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Research Article

A Study on Neutrophil Lymphocyte Ratio and C - reactive protein Levels in Acute Exacerbation of Chronic Obstructive Pulmonary Disease and Its Correlation with Clinical Outcome

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ABSTRACT

Background: Acute exacerbation of chronic obstructive pulmonary disease (AECOPD) is a major cause of hospitalization and mortality among patients with COPD. Identifying simple and readily available biomarkers that predict disease severity and clinical outcomes is essential for improving patient management. This study evaluated the roles of the neutrophil-to-lymphocyte ratio (NLR) and C-reactive protein (CRP) in patients admitted with AECOPD and assessed their associations with clinical outcomes.

Methods: A hospital-based prospective observational study was conducted among 60 patients aged 40–70 years admitted with AECOPD to the Department of General Medicine and MICU at PESIMSR Hospital, Kuppam, between April 2024 and October 2025. Demographic, clinical, and laboratory data including complete blood count and CRP levels were collected. NLR was calculated from differential leukocyte counts. Associations of NLR and CRP with disease severity, ICU admission, ventilator requirement, duration of hospital stay, and mortality were analyzed.

Results: The mean NLR and CRP levels were 5.44 ± 1.37 and 40.5 ± 15.5 mg/L, respectively. Neither NLR nor CRP showed a significant association with AECOPD severity, ICU admission, or duration of hospital stay. Elevated CRP levels were significantly associated with ventilator requirement ($p < 0.001$). NLR was significantly higher among non-survivors compared with survivors (6.11 ± 3.38 vs. 5.42 ± 1.32; $p = 0.016$). High NLR was also significantly associated with ventilator support, ICU admission, and prolonged hospitalization.

Conclusion: NLR appears to be a simple, inexpensive, and useful prognostic marker for adverse outcomes in AECOPD, while CRP may help identify patients at risk of requiring ventilatory support.

Keywords: Acute Exacerbation Of Chronic Obstructive Pulmonary Disease, Neutrophil-To-Lymphocyte Ratio, C-Reactive Protein, Inflammation, Prognosis, Intensive Care Unit, Mortality.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a common chronic airway inflammatorydisease characterizedby persistent respiratory symptoms and airflow limitation.[1] COPD was associated, worldwide, with high morbidity and mortality. In India, the overall prevalence of COPD was 6.5 to 7.7% in residents based on a cross-sectional survey.[2] COPD was the third maincauseof mortality in

2011.[3] Acuteexacerbation of COPD(AECOPD) is associated with an acute worsening of respiratory symptoms that result in additional therapy. AECOPD has an independent and significant negative influence on the prognosis of patients with COPD, it increases the frequency of further severe exacerbations, reduces health status and physical activity, speeds the decline of lung function, increases mortality, and places great economic burden on patients – with both high direct and in-direct medical costs.[4-6] AECOPD is one of the leading causes of hospitalization, and contributes significantly to mortality among patients with COPD.[7] Considering the important role of AECOPD in the prognosis of patients with COPD, early and accurate individual mortality risk assessment during exacerbation is of critical importance for clinical management, and is helpful for optimal allocation of limited medical resources. Clinicians are seeking clinically meaningful predictors of mortality following AECOPD admission, especially for biomarkers which can be easily obtained upon admission.[8]

Inflammation in COPD may be contributed to many cell types such as the macrophages, the neutrophils and the lym phocytes.[9] Neutrophils Contribute significantly to inflammatory condi tions more than macrophages. Neutrophils are an important source of proteases, especially reactive oxygen species and neutrophil elastase. They are the hallmark of acute inflamma tion.[10] Unlike other inflammatory biomarkers e.g., ESR and CRP, the Neutrophil–lymphocyte ratio (NLR) is derived from rou tine complete blood count (CBC) tests. It does not need a spe cial request. It is also a rapid, easy method, and cost-effective. Many studies have reported an increase of NLR during the inflammatory conditions in different diseases such as pancre atitis, inflammatory bowel diseases, and acute coronary syn drome.[11]

COPD is a multi-component systemic disease with elevated serum C-reactive protein (CRP) levels in stable conditions and during exacerbations. It is among the most extensively studied biomarkers, evaluated across various clinical settings in COPD patients to determine its potential association with baseline systemic inflammation during the stable phase, cardiovascular risk, disease prognosis, and the identification of infectious exacerbations. Systemic inflammation and raised levels of CRP were correlatedwith diminished lung function, decreased stamina to exercise, and poor QOL of COPD patients.[12] They also reflect disease severity, outcome, hospitalization &mortality in patients with chronicrespiratory failure. Upregulated levelsof CRP signal cardiovascular risk inCOPDpatients &can be treated with corticosteroids, statins, and exercise.[13] Serum CRP levels in COPD patients can predict exacerbations and may help guide therapeutic interventions, particularly in those at increased risk of mortality.

Aims and Objectives: To study neutrophil lymphocyte ratio & CRP levels in AECOPD and to correlate neutrophil lymphocyte ratio,C reactive protein with clinical outcome in acute exacerbation of chronic obstructive pulmonary disease.

MATERIAL METHODS

Study Design and Setting

A hospital-based prospective observational study was conducted in the Department of General Medicine and Medical Intensive Care Unit (MICU) of PES Institute of Medical Sciences and Research (PESIMSR) Hospital, Kuppam, Andhra Pradesh, India, from April 2024 to October 2025.

Study Population and Sample Size

The study included patients aged 40–70 years admitted with acute exacerbation of chronic obstructive pulmonary disease (AECOPD) to the emergency department, medical wards, or MICU. A total of 60 patients were enrolled using purposive sampling. The sample size was determined with reference to the study conducted by Sharma et al.

Inclusion Criteria

- Patients aged 40–70 years with clinically suspected or previously documented COPD presenting with acute exacerbation and requiring hospital admission.
- Patients who provided written informed consent. In critically ill patients unable to provide written consent, implied consent from legally authorized representatives was considered.

Exclusion Criteria

- Patients with malignancy or active pulmonary tuberculosis.
- Patients in a moribund condition.
- Pregnant or lactating women.

The sample size was calculated using the single population proportion formula based on the prevalence reported by Sharma et al.[14] Assuming an expected prevalence of 80.6%, a 95% confidence level (Z = 1.96), and an absolute precision of 10%, the required sample size was estimated using the following formula:

$n = \frac{Z^2_{1-\alpha/2} \times p(1-p)}{d^2}$. where n is the required sample size, Z is the standard normal deviate corresponding to a 95% confidence interval (1.96), p is the expected prevalence (0.806), and d is the absolute precision (0.10). The calculated sample size was 60. Therefore, a total of 60 patients with acute exacerbation of chronic obstructive pulmonary disease (AECOPD) were included in the study.

Data Collection

Following approval from the Institutional Ethics Committee, eligible participants were recruited after obtaining informed consent. A structured proforma was used to collect demographic, clinical, laboratory, treatment, and outcome-related information.

Demographic Variables

Information collected included age, sex, place of residence, occupation, and socioeconomic status.

Clinical Variables

The following clinical parameters were recorded at admission: Body temperature, Heart rate, Respiratory rate, Blood pressure, Suspected source of infection, Presence of comorbidities, Antibiotic therapy administered, Requirement for non-invasive ventilation (NIV), Requirement for invasive mechanical ventilation (IMV)

Disease severity was assessed using the Global Initiative for Chronic Obstructive Lung Disease (GOLD) ABE assessment after stabilization of acute symptoms.

Laboratory Investigations

The following investigations were performed as part of routine clinical care: Complete blood count (CBC), High-sensitivity C-reactive protein (hs-CRP), Chest radiograph (posteroanterior or anteroposterior view), Pulmonary function test (performed after clinical stabilization whenever feasible)

Estimation of High-Sensitivity C-Reactive Protein (hs-CRP)

Serum hs-CRP levels were measured using a high-sensitivity immunoturbidimetric assay. The assay is based on an antigen–antibody reaction between CRP present in the serum sample and specific anti-CRP antibodies, resulting in the formation of immune complexes. The degree of turbidity produced is directly proportional to the concentration of CRP and is measured photometrically. The method is capable of detecting CRP concentrations in the range of 0.1–10 mg/L. Serum samples collected within the first 24 hours of hospital admission were analyzed according to the manufacturer's instructions and standard laboratory protocols.

Estimation of Complete Blood Count (CBC)

Complete blood count parameters were measured using an automated hematology analyzer based on the electrical impedance principle (Coulter principle) and/or flow cytometry technology. The analyzer provided measurements of hemoglobin concentration, total leukocyte count, differential leukocyte count, red blood cell count, platelet count, hematocrit, and red cell indices. Venous blood samples collected in EDTA anticoagulated tubes within the first 24 hours of admission were processed according to standard laboratory procedures.

Patient Management and Follow-up

All patients received standard treatment for AECOPD according to institutional protocols, including bronchodilators, corticosteroids, mucolytics, antibiotics, oxygen therapy, non-invasive ventilation, and invasive mechanical ventilation when indicated. Patients were followed throughout their hospital stay until discharge or death.

Outcome Measures

The primary outcome measures included: Duration of hospital stay. Requirement for ventilatory support (NIV/IMV), In-hospital mortality, Clinical outcome at discharge

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 23.0 (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as frequencies and percentages. Continuous variables were summarized as mean ± standard deviation (SD) or median with interquartile range (IQR), as appropriate. Student's t-test was used to compare means between groups for normally distributed continuous variables. Chi-square test or Fisher's exact test was used for categorical variables. Pearson's or Spearman's correlation analysis was performed to assess associations between continuous variables, depending on data distribution. A p-value <0.05 was considered statistically significant

RESULTS

Table 1: Distribution of Sociodemographic, Smoking and Other Clinical Factors

Variable	Frequency (N=60)	Percentage

Age GROUP	40-50 51-60 61-70	15 12 33	25 20 55
Gender	Female Male	12 48	20 80
Smoking STATUS	Non SMOKER Smoker	15 45	25 75
Disease SEVERITY	Mild Moderate Sever	8 18 34	13.3 30 56.7
Icu ADMISSION	Yes No	26 34	43.3 56.4
Ventilator SUPPORT	Required Not REQUIRED	10 50	16.6 83.4
Outcome	Survived Died	58 2	96.7 3.3

The age distribution among the study participants are majority 55% of them belong to 61-70 years age group followed by 25% of them belong to 40-50 years of age group,20% of them belong to the age group of 51-60 years. Majority 80% of them are males. The disease severity among the study participants, majority 56.7% of them belong to severe, 30% of them belong to moderate, 13.3% of them belong to mild. ICU admission among the study participants, majority 56.4% of the participants doesn't require ICU admission and 43.3 % of them require ICU admission. The need for ventilator support among the study participants are only 16.6% of them. The outcome after the acute exacerbation of COPD among the study participants are 58 out of 60 study participants i.e. 96.7% of them are survived and 2 out of 60 i.e. 3.3% of them are died

Table 2: Mean Distribution of COPD, Hospital Stay and Investigations

Variable	Mean	SD
Duration Of COPD	7.36	2.30
Neutrophil_Count_X10^9_L	8.6	1.4
Lymphocyte Count _X10^9_L	1.65	0.33
Neutrophil Lymphocyte Ratio	5.44	1.37
CRP (Mg/L)	40.5	15.5
Hospital Stay In Days	6.9	2.0

The mean duration of COPD among the study participants 7.36 years with SD of 2.3 years. The mean neutrophil count among the study participants are 8.6 x10^9_L with SD of 1.4x10^9_L. The neutrophil lymphocyte ratio among the study participants with mean and SD of 5.44 and 1.37. The CRP among the study participants with mean 40.5 mg/dl and SD of 15.5 mg/dl. The mean hospital stay in days among the study participants are 6.9 days with SD of 2 days.

Table 3: NLR and CRP Distribution as Per Severity of AECOPD

Severity Of AECOPD		Mean	SD	P Value
Neutrophil–Lymphocyte Ratio	Mild	6.19	1.58	0.16
	Moderate	5.58	1.40	
	Severe	5.20	1.27	
C-Reactive Protein	Mild	31.5	14.4	0.19
	Moderate	40.5	13.8	
	Severe	42.6	16.1	

The comparison of NLR according to severity of AECOPD, in the mild group mean and SD of NLR is 6.19 and 1.58, in the moderate group mean and SD of NLR is 5.58 and 1.4, in the severe

group mean and SD of NLR is 5.2 and 1.27. The comparison of NLR with severity of AECOPD is not statistically significant. The comparison of CRP according to severity of AECOPD, in the mild group mean and SD of CRP is 31.5 and 14.4 mg/dl , in the moderate group mean and SD of CRP is 40.5 and 13.8 mg/dl, in the severe group mean and SD of CRP is 42.6 and 16.1 mg/dl. The comparison of CRP with severity of AECOPD is not statistically significant.

Table 4: Comparison of Neutrophil Count, NLR and CRP with ICU Admission

Variable	ICU Admission		P Value
	Yes Mean (SD)	No Mean (SD)	
Neutrophil Count	8.6 (1.13)	8.6 (1.16)	0.68
Lymphocyte Count	1.62 (0.34)	1.66 (0.34)	0.98
Neutrophil–Lymphocyte Ratio	5.52 (1.37)	5.39 (1.39)	0.94
CPR	45.34 (15.74)	36.79 (14.42)	0.57

The association between NLCt with ICU admission among the study participants, the mean and SD of neutrophil count with ICU admitted study participants are 8.6 and 1.13 $x10^9$_L and the mean and SD of lymphocyte count with ICU admitted study participants are 1.62 and 0.34 $x10^9$_L. The association between NLCt with ICU admission is not statistically significant**.** The association between NLR and CRP with ICU admission among the study participants, the mean and SD of NLR with ICU admitted study participants are 5.52 and 1.37 and the mean and SD of CRP with ICU admitted study participants are 45.34 and 15.74 mg/dl. The association between NLR and CRP with ICU admission is not statistically significant**.**

Table 5: Comparison of Neutrophil Count, NLR and CRP with Ventilator Support

Variable	Ventilator Required		P Value
	Yes Mean (SD)	No Mean (SD)	
Neutrophil Count	8.6 (1.19)	8.6 (1.14)	1.00
Lymphocyte Count	1.5 (0.31)	1.68 (0.33)	1.00
Neutrophil–Lymphocyte Ratio	5.97 (1.51)	5.34 (1.33)	0.62
CPR	36 (0)	41.4 (16.8)	<0.001

The association between NLC with Ventilator requirement among the study participants, the mean and SD of neutrophil count with required ventilator among study participants are 8.6 and 1.19 $x10^9$_L and the mean and SD of lymphocyte count with ICU admitted study participants are 1.5 and 0.31 $x10^9$_L. The association between NLC with Ventilator requirement is not statistically significant**.** The association between NLR and CRP with Ventilator requirement among the study participants, the mean and SD of NLR with required ventilator among study participants are 5.97 and 1.51 and the mean and SD of CRP with ICU admitted study participants are 36.3 and 11.1 mg/dl. The association between NLR with Ventilator requirement is not statistically significant and CRP with Ventilator requirement is statistically significant

Table 6: Correlation of Neutrophil–Lymphocyte Ratio with Duration of Hospital Stay

Variables	Mean	SD	Pearson Correlation R, P Value
Neutrophil–Lymphocyte Ratio	5.44	1.37	-0.36, 0.78
Duration Of Hospital Stay	6.9	2.0	

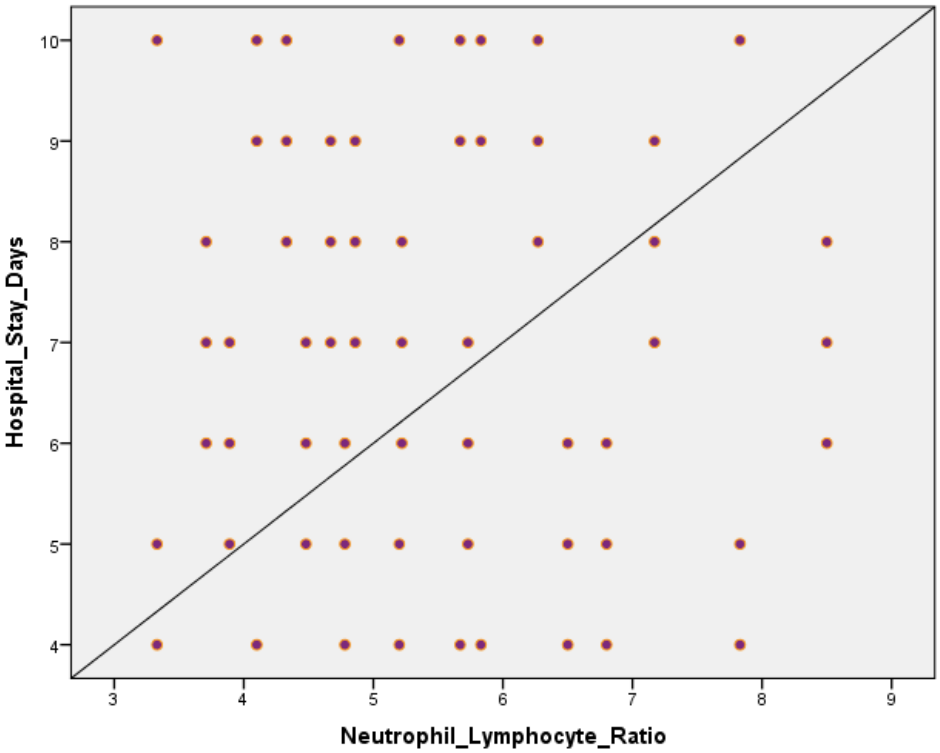

Figure 1: Correlation of Neutrophil–Lymphocyte Ratio with Duration of Hospital Stay

The correlation between hospital stay in days and neutrophil lymphocyte ratio, the mean and SD of NLR among the study participants is 5.44 and 1.37, the hospital stay in days among the study participants are 6.9 and 2.0, it is negatively correlated with r=-0.36 with p value 0.78**.**

Table 7: Correlation of C - reactive protein With Duration of Hospital Stay

Variables	Mean	SD	Pearson Correlation R, P Value
C-Reactive Protein	40.5	15.5	0.34, 0.79
Duration Of Hospital Stay	6.9	2.0	

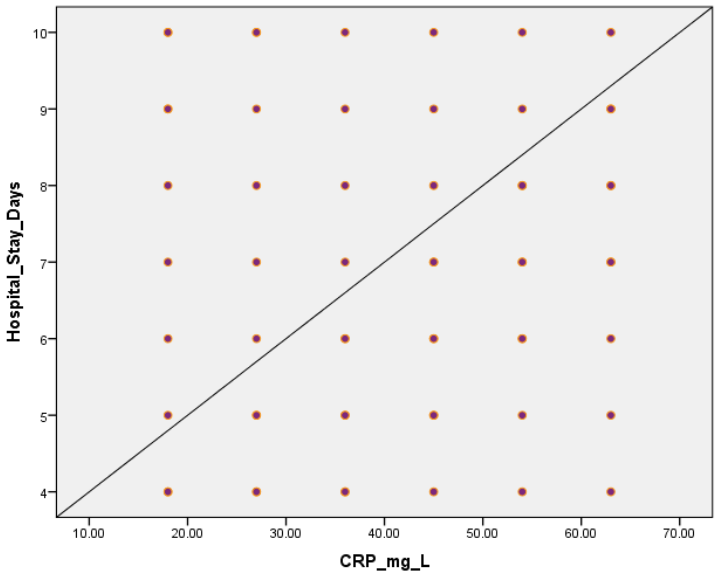

Figure 2: Correlation of C - reactive protein With Duration of Hospital Stay

The correlation between hospital stay in days and CRP, the mean and SD of CRP among the study participants is 40.5 and 15.5, the hospital stay in days among the study participants are 6.9 and 2.0, it is positively correlated with r=0.34 with p value 0.79**.**

Table 8: Comparison of Neutrophil Count, NLR and CRP with Outcome

Variable	Outcome		P Value
	Survivors Mean (SD)	Non Survivors Mean (SD)	
Mean Hospital Stay	6.9 (2.03)	7.0 (1.41)	0.321
C-Reactive Protein Levels	40.1 (15.47)	49.5 (19.09)	1.000
Neutrophil–Lymphocyte Ratio	5.42 (1.32)	6.11 (3.38)	0.016

The comparison of NLR among the outcome of the study participants the mean and SD of NLR among survivors are 5.42 and 1.32 and the mean and SD of NLR among non survivors are 6.11 and 3.38 the comparison between them are statistically significant. The comparison of CRP among the outcome of the study participants the mean and SD of CRP among survivors are 40.1 and 15.47 and the mean and SD of CRP among non survivors are 49.5 and 19.09 the comparison between them are not significant statistically. The comparison of hospital stay among the outcome of the study participants the mean and SD of hospital stay among survivors are 6.9 and 2.03 days and the mean and SD of hospital stay among non survivors are 7.0 and 1.41 days the comparison between them are not significant statistically.

Table 9: Association between Ventilator Supports, ICU Admission, Outcome between NLR

Variable		NLR		P Value
		High	Low	
Ventilator Support	Yes	6	2	0.001
	No	4	48	
ICU Admission	Yes	9	15	0.001
	No	1	35	
Outcome	Died	1	1	0.198
	Survived	9	49	

Patients with high NLR were more likely to require ventilator support compared to those with low NLR**.** High NLR patients had higher ICU admission rates**,** suggesting NLR as a marker **of** disease severity.` NLR was not significantly associated with mortality**,** although deaths occurred in both groups.

Table 10: Association between Ventilator Support, ICU Admission, Outcome between CPR

Variable		CPR		P Value
		High	Low	
Ventilator Support	Yes	8	4	0.417
	No	47	1	
ICU Admission	Yes	23	2	0.724
	No	33	2	
Outcome	Died	2	0	0.701
	Survived	54	4	

CRP levels did not predict the need for ventilator support. CRP was not a reliable predictor of ICU admission. CRP levels were not associated with mortality in this study

Table 11: Association between Ventilator Support, ICU Admission, Outcome between Duration of Hospital Stay

Variable	Hospital Stay		P Value
	≤7 Days	>7 Days	

CPR	High Low	32 4	24 0	0.090
NLR	High Low	0 36	10 14	0.001

Although more patients with high CRP had longer stays, this was not statistically significant**.** All patients with high NLR had prolonged hospital stay (>7 days)**,** indicating strong predictive value.

DISCUSSION

COPD is a major cause of morbidity & mortality,&acute exacerbations significantly contribute to disease progression and adverse outcomes. Identification of simple, cost-effective biomarkers whichcan predict severity disease and clinical outcomes during acute exacerbations is of clinical importance. This study was undertaken to evaluate the role of neutrophil–lymphocyte ratio (NLR) and C-reactive protein (CRP) in patients with AECOPD and to assess their correlation with clinical outcomes. The disease severity among the study participants, majority 56.7% of them belong to severe, 30% of them belong to moderate, 13.3% of them belong to mild.

In the study by Maurya KK et al., based on GOLD 2020 classification, the higher proportion of participants were in the moderate stage of COPD (73%), followed by the severe stage (24%) and mild stage (3%).[15] Increased COPD severity correlates with higher mortality, frequent hospitalizations, and significant systemic complications. As airway obstruction worsens—typically measured by GOLD criteria (FEV1%)—patients experience heightened dyspnea, reduced quality of life, and greater susceptibility to comorbidities like cardiovascular disease and muscle dysfunction. Consequently, advanced disease stage increases healthcare costs, complicates treatment algorithms, and necessitates more intensive management, including long-term oxygen or specialized surgical interventions to mitigate progression.

ICU admission among the study participants, majority 56.4% of participants doesn't require ICU care & 43.3 % of them need for intensive care support. In V Rathna Balakrishnan et al study, the mean NLR of participants who were in need for ICU care was significantly higher than patients who are managed in the general ward (8.5 & 4.58 respectively) with AUC 0.67, with p value of 0.002.[16] Hospitalization for a COPD exacerbation is a significant event that adversely affects lung function, long-term survival, and overall quality of life. Stays typically range from 5 to 12 days, with prolonged admissions often linked to advanced age, comorbidities, and higher disease severity. Repeated hospital admissions are associated with accelerated decline in lung function, increased healthcare expenditure, and a higher risk of mortality.

The comparison of NLR according to severity of AECOPD, in the mild group mean and SD of NLR is 6.19 and 1.58, in the moderate group mean and SD of NLR is 5.58 and 1.4, in the severe group mean and SD of NLR is 5.2 and 1.27. The comparison of NLR with severity of AECOPD is not statistically significant. In the Maurya KK et al study, The mean NLR was highest in severe COPD patients [5.46 ± 0.63], followed by moderate [4.28 ± 0.65] & mild COPD patients [3.03 ± 0.12]., a high significant difference Statistically is observed in N/L ratio among COPD population [$P < 0.0001^*$].[15] Gan WQ et al[17] identified the neutrophil-to-lymphocyte ratio (NLR) as an Indicator of inflammation with prognostic clinical relevance in COPD, reflecting systemic inflammation and increased airway permeability. The NLR, derived from the absolute neutrophil and lymphocyte counts, has also been proposed as a simple and cost-effective marker with prognostic and predictive value in various systemic inflammatory conditions, including cardiovascular disease, renal disorders, inflammatory bowel disease, and familial Mediterranean fever.

At the time of that study, limited data were available regarding the association between NLR and COPD severity. The findings of this study suggest that participants with severe COPD exhibit significantly higher NLR values compared to those with moderate and mild disease. Elevated NLR reflects increased neutrophil counts and decreased lymphocyte counts. Activated neutrophils release inflammatory cytokines and proteolytic enzymes—such as matrix metalloproteinases, calprotectin, and elastase—which contribute to lung tissue destruction and the development of emphysema.[18]

In recent yrs, considerable attention has been directed toward the neutrophil-to-lymphocyte ratio (NLR) as an inflammatory biomarker.

Several studies have demonstrated its predictive value in a range of inflammatory conditions, including cardiovascular diseases, renal disorders, and familial Mediterranean fever.[17]

With respect to COPD, a limited number of studies have evaluated the role of NLR. Günay E et al. (2014)[19] conducted a retrospective study comprising 178 participants with stable COPD, 91 patients during acute exacerbations, and 50 healthy controls. The study reported significantly higher NLR values in both COPD groups compared to controls, with even greater elevation during exacerbations. Additionally, a positive correlation between NLR and CRP levels was observed.

In a prospective study comprising 386 participants with mild to severe COPD followed over 10 years, NLR was identified as an independent predictor of increased all-cause mortality.[20] Another retrospective study of 140 stable COPD patients and 50 controls suggested that NLR may serve as a simple, effective, and practical biomarker for the early detection of metabolic syndrome.[21] Furthermore, A retrospective study comprising 100 participants with acute exacerbations of COPD and 50 healthy controls demonstrated that NLR is a reliable indicator of systemic inflammation, comparable to CRP, total leukocyte count, and ESR. [22]

The comparison of CRP according to severity of AECOPD, in the mild group mean and SD of CRP is 31.5 and 14.4 mg/dl, in the moderate group mean and SD of CRP is 40.5 and 13.8 mg/dl, in the severe group mean and SD of CRP is 42.6 and 16.1 mg/dl. The comparison of CRP with severity of AECOPD is not statistically significant. In the study by Maurya KK et al., the mean CRP levels were greater in patients with severe COPD (9.91 ± 0.79), followed by those with moderate (7.70 ± 0.76) and mild COPD (5.77 ± 0.21). This difference in CRP levels across the severity groups was found to be highly significant statistically [P < 0.0001*]. [45] In Manal A. Mahmoud et al study, showed that total WBCs, Neutrophils, and NLR were higher significantly while LC was lower significantly in AECOPD in comparison to stable COPD and control group (P< 0.05 for each). [23]

The association between neutrophil and lymphocyte count with Ventilator requirement among the study participants, the mean and SD of neutrophil count with required ventilator among study participants are 8.6 and 1.19 $x10^9$_L and the mean and SD of lymphocyte count with ICU admitted study participants are 1.5 and 0.31 $x10^9$_L. The association between neutrophil count, lymphocyte count with Ventilator requirement is not statistically significant**.**

In V Rathna Balakrishnan et al study, In the given study population, the mean NLR of patients was highest among the patients who required intubation (23.26) followed by the ones who required non-invasive ventilation (7.88).[16]

The correlation between hospital stay in days and NLR, the mean and SD of NLR among the study participants is 5.44 and 1.37, the hospital stay in days among the study participants are 6.9 and 2.0, it is negatively correlated with r=-0.36 with p value 0.78**.** In Babaoglu, et al study, mean length of hospital stay was 19.5 ± 13.5, and there was not any correlation between NLR & length of hospital stay.[24]

The comparison of NLR among the outcome of the study participants the mean and SD of NLR among survivors are 5.42 and 1.32 and the mean and SD of NLR among non survivors are 6.11 and 3.38 the comparison between them are statistically significant. In V Rathna Balakrishnan et al study, out of 128 patients, 106 improved, 15 died and 7 were transferred out. In the given study population higher NLR was markedly associated with adverse outcome. The average NLR of patients who are discharged was 6.17, those who are transferred out was 8.68. The NLR was highest among the patients who didn't survive (19.71). The area under the curve is 0.86, with p value of <0.00001.[16] Elevated neutrophil-to-lymphocyte ratio (NLR) has been associated with elevated risk of mortality. Xiong et al[25] demonstrated that higher baseline NLR values are linked to a elevated mortality risk in patients with COPD.

The comparison of CRP among outcome of study participants, mean &SD of CRP among survivors are 40.1 and 15.47 and the mean and SD of CRP among non survivors are 49.5 and 19.09 the comparison between them are not statistically significant. In study by Pahuja et al., a correlation between CRP levels and patient prognosis was observed. Among COPD patients, there were 17 deaths, with the majority occurring in individuals with CRP levels >20 mg/L. Of the 14 patients with CRP levels between 20–30 mg/L, 8 (57.14%) died, while the single patient with CRP >30 mg/L also died (100%). In comparison, 6 out of 33 patients (18.18%) with CRP levels between 10–20 mg/L died. The difference in improvement between

the CRP ranges of 0.6–10 mg/L and 10–20 mg/L was not statistically significant.[26]

In the control group (patients with pneumonia), 3 out of 15 patients (20%) died. Among these, 1 study participant had CRP levels between 10–20 mg/L, while two patients had CRP levels >30 mg/L. Higher CRP levels observed in deceased patients indicate more severe systemic inflammation, consistent with findings by Leuzzi G et al,[27] who reported Elevated mortality risk associated with elevated CRP levels.

The comparison of hospital stay among the outcome of study participants the mean and SD of hospital stay among survivors are 6.9 and 2.03 days and the mean and SD of hospital stay among non survivors are 7.0 and 1.41 days the comparison between the marenot statistically significant. In the study by Pahuja et al., a correlation between CRP levels &Necessity for ICU admission was observed in both the study and control groups. Among COPD patients, the majority with CRP levels >10 mg/L required ICU admission. Specifically, 87.87% of patients with CRP levels between 10–20 mg/L and 100% of those with levels between 20–30 mg/L required ICU care, compared to 57.14% in the 0.6–10 mg/L range. [26] In the control group, among 15 patients with pneumonia, 33.33% required ICU admission. Among asthma patients, 10% required ICU care, while all patients with ARDS required ICU management.

The current study demonstrates that neutrophil–lymphocyte ratio &CRP were increased in patients with AECOPD, reflecting the underlying systemic inflammatory response. Although both NLR and CRP were evaluated, neither showed a significant correlation with disease severity, ICU admission, or length of hospitalization, A significant relationship was observed between NLR and mortality, highlighting its value as a prognostic indicator in AECOPD. CRP levels showssignificant association with ventilator requirement, suggesting its usefulness in identifying patients at risk of respiratory compromise. However, there was no significant relationship between CRP levels and patient mortality or hospital stay.In conclusion, NLR may serve as a simple, readily available, and cost-effective prognostic indicator for adverse outcomes in AECOPD, while CRP may aid in assessing the need for ventilatory support. Further large-scale, multicentric studies are required to validate these findings and to establish the routine clinicalapplication of these inflammatory markers in medical management of AECOPD.

Conclusion: NLR appears to be a simple, inexpensive, and useful prognostic marker for adverse outcomes in AECOPD, while CRP may help identify patients at risk of requiring ventilatory support.

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