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# LIPID PROFILE PATTERNS AMONG PATIENTS UNDERGOING PERCUTANEOUS CORONARY INTERVENTION: A RETROSPECTIVE OBSERVATIONAL STUDY FROM CAPITAL CITY OF UTTARAKHAND

*Amar Nath Upadhyay[1], Richa Tripathi[2], Saijeet[2]*

[1]*Associate Professor, Department of Cardiology, Government Doon Medical College, Patelnagar, Dehradun, Uttarakhand, India*
[2]*Junior Resident, Department of Cardiology, Government Doon Medical College, Patelnagar, Dehradun, Uttarakhand, India*

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**Corresponding Author:**
**Dr. Amar Nath Upadhyay,**
Associate Professor, Department of Cardiology, Government Doon Medical College, Patelnagar, Dehradun, Uttarakhand, India.
Email: dramarupadhyay007@gmail.com

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ABSTRACT

**Background:** Dyslipidemia is a major modifiable risk factor for coronary artery disease (CAD) and plays a central role in atherogenesis and plaque instability. Percutaneous coronary intervention (PCI) is widely used for the management of obstructive CAD; however, limited data are available on lipid profile patterns among PCI recipients from Himalayan and Sub-Himalayan regions including Uttarakhand. The objective is to analyze lipid profile patterns among patients undergoing PCI at a tertiary care teaching hospital in Uttarakhand and to assess the burden of dyslipidemia in this population.

**Materials and Methods:** This retrospective observational study included adult patients (≥18 years) who underwent PCI between January and December 2025. Demographic characteristics, clinical risk factors, and fasting lipid profile parameters (total cholesterol, triglycerides, low-density lipoprotein cholesterol [LDL-C], and high-density lipoprotein cholesterol [HDL-C]) were retrieved from hospital records. Dyslipidemia was defined using standard guideline cut-offs. Patients were categorized as acute coronary syndrome (ACS) or chronic coronary syndrome (CCS). Data were analyzed using descriptive statistics.

**Results:** A total of 203 patients were included, of whom 65.5% were male. The most common age group was 55–65 years (34.5%). Overall dyslipidemia was present in 74.4% of patients. Low HDL-C was the most frequent abnormality (54.2%), followed by hypertriglyceridemia (37.9%) and elevated LDL-C (35.5%). Mixed dyslipidemia was observed in 43.8% of patients. Patients presenting with ACS demonstrated a higher prevalence of elevated LDL-C and mixed dyslipidemia compared with those presenting with CCS. Smoking, hypertension, and diabetes mellitus were common coexisting cardiovascular risk factors.

**Conclusion:** A high burden of dyslipidemia, particularly low HDL-C and mixed dyslipidemia, was observed among patients undergoing PCI in Uttarakhand. These findings highlight the need for region-specific lipid screening strategies and aggressive lipid management to improve secondary prevention and long-term cardiovascular outcomes.

**Keywords:** Acute coronary syndrome; Atherosclerosis; Coronary artery disease; Dyslipidemia; Percutaneous coronary intervention.

## INTRODUCTION

Coronary artery disease (CAD) remains the principal contributor to global cardiovascular morbidity and mortality. World Health Organization has reported cardiovascular diseases as the leading cause of death worldwide, accounting for

approximately 17.9 million deaths annually.[1] The epidemiological transition observed in developing nations has resulted in a substantial escalation in the prevalence of CAD, attributable to urbanization, sedentary lifestyles, dietary modifications, and a rising incidence of metabolic disorders such as diabetes mellitus and obesity.[2] In India, CAD manifests at a relatively younger age compared to Western populations, thereby amplifying its socioeconomic impact.[3] Atherosclerosis, the pathological substrate of CAD, is a chronic inflammatory process characterized by lipid accumulation within the arterial intima, endothelial dysfunction, and progressive plaque formation.[4] Among recognized cardiovascular risk determinants, dyslipidemia occupies a central position due to its direct involvement in the initiation and propagation of atheromatous lesions.[5] Elevated concentrations of low-density lipoprotein cholesterol (LDL-C) promote lipid deposition in the arterial wall, while reduced levels of high-density lipoprotein cholesterol (HDL-C) impair reverse cholesterol transport and exert pro-inflammatory effects.[6] Hypertriglyceridemia further contributes to endothelial injury and plaque instability through its association with small dense LDL particles and postprandial lipemia.[7]

Percutaneous coronary intervention (PCI) has evolved into a cornerstone therapeutic modality for the management of obstructive CAD, particularly in the context of acute coronary syndromes (ACS) and symptomatic chronic coronary syndrome (CCS).[8] Advances in stent technology, adjunctive pharmacotherapy, and procedural techniques have significantly improved short-term and long-term outcomes.[9] Nonetheless, secondary prevention strategies remain integral to sustained clinical benefit following revascularization, with lipid management constituting a critical component.[10]

Several large-scale trials have established the efficacy of statin therapy and other lipid-lowering agents in reducing cardiovascular events by modulating lipid fractions.[11] However, optimal therapeutic strategies require an understanding of prevailing lipid abnormalities within specific populations. Regional variations in genetic predisposition, dietary habits, socioeconomic status, and healthcare access may influence lipid profiles and cardiovascular risk.[12]

Data pertaining to lipid profile patterns among PCI recipients in northern Indian states, particularly in Uttarakhand, are scarce. Uttarakhand has distinctive geographical characteristics with approximately 86% of its territory comprised of mountainous terrain and nearly 65% covered by forest. The state is broadly divided into hilly and plain regions, which differ markedly in population density and sociocultural practices. Healthcare infrastructure and advanced cardiovascular services are largely concentrated in plains, leading to regional disparities in access to specialized care. A comprehensive evaluation of lipid parameters among patients undergoing PCI is warranted to inform region-specific preventive and therapeutic strategies. Against this backdrop, the current study was undertaken to analyze the patterns of lipid profile among patients undergoing PCI at a tertiary care teaching hospital located in the capital city of Uttarakhand and to assess the overall burden of dyslipidemia in this cohort.

## MATERIALS AND METHODS

**Study design, study setting and study population:** This retrospective, observational study was conducted in the Department of Cardiology at a tertiary-care teaching hospital in Dehradun, the capital city of Uttarakhand. The institution functions as a referral center catering to both urban and rural populations across the state. The medical records of the adult patients who underwent PCI over a span of one year (January 2025 to December 2025) were retrieved from the hospital database. Records of the patients aged ≥18 years, who underwent PCI for documented CAD and had their fasting lipid profile values recorded either prior to the procedure or during index hospitalization were included in the study. Cases with incomplete or missing patient data, history of documented familial hypercholesterolemia or other genetic dyslipidemias, prior long-term lipid lowering therapy, concomitant systemic illnesses altering lipid metabolism (e.g., nephrotic syndrome, hypothyroidism) were excluded from analysis. Only the consecutive cases, fulfilling the eligibility criteria were included for the final analysis.

**Data collection:** Demographic data including patient's medical record number, name, age, weight, height; clinical details of the patients including mode of presentation (ACS or CCS), presence of diabetes mellitus, hypertension, and smoking status; and details of the laboratory parameters like fasting lipid profile including total cholesterol (TC), LDL-C, HDL-C, and triglycerides (TG) were obtained from patient's medical records. Lipid abnormalities were defined as per the established guideline thresholds for cardiovascular risk: LDL-C ≥130mg/dl, HDL-C < 40 mg/dL (men)/ < 50 mg/dL (women), triglycerides ≥150 mg/dL, and total cholesterol ≥200mg/dl. Mixed dyslipidemia was defined as the coexistence of two or more abnormal lipid parameters in an individual patient.[13,14]

**Ethical Considerations:** Prior to the commencement of data collection, the study protocol was approved by the Institutional Ethics Committee. As the study involved secondary analysis of anonymized records, informed consent was waived. Confidentiality of patient information was maintained throughout the study.

**Statistical Analysis:** Data were entered into Microsoft Excel and analyzed using statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical

variables were represented as frequencies and percentages.

## RESULTS

A total of 203 cases who underwent PCI during the study period were included in the final analysis. Male patients constituted 133 (65.5%) of the cohort, while females accounted for 70 (34.5%). The age of the patients ranged from 35 to 81 years, with the majority belonging to the 55 to 65 years age group (70; 34.5%), followed by 65 to 75 years (52; 25.6%) and 45 to 55 years (38; 18.7%).

The most prevalent cardiovascular risk factors noted were smoking/tobacco use (90; 44.3%), hypertension (77; 37.9%) and diabetes mellitus (56; 27.6%). Obesity was observed in 38 patients (18.7%). Only five patients (2.5%) reported a family history of cardiovascular disease. Regarding physical activity, 67 patients (33.0%) reported no regular physical activity, while only 15 patients (7.4%) engaged in regular exercise. The demographic, behavioral and clinical characteristics of patients are depicted in [Table 1].

Overall, dyslipidemia was detected in 151 patients (74.4%). While, elevated total cholesterol was noted in 45 (22.2%) patients, hypertriglyceridemia was noted in 77 (37.9%) patients. Elevated LDL-C and reduced HDL-C was observed in 72 (35.5%) and 110 (54.2%) patients respectively. Mixed dyslipidemia, defined as the coexistence of two or more lipid abnormalities, was observed in 89 (43.8%) patients. Overall, low HDL-cholesterol emerged as the most common lipid abnormality in this cohort, followed by hypertriglyceridemia and elevated LDL-cholesterol. [Table 2] depicts the distribution of the lipid profiles among the study population.

Patients presenting with ACS demonstrated a higher prevalence of elevated LDL-cholesterol and mixed dyslipidemia compared with those presenting with CCS. Low HDL-cholesterol was observed with comparable frequency in both groups.

**Table 1: Demographic, behavioral and clinical characteristics of patients. (n=203)**

| Variables | Categories | Frequency (%) |
|---|---|---|
| Gender | Male | 133 (65.5) |
| | Female | 70 (34.5) |
| Age (in years) | 35-45 | 24 (11.8) |
| | 45-55 | 38 (18.7) |
| | 55-65 | 70 (34.5) |
| | 65-75 | 52 (25.6) |
| | >75 | 19 (9.4) |
| Family history of cardiac disease | Yes | 05 (2.5) |
| | No | 198 (97.5) |
| Smoking | Yes | 90 (44.3) |
| | No | 113 (55.7) |
| Hypertension | Yes | 77 (37.9) |
| | No | 126 (62.1) |
| Diabetes | Yes | 56 (27.6) |
| | No | 147 (72.4) |
| Obesity | Yes | 38 (18.7) |
| | No | 165 (81.3) |
| Physical activity | Never | 67 (33.0) |
| | Sometimes | 121 (59.6) |
| | Regular | 15 (7.4) |
| Coronary artery disease | ACS | 124 (61.1) |
| | CCS | 79 (38.9) |

ACS: acute coronary syndrome; CCS: chronic coronary syndrome

**Table 2: Distribution of lipid profiles among the study population. (n=203)**

| Parameters | Frequency | Percentage |
|---|---|---|
| Total cholesterol: mean±SD (mg/dl) | 183.5 ±263.1 | - |
| • Low (<200mg/dl) | 158 | 77.8 |
| • High (≥200mg/dl) | 45 | 22.2 |
| Triglycerides: mean±SD (mg/dl) | 145.6 ±72.4 | - |
| • Low (<150mg/dl) | 126 | 62.1 |
| • High (≥150mg/dl) | 77 | 37.9 |
| HDL: mean±SD (mg/dl) | 39.8 ±12.3 | - |
| • Low (<40mg/dl) | 110 | 54.2 |
| • Normal (40-59mg/dl) | 74 | 36.5 |
| • High/protective (≥60mg/dl) | 19 | 9.3 |
| LDL: mean±SD (mg/dl) | 114.3 ±52.1 | - |
| • Optimal (<100mg/dl) | 79 | 38.9 |
| • Near optimal (100-129mg/dl) | 52 | 25.6 |
| • Borderline high (130-159mg/dl) | 28 | 13.8 |
| • High (160-189mg/dl) | 17 | 8.4 |
| • Very high (≥190mg/dl) | 27 | 13.3 |

HDL: high density lipoprotein; LDL: low density lipoprotein; SD: standard deviation

## DISCUSSION

This present study evaluated the lipid profile patterns among patients undergoing PCI at a tertiary care teaching hospital. The principal findings of our study were: (i) a high prevalence of dyslipidemia (74.4%) among PCI patients, (ii) low HDL-cholesterol as the most frequent abnormality, and (iii) a substantial burden of mixed dyslipidemia (43.8%), particularly among ACS patients.

The predominance of male patients (65.5%) and the clustering of cases in the 55–65-year age group are consistent with previously published Indian data. Studies by Joshi et al. and the CREATE registry have reported a male preponderance of approximately 65–70% among patients undergoing coronary interventions.[12,15] The relatively younger age of presentation compared with Western populations highlights the aggressive nature of atherosclerotic disease in South Asians.[16] The high overall dyslipidemia prevalence (74.4%) in this PCI cohort aligns with large population surveys in India showing widespread lipid abnormalities, especially low HDL-C. The multicentric ICMR-INDIAB study reported that nearly 79% of adults have atleast one abnormal lipid parameter, with low HDL-C being the most common abnormality (72.3%) nationally.[17] Such findings reinforce that dyslipidemia is pervasive in the Indian population and is a major contributor to CAD risk. The atherogenic pattern (elevated triglycerides and low HDL-C) observed in this cohort, is consistent with recognized 'South Asian dyslipidemia' phenotype which is highly prevalent in India and its subpopulations.[17,18] Indian adults often exhibit this pattern, which is associated with increased small dense LDL particles and a higher propensity for atherosclerosis compared with western populations. The observed prevalence of elevated LDL-C in our PCI-cohort (35.5%) is somewhat higher than national general population estimates (≈11.8%), indicating that patients undergoing PCI comprise a higher-risk group with more advanced lipid abnormalities.[17]

Smoking/tobacco use (44.3%), hypertension (37.9%) and diabetes (27.6%) were prominent non-lipid risk factors in the study cohort. These results echo findings from broad Indian epidemiological surveys that illustrate clustering of multiple cardiovascular risk factors in adults – including obesity, diabetes and dyslipidemia – increasing overall CAD risk.[19] This pattern is also comparable to that reported in the INTERHEART South Asia study, which identified smoking and dyslipidemia as dominant contributors to myocardial infarction risk.[20,21] The urbanized nature of Dehradun may also influence these risk patterns due to dietary, lifestyle, and activity shifts. The low prevalence of documented family history likely reflects underreporting rather than true absence of genetic predisposition.

Although population based lipid data specific to Uttarakhand are limited, a lipid profile study from a tertiary care center in Dehradun reported a similar pattern with significant dyslipidemia among patients with hypertension and other metabolic conditions, emphasizing the interplay between traditional risk factors and altered lipid metabolism in this region.[22]

The higher burden of mixed dyslipidemia observed among ACS patients in our cohort is in agreement with other Indian hospital-based studies that have documented complex and overlapping lipid abnormalities in acute presentations of CAD.[23] These patterns suggest that patients with unstable coronary syndromes often harbor multiple deranged lipid fractions, which may contribute to plaque instability and thrombotic events. When comparing our data with regional studies, the prevalence of dyslipidemia among CAD patients in South India has also been observed to be similarly high. For example, single center studies in tertiary hospitals reported elevated triglycerides and low HDL-C as common in ACS patients, further reinforcing that dyslipidemia is a primary target for risk reduction across diverse Indian regions.[23]

Overall, the findings from our study further underscore that in North Indian and Himalayan populations, the dual burden of traditional risk factors (smoking, diabetes, hypertension) combined with profound lipid abnormalities – particularly low HDL-C and mixed dyslipidemia – accelerates coronary disease progression. The geographical context of Uttarakhand may further influence lipid patterns. The state's mountainous terrain, dietary practices, and limited access to specialized healthcare in remote regions may contribute to delayed diagnosis and suboptimal lipid control. Furthermore, the concentration of advanced cardiac care facilities in the plains may lead to referral bias, with more severe cases presenting to tertiary centers. This highlights the need for regionally tailored screening and aggressive lipid management strategies in addition to lifestyle and metabolic risk control.

**Study limitations**

Our study had few limitations. First, our study was retrospective, and evaluating the association between lipid abnormalities and clinical presentation was beyond the scope of the current study. Second, the patient-wise lipid combinations could not be analyzed in detail, restricting precise characterization of mixed dyslipidemia patterns. Third, the study findings being center-specific may not be representative to the broader population of Uttarakhand and hence need to be interpreted cautiously. A future prospective study with a higher sample size and patient follow-up may provide a better insight and statistically significant results, and our study findings may surely be helpful to design the same.

## CONCLUSION

Dyslipidemia is highly prevalent among patients undergoing PCI. Low HDL-C represents the most common lipid abnormality followed by hypertriglyceridemia and elevated LDL-C. A substantial proportion of patients exhibit mixed dyslipidemia particularly among those presenting with ACS. These findings underscore the need for region specific lipid management strategies and highlight the importance of early detection and aggressive modification of lipid abnormalities to improve long-term cardiovascular outcomes.

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