International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Trends in HDL Level and LDL/HDL Ratio Among Patients Attending a Tertiary Care Hospital in Silchar: A Retrospective Analysis

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Abstract

Dyslipidemia, particularly low high-density lipoprotein (HDL) cholesterol and an elevated LDL/HDL ratio, is a major contributor to atherosclerotic cardiovascular disease and is highly prevalent in South Asian populations. This retrospective cross-sectional study evaluated trends in HDL levels, LDL levels, and LDL/HDL ratios among adult patients attending a tertiary care hospital in Silchar, Northeast India. Lipid profile data of 8,955 adults (≥18 years) collected between April 2024 and March 2025 were analyzed using laboratory information system records. The mean HDL and LDL levels were 37.03 mg/dL and 102.80 mg/dL, respectively, with a mean LDL/HDL ratio of 3.13, exceeding established atherogenic risk thresholds. Sub-optimal HDL levels were observed in 68% of males and 82% of females. LDL levels and LDL/HDL ratios demonstrated a progressive increase with advancing age. Despite higher mean HDL levels in women, a greater proportion exhibited sub-optimal HDL concentrations. These findings highlight a distinct dyslipidemic pattern characterized by low HDL and elevated LDL/HDL ratios, underscoring a substantial cardiovascular risk burden in the Northeast Indian population and emphasizing the need for region-specific preventive strategies.

Keywords: Dyslipidemia, High-density lipoprotein (HDL), LDL/HDL ratio, Northeast India

1. Introduction

Dyslipidemias—particularly abnormalities in HDL and LDL cholesterol homeostasis— are central to the pathogenesis of atherosclerosis and its clinical outcomes, including coronary artery disease (CAD) [1], and others like ischemic stroke, peripheral artery disease (PAD), aortic aneurysm, and hypertension [2]. In recent decades, the burden of dyslipidemia has shown alarming increases in South Asian countries, especially India, thus warranting focused epidemiological scrutiny and preventive strategies.

1.1 Lipoprotein Biology and Biochemical Basis

Human plasma lipids are transported as complexes with specific apolipoproteins, termed lipoproteins, among which high-density lipoproteins (HDL) and low-density lipoproteins (LDL) are of central importance [3]. LDL delivers cholesterol from the liver to peripheral tissues, promoting atherogenesis, whereas HDL facilitates reverse cholesterol transport and clearance, conferring cardiovascular protection—the basis for its designation as “good cholesterol”. The first compelling reports of the strong inverse association between HDL and coronary heart disease were from the Framingham Heart Study [4].

Elevated LDL and low HDL have opposite associations with cardiovascular risk, influenced by genetics, metabolism, and lifestyle [5-7].

1.2 Rationale for Studying HDL and LDL/HDL Ratio

The independent assessment of LDL and HDL cholesterol provides limited prognostic value compared to strategic combinations such as the LDL/HDL ratio, better reflects the balance between atherogenic and anti-atherogenic lipoproteins than either value alone and is a stronger predictor of coronary risk [8]. Ratios above 2.5 have been linked to increased atherosclerosis severity [9].

1.3 Trends in the North-East and National Scenario

Indian studies (India Heart Watch, ICMR-INDIAB) reveal regional lipid variations: Assam shows low hypercholesterolemia (7.9%) and high LDL (4.6%) but markedly low HDL (>71%) [1]. Nationally, dyslipidemia is rising due to urbanization and metabolic risk factors. The PURE study highlights non-HDL cholesterol as a major CAD determinant among South Asians [10].

However, limited data exist from Northeast India, particularly Silchar, warranting this study to assess HDL and LDL/HDL patterns for better regional cardiovascular risk evaluation.

2. Outcomes

2.1 Primary outcomes: Mean total HDL and LDL and mean LDL/HDL cholesterol ratio among adult patients attending a tertiary care hospital in Silchar during the period from 1st April 2024 to 31st March 2025, were used.

2.2 Secondary outcomes: Gender-wise and age-interval–wise differences in HDL, LDL cholesterol and LDL/HDL ratio were assessed.

3. Methodology

Lipid profile data for 1 year duration (1st April, 2024-31st March, 2025) stored in LIS (Laboratory Integrated System) of CCL were accessed. (Estimation of HDL and LDL have been done through Vitros 5600 autoanalyer in Biochemistry section, Central Composite Laboratory (CCL), Silchar Medical College.) Data of patients (aged ≥18 years) with complete lipid profile results were used, regardless of fasting status of the collected sample because the differences between fasting and non-fasting measurements are negligible for our primary outcomes. A total of 8,955 eligible samples were collected for the time period which met our inclusion criteria, of which 5,283 were from men and 3,672 were from women. Mean HDL and LDL cholesterol and mean LDL-to-HDL cholesterol ratio by gender and 15-year age intervals were calculated. All statistical component of the study was done in MS Excel.

4. Results

The average age was calculated to be 53.29 (±14.96) years, where the average age of men was 54.09 (±14.73) years and women was 52.12 (±15.19) years.

Table 1: Mean Values of HDL and LDL Levels, and LDL/HDL Ratio Calculated from the Total Samples Collected (i.e, 8,955).

Mean HDL (mg/dL)	37.03 (±16.11)
Mean LDL (mg/dL)	102.80 (±43.54)
Mean LDL/HDL	3.13 (±1.59)

Table 2: Gender-wise Distribution of Mean HDL and LDL Levels and LDL/HDL Ratio

Gender	Total samples	Mean age (years)	Mean HDL (mg/dL)	Mean LDL (mg/dL)	Mean LDL/HDL
Male	5,283	54.09 (±14.73)	36.12 (±16.82)	98.52 (±42.73)	3.13 (±1.68)
Female	3,672	52.12 (±15.19)	38.30 (±14.97)	109.03 (±43.99)	3.14 (±1.47)

Table 3: 15-year Age-interval-wise Distribution of Mean HDL and LDL Levels and LDL/HDL Ratio

Age interval (years)	Total samples	Mean HDL (mg/dL)	Mean LDL (mg/dL)	Mean LDL/HDL
18-32	942	36.61	97.81	2.97
33-47	2,043	37.12	100.41	3.07
48-62	3,444	36.91	102.15	3.16
63-77	2,151	37.93	106.73	3.15
>77	375	35.41	102.80	3.09

N.B: The LDL-to-HDL cholesterol ratio was calculated using individual records before averaging for each gender and age interval.

The above data is visualized in the next three graphs.

Figure 1: Line Graph (with Markers) Showing Age Interval and Gender-wise Distribution of Mean HDL Level

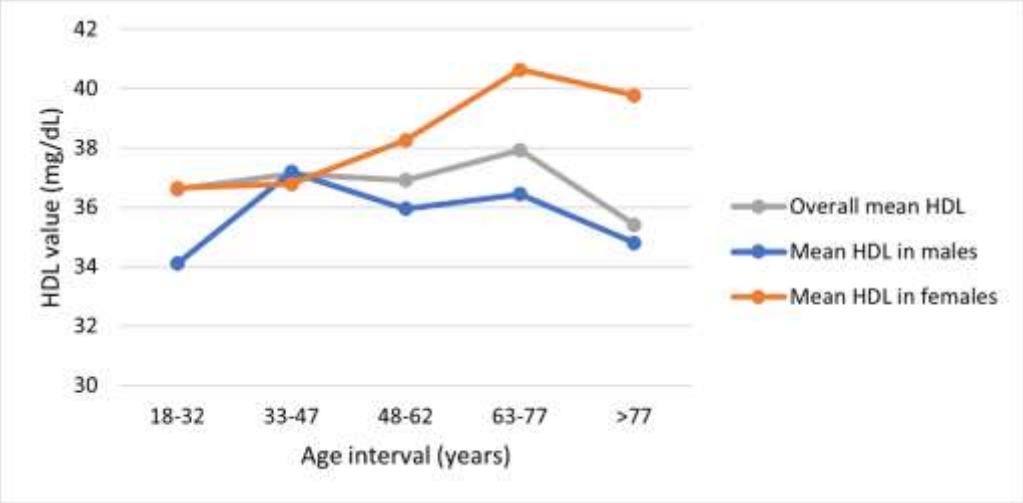


Figure 2: Line Graph (with Markers) Showing Age Interval and Gender-wise Distribution of Mean LDL Level

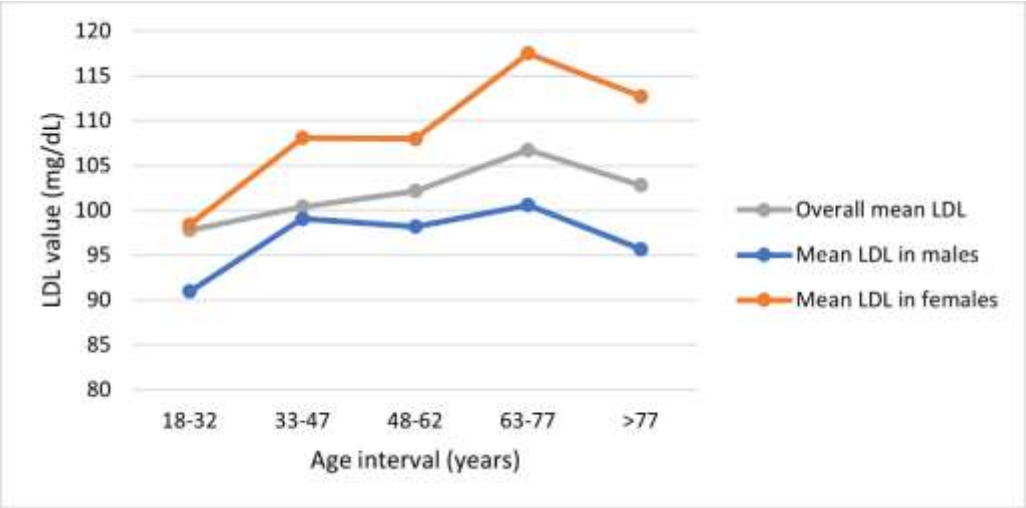


Figure 3: Line Graph (with Markers) Showing Age Interval and Gender-wise Distribution of Mean LDL/HDL Ratio

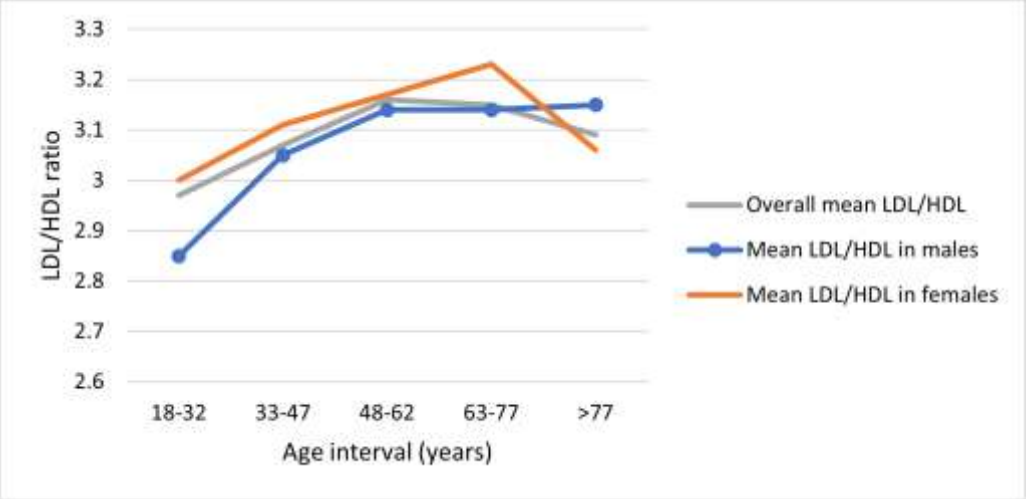


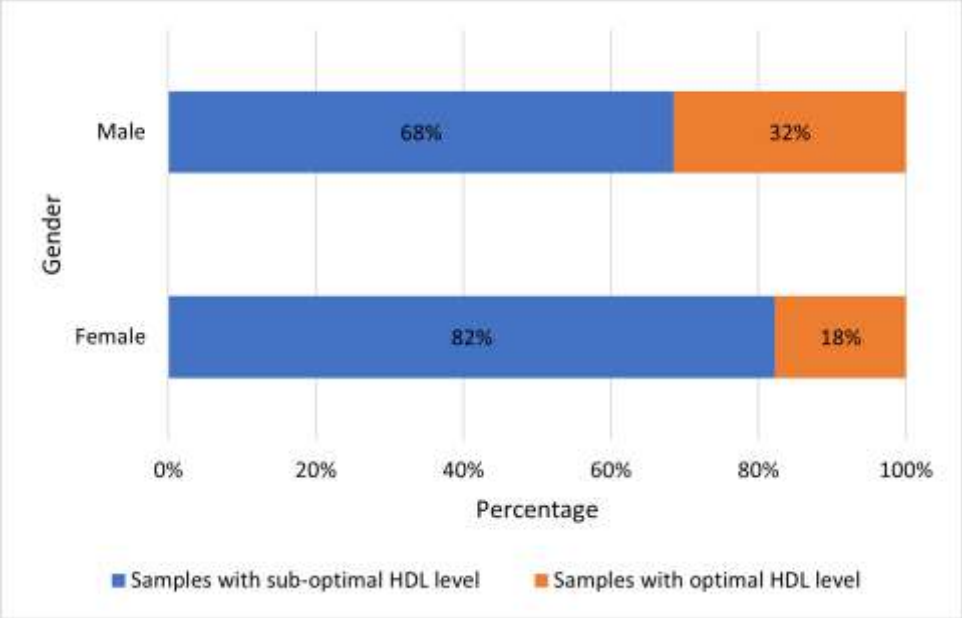
Table 4: Gender-wise Distribution of Sub-optimal HDL Levels

Gender	Total samples	Samples with sub-optimal HDL level	Percentage (%)
Male	5,253	3,597	68
Female	3,672	3,021	82

N.B: To consider sub-optimal level, cut-off for males was considered to be < 40 mg/dL, and cut-off for females to be < 50 mg/dL [11].

The above data is visualized in the next graph.

Figure 4: 100% Stacked Bar Graph Showing Comparison of HDL Level between the Two Genders



5. Discussion

This study conducted at Silchar Medical College offers crucial insights into HDL levels and LDL/HDL ratios among adults in Northeast India, addressing a significant gap in region-specific lipid epidemiology. Spanning 8,955 patients (April 2024–March 2025), it provides one of the few focused datasets from this underrepresented region, with implications for both epidemiological and clinical audiences.

5.1 Central Findings and Contextual Background

Mean HDL (37.03 mg/dL) and LDL (102.8 mg/dL) levels, and an elevated mean LDL/HDL ratio (3.13), were identified as central findings. Notably, sub-optimal HDL prevalence was alarmingly high—68% in men and 82% in women. This underscores that dyslipidemia, with a focus on HDL inadequacy and atherogenic imbalance, is more pervasive than previously recognized. These figures mirror patterns observed in the ICMR-INDIAB and India Heart Watch studies, where Northeast India consistently shows the nation's lowest HDL levels (Assam 71.3%, Kerala 45.3%, Delhi 56.0%, Maharashtra 37.7%) [1].

5.2 Age and Gender Differences: Trends Reflected and Explained

Women exhibited slightly higher mean HDL but a greater prevalence of sub-optimal levels, suggesting interactions between biological and sociocultural factors. LDL values increased progressively with age (from 97.8 to 106.7 mg/dL across increasing 15-year intervals), confirming national patterns in which cholesterol and its risk indices peak in the 40–60 age group. Multiple Indian studies—such as those by Gupta et al., and longitudinal cohort analyses— confirm that women often have higher total, LDL, and non-HDL cholesterol, and a greater prevalence of dyslipidemia than men [12].

5.3 Comparative Analysis with National and Regional Studies

The mean LDL/HDL ratio (3.13) exceeds recommended cut-offs for atherogenic risk, aligning with national averages (2.7–3.2) reported in urban Indian cohorts. Studies from tertiary centers in Telangana and Gujarat have demonstrated comparable dyslipidemia prevalence (50–75%) though familial combined hyperlipidemia is less common in Northeast India according to Fredrickson's classification [10, 13]. These

comparisons reinforce Silchar as situated within the higher-risk tier, especially given a substantial portion of the sample demonstrating HDL well below optimal protective levels.

5.4 LDL/HDL Ratio as a Prognostic Tool and Clinical Implication

The LDL/HDL ratio has gained prominence not only as a descriptive index but as a strategic clinical predictor. Millán and colleagues (2009) argued that the ratio better reflects the balance between atherogenic and anti-atherogenic lipoproteins than either marker alone [8], a conclusion mirrored by Sun et al. (2022) who found robust correlations between increases in LDL/HDL ratio and both the presence and severity of coronary atherosclerosis [9]. ROC analyses conducted by Jose et al. (2024) in Telangana further validated the cut-off of ~2.5 as clinically significant for CAD risk stratification [10]. This study shows a high ratio (3.13) which diagnoses both increased net risk and a likely need for intensive preventive intervention.

6. Limitation

The strength of this study lies in its large sample size, near-year long coverage, automated and standardized lipid profile estimation, and robust gender- and age-based granularity. However, as with other hospital-based cohorts, generalization to the broader population is limited; admissions bias, lack of detailed data on socio-economic status and demographic profile as well as other risk factors (BMI, hypertension, diabetes), and absence of medication tracking may influence prevalence estimates. Nevertheless, the trends match well with large epidemiological data [1], and the findings substantially enhance the evidence base for Northeast India—a region historically underrepresented in national surveys.

7. Conclusion

The overall lipid profile picture observed in this study is emblematic of a "South Asian dyslipidemia" with very low HDL and high LDL/HDL ratios. Compared to Western studies, which observe high LDL is predominant but HDL levels that remain protective [7], the Indian population faces a dual risk exacerbated by limited therapy access and sociocultural factors. The findings align closely with recent major retrospective and population studies in Telangana, Jaipur, and published evidence from both the India Heart Watch and ICMR-INDIAB studies [14].

The study underscores the urgent need for routine lipid screening, lifestyle modification, equitable treatment access, and regionally adapted public health strategies to mitigate the growing cardiovascular burden in Northeast India.

8. Acknowledgement

The authors sincerely acknowledge the Department of Biochemistry and the Central Composite Laboratory, Silchar Medical College and Hospital, for providing access to the laboratory information system and technical support necessary for data retrieval and analysis. The authors also thank the faculty and technical staff for their cooperation during the conduct of this study.

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