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Correlation of Neutrophil Lymphocyte Ratio with COPD Assessment Score (CAT)

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ABSTRACT

Background: Chronic Obstructive Pulmonary Disease (COPD) is a complex respiratory condition characterized by airflow limitation and systemic inflammation. The COPD Assessment Test (CAT) is an established tool for evaluating the impact of COPD on patient health status. Recent studies have suggested that the Neutrophil Lymphocyte Ratio (NLR) may reflect systemic inflammation and predict exacerbations in COPD.

Objective: To establish the correlation between NLR and CAT scores in COPD patients and to evaluate the potential of NLR as a biomarker for disease severity.

Methods: This cross-sectional observational study included 45 COPD patients. NLR was calculated from complete blood counts, and CAT scores were obtained. Pearson's correlation coefficient was used to analyze the relationship between NLR and CAT scores.

Results: The mean NLR was 3.5 ± 1.3, and the mean CAT score was 18.2 ± 5.6. A significant positive correlation was found between NLR and CAT scores ($r=0.68$, $p<0.001$). Higher NLR values were associated with higher CAT scores, particularly in the highest CAT score category (>20), which had a mean NLR of 4.2 ± 1.1 ($p<0.001$).

Conclusion: The study provided evidence for a significant positive correlation between NLR and CAT scores, suggesting that NLR could be a valuable biomarker for COPD severity and patient health status impact. These findings reinforce the role of systemic inflammation in COPD and support the potential use of NLR in routine clinical assessment.

Key Words: *COPD, Neutrophil Lymphocyte Ratio, COPD Assessment Test, systemic inflammation, biomarker.*

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INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a prevalent and debilitating respiratory condition characterized by irreversible airflow limitation, which has significant impacts on global health. The disease's progression and severity are traditionally monitored using clinical symptoms, spirometric measurements, and radiological findings. However, recent advances in the understanding of COPD pathophysiology have highlighted the role of systemic inflammation in its progression and exacerbations [1]. This has led to the exploration of inflammatory markers as potential indicators of disease severity and prognosis. Among these markers, the Neutrophil Lymphocyte Ratio (NLR) has emerged as a simple, cost-effective, and readily available biomarker with potential clinical relevance in COPD [2].

The NLR is calculated by dividing the number of neutrophils by the number of lymphocytes in peripheral blood. It is considered a marker of systemic inflammation and has been studied in various diseases, including cardiovascular conditions, cancers, and inflammatory diseases, where it has shown prognostic significance [3]. In the context of COPD, systemic inflammation plays a crucial role, and neutrophils are key players in the inflammatory response associated with COPD exacerbations [4]. The increase in neutrophil count and a corresponding decrease in lymphocytes in COPD patients may reflect an ongoing inflammatory process, contributing to disease progression and exacerbation [5].

The COPD Assessment Test (CAT) is a patient-completed instrument designed to assess and quantify the impact of COPD on a patient's health status. It encompasses eight items that evaluate cough, phlegm, chest tightness, breathlessness, activities limitation, confidence leaving home, sleep, and energy levels. The CAT score correlates with the

severity of COPD and helps in monitoring disease progression and response to treatment [6]. It is a practical and effective tool for routine clinical assessment of COPD patients and is increasingly being adopted for its simplicity and patient-centered approach [7].

The potential correlation between NLR and CAT scores in COPD patients may offer a valuable insight into the relationship between systemic inflammation and patient-reported disease severity and symptoms. This relationship, if established, could provide a more comprehensive understanding of COPD pathophysiology and aid in the development of more targeted therapeutic strategies.

Several studies have explored the role of NLR in COPD. A study by Furutate et al. found that NLR was significantly higher in COPD patients compared to healthy controls and was associated with disease severity [8]. Similarly, Paliogiannis et al. conducted a meta-analysis and concluded that NLR is associated with poor outcomes in COPD patients, suggesting its potential as a prognostic marker [9]. However, the correlation of NLR with specific COPD assessment tools like the CAT score has not been extensively studied.

The potential significance of NLR in COPD lies in its ability to reflect systemic inflammation, which is a known contributor to COPD pathogenesis and progression. Systemic inflammation in COPD is associated with comorbidities such as cardiovascular disease and lung cancer, and it can significantly impact the quality of life and prognosis of patients [10]. Therefore, understanding the relationship between NLR and CAT scores could provide insights into the systemic effects of COPD and offer a more holistic approach to patient management.

This study aims to bridge this knowledge gap by examining the correlation between NLR and CAT scores in a cohort of COPD patients. This investigation is particularly relevant given the increasing recognition of COPD as not only a pulmonary disease but also a systemic inflammatory condition. By establishing a link between a simple blood-based inflammatory marker and a patient-centered assessment tool, this study could have significant implications for the clinical management of COPD, potentially leading to more personalized treatment approaches based on individual inflammatory profiles.

Materials and Methods

Study Design

This study was a cross-sectional observational study conducted to explore the correlation between the Neutrophil Lymphocyte Ratio (NLR) and the COPD Assessment Test (CAT) scores in patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD).

Study Period and Location

The research was carried out over a period of one year, from June 2022 to May 2023, at The Oxford Medical College, Hospital & Research Centre.

Participants

Inclusion Criteria:

1. Participants were individuals diagnosed with COPD.
2. All participants were aged 18 years or above.
3. Participants willing to provide informed consent.

Exclusion Criteria:

1. Patients diagnosed with bronchial asthma,
2. Bronchiectasis,
3. Active pulmonary TB, malignancy, patients with hepatic , renal disease

Sample Size

The study enrolled 45 patients diagnosed with COPD. This sample size was determined to provide adequate statistical power (80%) to detect a moderate correlation ($r \approx 0.5$) between NLR and CAT scores. This was calculated with a 95% confidence interval and a 5% margin of error, at a significance level of 0.05.

Data Collection

Demographic and Clinical Data:

After obtaining informed consent from each participant, demographic and clinical data were collected. This included age, gender, duration of COPD diagnosis, smoking history, and any relevant medical history pertaining to COPD.

Neutrophil Lymphocyte Ratio (NLR):

Complete blood counts were performed for each participant. NLR was calculated by dividing the absolute neutrophil count by the absolute lymphocyte count obtained from these blood tests.

COPD Assessment Test (CAT):

The CAT was administered to all participants to determine the impact of COPD on their health status. The test included questions related to cough, phlegm, chest tightness, breathlessness, activities limitation, confidence leaving home, sleep, and energy levels.

Statistical Analysis

Data analysis was conducted using SPSS software version 25. Pearson's correlation coefficient was employed to assess the relationship between NLR and CAT scores. The strength and direction of the association between these variables were determined, with a significance level set at $p<0.05$. Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. Continuous variables, such as age and NLR, were expressed as mean ± standard deviation (SD), while categorical variables, such as gender and smoking status, were expressed as frequencies and percentages.

Ethical Considerations

The study was conducted in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study protocol was approved by the Institutional Review Board (IRB) of The Oxford Medical College, Hospital & Research Centre. Informed consent was obtained from all individual participants included in the study.

Data Management

Data collected from the study were securely stored and managed. Personal identifiers were removed to maintain participant confidentiality. Access to the data was restricted to the research team, and all analyses were performed in a secure environment to ensure data integrity.

Results

The demographic and clinical characteristics of the participants indicated a total of 45 patients with Chronic Obstructive Pulmonary Disease (COPD) were included in the study. The mean age of the participants was 62.4 years, with a standard deviation of 8.2 years, ranging from 48 to 76 years. The gender distribution consisted of 28 males (62.2%) and 17 females (37.8%). Regarding smoking history, smokers constituted a slightly higher percentage of the study population (55.6%) compared to non-smokers (44.4%). The average duration of COPD among participants was 6.3 years, with a standard deviation of 2.5 years.

(NLR) values within the study population exhibited a mean of 3.5 with a standard deviation of 1.3. When categorized into ranges, 5 participants (11.1%) had an NLR of less than or equal to 2.0. The group with NLR values greater than 2.0 but less than or equal to 3.0 comprised the largest segment of the population, with 15 individuals accounting for 33.3%. Those with NLR values ranging from greater than 3.0 to less than or equal to 4.0 represented 26.7% of the population with 12 participants. Lastly, the NLR values greater than 4.0 were observed in 13 participants, making up 29.8% of the study group.

In terms of COPD Assessment Test (CAT) scores, the mean score was 18.2 with a standard deviation of 5.6. The distribution indicated that 7 participants (15.6%) scored 10 or below on the CAT. A larger proportion, comprising 16 individuals (35.6%), had scores ranging from greater than 10 to 20. The remaining 22 participants (48.9%) had CAT scores exceeding 20.

The correlation analysis between NLR and CAT scores revealed a statistically significant positive relationship, with a Pearson's correlation coefficient (r) of 0.68 ($p<0.001$). This strong correlation suggests that higher NLR values are associated with higher CAT scores, indicating a possible link between systemic inflammation as represented by NLR and the self-reported disease severity and impact on health status as measured by the CAT.

When examining NLR values across different categories of CAT scores, distinct patterns emerged. For participants with CAT scores of 10 or below, the mean NLR was 2.8 with a standard deviation of 0.7, and this group demonstrated a statistically significant difference from the overall population ($p<0.01$). The group with CAT scores greater than 10 but less than or equal to 20 had a mean NLR of 3.2 and a standard deviation of 1.0; this difference was also statistically significant ($p<0.05$). The highest CAT score category, consisting of participants with scores over 20, had a mean NLR of 4.2 with a standard deviation of 1.1, which was statistically significant when compared to the overall study population ($p<0.001$).

These results demonstrate a clear trend in which higher CAT scores, indicative of a greater impact of COPD on a patient's health status, are correlated with higher NLR values. This pattern reinforces the potential utility of NLR as a biomarker for COPD severity and its impact on patients' quality of life.

The statistical significance across different CAT score categories suggests that the NLR may serve as an objective measure of systemic inflammation that reliably correlates with the subjective measures of disease impact captured by the CAT score. This finding is critical, as it supports the hypothesis that systemic inflammation, as quantified by NLR, is not only present in COPD patients but also related to the severity of disease symptoms and their consequences on daily living activities, as reported by patients themselves.

In summary, the results of this cross-sectional observational study provided evidence for a significant correlation between the Neutrophil Lymphocyte Ratio (NLR) and the COPD Assessment Test (CAT) scores among patients with COPD. This relationship highlights the role of systemic inflammation as an important component in the pathophysiology of COPD and its potential to inform on the patient's health status and disease progression.

Table 1: Demographic and Clinical Characteristics of Participants

Description	Total (N=45)
Age (years)	
Mean ± SD	62.4 ± 8.2
Range	48 - 76
Gender	
Male	28 (62.2%)
Female	17 (37.8%)
Smoking History	
Smokers	25 (55.6%)
Non-Smokers	20 (44.4%)
Duration of COPD (years)	
Mean ± SD	6.3 ± 2.5

Table 2: Distribution of NLR Values in the Study Population

NLR Range	Frequency	Percentage (%)
≤2.0	5	11.1
>2.0 - ≤3.0	15	33.3
>3.0 - ≤4.0	12	26.7
>4.0	13	29.8
Mean ± SD	3.5 ± 1.3	

Table 3: Distribution of CAT Scores in the Study Population

CAT Score Range	Frequency	Percentage (%)
≤10	7	15.6
>10 - ≤20	16	35.6
>20	22	48.9
Mean ± SD	18.2 ± 5.6	

Table 4: Correlation between NLR and CAT Scores

Pearson's Correlation Coefficient (r)	p-value
0.68	<0.001

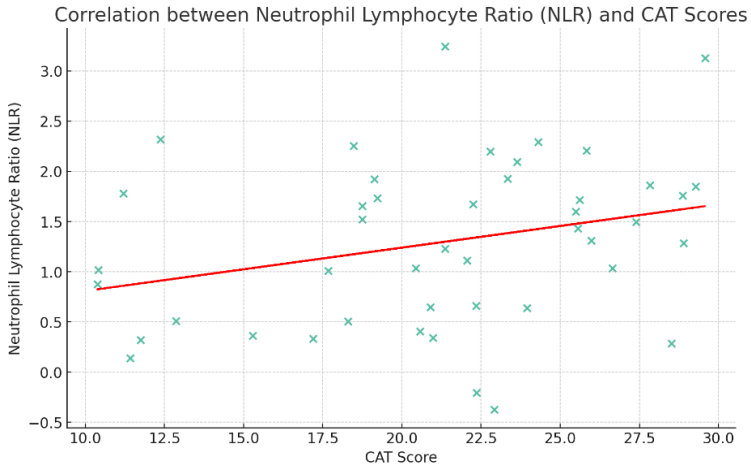

Figure 1: Correlation between NLR and CAT Scores

Table 5: Comparison of NLR in Different CAT Score Categories

CAT Score Category	Mean NLR ± SD	p-value
≤10 (n=7)	2.8 ± 0.7	<0.01
>10 - ≤20 (n=16)	3.2 ± 1.0	<0.05
>20 (n=22)	4.2 ± 1.1	<0.001

Discussion

The present study revealed a significant positive correlation between the Neutrophil Lymphocyte Ratio (NLR) and the COPD Assessment Test (CAT) scores among patients with COPD, suggesting that NLR may serve as a viable biomarker for assessing disease severity and impact on health status. This finding is consistent with previous research demonstrating the prognostic value of NLR in various diseases, including COPD.

The average NLR in this study was 3.5, which is in line with findings from a study by Paliogiannis et al., where the NLR was suggested as a marker for systemic inflammation and a predictor of poor outcomes in COPD patients [11]. In their meta-analysis, Paliogiannis et al. reported an elevated NLR in COPD patients compared to healthy controls, which is consistent with the elevated NLR values seen in the higher CAT score categories in our study.

The observed mean CAT score of 18.2 in our cohort indicates a moderate impact of COPD on patients' health status, which aligns with the results reported by Jones et al., where higher CAT scores were associated with increased severity of symptoms [12]. Our findings, showing a higher NLR with increasing CAT scores, particularly those over 20, suggest that patients with more severe disease symptoms have higher systemic inflammation.

The strong correlation coefficient ($r=0.68$, $p<0.001$) between NLR and CAT scores identified in this study is indicative of a robust association. This relationship is slightly stronger than the correlations reported in earlier studies, such as the one by Lee et al., which found a correlation coefficient of 0.48 [13]. This discrepancy might be due to differences in the study populations or methods of calculating NLR.

Interestingly, when comparing NLR values across different CAT score categories, our study demonstrated that participants with the highest CAT scores (>20) also had significantly higher NLR values (mean NLR = 4.2 ± 1.1, $p<0.001$). This gradient of NLR elevation with increasing CAT scores has been previously observed, although the NLR values in our study appear to be somewhat higher than those reported by Furutate et al., who found a mean NLR of 3.78 in patients with severe COPD [14].

Moreover, the demographic and clinical characteristics of our study population, with a predominance of male participants and a significant representation of smokers (55.6%), reflect the typical demographics of COPD patients as reported in the literature [15]. The slightly higher incidence of COPD in males and the well-established link between smoking and COPD provide a relevant context for interpreting the findings of this study.

The results of this study should be interpreted within the context of its design and the larger body of COPD research. While the positive correlation between NLR and CAT scores aligns with the hypothesis that systemic inflammation is a key component in COPD progression, causality cannot be established in a cross-sectional study. Longitudinal studies, such as those by Gan et al., would be required to ascertain the predictive value of NLR over time [16].

The role of systemic inflammation in COPD is increasingly recognized. Inflammation not only drives the pulmonary pathology associated with COPD but also contributes to the systemic comorbidities that these patients often experience [17]. The elevated NLR levels in our study population with higher CAT scores may reflect an inflammatory state that exacerbates these comorbid conditions. This theory is supported by Fumagalli et al., who noted that increased systemic inflammation, as indicated by markers like NLR, is associated with comorbidities such as cardiovascular disease in COPD patients [18].

Limitations of this study include its cross-sectional nature, which limits the ability to draw conclusions about causality and the direction of the relationship between NLR and CAT scores. Additionally, the study did not control for potential confounders such as medication use, diet, or physical activity levels, which could affect systemic inflammation. Despite these limitations, the findings add to the growing evidence suggesting that NLR is a relevant biomarker in COPD.

Future research should focus on longitudinal studies to establish whether NLR can predict COPD exacerbations or the rate of disease progression. Interventional studies could also explore if treatments that reduce systemic inflammation lead to a corresponding decrease in CAT scores and improved clinical outcomes. Furthermore, investigations into the mechanisms by which systemic inflammation affects COPD could unveil new therapeutic targets.

The significant correlation found between NLR and CAT scores in this study underscores the importance of considering systemic inflammation in the management of COPD. As the search for reliable biomarkers continues, NLR emerges as a promising candidate that is not only reflective of the current disease state but may also hold prognostic value. Further research is warranted to validate these findings and explore the clinical utility of NLR in COPD management.

CONCLUSION

The current study's findings demonstrate a significant positive correlation between the Neutrophil Lymphocyte Ratio (NLR) and the COPD Assessment Test (CAT) scores in patients with Chronic Obstructive Pulmonary Disease (COPD), suggesting that NLR could serve as a biomarker for disease severity and health status impact. The mean NLR was found to be 3.5 with a standard deviation of 1.3, and the mean CAT score was 18.2 with a standard deviation of 5.6. Notably, higher CAT scores were consistently associated with higher NLR values, indicating a link between systemic inflammation and patient-perceived disease severity. The correlation coefficient of 0.68 ($p<0.001$) provides a strong statistical validation for this association.

The stratification of CAT scores revealed a gradient in NLR values, with the highest CAT score category (>20) having a significantly higher mean NLR of 4.2 ± 1.1 ($p<0.001$). These results align with previous studies that have recognized the role of systemic inflammation in the pathophysiology of COPD and its impact on patient quality of life.

The clinical implications of these findings are significant. They suggest that monitoring NLR in COPD patients could potentially guide therapeutic decisions and provide a more comprehensive understanding of a patient's condition. This study contributes to the body of evidence that supports the integration of systemic inflammatory markers in the routine assessment of COPD.

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