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Atherogenic Index Of Plasma Lipids In Apparently Healthy Staff Of Abia State University Teaching Hospital, Aba

[1]Ikpeazu, V. O., [1]Offiah, S. A. U., [1] Onwubiko,D, [1]Chigbu L. N ., [1]Igboh, N. M. [1]Ekenjoku, A. J., Chikezie, J.A and [1]Titus, F. C.

[1]College of Medicine Abia State University Uturu, Nigeria.
*corresponding Author' E-mail: drngomi@yahoo.co.uk .
Tel: 2348037057570

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Abstract: Coronary artery disease is the epidemic of modern civilization in which dyslipidaemia contributes significantly to its pathogenesis. As lipid profile and lipid ratios such as atherogenic index of plasma are important markers to predict the risk of atherosclerotic coronary artery disease, this study is aimed at evaluating the atherogenic index of plasma lipids in apparently healthy staff of Abia State University Teaching Hospital (ABSUTH) Aba to enable early detection and identification of those at risk of developing coronary artery events. The study was conducted on 72 apparently healthy staff and these subjects were grouped into five according to their ages. All respondents for lipid and glucose estimations were asked to do an overnight fasting of 12 hours. About 7 millilitres (7 ml) of fasting blood samples were collected by venipuncture techniques from the antecubital vein into sterile containers under aseptic conditions. About 2 ml of blood was stored in fluoride oxalate containing bottles for glucose estimation and 5 ml of blood was stored in lithium heparin bottle for lipid assay. Plasma glucose, High density lipoprotein (HDL), Total Cholesterol (TC), Triglyceride (TG), Low density lipoprotein (LDL) were determined and Atherogenic index (AIP) was calculated. Data obtained were analyzed using Statistical Package for Social Sciences (SPSS version 25) and one-way analysis of variance (ANOVA), student t test and expressed as Mean standard deviation. Significant level for the analysis was set at P-value equal to or less than 0.05 (P-0.05) which was considered as being statistically significant .TC, TG and LDL values were significantly higher in females than males. Meanwhile, HDL was higher in males as compared to females. Elevated total cholesterol, elevated low-density lipoprotein, elevated triglycerides and low high-density lipoprotein were seen in 11%, 14%, 20% and 24% of the subjects respectively. Hyperlipidemia was more prevalent among female than males. Atherogenic index of plasma predicted a low risk (0.1±0.29) predisposition to cardiovascular events with females being at significantly higher risk (0.20±0.27 versus 0.02±0.26, p≤0.05) than males. The study revealed that staff of ABSUTH were at low risk for development of cardiovascular disease. However, it is advised that total lipid analysis be included as part of routine lipid profile test in the laboratory evaluation of cardiovascular events since prevention is better than cure.

Keywords: Cardiovascular disease, Hyperlipidemia, Triglyceride, Atherogenic index and Coronary artery

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INTRODUCTION

Dyslipidaemia is a single strong risk factor for the development of cardiovascular events and atherosclerosis is the most common. It has been described as a disease of the economically advanced societies, but recently, it has found its way into the semi-urban societies and among its dwellers, who are at the increasing risk of developing cardiovascular accidents (Olamoyegun, 2016). Hence, early identification and diagnosis of dyslipidaemia at its earliest stage among this populace is a worthwhile cardiovascular preventive measure.

According to the World Health Organization (WHO), globally, a third of ischemic heart disease is attributable to high cholesterol. Overall, raised cholesterol is estimated to cause 2.6 million deaths and 29.7 million disabilities yearly. In 2008, the global prevalence of raised total cholesterol among adults was 39% and in 2013, 80% of death and 87% of disability (Ugwuja *et al*., 2013).

Epidemiologic data show a continuous graded relationship between the total plasma cholesterol concentration and coronary risk, especially for younger men below the age of 40 years. In Nigeria, dyslipidaemia was previously thought to be rare because obesity and overweight were socially accepted as a sign of affluence. But recent finding shows that the current state of dyslipidaemia in Nigeria clearly contradicts previous perceptions and the prevalence is comparable to Caucasian values (Olamoyegun *et al*., 2016). This transition cuts across all the focal groups.

It was predicted that by 2020, coronary heart disease will be the leading cause of death in adults which will lead to 19 million deaths globally and 71% deaths in developing countries (Ugwuja *et al*., 2013) and due to its very slow progression, it is not surprising that atherosclerosis goes undetected and remains asymptomatic until the atheroma obstructs the blood flow within the artery (Glass *et al*., 2001 and Van *et al*., 2006) hence atherosclerosis is often referred to as the "silent killer", development of the fatty streak, damage to the endothelium lining the blood vessel sets the stage for lesion development.

Owing to the increased permeability of dysfunctional endothelium, lipoproteins –low-density lipoproteins (LDL) –from the blood enter the sub-endothelial tissue, where they are retained as components of the extracellular matrix. Following retention, these lipoproteins are modified either by chemical means (in particular, through oxidation) or by enzymatic activity. Macrophages, endothelial cells and smooth muscle cells, which are present within the endothelial space, have been shown to promote the oxidation and enzymatic modification of LDL receptor, the uptake of modified LDL by the scavenger receptor is not subject to negative feedback regulation (Lorkwoski *et al*., 2007).

Since macrophages, like all mammalian cells, are unable to break down cholesterol, this uncontrolled uptake of cholesterol via the scavenger receptor leads to massive accumulation of cholesterol within the cell. This problem is compounded by the fact that macrophages also ingest substantial amounts of cholesterol in the form of necrotic and apoptotic cells and cellular debris.

Macrophages possess two mechanisms to counteract the problem of excess cholesterol. First, the cholesterol is stored as cholesteryl esters in cytosolic lipid droplets giving the macrophages a foamy appearance. Second, macrophages export cholesterol to lipid acceptors such as apolipoprotein A-I, apolipoprotein E or high-density lipoproteins (HDL) as part of a process called reverse cholesterol transport system that redistributes excess cholesterol from peripheral tissues to the liver. If these mechanisms are overwhelmed, cholesterol builds up to toxic levels within the macrophage. This may impair the fluidity of the cell membrane and the function of signal proteins within it. In addition, cholesterol crystals or oxysterols may form within the cell triggering a physiological cell suicide programmed cell death called apoptosis or killing the cell in unregulated fashion by necrosis (Gonzalez and Selwyn, 2003).

Over the years, the continuous deposition of these lipids results in the formation of the large necrotic lipid core typical of advanced lesions. Smooth muscle cells within the inner layer of the artery known as the intima also express scavenger receptors and take up modified LDL. Such smooth muscle cell derived foam cells also contribute to the growth of atherosclerotic lesions, albeit to a much lesser extent than their macrophage-derived counterparts (Gonzalez and Selwyn, 2003).

A consequence of endothelial erosion or plaque rupture is the formation of a thrombus, which is formed due to the activation of the clotting cascade when sub-endothelial tissue encounters the circulating blood. Thrombi may occlude the artery at the site of rupture or erosion, or they may float with the blood stream into arteries with a smaller lumen than that of the artery where the thrombus was formed, which may occlude either partially or completely. Such an occlusion reduces the supply of nutrients and oxygen to downstream tissues and will lead to their death if the process is severe and prolonged enough. In the case of coronary or cerebral arteries such occlusion leads to myocardial infarction and stroke respectively (Lorkwoski *et al*., 2007).

This study is aimed at estimating the atherogenic index of plasma lipids in apparently healthy adults to enable early detection and identification of those at risk of developing coronary artery disease.

MATERIALS AND METHOD

The study was carried out at the Chemical Pathology Laboratory of Abia State University Teaching Hospital (ABSUTH). The study was conducted on 72 apparently healthy staff and these subjects were grouped into five according to their ages.

All respondents for lipid and glucose estimations were asked to do an overnight fasting of 12 hours. About 7 millilitres (7 ml) of fasting blood samples were collected by venipuncture techniques from the antecubital vein into sterile containers under aseptic conditions. About 2 ml of blood was stored in fluoride oxalate containing bottles for glucose estimation and 5 ml of blood was stored in lithium heparin bottle for lipid assay.

Plasma glucose, High density lipoprotein (HDL), Total Cholesterol (TC), Triglyceride(TG), Low density lipoprotein (LDL) were determined using the methods of

Tietz, (1995) and Atherogenic index (AIP) was calculated.

Data obtained were analyzed using Statistical Package for Social Sciences (SPSS version 25) and one-way analysis of variance (ANOVA), student t test and expressed as Mean standard deviation. Significant level for the analysis was set at P-value equal to or less than 0.05 (P-0.05) which was considered as being statistically significant.

RESULT AND DISCUSION

Table 1: Comparison Of Mean ± SD Of Lipoproteins and Atherogenic Ratios in the Population

MEAN ± SD					
Parameters	**Total**	**Male**	**Female**	**P(≤0.05)**	**Sig.**
Glu (mmol/L)	6.75±2.74	6.62±3.07	6.85±2.51	0.719	NS
TC (mmol/L)	4.91±1.23	4.23±0.89	5.42±1.21	0.000	Sig.
TG (mmol/L)	1.03±0.38	0.88±0.21	1.13±0.44	0.003	Sig.
HDL (mmol/L)	1.22±0.4	1.39±0.46	1.10±0.30	0.001	Sig.
LDL (mmol/L)	2.97±1.16	2.28±0.58	3.48±1.22	0.000	Sig.
CR-I	4.66±2.86	5.16±2.66	4.28±2.98	0.177	NS
CR-II	3.05±2.47	3.50±2.57	2.72±2.38	0.166	NS
AC	3.42±2.76	4.10±2.77	2.90±2.68	0.056	NS
AIP	0.10±0.29	0.02±0.26	0.20±0.27	0.000	Sig.
Weight (kg)	69.36±12.1	69.88±11.67	68.98±12.52	0.743	NS
Height(m^2)	1.62±0.07	1.66±0.07	1.60±0.06	0.000	Sig.
BMI (kg/m^2)	26.37±4.25	25.39±4.05	27.10±4.29	0.074	NS
Systolic(mmHg)	127.20±21.23	124.56±18	129.13±22.80	0.344	NS
Diastolic(mmHg)	82.10±12.40	81.41±.00	82.61±14	0.672	NS

KEYWORDS: The following abbreviations stands for:
Sig- Significant
NS- Not significant
Glu- Glucose
TC- Total cholesterol
TG- Triglycerides
HDL- High density lipoprotein
LDL- Low density lipoprotein
AC- Atherogenic coefficient
AIP- Atherogenic index of plasma
SBP- Systolic blood pressure
DSP- Diastolic blood pressure
CRI-I- Castelli risk index I
CRI-II- Castelli risk index II

Table 2: Comparison Of Mean ± SD of Lipoproteins Parameters and AIP of the Subjects by Age Classes

Age Classes (years)	TC (mmol/L)	TG (ml/L)	LDL (mmol/L)	HDL (mmol/L)	AIP
21-30	5.08±0.86	1.11±0.46	3.14±1.19	1.04±0.26	0.05±0.28
31-40	4.80±1.54	1.09±0.37	2.92±1.24	1.15±0.41	0.02±0.32
41-50	4.75±1.07	1.04±0.34	2.98±1.00	1.24±0.33	0.16±0.24.
51-60	4.60±1.32	0.88±0.44	2.74±0.77	1.43±0.42	0.25±0.31
61-70	5.43±1.51	0.94±0.23	2.98±1.69	1.38±0.57	0.04±0.27
F-value	0.934	0.899	0.214	2.575	1.75
***P*-value (p≤0.05)**	0.449	0.469	0.93	0.044*	0.15

KEYWORDS: The following abbreviations stands for:
* - Significant
TC – Total Cholesterol
TG – Triglycerides
LDL – Low Density Lipoprotein
HDL – High Density Lipoprotein

The first Table shows the comparison of Mean ± SD of lipoprotein and atherogenic ratios in the population. In the population, the average TC, TG, LDL-C and AIP were significantly higher in females compared to males (5.42 vs 4.23, P< 0.05; 1.13 vs 0.88, p< 0.05) with the combined average being 1.22 ± 0.4 and 1.62 ± 0.07 respectively. Other test parameters were not significantly different when both sexes (male and female) were compared (p> 0.05).

The second Table shows the comparison Mean ± SD of lipoprotein parameters and AIP of the subjects by age classes. The table showed that there was steady decrease in TC, TG and LDL with rise in age while the HDL increases with increasing age. Also, the mean ± SD of lipoprotein represented in age classes showed that there was significant difference (P <0.05) in the mean of HDL while no significant difference was observed in TC, TG and LDL. There was no significant difference of AIP between the age classes.

The current study revealed a mean total cholesterol, TG, HDL and LDL plasma values that corresponded with the desirable range of lipid according to National Cholesterol Education Programme (NCEP, 2002). Thus, the desirable range of the lipid parameters recorded in this study does not necessarily indicate freedom from cardiovascular risk. The result of the study conforms with that reported by Ugwuaja et al. (2013). However, the values were higher than the Caucasian values as reported by Idemudia et al (2018).

The mean TC, TG, and LDL were significantly higher in females and the mean HDL was significantly higher in males. These values were in agreement with values as reported by Olamoyegun et al. (2016). Nevertheless, this does not agree with the result of study conducted by, Okafor et al. (2014), Festus (2016), and Ebirien-Agana et al. (2017) .This may correlate with the fact that women have high adipose tissues more than men.

Furthermore, oestrogen which is a principal hormone in women reduces a woman's ability to burn energy after eating which result to the accumulation of fat in the body (Hanne, *et al*., 2020).

From the result of the study , majority of the females had elevated LDL and low HDL than the males .Elevated LDL and low HDL has stressed to be indicators of dyslipidaemia and modifiable risk factors for cardiovascular disease in individuals when other lipids seem normal ,as observed in this study. The high prevalence observed in this study showed that dyslipidaemia , is found even among health workers and this conforms with the study of (Idemudia *et al*., 2018).

The incidence may be due to chronic stress from excess workload and poor sleep pattern on shift duty which have been identified as disruptors of hypothalamo-pituitary adrenal axis in these workers. This leads to abnormal weight, dyslipidaemia and eventually increased cardiovascular risk (Alhaji, 2013 and Idemudia et al., 2018).

However, increase intake of dietary fatty foods or carbohydrate-rich foods, sedentary lifestyle, urbanization and reduction in physical activity also contribute to high incidence of dyslipidaemia. The result of this study was in conformity with the study conducted by Odenigbo et al. (2008), Olamoyegun et al. (2016), Igwe et al. (2017), and Idemudia et al. (2018) respectively.

The Castelli risk indices, body mass index, fasting blood glucose, blood pressure and atherogenic coefficient were not significantly different in the study and this correlates with values obtained by Olamoyegun et al. (2016) but does not conform with Igwe et al. (2017).

Atherogenic index of plasma which is a logarithm of the ratio of TG to HDL takes into consideration the balance between atherogenic and protective lipids. The average Atherogenic Index of Plasma obtained in this study showed, low risk of cardiovascular disease as established by Dobiasova (2006). The Atherogenic Index of Plasma level was significantly higher in females as compared to males. This correlates with the Caucasian values obtained by Niroumand et al. (2015) and Mahfuza et al. (2018). The values obtained does not conform with that of Olamoyegun et al. (2016) and Ebirien et al. (2017).

From the result of our study atherogenic index of Plasma and other lipid ratios should be used as a monitoring index of cardiovascular disease in everyday practice, especially in persons with high cardiovascular risk factors. Thus, the use of this indices should be encouraged to complement the existing profile of test for identifying high risk individuals for coronary artery disease and effective management.

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