Saudi Journal of Medical and Pharmaceutical Sciences
Scholars Middle East Publishers
Dubai, United Arab Emirates
Website: https://saudijournals.com/ DOI: 10.36348/sjmps.2017.v03i04.001

ISSN 2413-4929 (Print)
ISSN 2413-4910 (Online)

Original Research Article

Associations of Anthropometric Variables of Obesity with Blood Pressure and Gender Disparities Observed in a Referral Hospital in the Niger Delta of Nigeria

Tamaraemumoemi Emmanuella Ambakederemo[1]*, Sotonye Tamunobelema Dodiyi-Manuel[2]
[1]Department of Internal Medicine, Niger Delta University Teaching Hospital, Okolobiri, P.M.B 1 Yenagoa, Bayelsa, Nigeria
[2]Department of Internal Medicine, University of Port Harcourt Teaching Hospital, Choba, Port Harcourt, Rivers, Nigeria

***Corresponding Author:**
Tamaraemumoemi Emmanuella Ambakederemo
Email: nuellaokoro@gmail.com

Abstract: Studies on gender disparities of traditional cardiovascular risks such as anthropometric factors are limited in black Africans. We aimed to examine the relationship between anthropometric parameters and blood pressure (BP) and possible gender differences in hypertensive adult Nigerians. A cross sectional study was carried out involving 261 adult hypertensive patients recruited consecutively at the medical out-patient clinic of Niger Delta University Teaching Hospital. They comprised 118 males and 143 females aged 26years to 94years. Their BP and anthropometric measurements were assessed using standard protocols. More than 70% of subjects were either overweight or obese. Females had significantly higher WC, WHtR and BMI than males. For females, BP had a significant positive correlation with anthropometric measures and a regression analysis showed BMI in females was the most important anthropometric index in predicting systolic BP (SBP) and diastolic BP (DBP). For males, none of the anthropometric measures correlated with SBP or DBP. Female hypertensives were significantly more obese than males. Indices of adiposity in females had a direct relationship with BP but not so in males. Further studies are needed to assess gender disparities in cardiovascular risk factors.

Keywords: anthropometry, blood pressure, gender differences, hypertensives, Nigerians, obese

INTRODUCTION

Obesity is without any doubt an established risk factor for hypertension and both obesity and hypertension are risk factors for cardiovascular diseases [1-4]. An estimated one billion people worldwide are hypertensive [5]. More than 40% of Africans are hypertensive [6]. Weight loss through dietary adjustments and aerobic exercises results in significant reductions in blood pressure (BP) in hypertensive patients[7]. In school children, anthropometric indices have been shown to have a direct relationship to the systolic and diastolic blood pressures [8, 9]. Several studies have also found significant associations between hypertension and anthropometric indices in adults [10,11]. Body mass index (BMI) is the most cited index for obesity, reason being that it gives an approximation of adiposity and fat distribution. However, for abdominal adiposity, waist circumference, waist-to-hip ratio and waist-to-height ratio are used as markers [12-16].

Some studies have shown that certain anthropometric indices had the strongest relationship with BP or hypertension and that gender differences exist. A study by Sakurai *et al* [17] showed waist circumference had the strongest association with BP in men while BMI had the strongest association with BP and hypertension in women. However, their study and several other studies [11,17-20] have focused on Asians and Caucasians in their research with not too many studies on associations of anthropometric indices with hypertension in Africans and possible gender differences.

This study aimed at investigating gender differences in associations of four anthropometric variables of obesity with blood pressure (BP) in black hypertensive adults seen at the cardiology clinic of Niger Delta University Teaching Hospital in Southern Nigeria.

MATERIALS AND METHODS

Approval and Consent was obtained from the ethical committee of Niger Delta University Teaching Hospital (NDUTH) Okolobiri and only patients who gave consent were recruited for the study. A cross sectional study was done involving 261 adult hypertensive patients recruited consecutively at the cardiology clinic of Niger Delta University Teaching Hospital. The NDUTH is a 170 bed tertiary hospital situated in Okolobiri, a semi-urban city in the Bayelsa State, Nigeria. Demographic and clinical data were obtained from subjects. Anthropometric measurements (BMI, WC, WHtR and WHpR) were also taken. Height was measured in meters (m) using a height–o–meter with the subject standing without shoes, feet together, back and heel against a vertical ruled bar to which a movable horizontal bar was attached. During measurement, the horizontal bar was brought to the vertex of each subject's head and the reading at this level was taken to the nearest millimeter. Weight was measured in kilograms (kg) with the subject wearing only light clothing. A weight scale (Pyrochy medical, England) was used. It was standardized against a fixed weight. Body mass index (BMI) was calculated as weight in kg divided by the square of the height in meters (kg/m^2). Obesity was defined as BMI of ≥30 kg/m^2 following the Standard Treatment guidelines of Nigeria [21]. BMI of <18.9kg/m^2, 18.5-24.9kg/m^2, 25-29.9kg/m^2 were characterized as underweight, normal and overweight respectively. Waist and hip circumferences were obtained using a tape measure. The waist circumference was measured at the level of the umbilicus [22] using a stretch resistant tape, the hip circumference around the widest portion of the buttocks with the tape parallel to the floor. Measurements were taken at the end of normal expiration and repeated twice. If measurements were within 1cm of another, the average was calculated and used. If the difference exceeded 1cm the measurements were repeated. The waist/hip ratio was calculated as the waist circumference divided by the hip circumference. A waist hip ratio of ≥0.9 and ≥0.85 were regarded as abnormal in males and females respectively [23]. The waist height ratio was calculated as the waist circumference over the height both in centimeters. Waist circumference ≥102 cm for men and ≥88 cm for women were regarded as elevated and indicative of abdominal obesity [21]. A waist to height ratio (WHtR) of ≥0.5 was regarded as high risk [15, 24]. The blood pressure was measured on the same occasion as the anthropometric measurements, using Accoson mercury sphygmomanometer to determine the brachial artery systolic and diastolic blood pressures at Korotkoff 1 and 5 respectively in sitting position after 30 minutes rest, with the arm at heart level and readings taken at the nearest 2mmHg. Blood pressure readings were based on the JNC VII classification and guidelines [5]. Hypertension was defined as persistently elevated systolic and/or diastolic blood pressure ≥140/90 mmHg or documented use of antihypertensive medications in a previously diagnosed person with hypertension [5].

The data obtained was analyzed using SPSS version-20 for Windows. Descriptive statistics was used to summarize measurement as frequencies (%), means and standard deviations (SD). Continuous variables were expressed as means ± standard deviation, and categorical variables as percentages. Chi-square test was made use of in determining the statistical significance of associations between categorical variables while the student t-test was used to determine the difference between two means. The differences between groups were compared using one way analysis of variance (ANOVA). Alpha level was set as $p<0.05$. Correlation was assessed using Pearson correlation coefficient. A p-value of less than or equal to 0.05 was considered significant. Multiple regression analysis with adjustment for age, was used to assess the predictability of WC, WHtR, WHpR and BMI on hypertension in both sexes.

RESULTS

There were 118 male and 143 hypertensive females respectively (male/female ratio 0.8:1). Table 1 shows the characteristics of study participants. The mean WC was higher than normal in females and mean WHpR, WHtR, BMI, SBP, DBP of both male and female subjects were above normal limits. Females had significantly higher WC, WHtR and BMI than males (Table 2). Most of the females were either obese (n69/48.25%, mean BMI 35.82Kg/m^2±4.82) or overweight (n46/32.17%, mean BMI 27.47 Kg/m^2±1.55). The males were mostly overweight (n48/40.68%, mean BMI 27.01Kg/m^2±1.39) and obese (n29/24.58%, mean BMI 32.98Kg/m^2±2.29). For males, none of the anthropometric measures correlated with SBP or DBP. For females, SBP had a significant positive correlation with all four anthropometric measures while DBP had a significant positive correlation with BMI, WC and WHtR. (Table 3). Regression analysis as shown in table 4 shows BMI in females predicted both high systolic BP (0.005*) and diastolic BP (0.000*), and was the most important anthropometric index in predicting SBP and DBP in females followed by WC as well as WHtR (fig 1).

Table 1: Descriptive characteristics of study participants

	Mean	Minimum	Maximum
AGE	57±13	26	94
WC	97.84±13.24	64.00	137.00
WHpR	0.94±0.08	0.70	1.20
WHtR	0.60±0.09	0.37	1.07
BMI	28.84±5.95	17.99	49.77
SBP	167.55±25.93	120.00	290.00
DBP	101.64±16.29	60.00	160.00

Table 2: Male and Female descriptives and statistical differences

	Male (*n*=118)			Female (*n*=143)			
Variable	Mean	Min	Max	Mean	Min	Max	P value
AGE	58±15	26	94	56±11	31	90	0.276
WC	94.31±11.89	66.00	130.00	100.76±13.62	64.00	137.00	0.000
WHpR	0.94±0.07	0.73	1.11	0.94±0.08	0.70	1.20	0.305
WHtR	0.56±0.08	0.37	1.07	0.64±0.09	0.41	0.89	0.000
BMI	26.67±4.61	17.99	37.57	30.63±6.34	18.90	49.77	0.000
SBP	166.71±24.49	120.00	240.00	168.24±27.12	120.00	290.00	0.970
DBP	101.08±16.77	60.00	160.00	102.10±15.93	70.00	150.00	0.604

Table 3: Correlation between blood pressure and anthropometric variables

	Male (*n*=118)		Female (*n*=143)	
Variable	**SBP**	**DBP**	**SBP**	**DBP**
WC	-0.002 (0.985)	0.057 (0.541)	0.167 (0.046)*	0.282 (0.001)**
WHpR	.030 (0.747)	-0.021 (0.825)	0.165 (0.048)*	0.093 (0.269)
WHtR	.034 (0.716)	-0.009 (0.923)	0.191 (0.022)*	0.252 (0.002)**
BMI	-0.031 (0.740)	0.062 (0.503)	0.232 (0.005)**	0.320 (0.000)**

R=Pearson correlation coefficient.
*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed).

Table 4: Regression analysis examining the independent contribution of age and anthropometric measures (WC, WHpR, WHtR and BMI) to SBP and DBP in men and women

Dependent variable	Model	Men			Women		
		β	R^2	P-value	β	R^2	P-value
SBP	**Age (years)**	0.045	0.001	0.767	-0.119	0.003	0.550
	WC (cm)	-0.004	0.000	0.985	0.332	0.028	0.046*
	WHpR	10.550	0.001	0.747	55.349	0.027	0.048*
	WHtR	10.300	0.001	0.716	57.898	0.037	0.022*
	BMI (kg/m^2)	-0.164	0.001	0.740	0.993	0.054	0.005*
DBP	**Age (years)**	-0.340	0.092	0.001*	-0.124	0.008	0.289
	WC (cm)	0.080	0.003	0.541	0.329	0.079	0.001*
	WHpR	-4.955	0.000	0.825	18.294	0.009	0.269
	WHtR	-1.874	0.000	0.923	44.785	0.063	0.002*
	BMI (kg/m^2)	0.226	0.004	0.503	0.805	0.102	0.000*

* = Significant at 95% Confidence Interval; $P \leq 0.05$, β = Beta unstandardized coefficient, R^2 = Coefficient of determination, P-value = Probability value

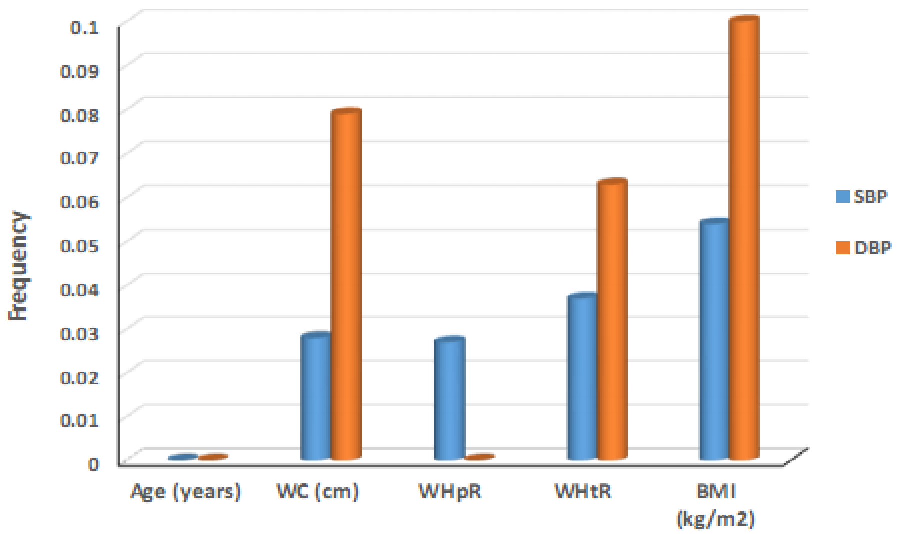

Fig-1: Predictability of anthropometric parameters for blood pressure (females)

DISCUSSION

Most of the subjects in this study were overweight or obese. There is a growing prevalence of being overweight or obese worldwide with associated increases in occurrence of hypertension [25]. Obesity, physical inactivity and hypertension occurring in combination are frequent cardiovascular risk factors among Nigerians [26]. Several studies have shown significant relationships between blood pressure (BP) and anthropometric indices in different populations' [8,11,27-32], including non-obese persons [27]. However, these relationships are poorly understood [31] and correlation coefficients were constantly found to be small [33, 34] indicating possibly a complex relationship between anthropometric indices and blood pressure. In our study, there was a positive correlation of anthropometric indices with blood pressure in women but not in men, with BMI having the strongest association with BP in women. Sex differences in associations of anthropometric indices with blood pressure have been observed by several investigators [17,27]. Sakurai *et al* [17], found BMI had the strongest association with BP and hypertension in women. In comparison with European women, black women in South Africa had less abdominal adipose tissue as determined by dual x-ray absorptiometry (DEXA) at the same waist circumference [35] indicating anthropometric measurements may also differ along race lines. A study by Adedoyin RA [10] showed six times greater risk of hypertension among obese women than their counterparts with normal weights while obese men had three times greater risk of hypertension than men with normal weight. Hu et al also found risk ratios of hypertension at BMI <25, 25–29.9, and ≥ 30 to be 1.00, 1.18, and 1.66 for males; and 1.00, 1.24, and 1.32 for females, respectively. Females may have significantly higher BMI than their male counterparts [2,10,36,37].

In our study, BMI in females predicted both high systolic BP (0.005*) and diastolic BP (0.000*), and was the most important anthropometric index in predicting SBP and DBP in females followed by WC as well as WHtR (fig 1) though with relatively poor accuracy (R^2 = 0.054 & 0.102 respectively). Anthropometric indices may predict elevated blood pressure in normotensive and hypertensive adults [10, 27].

CONCLUSION

There may be gender differences in the association between BP and anthropometric variables of obesity possibly because of differences in anthropometric measures in males and females. Some anthropometric indices may have stronger associations with BP than others. Appropriate weight loss programs should be emphasized by physicians as part of the management protocol for hypertension.

ACKNOWLEDGEMENT

The authors are grateful to the patients for their consent to be part of the study. We also thank the doctors and nurses in the department of Internal medicine at Niger Delta University Teaching Hospital for all of their kind assistance.

REFERENCES

1. Kannel, W. B., Brand, N., Skinner, J. J. Jr., Dawber, T. R., & McNamara, P. M. (1967). The relation of adiposity to blood pressure and development of hypertension: the Framingham study. *Ann Intern Med, 67*, 48–59.
2. Abiodun, A. G., Egwu, M., & Adedoyin, R. A. (2011). Anthropometric Indices Associated with Variation in Cardiovascular Parameters among Primary School Pupils in Ile-Ife. *International Journal of Hypertension*, 1-5.
3. Iloh, G. P., Ikwudinma, A. O., & Obiegbu, N. P. (2013). Obesity and its cardio-metabolic co-morbidities among adult Nigerians in a primary care clinic of a tertiary hospital in South-Eastern Nigeria. *J Fam Med Primary Care, 2*, 20-26.
4. Barbosa, A. R., Souza, J. M. P., Lebrão, M. L., Laurenti, R., & Marucci, M. F. N. (2005). Anthropometry of elderly residents in the city of São Paulo, Brazil. *Cad Saúde Pública, 21*(6), 1929-1938.
5. Chobanian, A. V., Bakris, G. L., Black, H. R., Cushman, W. C., Green, L. A., & Izzo, J. L. (2003). Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension*, (42),1206-1252.
6. Addo, J., Smeeth, L., & Leon, D. A. (2007). Hypertension in sub-Saharan Africa: a systematic review. *Hypertension, 50*(6), 1012-8,
7. U.S. Department Of Health And Human Services. (2006). Your Guide to Lowering Your Blood Pressure With DASH. *National Institutes of Health, National Heart, Lung, and Blood Institute*, NIH Publication No. 06-4082, Originally Printed 1998 Revised April 2006.
8. Akor, F., Okolo, S. N., & Okolo, A. A. (2010). Blood pressure and anthropometric measurements in healthy primary school entrants in Jos, Nigeria. *SA Journal of Child Health, 4* (2), 42-45.
9. Balogun, J. A., Obajuluwa, V. A., & Abereoje, O. K. (1990). Anthropometric determinants of resting blood pressure and heart rate of Nigerian school children. *Annals of Tropical Pediatrics, 10* (4), 425–431.
10. Adedoyin, R. A., Mbada, C. E., Bisiriyu, L. A., Adebayo, R. A., Balogun, M. O., & Akintomide, A. O. (2008). Relationship of anthropometric indicators with blood pressure levels and the risk of hypertension in Nigerian adults. *International Journal of General Medicine, 1*, 33–40.

11. Latiffah, A. L., & Hanachi, P. (2008). To investigate the relation of hypertension and anthropometric measurement among elderly in Malaysia. *Journal of applied sciences, 8*(21), 3963-3968.
12. Ross, R., Leger, L., Morris, D., de Guise, J., & Guardo, R. (1992). Quantification of adipose tissue by MRI: relationship with anthropometric variables. *J Appl Physiol, 72*, 787–795
13. Taylor, R. W., Jones, I. E., Williams, S. M., & Goulding, A. (2000). Evaluation of waist circumference, waist-to-hip ratio, and the conicity index as screening tools for high trunk fat mass, as measured by dual-energy X-ray absorptiometry, in children aged 3-19 years. *Am J Clin Nutr, 72*, 490-5.
14. Maffeis, C., Banzato, C., & Talamin, G. (2008). Obesity Study Group of the Italian Society of Pediatric Endocrinology and Diabetology. Waist-to-height ratio, a useful index to identify high metabolic risk in overweight children. *J Pediatr, 152*, 207-13.
15. Ashwell, M., & Hsieh, S. D. (2005). Six reasons why the waist-to-height ratio is a rapid and effective global indicator for health risks of obesity and how its use could simplify the international public health message on obesity. *Int J Food Sci Nutr, 56*, 303-307.
16. McCarthy, H. D., & Ashwell, M. (2006). A study of central fatness using waist-to-height ratios in UK children and adolescents over two decades supports the simple message--'keep your waist circumference to less than half your height'. *Int J Obes (Lond), 30*, 988-992.
17. Sakurai, M., Miura, K., Takamura, T., Ota, T., Ishizaki, M., Morikawa, Y., & Kido, T. (2006). Gender Differences in the Association between Anthropometric Indices of Obesity and Blood Pressure in Japanese. *Hypertens Res, 29*, 75–80.
18. Dalton, M., Cameron, A. J, & Zimmet, P. Z. (2003). On behalf of the Audsdiab Steering Committee 2003: Waist circumference, waist hip ratio and body mass index and their correlation with cardiovascular disease risks in Australian adults. *J Intern Med, 254*, 555–563.
19. Ho, S. Y., Lam, T. H., & Janus, E. D. (2003). Waist to stature ratio is more strongly associated with cardiovascular risk factors than other simple anthropometric indices. *Ann Epidemiol, 13*, 683–691.
20. Zhu, S. K., Wang, Z. M., Heshka, S., Heo, M., Faith, M. S., & Heymsfield, S. B. (2002). Waist circumference and obesity-associated risk factors among whites in the third National Health and Nutrition Examination Survey: clinical action thresholds. *Am J Clin Nutr, 76*, 743–749.
21. Federal ministry of Health Nigeria. (2008). *Standard Treatment Guidelines of Nigeria*.
22. Ross, R., Berentzen, T., Bradshaw, A. J., Janssen, I., Kahn, H. S., & Katzmarzyk, P. T. (2008). Does the relationship between waist circumference, morbidity and mortality depend on measurement protocol for waist circumference? *Obes Rev, 9*(4), 312-25
23. World Health Organization. (1998). Obesity: preventing and managing the global epidemic. Report of a WHO consultation on obesity. WHO, Geneva. PMID 112344.
24. Hsieh, S. D., Yoshinaga, H., & Muto, T. (2003). Waist-to-height ratio, a simple and practical index for assessing central fat distribution and metabolic risk in Japanese men and women. *Int J Obes, 27*, 610–616.
25. Brown, C. D., Higgins, M., Donato, M. O., Rohde, F. C., Garrison, R., & Obarzanek, N. D. (2000). Body mass index and prevalence of hypertension and dyslipidaemia. *Obes Res, 8*, 605-619.
26. Iloh, G. U. P., Chuku, A., Obiegbu, N. P., Ofoedu, J. N., & Ikwudinma, A. O. (2013). Frequency of Cardiovascular Risk Factors in Adult Nigerians with Family History of Non-Communicable Cardiovascular Disease in a Primary Care Clinic of a Tertiary Hospital in a Resource-Constrained Environment of Eastern Nigeria. *American Journal of Health Research, 1* (1), 17-25.
27. Sharaye, K. O., Olorunshola, K. V., Ayo. J. O., & Dikki, C. E. (2014). Correlation of obesity indices and blood pressure among non-obese adults in Zaria, Northern Nigeria. *Journal of Public Health and Epidemiology, 6*(1), 8-13.
28. Sanya, A. O., Ogwumike, O. O., Ige, A. P., & Ayanniyi, O. A. (2009). Relationship of Waist-Hip Ratio and Body Mass Index to Blood Pressure of Individuals in Ibadan North Local Government. *Afr. J. Physiother. Rehabilitation Sci, 1*, 7-11.
29. Kjeldsen, S. E., Lisa, N., Stefano, P., Walter, Z., & Csaba, F. (2008). Increase prevalence of metabolic syndrome in uncontrolled hypertension across Europe: The global cardiometabolic risk profile in patients with hypertension disease survey. *J. Hypertens, 26*, 2064-2070.
30. Duvnjak, L., Tomislav, B., & Željko, M. (2008). Hypertension and the metabolic syndrome. *Diabetologia Croatica, 37*, 85-91.
31. Olatunbosun, S. T., Kaufman, J. S., & Cooper, R. S. (2000). Hypertension in a black population: prevalence and biosocial determinants of high blood pressure in a group of urban Nigerians. *J Hum Hypertens, 14*, 249–57.
32. Kaufman, J. S., Asuzu, M. C., & Mufunda, J.l (1997). Relationship between blood pressure and body mass index in lean populations. *Hypertension, 30*, 1511–16.
33. Hsieh, S. D., Yoshinaga, H., & Muto, T. (2000). Health risks among Japanese men with moderate body mass index. *Int J Obes Relat Metab Disord, 24*, 358–362.

34. Shahbazpour, N. (2003). Prevalence of overweight and obesity and their relation to hypertension in adult male university students in Kerman, Iran. Int *J Endocrinol Metab, 2,* 55–60.
35. Rush, E. C., Goedecke, J. H., Jennings, C., Micklesfield, L., & Dugas, L. D. (2007). BMI, fat and muscle differences in urban women of five ethnicities from two Countries. *International Journal of Obesity, 31*(8), 1232- 1239,
36. Adediran, O. S., Adebayo, P. A., & Akintunde, A. A. (2013). *Anthropometric differences among natives of Abuja living in urban and rural communitie*s: correlations with other cardiovascular risk factors. BMC Research Notes, 6, 123
37. Adeoye, A. M., Adebiyi, A., Tayo, B. O., Salako, B. L., Ogunniyi, A., & Cooper, R. S. (2014). Hypertension Subtypes among Hypertensive Patients in Ibadan. *International Journal of Hypertension 2014*; Article ID 295916,6 pages http://dx.doi.org/10.1155/2014/295916