ORIGINAL ARTICLE

Obesity, overweight, and underweight among urban Nigerians

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Abstract

Background: Disease burden from communicable and noncommunicable diseases is a significant health challenge facing many developing nations. Among the noncommunicable diseases, is obesity, which has become a global epidemic associated with urbanization.

Objective: The aim was to evaluate the prevalence of weight abnormalities, their pattern of distribution and regional differences among apparently healthy urban dwelling Nigerians.

Methods: A cross-sectional community-based descriptive survey was carried out in five urban cities, each from one geo-political zone of Nigeria. Multistage sampling procedures were used to select participants using the World Health Organization STEPS instrument. Ethical approval and consents were duly and respectively obtained from the Ethics Committee in the tertiary centers and participants in each of these cities. Analysis was performed using SPSS version 20 (IBM Corp., Amonk, NY; released 2011) with *P* value set at < 0.05.

Results: A total of 5392 participants were recruited; of which, 54.5% and 45.5% were males and females respectively. Mean (standard deviation) age and body mass index (BMI) were 40.6 (14.3) years and 25.3 (5.1) kg/m^2. Obesity, overweight, and underweight were found in 17%, 31%, and 5% of participants respectively. Significantly, while underweight declined with increasing age, overweight, and obesity increased to peak in the middle age brackets. Age of ≥ 40 years was found to confer about twice the risk of becoming overweight. The prevalence of obesity and mean BMI were significantly higher both among the females and the participants from southern zones.

Conclusion: Obesity and overweight are common in our urban dwellers with accompanying regional differences. Attainment of middle age increases the likelihood of urban dwelling Nigerians to become overweight/obese. There is therefore the need to institute measures that will check development of overweight/obesity early enough, while improving the nutritional status of the few who may still be undernourished.

Key words: Nigerians, obesity, urban, weight distribution

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Background

The World Health Organizations (WHO's) technical report series of 1995 indicated that body weight significantly impacts on the health and disease status of an individual.[1] Specifically, extremes of body weight namely underweight and overweight/obesity are associated with increased risk of disease morbidity and mortality. Diseases related to poor immune function such as tuberculosis are more common in underweight individuals, whereas cardiometabolic disorders are more common in overweight/obese persons.

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These extremes of weight also tend to indicate the nutritional status of individuals and indirectly, the socioeconomic status.[2,3] Urban and rural residence are usually associated with higher and many a times, poorer socioeconomic status, respectively and thus the greater prevalence of overweight/obesity may be seen in urban dwellers.[4] This informed the rural-urban drift which many nations including Nigeria has been witnessing for many years now. Globally, the trend towards overweight/obesity in urban cities is now assuming an epidemic proportion and this is attributed to reduced physical activity and consumption of energy and fat-laden diets obtained from many fast food centers.

Bakari *et al.*[5] in 2007 reported these abnormalities of body weight to be common in two suburban communities in Northern Nigeria at the rates of 13.1% for obesity, 18.5% for overweight and 6.7% for underweight. Data on obesity have been commonly reported in the past among specific risk groups such as hypertensive and diabetic populations many of which are hospital based studies.[6,7] Other community based studies which are now emerging have been reported among rural or semi urban dwellers.[8,9] This study did not only focus on urban communities, but also on apparently healthy individuals (defined here as individuals who are not known to have hypertension or diabetes) living in these communities. This is in recognition of the fact that these individuals can be regarded as people who are unaware of their cardiovascular risk status. To the best of our knowledge, therefore, this is the first community based survey on the prevalence of overweight and obesity among a representative sample of urban adults selected from different geopolitical zones of Nigeria using the WHO Step-wise methodology. This study also provides opportunity for us to compare trends across different geo-political regions of the country studied.

The aim of this study was therefore to determine the overall burden and pattern of abnormal weight distribution among apparently healthy urban dwelling Nigerians and to evaluate if there were any regional differences.

Methods

Five urban cities, which belonged to different geo-political zones of Nigeria, were involved in the study. These cities namely Enugu (South East), Maiduguri (North East), Sokoto (North West), Sagamu (South West) and Calabar (South South) represented the place of medical practice of each investigator involved in this study. The study was duly approved by the Health Research and Ethics Committee of the tertiary hospitals located in these cities. Recruitment of participants was done through a multistage sampling. The first stage involved selection of some sections/wards in these cities using a simple random sampling technique. The second stage involved selection of households within these wards using cluster sampling technique and having obtained clearance from the ward heads. Adults within the households were invited to a convenient location within the wards for recruitment and some health enlightenment campaigns. Individuals who gave their consent were subsequently recruited consecutively to participate in the study. Participants were defined as apparently healthy if they neither had a history of hypertension, diabetes or both nor took medication(s) for hypertension and diabetes mellitus, which are known to be commonly associated with obesity.

Data collection and anthropometric measurements were done with the assistance of medically trained assistants drawn from each of the tertiary institutions using the standardized methods as stipulated in the WHO steps instrument for surveillance of behavioral risk factors (version 2.0).[10] Weight categorization was done as defined by body mass index (BMI); an index determined using weight and square of the height according WHO.[11,12] Accordingly, BMI of < 18.5 kg/m^2, 25-29.9 kg/m^2 and > 30 kg/m^2 were used to define underweight, overweight and obesity respectively. Obesity was further classified into mild (BMI of 30-34.5 kg/m^2), moderate (35-39.9 kg/m^2) and severe (>40 kg/m^2). Gender-specific waist circumference (WC) classification was defined using both the National Cholesterol Education Program (NCEP) and International Diabetes Federation (IDF) proposal for sub-Saharan Africa, which corresponds to that proposed for Europids.[13,14] WC $\geq$ 102 cm and $\geq$ 94 cm for males and $\geq$ 88 cm and $\geq$ 80 cm classified central obesity among the participants using NCEP and IDF criteria respectively. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were separately defined using SBPs and DBPs of $\geq$ 140 mmHg and $\geq$ 90 mmHg, respectively according to JNC 7 classification.[15] Hypertension hence was deemed to be present if SBP and DBP or any of either SBP or DBP were elevated and met the classification criteria of JNC 7. Forty years of age was used to define the lower boundary of middle age.[16]

Statistical analysis was performed using SPSS version 20 (IBM Corp., Amonk, NY; released 2011) with level of significance set at $P < 0.05$. Student's *t*-test and analysis of variance (ANOVA) were used for comparison of means between two groups and multiple groups respectively while Chi-square analysis was used for test of association. Correlation between continuous variables was determined using Pearson's correlation.

Results

General description of the participants

A total of 5392 participants consisting of 2937 (54.5%) males and 2455 (45.5%) females were recruited for the

study The general characteristics as shown in Table 1 revealed that the greater proportion of the participants below 44 years were males. From 45 years and above, the trend changed with females being in majority. Abnormalities of weight (underweight, overweight and obesity) affected more females than males. Similarly, more females had systolic hypertension as against the pattern with diastolic hypertension; however, the presence of hypertension generally leveled off between males and females. Prevalence of hypertension was high among the group (40.6% [2190/5392]). Central obesity using the gender-specific WC classifications proposed by IDF and NCEP was more common in the females. The IDF classification identified more participants as centrally obese. All the gender associations were significant except for that of hypertension [Table 1].

The mean (standard deviation) of the age and BMI for the group were 40.6 (14.3) years and 25.3 (5.1) kg/m^2 [Table 2] depicting that on the average the group belonged to the middle age bracket and were generally overweight respectively. Significant mean gender differences were observed except for systolic hypertension [Table 2]. The female participants had higher mean WC and BMI though male participants weighed more than the females.

Weight distribution and its pattern among the participants

The weight distribution among the participants is shown in Figure 1. Obesity was found in 933 participants giving a prevalence of 17.2%, while 1679 (31.1%) participants were overweight. A small proportion (4.9%) was underweight,

Table 1: Frequency distribution of the clinical characteristics of the group by gender

Clinical characteristics	Frequency distribution (*n* (%))			χ^2 value (df)	*P* value
	Males	Females	Total		
Age group (years)					
15-24	453 (15.4)	304 (12.4)	757 (14)	51.1 (5)	<0.0001
25-34	712 (24.2)	505 (20.6)	1217 (22.6)		
35-44	710 (24.2)	552 (22.5)	1262 (23.4)		
45-54	514 (17.5)	538 (21.9)	1052 (19.5)		
55-64	413 (14.1)	374 (15.2)	787 (14.6)		
65-74	135 (4.6)	182 (7.4)	317 (5.9)		
Total	2937 (100)	2455 (100)	5392 (100)		
Weight categories (based on BMI)					
Underweight	138 (4.7)	127 (5.2)	265 (5)	129.5 (5)	<0.0001
Normal	1532 (52.2)	983 (40)	2515 (47)		
Overweight	873 (29.3)	806 (32.8)	1679 (31)		
Mild obesity	320 (10.9)	356 (14.5)	676 (13)		
Moderate obesity	51 (1.7)	134 (5.5)	185 (3)		
Severe obesity	23 (0.8)	49 (2)	72 (1)		
Total	2937 (100)	2455 (100)	5392 (100)		
Systolic hypertension					
Yes	822 (28)	795 (32.4)	1617 (30)	12.3 (1)	<0.001
No	2115 (72)	1660 (67.6)	3775 (70)		
Total	2937 (100)	2455 (100)	5392 (100)		
Diastolic hypertension					
Yes	980 (33.4)	718 (29.2)	1698 (31.5)	10.5 (1)	<0.01
No	1957 (66.6)	1737 (70.8)	3694 (68.5)		
Total	2937 (100)	2455 (100)	5392 (100)		
Hypertension					
Yes	1199 (40.8)	991 (40.4)	2190 (40.6)	0.12 (1)	0.74
No	1738 (59.2)	1464 (59.6)	3202 (59.4)		
Total	2937 (100)	2455 (100)	5392 (100)		
Central obesity (IDF)					
Yes	785 (26.7)	1703 (69.4)	2488 (46.1)	978.4 (1)	<0.0001
No	2152 (73.3)	752 (30.6)	2904 (53.9)		
Total	2937 (100)	2455 (100)	5392 (100)		
Central obesity (NCEP-ATP III)					
Yes	311 (10.6)	1218 (49.6)	1529 (28.4)	1002.4 (1)	<0.0001
No	2626 (89.4)	1237 (50.4)	3863 (71.6)		
Total	2937 (100)	2455 (100)	5392 (100)		

BMI=Body mass index; IDF=International diabetes federation; NCEP=National cholesterol education program; ATP III=Adult treatment panel III

Table 2: Mean (SD) of clinical characteristics distributed by gender

Clinical characteristics	Males (n=2937)	Females (n=2455)	Total (n=5392)	P value*
Age (years)	39.4 (14.1)	42 (14.3)	40.6 (14.3)	<0.001
Height (m)	1.7 (0.1)	1.6 (0.1)	1.7 (0.1)	<0.001
Weight (kg)	71.1 (14.4)	68.3 (15.8)	69.9 (15.1)	<0.001
WC (cm)	85.6 (12.2)	87.3 (13.2)	86.3 (12.7)	<0.001
Hip circumference (cm)	94.8 (11.5)	98.5 (11.5)	96.5 (11.6)	<0.001
SBP (mmHg)	129.8 (19.7)	130.9 (22.7)	130.3 (21.1)	0.83
DBP (mmHg)	82.1 (12.6)	81.1 (13.8)	81.6 (13.2)	0.01
BMI (kg/m^2)	24.7 (4.6)	26.1 (5.6)	25.3 (5.1)	<0.001
WHR	0.91 (0.11)	0.87 (0.09)	0.9 (0.1)	<0.001

WC=Waist circumference; SBP=Systolic blood pressure; DBP=Diastolic blood pressure; BMI=Body mass index; WHR=Waist-to-hip ratio

while the rest (47%) of the participants had normal BMI. Among the obese participants, mild or stage 1 obesity was the most common [Table 1]. Prevalence of central obesity was higher than generalized obesity using NCEP (28.4%) and IDF criteria (46.1%). Correlation was positive, but stronger between WC and BMI (r = 0.71; P < 0.001) than with waist-to-hip ratio (r = 0.57; P < 0.001).

Age and pattern of weight distribution

Prevalence of obesity was found to increase with increasing age until after 45-54 years age group. Underweight, which involved 37% of the participants, was most frequent in 15-24 years age group steadily declining as the ages increased, whereas overweight and obesity increased with age with peaks in 35-44 years and 45-54 years age groups, respectively [Figure 2]. Overweight and obesity was less common in the lower and upper extremes of age.

Among the 933 obese participants, the highest prevalence of generalized obesity was seen in those within 45-54 years age group, which affected 277 (29.7%) participants. Using ANOVA to evaluate mean BMI and WC among the 5392 participants, it was observed that, the mean BMI and WC significantly increased with age; the highest ([BMI: 26.9 [5.4] kg/m^2 and WC: 91.4 [12.2] cm]) occurring in the middle age bracket of 45-54 years (F [5, 5386] =94 and 190.5; [P < 0.0001, respectively]). This trend in the pattern of mean BMI and significant observation was similar for both males and females. The trend described above is clearly shown in the means plot [Figure 3]. The risk of developing generalized obesity was about twice when middle-age (≥40 years) is attained or if there is hypertension [Table 3].

Gender and pattern of weight of weight distribution

The female gender was generally associated with greater proportion of individuals in the underweight, overweight, and obese categories ($\chi^{2[5]}$ =129.5; P < 0.0001), while the males were in greater proportion among those with normal BMI [Table 1]. Generalized obesity occurred in 22% of females as against 13.4% in males ($\chi^{2[1]}$ =68.2; P < 0.0001).

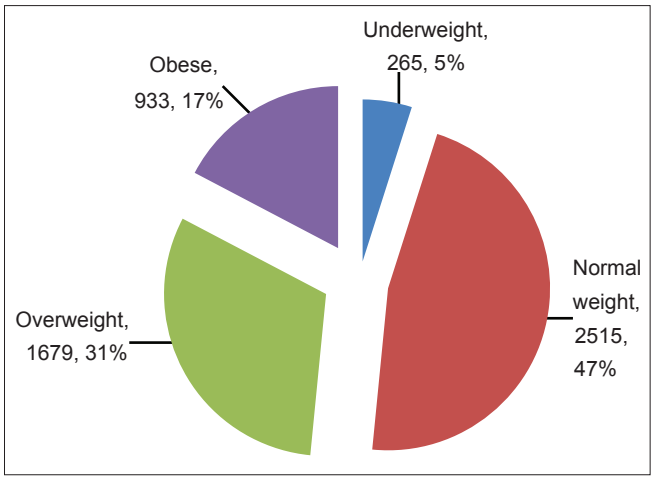

Figure 1: Weight distribution among the participants

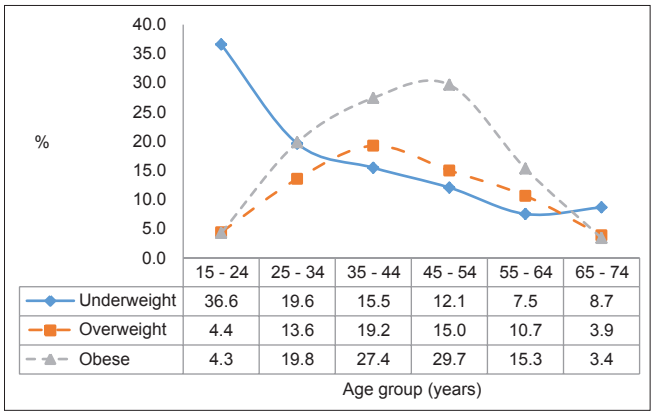

Figure 2: Pattern trend of the burden of underweight, overweight, and obesity among the participants by age groups (data table shows the percentages)

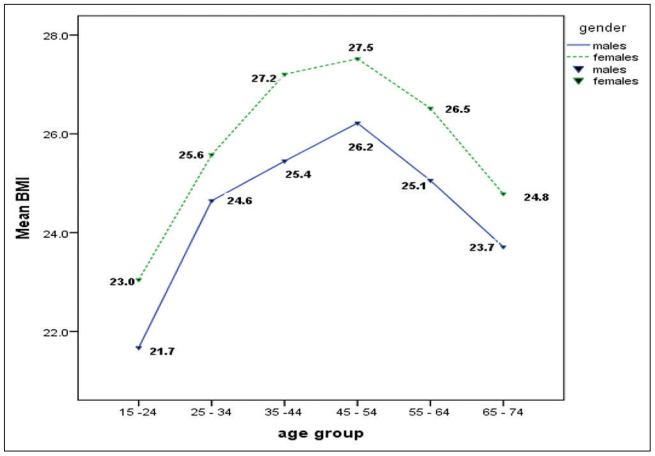

Figure 3: Means plots of body mass index (BMI) in male (F [5, 2391] = 61.2, P < 0.0001) and female (F [5, 2449] = 35.0, P < 0.0001) participants showing the peak BMI at 45-54 years age brackets

Regional patterns and differences

The five zones were categorized into two regions namely Northern and Southern regions. 2432 (45.1%) participants belonged to the Northern region while 2960 (54.9%) belonged to the Southern region. Significant regional differences were noted in the prevalence of obesity (tested using Chi-square) and mean difference in the indices or clinical characteristics (using *t*-test). The burden and mean values were higher among participants from the Southern region [Tables 4 and 5].

Table 3: Risk of obesity with attainment of middle-age and hypertension

Characteristic	Obesity		OR (95% CI)	*P* value
	Yes	No		
Age ≥40 years				
Yes	1576	1212	2 (1.8-2.2)	<0.0001
No	1036	1568		
Hypertension				
Yes	1309	881	2.2 (1.9-2.4)	<0.0001
No	1303	1899		

OR=Odds ratio; CI=Confidence interval

Table 4: Regional differences in prevalence of obesity

Characteristic	Frequency (*n* (% within region))		Test statistic χ^2 value (df)	*P* value
	Northern zones (*n*=2432)	Southern zones (*n*=2960)		
Generalized obesity (BMI)	297 (12.2)	634 (21.4)	79.2 (1)	<0.0001
Central obesity (IDF)	840 (34.5)	1648 (55.7)	240 (1)	<0.0001
Central obesity (NCEP)	469 (19.3)	1060 (35.8)	179.4 (1)	<0.0001
Hypertension	987 (40.6)	1203 (40.6)	0.002 (1)	0.978

BMI=Body mass index; IDF=International diabetes federation; NCEP=National cholesterol education program

Table 5: Mean differences in clinical characteristics of the participants distributed by zones

Clinical characteristics	Mean (SD)			*P* value
	Northern zones (*n*=2432)	Southern zones (*n*=2960)	Mean difference (95% CI)	
Age (years)	37.1 (14.3)	43.5 (13.6)	−6.4 (−7.1-−5.6)	<0.0001
Height (m)	1.67 (0.08)	1.66 (0.09)	0.01 (0.005-0.014)	<0.0001
Weight (kg)	67 (14.6)	72.2 (15.1)	−5.2 (−6.1-−4.5)	<0.0001
WC (cm)	83.4 (12.7)	88.8 (12.2)	−5.4 (−6.1-−4.5)	<0.0001
Hip circumference (cm)	93.7 (11.6)	98.8 (11.2)	−5.1 (−5.7-−4.4)	<0.0001
SBP (mmHg)	130.1 (20.5)	130.5 (21.6)	−0.41 (−1.5-0.7)	0.48
DBP (mmHg)	83 (12.9)	81 (13.3)	2 (1.7-3.1)	<0.0001
BMI (kg/m^2)	24.1 (4.9)	26.3 (5.1)	−2.2 (−2.5-−1.9)	<0.0001
WHR	0.89 (0.1)	0.9 (0.1)	−0.01 (−0.02-−0.01)	<0.0001

WC=Waist circumference; SBP=Systolic blood pressure; DBP=Diastolic blood pressure; BMI=Body mass index; WHR=Waist-to-hip ratio; CI=Confidence interval; SD=Standard deviation

Discussion

Globally, the prevalence of obesity has been reported to range from as low as 0.6% among males in Gambia to as high as 80.2% in Nauru, while among females, obesity ranged from 0.2% in Ethiopia to 78.6% in Nauru.[17] The prevalence of obesity found in our study (17.2%) is higher than the 9.8% and 4.2% reported by Desalu *et al.*[18] and Puepet *et al.*[19] from Ilorin and Jos respectively, but lower than the 19.2% reported from Dar es Salaam in Tanzania.[20] The overall prevalence of obesity in our study is also lower than that reported from developed and high income countries such as Australia[21] and the USA.[22] The high rate of consumption of energy dense high calorie diet coupled with low levels of physical activity in these countries could be responsible for the higher prevalence of obesity. These habits in some cultures are associated with high socioeconomic status where they may reflect affluence or high standards of living. It was clearly demonstrated in urban Cameroon that socioeconomic status was positively associated with adiposity.[23] In general, adoption of western lifestyles by developing nations, which is one of the negative impacts of urbanization could therefore contribute to the higher prevalence values as similarly observed in this study when compared to the studies by Desalu *et al.*[18] and Puepet *et al.*[19] which were done some years back. The observation that almost half of our studied population (48.3%) is either overweight/obese is in support of the rising epidemic of both overweight and obesity in our developing Nigeria. Rural-urban migration and the adoption of western lifestyle have become recognized as the two most popular theories for the rising trend in the prevalence of overweight and obesity in developing countries.[24] Both urbanization and westernization are associated with decreased physical activity and increased food supply, including access to high calorie energy dense food and sugar sweetened beverages.

In this study, we found the prevalence of both overweight and obesity to be higher among women compared with men. Similar findings have been reported from previous studies.[25,26] It is known that women usually do enjoy some cardiovascular protection before menopause as a result of the activities of estrogens. This protection is lost during and after menopause and one of the outcomes of this physiologic change is weight gain and decrease in basal metabolism.[27] Apart from genetic and hormonal differences, low levels of physical activity in women is also thought to contribute to the observed gender differences.[26] Amole *et al.*[9] demonstrated a significantly higher prevalence of physical inactivity among Nigerian females than males at Ogbomosho, Nigeria. In addition, it is well-documented that in some cultures there is the social desire for fat women, hence practices that encourage female obesity are also observed in such cultures.[28] A good example is the premarital "fattening rooms" prevalent in the South-South geopolitical zone of Nigeria among the

Annang people.[28] Besides the cultural practices, which tend toward female seclusion which is practiced widely in the north as acknowledged by Bakari *et al.*[5] and in some places in the south,[28] Wahab *et al.*[29] reported female sex as a significant predictor of high prevalence of obesity in northern Nigeria.

The prevalence of overweight and obesity in the index study was found to increase with age in both men and women. Participants within the middle age bracket had the highest prevalence of obesity. Other studies have reported similar observations.[30-32] The increased rate of obesity with age has been attributed to decreased physical activity and metabolism that accompanies aging.[33-35] We however noted a decline in obesity rates after the age of 55 years with the lowest prevalence in the 65-74 years age group. Puoane *et al.*[26] in a study of obesity in 13,089 South African men and women also reported similar findings. The reason for this observation is not quite clear, but it is possible that debility especially at the upper extreme of age could largely affect the turnout of such elderly people and hence the proportion of such participants available for recruitment. Underweight was detected in 5% of our studied participants and its prevalence was highest in the 15-24 years age group. This implies that these participants are not only undernourished but may actually be stunted. Stunting can occur if an individual is affected by chronic infection like tuberculosis, which develops on a background of nutritionally-induced immunosuppression. Stunting in adolescence has been linked with future development of overweight and obesity in adulthood.[36]

Significant regional differences in both prevalence and mean indices of obesity existed between the northern and southern regions with higher indices seen in southern regions. Several reasons such as the slender and taller stature of northerners, occupational differences such as the nomadic lifestyle of the northerners, which in turn impacts on level of physical activity, cultural attitudes to affluence and desire for weight gain, especially among the females for marital purposes[28] could all contribute to these observed differences.

Conclusion

The prevalence of obesity in Nigeria is high especially among urban dwelling, middle aged women consistent with the observations in other developing countries. Regional differences in prevalence with higher values among the participants from southern zones were observed too. With the demographic and nutritional transition going on in major cities across Nigeria, unless concerted efforts are made to enlighten the populace on the role of lifestyle changes in combating obesity and its associated health risks, we may begin to experience progressive increase in the burden of obesity in the years to come. Adolescents and young adults in our society also deserve attention since undernutrition in this age group is associated with increased morbidity and may add to the burden of obesity in later years. Our findings will go a long way in assisting health policy makers and other stakeholders in coming up with strategies aimed at reducing the burden of obesity in the country. Further studies are needed to determine the predictors of underweight, overweight, and obesity among Nigerians living in urban areas.

References

1. World Health Organization Expert Committee: Physical Status; the Use and Interpretation of Anthropometry. Report of a WHO Expert Committee. Technical Report Series 854. Geneva: WHO; 1995.
2. McLaren L. Socioeconomic status and obesity. Epidemiol Rev 2007;29:29-48.
3. Drewnowski A, Specter SE. Poverty and obesity: The role of energy density and energy costs. Am J Clin Nutr 2004;79:6-16.
4. Sola AO, Steven AO, Kayode JA, Olayinka AO. Underweight, overweight and obesity in adults Nigerians living in rural and urban communities of Benue State. Ann Afr Med 2011;10:139-43.
5. Bakari AG, Onyemelukwe GC, Sani BG, Aliyu IS, Hassan SS, Aliyu TM. Obesity, overweight and underweight in suburban northern Nigeria. Int J Diabetes Metab 2007;15:68-9.
6. Patel M, Patel IM, Patel YM, Rathi SK. A hospital-based observational study of type 2 diabetic subjects from Gujarat, India. J Health Popul Nutr 2011;29:265-72.
7. Akintunde AA, Akinwusi PO, Adebayo RA, Ogunyemi S, Opadijo OG. Burden of obesity in essential hypertension: Pattern and prevalence. Niger J Clin Pract 2010;13:399-402.
8. Ulasi II, Ijoma CK, Onodugo OD. A community-based study of hypertension and cardio-metabolic syndrome in semi-urban and rural communities in Nigeria. BMC Health Serv Res 2010 19;10:71.
9. Amole IO, OlaOlorun AD, Odeigah LO, Adesina SA. The prevalence of abdominal obesity and hypertension amongst adults in Ogbomosho, Nigeria. Afr J Prim Health Care Fam Med 2011;3 (1), Art. #188, 5 pages. doi: 10.4102/phcfm.V3i1.188. [Last accessed 2014 Apr 28].
10. World Health Organization. WHO STEPwise approach to chronic disease risk factor surveillance-Instrument v2.0. Department of Chronic Diseases and Health Promotion. 20 Avenue Appia, 1211 Geneva 27, Switzerland: World Health Organization. Available from: http://www.who.int/chp/steps. [Last accessed on 2006 Mar 31].
11. WHO: "BMI Classifications". Global database on body mass index. Available from: http://www.who.int/bmi/index.jsp?introPage=intro_3.html. [Last accessed on 2014 Apr 28].
12. World Health Organization. Obesity: Preventing and Managing the Global Epidemic. Report of a WHO Consultation on Obesity. WHO Technical Report Series 894. Geneva, Switzerland: World Health Organization; 2000.
13. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. The Final Report of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel On Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). National Cholesterol Education Program. Bethesda, Maryland, U.S.A. National Heart, Lung, and Blood Institute, National Institutes of Health. NIH Publication No. 02-5215; 2002.
14. International Diabetes Federation. The IDF Consensus Worldwide Definition of the Metabolic Syndrome. Brussels: IDF, 2006. Available from: http://www.idf.org/webdata/docs/IDF_meta_def_final.pdf. [Last accessed on 2014 Apr 28].
15. National High Blood Pressure Education Program. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure. Bethesda, Maryland, U.S.A. U. S. Department of Health and Human Services, National Institute of Health, National Heart Lung, and Blood Institute. NIH Publication No. 03-5233; 2003.
16. "Middle age" Merriam-Webstar.com, 2014. Available from: http://www.meeriam-webster.com/medical/middle+age. [Last accessed on 2014 May 02].
17. Krauss RM, Winston M, Fletcher BJ, Grundy SM. Obesity: Impact on cardiovascular disease Circulation 1998;98:1472-6.

18. Desalu OO, Salami AK, Oluboyo PO, Olarinoye JK. Prevalence and socio-demographic determinants of obesity among adults in an urban Nigerian population. Sahel Med J 2008;11:61-4.
19. Puepet FH, Zoakah AJ, Chuhwak EK. Prevalence of overweight and obesity among urban Nigerian adults in Jos. Highland Med Res J 2002;1:13-1.
20. Shayo GA, Mugusi FM. Prevalence of obesity and associated risk factors among adults in Kinondoni municipal district, Dar es Salaam Tanzania. BMC Public Health 2011 23;11:365.
21. The Australian and New Zealand Obesity Society. Obesity prevalence in several countries worldwide, c2012. Available from: http://.www.asso.org.au/home/obesityinfo/stats/worlwide. [Last accessed on 2013 Oct 20].
22. Flegal KM, Carroll MD, Ogden CL, Curtin LR. Prevalence and trends in obesity among US adults, 1999-2008. JAMA 2010;303:235-41.
23. Fezeu L, Minkoulou E, Balkau B, Kengne AP, Awah P, Unwin N, *et al.* Association between socioeconomic status and adiposity in urban Cameroon. Int J Epidemiol 2006;35:105-11.
24. Duda RB, Dark R, Seffah J, Adanu RM, Anarfi JK, Hill AG. Prevalence of obesity in women of Accra, Ghana. Afr J Health Sci 2007;14:154-9.
25. Gezawa ID, Puepet FH, Mubi BM, Uloko AE, Bakki B, Talle MA, *et al.* Prevalence of overweight and obesity in Maiduguri, North-Eastern Nigeria. Niger J Med 2013;22:171-4.
26. Puoane T, Steyn K, Bradshaw D, Laubscher R, Fourie J, Lambert V, *et al.* Obesity in South Africa: The South African demographic and health survey. Obes Res 2002;10:1038-48.
27. Handgraaf S, Riant E, Fabre A, Waget A, Burcelin R, Lière P, *et al.* Prevention of obesity and insulin resistance by estrogens requires ERa activation function-2 (ERaAF-2), whereas ERaAF-1 is dispensable. Diabetes 2013;62:4098-108.
28. Brink PJ. The fattening room among the Annang of Nigeria. Med Anthropol 1989; 12: 131-43.
29. Wahab KW, Sani MU, Yusuf BO, Gbadamosi M, Gbadamosi A, Yandutse MI. Prevalence and determinants of obesity – A cross-sectional study of an adult Northern Nigerian population. Int Arch Med 2011;4:10.
30. Nyaruhucha CN, Achen JH, Msuya JM, Shayo NB, Kulwa KB. Prevalence and awareness of obesity among people of different age groups in educational institutions in Morogoro, Tanzania. East Afr Med J 2003;80:68-72.
31. Hajian-Tilaki KO, Heidari B. Prevalence of obesity, central obesity and the associated factors in urban population aged 20-70 years, in the north of Iran: A population-based study and regression approach. Obes Rev 2007;8:3-10.
32. Vijayakumar K, Varghese RT. Prevalence and pattern of obesity across different age groups in a rural setting in Kerala. Calicut Med J 2008;6:e3.
33. Erem C, Arslan C, Hacihasanoglu A, Deger O, Topbas M, Ukinc K, *et al.* Prevalence of obesity and associated risk factors in a Turkish population (trabzon city, Turkey). Obes Res 2004;12:1117-27.
34. Stene LC, Giacaman R, Abdul-Rahim H, Husseini A, Norum KR, Holmboe-Ottesen G. Obesity and associated factors in a Palestinian West Bank village population. Eur J Clin Nutr 2001;55:805-11.
35. World Health Organization. Obesity: Preventing and Managing the Global Epidemic. Report of a WHO Consultation on Obesity. Geneva, Switzerland: World Health Organization; 1998.
36. Schroeder DG, Martorell R, Flores R. Infant and child growth and fatness and fat distribution in Guatemalan adults. Am J Epidemiol 1999;149:177-85.

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