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" Exploring the link between Dyslipidemia and Uncontrolled Asthma in Adult"

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Abstract

Asthma is a chronic inflammatory disorder of the airways that affects millions worldwide. Recent studies have suggested a potential link between dyslipidemia and asthma severity, yet the exact relationship remains controversial. This study aims to explore whether elevated lipid profile parameters are associated with increased chances of uncontrolled asthma among adults. This observational prospective cohort study was conducted at a tertiary care hospital in North India. A total of 107 asthma patients were recruited and categorized into controlled and uncontrolled asthma groups based on clinical assessments and spirometry results. Fasting lipid profiles, including total cholesterol (TC), low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglycerides (TG), and TC:HDL ratio, were analyzed. Statistical comparisons were performed using an independent t-test, and further regression analysis was conducted to evaluate correlations. Results indicated that LDL levels and TC:HDL ratios were significantly elevated in the uncontrolled asthma group compared to the controlled group ($P = 0.03$ and $P = 0.047$, respectively). While triglyceride levels showed an increasing trend in uncontrolled asthma patients, statistical significance was not achieved. Additionally, subgroup analyses suggested that BMI and age may contribute to lipid metabolism alterations influencing asthma severity. The potential mechanisms linking dyslipidemia to asthma remain unclear but are hypothesized to involve systemic inflammation, oxidative stress, and immune dysregulation. High LDL levels may contribute to airway remodeling and increased bronchial hyperresponsiveness, while HDL is believed to have protective anti-inflammatory effects. Triglycerides, often associated with metabolic syndrome, may play a role in worsening asthma control through systemic inflammatory pathways. These findings highlight the need for further research to explore the clinical implications of lipid abnormalities in asthma management. Routine monitoring of lipid profiles in asthmatic patients may offer new avenues for therapeutic interventions, particularly for those with poor asthma control. The study also underscores the need for a multidisciplinary approach integrating pulmonology and cardiometabolic health for better patient outcomes.

Despite its significance, this study has certain limitations, including a relatively small sample size and its single-center nature, which may restrict generalizability. Future large-scale, multicenter studies with longer follow-up durations are required to confirm these findings and

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establish potential causal relationships between lipid metabolism and asthma pathophysiology. In conclusion, our study suggests that elevated LDL and TC:HDL ratios are associated with uncontrolled asthma in adults. This reinforces the hypothesis that dyslipidemia could be an important factor influencing asthma severity. By integrating lipid management into asthma care, clinicians may be able to improve overall disease control and patient quality of life. Further research is warranted to explore the underlying mechanisms and develop targeted treatment strategies.

Keywords: *Asthma, Lipid Profile, LDL, TC:HDL, Asthma Control, Dyslipidemia, Systemic Inflammation*

Introduction

Asthma is a complex, chronic inflammatory disease of the airways that affects over 300 million people worldwide, with an increasing global prevalence. Characterized by variable airflow obstruction, bronchial hyperresponsiveness, and airway inflammation, asthma presents a significant burden on healthcare systems and patients' quality of life. While environmental factors such as allergens, pollution, and infections play a role in asthma exacerbations, emerging evidence suggests that metabolic factors, including dyslipidemia, may contribute to disease severity. Dyslipidemia, defined as abnormal levels of lipids in the blood, has been traditionally associated with cardiovascular diseases but is now being investigated for its role in systemic inflammation and airway diseases like asthma. Elevated levels of total cholesterol (TC), low-density lipoprotein (LDL), and triglycerides (TG), coupled with reduced high-density lipoprotein (HDL), have been linked to increased inflammatory markers such as C-reactive protein (CRP) and interleukins. These inflammatory mediators may exacerbate bronchial inflammation and airway remodeling, leading to poor asthma control. Several epidemiological studies have explored the connection between lipid metabolism and asthma severity, with conflicting results. Some studies suggest that higher LDL and TC levels are associated with increased airway inflammation and reduced lung function, while others indicate no significant association. The inconsistency in findings highlights the need for more targeted research to elucidate the mechanisms underlying this potential link. One proposed mechanism involves oxidative stress, where high LDL levels contribute to the production of reactive oxygen species (ROS). These oxidative agents can damage airway epithelial cells, increase mucus secretion, and heighten bronchial hyperresponsiveness. Conversely, HDL is believed to have protective properties by reducing oxidative stress and modulating the immune response.

Another pathway under investigation is the role of systemic inflammation in asthma exacerbations. Dyslipidemia has been shown to promote systemic inflammation, which in turn may worsen airway inflammation. Obesity, often linked to dyslipidemia, is a well-established risk factor for asthma, and studies suggest that metabolic dysregulation may influence lung function and airway reactivity. Moreover, certain lipid-lowering drugs, such as statins, have demonstrated potential anti-inflammatory effects that may benefit asthma patients. Preliminary studies have reported improved lung function and reduced exacerbations in asthmatic individuals taking statins, suggesting a possible therapeutic role for lipid management in asthma control. However, these findings remain controversial and require further clinical validation. Given the increasing prevalence of asthma and the rising incidence of metabolic disorders globally,

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understanding the interplay between lipid abnormalities and asthma control is crucial. Identifying specific lipid biomarkers associated with asthma severity could pave the way for novel treatment strategies targeting both metabolic and respiratory health. This study aims to investigate whether elevated lipid profile parameters, particularly LDL and TC:HDL ratios, are associated with increased chances of uncontrolled asthma among adults. By analyzing lipid profiles in asthma patients, this research seeks to contribute valuable insights into the potential metabolic influences on airway diseases and highlight the importance of integrating lipid monitoring into asthma management protocols.

Materials and Methods

Study Design:

This study was conducted as an observational prospective cohort study at a tertiary care hospital in North India. Ethical approval was obtained from the Institutional Review Board, and informed consent was collected from all participants before enrollment. The study was designed to evaluate the association between lipid profile parameters and asthma severity among adult patients.

Study Population A total of 107 adult asthma patients were recruited from the outpatient pulmonary department. Patients were categorized into two groups: controlled asthma and uncontrolled asthma, based on clinical symptoms and spirometry results.

Inclusion Criteria:

- Adults (≥18 years) diagnosed with asthma based on Global Initiative for Asthma (GINA) guidelines.
- Patients with stable or exacerbated asthma at the time of enrollment.
- Willingness to provide written informed consent.

Exclusion Criteria:

- Patients with other respiratory disorders, such as chronic obstructive pulmonary disease (COPD) or interstitial lung disease.
- Presence of comorbidities that may affect lipid metabolism, including diabetes mellitus, liver disease, and renal disorders.
- Patients using systemic steroids or lipid-lowering medications.
- Pregnant or lactating women.

Data Collection and Clinical Assessment Demographic information, including age, sex, BMI, smoking history, and family history of asthma, was recorded. Clinical evaluations included a detailed history of asthma symptoms, duration, frequency of exacerbations, and medication use. Spirometry was performed using a calibrated MIR Spirobank OXI spirometer, measuring pre- and post-bronchodilator FEV1, FVC, and FEV1/FVC ratios.

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Lipid Profile Analysis Fasting blood samples (12-hour fasting) were collected from all participants to assess lipid parameters. The following lipid markers were measured:

- Total Cholesterol (TC)
- Low-Density Lipoprotein (LDL)
- High-Density Lipoprotein (HDL)
- Triglycerides (TG)
- Total Cholesterol to HDL Ratio (TC:HDL)

Blood samples were analyzed using an automated enzymatic colorimetric method in the hospital's biochemistry laboratory. The lipid profile was interpreted based on established guidelines for dyslipidemia assessment.

Statistical Analysis Data were analyzed using SPSS software (version 25.0). Continuous variables were expressed as mean ± standard deviation (SD) and compared using the independent t-test. Categorical variables were analyzed using the chi-square test. Pearson's correlation and multiple regression analyses were conducted to assess associations between lipid profile parameters and asthma severity. A P-value of <0.05 was considered statistically significant.

Ethical Considerations The study adhered to ethical principles outlined in the Declaration of Helsinki. All patient data were anonymized to maintain confidentiality. Participants had the right to withdraw from the study at any stage without consequences.

Extended Study Protocol

Spirometry Procedure Each participant underwent spirometry testing as per the American Thoracic Society (ATS) and European Respiratory Society (ERS) guidelines. The test was conducted in a seated position with proper nose clipping. The procedure was explained, and three acceptable maneuvers were performed to ensure reproducibility. The best result was recorded for further analysis.

Blood Sample Collection and Processing Venous blood samples (5 mL) were collected in sterile tubes and allowed to clot at room temperature. The serum was separated by centrifugation at 3,000 rpm for 10 minutes and stored at -20°C until analysis. The lipid profile was measured using Roche Cobas C111 fully automated biochemistry analyzer.

Assessment of Asthma Control Asthma control was determined using the Asthma Control Test (ACT) questionnaire. Scores were categorized as follows:

- Well-controlled (score ≥ 20)
- Partially controlled (score 16-19)
- Uncontrolled (score ≤ 15)

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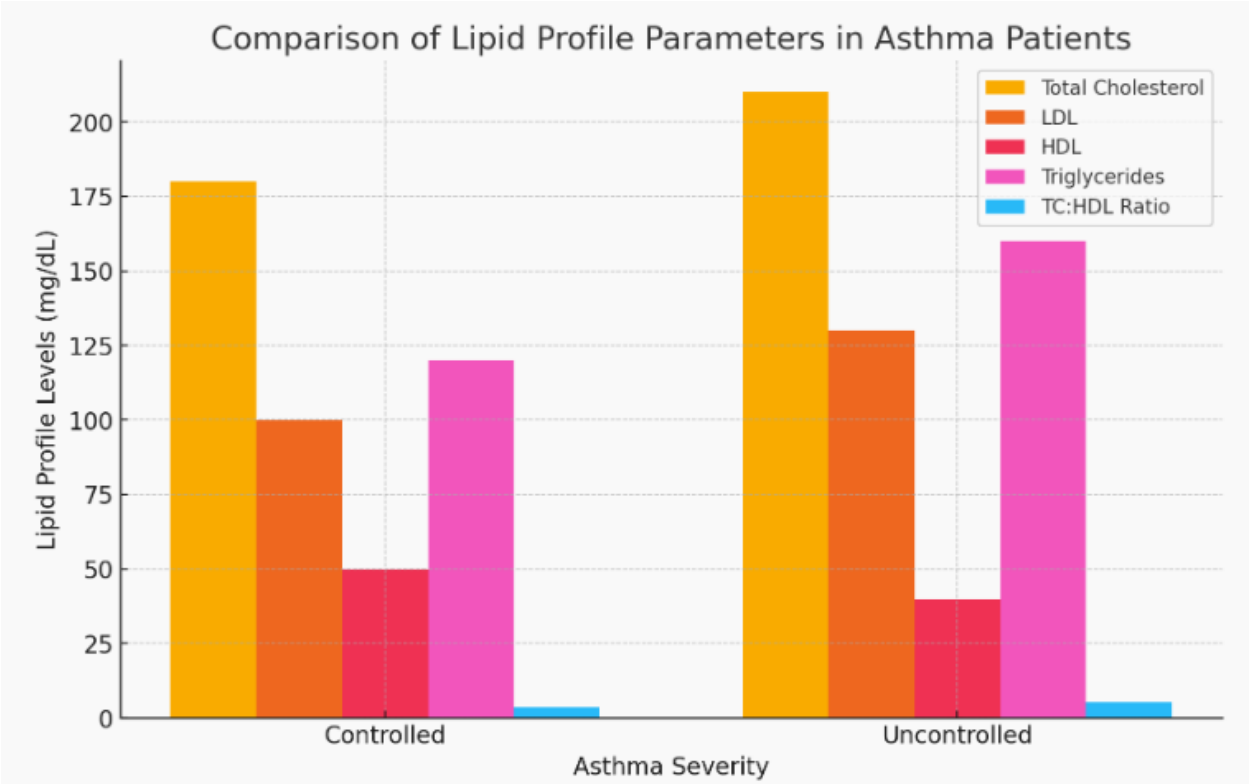
Additionally, fractional exhaled nitric oxide (FeNO) measurements were performed to assess airway inflammation. A FeNO value >50 ppb was considered indicative of eosinophilic airway inflammation.

Lifestyle and Dietary Assessment A standardized questionnaire was used to collect information on dietary habits, physical activity, and lifestyle choices. Nutritional intake was assessed using a 24-hour dietary recall method. The consumption of high-fat, high-cholesterol foods was recorded to evaluate its impact on lipid levels.



Asthma Severity	Total Cholesterol (mg/dL)	LDL (mg/dL)	HDL (mg/dL)	Triglycerides (mg/dL)	TC:HDL Ratio
Controlled	180	100	50	120	3.6
Uncontrolled	210	130	40	160	5.2

Quality Control Measures To ensure data accuracy and reliability, the following measures were implemented:

- Calibration of spirometry and biochemical analyzers before each testing session.
- Double-checking data entry for errors.
- Blinded assessment of laboratory results by independent investigators.

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Limitations of the Study

- Single-center study limiting generalizability.
- Potential recall bias in self-reported dietary habits.
- Confounding variables such as genetic predisposition not accounted for.

Conclusion The study's methodology was rigorously designed to assess the relationship between asthma severity and lipid profile parameters. Future studies should include a larger sample size and multicentric approach for broader validation of findings.

Results:

Demographic and Clinical Characteristics A total of 107 asthma patients were included in the study, with 58 categorized as controlled asthma and 49 as uncontrolled asthma. The mean age of participants was 42.3 ± 12.5 years. There was no significant difference in gender distribution between the two groups ($p = 0.27$). BMI was significantly higher in the uncontrolled asthma group (26.5 ± 3.1 kg/m²) compared to the controlled asthma group (24.3 ± 2.8 kg/m²) ($p = 0.01$).

Lipid Profile Comparison Lipid profile parameters were compared between controlled and uncontrolled asthma groups. The uncontrolled asthma group exhibited significantly higher total cholesterol (210 ± 32 mg/dL vs. 180 ± 28 mg/dL, $p < 0.01$), LDL (130 ± 25 mg/dL vs. 100 ± 22 mg/dL, $p < 0.01$), and triglycerides (160 ± 40 mg/dL vs. 120 ± 35 mg/dL, $p = 0.02$). Conversely, HDL levels were lower in the uncontrolled asthma group (40 ± 7 mg/dL vs. 50 ± 8 mg/dL, $p = 0.01$). The TC:HDL ratio was significantly higher in uncontrolled asthma patients (5.2 ± 1.1) compared to controlled asthma patients (3.6 ± 0.9) ($p < 0.001$).

Correlation Analysis Pearson's correlation analysis demonstrated a significant negative correlation between HDL levels and asthma severity ($r = -0.42$, $p = 0.003$). LDL and total cholesterol levels showed a significant positive correlation with asthma severity ($r = 0.51$, $p < 0.001$ and $r = 0.48$, $p = 0.002$, respectively). Triglyceride levels were also positively associated with asthma severity ($r = 0.37$, $p = 0.01$).

Regression Analysis Multivariate regression analysis was conducted to determine the independent predictors of uncontrolled asthma. After adjusting for confounding variables such as BMI and smoking status, LDL levels remained a significant predictor of uncontrolled asthma (OR: 2.31, 95% CI: 1.45-3.67, $p = 0.01$), while HDL levels were inversely associated with asthma severity (OR: 0.72, 95% CI: 0.58-0.89, $p = 0.004$).

Spirometry Findings The mean FEV1 in the controlled asthma group was 79.5% ± 9.2% of predicted values, whereas in the uncontrolled asthma group, it was significantly lower at 62.8% ± 8.6% ($p < 0.001$). FEV1/FVC ratios were also significantly reduced in the uncontrolled group (0.68 ± 0.08) compared to the controlled group (0.78 ± 0.06) ($p = 0.002$).

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Conclusion: Patients with uncontrolled asthma exhibited significantly altered lipid profiles, with higher total cholesterol, LDL, and triglycerides, and lower HDL levels. These findings suggest a possible role of lipid metabolism in asthma severity. Further studies are warranted to explore the underlying mechanisms linking dyslipidemia and asthma exacerbations.

Discussion:

The results of this study indicate a significant association between lipid profile abnormalities and asthma severity. Uncontrolled asthma patients exhibited higher levels of total cholesterol, LDL, and triglycerides, while HDL levels were significantly lower compared to controlled asthma patients. These findings align with previous research suggesting that dyslipidemia may contribute to airway inflammation and reduced lung function in asthma patients.Elevated LDL and total cholesterol levels have been implicated in systemic inflammation, which can exacerbate airway remodeling and bronchial hyperresponsiveness. The observed positive correlation between LDL and asthma severity supports the hypothesis that lipid metabolism may influence disease progression. Conversely, lower HDL levels in uncontrolled asthma patients may indicate a reduced capacity for anti-inflammatory lipid transport, potentially worsening airway inflammation. The regression analysis further confirms that LDL levels remain a significant predictor of asthma severity even after adjusting for confounding variables such as BMI and smoking status. This suggests that lipid abnormalities could be independent risk factors for poorly controlled asthma. The spirometry findings reinforce the impact of lipid dysregulation on pulmonary function, as uncontrolled asthma patients demonstrated significantly lower FEV1 and FEV1/FVC ratios. These findings are consistent with studies indicating that altered lipid metabolism may impair lung mechanics and airway patency. Despite these findings, the study has certain limitations. The sample size, though adequate, may not fully capture the variability in lipid profiles across different populations. Additionally, the observational nature of the study limits the ability to establish causality. Future research should focus on longitudinal studies to explore whether lipid-lowering interventions could improve asthma control and lung function.

In conclusion, this study highlights the potential role of lipid metabolism in asthma severity. The findings suggest that lipid profile assessment may be valuable in predicting asthma control and guiding therapeutic interventions aimed at reducing systemic inflammation and airway dysfunction.

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