Prevalence and sociodemographic determinants of adult obesity: a large representative household survey in a resource-constrained African setting with double burden of undernutrition and overnutrition

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ABSTRACT

Background The obesity epidemic has continued to spread across the globe involving even poor nations of the world.

Method Household population survey of adults aged 20–60 years. Multistage stratified cluster randomised sampling involving both urban and rural statewide representative population samples. Anthropometric measurements were taken using standard methods. Prevalences were weighted and multinomial regression analyses were done.

Results A total of 6628 individuals from 2843 households were surveyed. The weighted overall prevalence for underweight was 9.1% (95% CI 8.1 to 10.1), 65.1% (95% CI 63.6 to 66.6) for normal weight, 19.0% (95% CI 17.8 to 20.3) for overweight and 6.8% (95% CI 6.0 to 7.5) for obese. Men were less likely to be overweight (adjusted OR (AOR) 0.79; 95% CI 0.68 to 0.92) and obese (AOR 0.24; 95% CI 0.19 to 0.31) than women. Urban residents were more likely to be overweight (AOR 1.42; 95% CI 1.18 to 1.71) and obese (AOR 2.09; 95% CI 1.58 to 2.76) than rural residents. Each additional 1-year increase in age increased the risk of overweight by 1.012 (AOR 1.012; 95% CI 1.005 to 1.018) and that of obesity by 1.03 (AOR 1.03; 95% CI 1.02 to 1.04). The low-income class was less likely to be overweight (AOR 0.694; 95% CI 0.507 to 0.951) and obese (AOR 0.44; 95% CI 0.28 to 0.67).

Conclusion The prevalence of obesity and overweight in Enugu Nigeria is high and fast approaching that of underweight. Women, urban dwellers, older adults and high-income earners are at higher risk for obesity and overweight. The study provides robust information for public health policies towards the prevention of obesity in Nigeria.

INTRODUCTION

Obesity is a preventable condition with diverse adverse health implications. About 13% of the world's population is estimated to be obese. Obesity has significant impacts on increased mortality and morbidity in all races, ethnicities and ages.[1–3]

Obesity has immense economic implications both for the individual and for the national health systems, which are most pronounced in resource-constrained countries especially those with little or no functional health insurance coverage like Nigeria.

Previously, obesity was an unlikely public health problem in sub-Saharan Africa owing to the huge burden of undernutrition and infectious diseases. Accumulating evidence is showing that obesity and overweight are real public health problems in Africa.[4] Africa is faced with a double burden of communicable and non-communicable diseases and obesity is an important contributor to non-communicable diseases.[5] There is paucity of data on obesity and its determinants in sub-Saharan Africa. This may be due to the emphasis on undernutrition and communicable diseases which has overshadowed the emerging epidemics of obesity. In Nigeria, most of the information on obesity is obtained from small or non-representative studies whose results cannot easily be generalised to the adult population.[6–14] Large population studies like the Demographic Health Survey obtained data on obesity only from women of reproductive age (15–49 years of age).[15–17] There is a need to obtain robust, comprehensive, up-to-date and representative data on obesity from African settings.

This study aims to determine the prevalence of obesity and overweight and the associated sociodemographic risks in Enugu, south east Nigeria. The findings of this study will provide robust insight into the problem of obesity and overweight in a resource-constrained setting where undernutrition has hitherto been a major public health problem. The findings will also be a useful resource for policy planning and development on obesity and overweight in Nigeria.

METHOD

Study setting and population

Enugu State has a population of approximately 3.3 million people comprising 1.6 million men and 1.7 million women. The population of individuals aged 20–60 years is 1.6 million per the 2006 national population census.[18] The state is divided into 17 local administrative units called local government areas (LGA), with three LGAs located within the urban areas and 15 within rural areas. The majority of Enugu population (62%) is classified as poor while 38% is classified as non-poor.[19]

For ease of census data collection, the Nigerian National Population Commission divided each state

into distinct geographical areas with distinct boundaries called enumeration areas (EA). Enugu State has a total of 13 998 EAs.

Study design

The study is a cross-sectional household population survey of adults aged between 20 and 60 years. The study took place from 2015 to 2017.

Sample size determination

A minimum sample size of 6459 adults was estimated using the sample size formula for cluster representative sample.[20] The assumptions used in calculating the sample size were the national obesity prevalence of 8%, a 95% CI width of ±1 percentage point, an estimated design effect of 2.24 and an estimated response rate of 98%. These parameters were obtained from the Nigeria Demographic and Health Survey.[21]

Sample distribution

Allocation of clusters was 70% to the urban stratum and 30% to the rural stratum to obtain a representative sample of the urban population. The urban stratum was subdivided into upper class, middle class and lower class substrata. These substrata have definite geographical boundaries and defined population.

Allocation of clusters to the different urban substrata was done proportional to the official population figure of the areas. The last population census conducted in Nigeria in 2006 has not yet been analysed to the community level. The census figures that have been analysed to the community level is the 1991 national census. Hence, the 1991 census was used to project the population of areas for the year 2015, with the formula: $Pt = Po\ e^{rt}$[22]:

where:

Pt = Population at present (2015)

Po = Population at old reference point (1991)

e = Exponential

r = Population growth rate (3% (0.03) for Enugu State of Nigeria as obtained from the National Population Commission)

t = time frame in years (24 years (1991–2015))

Sampling method

Multistage stratified cluster randomised sampling was used. Each area within the different urban substrata had at least one cluster sampled. The selection of the participating EA in each area was done by simple random sampling using the list of EAs in the area as the sample frame. The unique identifier number called the EA code of all the EAs in an area was fed into a computer program and the computer asked to randomly pick one EA code. This process was repeated for the computer to pick one or two more EA codes depending on the number of EAs allocated to the area.

For the rural strata, the 15 LGAs that fall within the rural strata were assigned numbers 1–15. The numbers were fed into the computer program and instructed to select nine numbers. From each of the selected LGAs, one EA was randomly selected.

The sampling unit is the individual. Every consenting household within the selected EA was sampled and all consenting individuals within the age of 20–60 years were interviewed and measured. Repeated visits up to a maximum of three times were made to households where one or more eligible individuals were absent at the time of first visit.

Data collection tool

The data were collected using a structured, interviewer-administered questionnaire. The questionnaire was an adaptation of the Global School Health Survey questionnaire. The questionnaire

was tested in a pilot study involving 79 adults from 30 households; 12 households from two randomly chosen streets of the city centre and 18 households from a rural area.

Trained data collectors collected the data and took anthropometric measurements. The height was measured using a portable stadiometer (Seca 213, Hamburg, Germany) with participants in bare feet and measurement taken to the nearest millimetre (1 mm). The weight was measured using an analogue weight scale with participants in light clothing and measurements taken to the nearest kg (1 kg). The waist circumference was measured with a measuring tape to the nearest 0.1 cm. The triceps skinfold thickness was measured with a skinfold calliper (AK Sports) to the nearest 1 mm.

Data analysis

Body weight was classified into three categories, according to the WHO body mass index classification.[23]

Income was classified based on monthly income, into low (<36 000 Nigerian Naira), middle (36 000–180 000 Nigerian naira) and high (>180 000 Nigerian naira), using an adaptation of the income class classification of the African Development Bank.[24]

The estimates of prevalence are weighted according to the population proportions. Appropriate z-tests were used to compare the prevalence of overweight and obesity between different subgroups. Multinomial regression analysis was done to determine the sociodemographic correlates of overweight and obesity, reporting adjusted ORs (AOR) together with 95% CIs and p values of the Wald test. All tests were performed at a 5% significance level. The data were analysed using SPSS V.15.0.

RESULTS

Sixty-five EAs and one university community were sampled out of 13 998 EAs in Enugu State. The sampled EAs were in 12 out of the 17 LGAs of the state. The LGAs included all three urban LGAs of the city of Enugu and nine out of the 14 rural LGAs in the state. A total of 6683 individuals were interviewed and measured. A total of 55 cases who were pregnant and/ or had missing anthropometrics data were excluded, leaving 6628 for final analysis. According to the sampling scheme, 69.9% (n=4630) of participants were from the urban area, while 30.1% (n=1998) were from the rural area. Nearly 60% of the participants were female (n=3876) and mean age was 34.9 years (±13.2 years SD). According to ethnicity, 95.2% (n=6310) of participants were of Igbo ethnicity, 2.1% (n=137) were of Hausa ethnicity, 0.8% (n=51) were of Yoruba ethnicity and 2.0% (n=130) were of other ethnicities. Table 1 shows the demographic characteristics of the participants while table 2 shows the socioeconomic characteristics.

The weighted overall prevalence for underweight was 9.1% (95% CI 8.1% to 10.1%), 65.1% (95% CI 63.4% to 66.6%) for normal weight, 19.0% (95% CI 17.8% to 20.3%) for overweight and 6.8% (95% CI 6.0% to 7.5%) for obese. For men (n=2752), 9.7% (95% CI 8.1% to 11.3%) were underweight, 70% (95% CI 67.8% to 72.3%) had normal weight, 17.0% (95% CI 15.2% to 18.8%) were overweight and 3.2% (95% CI 2.4% to 4.0%) were obese. For women, 8.6% (95% CI 7.4% to 9.9%) were underweight, 61.7% (95% CI 59.8% to 63.7%) had normal weight, 20.4% (95% CI 18.8% to 22.1%) were overweight and 9.2% (95% CI 8.1% to 10.3%) were obese (see table 3).

The prevalence of overweight among women was 20.4% (95% CI 18.8% to 22.1%) and significantly higher compared with the prevalence among men of 17.0% (95% CI 15.2% to

Table 1 Demographic characteristics of participants

Characteristic	Number	Percentage (%)
Gender		
Female	3876	58.5
Male	2752	41.5
Age in years		
≤40	4376	66.2
>40	2233	33.7
Residence		
Urban	4630	69.9
Rural	1998	30.1
Urban class		
Upper	644	9.7
Middle	1745	26.3
Lower	2187	33.0
University	53	0.8
Ethnicity		
Igbo	6310	95.2
Hausa	137	2.1
Yoruba	51	0.8
Others	131	2.0

18.8%) with p=0.005. Similarly, the prevalence of obesity was significantly higher in women (9.2%; 95% CI 8.1% to 10.3%) than in men (3.2%; 95% CI 2.4% to 4.0%), with p<0.001.

Prevalence of overweight among the younger population aged 40 years or below was 18% (95% CI 16.4% to 19.6%) and was significantly lower than the older population aged above 40 years, 20.8% (95% CI 18.9% to 22.7%, p=0.027). Also, the prevalence of obesity among younger individuals aged 40 years and below was significantly lower than that of older individuals aged above 40 years (p<0.0001), with 5.4% (95% CI 4.5% to 6.4%) vs 9.8% (95% CI 8.5% to 11.1%).

Table 2 Socioeconomic characteristics of participants

Characteristic	Number	Percentage (%)
Marital status		
Single	3374	50.9
Married	3041	45.9
Divorced	22	0.3
Separated	23	0.3
Widowed	168	2.5
Education		
No education	127	1.9
Primary education	1212	18.3
Secondary education	3961	59.8
Postsecondary vocational education	180	2.7
University education	1146	17.3
Income class		
No income	2246	33.9
Low-income class	3113	46.9
Middle-income class	624	9.4
High-income class	645	9.7

Among urban residents, the prevalence of overweight and obesity was significantly higher compared with rural residents (24.7%, 95% CI 23.5% to 26.0% vs 16.6%, 95% CI 15.0% to 18.2%, p<0.001 for overweight; 9.8%, 95% CI 8.9% to 10.7% vs 5.5%, 95% CI 4.5% to 6.5%, p<0.001 for obesity).

Within the urban strata, prevalences of overweight and obesity were 24.4% and 8.5%, respectively, in the upper class. The corresponding figures within the middle class were 29.3% and 12.8%. In the lower class prevalences of overweight and obesity were 21.4% and 7.7%. The corresponding figures in the university community were 37.7% and 18.9%, respectively. These are also shown in table 3.

Age, gender and residence (urban/rural) were significant predictors of overweight in all the models. These remained significant after adjusting for education, income class, marital status, tribe, religion, migration status and family size. Individuals living in urban areas are 1.4 times more likely to be overweight than those in rural areas (AOR 1.42; 95% CI 1.18 to 1.71). Men are significantly less likely to be overweight compared with women (AOR 0.79; 95% CI 0.68 to 0.92). For each additional 1-year increase in age, the risk of overweight increased by a factor of 1.012 (AOR 1.012; 95% CI 1.005 to 1.018). Compared with the high-income class, the low-income class is less likely to be overweight (AOR 0.694; 95% CI 0.507 to 0.951). Education did not show a significant impact on the risk of overweight. These are shown in table 4.

Significant predictive factors for obesity were age, gender, residence (urban/rural) and income class. These remained significant even after adjusting for marital status, tribe, religion, migration status and family size. Urban dwellers are 2.1 times more likely to be obese than rural dwellers (AOR 2.09; 95% CI 1.58 to 2.76). Men are less likely to be obese than women (AOR 0.24; 95% CI 0.19 to 0.31). Compared with the high-income class, individuals in the low-income class are less likely to be obese (AOR 0.44; 95% CI 0.28 to 0.67). The middle-income class was also less likely to be obese compared with the high-income class, but the difference did not reach statistical significance (AOR 0.76; 95% CI 0.53 to 1.09). The risk of obesity increased by a factor of 1.03 for each additional 1-year increase in age (AOR 1.03; 95% CI 1.02 to 1.04). Education did not show a significant impact on the risk of obesity. These are shown in table 4.

The results of subgroup analysis of the urban and rural areas are shown in table 5.

DISCUSSION

The study provides robust data on the prevalence and sociodemographic risk factors of overweight and obesity in Enugu south east Nigeria, with a 95% CI width for the prevalence of obesity well below ±1 percentage points. To the best of our knowledge, this is the largest household survey on obesity and overweight to include both urban and rural populations as well as adult men and women in any Nigerian region. The overall prevalences of overweight and obesity of 19.0% and 6.8%, respectively, are very close to the range reported previously from Nigeria. A recent systematic review reported a range of 20.3%–35.5% for overweight and 8.1%–22.2% for obesity.[25] In Europe, the prevalence of overweight in adults is 34.8% while that of obesity was 12.8%.[26] In the USA, the prevalence of adult obesity for the year 2015–2016 was 39.8%.[27] While the prevalence of overweight and obesity in this study is still way below that of the USA, it is quite close to that of Europe. Nigeria's obesity rate may soon be at par or even overtake that of Europe. With an underweight rate of 9.1% in this study, Nigeria is clearly facing the double

Table 3 Prevalence (in per cent) and 95% CI according to BMI classification of weight (prevalences are weighted sums over sample strata)

	Underweight	Normal weight	Overweight	Obese
Total population	9.1% (8.1% to 10.1%)	65.1% (63.6% to 66.6%)	19.0% (17.8% to 20.3%)	6.8% (6.0% to 7.5%)
Male	9.7% (8.1% to 11.3%)	70.0% (67.8% to 72.3%)	17.0% (15.2% to 18.8%)	3.2% (2.4% to 4.0%)
Female	8.6% (7.4% to 9.9%)	61.7% (59.7% to 63.7%)	20.4% (18.8% to 22.1%)	9.2% (8.1% to 10.3%)
Rural residents	10.7% (9.3% to 12.1%)	67.2% (65.1% to 69.2%)	16.6% (15.0% to 18.2%)	5.5% (4.5% to 6.5%)
Urban residents (total)	5.3% (4.6% to 6.0%)	60.2% (58.7% to 61.6%)	24.7% (23.5% to 26.0%)	9.8% (8.9% to 10.7%)
Urban upper class	2.3% (1.2% to 3.5%)	64.8% (61.5% to 68.4%)	24.4% (21.1% to 27.7%)	8.5% (6.4% to 10.7%)
Urban middle class	1.7% (1.1% to 2.3%)	56.2% (53.8% to 58.5%)	29.3% (27.2% to 31.5%)	12.8% (11.3% to 14.4%)
Urban lower class	8.4% (7.2% to 9.5%)	62.5% (60.4% to 64.5%)	21.4% (19.7% to 23.2%)	7.7% (6.6% to 8.8%)
Urban university community	0.0% (0.0% to 0.0%)	43.4% (30.1% to 56.7%)	37.7% (24.7% to 50.8%)	18.9% (8.3% to 29.4%)
≤40 years of age	9.3% (7.9% to 10.6%)	67.3% (65.3% to 69.3%)	18.0% (16.4% to 19.6%)	5.4% (4.5% to 6.4%)
>40 years of age	8.9% (7.5% to 10.4%)	60.5% (58.2% to 62.8%)	20.8% (18.9% to 22.7%)	9.8% (8.5% to 11.1%)

BMI, body mass index.

burden of undernutrition and overnutrition. The burden of obesity is fast approaching the burden of underweight and this calls for concern.

Living in the urban area is a significant risk factor for overweight and even a much higher risk factor for obesity in all the models. This finding is similar to findings from earlier studies in Nigeria and other parts of West Africa.[17 28 29] In Europe, the urban-rural difference in obesity prevalence is not significant,[30]

Table 4 Sociodemographic predictors of overweight and obesity (multinomial regression)

Weight category†	Predictor	AOR	95% CI Lower	95% CI Upper	P values
Overweight	Age in years	1.012*	1.005	1.018	<0.001
	Urban residence	1.421*	1.183	1.707	<0.001
	Rural residence	–	–	–	–
	Male gender	0.786*	0.675	0.915	0.002
	Female gender	–	–	–	–
	Low-income class	0.694*	0.507	0.951	0.023
	Middle-income class	0.909	0.692	1.194	0.492
	High-income class	–	–	–	–
	University education	1.091	0.841	1.414	0.512
	No university education	–	–	–	
Obese	Age in years	1.031*	1.021	1.040	<0.001
	Urban residence	2.087*	1.577	2.764	<0.001
	Rural residence	–	–	–	–
	Male gender	0.243*	0.189	0.312	<0.001
	Female gender	–	–	–	–
	Low-income class	0.436*	0.284	0.670	<0.001
	Middle-income class	0.761	0.532	1.089	0.135
	High-income class	–	–	–	–
	University education	0.867	0.607	1.238	0.432
	No university education	–	–	–	–

*Significant, that is, p<0.05.
†Reference category=normal weight.
AOR, adjusted OR.

while in the USA, the burden of obesity appears to be more in the rural areas.[31] Urban-rural difference in obesity is mediated through diet and physical activity. In Nigeria, obesogenic foods are usually imported, and therefore more expensive than local foods that are less obesogenic. High-income earners almost exclusively reside in the urban areas in Nigeria. This means that almost only the urban residents will have the financial capacity to purchase these expensive imported foods. Hence, the imported high-calorie foods are almost exclusively available in the urban areas. Urban dwellers are more exposed to high-calorie foods. They are also more financially empowered to consume these foods than rural dwellers. Again, human commuting is more vehicular in the urban areas than in the rural areas, hence rural dwellers are more likely to walk more than urban dwellers. The rural dwellers mainly engage in non-mechanised farming requiring a good deal of physical strength. These might have contributed to the lower burden of overweight and obesity in rural areas.

Women were four times more likely to be obese than men. This risk remained significant in both urban and rural subgroup analysis. Previous authors reported similar findings from Nigeria.[6 9 12 29 32–34] The gender distribution of the burden of obesity in this study is the opposite of that in high-income countries. In Europe, men are more obese than women,[26] while in the USA no significant difference exists between men and women overall.[27] Previous authors attributed the higher prevalence of obesity in women in low-income countries to the fact that men are usually engaged in more strenuous jobs and many women are housewives with no formal employment and less physical activities.[35] The sociocultural desirability of large body size for women in this setting could also be an additional contributory factor. Also, women were 1.3 times more likely to be overweight than men in this study. Report from previous studies from Nigeria is conflicting. Some reported higher proportion of men than women being overweight,[7 12 29 35 36] others reported higher proportion of women than men.[6 9 32 34] In Europe, reports have consistently indicated a higher prevalence of overweight in men than women.[26]

The odds of overweight and obesity is increasing with increasing age in this study. This supports the findings from previous studies in Nigeria, Europe and the USA.[12 17 26 27 32] The impact of age on obesity could be explained by physical activity. It is known that younger adults are more physically active than older adults.[37 38]

Table 5 Sociodemographic predictors of overweight and obesity among urban and rural residents (multinomial regression)

Weight class†	Predictor	AOR	95% CI Lower	95% CI Upper	P values
Urban residents					
Overweight	Age	1.016*	1.009	1.024	<0.001
	Upper class	0.661*	0.475	0.921	0.014
	Middle class	1.221	0.976	1.526	0.080
	University community	1.645	0.695	3.890	.257
	Lower class	–	–	–	–
	Male gender	0.839	0.698	1.008	0.061
	Female gender	–	–	–	–
	Low-income class	0.729	0.514	1.033	0.075
	Middle-income class	0.895	0.668	1.200	0.459
	High-income class	–	–	–	–
	University education	1.196	0.910	1.571	0.199
	No university education	–	–	–	–
Obese	Age	1.043*	1.031	1.054	<0.001
	Upper class	0.558*	0.348	0.893	0.015
	Middle class	1.399*	1.026	1.907	0.034
	University community	1.446	0.513	4.074	0.485
	Lower class	–	–	–	–
	Male gender	0.251*	0.189	0.334	<0.001
	Female gender	–	–	–	–
	Low-income class	0.480*	0.299	0.771	0.002
	Middle-income class	0.653*	0.443	0.963	0.031
	High-income class	–	–	–	–
	University education	0.967	0.669	1.399	0.859
	No university education	–	–	–	–
Rural residents					
Overweight	Age	1.005	0.995	1.016	0.321
	Male gender	0.702*	0.530	0.929	0.013
	Female gender	–	–	–	–
	Low-income class	0.557	0.116	2.671	0.464
	High-income class	0.360	0.076	1.703	0.198
	Middle-income class	–	–	–	–
	University education	0.817	0.271	2.463	0.720
	No university education	–	–	–	–
Obese	Age	1.001	0.984	1.019	0.893
	Male gender	0.223*	0.125	0.400	<0.001
	Female gender	–	–	–	–
	Low-income class	0.538	0.041	7.012	0.636
	High-income class	1.679	0.166	16.939	0.660
	Middle-income class	–	–	–	–
	University education	0.774	0.172	3.477	0.738
	No university education	–	–	–	–

*Significant, that is, p<0.05.
†Reference category=normal weight.
AOR, adjusted OR.

Education did not have a significant impact on the risk of overweight and obesity. This contrasts with the findings of previous studies from Nigeria.[12 17 35] In high-income countries, the prevalence of overweight and obesity decreases with increasing education.[26]

The income level of the individual is a significant predictor of obesity in this study. The high-income class was 2.3 times more

What is already known on this subject

► The rising epidemic of obesity previously experienced only in high-income countries of the world is known to be permeating resource-constrained countries of Africa including Nigeria.
► The burden of obesity is known to be rising in Nigeria especially in the urban cities. However, until the present, there are no reliable and representative population data on the burden and sociodemographic determinants of adult obesity and overweight, which included male and female populations, as well as rural and urban populations.

What this study adds

► This study adds reliable and representative population data on the burden and sociodemographic determinants of adult obesity and overweight in south east Nigeria.
► For the first time, the double burden of undernutrition and obesity in Nigeria was confirmed using a rigorous large population survey method.
► The study provides robust population data which could serve as a source of information for the development of the much-needed obesity prevention policies in Nigeria.
► This study is also expected to stimulate obesity research in Nigeria, which is currently at a very low level, apparently due to the overshadowing effect of undernutrition and infectious diseases.

likely to be obese than the low-income class. Previous studies from Nigeria reported similar findings.[9 17 33 35] In high-income countries, there is an inverse relationship between obesity and income class.[26]

The findings of this study bring to the fore the problem of overweight and obesity in a setting that is equally plagued with undernutrition. The problem of overweight and obesity is likely to be ignored if not documented in robust data. Ignoring the emerging obesity epidemic might be a huge error in the future as the country's heath system might not be positioned to effectively handle these issues. The time for Nigeria to begin to evolve policies to prevent and/or halt the emerging epidemic of obesity and overweight is now. Data provided from this study are expected to assist health policymakers in this regard.

This study is limited by its cross-sectional design with its inherent response bias, but the large sample size and the representation of every sector of the adult population strengthen the study.

In conclusion, the prevalence of obesity and overweight in Enugu south east Nigeria is high and fast approaching that of underweight. Age, gender, urban-rural residence and income class are predictive sociodemographic factors for obesity and overweight. Public health policies towards the prevention and management of obesity and obesity-related issues are recommended.

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