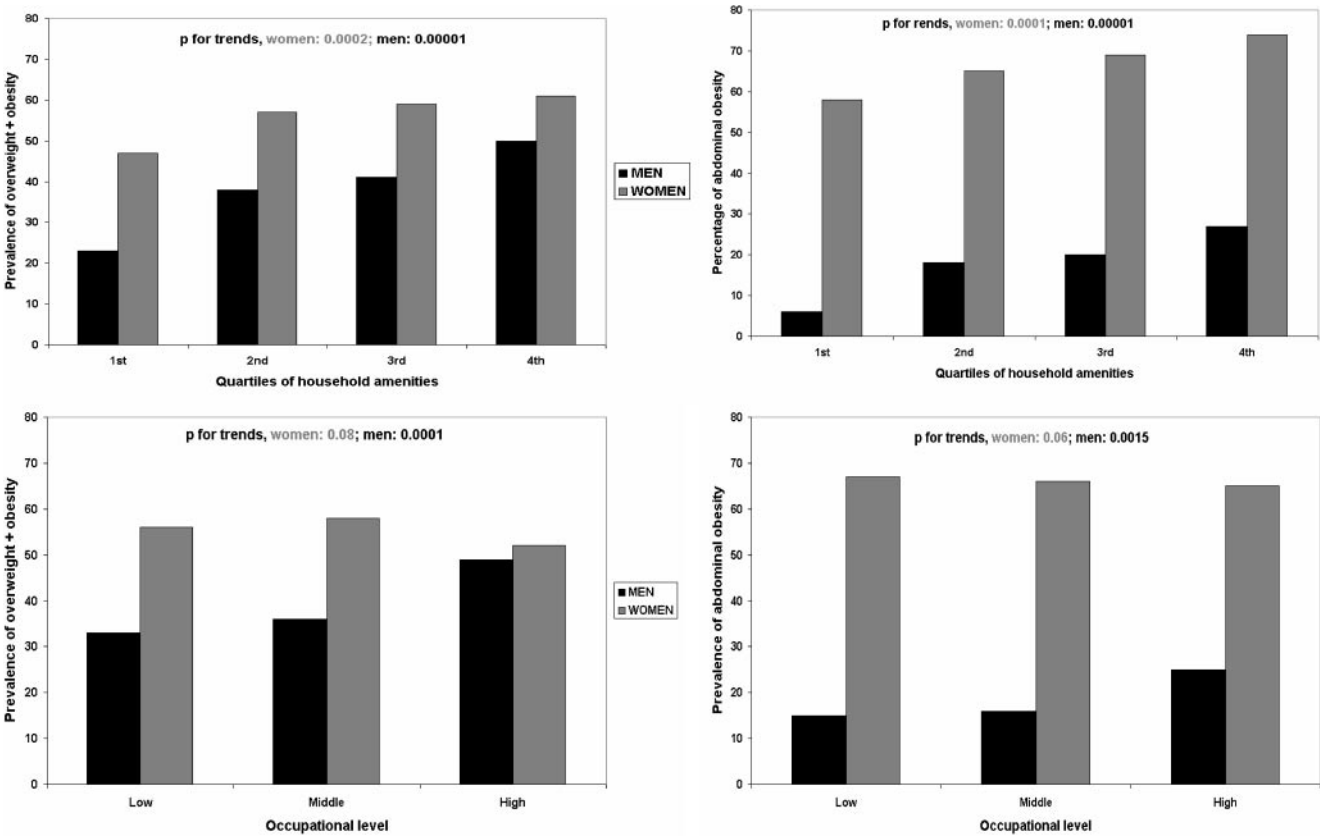

Figure 1 Age adjusted prevalence of overweight + obesity and abdominal obesity by sex, occupational level, and quartiles of household amenities in urban adult Cameroonians aged ⩾25 years

Table 4 Adjusted[a] odds ratios (95% CI) associated with markers of adiposity and studied socioeconomic variables by sex in urban Cameroonians aged ⩾25 years

	Women				Men			
Socioeconomic variables	*n*	Overweight + Obesity	Obesity	Abdominal obesity	*n*	Overweight + Obesity	Obesity	Abdominal obesity
Household amenities quartiles								
First (poorest)	379	1	1	1	330	1	1	1
Second	382	1.5 (1.1–2.0)	1.9 (1.2–2.8)	1.2 (0.9–1.7)	320	1.7 (1.2–2.4)	1.5 (0.7–3.1)	3.1 (1.8–5.7)
Third	387	1.5 (1.1–2.0)	2.0 (1.3–3.0)	1.3 (1.0–1.8)	327	1.6 (1.1–2.3)	2.1 (1.1–4.2)	3.3 (1.8–5.8)
Fourth (richest)	382	1.5 (1.1–2.0)	1.8 (1.2–2.8)	1.7 (1.2–2.4)	324	2.3 (1.6–3.2)	2.4 (1.5–6.0)	4.1 (2.3–7.3)
*P**		0.03	0.005	0.03		<0.001	0.01	<0.001
Occupational level								
Low	572	1	1	1	376	1	1	1
Middle	769	1.1 (0.9–1.4)	1.1 (0.8–1.5)	1.0 (0.8–1.3)	644	1.2 (0.9–1.5)	2.1 (1.1–3.9)	1.4 (0.9–2.2)
High	189	0.8 (0.6–1.2)	0.9 (0.5–1.4)	0.9 (0.6–1.3)	281	1.6 (1.2–2.3)	3.8 (1.8–7.8)	2.2 (1.3–3.6)
*P**		0.2	0.5	0.7		0.02	0.001	0.006

Reference category is normal weight for overweight and obesity, waist <80 cm (women) and <94 cm (men) for abdominal obesity.

[a] Odds ratios are adjusted for age classes, leisure time physical activity quartiles, classes of alcohol consumption, and classes of tobacco smoking.

* *P* for difference.

level. Further researches are needed in Cameroon, including cohort studies aiming at confirming and quantifying the above trends. However, the results of the present study highlight the need to develop plans for adequate prevention and management of obesity, taking into account environmental, socioeconomic, and genetic background interactions.

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KEY MESSAGES

- The relation between SES and adiposity may depend on the stage of development of a country.
- Increasing obesity (both overall and central obesity) is seen according to more household amenities, in both men and women in urban Cameroon.
- Occupational activity is only related with adiposity in men.

References

[1]Kaufman JS, Owoaje EE, James SA, Rotimi CN, Cooper RS. Determinants of hypertension in West Africa: Contribution of anthropometric and dietary factors to urban-rural and socioeconomic gradients. *Am J Epidemiol* 1996;**143:**1203–18.

[2]Okosun IS, Cooper RS, Rotimi CN, Osotimehin B, Forrester T. Association of waist circumference with risk of hypertension and type 2 diabetes in Nigerians, Jamaicans, and African-Americans. *Diabetes Care* 1998;**21:**1836–42.

[3]World health organisation. *Obesity: Preventing and managing the global epidemic. Report of who consultation on obesity, June 3–5, 1997*. Geneva: WHO, 1997, who/nut/ncd/98.1.

[4]Goran MI, Weinsier RL. Role of environmental vs. metabolic factors in the aetiology of obesity: Time to focus on the environment. *Obes Res* 2000;**8:**407–09.

[5]Stunkard AJ, Foch TT, Hrubec Z. A twin study of human obesity. *JAMA* 1986;**256:**51–54.

[6]Stunkard AJ, Sorensen TI, Hanis C *et al*. An adoption study of human obesity. *N Engl J Med* 1986;**314:**193–98.

[7]Sorensen TI, Price RA, Stunkard AJ, Schulsinger F. Genetics of obesity in adult adoptees and their biological siblings. *BMJ* 1989;**298:**87–90.

[8]Vogler GP, Sorensen TI, Stunkard AJ, Srinivasan MR, Rao DC. Influences of genes and shared family environment on adult body mass index assessed in an adoption study by a comprehensive path model. *Int J Obes Relat Metab Disord* 1995;**19:**40–45.

[9]Sobal J, Stunkard AJ. Socioeconomic status and obesity: A review of the literature. *Psychol Bull* 1989;**105:**260–75.

[10]Sorensen TI. Socio-economic aspects of obesity: Causes or effects? *Int J Obes Relat Metab Disord* 1995;**19 (Suppl 6):**S6–8.

[11]Winkleby MA, Jatulis DE, Frank E, Fortmann SP. Socioeconomic status and health: How education, income, and occupation contribute to risk factors for cardiovascular disease. *Am J Public Health* 1992; **82:**816–20.

[12]Yu Z, Nissinen A, Vartiainen E *et al*. Associations between socio-economic status and cardiovascular risk factors in an urban population in china. *Bull World Health Organ* 2000;**78:**1296–305.

[13]Monteiro CA, Moura EC, Conde WL, Popkin BM. Socioeconomic status and obesity in adult populations of developing countries: A review. *Bull World Health Organ* 2004;**82:**940–46.

[14]Monteiro CA, Conde WL, Popkin BM. The burden of disease from undernutrition and overnutrition in countries undergoing rapid nutrition transition: A view from brazil. *Am J Public Health* 2004; **94:**433–34.

[15]Monteiro CA, Conde WL, Lu B, Popkin BM. Obesity and inequities in health in the developing world. *Int J Obes Relat Metab Disord* 2004;**28:**1181–86.

[16]Davidson RG Sr, Kiersten J, Rohini P, Adam V for the HNP/Poverty Thematic Group of the World Bank. Socio-economic differences in health, nutrition and population in Cameroon. May, 2000.

[17]Sobngwi E, Mbanya JC, Unwin NC, Aspray TJ, Alberti KG. Development and validation of a questionnaire for the assessment of physical activity in epidemiological studies in sub-Saharan Africa. *Int J Epidemiol* 2001;**30:**1361–68.

[18]Ainsworth BE, Haskell WL, Leon AS *et al*. Compendium of physical activities: Classification of energy costs of human physical activities. *Med Sci Sports Exerc* 1993;**25:**71–80.

[19]Ainsworth BE, Haskell WL, Whitt MC *et al*. Compendium of physical activities: An update of activity codes and met intensities. *Med Sci Sports Exerc* 2000;**32:**S498–504.

[20]World population prospects: The 2002 revision. Volume 1. Sex and age distribution of the world population. United Nations publication. pp. 280–81.

[21]Bovet P, Ross AG, Gervasoni JP *et al*. Distribution of blood pressure, body mass index and smoking habits in the urban population of Dar es Salaam, Tanzania, and associations with socioeconomic status. *Int J Epidemiol* 2002;**31:**240–47.

[22]Bunker CH, Ukoli FA, Nwankwo MU *et al*. Factors associated with hypertension in Nigerian civil servants. *Prev Med* 1992; **21:**710–22.

[23]Gilberts EC, Arnold MJ, Grobbee DE. Hypertension and determinants of blood pressure with special reference to socioeconomic status in a rural south Indian community. *J Epidemiol Community Health* 1994; **48:**258–61.

[24]Kruger HS, Venter CS, Vorster HH, Margetts BM. Physical inactivity is the major determinant of obesity in black women in the North West province, South Africa: The Thusa study. Transition and health during urbanisation of South Africa. *Nutrition* 2002;**18:**422–27.

[25]Kaplan GA, Keil JE. Socioeconomic factors and cardiovascular disease: A review of the literature. *Circulation* 1993;**88:**1973–98.

[26]Han TS, Bijnen FC, Lean ME, Seidell JC. Separate associations of waist and hip circumference with lifestyle factors. *Int J Epidemiol* 1998;**27:**422–30.

[27]Rimm IJ, Rimm AA. Association between socioeconomic status and obesity in 59,566 women. *Prev Med* 1974;**3:**543–72.

[28]Oken B, Hartz A, Giefer E, Rimm AA. Relation between socio-economic status and obesity changes in 9046 women. *Prev Med* 1977; **6:**447–53.

[29]Kruger HS, van Aardt AM, Walker ARP, Bosman MJC. Obesity in african hypertensive women: Problems in treatment. *S Afr J Food Sci Nutr* 1994;**6:**103.

[30]Simmons D, Voyle J, Swinburn B, O'Dea K. Community-based approaches for the primary prevention of non-insulin-dependent diabetes mellitus. *Diabet Med* 1997;**14:**519–26.

[31]Feinstein JS. The relationship between socioeconomic status and health: A review of the literature. *Milbank Q* 1993;**71:**279–322.

[32]Helmert U, Shea S, Herman B, Greiser E. Relationship of social class characteristics and risk factors for coronary heart disease in west germany. *Public Health* 1990;**104:**399–416.

[33]Popkin BM, Keyou G, Zhai F, Guo X, Ma H, Zohoori N. The nutrition transition in China: A cross-sectional analysis. *Eur J Clin Nutr* 1993;**47:**333–46.