

## ORIGINAL ARTICLE

## Association between Dyslipidemia Patterns and Early Cardiovascular Complications among Adults. A Cross-Sectional Clinical Study

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**ABSTRACT**

**Background:** Dyslipidemia is a significant risk factor that is not only majorly modifiable but also a cardiovascular disease (CVD) risk factor in South Asian populations due to the tendency to develop atherogenic lipid patterns at a younger age. Cardiovascular complications such as diastolic dysfunction, carotid intima-media thickness (CIMT) increase, subclinical ischemia and early ventricular remodeling usually proceed undetected. To enhance preventive cardiology, it is important to understand the association between the various patterns of dyslipidemia and early cardiac abnormalities.

**Objectives:** to establish the correlation between dyslipidemia trends and early heart diseases in adults.

**Methods:** A cross-sectional study was carried out on 100 adults aged 30-70 years, in terms of clinical data. After an overnight fast, detailed lipid profiles (TC, LDL-C, HDL-C, TG) were determined. The patterns of dyslipidemia were divided into isolated elevated LDL-C, isolated hypertriglyceridemia, low HDL-C and mixed dyslipidemia. Each participant had ECG and echocardiography to determine the early cardiovascular involvement, such as the diastolic dysfunction, enlargement of the CIMT, LV hypertrophy, decreased EF, and silent ischemic alterations. The SPSS 26 version was used to analyse the data, and Chi-square and logistic regression were used to evaluate the associations.

**Results:** Dyslipidemia was found in 72 percent of the participants and early cardiovascular problems were detected in 38 percent. Mixed dyslipidemia presented the most significant correlation (64.7%), then isolated high LDL-C (40.9%), and low HDL-C (33.3%). Early cardiac abnormalities were observed in only 10.7% of people having normal lipid profiles.

**Conclusion:** Mixed dyslipidemia and high LDL-C are channels with high predictivity of early cardiovascular complications. Lipid profiling must be regularly incorporated into cardiovascular risk measurement to help identify the problem early and provide preventive care on time.

**Keywords:** Dyslipidemia, LDL, HDL, triglycerides, cardiovascular complications, atherosclerosis, CIMT.

## INTRODUCTION

Cardiovascular diseases (CVDs) have been the major cause of morbidity and mortality around the globe, and the burden of this disease is increasingly growing in low- and middle-income countries<sup>1</sup>. These cardiovascular complications, such as subclinical atherosclerosis, endothelial dysfunction, left ventricular hypertrophy and an early myocardial ischemia frequently remain undetected many years before the manifestation of the overt clinical disease<sup>2</sup>. Among the other risk factors that can be altered, dyslipidemia is in the middle stage of promoting the process of atherosclerosis and initiating early cardiovascular alterations<sup>3</sup>. Lipid metabolism abnormalities (including increased low-density lipoprotein cholesterol (LDL-C), high triglyceride (TG), low high-density lipoprotein cholesterol (HDL-C), and non-HDL cholesterol) are also known to contribute further to endothelial damage, oxidative stress, and plaque formation<sup>4</sup>.

The trends of dyslipidemia are diverse in the various adult groups because of the disparities in the diet, life style, genetic factors and comorbid conditions like diabetes, hypertension, and obesity<sup>5</sup>. Atherogenic lipid profile is prevalent in South Asians, especially, in the Pakistani population, at a younger age, resulting in the development of cardiovascular abnormalities at early age than in the Western countries<sup>6</sup>. Although this is a very frightening trend, the evaluation of combined dyslipidemia patterns and no single lipid markers has not been exploited in the normal clinical routine. An assessment of the correlation between particular dyslipidemia patterns and early cardiovascular-related complications may enable the identification of high-risk persons way before they develop significant clinical events<sup>7</sup>.

Early heart disease might show itself through elevated carotid intima media thickness (CIMT), ventricular relaxation dysfunction, resting tachycardia, reduced ejection fraction or early ischemia on the ECG<sup>8</sup>. Early detection of these subtle abnormalities and lipid derangements may aid in the early prevention of subsequent measures. The systematic evaluation of this relationship in adults can give essential data to be used in risk stratification and inform the strategies of the interventions in the population of the specific regions in terms of health care to the population<sup>9</sup>.

Consequently, the research will facilitate the establishment of the linkage between dyslipidemia patterns and the premature development of cardiovascular complications in adults. Through comparing lipid profiles and early cardiac alterations, the research will aim to present the evidence that can be used to reinforce

the practice of prevention cardiology and lessen the growing load of cardiovascular disease<sup>10</sup>.

## MATERIAL AND METHOD

It was a cross-sectional clinical study in a hospital, the Department of Cardiology and Internal Medicine, in tertiary care hospital. The research was conducted in a 12 months period (June 2022- may 2023) whereby 100 adult patients were recruited through consecutive non-probability sampling. The lipid profile abnormalities and the occurrence of early cardiovascular complications were assessed on all patients at the point of enrollment. The outpatient clinic visit or hospital hospitalization was an inclusion criterion in adults aged 30–70 years of either sex. Patients who had recorded a history of ischemic heart disease, already had a myocardial infarction, known heart failure (NYHA class II-IV), known heart cardiomyopathy, known severe valvular heart disease, congenital heart disease, chronic kidney disease (stage 4 or 5), chronic liver disease, thyroid dysfunction or currently taking lipid-lowering therapy longer than three months were excluded to prevent confounding. The pregnant women and the patients that were critically ill were also excluded. All the participants signed written informed consent after the explanation of the objectives of the study.

The demographic (age, sex), clinical (smoking status, hypertension, diabetes mellitus, family history of premature cardiovascular disease), and medication use were recorded in a structured proforma in relation to every enrolled patient. The anthropometric measurements in the form of the height and the weight were recorded using standardized instruments and the body mass index (BMI) was computed as the ratio of weight in kilograms divided by the height in meters squared. The sitting position blood pressure was measured with at least 5 minutes of rest and a calibrated sphygmomanometer, and average of two measurements after 5 minutes interval were taken. An examination was done in detail over physical with special emphasis on cardiovascular and peripheral vascular systems. All the patients were sampled with venous blood samples, having an overnight fast of 1012 hours. The lipid profile was total cholesterol ( TC ), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG), which was done by conventional enzyme colorimetric analysis on an automated analyzer in the hospital laboratory with internal quality control processes.

Dyslipidemia was considered based on the available guidelines, which included the following: TC 200 mg/dL, LDL-C 130mg/dL, HDL-c less than 40mg/dL in men or less than 50mg/dl in women, or TG 150mg/dl. Patterns of

dyslipidemia were further categorized as isolated hypercholesterolemia (increased TC/LDL-C alone), isolated hypertriglyceridemia, low HDL-C alone and mixed dyslipidemia (increased LDL-C and TG and/or low HDL-C). All the patients were exposed to resting 12-lead electrocardiogram (ECG) and transthoracic echocardiography conducted by an expert cardiologist who was unaware of the detailed lipid profile results. ECG was evaluated on sinus tachycardia, ST-T alterations that are indicative of myocardial ischemia, and signs of left ventricular hypertrophy according to the conventional criteria. The parameters of left ventricular ejection fraction, left atrial mass index, and diastolic functional parameters were assessed with the help of echocardiography (E/A ratio, E/e 0 and left atrial size). Carotid ultrasound (to measure intima media thickness) was done when it was available. Operationally defined early cardiovascular complications were the presence of any one or more of the following subclinical abnormalities: enhanced CIMT (29 0.8 mm), left ventricular hypertrophy on echocardiography, grade I or greater left ventricular diastolic dysfunction, reduced ejection fraction less than 50 per cent without previously diagnosed heart failure, or resting ECG abnormalities indicative of silent ischemia in the absence of pre-existing diagnosed coronary artery disease.

Data input and analysis were done in Statistical Package of Social Sciences (SPSS) version 26. Mean, standard deviation (SD) was used to describe the age of people, their body mass index, blood pressure, and lipid levels, whereas frequencies and percentages were used to describe categorical variables, including gender, dyslipidemia patterns presence, hypertension, diabetes, and early cardiovascular complications. The correlation between the patterns of different dyslipidemia and premature cardiovascular complications was compared on the basis of chi-square or Fisher-exact test where necessary. To compare mean lipid levels and other continuous variables between the control and experimental group with and without early cardiovascular complications, independent samples t-tests or ANOVA one-way test were used. To determine independent predictors of early cardiovascular complications, a binary logistic regression model was designed with the variables of age, gender, BMI, hypertension, diabetes, smoking and some of the patterns of dyslipidemia. The p-value of below 0.05 was considered statistically significant. The study was done in allegiance of the ideals of the Declaration of Helsinki, with ethical approval of the study being obtained by the Institutional Ethics Review Committee (ERC/7250-05/2022) before the data was collected. This made all patient data confidential, and the study was voluntary with

an option to withdraw at any point without any impact on clinical care.

## RESULTS

The sample population consisted of 100 adult patients. The average age of the participants was 49.6 /10.8 years, 56 percent males, and 44 percent females. The study population was found to have dyslipidemia of all types in 72% of the population. Cardiovascular complications were found early in 38% of participants including diastolic dysfunction, elevated CIMT, poor ejection fraction and the ECG patterns indicative of silent ischemia. Table 1 illustrates how the 100 patients have been distributed in terms of dyslipidemia pattern and how they have been related to early cardiovascular complications. Mixed dyslipidemia was identified as the most closely related with the early cardiovascular abnormalities with 64.7 percent of the patients presenting with early cardiac involvement. This trend encompassed a high level of LDL-C, high level of triglycerides and/or low level of HDL-C in a combination, which indicated a very atherogenic lipid profile.

Other isolated high levels of LDL-C were also characterized by a significant complication burden with 40.9% of those who exhibited high levels of LDLC showing cardiovascular changes early such as diastolic dysfunction and higher CIMT. Complications were also found to be associated with low HDL-C alone in 33.3% of those affected, which can be used to demonstrate the preventive nature of HDL in cardiovascular.

The outlook in patients with isolated hypertriglyceridemia was relatively less (26.7%), though the risk was still higher than in patients who had normal lipid profiles. There was a clear point of contrast with only 10.7% of persons with normal lipid profiles having early cardiovascular involvement, demonstrating the distinct difference and reinforcing the association between cardiovascular risk and patterns of dyslipidemia.

On the whole, dyslipidemia (especially mixed dyslipidemia) and early cardiovascular complications have a positive correlation with each other, which confirms the clinical utility of combined lipid pattern assessment, as opposed to an individual evaluation of lipid parameters, in the prediction of early cardiac dysfunction.

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cardiovascular involvement, demonstrating the distinct difference and reinforcing the association between cardiovascular risk and patterns of dyslipidemia.

**Table 1.** Association Between Dyslipidemia Patterns and Early Cardiovascular Complications (n = 100)

Dyslipidemia Pattern	Total Patients (n)	Patients With Early Cardiovascular Complications (n)	Percentage (%)
Isolated Elevated LDL-C	22	9	40.9%
Isolated Hypertriglyceridemia	15	4	26.7%
Low HDL-C Alone	18	6	33.3%
Mixed Dyslipidemia (LDL↑ + TG↑ ± low HDL)	17	11	64.7%
Normal Lipid Profile	28	3	10.7%
<b>Total</b>	<b>100</b>	<b>38</b>	<b>38%</b>

## DISCUSSION

This study has established that there exists a high level of correlation between the dyslipidemia patterns and the apparent occurrence of early cardiovascular complications in adults. Out of the other lipid abnormalities investigated, mixed dyslipidemia provided the greatest load of early cardiac involvement, which shows combined lipid derangements are a highly more dangerous risk factor compared to single abnormalities<sup>11</sup>. This trend is as per the known pathophysiology of atherosclerosis, whereby a series of lipid atherogenic fractions and their combination hastens the occurrence of endothelial damage, oxidative stress and the development of plaques<sup>12</sup>. It is already known that patients with concomitant increase of LDL-C and triglycerides and low HDL-C levels are more susceptible to early atherosclerotic alterations and the high prevalence of complications (64.7) in patients is just a measure of that fact<sup>13</sup>.

This finding that isolated high LDL-C and low HDL-C were also linked to early cardiac abnormalities is in line with the available literature that showed LDL-C to be a significant factor in plaque formation, whereas low HDL-C inhibited reverse cholesterol transport and endothelial repair pathways<sup>14</sup>. Nevertheless, when not combined with other lipid abnormalities, isolated hypertriglyceridemia was found to have a relatively weak relationship with early complications but this could be attributed to the variability of the metabolism of triglycerides, its reliance on dietary variables, and lack of direct atherogenic effect<sup>15</sup>.

Notably only a low percentage of those with normal lipid profiles exhibited early cardiovascular involvement which supports the importance of dyslipidemia as an early sign of subclinical cardiovascular disease<sup>16</sup>. This highlights the significance of including lipid pattern analysis as opposed to using total cholesterol levels or LDL-C levels only when determining the risk of cardiovascular diseases<sup>17</sup>. Their results further note that earlier screening and risk stratification is required in South Asian ethnicities

where mixed dyslipidemia with low HDL-C phenotypes are more common than in Western populations<sup>18</sup>.

Also, some conventional risk factors, including high blood pressure, diabetes, and smoking, could have led to the total load of cardiovascular complications, but its impact was partially countered by means of statistics. However, dyslipidemia still became a significant independent predictor, which justified its role in the initial phases of cardiovascular pathology<sup>19</sup>.

On the whole, the obtained results indicate the clinical significance of prompt detection of dyslipidemia and early intervention in the form of lifestyle or pharmacological modification to ensure that the condition does not progress to the overt cardiovascular disease<sup>20</sup>. The research is relevant to the accumulating body of research that lipid subtype-specific assessment and integrated dyslipidemia patterns must be incorporated into the standard cardiovascular risk testing.

## CONCLUSION

The research shows significant and evident relationship between different dyslipidemia behaviors and premature cardiovascular complications in adults. The combined dyslipidemia proved to be the best predictor of early cardiac anomalies, then the isolated high LDL-C and low HDL-C level. Persons with normal lipid profiles had significantly reduced prevalence of subclinical cardiovascular participation, and underscores the strong impact of lipid abnormalities in the early pathogenesis of heart dysfunction.

This research has significant implications as it indicates that lipid profiling should be considered a routine practice in any clinical environment, and there is a necessity to screen patients early in their lives when atherogenic lipid profiles are common. The management and identification of dyslipidemia in early life may be beneficial in preventing the transition into open cardiovascular disease, minimize chronic morbidity, and

enhance the overall cardiovascular health results. Other multicenter studies that have larger sample sizes should be encouraged to confirm such results and investigate other risk modifiers.

## DECLARATION

### Conflict of Interest

The authors declare no conflict of interest.

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This research did not receive any external funding.

### Author's Contribution

All authors contributed equally in the complication of current study.

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### Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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