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Correlation between central obesity and blood pressure in an adult Nigerian population

Authors:
Franklin M. Onuoha[1]
Canice C. Ebirim[2]
Benneth C. Ajonuma[3]
Nkechi A. Alabi[4]
Patricia Eseigbe[5]
Odinakachukwu S. Okezue[1]

Affiliations:
[1]Department of Family Medicine, Federal Medical Centre, Nigeria

[2]Department of Family Medicine, Federal Teaching Hospital, Nigeria

[3]Department of Internal Medicine, Federal Medical Centre, Nigeria

[4]Department of Family Medicine, General Hospital, Nigeria

[5]Department of Family Medicine, Ahmadu Bello University Teaching Hospital, Nigeria

Corresponding author:
Franklin Onuoha,
onuohaf11@yahoo.com

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Background: Obesity has been recognised as a major risk factor in the pathogenesis of cardiovascular disease. The aim of this study is to determine the prevalence of central obesity [using waist–hip ratio (WHR) as an indicator] and the correlation between central obesity and blood pressure (BP) in adults seen in a Nigerian tertiary health facility.

Materials and methods: The study was a cross-sectional design carried out between February and November 2015 at the General Outpatient Clinic of the Federal Medical Centre, Owerri, Nigeria. A total of 482 consenting adults aged 16–40 years formed the study population. Consecutive sampling was used in the recruitment of subjects, whereas data were collected by the use of an interviewer-administered questionnaire.

Results: The mean age of the study population was 25.37 ± 5.49, whereas the mean WHR for men and women was 0.83 ± 0.04 and 0.82 ± 0.05, respectively. The prevalence of central obesity in the study population was 39.4% (n = 190). Female respondents had a higher prevalence (59.2%) than male respondents (8.5%), and the relationship between central obesity and sex was statistically significant (p = 0.001). Correlation analysis showed a positive correlation between WHR and BP (diastolic BP: r = 0.122, p = 0.008; systolic BP: r = 0.015, p = 0.742) in both sexes. Obese respondents were observed to be more likely to develop hypertension than the non-obese respondents.

Conclusion: This study showed a correlation between central obesity and BP in adults aged 16–40 years.

Introduction

Obesity has reached an epidemic proportion worldwide with near double prevalence since 1980.[1,2] In adults aged 20 years and above, the prevalence of obesity was reported as 11%.[2] Available data revealed that the prevalence of overweight and obesity increased by about 20% between 2002 and 2010 in Nigeria, and its prevalence has been on the increase in most developed countries and in the urban areas of many less-developed countries.[3,4] It is equally interesting to note that obesity epidemic is growing faster in developing countries than in developed countries of the world.[1,2,5] This drastic change has been attributed to the impact of globalisation by many authors.[3,5,6]

Abdominal obesity though linked with cardiovascular diseases (CVDs) and some malignancies is socially acceptable amongst Nigerians and is therefore not usually recognised as a health risk.[7] Until recently and especially in the south-eastern part of Nigeria (where the index study was conducted), a protruding abdomen amongst men was seen as a sign of affluence and prosperity.[7] The net effect was for young adults who saw abdominally obese relations as role models to aim at gaining weight and accumulating fat in the abdomen. They were absolutely ignorant of the health implications of their actions. This negative perception would have been responsible for the increased prevalence of abdominal obesity reported by some studies carried out in Nigeria. For example, Iloh et al. while working on abdominal obesity in adult Nigerian Africans reported a prevalence of 11.6% amongst patients accessing care in a rural missionary hospital in southeast Nigeria. This prevalence was less than the prevalence value of 21.7%[7] observed at Aba which is located in the same region of Nigeria where the present study was carried out. Similar studies carried out in Okrika, south–south Nigeria and Ogbomoso, south–west Nigeria also recorded high prevalence rates of 31.7% and 33.8% respectively.[7]

Abdominal obesity has been particularly recognised as a major dependent risk factor for CVD. Many health hazards have been linked to abdominal obesity. They include but not limited to diabetes, hypertension, CVD, arthritis, respiratory diseases, breast cancer, ovarian dysfunction, menstrual irregularities and poor social image.[8] Epidemiological studies have reported that adiposity contributes to the increased incidence and deaths from cancers of the colon, endometrium, oesophagus, kidney, gall bladder, liver and pancreas.[8,9] Globalisation in Nigeria and its exponential negative impact on health has been linked to the increasing burden of abdominal obesity and a concomitant raise in the prevalence of hypertension. Evidence from unpublished data from the centre where the study was conducted over a 3-year period showed that most of the male hypertensive patients accessing care at the centre had protruding abdomen. Nevertheless, the above finding was at no time subjected to any scientific research, hence the justification of this study. More so, it has been proven by several studies that a reduction in body weight is vital in the management of hypertension.[2,4,6,7,9] For instance, being centrally overweight is associated with a two- to sixfold increase in the risk of developing hypertension, and an increase of 23 mmHg in systolic blood pressure (SBP) and 1–3 mmHg in diastolic blood pressure (DBP) has been recorded for each 10% rise in weight in the Western population.[10]

The mechanism linking abdominal obesity with hypertension might be explained by the activation of the renin–angiotensin–aldosterone system which primarily leads to the activation of the sympathetic activity, promotion of the leptin resistance by increased procoagulatory activity. The cumulative effect of this cascade is endothelial dysfunction and inflammatory changes. Additional mechanism includes the enhanced renal sodium reabsorption with a resultant increase in volume expansion usually observed in abdominally obese patients.[7]

The gold standard for the measurement of abdominal obesity is assessment using imaging techniques such as magnetic resonance or computed tomography. However, imaging techniques are impracticable in large epidemiological studies because they are arduous and expensive. In view of these disadvantages, the waist–hip ratio (WHR) remains the dominantly used alternative to imaging technique[11] irrespective of the fact that recent epidemiological data describe waist circumference (WC) as a better predictor of CVDs than WHR as it correlates better with the levels of visceral adiposity and reflects the aggregation of the body fat and its distribution. More so, it is devoid of some of the pitfalls observed with WHR such as lower sensitivity to weight gain, its greater variability across age, sex and ethnic group and its greater computational complexity and interpretation in a public health context.[12] Waist-to-height ratio (WHtR) is another commonly used index to predict the risk of obesity-related morbidity and mortality.[13,14] The WHtR has a unique advantage of detecting early cardiovascular risks. Further studies contradicted the observations by Molarius et al.[12] on the preference of WC to WHR as a measure of abdominal obesity. For instance, Kaur et al. did a comparative study of BMI, WC and WHR amongst nurses and reported that WHR as a measure of central obesity appeared to be the most sensitive indicator followed by WC and BMI as it detects obesity prevalence four times more when compared with WC and BMI.[15] Nevertheless, the present study was not targeted at identifying the most preferred index for the measurement of abdominal or visceral obesity. It was rather aimed at determining the relationship between abdominal adiposity (using WHR as an indicator) and blood pressure (BP) of young adults assessing care in a typical Nigerian tertiary health facility.

Health risks based on WHR is classified into low risk, moderate risk and high risk[16]. Low risk is WHR < 0.95 and < 0.80 for men and women, respectively, whereas moderate risk is WHR of 0.96–1.00 in men and 0.81–0.85 in women. Nevertheless, high risk is recorded when WHR > 1.00 in men and > 0.85 in women[16].

In view of the increasing burden of CVDs,[17,18] a study to determine the prevalence of central obesity (using WHR as an indicator) and its correlation with BP in a young Nigerian adult population is very apt. The outcome of this study would assist in policy formulation for the control and management of CVDs.

Materials and methods

This was a descriptive cross-sectional study carried out between February and November 2015 at the General Outpatient Clinic, Federal Medical Centre, Owerri, Nigeria. A total of 482 consenting young adults aged 16–40 years who met the inclusion criteria formed the study population. Subjects on oral contraceptive pills, patients with generalised oedema and those that were very ill were excluded from the study. Simple random sampling was used in the recruitment of the respondents, whereas data were collected with the aid of a well-structured, pre-tested and interviewer-administered questionnaire. The questionnaire had two sections: A and B. Section A dealt with the demographic characteristics of the study population, whereas Section B had columns for the recording of the SBP, DBP and WHR.

With the respondents in an erect position, arms by the side and feet together, the WC was measured horizontally at a mid-point between the margin of the iliac crest and the umbilicus with a non-stretchable tape. Two separate measurements were taken at the end of normal inspiration, and the average of the two readings determined and recorded. The most commonly cited WC cut-off points for abdominal overweight are WC ≥ 94 cm and ≥ 80 cm for men and women, respectively, whereas abdominal obesity is defined as WC ≥ 102 cm for men and ≥ 88 cm for women.[19] Similarly, the hip circumference was interpreted as the mean of two measurements taken at the maximum circumference over the buttocks, precisely along an imaginary line linking the two greater trochanters. In compliance with the World Health recommendation,[19] the tape was stretch resistant and applied snuggly (without constriction) at the measurement sites. The ratio of both waist and hip circumferences was thereafter calculated as the WHR. The WHR ≥ 0.95 for men and ≥ 0.80 for women was considered as abdominal/central/visceral obesity.

Likewise, the BP measurement was taken with the subject comfortably seated, hands on the table and feet on the floor.

The mercury sphygmomanometer was placed at the level of the heart and an appropriate-sized cuff was tied on the right arm. The first and the fifth Korotkoff sounds were recorded as corresponding to the SBP and DBP, respectively. The average of the two readings taken 6 minutes apart was recorded. In this study, hypertension was defined as SBP ≥ 140 mmHg and DBP ≥ 90 mmHg.

Data were analysed using the Statistical Package for Social Sciences (SPSS) version 15.0. Mean and standard deviation (SD) were used to summarise SBP and DBP. Pearson's correlation coefficient was used to assess the relationship between independent variable (WHR) and dependent variables (SBP/DBP). Statistical significance was set at $p < 0.05$.

Ethical considerations

The ethical approval to conduct this study was obtained from the ethics and research committee of the Federal Medical Centre, Owerri. Anonymity was assured as names were not required at any stage of the study. The information obtained from the patients was treated with the utmost level of confidentiality.

Results

Table 1 shows that respondents aged 21–25 years, single subjects, students and those with secondary level of education as the highest educational level attainment constituted the largest group.

Table 2 shows that the mean WHR for the female respondents was 0.82 ± 0.04; this falls within the range that is classified as obesity.

TABLE 1: Socio-demographic characteristics of the study population.

Characteristics	Gender		
	Male	Female	Total (%)
Age group (years)			
16–20	46 (24.5)	38 (12.9)	84 (17.4)
21–25	68 (36.2)	116 (39.9)	184 (38.2)
26–30	32 (17.0)	104 (35.4)	136 (28.2)
31–35	26 (13.8)	28 (8.8)	52 (10.8)
36–40	16 (8.5)	10 (3.4)	26 (5.4)
Marital status			
Single	164 (87.2)	214 (72.8)	378 (78.4)
Married	24 (12.8)	80 (27.2)	104 (21.6)
Level of education			
No formal education	0 (0.0)	2 (0.7)	2 (0.4)
Primary	24 (12.8)	6 (2.0)	30 (6.2)
Secondary	98 (35.1)	128 (43.5)	226 (46.9)
Tertiary	66 (35.1)	158 (53.7)	224 (46.5)
Occupation			
Unemployed	12 (6.4)	34 (11.6)	46 (9.5)
Student/apprentice	124 (66.0)	176 (59.9)	300 (62.2)
Farming/petty trader	18 (9.6)	22 (75)	40 (8.3)
Civil servant	6 (3.2)	48 (16.3)	54 (11.2)
Professional	6 (3.2)	0 (0.0)	6 (1.2)
Business executives	12 (6.4)	6 (2.0)	18 (1.2)
Others	10 (5.3)	8 (2.7)	18 (3.7)
Total	**188 (39.0)**	**294 (70.0)**	**482 (100.0)**

Table 3 shows that 53.1% and 38.6% of the study population in relation to SBP were observed to be normotensive and pre-hypertensive, respectively. However, 1.2% of the respondents had stage 2 hypertension. The relationship between gender and SBP was statistically significant ($p = 0.008$).

The DBP measurement showed that 89.2% of the study population was either normotensive or pre-hypertensive (Table 4). Nevertheless, 4.1% of the respondents had stage 2 hypertension. The relationship between gender and DBP was statistically significant.

The relationship between WHR and BP was determined using Pearson's correlation analysis, whereas the test of statistical association was performed by the use of chi-square (Table 5).

The correlation analysis showed that both WHR and BP were positively correlated (SBP: $r = 0.015$, $p = 0.742$; DBP: $r = 0.122$, $p = 0.008$).

Discussion

CVD is one of the major health challenges globally. Better understanding of the risk factors and their correlates has been the priority.[20] In consideration of the above-mentioned results, the index study was aimed at determining the relationship between central obesity (using WHR as an indicator) and the BP of young adult Nigerians aged 16–40 years.

The study recorded a mean age of 25.37 ± 5.49 years and a mean WHR of 0.83 ± 0.04 and 0.82 ± 0.05 for men and women, respectively. It was observed that 59.2% of the female respondents and 8.5% of the male respondents were abdominally obese. The mean age reported in this was slightly less than the mean age of 29.44 ± 16.85 years reported by Sanya et al. at Ibadan, Nigeria[21] and 31.1 ± 0.45 years recorded by Rajasthan et al. in India[22] while working independently on a similar topic. The observed discrepancies in the mean ages could be attributed to the variation in the age groups of different target populations. For instance, although the Ibadan study recruited subjects aged 15–85 years, the index study focused on young adults aged 16–40 years.

Previous studies have shown that Asians (especially Indians) have the highest prevalence of obesity and diabetes.[21,22,23] This is further exemplified by a lower mean WHR recorded in this study when compared with findings obtained from studies carried out amongst the Indian cohort (0.90 ± 0.07 for men and 0.87 ± 0.08 for women). More so, the prevalence of central obesity recorded in a population of Indian patients with and without diabetes was 98% and 79%, respectively. The observed difference in values when compared with the present study might be attributed to the variation in body build, dietary pattern and the absence or presence of regular physical activities. Furthermore, the

TABLE 2: Group statistics of the study population.

Variable	Gender	*N*	Mean	Standard deviation	Standard error mean
Age	Male	188	25.20	6.222	0.454
	Female	294	25.48	4.981	0.290
Height	Male	188	1.7257	0.06697	0.00488
	Female	294	1.6554	0.05341	0.00311
Weight	Male	188	64.9798	8.90599	0.64954
	Female	294	61.9782	10.17959	0.59369
BMI	Male	188	22.1489	2.95404	0.21545
	Female	294	23.0837	3.82739	0.22322
Waist	Male	188	77.4787	6.23896	0.45502
	Female	294	79.8435	8.88124	0.51796
Hip	Male	188	92.7340	5.65908	0.41273
	Female	294	96.3605	7.76352	0.45278
WHR	Male	188	0.8306	0.03929	0.00287
	Female	294	0.8228	0.04914	0.00287
SBP	Male	188	119.12	14.010	1.022
	Female	294	114.56	12.597	0.735
DBP	Male	188	77.67	10.473	0.764
	Female	294	74.76	9.372	0.547

BMI, body mass index; DBP, diastolic blood pressure; SBP, systolic blood pressure; WHR, waist–hip ratio.

TABLE 3: Systolic and diastolic blood pressure classification of the study population.

Systolic BP	Gender of participants		
	Male (%)	Female (%)	Total (%)
Normal	84 (44.7)	172 (58.5)	256 (53.1)
Pre-hypertensive	82 (43.6)	104 (35.4)	186 (38.6)
Stage-1 hypertensive	20 (10.6)	14 (4.8)	34 (7.1)
Stage-2 hypertensive	2 (1.1)	4 (1.4)	6 (1.2)
Total	**188**	**294**	**482**

BP, blood pressure.
$\chi^2 = 11.839$, $df = 3$, $p = 0.008$.

TABLE 4: Diastolic blood pressure classification of the study population.

Diastolic BP	Male (%)	Female (%)	Total
Normal	84 (44.7)	160 (54.4)	244 (50.6)
Pre-hypertensive	74 (39.4)	112 (38.1)	186 (38.6)
Stage-1 hypertensive	18 (9.6)	14 (4.8)	32 (6.6)
Stage-2 hypertensive	12 (6.4)	8 (2.7)	20 (4.1)
Total	**188**	**294**	**482**

BP, blood pressure.
$\chi^2 = 9.903$, $df = 3$, $p = 0.019$.

TABLE 5: Correlation analysis of WHR and BP of the respondents.

Variable	Systolic BP	Diastolic BP
Waist–hip ratio	-	-
Correlation coefficient (*r*)	0.015	0.122
p	0.742	0.008

BP, blood pressure.

mean SBP obtained from this study was 119.12 ± 14.01 mmHg and 114.56 ± 12.59 mmHg for men and women, respectively. Similarly, the DBP was 77.69 ± 10.47 mmHg and 74.76 ± 9.37 mmHg for men and women, respectively. The observed values were similar to the findings by Odili et al.[19] who reported a mean SBP of 116.50 ± 19.96 mmHg and 111.39 ± 12.02 mmHg for men and women, respectively. Mean DBP values of 75.25 ± 11.29 mmHg for men and 72.46 ± 8.73 mmHg for women were also reported by Odili et al. Nevertheless, the crude prevalence of hypertension reported from this study was 12.7%. In addition, the study showed that the relationship between BP and sex was statistically significant ($p = 0.01$). The crude hypertensive prevalence obtained from this study was far higher than the values recorded by Odili et al. and Zafar and co-workers[18] who independently reported crude prevalence rates of 3.4% and 7.24%, respectively. It should be noted that in the Zafar study, Pakistani medical students aged 17–26 years who presented for routine physical examination formed the study population, whereas in the index study young adults aged 16–40 years constituted the target population. The variation in the age groups of the two studies could be accountable for the observed differences in the prevalence rates as it has been proven that BP increases with age. Relatively, a high prevalence of hypertension was reported in this study; however, the value was less than the hypertensive prevalence rates reported by Ahaneku et al. (44.5%)[25] and Onuoha and co-workers (21.5%).[26] The influence of age on BP could once more be brought to fore while seeking for a possible explanation for the difference in values between findings by Ahaneku et al. and Onuoha et al. when compared with the index study as older adults (> 60 years) were recruited into the above-cited studies when compared with the present study that had subjects aged 16–40 years as the target population.

Furthermore, correlation analysis of WHR and BP showed that both variables were positively correlated ($r = 0.015$ for SBP and $r = 0.122$ for DBP). This finding is in tandem with the outcome of the study performed by Blair et al.[20] that posited that central obesity and excess fat are strong positive predictors of hypertension and risk of coronary heart disease. Nevertheless, a study on WHR during a comprehensive cardiovascular survey in an urban Indian population recorded a similar finding ($r = 0.11$).[21]

In summary, the present study in tandem with similar studies carried out globally reported a high prevalence of abdominal obesity (using WHR) and was also able to establish a correlation between WHR and elevated BP.

Conclusion and recommendation

The study recorded a high prevalence of central obesity amongst the study population. It further showed that there was a correlation between central obesity and BP. Armed with the above information, every contact with a young obese adult should serve as a gateway towards routine screening for hypertension as early detection could lead to a better control of hypertension and a reduction in the scourge of CVD-related morbidity and mortality.

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Competing interests

The authors declare that they have no financial or personal relationships which may have inappropriately influenced them in writing this article.

Authors' contributions

All authors equally contributed to the research and writing of this article.

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