Original Article

Evaluation of Lipid Profile Pattern among apparently Healthy Students of Niger Delta University

Benedicta Erere Kasia, Victoria Y. Nyondia[1], Promise O. Oseajeh[1], Prohp The Prophet[1]

Departments of Chemical Pathology and [1]Biochemistry, Niger Delta University, Amassama, Bayelsa, Nigeria

Abstract

Background: Dyslipidemia constitutes a high risk of cardiovascular disease. **Aim:** This study was designed to evaluate the lipid profile pattern of apparently healthy students of Niger Delta University to detect any possible abnormality. **Setting and Design:** This was a cross-sectional descriptive study. **Materials and Methods:** A total of 102 apparently healthy students were studied. A convenient sampling technique was employed for willing participants. The studied group constituted 55 males and 47 females aged within 20–40 years. Relevant demographic data were obtained by a one-on-one interview with the participants. A blood specimen was collected for measurements of total cholesterol (TC), triglyceride (TG), high-density lipoprotein cholesterol (HDL-c), and low-density lipoprotein cholesterol (LDL-c) by standard assay methods. The data obtained were analyzed using SPSS 22.0, and the student *t*-test was performed at $P < 0.05$ for comparison of means. **Results:** The mean plasma TC and LDL-c values for males were significantly lower than females values of 3.865 ± 0.675 mmol/L versus 4.251 ± 0.851 mmol/L and 2.38 ± 0.49 versus 2.64 ± 0.64 with $P = 0.012$ and 0.023, respectively. Similarly, the mean plasma HDL-c and TGs for males were lower than female values of 1.126 ± 0.190 mmol/L versus 1.194 ± 0.224 mmol/L and 0.77 ± 0.20 versus 0.82 ± 0.27 with $P = 0.099$ and 0.27, respectively which were not statistically significant. The age group of 24–27 years constituted the highest mean values and the age group of 28–40 years constituted the least mean values for all the studied parameters. These values, however, did not differ statistically. Most of the participants had significantly within low-normal reference range values. **Conclusion:** These findings revealed within normal lipid profiles for most subjects.

Keywords: Healthy young students, high-density lipoprotein cholesterol and low-density lipoprotein cholesterol, plasma total cholesterol, triglyceride

Received on: 16-03-20 **Review completed on:** 25-04-20 **Accepted on:** 24-06-20 **Published on:** ****

Introduction

It is widely acknowledged that Africans globally have one of the highest rates of cardiovascular disease (CVD),[1] and only limited data are available about the distributions of blood lipid concentrations and prevalence of hyperlipidemia in Nigeria.[2] Lipid profile assessment is an important tool to help in the diagnosis of CVDs. Thus, the stability of samples is crucial for the analysis of total cholesterol (TC), low-density lipoprotein cholesterol (LDL-c), high-density lipoprotein cholesterol (HDL-c), and triglycerides (TGs). These parameters show a continuous distribution within any population or group, with levels varying with age, sex, race, diet, physical activity, weight, genetic makeup, and environmental factors.[3] Normal homeostasis is required in keeping the concentrations of analytes within an acceptable variation from time to time.[4]

Access this article online

Quick Response Code:

Website: www.atpjournal.org

DOI: 10.4103/atp.atp_17_20

CVDs are among the topmost causes of death and disability in adults and one of the main reasons for morbidity with a direct correlation between the serum cholesterol level and incidence of cardiovascular events.[5] Although hypercholesterolemia itself is asymptomatic, long-standing elevation of serum cholesterol can lead to atherosclerosis (hardening of arteries).[6]

Cholesterol (from the Ancient Greek chole [bile] and sterol [solid], followed by the chemical suffix-ol for an alcohol)

Address for correspondence: Dr. Benedicta Erere Kasia, Department of Chemical Pathology, Faculty of Basic Medical Sciences, College of Health Sciences, Niger Delta University, Wilberforce Island, P M B 071, Yenagoa, Bayelsa, Nigeria.
E-mail: kasia.benedicta@yahoo.co.uk

How to cite this article: Kasia BE, Nyondia VY, Oseajeh PO, Prophet PT. Evaluation of lipid profile pattern among apparently healthy students of Niger Delta University. Ann Trop Pathol 2020;XX:XX-XX.

is an organic molecule. It is a sterol or modified steroid as defined by the US National Library of Medicine, a type of lipid. Cholesterol is a fatty substance essential for normal body functioning. Higher levels of cholesterol in the blood are associated with an increased risk of coronary heart disease (CHD), stroke, and peripheral arterial disease. The Global Burden of Disease Project estimated in 2015, high TC which accounted for 4.3 million deaths globally and the loss of 88.7 million disability-adjusted life years.[7] Globally, the burden attributable to high TC is increasing, probably because of aging populations and westernization of traditional diets. An observational epidemiologic study reported that decreasing levels of TC below those currently considered "normal" would further reduce the risk of CHD and stroke.[8] Elevated levels of non-HDL-c and LDL-c in the blood may be a consequence of diet, obesity, inherited (genetic) diseases (such as LDL receptor mutations in familial hypercholesterolemia), or the presence of other diseases such as type 2 diabetes and an underactive thyroid.[9] Avoiding trans fats and replacing saturated fats in adult diets with polyunsaturated fats are recommended dietary measures to reduce total blood cholesterol and LDL-c in adults.[10] In people with very high LDL cholesterol (e.g., familial hypercholesterolemia), diet is often not sufficient to achieve the desired lowering of LDL-c, and lipid-lowering medications are usually required.[11]

It is not clear if a lower than average cholesterol (hypocholesterolemia) level is directly harmful, A lower than average cholesterol (Hypocholesterolemia) level is often encountered in particular illnesses like adrenal insufficiency, liver disease, malabsoption syndrome such as celiac disease, malnutrition, hypo betalipoproteinemia (a genetic disease that causes cholesterol readings to be less than 50mg/dl).[12] In the elderly, low cholesterol may confer a health risk that may predict short-term mortality.[13,14] The prevalence of hypocholesterolemia in the elderly ranges between 2% and 36%, depending on the specific cutoff levels and age range investigated.[15]

Elevated levels of TC increase the risk of CHD. TC is measured to help assess the patient's risk status and to follow the progress of patient's treatment to lower serum TC concentrations. Desirable TC levels are considered to be those below 200 mg/dL (5.2 mmol/L) in adults and below 170 mg/dL (4.4 mmol/L) in children.[16]

HDL-c is the smallest of the lipoprotein particles. It is the densest because it contains the highest proportion of protein-to-lipid ratio. Increasing concentrations of HDL particles are strongly associated with decreasing the accumulation of atherosclerosis within the walls of arteries. This is important because atherosclerosis eventually results in sudden plaque ruptures, CVD, stroke, and other vascular diseases. HDL-c is sometimes called "good cholesterol" despite being the same as cholesterol in LDL particles. Those with higher levels of HDL-c tend to have reduced risk with CVDs, while those with low HDL-c levels (especially <40 mg/dL or about 1 mmol/L) have increased risks of heart disease.[17] Higher native HDL-c levels are correlated with better cardiovascular health,[18] but it does not appear that further increasing one's HDL-c improves cardiovascular outcomes (National Institute of Health).[19] Research finding[20] stated that HDL-c in patients with CHD, kidney disease, or diabetes demonstrated no protective vascular effects and was even thought to have some harmful effects. In acute and chronic diseases, the HDL-c composition itself changes, undergoing modification in complex ways. This needs to be considered when interpreting lipid panel results, as it may be misleading to assume an equivalence between HDL-c levels and "good cholesterol."[20]

In humans, high levels of TGs in the bloodstream have been linked to atherosclerosis and, by extension, the risk of heart disease and stroke.[21] However, the relative negative impact of raised levels of TG compared to that of LDL-c: HDL-c ratio is yet unknown. The risk can be partly accounted for by a strong inverse relationship between TG level and HDL-c. Their levels remain temporarily high for a period after eating; hence, they are best tested after fasting 8–12 h. The American Heart Association recommends optimal TG level of 100 mg/dl (1.1 mmol/L) or lower to improve heart health.[22] High level of TGs is a component of metabolic syndrome (a cluster of conditions that includes too much fat around the waist, high blood pressure, high blood sugar, obesity, and abnormal cholesterol levels). Extremely high TG of >1000 mg/dl (11.29 mmol/L) can cause acute pancreatitis. Certain medications such as beta-blockers, birth control pills, diuretics, or steroids could also increase TGs levels. Low levels will affect the absorption of fat-soluble vitamins (A, D, E, and K). These vitamins are involved in varying metabolism from the cycling of calcium to the production of a beneficial blood clot.[23] The consequence of this is insulin resistance (a hallmark of type 2 DM) and malabsoption syndrome. Any cause of malnutrition like cancer, memory loss, depression, and trauma can deplete the body of fat, thus contributing to low TGs levels.[23]

LDL-c is one of the five major groups of lipoproteins which transports fat molecules around the body in extracellular water.[24] LDL-c delivers fat molecules to cells. It can contribute to atherosclerosis if oxidized within the walls of the arteries. It is important to note that the popular press calls LDL-c a "bad cholesterol." However, much recent research has shown that it is not necessarily bad because LDL particle appears harmless until they are within the blood vessel walls and oxidized by free radical. It has been stipulated that ingesting antioxidants and minimizing free radical exposure may reduce LDL-c contribution to atherosclerosis, though results are inconclusive.[25]

Our present study aims to evaluate plasma TC, TG, HDL-c, and LDL-c, in apparently healthy young students, males, and females with age ranging from 21 to 40 years of the Niger Delta University, Bayelsa State. There are very few studies on lipid profile in this part of the world. To the best of our knowledge,

studies on lipid profile within this age range is scanty in our environment hence the preference. The results from this study will be useful in identifying early morbidities and mortality that may be associated with lipid abnormalities.

Materials And Methods

Study area and design

This was a cross-sectional study carried out among the students of the Faculty of Basic Medical Sciences, College of Health Sciences, Niger Delta University, Bayelsa State. A total of 102 apparently healthy students aged within 20–40 years were recruited for the study. The selection of participants for the study was done by a convenient sampling method of readily available consenting students.

Ethical consideration

Ethical approval was sought and obtained for this study from the Niger Delta University Ethical Committee after explaining the objectives and benefits of the study. Written and informed consent was sought and obtained from each participant before the study.

Participants selection and exclusion

Apparently healthy students aged within 21–40 years who gave informed consent to participate in the study were selected for the study, while students with known medical conditions such as renal disorders, heart disease, and diabetes mellitus and students who declined study participation were excluded from the study.

Methods

Relevant information such as age, sex, tribe, and religion were obtained through a one-on-one interview from each participant for their demographic data.

Specimen Collection and Storage: About 4 ml of free-flowing venous blood was obtained after 12 h fast (at 8.00 am the next morning) from the antecubital vein by routine aseptic technique without a tourniquet. The blood was dispersed into lithium heparin specimen bottles and thereafter centrifuged at 3500 rpm for 10 min. The plasma was harvested with a clean Pasteur pipette into plane bottles and stored frozen in a deep freezer (at −20°C) until the analysis was done within 24 h of collection.

Measurements of biochemical parameters

The measured plasma lipids such as TC, TG, HDL-c, and LDL-c were analyzed using standard assay methods (enzymatic endpoint,[26] hydrolysis,[27] precipitation methods,[28] and Friedwald's formula,[29] respectively). Hemolyzed and visibly lipemic samples were excluded. All assays were performed in duplicates and quality control sera were analyzed in each batch and the intra- and inter-assay coefficients of variations were 5% and 8%, respectively, in our laboratory. All reference intervals were interpreted in accordance with established procedures.[30] TC = 3.5–6.5 mmol/L, TG = 0.5–2.2 mmol/L, HDL-c = >0.9 mmol/L, and LDL-c = 2.0–3.5 mmol/L were normal reference values.

Statistical analysis

The statistical analysis was performed using SPSS version 23 software application. The mean and standard deviation were determined for quantitative data. Percentage frequencies were used for categorical variables. The differences in means were compared using the student *t*-test. Statistically significant probability or *P* value was set at 0.05 or 5% confidence interval.

No conflict of interest was declared by the authors.

Results

Demographic data of participants

A total of 102 respondents which comprises 55 males and 47 females were interviewed. The age groups were between 20 and 40 years. A total of 61 (59.8%) respondents were aged between 20 and 23 years which comprises 28 (45.9%) males and 33 (54.1%) females. About 33 (32.4%) of the respondents were between 24 and 27 years which comprises 21 (64%) males and 12 (36%) females. While, a total of 8 (7.8%) of participants were between 28-40 years.

The mean plasma TC and LDL-c values for males were significantly lower than females values of 3.865 ± 0.675 mmol/L versus 4.251 ± 0.851 mmol/L and 2.38 ± 0.49 versus 2.64 ± 0.64, with $P = 0.012$ and 0.023, respectively. Similarly, the mean plasma HDL-c and TGs for males were lower than female values of 1.126 ± 0.190 mmol/L versus 1.194 ± 0.224 mmol/L and 0.77 ± 0.20 versus 0.82 ± 0.27, with $P = 0.099$ and 0.27, respectively, which were not statistically significant, [Table 1].

Comparison of mean plasma total cholesterol, high-density lipoprotein cholesterol, triglyceride, and low-density lipoprotein cholesterol levels in participants by age groups

The age group of 24–27 years constituted the highest mean values and 28–40 years the least mean values for all the studied parameters. These values, however, did not differ statistically, [Table 2].

Table 1: Comparison of mean plasma total cholesterol, high-density lipoprotein cholesterol, TG, and low-density lipoprotein cholesterol levels in participants by gender

Parameter (Mmol/L)	Sex	Mean	SD	SEM	*P*	Remark
Total cholesterol	Male	3.865	0.675	0.091	0.012	S
	Female	4.251	0.851	0.124		
HDL-c	Male	1.126	0.189	0.026	0.099	NS
	Female	1.194	0.224	0.033		
TG	Male	0.771	0.200	0.027	0.27	NS
	Female	0.820	0.270	0.040		
LDL-c	Male	2.381	0.49	0.067	0.023	S
	Female	2.642	0.64	0.093		

NS: Not statistically significant, S: Statistically significant ($P<0.05$). HDL-c: High-density lipoprotein cholesterol, LDL-c: Low-density lipoprotein cholesterol, TG: Triglyceride, SD: Standard deviation, SEM: Standard error of mean

Table 2: Comparison of mean plasma total cholesterol, high-density lipoprotein cholesterol, triglyceride, and low-density lipoprotein cholesterol in participants by age groups

Group statistics				
Age (grouped) years	**Mean mmol/l**	**SD**	**SEM**	***P***
Total cholesterol				
20-23	3.62	0.77	0.06	0.86 (NS)
24-27	8.42	2.85	0.23	
28-40	2.20	0.42	0.03	
HDL-c				
20-23	0.92	0.31	0.05	0.77 (NS)
24-27	1.59	0.60	0.10	
28-40	0.42	0.08	0.01	
TG				
20-23	0.80	0.23	0.03	0.02 (S)
24-27	0.79	0.25	0.04	
28-40	0.80	0.23	0.08	
LDL-c				
20-23	0.73	0.23	0.04	0.61 (NS)
24-27	1.59	0.60	0.11	
28-40	0.52	0.09	0.01	

NS: Not statistically significant, S: Statistically significant (P<0.05). HDL-c: High density lipoprotein cholesterol, LDL-c: Low-density lipoprotein cholesterol, TG: Triglyceride, SD: Standard deviation, SEM: Standard error of mean

Percentage frequency distribution plasma total cholesterol, high-density lipoprotein cholesterol, triglyceride, and low-density lipoprotein cholesterol in participants based on our laboratory reference intervals

Majority of the participants had significantly within low-normal reference range values as in 77/102 (75.5%), 74/102 (72.5%), 97/102 (95%), and 76/102 (75%) in terms of TC, HDL-c, TG, and LDL cholesterol values, respectively. In addition to this, up to about 28/102 (27.5%) of the studied group had high levels of HDL (good cholesterol).

Discussion

Over the years, the growing epidemic of childhood and adult obesity, insulin resistance, type 2 diabetes mellitus, and dyslipidemia has led to atherosclerotic CVD which remains the leading cause of death and disability in the Western world.[31] The four elements of fat metabolism such as TC, LDL-c, HDL-c, and TG are known to affect the development of heart disease.[32] Over a period of time, elevated levels of plasma TC contribute to the formation of atheromatous plaque, especially over small arteries which may rupture and cause a clot to form. This could obstruct blood flow as in the coronary arteries with a resultant heart attack.[33]

In this study, it was observed that the participants aged within 24–27 years had the highest mean values for TC, HDL-c, LDL-c, and TG. This is comparable with studies by Zhao *et al*.[34] where higher age groups tend to have lower TC levels. Contrary to this are findings by Bushnell[35] and Ngwogwu *et al*.[36] who reported that TC and HDL-c were higher in the older age groups. The effect of age on lipid profile could not be explained; hence, it demands further studies.

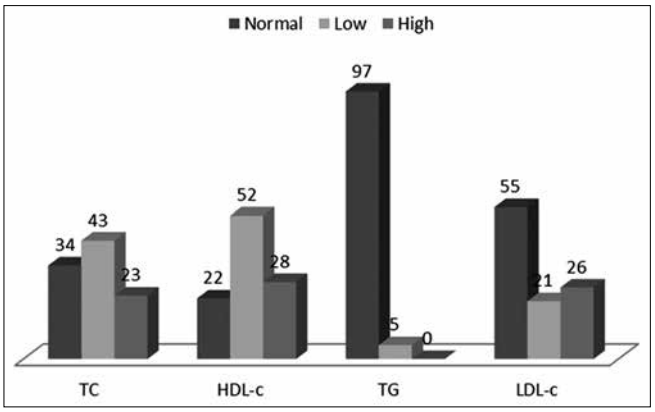

Figure 1: Percentage-frequency distribution: plasma TC, HDL-c, TG, and LDL-c in participants into normal, low and high values based on our laboratory reference intervals. TC: Total cholesterol, HDL-c: High-density lipoprotein cholesterol, TG: Triglyceride, LDL-c: Low-density lipoprotein cholesterol

In an attempt to establish gender relationship to lipid profile in this study, it was observed that the female values were more than the males. This is in keeping with studies by Ofori *et al*.[37] and Madhumita and Mauchumi[38] whose study was with reference to age and sex whereby HDL-c and TC values increased with increasing age with higher values in females than males. The higher HDL-c value in the females may be attributable to the cardioprotective effects of estrogen through glucose metabolism and hemostatic system at younger age, and it may also have an effect on endothelial function. While the differential higher levels of TC in females could not be explained, but there was a hypothetical finding by Kautzky-Willer *et al*.,[39] stating gender-specific lipid-lowering resistance in females leading to defective lipid metabolism in females than males.

This study also showed that the majority of the participants had significantly within low-normal reference range values as in 77 (75.5%), 74 (72.5%), 97 (95%), and 76 (75%) in terms of TC, HDL-c, TG, and LDL cholesterol values, respectively Impute [Figure 1]. This is in keeping with a study done by Kasia and Idogun[40] on the frequency of atherogenic risk in type 2 diabetes mellitus and healthy controls which reported a high percentage of low risk in the healthy controls as 80%, 79%, 94%, and 86% for TC, HDL, TG, and LDL cholesterol values, respectively. In addition to this, up to about 28 (27.5%) of the studied group had high levels of HDL (good cholesterol). This finding also corroborates with that of Solomon *et al*.[41] who found a high percentage of participants within desirable (low-normal) TC levels. These findings support low cardiovascular risk among the studied participants.

Conclusion

These findings revealed that majority of the participants had within normal lipid profile in keeping with good health status.

Recommendations

Dyslipidemia is one of the highest risk factors for CVD; hence, it is suggested that all adults 20 years of age or older should have a fasting lipid profile (TC, LDL-c, HDL-c, and TG) performed at least once every 5 years and more often if the profile is abnormal. Patients who have had an acute event (e.g., myocardial infarction), a percutaneous coronary intervention, or a coronary artery bypass graft require assessment of their LDL cholesterol level within a few months of the event or procedure because LDL levels may be low immediately after the acute event or procedure. Subsequently, lipids should be monitored every 6 weeks until the desired level is achieved and then every 4–6 months. These measures will, in the long run, detect new cases for treatment or prevent complications of CVD if any.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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