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Lipid Profile Parameters and Their Correlation with Anthropometric Indices among Adult Female Subjects in Port Harcourt and Obio/Akpor Local Government Areas of Rivers State

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Abstract **Original Research Article**

***Introduction*:** obesity is a well-known risk factor for heart disease which is associated with high rates of dyslipidaemia which is abnormal lipids in the blood. ***Aim*:** The aim of this study was to evaluate the correlation of anthropometric indices with lipid profile among women resident in Port Harcourt and Obio/Akpor local government areas of Rivers State. ***Materials and Methods*:** We performed a cross-sectional analytical study. A total of 332 participants were selected using the multi-stage sampling method after giving their consent. Anthropometric measurement was done using the standard protocol and the lipid profile parameters was analysed. 5mls of random blood was collected into lithium heparin bottles and spun at 3000 rpm for 5 minutes to obtain plasma. Total cholesterol was measured enzymatically, high density lipoprotein cholesterol was measured using the direct method, triglyceride was estimated using the Gpo-pap method while low density lipoprotein was estimated using the Friedwald equation. ***Results*:** There was a significant positive correlation between Total cholesterol TC, triglycerides and low density lipoprotein LDL with anthropometric indices BMI, AC, WC, HC, WHR, W-HT-R, CI, VAI, BAI, AVI, ABSI, and HI. High density lipoprotein cholesterol HDL was positively correlated with anthropometric indices of BMI, AC, WC, HC, WHR, W-HT-R, CI, BAI, AVI, ABSI and HI but was negatively correlated with VAI. ***Conclusion*:** High levels of total cholesterol TC, triglycerides, TG and low density lipoprotein cholesterol LDL observed in this participants that are obese and overweight are risk factors for cardiovascular disease. This shows that anthropometric indices are sensitive and better predictor of cardiovascular risks particularly in subjects that are obese. It can be used as an effective screening tool to predict dyslipidaemia and its associated complications.
Keywords: Anthropometric, Indices, Lipids, Obesity Overweight.

1 INTRODUCTION

Dyslipidaemia is abnormal quantity of lipids in the blood. It may be shown as high level of total cholesterol TC, low density lipoprotein cholesterol (LDL-C) and triglycerides TG concentration and reduction in high density lipoprotein cholesterol (HDL-C) this is mostly caused by lifestyle and diet. Obesity and weight are two main modifiable risk factors in the causation of dyslipidaemia, obesity is a well-known risk factor for heart disease, and a number of conventional cardiovascular factors have been proposed in the pathways that is between obesity and heart diseases such as hypertension, diabetes, dyslipidaemia and so on [1]. Abnormal abdominal fat produces physiological changes that alter lipid profile, which will lead to hyperlipidaemias and dyslipidaemia which will cause an increase in the risk of cardiovascular events. This is specifically true of alterations in the low density lipoprotein cholesterol (LDL-C) which is an independent causal factor in atherosclerosis [2]. Anthropometric indices are simple and non-invasive tests. It can be applied to predict lipid profile abnormality and at-risk population for future cardiovascular and other endocrine events. The aim of this study is to correlate between measures of adiposity and lipid profile parameters among adult female subjects resident in Obio/Akpor and Port Harcourt local government areas of Rivers State.

2. MATERIALS AND METHODS

A cross-sectional analytical study conducted in females resident in Obio/Akpor and Port Harcourt local government areas in Rivers State Southern Nigeria among apparent non-pregnant adult females of reproductive age 20-50 years. Ethical clearance was obtained from the research ethics committee of the

University of Port Harcourt with reference number UPH/CEREMAD/REC/MM77/017. Informed consent of each subject was obtained.

1. Measurements of Anthropometric Indices

BMI was calculated as body weight (kg) divided by height (m2). Waist and hip circumferences was obtained using a measuring tape in standing position. Waist circumference was measured at approximate midpoint between the lower margin of the last costal rib and the top of the iliac crest. Hip circumference was taken around the widest portion of the buttocks [3]. Waist-to-hip Ratio (WHR) was calculated from the above measurements by using the formula, WHR = waist circumference (cm) divided by hip circumference (cm). Waist to height ratio was calculated from the above measurements by using the formula, waist circumference (cm) divided by height (cm). The conicity index (C index) was derived using the following formula [4]CI $\frac{\text{Waist circumference (m)}}{0.109\sqrt{\frac{weight\ (kg)}{height\ (m)}}}$

Abdominal Volume Index: was calculated from waist and hip circumference

[2×(waist(cm))2+0.7cm×(w(cm) -hip(cm)-hip2)]/1000 [5]

Visceral Adiposity Index VAI (Females) = [waist circumference (cm)/ (36.58+ (1.88×BMI)] × (triglyceride /0.81) × (1.52/HDL-K

Body Adiposity Index BAI (Females) = [Hip circumference (cm) / height (m) 1.5]-18

A Body Shape Index ABSI = WC / BMI2/3 × Height1/2

Hip index . $\frac{\text{Hip circumference (m)}}{Height\ in\ cm\sqrt{weight\ in\ kg}}$

Determination of Lipid Profile Parameters

5mls of random blood was collected into lithium heparin bottles and spun at 3000 rpm for 5 minutes to obtain plasma. The total cholesterol TC in the serum was measured enzymatically using the method as described by [6]. High density lipoprotein (HDL): was estimated using the direct method as described by [7]. Triglyceride estimation: The concentration of triglyceride TG was estimated through the Gpo-pap method as described by [8]. Low density lipoprotein (LDL): It was estimated by using the Friedwald equation [9].

2.2 Statistical Analysis

Carried out using statistical package for social sciences (SPSS) version 25. Relationship or association between variables was determined using Pearson's correlation, as appropriate. Significant values was determined at P≤ 0.05.

3 RESULTS

Table 1: Anthropometric distribution of subjects in the study population

Parameters	Class	Frequency(n)	Percentage (%)
BMI (kg/m^2)	<18.5 (underweight)	17	4.7
	18.5-24.99 (normal)	147	44.1
	25-29.99 (Overweight)	118	36.1
	>=30(Obese)	50	15.1
	Total	332	100.0
Abdominal circumference (cm)	<88cm	193	59.8
	>88cm	139	40.2
	Total	332	100.0
Waist circumference (cm)	<=88cm	182	56.5
	>88cm	150	43.5
	Total	332	100
Hip circumference (cm)	<97cm	136	42.1
	97-108cm	106	32.1
	>108cm	90	25.8
	Total	332	100.0
Conicity index (CI)	Low (1.04-1.36)	270	83.6
	Middle(1.37-1.50)	62	16.4
	Total	332	100.0
Abdominal volume index (AVI)	Optimal (<=0.700)	214	64.9
	Non-optimal (>7.00)	118	35.1
	Total	332	100.0
Waist to hip ratio (WHR)	<=0.85	93	26.8
	>0.85	239	73.2
	Total	332	100.0
Waist to height ratio (W-HT-R)	<=0.5	247	75.9
	>0.5	85	24.1
	Total	332	100.0

Table 2: Correlation of anthropometric parameters and lipid profile among subjects

Anthropometric Parameters	Correlation Coefficient	Total cholesterol (mmol/L)	Triglycerides (mmol/L)	HDL (mmol/L)	LDL (mmol/L)
Height (M)	R	0.229	0.278	0.054	0.201
	P-value	0.000**	0.000**	0.327	0.000**
Weight (kg)	R	0.939	0.552	0.544	0.820
	P	0.000**	0.000**	0.000**	0.000**
BMI(kg/m^2)	R	0.838	0.417	0.525	0.734
	P	0.000**	0.000**	0.000**	0.000**
Abdominal circumference (cm)	R	0.842	0.476	0.528	0.715
	P	0.000**	0.000**	0.000**	0.000**
Waist circumference (cm)	R	0.869	0.525	0.521	0.741
	P	0.000**	0.000**	0.000**	0.000**
Hip circumference (cm)	R	0.858	0.522	0.535	0.720
	P	0.000**	0.000**	0.000**	0.000**
Waist to hip ratio(WHR)	R	0.318	0.182	0.133	0.304
	P	0.000**	0.001**	0.015*	0.000**
Waist to height ratio (W-HT-R)	R	0.813	0.446	0.513	0.693
	P	0.000**	0.000**	0.000**	0.000**
Conicity index (CI)	R	0.556	0.387	0.339	0.451
	P	0.000**	0.000**	0.000**	0.000**
Visceral adiposity index (VAI)	R	0.234	0.838	-0.232	0.201
	P	0.000**	0.000**	0.000**	0.000**
Body adiposity index (BAI)	R	0.727	0.371	0.499	0.607
	P	0.000**	0.000**	0.000**	0.000**
Abdominal volume index (AVI)	R	0.868	0.531	0.519	0.739
	P	0.000**	0.000**	0.000**	0.000**
A body shape index (ABSI)	R	0.291	0.263	0.177	0.215
	P	0.000**	0.000**	0.001**	0.000**
Hip index (HI)	R	0.430	0.307	0.311	0.320
	P	0.000**	0.000**	0.000**	0.000**

Table 1 Shows anthropometric distribution of subjects in the study population which are BMI, abdominal circumference, waist circumference, hip circumference, WHR, W-HT-R, CI and AVI, shows their class frequency and percentage.

Table 2 Shows correlation of anthropometric indices with lipid profile parameters. There was a positive correlation between lipid profile parameters of total cholesterol TC, triglycerides, TG, low density lipoprotein cholesterol LDL, HDL with BMI, AC, WC, HC, WHR, W-HT-R, CI, AVI, VAI, BAI, ABSI and HI. HDL was negatively correlated with VAI.

4. DISCUSSION

Dyslipidaemia is an important known modifiable risk factors that will result in the development of coronary artery disease and other complications. Obesity being one of the causes of dyslipidaemia, is a condition of excess fat in the body. This study was done to correlate simple anthropometric indices with lipid profile parameters and hence to signify the importance of implementing anthropometry in routine screening procedures.

Total cholesterol was positively correlated with anthropometric indices body mass index BMI, abdominal circumference, waist circumference WC, hip circumference HC, waist hip ratio WHR, waist height ratio W-HT-R, conicity index CI, visceral adiposity index VAI, body adiposity index BAI, abdominal volume index AVI, a body shape index ABSI, and hip index HI. This is consistent with the findings of [10], they observed a positive significant correlation between central obesity indices of WC and TC and also a significant positive correlation WHR and TC. This also agrees with the findings of [11, 12]. were significant positive correlation were seen between WHR and TC in type 2 diabetics [13], also reported that total cholesterol TC is highly correlated with anthropometric measurements of WC and WHR of central obesity that can predict obesity associated with cardiovascular risks. Some studies have demonstrated a statistically significant correlation between lipid profile and gender, but reported that women had high mean values of total cholesterol TC, low density lipoprotein cholesterol LDL-C and triglycerides when compared to men [14]. Significant correlation from this study could be as a result of lifestyle habits with respect to anthropometric data with lipid profile. Studies have reported that lifestyle such as sedentary, smoking, lack of physical activity, being overweight, high waist circumference subjects were those who had dyslipidaemia. Obesity can cause the increase in free fatty acids in the liver leading to the formation of density lipoprotein. These free fatty acids are taken up by the liver to increased very-low-density lipoprotein (VLDL) synthesis which elevates total cholesterol levels. [15].

There was also a positive significant correlation with BMI, central anthropometric indices of AC, WC, HC, WHR, W-HT-R, CI, VAI, BAI, AVI, ABSI, VAI and HI with triglycerides.

This is consistent with the findings of [10], who reported a significant positive correlation between central obesity indices of WC and WHR with triglyceride. Studies have [16], reported significant relationship only with anthropometric indices with triglycerides in Dekina area of Kogi State Nigeria [12], also proved that triglyceride correlated more strongly and significantly with WHR [13], reported that WC, WHR was significantly linked with triglyceride and that both waist circumference and waist to hip ratio of central obesity can predict obesity that is associated with cardiac risks. Shamekhi and Keshvari also reported in 2017 a significant positive correlation between central obesity indices of waist circumference and WHR with triglycerides [17], reported confirmed the significant correlation between visceral adiposity index VAI with triglycerides TG with an increased risks of impaired 2 hours glucose tolerance test in healthy obese adults [18], reported a positive correlation between a body shape index ABSI with triglycerides from their study. The strength of waist circumference WC and waist to hip ratio WHR correlation varies with dyslipidaemia in different studies. Many biological mechanisms can explain the relationship but the possible mechanisms is the effect obesity has on insulin resistance this will result in the increase of triglycerides [19]. Insulin resistance is the decreased ability of insulin to effectively act on target tissues especially on the liver, fat muscles which is an important feature of type 2 diabetes and results from combination of obesity and genetic susceptibility [20].

High density lipoprotein cholesterol HDL was positively correlated with BMI, AC, WC, HC, WHR, W-HT-R, CI, BAI, AVI, ABSI, and HI. Estrogen and lipid metabolism: Estrogen playa a key role in increasing HDL levels by upregulation hepatic apolipoprotein A1 (APOA1) production a key structural component of HDL. Estrogen also reduces hepatic lipase activity, which slows HDL clearance and increases its circulating levels. Women particularly pre-menopausal women have a more favourable lipid profile, including higher HDL levels, due to estrogen effects. Fat distribution and metabolism in females: Women naturally have higher body fat percentages than men, and fat is preferentially stored in subcutaneous and gluteofemoral depots rather than visceral fat. This deposition pattern is linked with higher HDL levels as subcutaneous adipose tissue is less metabolically active than visceral fats and releases fewer free fatty acids and lower HDL. Adipokines and Inflammation**:** Adipose tissue secretes bioactive molecules (adipokines) like adiponectin, which enhances HDL biogenesis and reverse cholesterol transport by activating AMPK and PPAR-a pathways. More adipose tissue in women particularly in the gluteofemoral region, correlates with high adiponectin levels, promoting HDL stability and functionality. Lipoprotein lipase (LPL) and HDL metabolism: LPL is more active in subcutaneous fat than in visceral fat, leading to enhanced lipid uptake into adipose tissue and higher HDL- triglyceride ratio in women. This contributes to a paradox where higher BMI or WC in females does not necessarily imply HDL levels as seen in males.

HDL was negatively correlated with VAI [21], from their study reported that waist circumference was best correlated with high density lipoprotein HDL negatively, it was also similarly reported by [22-24], reported that WHR was independently associated with decreased HDL from their study [22-25], reported a significant negative correlation between waist hip ratio WHR and HDL they concluded that regarding the significant relationship of anthropometric indices with lipid profile their significant differences of these parameters can be used to evaluate and screen metabolic disease related risk factors and heart disease [26], reported that the abdominal volume index AVI was negatively correlated with HDL-C in patients with coronary artery disease. They also stated that abdominal obesity is a risk factor for atherosclerosis [27], reported a significant negative correlation between HDL cholesterol with WC and W-TH-R in women. HDL-C is known to play an important role the prevention and formation of atheromatous plaques and also cardiovascular events, the results from this study shows that central anthropometric indices could be used as predictors of HDL-C that is abnormal.

Low density lipoprotein LDL was positively correlated with anthropometric indices body mass index BMI, abdominal circumference AC, waist circumference WC, hip circumference HC, waist hip ratio WHR, waist height ratio W-HT-R, Conicity index CI, visceral adiposity index VAI, body adiposity index BAI, abdominal volume index AVI, a body shape index ABSI, and hip index HI. This is also similar to the findings [12], they proved that high low density lipoprotein cholesterol LDL-C correlated more significantly and strongly with waist to hip ratio WHR and concluded that waist to hip ratio can be good anthropometric indices to predict cardiometabolic risk in type 2 diabetic obese patients. Studies have proved that dyslipidaemia was prevalent in type 2 diabetes obese patients and the most affected lipid parameter is low density lipoprotein cholesterol LDL-C [12]. A report by [28, 29], proved that high LDL-C is followed by hypertriglyceridemia. Similarly [30], reported significant serum increase of low density lipoprotein LDL in patients with coronary artery disease CAD. This could be linked with triglycerides because it causes changes in low density lipoprotein LDL particle density distribution and composition, particle size which will produce small dense LDL that is more atherogenic [30]. A report by [15], observed that students with large waist circumference WC had higher mean values of total cholesterol TC, low density lipoprotein cholesterol LDL-C and high triglycerides levels when compared to those with normal waist circumference. Many cardiovascular risk factors such as abnormal lipid profile and obesity are affected by dietary factors specifically high intake of calorie, sedentary lifestyle in a population and very low physical activity [32]. Some researchers have proposed that the size of low density lipoprotein LDL particle, may be a more determinative factor of atherogenicity rather than its level. Research studies have proved that metabolic condition changes such as obesity influence predominantly the low density lipoprotein LDL particle more than levels [33]. Low density lipoprotein LDL size particle is under the influence of insulin resistance, which is greatly affected by obesity [34]. The relationship between anthropometric indices and lipid profile remains controversial which may be partly explained by body composition and fat distribution differences in racial groups, sexes, genetic susceptibility dietary pattern and age groups [35].

5. CONCLUSION

High levels of total cholesterol TC, triglycerides, TG and low density lipoprotein cholesterol LDL observed in this participants that are obese and overweight are risk factors for cardiovascular disease. This shows that anthropometric indices are sensitive and better predictor of cardiovascular risks particularly in subjects that are obese. It can be used as an effective screening tool to predict dyslipidaemia and its associated complications.

Obesity is a world-wide health epidemic we have a duty as a society to promote healthy eating, physical activity and promote good nutrition so as to stop the rising trend.

Consent: It is applicable

Ethical Approval

Ethical approval for this study was sought for and was granted by the Research and Ethical Committee of the University of Port Harcourt.

Competing Interest: Authors have declared that no competing interests exists.

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