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A Pilot Correlative Study of Anthropometric Indices with Lipid Parameters in Normal Weight, Overweight and Obese Participants in Port Harcourt Metropolis

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Aim: The study was aimed at correlative and comparative assessment of anthropometric indices and lipid parameters in normal weight, overweight and obese individuals as a means of evaluating their cardiovascular risks.

Study Design: A pilot study was carried out in Port Harcourt Metropolis in Rivers State, Nigeria. The study was conducted within a period of 4 months (June – September, 2018). A total of 82 participants were selected from the recruitment process after consenting to participant in the study. Anthropometric measurements and lipid parameters analysis were done at the Department of Medical Laboratory Science, Rivers State University, Port Harcourt, Nigeria.

Methodology: 5mls of fasting blood samples were collected into lithium heparin bottles and spun at 3000 rpm for 5 minutes to obtain plasma. Total cholesterol (TC) and Triglyceride (TG) were analysed based on enzymatic methods. High density lipoprotein (HDL) was analysed using precipitation and enzymatic method while low density lipoprotein (LDL) was calculated using Friedewald equation. Anthropometric measurements were collected using stadiometer, non-stretchable tape and weighing scale.

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Results: Significant increases were seen in lipid parameters (HDL-C indicated a decrease) as well as in BMI, WHR, WC and WHtR of obese (OB) and overweight (OV) participants compared to normal weight (N) participants. Correlation of anthropometric indices with lipid parameters in obese (OB) indicated significant positive correlation between WC and LDL-C, WHR and TC as well as between WHR and LDL-C. Significant negative correlations were seen between BMI and HDL-C, WC and HDL-C as well as between WHR and TG in Normal participants while significant positive correlation was seen between WHtR and TG.

Conclusion: Elevated TG, TC, and LDL-C and reduced HDL-C were seen in overweight and obese participants which are risk factors of CVD. Anthropometric indices such as WC and WHR were seen to be better and sensitive predictor of CVD risks especially in obese subject compared to BMI and WHtR.

Keywords: Anthropometric indices; lipid parameters; obese; overweight.

ABBREVIATIONS

BMI	:	*Body Mass Index*
CVD	:	*Cardiovascular Disease*
HC	:	*Hip Circumference*
HDL-C	:	*High Density Lipoprotein Cholesterol*
LDL-C	:	*Low Density Lipoprotein Cholesterol*
N	:	*Normal Weight*
OB	:	*OBESE*
OV	:	*OVERWEIGHT*
TC	:	*TOTAL CHOLESTEROL*
TG	:	*Triglycerides*
WC	:	*Waist Circumference*
WHR	:	*Waist To Hip Ratio*
WHtR	:	*Waist To Height Ratio*

1. INTRODUCTION

Cardiovascular disease (CVD) is a class of diseases that involve the heart and blood vessels [1,2]. According to Upadhyay [1], CVD is a leading cause of morbidity and mortality for some population in developed and developing countries of the world. As reported in some studies, in 2008 alone, more than 1.4 billion adults were overweight globally of which over 200 million men and nearly 300 million women were obese [3,4]. In Nigeria the prevalence of CVD between 1993 and 2003 was reported to be 18.8% in South-East Nigeria, 19.9% in South-South Nigeria, 17.4% in South-West Nigeria and 14.1% in Northern Nigeria which was 8% in 1970 [3]. In 2017, it was reported that Nigeria has encountered an increasing trend in overweight and obesity in adults with CVD prevalence of 20.1% in the South-East Nigeria [3]. The increased prevalence of CVD is as a result of increasing urbanization, prolong physical inactivity, increase use of computers (and computer games) and consumption of high calories foods [3,4]. Port Harcourt (South-South Nigeria), Rivers State of Nigeria have been the main producers of crude oil in Nigeria and in the process has encountered series of environmental pollution in form of oil spillage and gas flaring polluting the air, water and land [5]. Pollution has also been reported as a major risk factor for CVD [3,4,5]. Several clinical parameters are available for CVD diagnosis and prognosis or in the evaluation of CVD risks and one of such involve the use of anthropometric data and lipid parameters [2,3]. The measurement of the human body in terms of the dimensions of bone, adipose (fat) tissue and muscle defines anthropometry [3,4]. In developed and developing countries, changes and pattern of diet and lifestyle have led to an increase in obesity which is one of the major risk factors of CVD [4,6]. Obesity is a serious health problem, which is affected by factors such as culture, genetics and the environment [2,7]. Studies have also revealed that anthropometric indices are the most used indicators of cardiovascular risk factors in clinical practice [7,8,9,10]. However, increased risk of CVD in populations is strongly associated with hyperlipidemia that is found around the abdominal region which leads to obesity related morbidity and metabolic disorders [11,12,13]. As reported by *Ukpabi & Uwanurochi* [3], the prevalence of CVD in Northern Nigeria was reported to be 8% in 1970. Between 1993 and 2003, CVD prevalence was reported to be an average of 17.6% across the six geo-political zones of the Country [3]. However, in 2017, it was reported that Nigeria has encountered an increasing trend in overweight and obesity with CVD prevalence of 20.1% in South-East Nigeria [3]. It was also reported that hypertension and heart failure had the highest admissions with a prevalence rate of 54.6% and 36.8% respectively [3]. Therefore, having a better understanding of the relation between anthropometry, lipid profile and cardiovascular disease could give assistant in prediction, diagnosis and management of cardiovascular disease and other health conditions [9,14,15]. Several other studies have also stated that anthropometric data are important because of its use in evaluating dietary and health status which changes over time [16,17,18]. Anthropometric indices are obtained by collecting precise and accurate body measurements using calibrated equipment and standardized methods [16,19,20].

Anthropometric measurements are grouped into basic and derived. The basic measurements include: height, weight, waist circumference and hip circumference. They are used in calculating the derived anthropometric indices. Heights are measured in centimeters using a steel, anthropometric rod while weights are measured in kilograms using a weighing scale [21]. The waist circumference (WC) and hip circumference (HC) are measured in centimeter with a non-stretchable tape below the umbilical cord region. WC is a composite measure of all underlying tissues including muscle, organs and subcutaneous adipose tissue [11,22]. It has been reported that accumulation of lipids in visceral adipose tissue carries greater cardiovascular health risk compared to subcutaneous adipose tissue accumulation because subcutaneous adipose tissue has a lower lypolytic activity which points towards dyslipidemia and metabolic disorder. WC correlates strongly with visceral and abdominal fat which is a factor in CVD risk [18,20,22].

Derived anthropometric indices include Body mass index (BMI), Waist-Hip Ratio (WHR), Waist-Height Ratio (WHtR) [22]. BMI seems to correlate well with total body adiposity and therefore used as an indicator of obesity. BMI of 18.5 -25.00kg/m^2 is classified as normal while BMI of 26.0 – 30.0kg/m^2 is overweight and BMI of > 30.0kg/m^2 is obese [22]. However, BMI cannot discriminate between adipose and non-adipose tissue in individuals and also cannot distinguish the different types of adipose tissue. WHR assess the regional adipose distribution in the legs with women having higher proportions of adipose tissue compared to men who have more accumulated excess adipose tissue within the abdominal cavity. Elevated WHR value = 0.88 for women and 0.95 for men [21]. WHtR has been reported to predict coronary artery risk factors along with WC, WHR, and BMI [9]. The cut-off value is 0.5 for both sexes [9].

There has been inconsistency in the correlation between anthropometric indices and lipid parameters in several studies probably due to variation in environmental factors. Therefore, the need for this study in Port Harcourt. The aim of the study was to compare and correlate anthropometric indices with lipid parameters in normal weight, overweight and obese individuals in Port Harcourt as a means of evaluating their cardiovascular risks.

2. MATERIALS AND METHODS

2.1 Materials

Materials used include spectrophotometer, lithium heparin bottles, plain bottles, centrifuge, refrigerator, lipid profile reagents, hand gloves, stadiometer, a non-stretchable tape and weighing scale.

2.2 Reagents

The reagents used were total cholesterol reagents, triglyceride reagent and HDL-C reagent purchased from Agappe Diagnostics, Switzerland.

2.3 Subjects

A total of 109 participants were recruited in this study of which 82 participants were selected based on the feedbacks obtained from the questionnaire given. The recruitment process lasted for a period of six weeks. The selected 82 participants (males and females) were within the age range of 18-30 years. Prior to the recruitment process, informed consent of all the participants were obtained. A structured questionnaire was also given to all of the participants to obtain demographic information, medical history and pattern of lifestyle. The participants were recruited within Port Harcourt Metropolis, Port Harcourt, Nigeria and were divided into three major groups; overweight, obese and normal weight. They were grouped based on their respective BMI. Those with BMI of 18.5 -25.5kg/m^2 were groped as normal weight while those with BMI of 25.5 – 30.0kg/m^2 were grouped as overweight and those with BMI of > 30.0kg/m^2 were grouped as obese as described by Khana et al. [22]. Participants that did not return or fill their questionnaire, with BMI < 18.00kg/m^2, < 18 years or > 30 years or did not meet up with the selection criteria were allowed not to participant in the study. Of the 82 selected participants, 11 were overweight, 31 were obese and 40 were of normal weight. Anthropometric measurements were done, derived anthropometric indices were calculated and blood samples collected for the estimation of lipid parameters.

2.4 Study Area

The study was carried out in Port Harcourt, Nigeria. Port Harcourt is one of the most industrialized and populous city in Nigeria due to the presence of multi-national and local oil and gas companies as well as increased levels of business activities. Due to the city's busy nature, Port Harcourt had witness enormous increase in the number of restaurants (fast foods) making junk or high calorie foods easily accessible.

2.5 Experimental Design

The experimental approach used was a pilot study design. A total of 109 participants were recruited of which 82 were selected. The selected participants were within the age range of 18 - 30 years. Anthropometric measurements were collected and lipid parameters analysed at the Department of Medical Laboratory Science, Rivers State University, Port Harcourt, Nigeria.

2.6 Inclusion and Exclusion Criteria

A structured questionnaire was given to all participants to obtain demographic information, medical history and pattern of lifestyle. Participants included in this study were apparently healthy (asymptomatic) subjects between 18 - 30 years of age, non-smokers, non-hypertensive, non-diabetic and without any history of chronic disease(s). Blood pressure was checked using Omron digital blood pressure kit (Omron healthcare co., Ltd, Japan). Participants excluded from this study were subjects below 18 years or above 30 years, smokers and subjects with history of hypertension and diabetes mellitus. Subjects with history of other chronic diseases like liver and renal diseases were excluded. Also, subjects on lipid lowering drugs or anti-hypertensive drugs or anti-diabetic drugs were also excluded.

2.7 Anthropometric Measurements

Heights (in cm) and Weights (in kg) were measured using a stadiometer and a weighing scale respectively with the participants wearing light Clothing, standing barefooted in an erected position, and head positioned straight as described by Jimoh et al. [21]. Waist Circumferences and Hip Circumference were measured in centimeters with a non-stretchable tape below the umbilical cord region as described by Jimoh et al. [21]. The Body Mass Index was calculated as body weight (in kilograms) divided by squared height (in meters) as described by Khana et al. [22]. Waist Hip Ratio was calculated by Waist Circumference (in cm) divided by Hip Circumference (in cm) as described by Jimoh et al., [21] while Waist Height Ratio or Waist Stature Ratio was calculated as Waist Circumference (in cm) divided by Height (in cm) as described by Jimoh et al. [21].

2.8 Blood Specimen Collection, Preparation and Analysis

5mls of fasting sample was collected into lithium heparin bottle and was well spun at 3000 rpm for 5 minutes. The plasma obtained was analysed for TC, TG and HDL-C. The method of analysis for TC and TG were based on enzymatic methods as described by Stavropoulous et al. [23] and Flegg et al. [24] respectively. HDL-C was analysed by precipitating out VLDL-C and LDL-C using phosphotungstic acid and magnesium ions, and enzymatic evaluation of HDL-C in the supernatant as described by Flegg et al. [24]. Low Density Lipoprotein (LDL-C) was calculated as described by Friedwald et al. [25] using the Friedwald equation: LDL - C (mg/dl) = TC - (TG/5.0 + HDL-C).

2.9 Statistical Analysis

Mean, standard deviation, ANOVA and spearman's correlation were the statistical tools employed using Graphpad prism version 5.03 (San Diego, California, USA). One-Way ANOVA with Turkey's multiple comparative analysis (post-analysis) was done to compare the anthropometric and lipid parameters in the various body weights. Spearman's correlation of anthropometric indices with each lipid parameter was done and represented by the correlation coefficient (r). Results were presented as mean±standard deviation. The statistical significance was seen at P=.05.

3. RESULTS

3.1 ANOVA of Anthropometric Indices and Lipid Parameters in Body Weights

When the BMI, WC and WHR and WHtR values of group N was compared with group OV and OB a significant increases were observed at P=.05

(Table 1). When the HDL-C value of group N was compared with group OV and OB there was no significant increase observed. Comparing the TG, TC and LDL-C value of group N with group OV and OB a significant increases were observed at *P*=.05 (Table 2).

3.2 Correlation of Lipid Parameters with Different Anthropometric Indices

A. Correlation of Anthropometric Indices and Lipid Parameters of Obese (OB) Subject

Spearman's correlation, showed that the association between BMI, WC, WHR and WHrR with lipid parameters for Obese (OB) participants showed no significant correlations except that WC had a positive correlation with LDL-C while WHR showed positive correlation with TC and LDL at *P* =.05), (Table 3).

B. Correlation of anthropometric indices and Lipid Parameters of Overweight (OV) Subjects

Results obtained from spearman's correlation, indicated that the association between anthropometric indices with lipid profile parameters for group OV (overweight) participants were not significantly correlated (Table 4).

C. Correlation of Anthropometric Indices and Lipid Parameters of Normal Weight (N) Subjects

Spearman's correlation showed that the associations between BMI, WC, WHR and WHtR with lipid profile parameters for Normal weight participants were not significantly correlated. However, BMI versus HDL as well as WC versus HDL indicated significant negative correlation while WHR versus TG showed significant negative correlation. WHtR versus TG indicated significant positive correlation at *P*=.05 (Table 5).

4. DISCUSSION

The comparative analysis of the various anthropometric indices using ANOVA showed that participants with Normal weight (N) had significantly lower values for BMI, WHtR, WHR and WC compared to overweight (OV) and Obese (OB) participants. This result obtained is in line with the reports of [2,4]. The significant increases observed in BMI, WC WHR and WHtR in the overweight and obese participants could be as a result of accumulation of excess fat or

Table 1. ANOVA of anthropometric indices

Parameters	BMI (kg/m2)	WC (cm)	WHR	WHtR
Group N	21.61±1.51[a]	69.90±5.59[a]	0.75±0.18[a]	0.39±0.03[a]
Group OV	27.61±1.84[bc]	82.36±9.77[bc]	0.87±0.108[bc]	0.48±0.05[bc]
Group OB	33.1±1.93[bd]	89.52±10.93[bc]	0.81±0.06[bd]	0.56±0.06[bd]
P value	<0.0001	<0.0001	0.0127	<0.0001
F value	390.5	47.11	4.616	122.1
Remark	S	S	S	S

Post Analysis: Values in the same column with different superscripts (a, b) differ significantly when comparing Group N with other groups. Values in same column with different superscripts (c, d) differ significantly when comparing Group OV (Overweight) with group OB (Obese). NS= Not Significant: S = Significant. N=Normal weight, OV=Overweight, OB=Obese

Table 2. ANOVA of lipid parameters

Parameter	HDL-C (mg/dl)	TG (mg/dl)	TC (mg/dl)	LDL-C (mg/dl)
GROUP N	46.0 ± 11.37[a]	93.95 ± 40.68[a]	229.0 ± 99.20[a]	164.3 ± 98.73[a]
GROUP OV	41.88 ± 14.39[ab]	105.4 ± 61.42[ac]	408.1 ± 79.14[bc]	345.1 ± 81.07[bc]
GROUP OB	41.51 ± 16.07[ab]	142.5 ± 58.07[bc]	536.3 ± 181.2[bd]	430.1 ± 138.1[bc]
P value	0.3508	0.0006	< 0.0001	< 0.0001
F value	1.062	8.203	51.60	49.85
REMARK	NS	S	S	S

Post Analysis: Values in the same column with different superscripts (a, b) differ significantly when comparing Group N with other groups. Values in the same column with different superscripts (c, d) differ significantly when comparing Group OV (Overweight) with group OB (Obese). NS= Not Significant: S = Significant. N=Normal weight, OV=Overweight, OB=Obese

Table 3. Spearman's correlation of anthropometric indices with lipid profile for group OB

Correlation	r value	*P* value	Remark	Interpretation
BMI vs HDL	-0.2468	0.1808	NS	No correlation
BMI vs TG	-0.1326	0.4771	NS	No correlation
BMI vs TC	-0.1797	0.3335	NS	No correlation
BMI vs LDL	-0.1240	0.5063	NS	No correlation
WC vs HDL	-0.2121	0.2520	NS	No correlation
WC vs TG	0.08726	0.6406	NS	No correlation
WC vs TC	0.3548	0.0502	NS	No correlation
WC vs LDL	0.3785	0.0358	S	Positive correlation
WHR vs HDL	-0.2526	0.1703	NS	No correlation
WHR vs TG	-0.1408	0.4501	NS	No correlation
WHR vs TC	0.4488	0.0113	S	Positive correlation
WHR vs LDL	0.4689	0.0078	S	Positive correlation
WHtR vs HDL	-0.2324	0.2084	NS	No correlation
WHtR vs TG	-0.09440	0.6135	NS	No correlation
WHtR vs TC	0.4488	0.0113	NS	No correlation
WHtR vs LDL	0.4689	0.0078	NS	No correlation

NS= No Significant Correlation: S = Significant Correlation.

Table 4. Spearman's correlation of anthropometric indices with lipid profile for group OV

Correlation	r value	*P* value	Remark	Interpretation
BMI vs HDL	-0.1182	0.7293	NS	No correlation
BMI vs TG	-0.09589	0.7791	NS	No correlation
BMI vs TC	-0.05455	0.8734	NS	No correlation
BMI vs LDL	-0.1636	0.6307	NS	No correlation
WC vs HDL	0.03653	0.09151	NS	No correlation
WC vs TG	0.0	1.0000	NS	No correlation
WC vs TC	0.2055	0.5444	NS	No correlation
WC vs LDL	0.05936	0.8624	NS	No correlation
WHR vs HDL	-0.3632	0.2722	NS	No correlation
WHR vs TG	0.4273	0.1900	NS	No correlation
WHR vs TC	0.4736	0.1412	NS	No correlation
WHR vs LDL	0.3403	0.3059	NS	No correlation
WHtR vs HDL	0.04598	0.8932	NS	No correlation
WHtR vs TG	0.1524	0.6546	NS	No correlation
WHtR vs TC	-0.03678	0.9145	NS	No correlation
WHtR vs LDL	-0.1747	0.6074	NS	No correlation

NS= No Significant Correlation, S= Significant Correlation

lipid in their adiposity which is also in agreement with the reports of [2,16]. Furthermore, when overweight (OV) participants were compared with Obese (OB) participants, significant differences were also seen in BMI, WHR and WHtR of obese (OB) participants. However, no significant difference was observed in WC. The non-significant difference seen in WC could be as a result of approximate level of lipid accumulation in their adiposity. This finding is also in line with the reports of [19]. Our finding further suggest that increased anthropometric indices such as BMI, WHR and WHtR indicate increased lipid accumulation in their adiposity which is a risk factor for cardiovascular disease.

The comparative analysis of lipid parameters in the Normal weight (N) participant against overweight (OV) and obese (OB) participants showed significant increases in TG, TC, LDL-C and a non-significant reduction in HDL-C levels of obese and overweight participants. The result obtained is in line with the findings of [9,26]. They reported increased TG, TC and LDL-C levels in overweight and obese participants. This finding suggests that overweighing and obese

Table 5. Spearman's correlation of anthropometric indices with Lipid Profile for Group N

Correlation	r value	*P* value	Remark	Interpretation
BMI vs HDL	-0.3487	0.0274	S	Negative correlation
BMI vs TG	0.06222	0.7029	NS	No correlation
BMI vs TC	0.07098	0.6634	NS	No correlation
BMI vs LDL	0.1289	0.4279	NS	No correlation
WC vs HDL	-0.04424	0.0043	S	Negative correlation
WC vs TG	-0.1977	0.2215	NS	No correlation
WC vs TC	-0.04703	0.7732	NS	No correlation
WC vs LDL	0.06504	0.6901	NS	No correlation
WHR vs HDL	-0.2588	0.1069	NS	No correlation
WHR vs TG	-0.3455	0.0290	S	Negative correlation
WHR vs TC	-0.3077	0.0534	NS	No correlation
WHR vs LDL	-0.2141	0.1847	NS	No correlation
WHtR vs HDL	-0.02010	0.9020	NS	No correlation
WHtR vs TG	0.3720	0.0181	S	Positive correlation
WHtR vs TC	0.01352	0.9340	NS	No correlation
WHtR vs LDL	-0.1050	0.5190	NS	No correlation

NS= No Significant Correlation: S = Significant Correlation.

participants with reduced levels of HDL-C and increase TG, TC and LDL-C could be prone to increased risk in cardiovascular disturbances because of the increased TC, TG, and LDL-C lipid fractions without a corresponding increase in HDL-C fraction. As reported by Ali et al. [27], elevated levels of TC or LDL-C accompanied by high levels of HDL-C might prevent or reduce the risks of cardiovascular disease. The comparative analysis between overweight (OV) and obese (OB) participant showed significant increase in TC of obese participants. However, non-significant increases and decrease were seen in LDL-C, TG and HDL-C respectively. Our findings further suggest that, though obese participants had higher levels of TC levels compared to overweight participant, the risks level with respect to their proneness of cardiovascular diseases might almost be the same as shown by the similarity in their lipid accumulation. This finding also concurs with the reports of [7,9,27].

The correlation of anthropometric indices with lipid parameters in obese (OB) showed no correlations between BMI, WHtR and lipid parameters but significant positive correlation were seen between WC and LDL-C as well as between WHR and TC and LDL-C. Also, in overweight (OV) participants no significant correlation were seen between anthropometric indices and lipid parameters. Finally, in Normal weight (N) participants, significant negative correlation was observed between BMI and HDL-C, WC and HDL-C as well as between WHR and TG while significant positive correlation was observed between WHtR and TG.

The results obtained suggest that BMI and WHtR are not better and sensitive predictor of cardiovascular risks in obese and overweight subjects but tend to be better in normal weight subjects compared to WC and WHR. In Normal (N) weight participant, WHtR was sensitive with positive correlation with TG which implies that an increase in WHtR will also induce an increase in TG. However, WHtR seem to be less sensitive in obese and overweight participants. Our finding relates with the work done by [6,15,28], but is contrary to the reports of [11,18,20]. They reported BMI and WHtR as better discriminator of cardiovascular risk. However, the correlation study revealed that, WC and WHR are better predictors of cardiovascular disease risks which were positively associated with some of the lipid parameters that are risk for CVD especially in obese participants compared to BMI and WHtR. WC and WHR have also shown to be significantly negatively correlated with HDL-C and TG respectively in Normal (N) participants. The negative correlations suggest that a reduction in WC will induce an increase in HDL-C which is a good lipid. Our results concur with the works done by [29,30,31,33]. They also reported that WC and WHR are good indicators for predicting the risk of cardiovascular disease. However, contrary view was seen in the work done by many researchers [18,32,33], reporting that BMI and WHtR are better predictor of CVD risk compared to WC and WHR.

5. CONCLUSION

It has been observed that overweight and obese subjects are of risk to CVD from the result obtained: elevated TG, TC, and LDL-C and reduced HDL-C which are vital risk factors for the development of CVD. BMI and WHtR were observed to be sensitive predictors of CVD risk especially in normal weight participants but their sensitive was reduced in obese and overweight participants. However, indices like WC and WHR have shown to be better and sensitive indicators to predict CVD risk especially in obese subject as well as in normal weight subjects compared to BMI and WHtR.

6. RECOMMENDATION

The common use and reliance on BMI only as an anthropometric index in assessing or predicting cardiovascular risk in most clinical settings should be discouraged especially in developing countries. It is important to note for effective and reliable prediction of cardiovascular risks, BMI, WC, WHR and WHtR should be employed.

7. LIMITATION OF THE STUDY

The number of participants for this study was small, blood pressures of the participants were not considered in our analysis, and other confounding factors like family history and the presence of other diseases such as cancer and asthma were possibly overlooked. Therefore, our findings are subject to further research and verification.

CONSENT AND ETHICAL CLEARANCE

Informed consent was obtained from the participants prior to enrolment upon ethical clearance by the Ethics Committee of the Department of Medical Laboratory Science, Rivers State University.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Upadhyay, RR. Emerging risk biomarkers in cardiovascular disease and disorders. Journal of Lipids. 2015;10:11-15.
2. Arjmand G, Farzard S, Marzieh MN, Abdullah A. Anthropometric indices and their relationship with coronary artery diseases. Health Scope. 2015;4(3):25-30.
3. Ukpabi JO, Uwanurochi K. Comparing indications for cardiovascular admissions into a Nigerian and Isreali hospital. Annals of African Medicine. 2017;16(2):70-73.
4. Manjareeka M, Namda S, Mishra J, Mishra S. Correlation between anthropometry and lipid profile in healthy subjects of Eastern India. Journal of Mid-life Health. 2015;6(4):164-168.
5. Agunobi KN, Obienusi EA, Onuoha DC. An investigation of the pattern and environmental impact of oil spillage in Etche Local Government Area of River State, Nigeria. Journal of Natural Sciences Research. 2014;4(16):124-137.
6. Reddy RR, Nambiar S. Correlation of anthropometric indices with lipid profile in Adult females. National Journal of Physiology, Pharmacy, and Pharmacology. 2018;8(4):512-516.
7. Shahraki M, Niknejad N, Shahraki T, Niknejad B, Rabati S. The leading anthropometric indicator of cardiovascular health risk among female nurses: A cross-sectional study. Annals of Medical and Health Sciences Research. 2017;7:52-59.
8. Visscher TL, Kromhout D, Seidell JC. Long-term and recent time trends in the prevalence of obesity among Dutch men and women. International Journal of Obesity Related Metabolic Disorder. 2002; 26:218-224.
9. Shabana SUS, Shatida H. Association of anthropometric and metabolic indices in obese Punjabi subjects. Pakistan Journal of Zoology. 2018;50(6):2367-2370.
10. Patil VC, Parale GP, Patil HV. Relation of anthropometric variables to coronary artery disease risk factors. Indian Journal of Endocrinology and Metabolism. 2011; 15(1):31-37.
11. Sakar P, Mahadeva KS, Raghunath H, Nimisha T, Mandela ST. Utility of anthropometric indices as a predictor of

dyslipidaemia. Journal of Medical Science and Health. 2015;1(3):10-13.

12. Seafoglieri A, Jan PC, Erik C, Ivan B. Use of anthropometry for the prediction of regional body tissue distribution in adults; benefits and limitation in clinical practice. Aging and Disease. 2014;5(6):373-393.
13. Ortega FB, Lee DC, Katzmarzyk PT, Ruiz JR, Sui X, Church TS, Blair, SN. The intriguing metabolically health but obese phenotype; cardiovascular prognosis and role of fitness. European Heart Journal. 2013;34:389-397.
14. Kataria SK, Isha S, Abhilasha D. The study of anthropometric parameters to predict cardiovascular disease risk factors in adult population of western Ragasthan. Journal of Anatomical Society of India. 2010; 59(2):211-215.
15. Ramya N, Selvaraj M. A study of correlation of anthropometric indices with lipd profile in Adult females in a rural tertiary health centre. International Journal of Current innovation Research. 2018; 4(4):1162-1165.
16. Sabia P, Kaur H, Sabia SR, Yadav S, Singh ID. A study of correlation of body mass index, waist to hip ratio and lipid profile in type 2 diabetes mellitus subjects. IOSR Journal of Dental and Medical Sciences. 2018;17(2):29-33.
17. Sebo P, Beer-Borst S, Haller DM, Bovier PA. Reliability of doctor's anthropometric measurements to detect obesity. Preventive Medicine. 2008;47:389-393.
18. Yang Z, Ding X, Liu J, Duan P, Si L, Wan B. Association between anthropometric parameters and lipid parameters in Chinese individuals with age ≥ 40 years, BMI ≤ 28kg/m^2. PloS ONE. 2017;12(8): e0178343.
DOI:10.1371/joural.pone.0178343.
19. Luksiene D, Abdonas T, Dalia V, Gailute B, Anne P. Anthropometric trends and the risk of cardiovascular disease mortality in a lithuanian urban population. Scandinarian Journal of Public Health. 2015;43:882-889.
20. Lee JW, Nam-Kyoo L, Tae HB, Sung HP, Hynn YP. Anthropometric indices as predictors of hypertension among men and women aged 40-69 years in the Korean population. The Korean Genome and Epidemiology Studies. 2015;15:140-141.
21. Jimoh KA, Adediran OS, Agboola SM, Olugbodi DT, Idowu AA, Adebisi SA. A study of correlation between derived unit and basic anthropometric indices in type 2 diabetes mellitus. European Journal and Science Research. 2009;36(3):437-44.
22. Khana N, Ram SS, Rajinder SS. A study of the basic and derived anthropometric indices among the health adults of Amritsar city (Punjab) having family history of hypertension. International Journal of Biological and Medical Research. 2011; 2(3):743-746.
23. Stavropoulous WS, Crouch RD. A new Colourimetric Procedure for the determination of Serum Triglycerides. Clinical Chemistry. 1975;20:857-858.
24. Flegg HM. An investigation of the determination of serum cholesterol by an enzymatic method. Annals of Clinical Biochemistry. 1973;10:79-80.
25. Friedewald WT, Levy RT, Fredickson DS. Estimation of the concentration of LDL-Cholesterol without use of plasma ultracentrifuge. Clinical Chemistry. 1972;18:499-520.
26. Choa-Yang Y, Chien Y, Ying C, Wen-Zhi, C, Wen-Ko C. Surface anthropometric indices in obesity- related metabolic diseases and cancers. Medical Journal. 2011;34:1-2.
27. Ali AM, Seyed NM, Sepide S, Seyed NK, Mohamamad HE, Hossain D. Correlation of anthropometric indices with common cardiovascular risk factors in an urban adult population of Iran; data from Zanjan health heart study. Asian Pacific Journal of Clinical Nutrition. 2009;18(2):217-225.
28. Choi S. Anthropometric measures and lipid coronary heart disease risk factors in Korean immigrants with type 2 diabetes. Journal of Cardiovascular Nursing. 2011; 26(5):414-422.
29. Baltadjiev A, Vladeva S, Tineshev S, Andeenko E. Correlations between some anthropometric parameters the lipid profile and glycated haemoglobin in Bulgarian Women with type 2 diabetes mellitus. International Journal of Pharmaceutical Science Invention. 2016;5(3):31-34.
30. Moy FM, Atiya AS. Waist circumference as a screening tool for weight management; evaluation using receiver operating characteristics curves for Melay subjects.

Asian Pacific Journal of Public Health. 2003;15(2):99-104.
31. Dholakia J, Sharma H, Vasava NS, Kayal S. Correlation of anthropometric parameters with lipid profile in first year medical students. International Journal of Clinical Biochemistry and Research. 2017;5(1):54-60.
32. Yusuf S, Hawken S, Oumpuus S, Bautista L, Franzosi MG, Commerford P. Obesity and the risk of myocardial infarction in 27,000 participants from 52 countries; A case-control study. Lancet. 2005; 366(9497):1640-1649.
33. Ezekwu AO, Agwubike OE. Anthropometric measures of adiposity as correlates of atherogenic index of plasma in non-obese sedentary Nigerian males. Libyan Journal of Medicine. 2014;9:1-5.

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