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Research Paper

Analysis of Obesity Indices in Predicting Some Traditional Cardiovascular Risk

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ABSTRACT
Background: *The prevalence of cardiovascular disease associated mortality is on increase in the developing countries due to lifestyle modification. This is a cross-sectional study that examined the best anthropometric index in apparently healthy adults in Ogbomoso.*
Methods: *The study was carried out in Ogbomoso, Oyo state, Nigeria. Anthropometric data, blood pressure (BP), fasting plasma glucose (FPG) and lipid profile were obtained using standard procedures. The bench marks for the variables were according to International Diabetes Federation (IDF) and Joint Interim Statement (JIS) criteria. ≤0.5 is set for normal values of waist:height ratio (WHtR) while >0.5 is abnormal.*
Results: *A total of 441 apparently healthy subjects aged 18-60 (178 males and 263 females) participated in the study. The mean age of the males was statistically higher than the females (37.92±11.80 vs 34.72±12.16, p=0.006). Blood pressure, pulse rate, height and other obesity indices apart from waist circumference were all significantly higher in the males. There was significant relationship between all the indices of obesity and the cardiovascular risk factors apart from TG and HDLC*
Conclusion: *Anthropometric data will be most beneficial in categorizing and starting prompt management in patients with cardiovascular risk. Furthermore the waist to height ratio requires just an inexpensive, in-elastic,afordable and available tape measure rather than weight measurement in BMI.*
Keywords: Cardiovascular risk, rural, obesity, waist circumference, weight to height ratio

I. INTRODUCTION

Cardiovascular diseases have been a major health problem in the developed world and more people die from cardiovascular diseases than from other non-communicable diseases globally [1]. Although thought to be a disease of the developed world alone, data has shown that over 80% of all deaths due to cardiovascular diseases are from low and middle income countries [1]. The influential lifestyles of the developed countries are now being copied by the developing countries and with it the trend of cardiovascular diseases [2, 3]. Some risk factors have been identified to predispose to the chances of developing cardiovascular diseases. And while some of them are not modifiable such as age, gender, and heredity, some are modifiable like obesity, hypertension, cigarette and alcohol intake, lipid profile, and diet [4].

The indices of obesity (measured with Body Mass Index, waist circumference, and weight to height ratio) have been observed to be strongly associated with cardiovascular risk [5–9]. Studies over the years in different parts of the world shows these association [7, 9–11] and as attempts to reduce the burden of cardiovascular diseases are being made, obesity as a modifiable risk factor can be targeted. Body mass index (BMI) is a measure of general obesity while waist circumference (WC) and waist to height ratio (WHtR) are used to measure central obesity, with the latter suggested to be the indicator for the prediction of cardiovascular risks [12–16].

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While these studies have shown the association of obesity indices and cardiovascular risks, it is still not established the indices with the strongest association with cardiovascular risk. Hence, this study examines the obesity indices with the strongest association with cardiovascular risk factor in a sample adult Nigerian population.

II. MATERIALS AND METHODS

The study was carried out in Ogbomosho community in and around the Teaching hospital, Oyo State, Nigeria. The study population consisted of students and civil servants.

We excluded subjects who were pregnant and/or breast feeding; those with clinical thyroid disease; those diagnosed to have hypertension, diabetes, or hyperlipidaemia prior to the commencement of the study; those on blood-pressure, blood-glucose or lipid-lowering medications; those on weight-control medications or supplements; and those who declined to participate in the study.

The study was in two stages. The first stage involved explaining the aims of the study, the inclusion and exclusion criteria and the study protocol to the participants. The subjects who met the criteria for the study and agreed to participate in the study were then asked to proceed to the second stage of the study which took place at the Metabolic Clinic Laboratory of LAUTECH Teaching Hospital, Ogbomosho, Oyo state, Nigeria. Participants were instructed to fast overnight (8-12 hours). On presentation at the Metabolic Clinic Laboratory, participants were required to complete a structured questionnaire to obtain socio-demographic information such as gender, age, smoking status, alcohol intake status, and family history of hypertension, diabetes, and hyperlipidaemia.

The weight (kg) to the nearest 0.1kg and height (m) to the nearest 0.1cm were obtained with the participants in light clothing and without shoes using the stadiometer and weighing scale (Heightiometer and weighing scale Lincoln Mark Medical, England) respectively. The body mass index was calculated (kg/m^2). Body mass index was classified according to WHO classification [17]. Waist circumference (WC) was measured midway between iliac crest and lowest rib and hip circumference (HC) at the level of the greater trochanters using a non-stretchable tape measure. The waist:height ratio was calculated by dividing the WC by the Ht (i.e. WC/Ht). The blood pressure (BP) and pulse rate (PR) of the participants were obtained using A&D UA767 digital monometer which has been validated by the British Hypertension Society [18]. Blood pressure was taken using appropriate cuff after ensuring that the participant had rested.

10ml of venous blood specimens were obtained by venipuncture under sterile condition and dispensed into lithium heparinized as well as floride oxalate specimen bottles. Blood samples were centrifuged using a benchtop centrifuge at 3000rpm for 5 minutes and the plasma stored until laboratory analysis. Fasting plasma glucose was obtained using the glucose oxidase method. Concentration of total cholesterol (TC), its fractions and trigycerides (TG) were assessed enzymatically using commercially available reagents (Randox Laboratories Ltd, UK) [19]. The HDL-c was determined from the supernatant after other fractions were separated by precipitation techniques using sodium phosphotungstate and magnesium chloride [19]. The concentration of low density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald equation for participants with TG level <4.5 mmol/L [20]. Accuracy was ensured using commercial quality control sera. Participants with abnormal BP readings, lipid profile and FPG re-checked. Participants with any persistent abnormal findings were counseled and referred to the health facility of their choice.

Statistical analyses

Categorical variables were expressed as proportions and continuous variables as means ± standard deviation. Comparisons between 2 d >/=3 continuous variables were analyzed using the student t-test and regression respectively. All p values were two-tailed, and values </=0.05 were considered as being statistically significant. All statistical analyses were done using the Statistical Package for Social Sciences (SPSS) software, version 16 (SPSS, Chicago, IL).

III. RESULTS

A total of 441 subjects aged 18-60 years were recruited for the study – 178 males and 263 females. The mean age of the males was statistically higher than the females (37.92±11.80 vs 34.72±12.16, p=0.006). Blood pressure, pulse rate, height and other obesity indices apart from waist circumference and WHtR were all significantly higher in the males than in the females (Table 1).

Table 1: Gender distribution of cardiovascular risk factors of the subjects

Variable	Total n=441	Male n=178	Female n=263	*p* – value
Age	36.01±12.10	37.92±11.80	34.72±12.16	0.006*
Weight	70.14±17.00	70.74±16.36	69.74±17.43	0.546
Height	1.63±0.08	1.67±0.08	1.60±0.06	< 0.001*
BMI	26.60±6.83	25.30±6.01	27.48±7.22	0.001*
WC	86.46±15.73	86.07±14.83	86.72±16.33	0.668
SBP	125.86±23.01	131.44±22.24	122.09±22.79	< 0.001*

DBP	78.46±13.99	80.33±14.09	77.19±13.80	0.021*
PR	77.08±13.32	75.14±14.47	78.39±12.33	0.012*
WHtR	0.53±0.01	0.52±0.09	0.55 ±0.01	0.004*
FPG	5.26±1.68	5.40±1.81	5.16±1.58	0.128
TC	4.52±1.46	4.64±1.48	4.44±1.44	0.143
TG	0.97±0.30	1.18±0.35	0.82±0.50	0.215
HDL – C	1.52±0.58	1.25±0.50	1.70±0.46	0.432
LDL – C	3.11±1.58	3.25±1.64	3.02±1.54	0.123

BMI = Body Mass Index, WC = Waist circumference, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, TC = Total Cholesterol, HDL–C = High density lipoprotein–Cholesterol, LDL–C = Low density lipoprotein–Cholesterol, TG = Triglycerides, PR =Pulse Rate, FPG = Fasting Plasma Glucose
**Statistical Significant*

Table 2 presents the family history and the categorized characteristics of the subjects. Here, there is significant difference in the BMI between the sexes for all categories, of particular note is the fact that more than half (55.5%) of the female subjects have abnormal BMI as opposed to 42.1% of the males. Also, the female subjects with abnormal waist circumference are more their male counterparts (41.8% vs 16.3%, $p = < 0.001$).

Table 2: Socio-demographic and some clinical parameters of the subjects

Variable	**Male n (%)**	**Female**	***p*–value**
Occupation			
Civil servant	115 (64.6)	156 (59.3)	0.154
Student	63 (35.4)	107 (40.7)	
BMI			
Underweight	7 (3.9)	8 (3.0)	0.005*
Normal	103 (57.9)	117 (44.5)	
Overweight	37 (20.8)	53 (20.2)	
Obesity	31 (17.4)	85 (32.3)	
Abnormal WC	29 (16.3)	110 (41.8)	< 0.001*
Abnormal TC	52 (29.2)	66 (25.1)	0.198
Abnormal TG	13 (7.3)	15 (5.7)	0.314
Abnormal HDL – C	31 (17.4)	52 (19.8)	0.311
Abnormal LDL – C	73 (41.0)	95 (36.1)	0.174
Family history of HTN	43 (24.2)	43 (16.3)	0.125
Family history of DM	18 (10.1)	24 (9.1)	0.858

*TC = Total Cholesterol, HDL–C = High density lipoprotein–Cholesterol, LDL–C = Low density lipoprotein–Cholesterol, TG = Triglycerides, HTN = Hypertension, DM = Diabetes Mellitus, BMI = Body Mass Index *Statistical Significant* There was significant relationship between all the indices of obesity and the cardiovascular risk factors apart from TG and HDLC (Table 3).

Table 3: Regression Analysis For Risk Factor Levels On Wc, Whtr And Bmi

Variables	**BMI**	**Waist/Height Ratio**	**Waist circumference**
	Regression coefficient (p-value)	Regression coefficient (p-value)	Regression coefficient (p-value)
FPG	0.13 (0.006*)	0.17 (<0.0001*)	0.18 (<0.0001*)
TC	0.32 (<0.0001*)	0.35 (<0.0001*)	0.34 (<0.0001*)
TG	0.007 (0.872)	-0.0007 (0.987)	-0.006 (0.903)
HDLC	0.03 (0.571)	-0.02 (0.652)	0.03 (0.491)
LDLC	0.33 (<0.0001*)	0.37 (<0.0001*)	0.36 (<0.0001*)
SBP	0.33 (<0.0001*)	0.32 (<0.0001*)	0.36 (<0.0001*)
DBP	0.39 (<0.0001*)	0.40 (<0.0001*)	0.42 (<0.0001*)

FPG = Fasting Plasma Glucose, TC = Total Cholesterol, HDL–C = High density lipoprotein–Cholesterol, LDL–C = Low density lipoprotein–Cholesterol, TG = Triglycerides, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure.
**Statistical Significant*

IV. DISCUSSION

This study aimed to assess the most reliable predictor of cardiovascular diseases amidst the various indices of obesity as a form of first hand pointer while waiting for laboratory results of the cardiovascular risk markers such as lipid profile and also blood pressure. The female subjects in this study were more than their male counterpart and this is common to other studies carried out in the country [21, 22] which could be due to

the fact that there are more females in the Nigerian population than males and also due to the willingness of the females to be questioned and follow up than the males [23].

The distribution of the age of the subjects shows that almost all were less than 55 years old as would be expected in a community in and around a Teaching hospital mostly populated by civil servants and students. The mean blood pressure of the male subjects is also higher. This is in concert with other findings by Adeoye *et al* in a study of 352 health workers in Ibadan, Nigeria [24] and by Wokoma and Alasia in Barako, a rural community in Rivers state [25]. Our present study reported the waist to height ratio to be higher in the females; this is in concert with studies by Ajani *et al* [26] and Pam *et al* [27]. Using BMI as a measure of central obesity, the females were more at risk of cardiovascular disease as was revealed in a study [27], our study corroborate this finding.

Using waist height ratio and waist circumference to predict the risk of cardiovascular diseases was more significant than using BMI according to our study; this suggests that central obesity predicts the risk of cardiovascular disease more than generalized obesity and when considering cardiovascular risk in a patient, instead of measuring weight, checking the waist circumference could be more beneficial. Although waist to height ratio has been reported to predict more efficiently the risk for other diseases [28, 29].

Moreover, in developing countries with many remote communities where laboratory results and reports are either not accessible or received after a long delay, this anthropometric data will be most beneficial in categorizing and starting prompt management in patients with cardiovascular risk. Furthermore the waist to height ratio requires just an inexpensive in-elastic and available tape measure rather than weight measurement in BMI.

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