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Age And Sex-Related Variations In Lipid Profiles And Ratios Among Patients With Hypertensive Heart Disease In A Tertiary Health Institution In South-South Nigeria

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Abstract
This study investigated age and sex-related variations in lipid profiles and ratios among patients with hypertensive heart disease (HHD) at a tertiary health institution in South-South Nigeria
Hypertension, a major global health concern, is a significant risk factor for cardiovascular disease (CVD) and often co-occurs with dyslipidemia. Understanding the interplay between hypertension, dyslipidemia, and HHD is crucial for effective management and risk stratification. This cross-sectional, descriptive, and retrospective study analyzed lipid profiles from laboratory requests of HHD patients over a six-month period.
Three hundred and four request were analysed and 62% had abnormal results, with increased LDL having the highest frequency followed by reduced HDL, then increased total cholesterol and finally increased triglycerides. Lipid ratios, including the atherogenic index of plasma (AIP) and atherogenic coefficient (AC), also revealed no significant age or sex-related differences. These findings highlight the importance of modifiable risk factors (as against non modifiable) in assessing the risk of patients with HHD. More emphasis should be on reducing these risk factors through continuous education, establishing of policies and implementation. Further research to assess the efficacy of these interventions would be required.

Keywords: *Hypertension, Hypertensive Heart Disease (HHD), Lipid Profile and Ratios*

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I. Introduction:

Hypertension, defined as persistently elevated arterial blood pressure exceeding 140/90 mm Hg, affects approximately one billion individuals globally and poses a substantial risk for both cardiovascular and non-cardiovascular complications [1, 2]. Often asymptomatic, hypertension can lead to severe kidney damage, potentially causing chronic kidney disease and renal failure. It also significantly impacts the brain, increasing the risk of stroke, transient ischemic attacks, and dementia. Hypertension contributes to left ventricular hypertrophy, angina, myocardial infarction, coronary artery disease, heart failure, peripheral arterial disease, and retinopathy [3, 4]. Hypertension can be classified as primary (essential), which is more common and multifactorial, involving genetic predispositions, (It is moderated by environmental influences), or secondary.

Two decades ago, Franco et al proposed that persons with hypertension on average have an estimated 5 year lower life expectancy than their age and sex matched counter pacts who are not hypertensive. [5] More recent studies have made similar findings though the life expectancy all around the world has increased. [6] Having cardiac disease further reduces this.

A major consequence of uncontrolled hypertension is hypertensive heart disease (HHD), a condition characterized by coronary flow irregularities, systolic and diastolic dysfunction, and left ventricular hypertrophy, ultimately leading to heart failure [7]. The Framingham Study, a long-term observational study, highlighted the strong association between hypertension and the development of congestive heart failure and coronary heart disease [8]. The pathogenesis of left ventricular hypertrophy in hypertension involves increases in cardiac myocyte size, proliferation of non-myocyte cells (fibroblasts), collagen deposition, and infiltration of immune cells (monocytes and lymphocytes) [9].

Patients with HHD are at increased risk of ventricular arrhythmias and sudden cardiac arrest, ischemic episodes, CHF with those exhibiting left ventricular hypertrophy being particularly susceptible to ventricular arrhythmias [8,9,10]

The global prevalence of hypertension is projected to increase with time. [13]. As a major risk factor for cardiovascular disease (CVD), hypertension is a leading cause of disability and mortality worldwide [13]. Dyslipidemia, characterized by elevated total cholesterol, LDL cholesterol, and triglycerides, along with reduced HDL cholesterol, frequently coexists with hypertension, irrespective of age or sex [14]. Dyslipidemia is

an independent risk factor for CVD, contributing to atherosclerosis and endothelial dysfunction [15, 16]. The co-occurrence of hypertension and dyslipidemia significantly elevates the risk of cardiovascular events, with hypertensive patients who also have dyslipidemia being 18 times more likely to develop coronary heart disease compared to those with hypertension alone.

Hypertensive heart disease is a substantial public health issue, especially in Nigeria, where cardiovascular diseases are increasingly prevalent. Lipid profiles and ratios are essential indicators of cardiovascular health, and their alterations play a crucial role in the development and progression of HHD. Despite this importance, research on age and sex-related variations in lipid profiles and ratios among Nigerian HHD patients is limited. Existing studies often focus on broader populations or subgroups, leaving a significant knowledge gap regarding specific lipid patterns and ratios in HHD patients. This lack of age and sex-stratified data hinders the development of targeted interventions and treatment strategies, potentially leading to suboptimal HHD management and increased morbidity and mortality.

This study addresses this critical gap by investigating age and sex-related differences in lipid profiles and ratios among patients diagnosed with hypertensive heart disease at a tertiary health institution in South-South Nigeria. The findings will inform the development of targeted treatment guidelines and risk stratification strategies, enabling healthcare providers to deliver more effective and personalized care, ultimately improving patient outcomes.

II. Participants And Methods:

This study employed a cross-sectional, descriptive, and retrospective design to investigate lipid profiles and ratios in patients with hypertensive heart disease. The research was conducted at the University of Port Harcourt Teaching Hospital laboratory, one of two tertiary hospitals serving the large and diverse population of Port Harcourt, Rivers State, Nigeria. This 800-bed facility houses over twenty specialized clinics, providing a broad patient base for the study. The study population comprised all laboratory requests submitted from the hospital clinics to the laboratory over a six-month period where hypertensive heart disease was listed as a diagnosis.

Given the retrospective nature of the study, the sample size was determined by the availability of laboratory requests meeting specific criteria. All laboratory requests from patients diagnosed with hypertensive heart disease that included a complete lipid profile within the six-month study period were included. A convenience sampling method was utilized, incorporating all consecutive laboratory requests that met the inclusion criteria. Specifically, all laboratory requests and corresponding blood specimen from patients with a diagnosis of hypertensive heart disease and a complete lipid profile were included in the study. Conversely, any laboratory requests or samples that either lacked a lipid profile or were not associated with a patient diagnosed with hypertensive heart disease were excluded from the analysis.

Data collection involved transcribing all eligible lipid profile results from the laboratory records into a digital format. The transcribed data were initially entered into a Microsoft Excel spreadsheet for organization and then exported into SPSS version 23 for statistical analysis. Descriptive statistics, including means and standard deviations, were calculated to summarize the data. Further statistical analysis, the specifics of which are missing from the provided text, was planned to determine relationships and variations within the data. A p-value of less than 0.05 was pre-determined to be the threshold for statistical significance in all analyses.

III. Results:

Three hundred and four requests were consecutively selected**.** Out of these, 137 were females, 116 were males and 51 requests did not indicate the sex category.

Below is a chart showing the distribution of the wards and clinics that the requests came from.

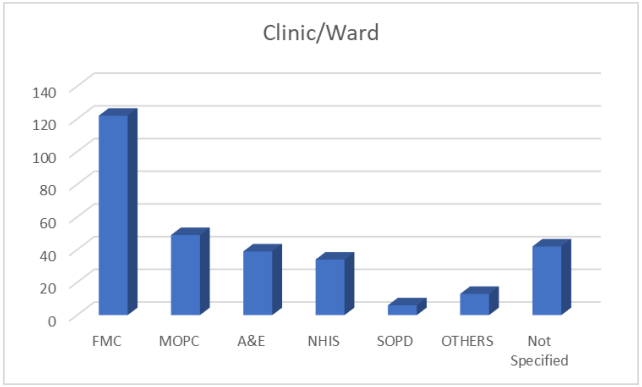

Figure 1. Distribution of originating clinics and wards.

(FMC- Family Medicine Clinic, MOPC – Medical Out Patient Clinic, A&E-Accident and Emergency, NHIS-National Health Insurance Scheme, GOPD- General Out Patient Department, SOPD- surgical Out Patient Department, MOPC – Medical Out Patient Department)

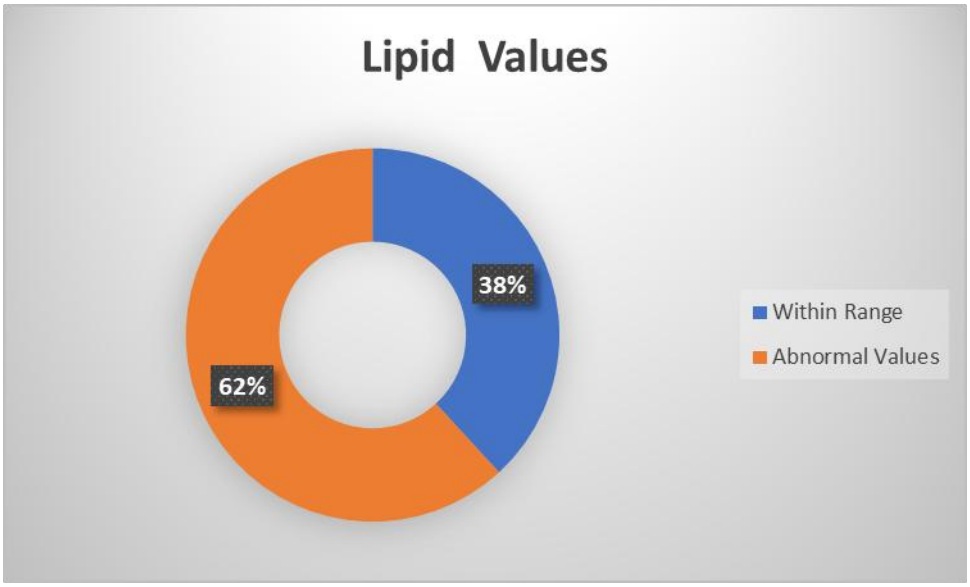

Figure 2. Distribution of within range and abnormal lipid results.

The following percentages had clear cut abnormal results or dyslipidaemias. 14.5% (44) had hypertriglyceridemia, 19.1%(58) had hypercholesterolemia, 28.6%(87) had reduced HDL-C while 48%(147) had increased LDL-C. Among those(116 participants) with within range values the Atherogenic Index of plasma all had low risk. Among those with results within range females accounted for 56.7% while males were 43.3%.

Lipid profiles, stratified by age and sex. Among female patients, triglyceride (TG) levels showed some variation across age groups. The 30-39 year age group had an average TG level of 93.00 mg/dL, while the 50-59 year group had an average of 88.55 mg/dL. However, statistical analysis revealed no significant difference in triglyceride levels between males and females across all age ranges ($p>0.05$).

Table 1: Lipid ratios of patients with hypertensive heart disease receiving care in a tertiary institution in southern Nigeria

	AIP	NonHDL	AC	VLDL	CRI-I	CRI-II
FA	0.25±0.12ab	119.62±17.77ab	1.25±0.07a	18.60±3.24a	3.90±0.53a	2.41±0.46ab
FB	0.39±0.12b	149.21±16.90ab	1.18±0.03a	23.38±6.30a	5.63±1.10a	3.96±0.99ab
FC	0.25±0.07ab	134.80±12.70ab	1.16±0.02a	17.71±3.11a	4.06±0.32a	2.66±0.28ab
FD	0.21±0.10ab	142.21±9.58ab	1.19±0.05a	19.84±3.84a	3.87±0.42a	2.46±0.39ab
FE	0.31±0.15ab	140.24±18.04ab	1.21±0.07a	18.43±3.07a	5.78±1.41a	4.16±1.34b
MA	0.23±0.10ab	135.58±18.31ab	1.53±0.37a	19.66±2.90a	3.84±0.47a	2.44±0.43ab
MB	0.23±0.12ab	144.91±13.93ab	1.17±0.04a	20.90±5.21a	4.16±0.39a	2.70±0.32ab
MC	0.29±0.07ab	164.01±23.00b	1.23±0.07a	26.04±5.19a	4.11±0.55a	2.68±0.53ab
MD	0.01±0.08a	139.11±18.16ab	1.12±0.02a	14.35±3.08a	3.37±0.38a	2.14±0.35a
ME	0.11±0.13ab	107.14±12.87a	1.23±0.08a	17.71±6.94a	3.38±0.48a	1.89±0.28a
Sum of squares	1.02	21791.62	1.14	946.12	62.54	48.85
MS	0.11	2421.29	0.13	105.12	6.95	5.43
F	0.948	0.886	0.760	0.515	1.452	1.367
Sig.	0.488	0.541	0.653	0.860	0.178	0.215

Key.
F- female, M – male

A (30-39 yrs), B (40-49 yrs), C (50-59 yrs), D (60-69 yrs), E (70 - 79) yrs, and E (80 yrs and above
AIP =,atherogenic index plasma, AC atherogenic coefficient, CRI= Catelli Risk Index I and II.

The lipid ratios of patients with hypertensive heart disease were also evaluated, and the results are presented in Table 1. Notably, age and gender did not have a significant impact on the lipid ratios, suggesting that these factors may not be major determinants of lipid ratio outcomes in this patient population. Specifically, the atherogenic index of plasma (AIP) ranged from 0.01 to 0.39, indicating a moderate to high risk of atherosclerosis. The atherogenic coefficient (AC) also ranged from 1.12 to 1.53, further supporting the presence of atherogenic dyslipidemia in these patients.

Table 2: Coefficient of variation (%) of data collected

	Age-A	Age-B	Age-C	Age-D	Age-E
Female	*(CV%)*				
TG	55.05	85.26	55.58	61.27	52.70
CHO	37.60	24.18	27.75	12.52	28.57
HDL	42.29	40.38	32.81	31.41	60.62
LDL	53.22	31.67	29.94	27.47	47.63
AIP	148.28	94.51	83.18	158.53	155.01
NonHDL	46.98	35.81	29.79	21.31	40.68
AC	17.33	8.76	6.35	12.15	17.41
VLDL	55.05	85.26	55.58	61.27	52.70
CRI-I	43.09	61.56	24.74	34.00	76.97
CRI-II	59.83	78.88	33.38	49.59	101.60
Male					
TG	46.60	78.78	63.00	68.00	123.93
CHO	26.94	21.57	32.25	27.58	25.73
HDL	25.22	21.34	38.01	28.70	40.38
LDL	48.47	27.45	51.47	40.54	40.46
AIP	136.26	172.25	80.04	498.99	396.61
NonHDL	42.70	30.40	44.35	41.28	38.00
AC	77.37	9.58	19.19	5.29	21.00
VLDL	46.60	78.78	63.00	68.00	123.93
CRI-I	38.49	29.93	42.24	35.61	45.09
CRI-II	55.67	37.99	62.41	52.09	46.10

A (30-39 yrs), B (40-49 yrs), C (50-59 yrs), D (60-69 yrs), E (70 - 79) yrs, and E (80 yrs and above
AIP =,atherogenic index plasma, AC atherogenic coefficient, CRI= Catelli Risk Index I and II.

The coefficient of variation (CV) for the atherogenic index of plasma (AIP) varied significantly across different age groups of females. Notably, the CV for AIP was highest among 40-49 year old females, with a value of 148.28%. This suggests that the AIP values for this age group were highly variable, indicating a wide range of individual values. In contrast, the CV for AIP was lower among 50-59 year old females, with a value of 83.18%. This indicates that the AIP values for this age group were less variable, suggesting a more consistent pattern of atherogenic risk. These findings highlight the importance of considering age-related differences in lipid profiles and atherogenic risk.

Table 3: Comparison of lipid parameters between male and female subjects irrespective of age. (values in mmol/L

Ratios	Female Average	Male Average	t	p-value
TG	1.1±0.68	1.2±0.9	0.690	0.491
CHO	5.0±1.2	5.0±1.3	0.997	0.320
HDL	1.4±0.5	1.3±0.5	0.350	0.727
LDL	3.1±1.2	3.15±1.2	0.769	0.426
AIP	0.28±0.05	0.17±0.05	1.615	0.110

Table 3 presents a comparison of lipid parameters between male and female subjects, irrespective of age. The results reveal no significant difference in any of the parameters.

IV. Discussion:

In this study, most of the requests came from the family medicine clinic. This is not unexpected as it is the first point of call for most patients coming into the hospital since it is a tertiary center. Thirty -eight percent had normal lipid values, this is higher than the 19.7% seen in Ethiopia, [17] however it is close to the 40% found in Uyo teaching hospital. [18]

Increased LDL-c was the most common Lipid abnormality in this study while Hypertriglyceridemia was the least. This is different from what was found in Bida and Abuja where low HDL was the most common lipid abnormality. However, the Abuja study also had increased triglycerides as the least abnormality. [19,20] It is an established fact that patients with dyslipidemias have an increased risk of cardiac events.

Comparing the males with the females in the study across 5 age groups divided into decades, none of the lipid parameters had a statistically significant difference. Comparing all the lipid ratios across the age matched sex groups, none of them had a statistically significant difference either. (Table 1) This emphasizes the fact that focusing on moderating the non-modifiable risk factors for heart disease is very crucial to interrupting its evolution and altering outcomes. [21]

The coefficient of variation was however higher among females within the 40-49 age group. (Table 2) This shows that persons in this sex and age group would need tighter control. This agrees with the findings from a longitudinal study done in the Uk where the middle age group was found to have the highest percentage of behavioural modifiable risk factors. These include diet, physical activity/inactivity, sleep or lack of sleep, alcohol intake and smoking. [22] It is noteworthy that these still further modify the metabolic risk factors such as dyslipidaemia (which is the primary subject of discussion), obesity, (especially abdominal circumference) hypertension and diabetes.

In some populations the modifiable risk factors are overshadowing the non-modifiable and due to the changes, that come with modernization, people from the younger age group; adolescents are having an increasing prevalence of the presence of cardiovascular risk factors. [21] moderating these risk factors and reducing or eliminating them are key indices in managing patients with hypertensive heart disease. This same management will inadvertently reduce or correct dyslipidemias.

V. Conclusion:

This study examined the lipid profiles and ratios between intra and inter sex age groups. There was no statistically significant difference. To improve outcomes of affected patients, management should focus on improving lipid profiles through lifestyle modifications and, when indicated, pharmacological interventions to reduce cardiovascular risk in both males and females as well as screening of first-degree relatives.

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