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ORIGINAL RESEARCH ARTICLE

Association between Anthropometric Indices of Obesity and Lipid profile Parameters among Hypertensive Patients Attending some Selected Hospitals in Kano Metropolis

Abdullahi Muhammad Umar[1], Nasir Sirajo Sadi[2], Aisha Muhammad Gadanya[2], Lawan Hassan Adamu[3], Muhammad Ali Gambo[4], Faiza Aliyu Ismail[1], and Aisha Murtala[5]
[1]Department of Integrated Science, Faculty of Sciences Education, Yusuf Maitama Sule Federal University of Education, Kano, Nigeria
[2]Department of Biochemistry, Faculty of Basic Medical Sciences, Bayero University, Kano, Nigeria
[3]Department of Human Anatomy, College of Medicine and Allied Medical Sciences, Federal University Dutse, Jigawa, Nigeria
[4]Department of Integrated Science, Federal College of Education (Technical) Bichi, Kano, Nigeria
[5]Department of Biochemistry, Faculty of Science and Computing, Baba-Ahmed University, Kano-Nigeria

ABSTRACT
Hypertension is a growing global health issue, especially in low-income countries, with obesity as a key risk factor measured through indices like BMI, waist circumference, and waist-to-hip ratio. Assessing the relationship between lipid profiles (TC, TG, HDL-C, LDL-C) and these obesity measures is crucial for effective hypertension management. This study investigates the link between anthropometric indicators of obesity and lipid profile parameters in hypertensive patients who visit specific hospitals in Kano Metropolis, Nigeria. Between November 2024 and February 2025, 200 individuals aged 60 or older participated in a cross-sectional study involving interviews. Each participant's anthropometric indices were measured using techniques employed by trained professionals. The Body Composition Monitor (Karada Omron Scan) was used to measure the participants' weight, BMI, visceral fat, fat composition, muscle composition, and resting metabolism. Standard techniques were then applied to establish the remaining anthropometric data. Lipid parameters were measured using a lipid panel test apparatus. SPSS V 24. 00 was utilized for data analysis. The findings revealed a significant positive correlation between WC and BMI, visceral fat, hip circumference, and TC, HDL, TAG, and LDL-C levels ($p < 0.05$), indicating that higher levels of atherogenic lipids are associated with increased obesity. This study also found a significant difference ($p < 0.05$) in hip circumference, fat composition, muscle composition, and waist circumference between hypertensive patients and controls. The study demonstrates a notable association between anthropometric indices of obesity and adverse lipid profile parameters among hypertensive patients in the Kano Metropolis.

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Anthropometric Indices, Obesity, Lipid Profile, Hypertension, Cardiovascular Risk, Kano Metropolis

INTRODUCTION

The primary risk factor for cardiovascular disease (CVD) worldwide is hypertension. According to Wang *et al.* (2018), it causes around 9.4 million deaths globally each year. Recent studies indicate that nearly half of individuals with hypertension are unaware of their condition. According to Richardson *et al.* (2024), there is an unusually high incidence of hypertension among young people. Current estimates show that the prevalence of hypertension in Nigeria has been rising over the past few decades, with regional variations ranging from 22% to 44% (Ogungbe *et al.*, 2024). However, rates of control, treatment, and awareness remain low. Only 29% of Nigerians with hypertension knew they had been diagnosed, 12% were receiving treatment, and only 3% had their condition under control, according to a 2021 meta-analysis (Ogungbe *et al.*, 2024). More studies have reported slightly higher control rates. These poor control rates significantly increase the risk of outcomes such as myocardial infarction, strokes, heart failure, and kidney disease (Ogungbe *et al.*, 2024).

Any excessive accumulation or abnormal amount of fat that indicates a health concern is referred to as overweight or obesity (Ayogu *et al.*, 2022; WHO, 2024). Excessive fat accumulation and associated health risks characterize obesity, a complex illness. Despite being a preventable and treatable issue, 39% of people worldwide suffer from obesity (WHO, 2024). Since the risk of non-communicable diseases rises with body mass index, obesity and overweight are linked to more deaths globally

Correspondence: Umar Abdullahi Muhammad. Department of Integrated Science, Faculty of Sciences Education, Federal University of Education, Kano-Nigeria. ✉ amumagashi@gmail.com.
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(WHO, 2024). Research indicates that among the leading causes of death are conditions associated with obesity, such as hypertension, type 2 diabetes, and cardiovascular disease (CDC, 2017). In 2019, the prevalence of obesity in Nigeria was 9.9% for women, 10.3% for girls, 8.3% for boys, and 6.5% for men. According to the report, 18.2% of women, 16.7% of girls, and 10.3% of boys are overweight (World Obesity, 2019).

A variety of anthropometric measurements and indices can be used to define obesity. The question of which obesity metric best predicts CVD has been the subject of growing conjecture in recent years (Wang *et al.*, 2018). Previous research on this topic remains debatable, though. Numerous epidemiologic studies on obesity often employ the body mass index (BMI). However, several studies have revealed that it cannot discriminate between body fat and lean body mass (Khashayar *et al.*, 2017). Some studies indicate that centralized measures of obesity, such as waist circumference (WC), waist-to-hip ratio (WHR), or waist-to-height ratio, are statistically superior to body mass index (BMI) in identifying cardiovascular risk factors in both men and women (Wang *et al.*, 2018). Others have discovered that central obesity markers and BMI perform similarly for both sexes and all ages. Additionally, several new anthropometric indices have been created recently, such as the new hip index (HI) and the body shape index (ABSI), which have been demonstrated to be additional to BMI and other known risk factors (Krakauer & Krakauer, 2016). To make our results more distinctive and complete, we therefore included more indices in our present study than in earlier ones, such as height, weight, BMI, HI, ABSI, WC, hip circumference (HC), WHR, and WHtR.

A variety of anthropometric measurements and indices can be used to define obesity. The question of which obesity metric best predicts CVD has been the subject of growing discussion in recent years (Wang *et al.*, 2018). Previous research on this topic is still debatable, though. Numerous epidemiologic studies on obesity frequently employ the body mass index (BMI). However, many studies have found that it is unable to distinguish between lean body mass and body fat (Khashayar *et al.*, 2017). In order to identify cardiovascular risk factors in both men and women, several studies have established statistical evidence that centralized obesity measurements, such as waist circumference (WC), waist-to-hip ratio (WHR), or waist-to-height ratio (WHtR), are superior to BMI (Wang *et al.*, 2018). Others have discovered that central obesity markers and BMI perform similarly for both sexes and all ages. In addition, a number of new anthropometric indices have been developed recently, including the body shape index (ABSI) and the new hip index (HI), which have been shown to be complementary to BMI and other established risk factors (Krakauer & Krakauer, 2016). To make our results more complete, we therefore included more indices in our present study than in earlier ones, including height, weight, WC, hip circumference (HC), WHR, WHtR, BMI, HI, and ABSI.

Although the relationship between obesity and hypertension has been well-documented, this study uniquely examines the role of new anthropometric indices, such as ABSI and HI, in predicting lipid abnormalities in hypertensive patients. When combined with traditional measurements, these indices may improve risk stratification and management of hypertensive patients in clinical settings. Therefore, this study aims to assess the new anthropometric indices of obesity and their relationship with lipid profiles among hypertensive patients attending selected hospitals in Kano Metropolis.

MATERIALS AND METHOD

Target Population

The study was an observational, cross-sectional study. Hypertensive subjects were selected by simple random probability sampling method from patients (males and females) attending the hypertensive clinic of some selected hospitals in the Kano metropolis (Murtala Muhammad Specialist Hospital, Sheik Muhammad Jidda, Sir Muhammad Sunusi General Hospital, Muhammad Abdullahi Wase Specialist Hospital), Kano State, Nigeria. The study subjects comprised hypertensive patients and apparently healthy subjects between the ages of 20 and 70 years whose weight falls into normal, obese, or overweight groups.

Inclusion and Exclusion Criteria

The patients studied were those diagnosed as hypertensive. The hypertensive status of the patients was defined as described. Systolic blood pressure (SBP) of 140 mmHg or higher and diastolic blood pressure (DBP) of 90 mmHg or higher are defined by the Seventh Joint National Committee on Detection, Evaluation, and Treatment of Hypertension (JNC-VII) of the United States. The study excluded pregnant women, breastfeeding moms, women on hormone replacement therapy or oral contraceptives, and those who declined to provide their permission.

Sample Size Determination

The sample size was determined in accordance with Fisher's formula (Babandi *et al.,* 2017), with the following resource equation.

$$n = \frac{Z^2pq}{d^2}$$

Where;

n = minimum sample size required in a population

Z = standard normal deviation, usually at 1.96, which corresponds to 95% confidence interval

P =Hypertension prevalence rate in a previous study 32.8% (Adeloye *et al.,* 2015).

q = proportion of failure = (1- p)

d = degree of accuracy, which is chosen as 5 % (0.05)

$$n = \frac{Z^2pq}{d^2} = \frac{(1.96)^2 * (0.328) * (1 - 0.328)}{(0.05)^2} = 154$$

154 will be the minimum sample size

Therefore, 200 participant were recruited for the whole study.

Ethical Approval.

The Kano State Ministry of Health granted ethical approval (SHREC/2024/5791, NHREC/17/03/2018). Participants provided their informed consent after being fully informed about the study.

Administration of Questionnaires

Data on the socioeconomic and demographic features of the subjects, such as their nutritional condition, food frequency questionnaire, knowledge, attitude, and habits, were gathered using a structured questionnaire. A re-structure validated FAO-UN questionnaire was adopted and administered to collect Data on the subjects' socioeconomic and demographic features, such as their nutritional condition, food frequency questionnaire, knowledge, attitude, and habits, were gathered using a structured questionnaire.

Determination of Blood Pressure

Trained medical professionals and nurses used a mercury sphygmomanometer to monitor blood pressure (BP) while seated.

Lipid profile

Lipid parameters were measured using a lipid panel test equipment. This test system measures triglycerides, HDL, and cholesterol in whole blood, plasma, and serum using lipid panel test strips. The formula LDL = TC – HDL– [Trig/5] can then be used to determine the LDL cholesterol based on the results obtained for other parameters. The professional analyzer CardioChek Plus offers the quantifiable result. Each box of test strips included a MEMo Chip, which needs to be correctly put into the analyzer before any tests can be conducted.

Anthropometric Measurements

The Body Composition Monitor measured the study participants' weight, BMI, visceral fat, fat composition, muscle composition, and resting metabolism. The majority of conventional anthropometric indices (height, weight, WC, HC, WHR, WHtR, and BMI) and a few recently created anthropometric indices (HI and ABSI) are included in our study to produce more trustworthy results.

Weight in light clothing was measured in kilograms (precision 0.01 kg), while height without shoes was recorded in centimeters (accuracy 1.0 cm). Participants stood without bulky outerwear, with their pockets emptied and their breaths out slowly, and their waist circumference was measured at a level point halfway between the iliac crest and the lower rib edge (accuracy 1 cm). With an accuracy of 1 cm, HC was measured as the maximal circumference over the buttocks. Weight divided by height squared (kg/m^2) was used to compute BMI. WC divided by HC was used to compute the waist-to-hip ratio (WHR).

Statistical Analysis

IBM SPSS Advanced Statistics version 24.0 (SPSS Inc., Chicago, IL) was used to analyze the data. The mean and standard deviation or, if applicable, the median and range were used to represent numerical data. Frequencies and percentages were used to express qualitative data. To investigate the relationship between qualitative variables at $P < 0.05$, the chi-square test, confidential interval, and odd ratio were employed.

RESULTS

Socio-demographic Data

Table 1 shows the socio-demographic data of the study subjects. Among the study population, 128 (64%) were female and 72 (36%) were male, almost (80%) of the participants were hypertensive. Majority of the participants (80%) were within the age of 45-70 years in which (80%) were hypertensive. In general, the following traits were present in the majority of participants: married (92%), female (64%), secondary education (58%), civil servant (38%), income less than #18000 per month (40%) and number of children 9- above (38%).

Anthropometric results

Table 2 indicates the distribution of anthropometric variables in hypertensive and control individuals as follows: comparing the status of the individuals, there were no statistically significance differences at $p<0.05$ in the anthropometric indices except hip, fat composition, and muscle composition, which showed statistical difference at $p<0.05$.

Lipid Profile Parameters

Table 3 shows the descriptive statistics with mean, SD, t-value, and p-value of Lipid Profile parameters among hypertensive and non-hypertensive patients. It was found that there was no statistical difference $p > 0.05$ among hypertensive and Control individuals. But when stratified into male and female, LDL shows significant difference between male hypertensive and Control, and in females at $p < 0.05$, only TAG exhibits a meaningful difference.

Correlation results between biochemical parameters and anthropometric indices

Table 4 presents the results of the correlation between the anthropometric indices with the biochemical parameters in hypertensive and control individuals. All anthropometric indices correlated significantly with cholesterol, body fat, hip, and BMI. BMI had the highest correlation coefficient with body fat, visceral fat with cholesterol, and LDL; Weight also had the highest correlation with cholesterol, HDL, LDL, and BMI, while CI had the lowest.

Table 1: Socio-demographic Features of Participants with and Without Hypertension

Fearures	Total (n=200)n(%)	Hypertensive (n =160) n(%)	Control (n=40) n (%)	Chi²	P
SEX					
Male	72(36)	56 (35)	16 (40)	0.347	0.556
Female	128(64)	104 (65)	24 (60)		
AGE					
25-34	16(8)	8 (5)	8 (20)	15	0.001
35-44	24(12)	24 (15)	0 (0)		
45-70	160(80)	128 (80)	32 (80)		
MARITAL STATUS					
Married	184(92)	152 (95)	32 (80)	9.783	0.002
Divorced	16(8)	8 (5)	8 (20)		
EDUCATIONAL LEVEL					
No formal Education	44(22)	32 (20)	12 (30)	3.989	0.136
Secondary	116(58)	92 (57.5)	24 (60)		
Tertiary	40(20)	36 (22.5)	4 (10)		
EMPLOYMENT STATUS					
Self employed	64(32)	48 (30)	16 (40)	1.842	0.398
Civil Servant	76(38)	64 (40)	12 (30)		
Not Employed	60(30)	48 (30)	12 (30)		
MONTHLY INCOME (PM)					
<#18,000	80(40)	68 (42.5)	12 (30)	6.042	0.11
#18 –#50,000	24(12)	16 (10)	8 (20)		
#51 – #100,000	64(32)	48 (30)	16 (40)		
>#100,000	32(16)	28 (17.5)	4 (10)		
NUMBER OF CHILDREN					
None	63(31.5)	63 (39.4)	0 (0)	31.245	0.001
1 – 4	17(8.5)	9 (5.6)	8 (20)		
5 – 8	44(22)	28 (17.5)	16 (40)		
9 – above	76(38)	60 (37.5)	16 (40)		

DISCUSSION

This study was conducted on patients attending some selected hospitals (Murtala Muhammad Specialist Hospital, Muhammad Abdullahi Wase Teaching Hospital, Sheik Muhammad Jiddah General Hospital, and Sir Muhammad Sunusi General Hospital) in the Kano metropolis. Most participants were women and married, with the highest percentage having primary education.

In hypertensive and normotensive, there is a difference in most of the anthropometric indices between hypertensive patients and normotensive individuals, including both overall and abdominal obesity indicators. These results suggested that hypertension is linked to obesity in both males and females, which is consistent with previous studies that both overall and abdominal obesity are significantly associated with hypertension (Nguyen *et al.*, 2008; He *et al.*, 2009). It has been proposed that leptin, renin-angiotensin-aldosterone axis activation, and structural artery anomalies are the mechanisms behind this connection (Nguyen and Lau, 2012). Numerous long-term investigations, such as the Framingham Heart Study, have also demonstrated the negative impact of waist circumference and BMI on the risk of hypertension (Wang *et al.,* 2018). In the normotensive category, an increase in WC is similarly linked to high risk, according to the NIH (US), which has shown that there is a graded increase in health risk with an increase in BMI (NIH 1998). Moreover, additional research revealed that it might potentially be connected to the gene variant (Baudrand *et al.,* 2015; Skrypnik *et al.*, 2017). Fortunately, the incidence of hypertension can be reduced by dietary changes, nutritional knowledge, attitude, and practice, increased physical activity, endurance, and endurance-strength exercise, and the fact that obesity is a modifiable factor (Skrypnik *et al.,* 2015 and 2016; Szulinska *et al.,* 2016).

Without taking age into account, the current study demonstrates a substantial correlation between BMI and hypertension. Numerous studies that show an increase in BMI causes blood pressure to rise to confirm these findings (Wilsgaard *et al.*, 2000; Droyvold *et al.*, 2005; Wang *et al.,* 2018). However, when age increased in females, the association between HI and hypertension became more pronounced. Moreover, some research continues to show that elevated HC is a risk factor for multi-metabolic illnesses (Liu *et al.*, 2008). There are two possible explanations for this outcome. First, because HC has a positive correlation with both BMI and WC, it provides some information on both overall and abdominal obesity (Wang *et al.*, 2010). Second, research has shown that women who are more gravid are consistently at higher risk of developing metabolic syndrome (Xu *et al.*, 2014). Given these findings, it should be a top priority to urge women with high HC and men with high BMI to pay more attention to hypertension recommendations.

Table 2: Anthropometric Parameter Comparison of Participants with and Without Hypertension

Parameters	Total *(n= 200)n (%)*	Hypertensive *(n= 160) n (%)*	Control *(n= 40) n (%)*	Chi²	*P*
Height (m)					
Q1	52 (26)	44(27.5)	8(20)	7.986	0.069
Q2	44 (22)	40(25)	4(10)		
Q3	44 (22)	32(20)	12(30)		
Q4	60 (30)	44(27.5)	16(40)		
Weight(Kg)					
Q1	52 (26)	40(25)	12(30)	5.449	0.143
Q2	48 (24)	44(27.5)	4(10)		
Q3	52 (26)	40(25)	12(30)		
Q4	48 (24)	36(22.5)	12(30)		
Hip C. (cm)					
Q1	52 (26)	36(22.5)	16(40)	18.11	0.000
Q2	48 (24)	44(27.5)	4(10)		
Q3	52 (26)	48(30)	4(10)		
Q4	48(24)	32(20)	16(40)		
BMI					
Normal	28(14)	24(15)	4(10)	3.473	0.324
Overweight	80(40)	64(40)	16(40)		
Obese I	68(34)	56(35)	12(30)		
Obese II	24(12)	16(10)	8(20)		
Body shape Index					
Q1	52 (26)	40(25)	12(6)	2.083	0.555
Q2	48 (24)	40(25)	8(4)		
Q3	52 (26)	44(27.5)	8(4)		
Q4	48 (24)	36(22.5)	12(6)		
Conicity Index					
Q1	52 (26)	36(22.5)	16(40)	8.494	0.037
Q2	48 (24)	40(25)	8(20)		
Q3	52 (26)	40(25)	12(30)		
Q4	48 (24)	44(27.5)	4(10)		
Fat comp.(%)					
Q1	52 (26)	36(22.5)	16(40)	21. 795	0.000
Q2	48 (24)	48(30)	0(0)		
Q3	52 (26)	44(27.5)	8(20)		
Q4	48 (24)	32(20)	16(40)		
Musclecomp.(%)					
Q1	52 (26)	40(25)	12(30)	23.397	0.000
Q2	48 (24)	44(27.5)	4(10)		
Q3	52 (26)	48(30)	4(10)		
Q4	48 (24)	28(17.5)	20(50)		
Visceral fat					
Q1	60 (30)	44(27.5)	16(40)	8.135	0.043
Q2	44 (22)	36(22.5)	8(20)		
Q3	44(22)	32(20)	12(30)		
Q4	52 (26)	48 (30)	4(10)		
Waist (cm)					
≥ 94	60(30)	48(30)	12(30)	17.56	0.000
≥80	140(70)	112(70)	28(70)		
W/H Ratio					
>0.9	4(2)	4(2.5)	0(0)	1.020	0.312
>0.85	196(98)	156(97.5)	40(100)		

Additionally, in order to detect and treat elderly hypertensive patients early, healthcare facilities should improve screening and surveillance for those at-risk segments.

The primary findings of this study showed that, overall, obesity was linked to hypertension in both genders, which may mean that the distribution of body fat in women and the amount of body fat mass in men are closely related to hypertension (Wang *et al.*, 2018). Previous research has shown that general obesity and partial obesity typically have similar relationships with hypertension in different genders, with some studies showing that general obesity has a stronger association with hypertension in both males and females (Kashayar *et al.,* 2017), while other studies found that partial obesity had a stronger association with hypertension in both genders (Wang *et al.*, 2018). Our findings suggested that the roles of overall obesity and partial obesity in hypertension in distinct genders may differ. Additional research is required to validate this hypothesis.

Table 3: Lipid Profile Parameters for the Hypertensive and Control Individuals Attending Selected Hospitals in Kano Metropolis

Sex	Parameters (mg/dl)	Hypertension *n =(80)*	Control *n =(20)*	T	*P*
All	**Cholesterol**	143.83 ± 44.75	140.60± 40.56	0.29	0.770
	HDL	55.58 ± 14.45	59.80 ± 14.76	-1.16	0.247
	TAG	115.98 ± 55.69	103.10± 56.63	0.92	0.359
	LDL	71.93 ± 35.10	64.37 ± 35.10	0.86	0.391
	Tcl/HDL	3.08 ± 1.18	2.77 ± 0.75	-0.35	0.728
Male	**Cholesterol**	134.71± 40.81	117.75± 23.29	-1.117	0.272
	HDL	54.07 ± 7.30	58.50± 6.52	1.549	0.130
	TAG	118.86 ± 61.72	139.5 ± 76.63	0.79	0.430
	LDL	69.42 ± 34.39	41.93 ± 25.50	-2.09	0.040[a]
	Tcl/HDL	2.91 ± 0.90	2.89 ± 0.90	-0.05	0.960
Female	**Cholesterol**	148.73 ± 46.37	155.83± 43.16	0.48	0.630
	HDL	56.38 ± 17.13	60.67 ± 18.63	0.77	0.450
	TAG	114.42 ± 52.72	60.67 ± 18.63	-2.88	0.020[b]
	LDL	73.33 ± 35.75	79.33 ± 33.22	0.53	0.590
	Tcl/HDL	3.17 ± 1.31	2.68 ± 0.67	-1.25	0.220

Values are expressed as mean± SD; mean values having different superscripts in the same row are significantly different at (p<0.05)

Table 4: Correlation between Biochemical Parameters and Anthropometric Indices in Hypertensive and Control Individuals Attending Selected Hospitals in Kano Metropolis

VARIABLES	Cholestrol (r)	HDL (r)	TAG (r)	LDL (r)	TC/HDL
Height (cm)	0.032	0.191	0.184	-0.050	-0.049
Weight (kg)	0.580**	0.367**	-0.099	0.462**	-0.109
Hip index	0.239*	0.163	-0.032	0.137	-0.140
ABSI	0.080	0.118	-0.001	0.011	-0.150
Conicity I	-0.094	0.083	0.064	-0.161	-0.134
BMI	0.585**	0.252*	-0.244*	0.517**	-0.042
Bodyfat(%)	0.502**	0.182	-0.174	0.418**	0.071
Muscle (%)	-0.364**	-0.347**	0.137	-0.200*	0.129
Visceral fat	0.414**	0.129	-0.085	0.360**	0.026
RM (kcal)	0.216*	-0.074	0.087	0.188	0.198*
WC (cm)	0.359**	0.253*	-0.083	0.250*	-0.136
Hip (cm)	0.398**	0.232*	-0.079	0.285**	-0.132
WHR	-0.158	-0.012	0.074	-0.109	0.075
AGE	-.206*	-0.111	-0.053	-0.238*	-0.003

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

CONCLUSION

In conclusion, a significant high correlation between anthropometric indices and the lipid profile parameters was observed; hip circumference, Fat composition, Muscle composition, and waist show a significance difference between the hypertensive and control. Also, there is a gender difference in the level of TAG and LDL among the study participants.

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