Prevalence of Generalized Obesity, Abdominal Obesity, Hypertension, and Type 2 Diabetes among Adults in Calabar Metropolis, Cross River State, Nigeria

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ABSTRACT

Background: *Developed and developing countries worldwide are witnessing high rates of obesity, which are generalized and abdominal obesity, along with related chronic disorders, particularly non-communicable diseases that lead to increasing morbidity and mortality. This study aimed to assess the prevalence of generalized obesity, abdominal obesity, hypertension, and type 2 diabetes (cardiovascular risk factors) among adults in Calabar Metropolis.*

Methods: *It was a cross-sectional study involving 500 randomly selected adults aged 20 to 70 years, utilizing a multistage sampling technique. The study adopted the WHO standard methods for data collection on non-communicable diseases. Data were analyzed using frequency, percentages, and chi-square, with significant differences recorded at $p<0.05$.*

Results: *The prevalence of generalized obesity was 24%, and overweight was 33%, while abdominal obesity was higher among females (39.3%) than males (20%). Respondents with known/diagnosed hypertension and diabetes were 26.6% and 5.2%, respectively. Significantly ($P<0.05$), more abdominally obese diabetic males (72.2%) were observed than abdominally obese diabetic females (62.5%), and more abdominally obese hypertensive males (56.9%) were recorded than abdominally obese hypertensive females (41.0%).*

Conclusions: *A high prevalence of obesity and hypertension was identified as public health problems in the study area. Therefore, nutritionists and dietitians in the metropolis should intensify efforts to provide the necessary professional and community services, including awareness creation on obesity and related non-communicable diseases. Such interventions as proper dietary counseling and routine follow-ups for individuals diagnosed with the prevailing conditions are strongly recommended.*

Keywords: Obesity, hypertension, diabetes, body mass index (BMI), prevalence

Doi: https://dx.doi.org/10.4314/njns.v45i2.3

INTRODUCTION

Both developed and developing nations worldwide are experiencing high rates of obesity, encompassing generalized and abdominal obesity, and related chronic disorders, particularly non-communicable diseases (NCDs), leading to increasing morbidity and mortality (1,2). It is documented that a significant proportion of the global population is grappling with the issues of generalized obesity

across all age groups, resulting in various NCDs (3). Globally, the prevalence of NCDs has become alarming in recent years, with high morbidity and mortality rates annually (4). Reports indicate that over 14 million individuals die prematurely between the ages of 30 and 70, with 48% of yearly deaths attributed to cardiovascular diseases (CVDs), 21% to cancers, 12% to chronic respiratory diseases, and 3.5% to diabetes (4). According to the World Obesity Federation, the health implications of overweight and obesity are substantial, resulting in a high cost of medical treatment for associated conditions, with projected treatment expenses reaching up to US$1.2 trillion annually by 2025 (5).

Literature suggests that 22.1% of the adult population worldwide has high blood pressure, with more males (24.1%) than females (20.1%) experiencing hypertension (6). Additionally, 13.1% of adults globally are reported to be obese, with a higher proportion of females (15.1%) than males (11.1%) being obese (6). Equally, 8.5% of adults are reported to be diabetic, with a slightly higher prevalence rate in men (9.0%) than in women (7.9%) (6). A Southern Chinese study documented overweight prevalence at 25.8% among the study population, with the prevalence of obesity at 7.9% and abdominal obesity at 10.2% (7). In the same study, generalized obesity was higher among urban dwellers (37.1%) than rural dwellers (30.2%) (7).

In Nigeria, varying prevalence reports on generalized obesity and overweight have been documented. For instance, Chukwuonye *et al.* (8) reported that the prevalence of overweight ranged from 20.3% to 35.1%, while obesity ranged from 8.1% to 22.2%, concluding that the prevalence of generalized obesity among adult Nigerians is high and requires serious attention. Similarly, generalized obesity and overweight were reported to be prevalent at 17% and 31%, respectively, among a population of adults (9). Conversely, Amole *et al.* (10) documented that the total prevalence of abdominal obesity among Ogbomoso adults was 33.8%, with 8.9% in men and 53.8% in women.

The World Health Organization documented that the fraction of the global population with hypertension has steadily risen in the past 40 years, particularly in developing nations of South Asia and sub-Saharan Africa, due to fast-growing and aging populations often witnessed in low- and middle-income countries (LMICs) (11). According to the International Diabetes Federation, one out of the global population is said to die every eight seconds due to diabetes and its complications, with the projection of more rising cases in the years to come (12). Approximately 10% (US$760 billion) of the global expenditure is allocated to diabetes (12). Moreover, the report notes that one out of two diabetic adults is yet to be diagnosed, two out of three diabetic individuals reside in urban areas, and three out of four individuals with diabetes are residents of LMICs (12). It was also recorded that the past 40 years have seen a rising prevalence of type 2 diabetes in almost every nation worldwide, with a rapid progression in LMICs compared to high-income nations (11).

In light of these existing reports, this study seeks to address a critical gap by assessing the prevalence of generalized obesity, abdominal obesity, hypertension, and type 2 diabetes among adults in Calabar Metropolis, Cross River State, Nigeria. This investigation is vital for developing targeted interventions and evidence-based strategies to address these pressing public health issues in this specific population.

MATERIALS AND METHODS

Design and Population of the Study

This study was a cross-sectional study that selected adult residents aged 20 to 70 years from the two local councils of the Metropolis, namely Calabar Municipality and Calabar South Local Government Areas. Individuals who were disabled, immobilized, pregnant, or breastfeeding were excluded from the study.

Sample Size Estimation and Sampling Technique

Estimation of the sample size was done with the use of the statistical formula put forward by Cochran, $n = [t^2 \times p\,(1\text{-}p)]/m^2$ as documented in Bartlette *et al.* (13) adopting the local report of the prevalence of obesity (17.0%) among urban Nigerians by Okafor *et al.* (9) setting the confidence level and precision at 95% and 5% respectively. Five hundred (500) persons participated in the study. The study adopted a multistage sampling procedure to select nine wards, four and five wards respectively from the two local governments that make up the Calabar Metropolis, which has a total of 22 wards, as described in figure 1 below. As equally detailed in Ide *et al.* (14), and with the use of a table of random numbers, a total of 360 households were selected from the nine wards, out of which 500 participants were sampled for the study.

Recruitment and Training of Research Assistants

Four students of Human Nutrition and Dietetics, trained in appropriate methods and guidelines for surveillance of Non-Communicable Diseases (NCDs) and associated risk factors, served as research assistants for data collection. The adapted WHO STEPwise Instrument for surveillance of NCDs

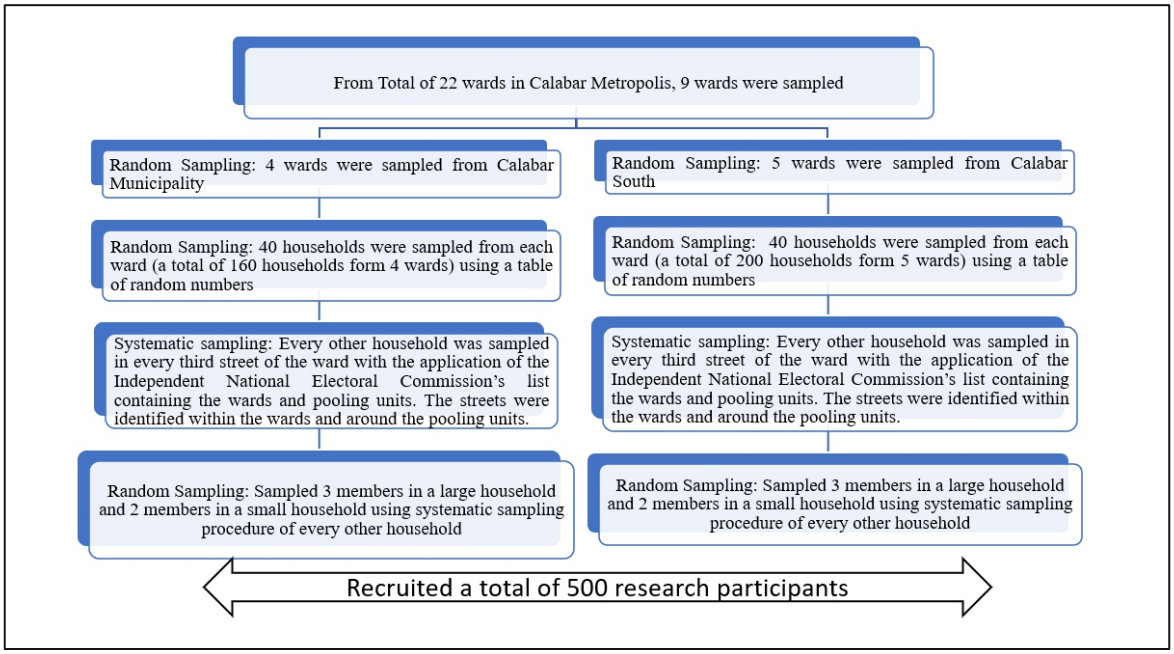

Fig. 1: Multistage sampling procedure used in recruitment of research participants

and associated risk factors was utilized (15).

Ethical Considerations

Ethical approval for the study was obtained from the Health Research Ethics Committee of the University of Calabar Teaching Hospital, Calabar (Ethical Approval Number: UCTH/HREC/33/568). All necessary ethical procedures were meticulously followed throughout the study. Participants were provided with written consent forms outlining the data collection procedures, which they accepted before the assessment. Participants' data were treated with utmost confidentiality, adhering to biomedical ethics.

Anthropometric Assessments

Participants' weight was measured using digital weighing equipment (HN289 Electronic Scale produced by OMRON HEALTHCARE Co., Ltd., Muko, Kyoto, Japan). Two repeated readings were obtained, and the average figure was recorded. Height was measured with a stadiometer, and readings were noted to the nearest 0.1cm, following standard protocols (16). Waist and hip circumference measurements adhered to WHO recommendations, utilizing non-elastic tapes (17). All the anthropometric measurements followed their respective standard procedures.

Blood Glucose Measurement

Blood glucose levels were estimated by measuring random blood glucose (RBG) using electronic glucose monitoring equipment (ACCU-CHEK Model by Roche, Mannheim, Germany). RBG was preferred over fasting blood glucose (FBG) in line with the method of Hendriks *et al.* (18), which described and utilized RBG as an immediate biochemical assay rather than FBG.

Blood Pressure Measurement

Blood pressure assessment was conducted using an electronic blood pressure (BP) apparatus (OMRON Big Cuff Model - OMRON-4, Omron Corporation, Tokyo, Japan), with systolic and diastolic blood pressure recorded following the standard procedures of assessment. First of all, the participants were prepared prior to the assessment by ensuring they did not smoke, nor exercised, nor consumed caffeinated drinks and alcohol about 30 minutes before the measurement was carried out. They rested for at least five minutes with empty bladder, sitting calmly and upright with the back straight and supported, keeping legs not crossed with the feet flat on the floor; the arm on which the measurement was done was well supported at the heart level; not talking during the assessment, while the bottom of the cuff was placed above the bend of the elbow and gently wrapped against the bare skin, not over clothing (19). Three consecutive readings of the blood pressure of each participant were taken and the average value recorded according to the WHO Stepwise recommendation for NCDs risk factors assessment (15).

Data Analysis

The body mass index (BMI) was calculated according to WHO guidelines using the ratio formular of height in square metres all over weight in kilogram for each participant, approximated to two decimal places in kg/m^2, with the BMI of ≥30 kg/m^2 defined as obesity and 25 – 29.9 kg/m^2 as overweight as documented in Ide *et al*. (14). Obesity and overweight classifications followed the WHO standard classification as described in the previous study (14), while waist circumference (WC) and waist–hip ratio (WHR) were interpreted based on WHO recommendations (17). The WC readings of above 102 cm for men and above 88 cm for women referring to abdominal obesity as previously documented, further categorized in comparison with the WHR calculations of greater than 0.90 for males and greater than 0.85 for females according to the WHO (17) in (14).

Hypertension was defined as an average systolic blood pressure (SBP) of greater or equal to 130 mmHg or diastolic blood pressure (DPB) of greater or equal to 80 mmHg, and/or the use of anti-hypertensive drugs (20). A record of 200mg/dl (11.1mmol/L) or more for RBG, as well as the personal report of the use of anti-diabetic drugs, was used to diagnose type 2 diabetes according to the WHO (21).

Data were analyzed using the Statistical Package for the Social Sciences, version 22.0. Descriptive and inferential statistics were employed, with statistical significance set at $p<0.05$. The data were considered alongside other local and global prevalence reports on obesity and NCDs.

RESULTS

General Characteristics of the Study Participants

Table 1 presents the general characteristics of the study participants. The proportion of the participants

Table 1: General characteristics of the study participants

Characteristics		Gender		Total N (100%)
		Male N (%)	Female N (%)	
Sex		230(46.0)	270(54.0)	500(100.0)
Age Bracket (Years)	20 – 39	152(66.1)	181(67.0)	333(66.6)
	40 – 59	61(26.5)	57(21.1)	118(23.6)
	60 and above	17(7.4)	32(11.9)	49(9.8)
	Total	**230(100.0)**	**270(100.0)**	**500(100.0)**
Academic Qualification	None	0(0)	4(1.5)	4(0.8)
	First School Leaving Certificate	16(7.0)	14(5.2)	30(6.0)
	Senior Secondary School Certificate	3(36.1)	132(48.9)	215(43.0)
	Diploma, NCE, TTC, NTI	7(3.0)	21(7.8)	28(5.6)
	HND, first degree	34(14.8)	63(23.3)	97(19.4)
	Postgraduate degree(s)	90(39.1)	36(13.3)	126(25.2)
	Total	**230(100.0)**	**270(100.0)**	**500(100.0)**
Marital Status	Single	113(49.1)	142(52.6)	255(51.0)
	Married	109(47.4)	115(42.6)	224(44.8)
	Separated	0(0)	6(2.2)	6(1.2)
	Divorced	0(0)	2(0.7)	2(0.4)
	Widowed	8(3.5)	5(1.9)	13(2.6)
	Total	**230(100.0)**	**270(100.0)**	**500.0(100.0)**
Religion	Christianity	227(98.7)	270(100.0)	497(99.4)
	Islam	3(1.3)	0(0)	3(0.6)
	Total	**230(100.0)**	**270(100.0)**	**500(100.0)**
Employment Status	Unemployed	54(23.5)	109(40.4)	163(32.6)
	Self-employed	73(31.7)	94(34.8)	167(33.4)
	Civil/public servant	91(41.3)	51(18.9)	146(29.2)
	Others	8(3.5)	16(5.9)	24(4.8)
	Total	**230(100.0)**	**270(100.0)**	**500(100.0)**
Monthly Income (₦)	Below 18,000	16(7.0)	26(9.6)	42(8.4)
	18,000 – 30,000	21(9.1)	11(4.1)	32(6.4)
	30,001 – 50,000	32(13.9)	27(10.0)	59(11.8)
	Above 50,000	80(34.8)	65(24.1)	145(29.0)
	Not applicable	77(33.5)	141(52.2)	218(43.6)
	Others	4(1.7)	0(0)	4(0.8)
	Total	**230(100.0)**	**270(100.0)**	**500(100.0)**

who had post-secondary educational qualifications (Diploma, NCE, TTC, NTI, HND, first degree and postgraduate degree(s)) was 251(50.2%) as previously reported (14), which was slightly more than half of the total study population. The proportion of the study participants who were in civil or public service were 146(29.2%) as against those who were either self-employed or unemployed 330(66.0%). The study population had more unemployed (40.4%) and self-employed (34.8%) female participants than the males, whereas more males (41.3%) than females (18.9%) were civil/public servants. A very large proportion of the participants 422(84.4%) earned more than ₦30,000 as monthly income compared with 74(14.8%) who earned ₦30,000 and less monthly.

Prevalence of Generalized Obesity in the Population

Figure 2 illustrates the prevalence of generalized obesity. The prevalence of generalized obesity in the study was 24.0%, while overweight was 33.0%, and underweight was 8.0%. Exactly 35.0% of the participants had an ideal BMI.

Prevalence of Abdominal Obesity, Hypertension, and Type 2 Diabetes in the Study Population

Table 2 presents the prevalence of abdominal obesity, hypertension, and type 2 diabetes in the study population. The WHR calculation indicated that 46.1% of men had a higher cardiovascular risk based on their high waist-hip ratio, while 53.9% were normal. In the women category, 45.2% had abdominal obesity based on a high waist-hip ratio, while 54.8% were normal. Regarding WC measurements, 20.0% of men and 39.3% of women had abdominal obesity. The table also revealed that 26.6% of the respondents were known and diagnosed hypertensive patients, while 73.4% were not diagnosed. Additionally, 5.2% of the respondents were known and diagnosed diabetics with different treatment options, while 94.8% were not diagnosed.

Gender Differences in the Association Between NCDs and Abdominal Obesity

Table 3 presents the results of the Chi-square analysis carried out in the study. It shows that there were significantly ($p<0.05$) more abdominally obese diabetic men (72.2%) than abdominally obese diabetic women (62.5%), and more abdominally obese hypertensive men (56.9%) than abdominally obese hypertensive women (41.0%) among the study population. It was found that 97.1% of females who had generalized obesity were also abdominally obese, whereas 80.0% of males who had generalized obesity also had abdominal obesity. Furthermore, more women (43.7%) than men (4.7%) had both overweight and abdominal obesity.

Tables 4a and 4b present the prevalence of hypertension and type 2 diabetes based on the participants' reported medical histories and their field assessments, respectively. It is shown that 26.6% of the participants were known and diagnosed hypertensive patients, while 73.4% were not diagnosed hypertensive as at the time of the data collection. The distribution of the treatment options undertaken by patients showed that the participants on prescribed drugs were 42.1% of the diagnosed participants, while 7.5% of the diagnosed participants were on recommended diets, and 41.1% on or recommended lifestyle modifications. It is also shown that 5.2% of the participants were known and diagnosed diabetics, while 94.8% were not diagnosed. In the treatment or management given to the diagnosed diabetic patients among the

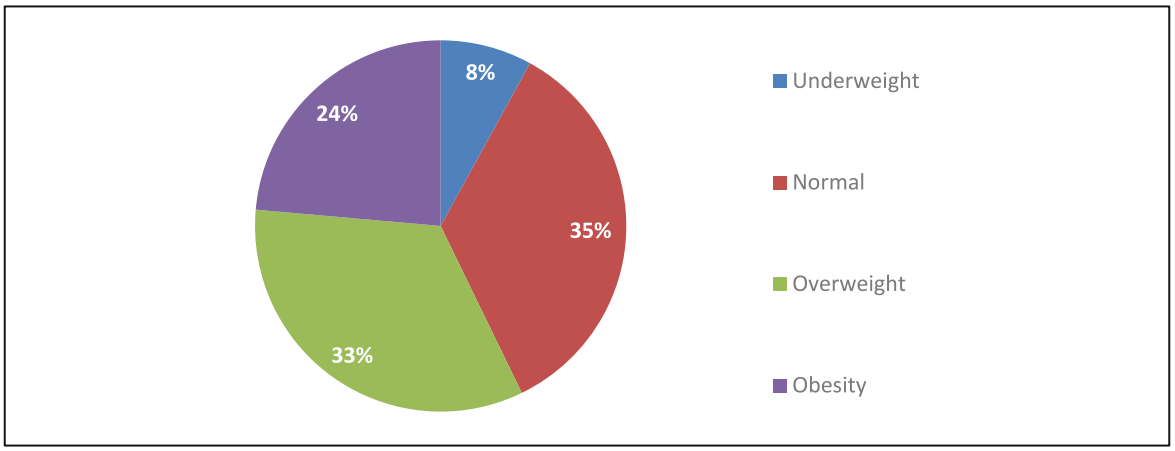

Fig. 2: Prevalence of generalized obesity

Table 2: Prevalence of abdominal obesity, hypertension and type 2 diabetes among the population

Anthropometric Parameter	Frequency (n)	Percentage (%)
Waist Circumference		
Men		
Normal (< 94cm)	141	61.3
High (94 – 102cm)	43	18.7
Very high (> 102cm)	46	20.0
Total	**230**	**100.0**
Women		
Normal (< 80 cm)	124	45.9
High (80 – 88 cm)	40	14.8
Very high (> 88 cm)	106	39.3
Total	**270**	**100.0**
Waist-Hip Ratio		
Men		
Normal (≤ 0.90)	124	53.9
Obese (> 0.90)	106	46.1
Total	**230**	**100.0**
Women		
Normal (≤ 0.85)	148	54.8
Obese (> 0.85)	122	45.2
Total	**270**	**100.0**
Known Hypertensive		
Yes	133	26.6
No	367	73.4
Total	**500**	**100.0**
Known Diabetic		
Yes	26	5.2
No	474	94.8
Total	**500**	**100.0**

study participants, 7.7% of the respondents were on insulin, 42.3% were on oral drugs, 26.9% were on recommended diabetic diet, while 23.1% were placed on healthy lifestyle regime. The distribution of the systolic and diastolic blood pressure measurements conducted on the participants which indicated their current blood pressure or hypertensive state (as at the time of the data collection), which showed that 19.4% of the participants had high systolic blood pressure and as such were hypertensive, while 20.0% had high diastolic blood pressure and as such were hypertensive. It is also shown that 0.8% of the participants had elevated blood glucose and as such were diabetic or at least had hyperglycaemia, while majority of the participants (99.2%) had normal blood glucose and as such were not diabetic or hyperglycaemic.

Gender-Specific Prevalence of Hypertension, Type 2 Diabetes, and Generalized Obesity

Figure 3 presents the gender-specific prevalence of hypertension, type 2 diabetes, and generalized obesity. It shows that 31.3% of males, as opposed to 22.6% of females, were known or previously diagnosed hypertensive patients, whereas 32.6% of males compared to 9.3% of females were assessed to have high diastolic blood pressure (HDBP). Additionally, 25.9% of females compared to their male counterparts (21.7%) had generalized obesity. Significantly, more males than females had type 2 diabetes.

Table 3: Gender differences in the association between NCDs and abdominal obesity

Variables of NCDs/ Anthropometry	Males Abdominal Obesity Marker NWC (<94cm)	AOv (94-102cm)	AO (>102cm)	TN	Females Abdominal Obesity Marker NWC (<80cm)	AOv (80-88cm)	AO (>88cm)	TN
Diagnosed HTN	15.3	27.8	56.9	**72**	27.9	31.1	41.0	**61**
Undiagnosed HTN	82.3	14.6	3.1	**158**	51.2	10.0	38.8	**209**
	$X^2 = 126.356$; df = 2; $p<0.01$				$X^2 = 80.254$; df = 2; $p<0.01$			
Diagnosed DM	0.0	27.8	72.2	**18**	0.0	37.5	62.5	**8**
Undiagnosed DM	66.5	17.9	15.6	**212**	47.3	14.1	38.6	**262**
	$X^2 = 28.533$; df = 2; $p<0.01$				$X^2 = 12.071$; df = 2; $p<0.01$			
Underweight	100.0	0.0	0.0	**14**	100.0	0.0	0.0	**26**
Ideal Weight	95.1	4.9	0.0	**81**	87.2	8.5	4.3	**94**
Overweight	60.0	35.3	4.7	**85**	18.8	37.5	43.7	**80**
Generalized Obesity	2.0	18.0	80.0	**50**	0.0	2.9	97.1	**70**
	$X^2 = 195.739$; df = 6; $p<0.01$				$X^2 = 241.200$; df = 6; $p<0.01$			

NWC = normal waist circumference; AOv = abdominal overweight; AO = abdominal obesity;
TN = total number; HTN = hypertension; DM = diabetes mellitus

Table 4a: Prevalence of hypertension and type 2 diabetes based on the participants' reported medical histories

Characteristics		Frequency (n)	Percentage (%)
Known Hypertensive	Yes	133	26.6
	No	367	73.4
	Total	**500**	**100.0**
Treatment or Management	Prescribed drugs	56	42.1
	Prescribed diet	10	7.5
	Prescribed lifestyle	55	41.4
	Others	12	9.0
	Total	**133**	**100.0**
Known Diabetic	Yes	26	5.2
	No	474	94.8
	Total	**500**	**100.0**
Treatment or Management	Insulin	2	7.7
	Drug	11	42.3
	Prescribed diet	7	26.9
	Prescribed lifestyle	6	23.1
	Total	**26**	**100.0**

Table 4b: Prevalence of hypertension and type 2 diabetes based on the participants' field assessments

Measurements		Frequency (n)	Percentage (%)
Blood Pressure			
Systolic Blood Pressure (SBP)	Normal	403	80.6
	Hypertensive	97	19.4
	Total	**500**	**100.0**
Diastolic Blood Pressure (DBP)	Normal	400	80.0
	Hypertensive	100	20.0
	Total	**500**	**100.0**
Blood Glucose			
Random Blood Glucose	Normal	496	99.2
	Diabetic	4	0.8
	Total	**500**	**100.0**

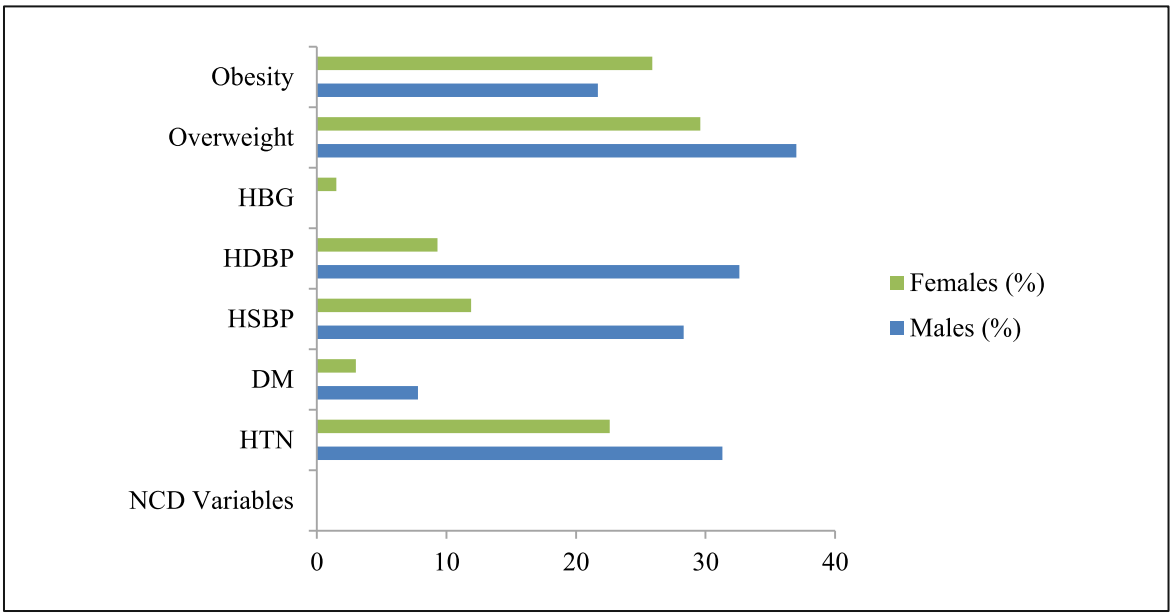

Fig. 3: Gender-specific prevalence of hypertension, type 2 diabetes and generalized obesity

DISCUSSION

The general characteristics of the study participants revealed that a very large proportion of the participants earned more than ₦30,000 (about 20 US dollars) as monthly income, while a little proportion earned ₦30,000 (about 20 US dollars) and lower as monthly income, which is the current national minimum wage in Nigeria. In the previous study it was documented that some socio-economic attributes related to the wellbeing of a population, particularly financial earning of the individuals and the associated demographic characteristics, often predispose such individuals to the development of such lifestyle chronic disease as hypertension (14), which is one of the risk factors for most diet-related noncommunicable diseases (NCDs), including type 2 diabetes. Similar to the report of another previous study by Ide *et al.* (22) on the same study population and in consistent with large number of other nations of Africa as documented by the World Bank (23), the study area is best described as a low income-population.

The prevalence of generalized obesity (and overweight) in this study was higher than the observed obesity prevalence among urban Nigerians (17%) reported by Okafor *et al*. (9), but relatively similar to the prevalence report of generalized obesity (25.5%) and overweight (32%) among the staff of Federal Polytechnic, Ilaro (FPI), Ogun State by Adebayo *et al*. (24). The disparity in prevalence could be attributed to the fact that the present study focused on a specific urban area, while Okafor *et al*. (9) included various urban areas across the country. The higher prevalence of abdominal obesity recorded among the female population compared to the male population, using waist circumference, may be influenced by the larger number of women participants in the study. Existing literature suggests that waist circumference is more sensitive than waist-hip ratio in assessing abdominal obesity; therefore, waist circumference measurement was adopted as the preferred assessment for abdominal obesity in this study (17). The observed difference in using the two measures of abdominal obesity could be attributed to the challenge of obtaining an accurate measurement of hip circumference (the denominator in waist-hip ratio) compared to waist circumference.

The high rate of abdominal obesity observed in the present study is consistent with some previous studies on abdominal obesity, demonstrating a continuous increase in prevalence over the years (7, 25-29). Okafor *et al*. (9) reported a higher prevalence of abdominal obesity than generalized obesity among urban Nigerians. The study also highlighted that abdominal obesity was more common in females. Amole *et al*. (10) documented a high prevalence (33.8%) of abdominal obesity among Ogbomoso women in the southwest region of Nigeria (10). Similarly, Hu *et al*. (7) reported a higher prevalence of abdominal obesity in females than in males, with a higher occurrence in urban areas than in rural places of China. The increased prevalence of abdominal obesity among the female population in this study could be attributed to certain physiological attributes, such as childbearing, which predispose women to excess body weight compared to their male counterparts. Scientifically, it is proven that every pregnant woman gains an additional 12 – 15 kg of body weight due to foetal weight, surrounding tissues, and post-childbirth body changes if not managed properly; hence, childbearing and other physiological attributes contribute to the accumulation of body weight in women over time (30, 31).

A higher prevalence of hypertension compared to type 2 diabetes was observed among the study population. The 5.2% prevalence of known type 2 diabetes in this study is slightly lower than the WHO's reported prevalence of type 2 diabetes in the African region, which was 7.1% (32). The difference in prevalence reports could be attributed to increasing awareness about type 2 diabetes, especially in urban areas, including Calabar Metropolis.

The prevalence of hypertension observed in this study is slightly lower than the Global Nutrition Report of 2017, which showed a 28% prevalence of hypertension among African adults (32). This could be as a result of the high consumption of vegetables (94.8%) reported previously of the same study population by Ide *et al*. (22), as vegetables are known to be rich in dietary fibre which aids the prevention and control of hypertension and cardiovascular diseases. The gender-specific prevalence of hypertension is 31.3% for males and 22.6% for females in the current study, supporting existing literature that adult males in Africa are more vulnerable to hypertension (33). Similarly, in the present study, more abdominally obese diabetic males than abdominally obese diabetic females, and more abdominally obese hypertensive males than abdominally obese hypertensive females, were noted. It was stated that the prevalence of type 2 diabetes and hypertension were a mixed finding, whereas the obesity prevalence tilts towards the feminine gender (33).

These reports are similar to the findings of the present study, with more males, as opposed to fewer females, being known or previously diagnosed hypertensive patients, and more males compared to fewer females being discovered to have high diastolic blood pressure (HDBP). More females, compared to their male counterparts, were found to have generalized obesity. In the literature, a larger number of males than females were reported to have type 2 diabetes in some countries, while hypertension cases were recorded more in males than in female populations globally, with the exclusion of Africa (33). However, Amole *et al*. (10) observed that more males had hypertension regardless of the reported elevated cases of abdominal obesity among females (10), which is similar to Olatunbosun *et al*. (33) in Ibadan, Nigeria. The findings of this present study are consistent with Amole *et al*. (10) and Olatunbosun *et al*. (33). The World Health Organization has described diabetes as one of the worrying public health disorders with escalating prevalence for a couple of decades now (4). Out of the total of 422 million adults with type 2 diabetes worldwide in 2016, 8% were women and 19% were men (4). In the present study 3.6% of the known and diagnosed

type 2 diabetics were males, and 1.6% were females. Proportionally, both reports are similar.
There was a higher prevalence of hypertension than type 2 diabetes among the study population, with 26.6% known and previously diagnosed hypertensive patients based on existing medical history of hypertension, and 20.0% non-diagnosed hypertensive participants determined through blood pressure measurements in the field. The prevalence of both generalized and abdominal obesity was high, especially among the females in the study population. However, there was a slightly lower prevalence of the specific NCDs observed compared to that documented in an existing report about the African region, suggesting that more efforts should be directed towards the improved and sustainable management of obesity and NCDs as public health problems.

Nutritionists and Dietitians in the Metropolis should intensify efforts to render the necessary professional community services, creating awareness on obesity and related NCDs, and providing interventions such as proper dietary counseling and diet planning with routine follow-ups for individuals diagnosed with the prevailing conditions.

Acknowledgments
Our sincere gratitude goes to Inyang, Stephanie; Essien, Mfonobong; and Ofem, Ukata; who assisted in data collection. We also extend our thanks to the adult residents of Calabar Metropolis whose responses and cooperation contributed to the findings of this study. The valuable efforts of other collaborators in this research are greatly appreciated.

Authors' Contribution
Conceptualization of the study was done by Ide, TJP; study design by Ide, TJP and Ene-Obong, HN. Data collection was carried out by Ide, TJP and the research assistants. Analysis of the data was performed by Ide, TJP; interpretation of data by Ide, TJP and Ene-Obong, HN. The manuscript was drafted by Ide, TJP; Maduforo, AN; Nwofia, BK; Onyenweaku, EO and Ide, CO reviewed it critically for necessary intellectual components. All authors read and approved the manuscript for publication.

Data Availability Statement:
The datasets for this article will be made available by the corresponding author upon request.

Conflicts of Interest:
There are no conflicts of interest disclosed.

Funding:
There was no funding from any organization for this study.

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Appendix I

HEALTH RESEARCH ETHICS COMMITTEE
UNIVERSITY OF CALABAR TEACHING HOSPITAL

P. M. B. 1278, CALABAR, NIGERIA

CHIEF MEDICAL DIRECTOR:
Dr. Thomas U. Agan
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MBBCH, DA (WACS), DA (WFSA)
SECRETARY:
Ededet Eyoma Esq.
BA, LLB, BL, MPA, DIP-Comp. Sc, ANIM, AIHSAN

Our Ref:_____

Date: 29th Jan., 2018

Your Ref:_____

NOTICE OF FULL APPROVAL OF PROTOCOL
RELATIONSHIP BETWEEN ABDOMINAL OBESITY AND SOME DIET-RELATED NON-COMMUNICABLE DISEASES AMONG ADULTS IN CALABAR METROPOLIS, CROSS RIVER STATE, NIGERIA

UCTH NHREC REG. NUMBER:	NHREC/07/10/2012
HREC Protocol Assigned Number:	UCTH/HREC/33/568
Name of Principal Investigator:	Ide, Toochukwu James Paulmiki
Address of Principal Investigator:	Human Nutrition and Dietetics Unit Department of Biochemistry, Faculty of Basic Medical Sciences, University of Calabar
Date of Receipt of Valid Application:	17th December, 2017
Date of Meeting where decision was made:	29th January, 2018

This is to inform you that the Research described In the submitted protocol, the Consent Forms, and other participant information materials have been reviewed and given *full approval by the Health Research Ethics Committee.*

This approval dates from 29th January 2018 to 28th January, 2019. If there is delay in starting the research, please inform the HREC so that the dates of approval can be adjusted accordingly. Note that no participant accrual or activity related to this research may be conducted outside of these dates. In multi year research, endeavour to submit your annual report to the HREC early in order to obtain renewal of your approval and avoid disruption of your research.

The National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the Code including ensuring that all adverse events are reported promptly to the HREC. No changes are permitted in the research without prior approval by the HREC except in circumstances outlined in the Code. The HREC reserves the right to conduct compliance visit to your research site without previous notification.

Prof. Martin Meremikwu
CHAIRMAN, UCTH HREC