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# Utility of lipid ratios as a cardiometabolic risk assessor of hypertensive heart disease patients with artrial fibrillation in a secondary health institution in Benin City, Nigeria

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## Abstract

*Atrial fibrillation is the most common cardiac arrhythmia worldwide, and risk factors for the condition include ageing, obesity, hypertension, diabetes mellitus, and diabetes. The control group included at least one male participant for every two participants, according to the results, but 47.2% of the subject group had female participants. At a secondary health facility in Benin City, Nigeria, this study attempts to test the usefulness of lipid ratios as a cardiometabolic risk assessor in patients with hypertensive heart disease and atrial fibrillation. There are 100 participants in the study: 53 patients with atrial fibrillation and hypertensive heart illness and 47 non-hypertensive people who serve as the control group. Cardiometabolic risk variables were assessed by the analysis of lipid profiles, blood pressure readings, and different lipid ratios. Results whoed that The study group's mean age was 59.5 years, in contrast to the control group's mean age of 58.3 years. Total cholesterol in the control (159.13 mg/dl) significantly differed from the subject group (216.79 mg/dl) (p<0.05). Antherogenic index plasma (AIP), non-HDL cholesterol, and antherogenic coefficent all increased significantly in the subject group. The results imply that lipid profiles and ratios are crucial for determining cardiometabolic risk in this patient.*

**Keywords:** Cardiometabolic risk, lipid ratios, hypertensive heart disease, atrial fibrillation, hyperlipidemia, lipid profiles.

## Introduction

The most frequent cardiac arrhythmia globally is atrial fibrillation. Ageing, obesity, hypertension, diabetes mellitus, and diabetes are only a few of the many cardiovascular disease risk factors that might increase the occurrence of atrial fibrillation[1]. Patients with AMI who regularly develop atrial fibrillation (AF) also have a higher chance of dying and having a cerebral infarction. Studies[2-4]. Although the possibility of developing atrial fibrillation is adversely or insignificantly correlates with HDL-C levels; high amounts of TC (total cholesterol) and low-density lipoprotein cholesterol are linked to an elevated risk of the condition. Furthermore, TC/LDL, TC/HDL, TG/HDL, and LDL/HDL lipid ratios are considered to be useful indications for the categorization of cardiovascular diseases[5].

According to Prabhu *et al.*[6], comorbidities including atrial fibrillation and hypertension frequently coexist in the same populations. Among cardiac arrhythmias, atrial fibrillation is quite prevalent, and older persons are more commonly affected by it, according to Stegmann and Hindricks[7] and Carlisle *et al.*[8]. The combination of hypertension and atrial fibrillation may result in bad diagnosis, less favorable medical plus practical results whichcaused healthcare expenses, according to Stegmann and Hindricks[7] and Neuberger *et al.*[9]. The cardiovascular system is deprived of atrial replenishment during every cardiac beat when atrial propulsion is lost in atrial fibrillation, which can precipitate heart failure or worsen other risk factors to induce a rapid degeneration of the heart and arteries system[10,11].

Because rheumatism as well as viral structural coronary artery disease are so common, AF in Africans is more probable to be structural[12,13]. Age, gender, and heart failure (HF) phenotype are only a few of the clinical features that some authors have found to be linked with atrial fibrillation[14,15]. Study shown that progressive HF as well as AF are related. A complex interaction between heart failure and atrial fibrillation occurs. Lubitz *et al.*[16] assert that both heat failure and atrial fibrillation can contribute to the other. Given that Africans and Caucasians experience atrial fibrillation AF for different reasons, Africans should be especially interested in how AF affects those with hypertension.

By comparing the frequency with which people with BDs satisfy the criteria for dyslipidemia[17] and hypertension[18] with those in community, researched have demonstrated that people with BDs experience cardiometabolic health issue. Variations in HDL-C, BMIs, waist circumference, systolic as well as diastolic total cholesterol (TChol), low-density lipoprotein cholesterol

(LDL-C), plasma triacylglycerol (TAG), continues cardiometabolic risk indicators (CMRIs)and plasma glucose have only been examined within a small number of research studies. A common cause for atherosclerotic heart disease is hyperlipidemia. The development of coronary heart disease (CHD) and other cardiovascular disorders has been linked to higher levels of low-density lipoprotein cholesterol (LDLC) and lower levels of higher-density lipoprotein cholesterol (HDL-C)[19,20].

The most serious form of cardiovascular illnessis acute myocardial infarctionas well as its morbidity is undoubtedly linked to increased cholesterol levels. In addition to heart disease, renal disease, artery hardening, damage to the eyes, stroke, high morbidity and mortality, hypertension is a silent killer and a non-communicable illness. However it is the most significant risk factor that can be changed for dying from cardiovascular illnesses[21]. Different geographic areas, people, age groups, professions, behavioral habits, gender, and socioeconomic groupings have distinct prevalence rates of hypertension[22]. Globally, 1.3 billion people between 29 and 79 are expected to have hypertension, with a majority of them living in nation with moderate income[21].

The importance of the lipid profile in the development of cardiovascular disease has been shown in several research. Triglycerides (TG) and total cholesterol (also known as TC) ratios are strongly associated with the possibility of cardiovascular disease, and a surge in these levels may have an impact through the constriction as well alienation of heart arteries[23]. Elevation of low-density cholesterols (LDL-C) can additionally promote thrombocytopoiesis by building up in the artery's, and these may eventually result in arteriosclerosis[24]. However, for certain individuals, having high HDL-C levels may lower their risk of developing cardiovascular disease. Therefore, individuals having elevated HDL cholesterol levels and little non-HDL cholesterol may have a lower risk of developing cardiovascular disease.

While statin therapy did not significantly lower cardiovascular disease and overall mortality in women, it did significantly lower the chance of cardiovascular diseases in both male and female when used to manage lipid profiles, according to research by Gutierrez *et al*.[25]. Given that most people with coronary heart disease consistently use cholesterol-managing drugs, it is debatable if such patients' cholesterol levels should be evaluated.

In a comprehensive evaluation of six studies, Afilalo *et al*.[26] discovered showed intensive statin medication was preferable compared to light statin treatment for lowering MACE-related symptoms as well as hospitalizations for cardiovascular disease. Among patients with current coronary syndrome, vigorous statin treatment dramatically decreased any cause death rate; however, this benefit did not occur among individuals having persistent cardiovascular disease. In a secondary health institution, resource allocation is critical. By identifying specific risk factors that are prevalent in the local population, healthcare providers can optimize resource allocation to address the most pressing needs, thereby improving the efficiency and effectiveness of healthcare delivery.

Cardiovascular problems are frequently occurring in those with hypertensive and atrial fibrillation. Understanding their cardiometabolic risk factors, particularly lipid profiles and ratios, can aid in the development of targeted intervention strategies to mitigate these risks. This is especially relevant in a secondary health institution, where resources may be limited, and effective risk assessment is crucial for optimized patient care. This study addresses a specific patient population in Benin City, Nigeria. It is important to recognize that risk factors and disease patterns can vary based on geographic and demographic characteristics. Investigating these factors in a local context is essential for tailoring healthcare interventions to the population's needs.

Active risk reduction can begin when individuals with hypertensive heart disease and atrial fibrillation are identified as having high blood pressure and poor lipid profiles. Effective management of lipid profiles through interventions such as lifestyle modifications or lipid-lowering medications can lead to improved cardiovascular outcomes for these individuals.

In order to decrease the percentage of fatalities and problems linked to hypertension in areas of Africa, it is crucial to examine the precise effects and differences in the medical characteristics as well as the standard of existence associated with some disorders. Therefore, in a secondary medical facility in Benin City, Nigeria, we intended to characterize the usefulness of lipid ratios as a cardiometabolic risk assessor of hypertensive heart disease patients with arterial fibrillation.

## Materials and Methods

The study involved 100 individuals in all. Forty-seven (47) non-hypertensive individuals served as the control group, whereas 53 patients with hypertensive cardiac disease and atrial fibrillation were present. The same age range was shared by the subjects and the control group. After receiving the written consent of every study participant, the individuals were chosen from the metabolic clinic of the State General Hospital in Auchi, Edo State. Age and sex information that was pertinent was acquired. Following ECG results, those with atrial fibrillation were chosen. For all participants, a general physical examination was done. Using a sphygmomanometer, blood pressure was measured while the patient was seated.

**Sample Collection** Under aseptic settings, 5ml of venous blood was drawn from the antecubital vein and distributed into a plain sample bottle. The samples were allowed to retract and clot before being centrifuged at 3000rpm, the serum were transferred with a Pasteur pipette into plain bottles, and stored at -80°C in an ultra frizer until analysis. The lipid analysis was done using the enzymatic method, the reagents were manufactured by Randox Laboratory Limited and standard operating assay procedure was used. The blood lipid indexes were calculated using the following equations;

Friedewald equation for LDL-C = TC–TG/5 – HDL-C (mg/dL)

Atherogenic index of plasma, AIP = $\frac{\text{LogTG}}{\text{HDL-C}}$

Atherogenic coefficient, AC = $\frac{\text{Non HDL-C}}{\text{HDL-C}}$

Non-HDL cholesterol, NHDL = TC – HDL-C

Very low density lipoprotein, VLDL = $\frac{\text{TRIGLYCERIDES}}{5}$

Castelli Risk Index I( CRI I) = $\frac{\text{TC}}{\text{HDL-C}}$

Castelli Risk Index II, (CRI II) = $\frac{\text{LDL-C}}{\text{HDL-C}}$

Statistical analysis of the study's data was performed using SPSS® version-21. The percentages and the mean of the duplicated data were used to display the results. Correspondence analyses were utilized to demonstrate the relationship between particular factors and participant lipid status.

## Results and Discussion

Figure-1 presents the percentage occurrence of male and female participants in the study. At least every one in two participants within the control group was a male, while 47.2% of the subject group was a female. The study group's mean age was 59.5 years, in contrast to the control group's mean age of 58.3 years. (Table-1). Mean systolic BP within the control group was 108mmHg, compared to 142mmHg within the subject group. Similar increase in diastolic BP was reported in the subject group.

Table-2 presents the lipid concentration of the test group versus the control. Total cholesterol in the control (159.13mg/dl) significantly differed from the subject group (216.79mg/dl) ($p<0.05$). Similarly triglyceride levels in the subject were significantly higher than the control. Generally, lipid concentrations provided in Table-2 were higher than those in the control counterparts except for HDL cholesterol which was less than the control group.

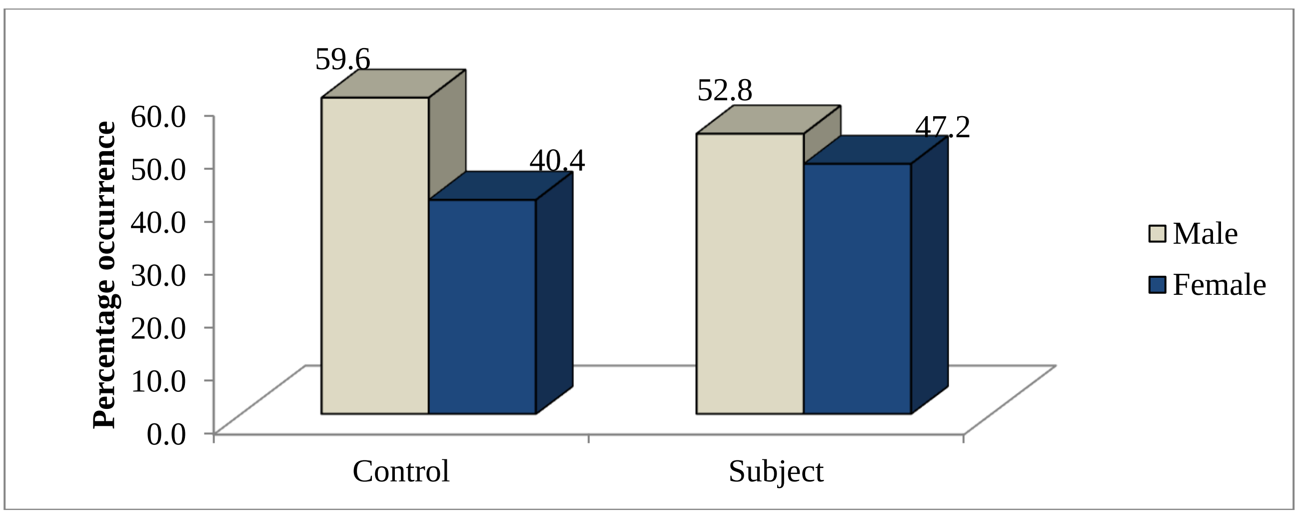


**Figure-1:** Percentage occurrence of male and female participants in the study.

**Table-1:** General information of the study participants.

| Group | Age (yr) | | Systolic BP (mmHg) | | Diastolic BP (mmHg) | |
|---|---|---|---|---|---|---|
| | Control | Subject | Control | Subject | Control | Subject |
| Mean | 58.319 | 59.453 | 108.085 | 142.981 | 71.723 | 97.094 |
| SD | 8.837 | 10.020 | 6.763 | 5.183 | 5.020 | 7.458 |
| t-value | -0.597 | | -29.141 | | -19.693 | |
| p-value | 0.552 | | <0.001 | | <0.001 | |

Antherogenic index plasma (AIP), non-HDL cholesterol, and antherogenic coefficient all increased significantly in the subject group. Table-3 shows the lipid concentrations and ratios in the subject as impacted by sex. Females had greater TC levels than males ($p>0.05$). Figure-2 depicts the impact of age on TC in the subject group. The findings revealed no statistically significant relationship.

**Table-2:** Lipid concentration of study participants.

| Group | | Mean(mg/dl) | SD | t-value | Df | p-value |
|---|---|---|---|---|---|---|
| T_Chol | Control (n=47) | 159.13 | 40.96 | -7.852 | 98 | <0.001 |
| | Subject (n=53) | 216.79 | 32.38 | | | |
| Trigly | Control (n=47) | 86.66 | 15.55 | -3.882 | 98 | <0.001 |
| | Subject (n=53) | 112.79 | 43.74 | | | |
| HDL_Chol | Control (n=47) | 46.30 | 8.40 | 6.423 | 98 | <0.001 |
| | Subject (n=53) | 38.04 | 3.90 | | | |
| LDL_Chol | Control (n=47) | 95.60 | 37.00 | -8.490 | 98 | <0.001 |
| | Subject (n=53) | 156.25 | 34.42 | | | |
| VLDL | Control (n=47) | 17.45 | 3.11 | -3.715 | 98 | <0.001 |
| | Subject (n=53) | 22.42 | 8.68 | | | |

**Table-3:** Lipid ratios of study participants.

| Group | | Mean | SD | t-value | Df | p-value |
|---|---|---|---|---|---|---|
| AIP | Control (n=47) | 0.00 | 0.00 | -5.881 | 98 | <0.001 |
| | Subject (n=53) | 0.55 | 0.64 | | | |
| NonHDLChol | Control (n=47) | 112.89 | 37.76 | -9.190 | 98 | <0.001 |
| | Subject (n=53) | 178.94 | 34.11 | | | |
| AC | Control (n=47) | 2.43 | 0.97 | -10.289 | 98 | <0.001 |
| | Subject (n=53) | 4.87 | 1.35 | | | |
| CRI_I | Control (n=47) | 3.43 | 0.97 | -10.289 | 98 | <0.001 |
| | Subject (n=53) | 5.87 | 1.35 | | | |
| CRI_II | Control (n=47) | 2.06 | 0.92 | -9.116 | 98 | <0.001 |
| | Subject (n=53) | 4.17 | 1.33 | | | |

**Table-3:** Lipid concentrations and ratios in the subject as influenced by sex.

| Group | | Mean | Std. Deviation | T | p-value |
|---|---|---|---|---|---|
| Sys_BP | Male | 143.6 | 6.2 | 0.875 | 0.385 |
| | Female | 142.3 | 3.7 | | |
| Dia_BP | Male | 97.4 | 8.8 | 0.342 | 0.734 |
| | Female | 96.7 | 5.8 | | |
| T_Chol | Male | 207.8 | 23.8 | -2.223 | 0.031 |
| | Female | 226.9 | 37.9 | | |
| Trigly | Male | 95.0 | 45.2 | -3.446 | 0.001 |
| | Female | 132.7 | 32.7 | | |
| HDL_Chol | Male | 37.4 | 2.8 | -1.354 | 0.182 |
| | Female | 38.8 | 4.8 | | |
| LDL_Chol | Male | 151.3 | 25.2 | -1.113 | 0.271 |
| | Female | 161.8 | 42.3 | | |
| VLDL | Male | 19.0 | 9.1 | -3.349 | 0.002 |
| | Female | 26.3 | 6.4 | | |
| AIP | Male | 0.4 | 0.7 | -1.912 | 0.061 |
| | Female | 0.7 | 0.5 | | |
| NonHDLChol | Male | 170.4 | 25.8 | -1.976 | 0.054 |
| | Female | 188.5 | 39.9 | | |
| AC | Male | 4.6 | 1.1 | -1.298 | 0.200 |
| | Female | 5.1 | 1.5 | | |
| CRI_I | Male | 5.6 | 1.1 | -1.298 | 0.200 |
| | Female | 6.1 | 1.5 | | |
| CRI_II | Male | 4.0 | 1.1 | -0.986 | 0.329 |
| | Female | 4.4 | 1.6 | | |

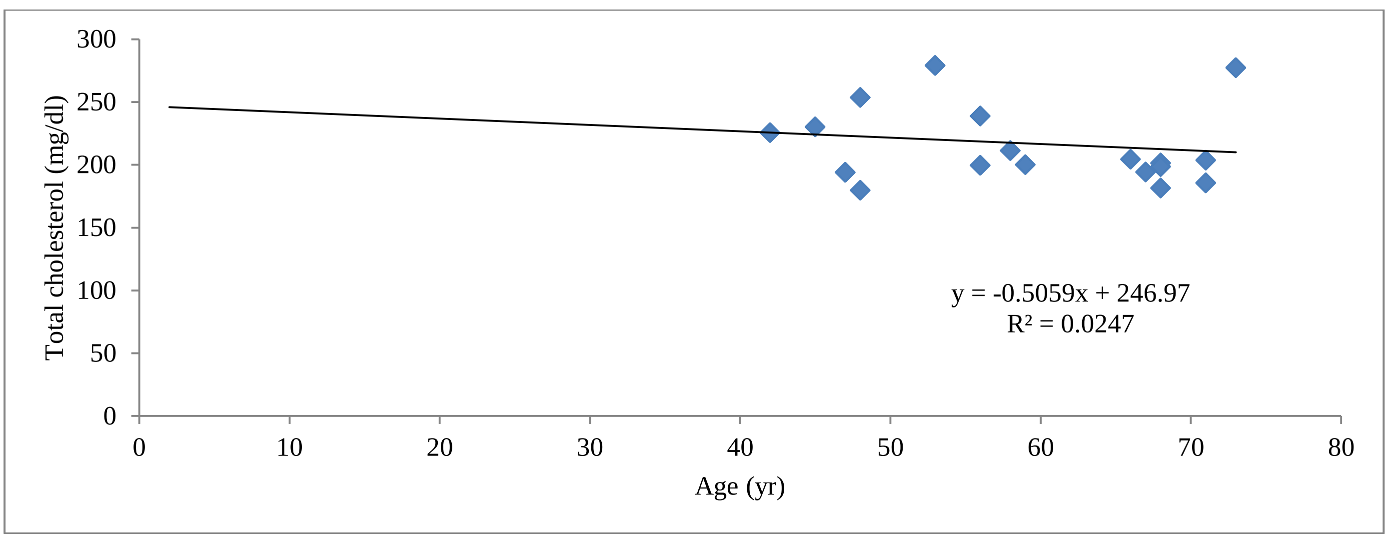


**Figure-2:** Influence of age on total cholesterol of subject group.

**Discussion:** In a secondary healthcare institution in Benin City, Nigeria, the aim of this research proved to evaluate the usefulness in lipid ratios as a tool for measuring the cardiometabolic risk for hypertensive cardiovascular disease among individuals who have atrial fibrillation (AF).

The lipid profiles of the individuals experiencing atrial fibrillation and hypertension were noticeably different from those of the non-hypertensive control subjects. The patients' cholesterol levels (HDL-C) were lower than those of the control group, whereas those of TC, TG, LDL-C, VLDL-C, and non-HDL-C were higher. According to these researches, the people had dyslipidemia, which is an indicator for cardiovascular diseases.

The present research demonstrates that elevated cholesterol levels is a known precursor underlying cardiovascular diseases, particularly atherosclerosis, in line with Colantonio *et al*.[19] and Di Angelantonio *et al*.[20] The paper emphasizes the association between elevated levels of LDL-C as well as decreased levels of high-density lipoprotein cholesterol (HDL-C) in addition to an increased chance of cardiac disease along with various cardiovascular conditions[19,20].

This study emphasizes the importance of hypertension as a significant contributor for cardiovascular diseases. It has been shown that hypertension is a silent killer and a serious non-communicable disease that accounts for a large amount of cardiovascular-related morbidity and death. The fact that the prevalence of hypertension differs across various socioeconomic categories, genders, age groups, occupations, and geographic locations is also noted[22].

According to the study, the lipid ratios of the atrial fibrillation and hypertensive heart disease patients were substantially different from those of the non-hypertensive control group. The patients' AC, AIP, CRI I, and CRI II values were higher compare to the control groups. However, the findings suggest that the patients' levels of atherogenicity, which is a gauge of lipids' propensity to encourage plaque development in arteries, were greater. Furthermore, it cites research demonstrating that decreased in LDL-C and TC are as a result of an increased risk of AF development, but HDL-C appears to have a neutral or insignificant association atrial fibrillation[2,4]

Patients with hypertensive cardiac disease and atrial fibrillation had lipid profiles and lipid ratios that were relatedto their blood pressure readings. greater levels of TC, TG, LDL, VLDL, non-HDL, AC, AIP, CRI I, and CRI II are associated with greater blood pressure, whereas decreased in HDL is as result of higher blood pressure. These findings imply that hypertension may aggravate patients' dyslipidemia and atherogenicity by having a direct or indirect impact on lipid metabolism.

The result is consistent with the earlier research, which indicates that high levels of triglycerides and total cholesterol may have a role in the hardening and constriction of cardiac arteries, which raises the risk of cardiovascular disease (CVD). As a mechanism causing arteriosclerosis and perhaps thrombosis, the buildup of LDL-C in arterial walls is stressed[23].

According to earlier research[2-5,26] individuals having hypertensive cardiac disease and atrial fibrillation had dyslipidemia and elevated atherogenicity. The findings of this study corroborate these findings. But by demonstrating the relationship between lipid profiles and ratios in this cohort and blood pressure, this work advances the body of knowledge. This data suggests that lowering blood pressure may be a key tactic to help these individuals' lipid balance and lower their risk of cardiovascular disease.

## Conclusion

This study clarifies, in individuals with hypertensive cardiac disease and atrial fibrillation, the crucial link between lipid profiles and cardiometabolic risk. The findings reveal substantial variations in blood pressure, lipid profiles, as well as various lipid ratios between this patient population and non-hypertensive individuals. These disparities underscore the potential utility of lipid ratios as valuable indices for assessing cardiovascular risk in a secondary health institution in Benin City, Nigeria.

Managing lipid profiles may prove to be a crucial aspect of reducing the cardiometabolic risk faced by these patients. These results emphasize the need for tailored strategies for risk reduction in this specific population. By addressing lipid imbalances and other related factors, the overall cardiovascular health of individuals with hypertensive heart disease and atrial fibrillation can be improved by healthcare professionals in this context.

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