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Contents

Original Articles

PREVALENCE OF OBESITY AND ETHNO-GEOGRAPHIC VARIATION IN BODY SIZES OF NIGERIANS WITH TYPE 2 DIABETES MELLITUS - A MULTI-CENTRE STUDY

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ABSTRACT

BACKGROUND: Excess weight gain is common in people with type 2 diabetes mellitus (DM) but little is known about its ethno-geographic variation among the Nigerian populace. We aimed to report the prevalence and regional variation of overweight/obesity among subjects with type 2 DM in all the six geo-political regions of Nigeria.

METHOD: Basic demographic and anthropometric data were consecutively collected from patients with type 2 DM attending out-patient clinics of seven designated teaching hospitals in the six geographic regions of the country using a pre-agreed method of measurement of anthropometry including waist circumference. The study was hospital-based descriptive cross-sectional in design. Body Mass Index (BMI) was categorised using the WHO criteria. Based on recommendations of the International Diabetes Federation (IDF) cut-off values for waist circumference, values >94 cm and > 80 cm were taken as abnormal for men and women respectively.

RESULTS: A total of 709 subjects with DM comprising 378 (53.3%) females and 331 (46.7%) males (female: male ratio 1:1.14) with an overall mean age (SD) of 51.9 (13.9) years were evaluated. The prevalence of excess body weight among Nigerian subjects with type 2 DM was: peripheral (417 or 58.8%) and abdominal obesity (449 or 63.3%). Also, there was a significant wide variation in excess weight gain (both peripheral and central) across ethno-geographic regions (p=0.001) and between both sexes (p=0.001). In both peripheral and abdominal obesities, whether intra or inter centres, the female subjects with type 2 DM demonstrated relatively higher proportions of anthropometric measures. Generally, subjects from south-south and south-east Nigeria had higher BMI and abdominal obesity compared to those from south-west who had the lowest. The female subjects with type 2 DM were heavier peripherally and centrally compared to their male counterparts.

CONCLUSION: The prevalence of peripheral and central obesity among Nigerians living with type 2 DM (especially the female subjects) is unacceptably high. Additionally, there is a wide variation in the proportion and absolute values of both peripheral and central obesity across different parts of Nigeria.

KEY WORDS: Obesity, Prevalence, Ethno-Geographic Variation, Nigerians, Type 2 Diabetes Mellitus

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INTRODUCTION

The burden of obesity is high in both developed and developing nations.[1] Obesity is a common occurrence in people living with type 2 diabetes mellitus (T2DM) and prevalence varies across regions, races and ethnicities.[2] A global systematic review reported obesity rates of more than 50% among subjects with T2DM.[3] Obesity is both a major risk factor for the development of T2DM, as well as a compounding risk for cardiovascular events in those with existing diabetes. Each 5kg/m^2 gain in weight above 25kg/m^2 is associated with over 30% increase in overall mortality.[4] Studies also showed that each 1 kg body weight gain results in 3% and 6% increased risk of heart failure or coronary heart disease in men and women respectively.[5] Weight loss in patients with diabetes improves glycaemic control by enhancing insulin sensitivity and consequent reduction in late vascular diabetic complications.[6] In spite of the severe consequences of excess weight gain in people with T2DM, there is limited data on the magnitude of the problem especially in Africa.

Nigeria is a multi-ethnic nation. Over 300 tribes exist in the country under six geo-political locations based on shared culture,

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ethnicity and common ancestries. A systematic review reported that the prevalence of overweight individuals ranged from 20.3%–35.1%, while the prevalence of obesity ranged from 8.1%–22.2%.[7] One study involving non-diabetic and non-hypertensive Nigerians across five of the six geo-political zones reported an overall obesity prevalence of 17%.[8] To the best of our knowledge, there are no studies on prevalence of obesity with national representative sample in subjects living with T2DM in different regions of Nigeria. We hypothesise that the prevalence of overweight and obesity among persons with T2DM may vary across the different geo-political regions of Nigeria. For example, the prevalence of overweight/obesity in Lagos and Ilorin, two cities in the South West and North Central regions of Nigeria were 18.6% and 66.8% respectively.[9,10]

In this study, we aimed to report the prevalence and regional variation of overweight/obesity among subjects with type 2 diabetes mellitus in all the six geo-political regions of Nigeria.

METHOD

A technical team was constituted from among the members of the American Association of Clinical Endocrinologists (AACE), Nigerian Chapter, with members across each of the six geo-political zones. Their objective was to recruit type 2 diabetes subjects from all the six geopolitical zones and collect basic data including demographics and anthropometric measurements, based on pre-agreed criteria. The study was hospital-based descriptive cross-sectional in design. The AACE Nigeria has members in 19 centres spread all over the six geo-political zones of Nigeria. The committee discussed and reached a consensus on the variables for which data should be furnished as well as the methods by which anthropometry measures should be carried out. Subjects with clinical type 2 diabetes should have been diagnosed based on WHO criteria.[11] To be included in the study, T2DM duration must be at least six months from the time of diagnosis regardless of treatment type. Weight was measured using a digital weighing scale on a horizontal surface with patient wearing only light clothing, without footwear, and recorded to the nearest 0.1 kilogram (Kg). Height was measured using a stadiometer with patients standing erect on a flat surface and without headgear or footwear and recorded to the nearest 0.1 meter (m). Body Mass Index (BMI) was calculated using the Quetelet's index[12] as a ratio of weight to the square of the height and recorded in kilogram per square meter (Kg/m2). Waist circumference was measured to the nearest 0.1 cm using a flexible non-stretchable measuring tape at the level of umbilicus at the end of a normal expiration with the tape parallel to the floor. Other data requested were age, sex, systolic and diastolic blood pressure.

BMI was categorised based on WHO criteria[13] :18 – 24.9kg/m^2 = Normal; 25 –29.9kg/m^2 = Overweight; and ≥30 = Obesity. Based on recommendations of the International Diabetes Federation (IDF) on cut-off values for waist circumference,[14] values >94 cm and > 80 cm were taken as abnormal for men and women respectively.

Data analysis: Data was captured on Excel spreadsheet transferred into and analysed on SPSS version 20. Categorical variables were summarised as frequencies/percentages and analysed with Chi Square. Comparisons of quantitative variables were made with One Way ANOVA. Significant level was taken as $p<0.05$.

RESULTS

A total of 709 subjects with type 2 diabetes comprising 331 (46.7%) males and 378 (53.3%) females with an overall mean age (SD) of 51.9 (13.9) years. The mean (SD) BMI was 26.6 (5.2) with Calabar and Enugu having the highest mean BMI and Lagos and Ibadan having the lowest mean BMI. The mean (SD) waist circumference for males and females were

90.2 (13.1) and 92.5 (14.1) respectively. Ilorin men and Maiduguri women respectively had the highest waist circumferences compared to males and females in other regions (table 1).

Table 1: Characteristics of study population

	All	Calabar	Enugu	Ibadan	Lagos	Kano	Ilorin	Maiduguri
Age-yrs (SD)	51.9(13.9)	54.6(11.9)	56.6(12.9)	61.7(10.0)	38.5(12.8)	48.2(14.7)	50.7(11.4)	46.1(11.3)
Sex: n (%) M	331(46.7)	47(47.5)	31(39.2)	66(44.6)	36(50.7)	46(46.0)	58(55.8)	47(43.5)
F	378 (53.3)	52(52.5)	48(60.8)	82(55.4)	35(49.3)	54(54.0)	46(44.2)	61(56.5)
BMI: n (SD)	26.6 (5.2)	28.8(5.6)	27.5(5.6)	25.8(4.2)	24.3(3.9)	26.6(4.8)	27.0(5.6)	26.0(5.6)
WC: M	90.2(13.1)	93.9(11.1)	89.8(11.9)	90.2(11.5)	80.9(9.3)	86.8(12.2)	96.0(16.4)	90.6(12.4)
F	92.5(14.1)	93.6(9.1)	94.8(12.8)	92.8(11.2)	82.7(9.8)	91.1(9.8)	92.4(21.9)	96.2(17.6)

N (SD)- mean (standard deviation); M- Male; F- Female n (%)- frequency (%)
BMI- Body Mass Index; WC- Waist Circumference

As shown in table 1, analysing with One-Way ANOVA showed a significant between-groups variation in the mean BMI across ethno-geographic centres (Range= 24.3 – 28.8; F= 6.92; p= 0.001). For men, the range of One-Way ANOVA analysis was 80.9 – 96.2; (F= 6.67; p= 0.001). Similarly for women, there was a significant between groups variation; range=82.7 – 96.2; (f = 4.05; p = 0.001).

Comparing the different age groups (table 2), overweight and obesity were commonest in subjects with age between 51-64 years and least in those 30 years or less.

Table 2: Relationship between age categories and bmi class

Age group	BMI Categories			Total
	Normal	Overweight	Obese	
30 years or less	46 (15.9)	4 (2.4)	12 (4.7)	62 (8.8)
31 – 40 years	34 (11.7)	31 (18.9)	32 (12.6)	97 (13.7)
41 – 50 years	65 (22.4)	39 (23.8)	59 (23.3)	163 (23.1)
51 – 64 years	96 (33.1)	65 (39.6)	88 (34.8)	249 (35.2)
65 years & above	49 (16.9)	25 (15.2)	62 (24.5)	136 (19.2)
Total	**290 (100)**	**164 (100)**	**253 (100)**	**707 (100)**

Chi-Square = 40.29; df = 8; p = 0.001

The overall prevalence of peripheral obesity among subjects with DM was 164(23.1%), while the prevalence of excess body weight (overweight plus obesity) was 417(58.7%). Obesity was significantly higher in females than males 120(31.7%) versus 44(13.3), p = 0.001}. Similarly, excess body weight was significantly higher among females 260 (68.7%) than males 175(47.4%). Calabar (South-South), followed by Ilorin (North-Central) and Enugu (South-East) had the highest prevalence of peripheral obesity while Lagos and Ibadan, both in south-west Nigeria had the lowest figures.

The overall prevalence of abdominal obesity among subjects with DM was 124(37.5%) for males and 325(86.0%) for females, while prevalence for both sexes was 449(or 63.3%). Male subjects in Calabar, followed by Ilorin and Enugu had the highest prevalence of abdominal obesity, while Lagos and Kano (north-west Nigeria) had the lowest. In the case of females, Calabar women again had the highest prevalence of visceral obesity.

The details are displayed in tables 3, 4 and 5.

Table 3: Characteristics of study population

Centre	Males	Females	Both Sexes	*P*
All	44 (13.3)	120 (31.7)	164 (23.1)	0.001*
Calabar	13 (27.7)	25 (48.1)	38 (38.4)	0.110
Enugu	2 (6.5)	20 (41.7)	22 (27.8)	0.001*
Ibadan	5 (7.6)	17 (20.7)	22 (14.9)	0.008*
Lagos	1 (2.8)	3 (8.6)	4 (5.6)	0.167
Kano	5 (10.9)	16 (29.6)	21 (21.0)	0.054
Ilorin	14 (24.1)	15 (32.6)	29 (27.9)	0.079
Maiduguri	4 (8.5)	24 (39.3)	28 (25.9)	0.001*

*P = p-value; *Significant*

Table 4: Prevalence of excess body weight (overweight + obesity) according to centre

Centre	Males N (%)	Females N (%)	Both N (%)	P
All	157 (47.4)	260 (68.5)	417 (58.8)	0.001*
Calabar	32 (68.1)	40 (76.9)	72 (72.7)	0.324
Enugu	14 (45.2)	37 (77.1)	51 (64.6)	0.004*
Ibadan	27 (40.9)	53 (64.6)	80 (54.1)	0.004*
Lagos	12 (33.3)	19 (54.3)	31 (43.7)	0.075
Kano	23 (50.0)	37 (68.5)	60 (60.0)	0.086
Ilorin	29 (50.0)	33 (71.7)	62 (59.6)	0.025*
Maiduguri	20 (42.6)	40 (65.6)	28 (25.9)	0.017*

*P= p-value;*Significant*

Table 5: Prevalence of abdominal obesity according to centre

Centre	Males N (%)	Females N (%)	Both Sexes
All	124 (37.5)	325 (86.0)	449 (63.3)
Calabar	23 (48.9)	48 (92.3)	71 (69.6)
Enugu	13 (41.9)	43 (89.6)	56 (70.9)
Ibadan	25 (37.9)	71 (86.6)	96 (64.9)
Lagos	2 (5.6)	23 (65.7)	25 (35.2)
Kano	13 (28.3)	49 (90.7)	62 (62.0)
Ilorin	28 (48.3)	36 (78.3)	64 (61.5)
Maiduguri	20 (42.6)	55 (90.2)	75 (69.4)

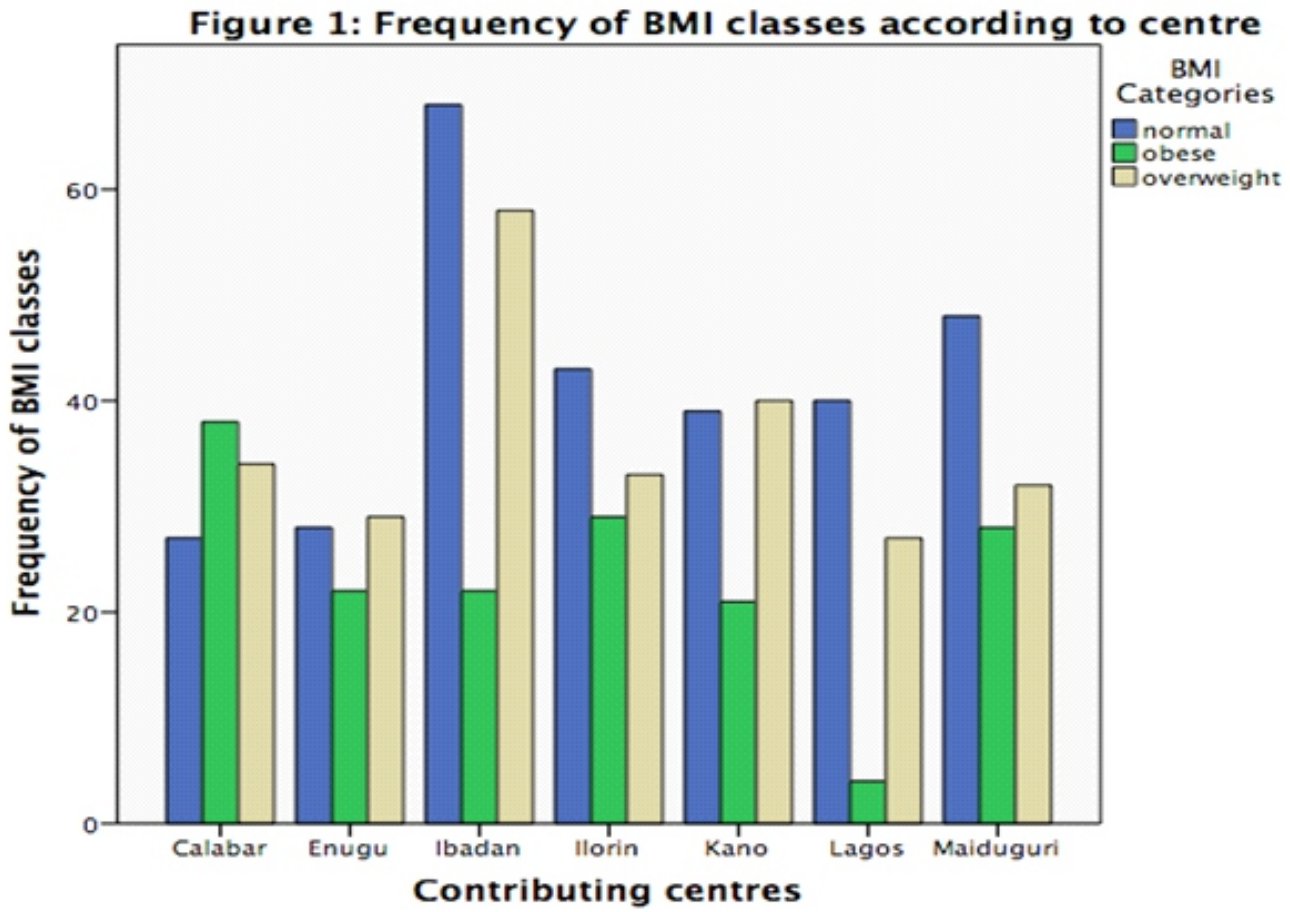

Figure 1: Frequency of BMI classes according to centre

DISCUSSION

Overweight or obesity is one of the phenotypic characteristics of persons with type 2 diabetes. Even after diagnosis, excess weight accumulation in subjects with type 2 diabetes is still of concern to clinicians. It has been reported that every 5 units weight gain in patients with type 2 diabetes results in risk of coronary heart disease, stroke, cardiovascular disease and total mortality of 15%, 11%, 7% and 2% respectively.[15] Insulin resistance, either directly or through worsening glycaemic control is widely believed to underlie the association between excess weight and diabetes on one hand, and increased risk for cardiovascular morbidity and mortality on the other hand.[16,17] This study has confirmed the high prevalence of excess body weight - peripheral (417 or 58.8%) and abdominal obesity (449 or 63.3%) among Nigerian subjects with type 2 DM. Also, there was a significant wide variation in excess body weight (both peripheral and central) across ethno-geographic regions and between both sexes. Additionally, in both peripheral and abdominal obesities, whether in the same centre or between centres, the female subjects with type 2 DM demonstrated relatively higher proportions of anthropometric measures. These female subjects were heavier peripherally and abdominally compared to their male counterparts. Generally, subjects with DM from Calabar and Enugu had higher BMI and abdominal obesity while those in Ibadan and Lagos had the lowest.

To the best of our knowledge, this is the first description of regional differences and variations in excess body weight among Nigerians living with diabetes from representative centres across all the six geo-political zones of Nigeria. Nigeria is the most populous country in Africa and arguably harbours one of the largest number of people living with diabetes in the continent.[18] With a

highly diversified demography, socioeconomic status and culture, data such as provided by our study is needed to inform judicious distribution of inadequate resources for effective management and prevention of diabetes. For a resource-poor country like Nigeria, secondary prevention of cardiovascular complications and mortality is crucial. Globally there is a paucity of studies showing spatial country-wide distribution of the magnitude of a key risk factor of morbidity and mortality in people being managed for T2DM such as obesity. This study has attempted to show the spatial heterogeneous distribution of obesity among subjects with T2DM in all the six ethno-geographic zones of Nigeria.

The Diabcare Project [19], a cross-sectional study involving 518 diabetic subjects attending tertiary health centres in Nigeria reported higher prevalences of abdominal obesity in males and females (43.3% and 91.2% respectively) compared to present study. Although the mean BMI of persons with DM as provided by the Diabcare Nigeria study was 27.2±5.4kg/m^2, there was no detailed report on the prevalence of peripheral obesity across seven tertiary health centres spread across the six geopolitical zones of the country. The high prevalence rates of both peripheral and central obesity are consistent with global findings. Peripheral obesity rates among T2D subjects were well above 30% in most countries of the world. Reports of previous isolated local studies from different parts of Nigeria also support the observation that overweight /obesity is common in T2D subjects[9, 10, 18]. Among 211 newly diagnosed T2D patients from Enugu, South-Eastern Nigeria, Olebu et al[20] reported prevalence rates of 58.29% and 56.4% for overweight and obesity respectively.[20] In another hospital-based study from Lagos, South Western Nigeria, Fasanmade et al[9] reported prevalences of 39.9% and 18.6 % respectively of overweight and obesity among 258 patients with T2D attending the diabetes clinic in Lagos University Teaching Hospital. Similar findings from the Middle Belt or North Central Nigeria among 315 patients in a teaching hospital at Ilorin were 30.2% and 36.6% for overweight and obesity respectively. Puepet et al[21] from Jos, also in the middle belt of Nigeria reported prevalences of overweight and obesity among 634 T2D subjects as 49.1% and 41.4% respectively[2], much lower than corresponding findings in our study. Consistent with our findings, all these local studies supported the observation that the female participants had higher mean BMI and prevalences of excess weight gain compared to the male subjects. In the study by Fasanmade et al[9], there was additional report of prevalences of waist circumference in both gender as 21.1% and 71.9% (male versus females), allowing comparison with similar findings in the present study of 37.5% and 86.0% (male versus females respectively).

The wide variation in the rates of obesity across the ethno-geographic zones could be genetic. Nigeria is composed of three dominant ethnic groups (the Hausa-Fulani, Yoruba and Igbo) and over 300 other smaller different tribes. Therefore, the significant wide disparities could be a reflection of dietary variations and the genetic diversity since this observation has also been reported among apparently healthy subjects in Nigeria.[8] Additionally in that study by Okafor and colleagues, the prevalences of both generalised and central obesities were significantly higher in the southern subjects than their northern counterparts, similar to our findings in the subjects living with diabetes. Differing cultural practices, beliefs and lifestyles expectedly vary among the different ethnic groups of Nigeria and could impact weight gain in the subjects, whether diabetic or not. As an example, there are places in the southern part of Nigeria where young women are deliberately fed high-energy dense calorie diet to 'fatten' them just before commencing married life. Furthermore, the huge differences and variation in socioeconomic status across Nigeria could be related to the observed variation in rates of obesity. Although outside

the objectives of our study, the relationship between socioeconomic status and weight distribution is well established. [20-24]

In a developing country like Nigeria, access to quality healthcare including counseling on lifestyle adjustment is generally poor but varies across the different regions of the country. The South, for instance has a relatively higher concentration of healthcare institutions and manpower than the north. Most participants in this study were already on glucose-lowering medications (data not shown in this study) some of which could have significantly contributed to weight gain. Sulphonylureas, thiazolidinediones and insulin are known to increase weight as a side effect.[23]

The finding of higher prevalence rate of obesity in women compared to men is consistent with what is known and established globally. Women have a tendency to gain weight due to hormonal changes that occur around menopause and conception.[13] With a mean age of 46.7 years, many of the female participants in our study were likely to be at the peri-menopausal stage in life. Additionally, women are less physically active than men.[24] Widespread practice of female seclusion occurs mostly in the Northern part of Nigeria[25] further promoting physical inactivity. Wahab et al[26] found that being female was a significant predictor of obesity in the northern part of Nigeria. In our study, women from the northeast, northwest and north central had higher prevalence rates of both peripheral and central obesity.

The prevalence rates of overweight and obesity increased with age up to 64 years and then decreased in our study. This finding is similar to other reports.[27-28] Plausible reasons for the increased rate of obesity with aging include decreased physical activity and body metabolism. On the other hand, weight loss ensues in the elderly as a result of the reversed physiological process occasioned by early satiation due to early antral filling.[29] The levels of cholecystokinin and leptin, which play important roles in initiation of anorexia and decreased food intake respectively are reduced, while the activities of both opiate and Neuropeptide Y which mediate the central feeding drive decline.[30]

The strength of our study is that it was a multicenter coverage of all the regions in the country. Some of the observed limitations of this study include the relatively smaller sample size compared to the high prevalence of DM in Nigeria, the hospital-based nature and our inability to cover every single city in the country.

CONCLUSION

In conclusion, we have established that obesity is common among Nigerians living with diabetes with a higher tendency among females. Notably, there is a wide variation both in the proportion and mean values of both peripheral and central obesity among Nigerians living with diabetes across the ethno-geographical regions of the country. We recommend a more comprehensive nation-wide multi-centre population based evaluation of excess weight among Nigerians living with diabetes in view of the implications on mortality and morbidity in these subjects.

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