Research Article

# Investigation of Dyslipidemia and Lipid Profile Ratios Among Patients in Tertiary Care Hospitals

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**Abstract**

Dyslipidemia, characterized by imbalances in lipid profiles, has emerged as a multifaceted health challenge in the population. Factors such as urbanization, dietary shifts, and genetic variations contribute to the rising prevalence of abnormal lipid levels. This condition significantly amplifies the risk of cardiovascular diseases, a leading cause of mortality. This study focused on dyslipidemia, risk factors, prevalence, evaluating the ratio of cholesterol to HDL (High density lipoproteins), triglyceride to HDL, LDL (Low density lipoproteins) to HDL, Cholesterol to LDL, triglyceride to LDL,HDL to LDL along with their comparative analysis and age-related patterns of dyslipidemia. A total of 100 were collected, comprising 64 males and 36 females. The findings revealed a significant prevalence of dyslipidemia, reaching 86%. Breakdown of lipid profiles showed specific prevalence rates for cholesterol (29%), triglycerides (50%), HDL (48%), and LDL (31%). Alarmingly, out of the 100, only 14 individuals had a normal lipid profile, indicating a high incidence of dyslipidemia in the region. Additionally, the study highlighted an age-dependent increase in the likelihood of developing dyslipidemia. The high prevalence of dyslipidemia is an important public health problem. Enhanced public health preventive measures should be implemented to better diagnose and comprehensively treat dyslipidemia.

## Introduction

Lipids, including cholesterol and triglycerides, are absorbed from the intestines, and transported throughout the body by lipoproteins to support energy production, steroid synthesis, or bile acid formation. Key components in these processes are cholesterol, low-density lipoprotein cholesterol (LDL-C), triglycerides, and high-density lipoprotein (HDL). Dyslipidemia can arise from an imbalance in any of these factors, resulting from either organic or nonorganic causes [1]. Dyslipidemia refers to the disturbance in lipid levels, including cholesterol, low-density lipoprotein cholesterol (LDL-C), triglycerides, and high-density lipoprotein (HDL). Factors such as diet, tobacco exposure, and genetics can contribute to this condition, potentially leading to severe cardiovascular complications [2]. Consequently, individuals with dyslipidemia commonly exhibit elevated levels of LDL cholesterol and triglycerides, accompanied by decreased HDL cholesterol levels in blood tests. This imbalance heightens the risk of fatty plaque deposition within blood vessels, consequently increasing the likelihood of heart-related issues. Dyslipidemia represents an abnormal metabolic state characterized by a sustained elevation in plasma lipid concentrations. This condition manifests in three distinct presentations: hypercholesterolemia (elevated cholesterol), hypertriglyceridemia, and mixed hyperlipidemia (elevated levels of both triglycerides and cholesterol). The typical trend observed in total cholesterol levels involves an increase from birth to 2 years of age, followed by stabilization. Subsequently, there is a resurgence in levels leading up to a peak just before puberty. Post adolescence, these levels experience a slight decline [3].

Genetic inheritance plays a role in dyslipidemia, with examples including familial combined hyperlipidemia, familial hypertriglyceridemia, and familial hyper abetalipoproteinemia. Additionally, several factors contribute to this condition, such as high BMI, alcohol consumption, and waist circumference. Moreover, dyslipidemia can also be secondary, arising from other medical conditions like diabetes, hypothyroidism, Cushing's syndrome, inflammatory bowel disease, and severe infections. Hence, dyslipidemia can be categorized into primary (predominantly genetic) and secondary (resulting from lifestyle or underlying medical conditions) [4]. Physiological factors such as age and gender significantly impact plasma lipid levels across various species. Gender differences in lipid and lipoprotein levels are additionally influenced by age. Notably, findings from a Study indicate that aging is linked to a gradual rise in plasma LDL-C levels in both men and women aged 20 to 60 years. Beyond the age of 20, there is a progressive increase in plasma LDL-C concentrations for both men and women [5]. Dyslipidemia results from changes in the body that lead to an excessive production of triglycerides and LDL cholesterol or a decreased production of HDL. This alteration can be categorized into two main types based on the cause: Primary Dyslipidemia are caused by genetic factors; it is often observed in families where other members also experience dyslipidemia. Secondary Dyslipidemia arises due to lifestyle factors or other concurrent diseases. It is the more common type and may result from situations such as a sedentary lifestyle, high-fat diet, Type 2 diabetes, obesity, excessive alcohol consumption, chronic renal failure, chronic liver disease, hypothyroidism, smoking, and eating disorders like anorexia or bulimia [6]. Various health behaviors, including tobacco use, physical inactivity, nutrition, and obesity, can impact lipid levels. Nutrition-related risk factors involve insufficient consumption of fruits, nuts/seeds, and vegetables, or excessive intake of saturated fats. Dyslipidemia can also be linked to familial disorders, with autosomal dominant mutations, particularly in LDL receptors, causing most cases of familial hypercholesterolemia and resulting in elevated LDL-C levels. While less common, other mutations in the cholesterol pathway have been identified [7,8]. Dyslipidemia is typically asymptomatic and is often diagnosed incidentally or through routine screening. However, in severe cases, patients may exhibit symptoms related to complications such as coronary or peripheral artery disease. These symptoms can include leg pain, chest pain, dizziness, palpitations, swelling in lower limbs or veins (e.g., neck or stomach), and fainting [9].

An alarmingly high dyslipidemia prevalence of 96% has been reported in Pakistan. The highest prevalence of hypercholesterolemia is found in Punjab at 41.6%, while the lowest prevalence is observed in Baluchistan at 22.7% [10]. Major contributors to secondary dyslipidemia include alcohol overuse, a sedentary lifestyle with a high intake of saturated fat, cholesterol, and trans fats. Additionally, certain medical conditions, such as diabetes mellitus, chronic kidney disease, primary biliary cirrhosis, and other cholestatic liver diseases, are associated with secondary dyslipidemia [11]. Cardiovascular disease stands out as the most significant complication of dyslipidemia, leading to outcomes such as sudden cardiac death, acute myocardial infarction, or stroke [12]. Dyslipidemia is a prevalent characteristic of diabetes, and both type 1 and type 2 diabetes show an association between atherosclerotic cardiovascular disease and serum cholesterol and triglyceride levels. In individuals with diabetes, the risk of coronary heart disease (CHD) is elevated at any given serum cholesterol level, and the association with hypertriglyceridemia is more pronounced than in the general population [13, 14].

Obesity, a global pandemic in the contemporary world, is intricately linked to dyslipidemia, primarily influenced by insulin resistance and pro-inflammatory adipokines [15]. Furthermore, dyslipidemia is recognized as a risk factor for peripheral artery disease, stroke, and dementia in older adults. Chronic kidney disease (CKD) significantly heightens the risk of cardiovascular disease (CVD) [16]. Other disorders: Lipid disorders play a role, both directly and indirectly, in the development of several diseases, including type 2 diabetes mellitus, various common cancers, polycystic ovary syndrome (PCOS) in females, and mental illnesses such as bipolar disorder, schizophrenia, stress, and physical inactivity [17]. Additionally, dyslipidemia contributes to prostatic growth and contractility, serving as significant risk factors for the onset of benign prostatic

hyperplasia [18]. The process of lipid metabolism is intricate, involving numerous pathways, enzymes, proteins, and factor [19,20]. In accordance with earlier literature, males exhibit higher rates of dyslipidemia, potentially due to additional risk factors such as smoking, alcohol consumption, and hypertension [21,22].

## Matrial and Methods

### Sample Collection

A total of 100 samples were collected. The target population for this study included population of Islamabad and Rawalpindi Pakistan. Venipuncture technique was used to draw the blood sample. The patients were with fasting for at least 9 to 12 hours before the blood test. Fasting is necessary for accurate measurement of certain lipid parameters, such as triglycerides and LDL cholesterol.

The patient's identity was verified to ensure that the sample is correctly labeled.

### Sample Processing

The blood sample was transferred into the serum separator tube (SST), also known as a plain redtop tube. The SST contains a gel that, after centrifugation, forms a barrier between the serum (the liquid component of blood) and the blood cells. This allows for the easy separation of serum for lipid profile analysis. No anticoagulant was used in the SST because anticoagulants can interfere with the lipid measurements. Each sample tube was labeled with the patient's information, including name and date of birth, to ensure proper identification. Serum was obtained after centrifugation of sample by Centrifuge at 5000 rpm for 5 minutes [23].

### Analysis

In the laboratory, the blood samples were analyzed via clinical chemistry analyzer Cobas e-311, for various lipid components, including total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides. The analyzer required calibration using specific calibrators to ensure accurate and reliable results. The serum samples were placed, obtained after centrifugation, into the sample rack or tray. The Cobas 311 automatically processed the samples, pipetting the required volume into the reaction cuvette or well. Reagents specific to lipid profile testing were added to the samples. These reagents reacted with the lipids present in the serum to produce measurable signals. The mixture of samples and reagents went through an incubation period, allowing the chemical reactions to take place [24].

### Measurements

Cobas e-311 measured the absorbance or fluorescence produced by the reaction, translated it into quantifiable values for each lipid parameter, including total cholesterol, HDL cholesterol, LDL cholesterol, and triglycerides [25].

### Statistical Analysis

The statistical analysis was performed by using IBM SPSS statistics to calculate the lipid profile parameters. Normal values for Cholestrol, Triglycerides, HDL and LDL are displayed in Table 1.

**Table 1:** Normal values of Lipids profile.

| Parameters | Normal Values |
|---|---|
| **Cholesterol** | <200 mg/dl |
| **Triglycerides** | <150 mg/dl |
| **HDL** | >35 mg/dl in males<br>>45 mg/dl in females |
| **LDL** | <130 mg/dl |

## Results

In this study, total 100 samples were collected, in which 64 were males and 36 were females. After this study, we concluded that dyslipidemia is becoming quite common in the population of Islamabad and Rawalpindi with the prevalence of 86%. The prevalence of Cholesterol, triglycerides, HDL, and LDL was 29%, 50%, 48% and 31%, respectively. In 100 samples, only 14 samples displayed normal results of cholesterol, triglycerides, HDL, and LDL. it means out of 100 only 14 people were having normal lipid profile which revealed the high prevalence of dyslipidemia in Islamabad and Rawalpindi. It was also observed that with the increase of age, the chances of getting dyslipidemia became higher.

**Figure 1:** Reveals 14 normal cases who had normal values of all four parameters cholesterol, triglycerides, HDL, and LDL, while 86 samples had abnormal values of all four parameters.

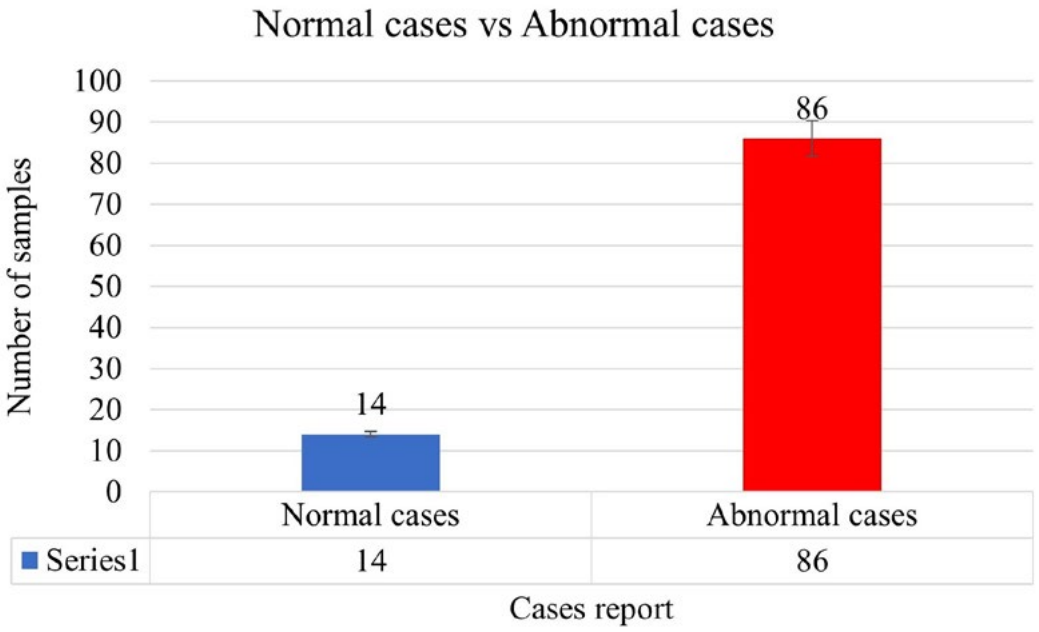



**Figure 2:** Represents total, normal and abnormal cases in males and females. According to gender wise distribution total males were 64 and females were 36, from which the males and females having abnormal lipid profile were 55 and 31, respectively and males and females having normal lipid profile were 9 and 5, respectively.

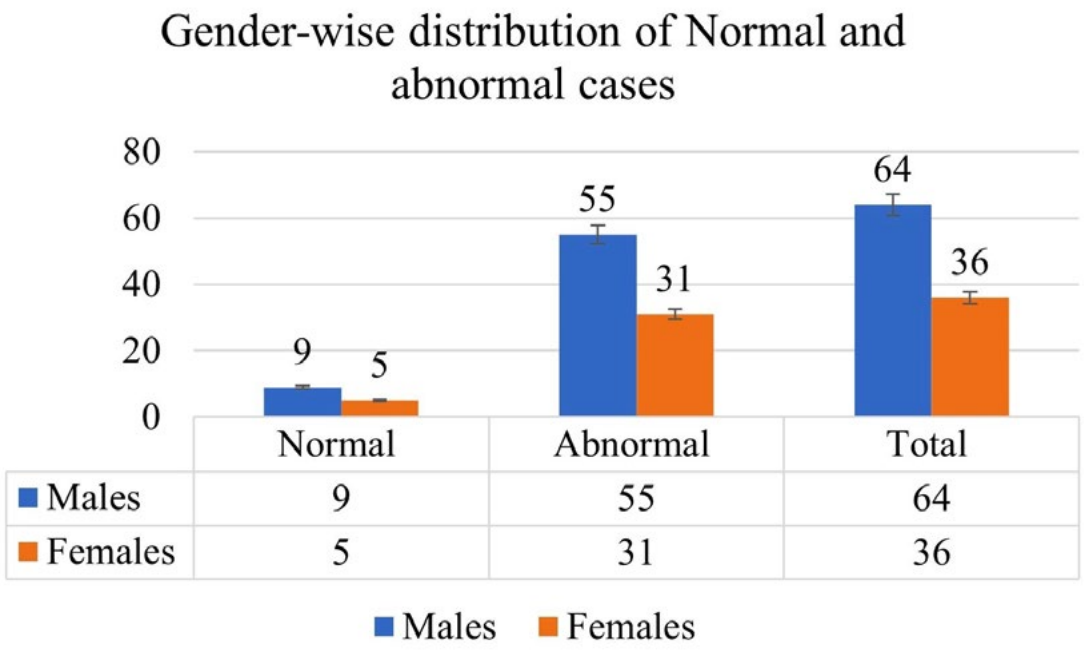


**Figure 3:** revealed the lipid profile analysis revealed that 29% of the sampled individuals exhibited elevated cholesterol levels, 50% experiencing heightened triglyceride levels, 48% having low levels of high-density lipoprotein (HDL), and 31% presenting elevated low-density lipoprotein (LDL) levels.

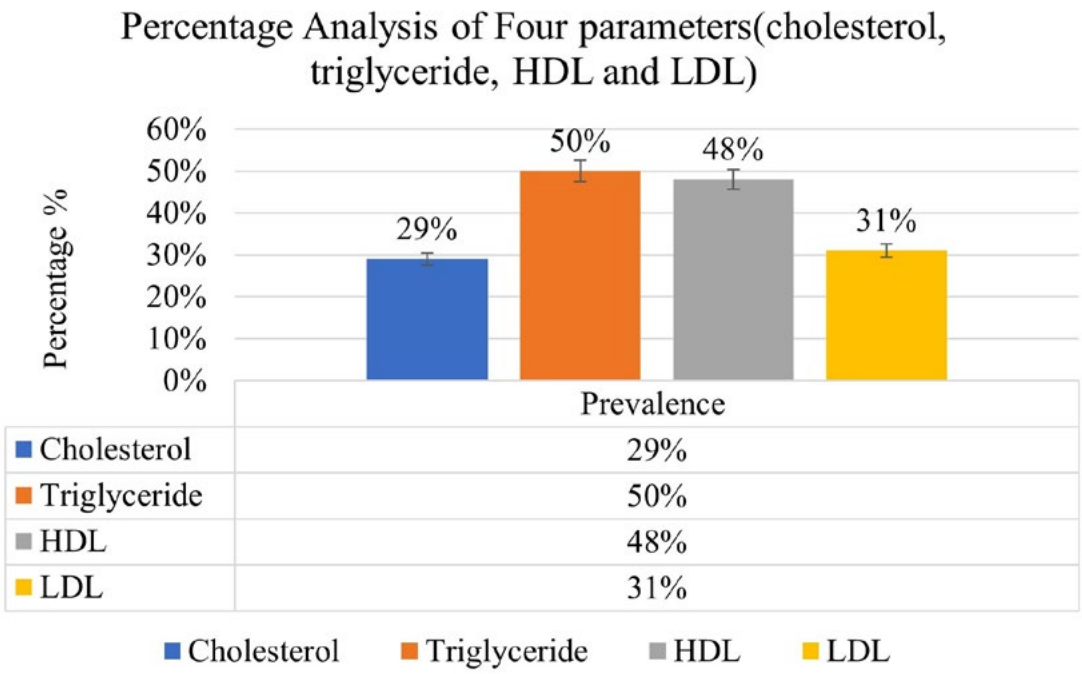
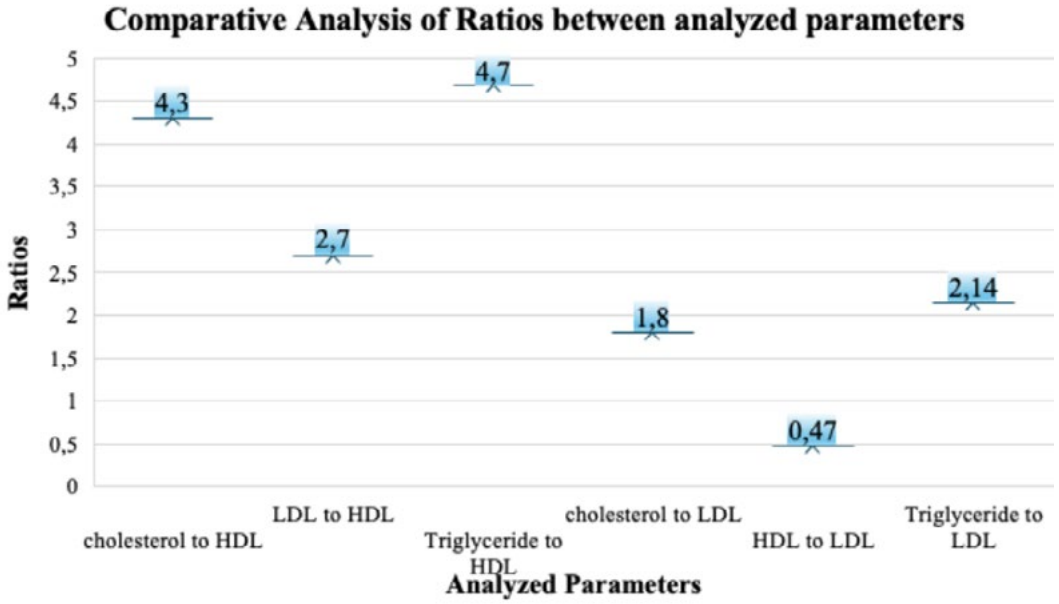



**Figure 4:** displayed the comparative analysis between ratios of all four parameters.




The cholesterol to HDL Ratio was 4.3, higher than the ideal ratio (<3.5), indicating a higher risk of cardiovascular disease. The LDL to HDL Ratio: 2.7, it was Higher than the ideal ratio (<2), indicating a higher risk of cardiovascular disease. Triglyceride to HDL Ratio: 4.7, Higher than the ideal ratio (<2), indicating a higher risk of insulin resistance and cardiovascular disease. Cholesterol to LDL Ratio: 1.8 Within the normal range (1.3-2.1), indicating a balanced cholesterol profile. HDL to LDL Ratio: 0.47, Lower than the ideal ratio (>0.5), indicating a higher risk of cardiovascular disease. Triglyceride to LDL Ratio: 2.14 Higher than the ideal ratio (<1.5), indicating a higher risk of cardiovascular disease.

The LDL to HDL Ratio: 2.7, it was Higher than the ideal ratio (<2), indicating a higher risk of cardiovascular disease. Triglyceride to HDL Ratio: 4.7, Higher than the ideal ratio (<2), indicating a higher risk of insulin resistance and cardiovascular disease. Cholesterol to LDL Ratio: 1.8 Within the normal range (1.3-2.1), indicating a balanced cholesterol profile. HDL to LDL Ratio: 0.47, lower than the ideal ratio (>0.5), indicating a higher risk of cardiovascular disease. Triglyceride to LDL Ratio: 2.14 Higher than the ideal ratio (<1.5), indicating a higher risk of cardiovascular disease.

**Comparative Analysis**

Population had higher than ideal ratios for Cholesterol to HDL, LDL to HDL, Triglyceride to HDL, and Triglyceride to LDL, indicating a higher risk of cardiovascular disease. The HDL to LDL ratio is lower than ideal, indicating a higher risk of cardiovascular disease. Only the Cholesterol to LDL ratio is within the normal range. These ratios suggest that our population may have a higher risk of cardiovascular disease and insulin resistance.

**Discussion**

In current study 100 samples were collected, consisting of 64 males and 36 females. The findings of the study suggested a notable increase in the prevalence of dyslipidemia of 86%, similar findings Liu LY et al., (2023) conducted a study including more than 20,000 samples, and research found out that the overall prevalence of dyslipidemia with a significantly higher occurrence in men (23%) compared to women (7.2%) [26].While a contradict study by Fatmi et al. (2020) in Karachi echoes the concerning trend, reporting dyslipidemia prevalence of 68.5% in males and 79.4% in females [27].

In present study the lipid profile analysis revealed concerning figures, with 29% of the sampled individuals exhibiting elevated cholesterol levels, 50% experiencing heightened triglyceride levels, 48% having low levels of high-density lipoprotein (HDL), and 31% presenting elevated low-density lipoprotein (LDL) levels, moreover, similar findings by Hussain et al., (2023) conducted a study, revealed a high prevalence of mixed dyslipidemia (92.26%) and isolated dyslipidemia (5.24%), elevated LDL-C emerged as the most common lipid disorder (84.25%), while hypercholesterolemia was the least common [28]. In another study by A study conducted by Basit et al., (2020) across Pakistan has reported an alarmingly high prevalence of dyslipidemia at 96%. Hypercholesterolemia, across Pakistan, has been reported to be highest in Punjab and lowest in Baluchistan, with a prevalence of 41.6% and 22.7%, respectively [29].

In current study comparisons between the ratios of each of the four parameters. A higher risk of cardiovascular disease is indicated by the cholesterol to HDL ratio of 4.3, which is higher than the recommended ratio of <3.5. A higher risk of cardiovascular disease is indicated by the LDL to HDL ratio of 2.7, which is higher than the optimal ratio of less than 2. Triglyceride to HDL Ratio: 4.7, increased than the optimum ratio (<2), indicating an increased risk of insulin resistance and cardiovascular disease. A balanced cholesterol profile is indicated by a cholesterol to LDL ratio of 1.8, which is within the normal range of 1.3-2.1. The ratio of HDL to LDL is 0.47, which is below the optimal value of >0.5 and suggests an increased risk of cardiovascular disease. increased than the optimal ratio (<1.5), the triglyceride to low-density lipoprotein ratio (2.14) indicates an increased risk of cardiovascular disease. Similar findings by Behnam Tajik et al., 2022 For coexisting T2D-CHD, the HRs were 1.89 (95% CI, 1.03–2.46) for apoB/apoA1, 1.85 (95% CI, 1.04–3.29) for triglycerides/HDL-C, 1.69 (95% CI, 1.01–2.31) for non-HDL-C/HDL-C, and 2.02 (95% CI, 1.01–3.07) for total cholesterol/HDL-C. On the other hand, the incidence of coexisting T2D-CHD was negatively correlated with serum LDL-C/apoB ratios [HRs 0.50 (95% CI, 0.28–0.90)]. Our exposures did not appear to be associated with any other CMM problems. Finally, it was found that a higher risk of T2D-CHD coexistence was independently correlated with raised triglyceride, VLDL-C, total cholesterol/HDL-C, TG/HDL-C, apoB/apoA1, and decreased LDL-C/apoB [30]. In another study by Zubair et al., (2020) specifically excluded diabetic and hypertensive patients from their study, identifying dyslipidemia in 68.1% of diabetic individuals and 71.6% of hypertensive patients, establishing a statistically significant connection between these conditions and abnormal lipid profiles [31].

Current study contributes valuable insights into the prevalence of dyslipidemia in Islamabad and Rawalpindi, aligning with the broader narrative seen in studies across Pakistan. The collective evidence underscores the urgent need for comprehensive public health strategies to address dyslipidemia, incorporating lifestyle modifications, dietary changes, and targeted interventions for at-risk populations.

**Conclusion**

The high prevalence of dyslipidemia in the population of Islamabad and Rawalpindi necessitates urgent attention as it poses a significant public health challenge. The data presented underscores the pressing need for enhanced preventive measures aimed at both diagnosis and comprehensive treatment of dyslipidemia in this region. The numbers we found highlight the seriousness of the situation. Out of 100 people we looked at, 86 had dyslipidemia. This means many people are at risk of heart-related problems. When we looked closer, we saw that distinct types of cholesterol problems are quite common here. Looking into the future, we need to understand more about why people here have these cholesterol problems. It could be related to their lifestyle. Also, checking if there is a genetic influence on these issues can help us plan better ways to manage and prevent them. We also need to make sure people in these areas know more about how to keep their cholesterol in check. As we move ahead, it would be useful to keep studying this problem over time to see if things are getting better with the steps we take. This way, we can keep adjusting our plans to make sure people in Islamabad and Rawalpindi have better heart health in the future.

**Data Availability Statement**
Data will be provided on request.

**Declaration of conflict of Interest**
Authors do not have any conflict of interest.

**Ethical Approval**
Ethical approval was obtained by the research panel.

**Authors contributions**
Muhammad Bilal Habib contributed to conceptualization, data curation, formal analysis, investigation, validation, methodology, visualization, writing – original draft. Noreen Sher Akbar and Ghanwa Batool, role in data curation, writing – review, editing and visualization.

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