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Original Article

Exploring the Relationship between Chronic Obstructive Pulmonary Disease and Serum Lipid Levels

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is a major global health problem associated with chronic inflammation, oxidative stress, and metabolic disturbances, including dyslipidemia. Dyslipidemia contributes to increased cardiovascular risk, which is commonly observed in COPD patients. Understanding the relationship between serum lipid levels and COPD severity is essential for comprehensive disease management.

Objective: To investigate the association between serum lipid profile and COPD severity, and to assess the correlation between dyslipidemia and disease progression.

Methods: This analytical cross-sectional study was conducted at the Department of Medicine, Al Noor Hospital, Abu Dhabi, United Arab Emirates, from August 2023 to January 2024. A total of 100 patients with spirometry-confirmed COPD were enrolled using consecutive non-probability sampling. Fasting serum lipid profiles, including total cholesterol, LDL-C, HDL-C, and triglycerides, were measured using standard laboratory methods. COPD severity was classified according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria. Pearson correlation coefficient and one-way analysis of variance (ANOVA) were used for statistical analysis, with $p < 0.05$ considered statistically significant.

Results: The study included 100 patients (60 males, 40 females) with a mean age of 62 ± 8 years. Patients with severe COPD had significantly higher total cholesterol and LDL levels. Approximately 60% had low HDL (<40 mg/dL), while 40% had elevated triglycerides (>150 mg/dL). Increased LDL levels were significantly associated with greater COPD severity ($p = 0.02$), and elevated triglycerides also showed a significant association ($p = 0.03$).

Conclusion: Dyslipidemia is significantly associated with COPD severity. Comprehensive management of COPD should include evaluation and control of lipid abnormalities to reduce cardiovascular risk and improve patient outcomes.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) has been one of the major causes of morbidity and mortality both globally and locally, with its characteristic persistent respiratory symptoms and airflow limitation caused by airway and/or alveolar abnormalities and /or abnormalities in the alveoli [1]. The systemic nature of COPD and the high prevalence of cardiovascular comorbidities highlight the importance of consideration of a full spectrum of risk factors of the disease overall rather than pulmonary functioning indices [2]. Systemic inflammation mediated by dyslipidemia, a well-recognized modifiable risk factor of cardiovascular disease, has been implicated in many systemic inflammatory disorders. However, the interaction between abnormal lipid profile levels and disease severity of COPD is poorly understood. There is emerging evidence to indicate that changes in serum lipid profiles are not merely a consequence of systemic inflammation. However, it can also contribute to disease progression and comorbidity burden in known COPD patients [3].In fact, total cholesterol, LDL, and triglycerides, and low levels of HDL correlate with increased systemic inflammation, oxidative stress, and dysfunction of the endothelium, all of which cause increased morbidity of COPD [4]. Moreover, cardiovascular events are a leading cause of mortality in COPD, which highlights the clinical significance of lipid abnormalities among these patients. In the Middle East, where the prevalence of COPD remains on the increase against the backdrop of elevated incidences of metabolic syndrome and dyslipidemia, there is a dearth of published evidence relating COPD severity to lipid abnormalities [5]. Limited evidence is available regarding the association between serum lipid abnormalities and COPD severity among patients with COPD in the United Arab Emirates. between the serum lipid profile and the severity of the disease in the United Arab Emirates (UAE) [6].To bridge this gap, we have conducted a cross-sectional study in Al Noor Hospital, Abu Dhabi, regarding the connection between serum lipid profiles and severity of COPD. We theorized that progressive severity of COPD as per the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria would correlate with a progressively worsening lipid profile. That would include elevated levels of total cholesterol and LDLs and triglycerides and decreased levels of HDLs [7]. This relationship may improve risk stratification in COPD and inform a multidisciplinary approach to integrative therapeutic recommendations for these patients.

By extension, this has the potential to reduce cardiovascular risk and improve overall outcomes. We aimed to measure differences in lipid levels according to GOLD-defined severity grades in COPD, and whether individual lipid fractions are significantly associated with COPD severity. This paper therefore seeks to reconcile pulmonary and metabolic approaches to this complex, with the view of enhancing an integrated model of COPD management in a jurisdiction where the burden of COPD and metabolic abnormalities is rising [8, 9].

MATERIAL AND METHODS

Study Design and Setting

This analytical cross-sectional study was conducted in the Department of Medicine, Al Noor Hospital, Abu Dhabi, United Arab Emirates, from August 2023 to January 2024. A total of 100 patients with spirometry-confirmed chronic obstructive pulmonary disease (COPD) were enrolled using consecutive non-probability sampling. Fasting serum lipid profiles, including total cholesterol, LDL-C, HDL-C, and triglycerides, were measured using standard laboratory methods. COPD severity was classified according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria. Pearson correlation coefficient and one-way analysis of variance (ANOVA) were used for statistical analysis. A p-value <0.05 was considered statistically significant.

Sampling Technique

Consecutive non-probability sampling was used to recruit all eligible patients with spirometry-confirmed COPD who met the inclusion criteria during the study period.

Sample Size Calculation

Sample size was calculated using OpenEpi version 3.01 assuming an expected prevalence of 50%, a 95% confidence level, and a 5% margin of error. Since all eligible COPD patients meeting the inclusion criteria during the study period were included, the final sample comprised 100 participants.

Operational Definitions

- COPD Severity: Classified according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria into mild (Stage I), moderate (Stage II), severe (Stage III), and very severe (Stage IV).
- Dyslipidemia: Presence of one or more abnormal lipid parameters according to standard clinical guidelines.
- High LDL-C: LDL cholesterol ≥160 mg/dL
- Low HDL-C: HDL cholesterol <40 mg/dL
- Hypertriglyceridemia: Serum triglyceride concentration >150 mg/dL

ETHICAL APPROVAL

This study was approved by the Institutional Review Board of Al Noor Hospital, Abu Dhabi, UAE (IRB No. ANH- IRB/2022/219). All participants provided written informed consent before enrollment. The research adhered to the ethical principles of the Declaration of Helsinki, ensuring confidentiality and patient rights.

INCLUSION CRITERIA

Patients who were 40 years or above with clinically and spirometrically proven COPD (post bronchodilator FEV 1/FVC: < 0.70) who consented were included.

EXCLUSION CRITERIA

Excluded were patients with active infection, significant COPD flare, and well-known cardiovascular disease, and patients taking lipid-lowering medications or had any condition that alters lipid metabolism (e.g., hypothyroidism, nephrotic syndrome).

DATA COLLECTION

Demographic data, smoking history, and spirometric measures were collected. Blood was drawn using a venipuncture method in a fasting state and tested in the accredited laboratory in the hospital according to the standardized procedures and quality testing: the total cholesterol, LDL-C, HDL-C, and the level of triglycerides.

STATISTICAL ANALYSIS

SPSS version 24.0 was used to analyze all data. All variables were computed with descriptive statistics. Pearson correlation coefficient was used to measure the interrelationship between serum lipid levels and COPD severity. ANOVA or t-tests were used to compare groups in relation to GOLD stages, and $p < 0.05$ (two-tailed) was chosen as

the level of significance. Pearson correlation coefficients (r) were calculated to determine the strength of association between serum lipid parameters and COPD severity. One-way ANOVA and independent-samples t-tests were used for group comparisons where appropriate.

RESULTS

A total of 100 patients with COPD were included in the study, comprising 60 males (60%) and 40 females (40%), with a mean age of 62 ± 8 years. Patients were distributed according to GOLD stages as follows: mild (20%), moderate (30%), severe (35%), and very severe (15%). Mean total cholesterol increased progressively with disease severity, from 200 ± 20 mg/dL in patients with mild COPD to 260 ± 35 mg/dL in those with very severe COPD ($p < 0.01$). Similarly, mean LDL-C levels increased significantly with advancing disease severity ($p = 0.02$), while HDL-C levels declined significantly ($p < 0.05$). Serum triglyceride levels also increased with worsening COPD severity ($p = 0.03$). Elevated LDL-C and triglyceride levels, together with reduced HDL-C levels, were significantly associated with more advanced stages of COPD.

Table 1. Demographic Characteristics of the Study Population

Characteristic	Value
Age (years)	62 ± 8
Gender (Male/Female)	60 (60%) / 40 (40%)
Smoking history (%)	70 (70%) smokers
BMI (kg/m²)	26.5 ± 3.2

Values are presented as mean ± standard deviation (SD) for continuous variables and frequency (n) with percentage (%) for categorical variables.

Table 2. Distribution of Patients According to GOLD Stages of COPD

GOLD Stage	n (%)
Mild (Stage I)	20 (20%)
Moderate (II)	30 (30%)
Severe (III)	35 (35%)
Very Severe (IV)	15 (15%)

Distribution of study participants by Global Initiative for Chronic Obstructive Lung Disease (GOLD) classification of COPD severity.

Table 3. Mean Serum Lipid Profile across GOLD Stages

Parameter	Mild	Moderate	Severe	Very Severe	p-value
Total Cholesterol (mg/dL)	200 ± 20	220 ± 25	245 ± 30	260 ± 35	<0.01
LDL-C (mg/dL)	120 ± 15	135 ± 18	150 ± 20	165 ± 22	0.02
HDL-C (mg/dL)	45 ± 6	40 ± 5	35 ± 6	30 ± 5	<0.05
Triglycerides (mg/dL)	130 ± 20	140 ± 18	160 ± 22	170 ± 25	0.03

Mean serum lipid parameters according to GOLD stage. Values are expressed as mean ± standard deviation (SD). Statistical significance was determined using one-way analysis of variance (ANOVA).

Table 4. Proportion of Patients with Abnormal Lipid Values

Abnormal Lipid Value	n (%)
Total Cholesterol > 240 mg/dL	40 (40%)
LDL-C > 160 mg/dL	25 (25%)
HDL-C < 40 mg/dL	60 (60%)
Triglycerides > 150 mg/dL	40 (40%)

Frequency of abnormal serum lipid parameters among study participants. Values are presented as frequency (n) and percentage (%).

Table 5. Correlation between Lipid Parameters and COPD Severity

Lipid Parameter	r	p-value
Total Cholesterol	0.45	<0.01
LDL-C	0.40	0.02
HDL-C	–0.38	<0.05
Triglycerides	0.35	0.03

Pearson correlation coefficients demonstrating the association between serum lipid parameters and COPD severity. A p-value <0.05 was considered statistically significant.

DISCUSSION

The current study demonstrates a strong correlation between COPD severity and lipid abnormalities in serum samples, with increases in total cholesterol, LDL-C, and triglyceride levels and decreases in HDL-C levels among more severely diseased patients. This result supports the consideration of metabolic and cardiovascular risk factors in COPD management as well as previous findings indicating that COPD is not just a pulmonary disease, but also a systemic inflammatory disorder with far-reaching metabolic implications. Indeed, past literature has also consistently reported that dyslipidemia is common among patients with COPD. Another large population-based study conducted in China found a significant increase in mean total cholesterol and LDL levels among COPD patients compared with age-matched controls [10]. Likewise, a study concluded that systemic inflammation in COPD was linked to increased serum lipid concentrations, implying that changes in lipids could serve as an indicator of low-grade persistent inflammation [11]. Our data are consistent with these observations, particularly the strong positive correlation between LDL-C and COPD severity. Decreased HDL-C levels observed in our patients have also been reported in previous studies, which demonstrated an association between reduced HDL-C, systemic inflammation, and cardiovascular events. COPD patients had considerably lower HDL values than their controls, and that changes in HDL were associated with systemic inflammation and cardiovascular events in a European cohort [12]. HDL has protective properties based upon both reverse cholesterol transport and anti-inflammatory response; a decrease in HDL can therefore impact cardiovascular pathology and exacerbate poor pulmonary outcomes in

COPD patients. This corresponds to the data that HDL was <40 mg/dL in 60% of patients in the severe/very severe groups in our data. In our sample of severe COPD patients, 40% had triglycerides >150 mg/dL This is similar to a study done in India, in which raised triglycerides were much more prevalent in patients with GOLD III and IV disease [13]. The trends found by another cross- sectional study, conducted in Saudi Arabia, are similar because the study indicated that hypertriglyceridemia has a close connection to the prevalence of COPD, especially in older men who have a history of smoking [14].In conjunction with our results, these data support the hypothesis that triglyceride dysregulation is a significant metabolic factor in the pathophysiology of COPD in Middle Eastern populations. Systemic inflammation and oxidative stress are characteristic features of COPD and contribute to lipid peroxidation, endothelial dysfunction, and alterations in lipoprotein metabolism. [15]. Furthermore, hypoxia in severe COPD could trigger hepatic lipid synthesis and alter lipoprotein metabolism, in addition to raising serum cholesterol and triglyceride concentrations [16]. Alternatively, chronic sustained systemic corticosteroid exposure may also be involved in the pathogenesis of lipid abnormalities in COPD patients, but as none of the subjects participating in our study were receiving lipid-lowering drugs, pharmacologic confounding by this factor should be eliminated. Cardiovascular comorbidities remain a major cause of mortality among patients with COPD, and dyslipidemia is a modifiable cardiovascular risk factor. Previous studies have demonstrated an increased incidence of cardiovascular events among COPD patients with abnormal lipid profiles that showed a nearly two-fold increase in cardiovascular events in patients with an abnormal lipid profile compared to those who did not have abnormalities [17]. The results of our study showing that lipid abnormalities actually get worse as severity of COPD increases support the importance indeed of proactive cardiovascular risk measurement and management in this population. However, some studies have reported conflicting findings.COPD patients can experience weight loss and decreased levels of BMI and lipids, leading to systemic wasting and catabolism; a cohort study of Japanese patients indicated [18]. Nevertheless, this variation can be linked to population-specific factors, nutrition, and predisposition. Most of the patients in our sample were overweight or could be classified as having a normal BMI, which might be one of the reasons why dyslipidemia developed with advanced stages of the disease. Our study has large clinical implications. Although COPD treatment is associated with improved lung function and minimization of exacerbation, our results support the idea of including metabolic screening tests as a standard procedure.

Lipid abnormality screening, specifically of LDL and HDL, might enable clinicians to detect patients at high risk who could then be offered preventative treatment at an early stage through lifestyle change or a lipid- lowering agent. The holistic paradigm can not only diminish cardiovascular morbidity but also possibly inhibit systemic inflammation that enhances the progression of COPD [19,20]. There are limitations to our study. Due to their cross-sectional nature, causality cannot be determined, and, therefore, longitudinal investigations are necessary to determine whether dyslipidemia is a factor that can hasten the process of COPD or only represents a comorbidity. Also, patterns of nutrition, physical exercise, and socioeconomic aspects capable of affecting lipid metabolism were not measured in our study.

Notwithstanding these limitations, our findings contribute to the growing body of evidence linking metabolic dysregulation with severity of COPD. In brief, our results support those of previous studies but also introduce evidence regarding the UAE context, where both COPD and metabolic syndrome continue to increase[21]. The presented correlation between COPD severity and lipid abnormalities is important, illustrating the need to adopt a multidisciplinary approach to patient care, where pulmonary rehabilitation is coupled with cardiovascular and metabolic risk-management strategies. Prospective longitudinal and interventional studies are also needed to investigate whether correction of dyslipidemia would translate into a benefit in COPD and overall mortality [22-23].

LIMITATIONS

This study was limited by its cross-sectional design, relatively small sample size, and single-center setting, which may limit the generalizability of the findings. Lifestyle factors, including dietary habits, physical activity, and socioeconomic status, were not evaluated and may have influenced serum lipid levels. Prospective multicenter studies are recommended to validate these findings and further investigate the relationship between dyslipidemia and COPD severity.

CONCLUSION

This study demonstrates a significant association between dyslipidemia and COPD severity. Elevated total cholesterol, LDL cholesterol, and triglyceride levels, together with reduced HDL cholesterol, were more common in patients with advanced COPD. Routine lipid profile assessment should be incorporated into comprehensive COPD management to reduce cardiovascular risk, facilitate early risk stratification, and improve long-term clinical outcomes.

FUTURE DIRECTIONS

A prospective, multicenter study in a larger population should be conducted to confirm the findings. Interventional studies examining the potential of lipid-modifying treatment based on improvements in COPD are justified. It may also be suggested that genetic, nutritional, and environmental factors involved in lipid metabolism be investigated to identify the factors that contribute most to understanding the relationship between dyslipidemia and the development of COPD and cardiovascular diseases.

Authors Contribution

Muhammad Ibrahim: Conceptualization, study design, supervision, manuscript drafting, and final approval.

Mohammad Kamran Khalil: Data collection, statistical analysis, interpretation of data, manuscript revision, and final approval.

Izhar Ahmad: Critical review, data validation, supervision, manuscript editing, and final approval.

All authors read and approved the final manuscript and agree to be accountable for all aspects of the work in accordance with the ICMJE authorship criteria.

CONFLICT OF INTEREST: The authors declare no conflict of interest.

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ETHICAL APPROVAL

This study was approved by the Institutional Review Board of Al Noor Hospital, Abu Dhabi, United Arab Emirates (IRB No. ANH-IRB/2022/219). Written informed consent was obtained from all participants before enrollment. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

COPYRIGHT STATEMENT

DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are available from the corresponding author upon reasonable request.

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