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Original Article

Lipid Profiles of Apparently Health Inhabitants of a Metropolitan City in South-East Nigeria: Setting Local Reference Values

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ABSTRACT

Background: Differences in nutritional intakes of different regions and countries have been found to influence the nutritional indices of such areas. These, in turn, influence the blood levels of many biochemical parameters. Aim: This study was aimed to investigate the lipid profiles of apparently healthy adults of a metropolitan city in south eastern part of Nigeria, which can be used as the reference values of these parameters in the area. Methods: A total of 400 participants, evenly distributed in sexes and age groups, were recruited for the study. Serum levels of total cholesterol, high-density lipoprotein, low-density lipoprotein, very-low-density lipoprotein and triglycerides were determined by spectrophotometric methods and the results were analysed using GraphPad Prism 10.6. Results: Results showed that there were no significant changes in the levels of the parameters when compared with the recommended reference values. Also, there were no significant differences between the levels got from males when compared with the levels got from females. However, the results showed significant positive correlation between all the parameters and age, except for high-density cholesterol. Conclusion: Though the ranges obtained from this study are relatively lower than the previously established values, the positive correlation of the values with age implies possible predisposition to cardiovascular diseases, possibly later in adult age. These results will help clinicians to have better diagnosis, management and prognosis of cardiovascular diseases.

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Introduction

Lipids of medical importance comprises mainly cholesterol, triglycerides and the lipoproteins. The lipoproteins include high density lipoproteins (HDL), low density lipoproteins (LDL and very low density lipoproteins (VLDL). Abnormalities in metabolism of lipids and lipoproteins are associated with many disease conditions including hypertension, diabetes, liver disease, and atherosclerosis [1].

Cholesterol is a naturally occurring lipophilic fatty molecule that is very essential for human life [2,3]. It is needed by the body for the synthesis of steroid hormones, vitamin D, and substances that help the body to digest foods, and also serves as a structural component of the cell membrane that ensures the membrane's fluidity [2,4]. Cholesterol synthesised in the liver is a component of bile salt that facilitates the digestion of fats in the intestine and absorption of fat-soluble vitamins from the intestine [5].

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Deposition of cholesterol and fibrous tissues on arterial walls leads to narrowing and thickening of the arterial walls, leading to blocking of the arterial lumen [6]. This ultimately leads to cardiovascular disease, a leading cause of morbidity and mortality worldwide[7]. Triglycerides serve as the main form of energy store in the body. They are the main form of fat in the body, and are derived from glycerol and three fatty acids. Like cholesterol, triglycerides contribute to hardening of the arteries and thickening of the arterial walls, leading to cardiovascular disease.

In fact, triglycerides have been recognised by some researchers as a sole risk factor for the development of cardiovascular disease [8,9]. Apart from the cardiac disease, hypertriglyceridemia has been linked to other disease conditions, including pancreatitis, obesity and metabolic syndrome [10]. LDL transports cholesterol to various tissues throughout the body [11], and its high value in blood also causes plaque build up in arteries, increasing the risk of cardiovascular disease [12]. On the other hand, HDL helps remove excess cholesterol from the bloodstream and transport it to the liver for excretion [13], hence, its association with a lower risk of cardiovascular disease [14]. VLDL transports endogenous triglycerides, cholesterol, and other lipids from the liver to various tissues in the body [15].

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Its high value in the blood is associated with the development of atherosclerosis, thus, increasing the risk of cardiovascular disease [16]. Lipids and lipoprotein particles are therefore known to contribute substantially, and arguably solely, to atherosclerosis as underlying pathology of cardiovascular disease, influencing inflammatory processes and functions of leukocytes, vascular and cardiac cells [17].

Hence, their high levels in blood, and increased ratio of low density lipoprotein (LDL)/apolipoprotein B (apo B), singly or jointly, have been recognised as sole risk factor(s) for cardiovascular disease [6,8,9,16,18], a condition that has been shown to be highly prevalent in middle-aged men and women [19].

Factors implicated in the causation of hyperlipidemia, especially among women, include urbanization, lifestyles, diets, and culture [20]. A key driver of this is urbanization and the corresponding expansion of processed food outlets [21]. We had earlier reported prevalence of hyperlipidemia among adolescents with high body mass index (BMI), especially high cholesterol, triglycerides and LDL in the same study area [22]. Though this collaborated with some of the earlier studies from other zones of the country [23,24,25], all these studies used already established reference values in their comparative analyses.

The present study is aimed at establishing local reference values for these lipids as basis of comparison in subsequent studies. This will help medical scientists properly interpret lipid profile results from the study area, and possibly establish the epidemiology of cardiovascular diseases in the area. It will also help clinicians for better diagnosis, management and prognosis of disease conditions that have dyslipidemia as etiological factors.

Materials And Methods

Ethical clearance: Ethical clearance for this study was obtained from the Ethical Committee of the Faculty of Basic Medical Sciences, College of Medicine, Enugu State University of Science and Technology, Enugu, Nigeria (ESUT/FBMS/EC/2024/088). Oral informed consents were sought and obtained from the participants after detailed explanation of the procedures for the study.

Study area: This study was done in Enugu metropolis, Enugu State of Nigeria. The State, which is in the South-eastern part of the country has 2025 estimated population of 907,000 and a growth rate of 3.5% [26]. The study was conducted between June and December, 2024.

Study design: This is a cross-sectional study that involved apparently healthy individuals of both sexes aged 18 – 65 years. These participants have resided in Enugu metropolis for a minimum of two (2) years. Standardized questionnaires were used to collect the participants' demographic data before the collection of blood samples for the lipid profiles. The participants were grouped into five (5) according to age, with a band width of ten (10), except the first group which was eight (8). Each group contained a uniform predetermined number of participants - sixty (60).

Inclusion criteria: The following criteria were considered before a participant was included in the study. A participant,

a. Must be apparently healthy with no previous history of cardiovascular disease or other disease conditions that can cause dyslipidemia.

b. Must be aged 18-65 years

c. Would have been resident in Enugu metropolis for at least 2 years prior to the study.

d. Must be willing to participate and provide informed consent.

Exclusion criteria: Even when one has shown willingness to participate, he/she

a.Must not have cardiovascular disease or any lipid disorder.

b.Must not be on cholesterol-lowering medications

c.Must not be pregnant or breastfeeding.

d.Must not been diagnosed of other chronic illnesses (e.g diabetes, kidney diseases)

Sample size: Sample size was determined using the Taro Yamane Formula of 1967, given as

$$n = N/1 + N \times e2$$

Where:

n = sample size

N = population size

e = margin of error (set at 0.05)

Therefore,

n = 907,000/1 + 907000 x 0.052

n = 907,000/1 + 90,700 x 0.0025

n = 907,000/1 + 2,267.5

n = 907,000/2.268.5

n = 399.8

n ≈ 400

Sample collection: A total of 3.0ml of blood sample was collected from each participant into a clean, grease-free glass test tube. This was then transported to the laboratory, during which it would have clotted. It was then spun in a centrifuge at 5000 rpm for 5 minutes. The resulting serum was separated into a separation tube, and stored frozen at -20 °C until needed for analysis.

Laboratory analysis: The blood levels of the lipids and lipoproteins were determined spectrophotometrically as earlier reported [1]. Each sample had duplicate analysis to ensure consistency and check for pipetting errors.

Data analysis: The data obtained were analyzed using GraphPad Prism (version 10.6). Wilcoxon test was used to calculate the means and standard of error means while simple regression analysis was used to calculate the correlation between the values and age groups at 95% confidence intervals. Statistical significance was set at $p \leq 0.05$.

Results

Table 1 shows the mean (±SEM) levels of lipid profile of the study population. The total cholesterol (TCHOL) level was 5.35 ± 0.08mmol/L, high-density lipoprotein (HDL) was 1.64 ± 0.03 mmol/L, low-density lipoprotein (LDL) was 3.35 ± 0.08mmol/L, and very low-density lipoprotein (VLDL) was 0.40 ± 0.02mmol/L, while triglycerides (TG) had a mean level of 0.87 ± 0.04 mmol/L. These values reflect the overall lipid profile of the participants in the study.

Table 1: Mean (±SEM) levels of lipid profile among the study population

Variables (mmol/L)	Mean ± SEM N=400	Range
TCHOL	5.35±0.08	5.27 – 5.44
HDL	1.64 ±0.03	1.61 – 1.67
LDL	3.3 ±0.08	3.22 – 3.38
VLDL	0.40±0.02	0.38 – 0.42
TG	0.87±0.04	0.83 – 0.91

Table 2 shows the lipid profiles in both female and male participants when grouped according to gender. The mean TCHOL from females was 5.48 ± 0.12 mmol/L, and 5.23 ± 0.11mmol/L from males. The mean HDL from females was 1.67 ± 0.05mmol/L, and 1.61 ± 0.04 mmol/L from males. For LDL, the mean levels were 3.41 ± 0.12 mmol/L in females and 3.28 ± 0.11mmol/L in males, while for VLDL, females had a mean of 0.40 ± 0.02mmol/L and males had 0.39 ± 0.03mmol/L. Lastly, TG levels were 0.86 ± 0.05mmol/L in females and 0.87 ± 0.06mmol/L in males. The results showed that there were no statistical significant differences between the values in females and those in males.

Table 2: Lipid profiles in different genders of the study population

Variables (mmol/L)	Female N = 204	Male N = 196	t-value	p-value
TCHOL	5.48 ± 0.12	5.23 ± 0.11	1.49	0.14
HDL	1.67 ± 0.05	1.61 ± 0.04	0.98	0.33
LDL	3.41 ± 0.12	3.28 ± 0.11	0.85	0.40
VLDL	0.40 ± 0.02	0.39 ± 0.03	0.04	0.97
TG	0.86 ± 0.05	0.87 ± 0.06	0.17	0.87

The lipid profiles across different age groups were analyzed (Table 3). Using simple regression analysis at 95% confidence intervals, TCHOL levels were found to significantly increase with age (p=0.003), with participants in the 56-65 age group showing the highest mean at 5.89 ± 0.21 mmol/L, while HDL did not show any significant change with age (p=0.149), with the lowest value (1.63 ± 0.06) found at 26 – 35 years of age. Other parameters increased significantly with age (p<0.05 each). The highest value of LDL (3.85 ± 0.22) was found in 56 – 65 age group, while highest values of VLDL (0.46 ± 0.03) and TG (0.99 ± 0.08) were found in 46 – 55 age group.

Table 3: Mean (±SEM) values of lipid profile in different age groups

Variables	18 – 25	26 – 35	36 - 45	46 – 55	56 – 65	F-value	P-value
TCHOL	4.81 ± 0.15	4.94 ± 0.11	5.37 ± 0.20	5.75 ± 0.13	5.89 ± 0.21	89.43	0.003
HDL	1.66 ± 0.07	1.63 ± 0.06	1.62 ± 0.06	1.66 ± 0.09	1.62 ± 0.05	0.525	0.149
LDL	2.89 ± 0.15	2.97 ± 0.11	3.35 ± 0.19	3.65 ± 0.16	3.85 ± 0.22	103.0	0.002
VLDL	0.28 ± 0.02	0.35 ± 0.04	0.44 ± 0.06	0.46 ± 0.03	0.44 ± 0.03	11.03	0.045
TG	0.64 ± 0.07	0.76 ± 0.08	0.96 ± 0.13	0.99 ± 0.08	0.98 ± 0.06	14.87	0.031

Discussion

The results of this study revealed a mean total cholesterol level of 5.35 ± 0.08mmol/L in the studied population. This is at variance with the results of earlier studies from the same area and other regions of the country[27,28,29]. These earlier results, as well as the internationally accepted reference value of ≤5.2mmol/L, were slightly but non-significantly lower than the results of the present study. The disagreement between these results is consistent with variations in food habits and socioeconomic circumstances in the different areas and times.

As earlier noted [22], rapid weight gains resulting from physical inactivity as well as change from eating the traditional high carbohydrate, high fibre and unsaturated fats to the consumption of fast food, and cheap Western diets, is contributory to this difference. Of recent, there is general relative increase in consumption of fatty foods and changes in lifestyle towards sedentary disposition due to changes in socioeconomic levels, and increase in urban shift that necessitated higher consumption of preformed foods.

Therefore, relative increase in level of income in multicultural metropolis of Enugu may have changed lifestyles in the area towards sedentary pattern, which will also lead to increased body mass index (BMI), and later obesity. This might account for the increase in the level of cholesterol when compared with the data from earlier studies. Such relationship has earlier been reported in adolescents from the same study area [22].

Therefore, this does not just stand as a warning for impending prevalence of hyper cholesterolemia in the area, but may serve as a new reference value of cholesterol in the area. Serving as a new reference value is only possible if there is an indication that the increased changes will not predispose to or correlate with increased cardiovascular diseases in the area. Therefore, the need to constantly re-evaluate and establish reference values of biochemical parameters for a particular area, region or country cannot be overemphasised. This helps, in no small measure, in guiding the decisions of clinicians, since what is applicable in one city or region may not apply to another area.

The mean high-density lipoproteins (HDL) level from this study is higher than values from another Nigerian study[30], but about the same value as recommended in American States [31]. Since HDL is required to be as high as possible for good health of the heart, this value gives a comfortable safe gap in the metropolis, in terms of development of cardiovascular diseases, given that aprevious observational study has suggested a graded inverse relationship between HDL and both cardiovascular disease and total mortality[32].

Furthermore, LDL value from this study is within the required reference values of 2.6 – 4.1 mmol/L [31]. Though this was found to increase with age, the highest level found at 56 – 65 age group was not higher than the upper limit of the reference values. Thus, based on the levels of HDL and LDL and using the prescribed reference values, there is no likelihood of development of cardiovascular diseases, even at that adult age. However, there is absolute need to individualise investigations to rule out those that may fall outside the range obtained.

This also re-emphasises the need for regional and national reference values, given that nutritional indices of the inhabitants of different regions influence the values of their lipid profile. Again the value of triglycerides obtained from this study is less than the lower value of the range used in American State [31]. Though there was increase in its value with age, with a sharp increase from36-45 age group, the highest value is below the upper limit of the given reference values. Moreover, metabolism of triglycerides has earlier been found altered by age in both humans and rodents [33]. It is also certain that values may vary due to change in diet, eating habits and physical activities, increasing the need for regional reference values.

Generally, the results of this study revealed that all the parameters increased significantly as age increased, with the exception of HDL. However, HDL still increased relatively but not significantly. The summation of these changes is a possible increase in prevalence of cardiovascular diseases, especially later in adult life. The metabolism of different plasma lipids is known to be under multi-factorial control involving genetic as well as environmental factors including geographical, socio-cultural, economic, dietary habits, age and gender differences[33,34].

These may have accounted for the differences in the values obtained from this study and those from the western world. If these differences in causative factors abound across difference regions, the need for regional reference values cannot be over-emphasised. Likewise, if these lipids are risk factors for cardiovascular diseases, the inhabitants of the study area might easily develop the disease with values thought to be comfortable for other regions. Hence, the absolute need to establish the reference values of all biochemical parameters in different areas, regions and nations.

Conclusion

The ranges of the lipid parameters obtained from this study are relatively lower than earlier quoted ranges that have been used in comparative analyses. This might have been caused by differences in the nutritional pattern of the different areas, but does not imply safety values for the inhabitants. Moreover, the values showed positive correlation with age, implying possibility of developing cardiovascular diseases later in adult life. Therefore, the values of the present study should serve as authentic reference values for the study area.

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