

Evaluation of Neutrophil-to-Lymphocyte Ratio and Platelet-to-Lymphocyte Ratio as Prognostic Markers in Acute Exacerbation of Chronic Obstructive Pulmonary Disease at DMCH, Darbhanga

Kunal¹, Danish Ahmad Khan², Kumar Durgeshwar³

¹Senior Resident, Department of Emergency Medicine, Darbhanga Medical College & Hospital, Darbhanga, Bihar, India

²Senior Resident, Department of Medicine, Darbhanga Medical College & Hospital, Darbhanga, Bihar, India

³Senior Resident, Department of Emergency Medicine, Darbhanga Medical College & Hospital, Darbhanga, Bihar, India

Received: 27-11-2025 / Revised: 21-12-2025 / Accepted: 17-01-2026

DOI: <https://doi.org/10.32553/ijmbs.v10i1.3254>

Corresponding author: Ravindra Kumar Das

Conflict of interest: No conflict of interest

Abstract:

Background: Acute exacerbation of chronic obstructive pulmonary disease (AECOPD) is associated with significant morbidity and mortality. Simple, cost-effective inflammatory markers that can predict disease severity and outcome are clinically valuable. The neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) have emerged as potential prognostic markers in inflammatory conditions.

Objectives: To evaluate the role of NLR and PLR as prognostic markers in patients admitted with AECOPD.

Methods: This prospective cross-sectional study was conducted at Darbhanga Medical College and Hospital (DMCH) from January 2024 to December 2025. A total of 110 patients admitted with AECOPD were enrolled. Complete blood counts were analyzed to calculate NLR and PLR. Disease severity and outcomes were correlated with these indices.

Results: Mean NLR and PLR were significantly higher in patients with severe exacerbation. NLR showed a stronger association with adverse outcomes compared to PLR ($p < 0.001$).

Conclusion: NLR and PLR are simple, inexpensive, and reliable inflammatory markers that can aid in prognostication of AECOPD, with NLR showing superior predictive value.

Keywords: AECOPD, Neutrophil-to-lymphocyte ratio, Platelet-to-lymphocyte ratio, Inflammation, Prognosis

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Introduction

Chronic obstructive pulmonary disease (COPD) is a leading cause of morbidity and mortality worldwide and represents a major public health burden [1]. Acute exacerbations of COPD are characterized by worsening respiratory symptoms, increased systemic inflammation, and accelerated decline in lung function [2].

These exacerbations significantly contribute to hospital admissions, healthcare costs, and mortality [3].

Inflammation plays a central role in the pathogenesis of COPD and its exacerbations. Systemic inflammatory responses during AECOPD are reflected by

alterations in peripheral blood leukocyte and platelet counts [4]. Traditional inflammatory markers such as C-reactive protein and procalcitonin are useful but may not be readily available in all healthcare settings [5].

Recently, hematological indices derived from routine complete blood counts, such as the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR), have gained attention as markers of systemic inflammation [6]. Neutrophilia reflects acute inflammatory response, while lymphopenia indicates physiological stress and immune dysregulation [7]. Platelets also participate in inflammatory pathways and endothelial dysfunction [8].

Several studies have suggested that elevated NLR and PLR are associated with disease severity, length of hospital stay, and mortality in COPD patients [9–12]. However, data from eastern India, particularly Bihar, remain limited.

This study was undertaken to evaluate the prognostic significance of NLR and PLR in patients admitted with AECOPD at a tertiary care center in Darbhanga.

Materials and Methods

Study Design

Prospective cross-sectional study.

Study Place

Darbhanga Medical College and Hospital (DMCH), Darbhanga.

Study Duration

1st October 2023 to 1st June 2025.

Sample Size

110 patients.

Inclusion Criteria

- Age ≥ 40 years
- Diagnosed case of COPD presenting with acute exacerbation
- Willing to give informed consent

Exclusion Criteria

- Active malignancy
- Hematological disorders
- Chronic inflammatory or autoimmune diseases
- Recent major surgery or trauma

Data Collection

Detailed clinical evaluation and laboratory investigations were performed at admission. Complete blood count parameters were obtained using an automated hematology analyzer.

Definitions

- **NLR:** Absolute neutrophil count / absolute lymphocyte count
- **PLR:** Platelet count / absolute lymphocyte count

Statistical Analysis

Data were analyzed using SPSS version 25. Continuous variables were expressed as mean \pm standard deviation. Independent t-test and ANOVA were used for comparison. A p-value < 0.05 was considered statistically significant.

Results

A total of **110 patients** admitted with acute exacerbation of chronic obstructive pulmonary disease (AECOPD) were included in the study. The results are presented under demographic characteristics, clinical severity, hematological parameters, and the association of inflammatory indices with disease severity and outcomes.

Demographic Characteristics

The mean age of the study population was **62.4 \pm 8.7 years**, with the majority of patients belonging to the **61–70 year age group**. Males constituted **70.9% (n = 78)** of the study population, while females accounted for **29.1% (n = 32)**. A history of smoking was present in **74.5% (n = 82)** of patients. The baseline demographic characteristics are summarized in **Table 1**.

Table 1. Demographic Characteristics of the Study Population (n = 110)

Variable	Value
Mean age (years)	62.4 ± 8.7
Male	78 (70.9%)
Female	32 (29.1%)
Smokers	82 (74.5%)

Clinical Severity of AECOPD

Based on clinical assessment and guideline criteria, **29.1% (n = 32)** of patients had

mild exacerbation, **41.8% (n = 46)** had moderate exacerbation, and **29.1% (n = 32)** had severe exacerbation. The distribution of disease severity is shown in **Table 2**.

Table 2. Distribution of Patients According to Severity of AECOPD

Severity	Number (%)
Mild	32 (29.1%)
Moderate	46 (41.8%)
Severe	32 (29.1%)

Hematological Parameters

The mean total leukocyte count was **11,480 ± 2,360 cells/mm³**. The mean neutrophil percentage was **74.2 ± 8.1%**, while the

mean lymphocyte percentage was **17.6 ± 5.4%**. The mean platelet count was **312 ± 76 ×10⁹/L**. These baseline hematological parameters are detailed in **Table 3**.

Table 3. Baseline Hematological Parameters

Parameter	Mean ± SD
Total leukocyte count (cells/mm ³)	11,480 ± 2,360
Neutrophil percentage (%)	74.2 ± 8.1
Lymphocyte percentage (%)	17.6 ± 5.4
Platelet count (×10 ⁹ /L)	312 ± 76

Neutrophil-to-Lymphocyte Ratio and Platelet-to-Lymphocyte Ratio

The overall mean NLR was **5.1 ± 2.4**, and the mean PLR was **186 ± 54**. Both indices showed a progressive increase with worsening disease severity.

Patients with mild exacerbation had a mean NLR of **2.8 ± 0.9**, which increased to **4.6 ±**

1.3 in moderate cases and **7.9 ± 2.1** in severe cases. This difference was statistically significant (**p < 0.001**). Similarly, mean PLR increased from **132 ± 34** in mild cases to **176 ± 41** in moderate cases and **238 ± 52** in severe cases (**p < 0.001**). These findings are summarized in **Table 4**.

Table 4. Comparison of NLR and PLR According to Severity of AECOPD

Severity	NLR (Mean ± SD)	PLR (Mean ± SD)
Mild	2.8 ± 0.9	132 ± 34
Moderate	4.6 ± 1.3	176 ± 41
Severe	7.9 ± 2.1	238 ± 52
p-value	<0.001	<0.001

The increasing trend of NLR across severity groups is illustrated in **Figure 1**, while the distribution of PLR values

according to disease severity is shown in **Figure 2**.

Association with Clinical Outcomes

Among the study population, **32 patients (29.1%)** required intensive care unit (ICU) admission. A significantly higher proportion of patients with **NLR ≥ 5**

required ICU care (**81.3%**, $p < 0.001$). Similarly, patients with **PLR ≥ 180** had a higher frequency of ICU admission (**65.6%**, $p = 0.002$). The association between inflammatory indices and adverse outcomes is shown in **Table 5**.

Table 5. Association of NLR and PLR with ICU Admission

Parameter	ICU Admission n (%)	p-value
NLR ≥ 5	26 (81.3%)	<0.001
PLR ≥ 180	21 (65.6%)	0.002

Distribution of NLR and PLR Across Severity Groups

The distribution of NLR values across mild, moderate, and severe AECOPD

demonstrated a clear stepwise increase, as depicted in **Figure 1**. Likewise, **Figure 2** illustrates the progressive rise in PLR values with increasing disease severity.

Distribution of Neutrophil-to-Lymphocyte Ratio Across Severity Groups

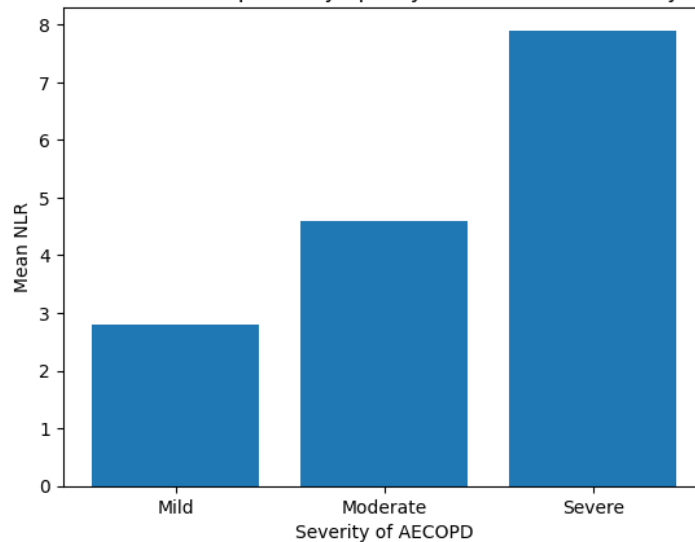


Figure 1. Distribution of Neutrophil-to-Lymphocyte Ratio Across Severity Groups of AECOPD

Distribution of Platelet-to-Lymphocyte Ratio Across Severity Groups

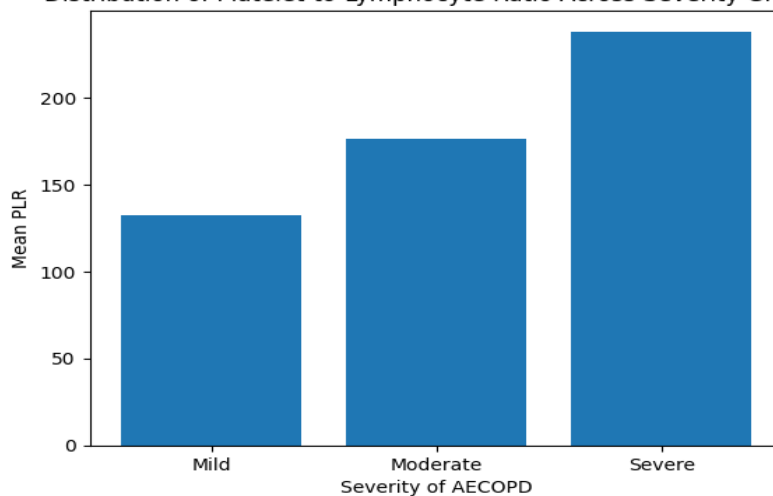


Figure 2. Distribution of Platelet-to-Lymphocyte Ratio Across Severity Groups of AECOPD

Summary of Key Results

The study demonstrated that both **NLR and PLR were significantly elevated in severe AECOPD**, with NLR showing a stronger association with disease severity and ICU admission. These findings support the role of NLR and PLR as useful inflammatory markers for risk stratification in patients with acute exacerbation of COPD.

Discussion

Acute exacerbation of chronic obstructive pulmonary disease is characterized by an amplified systemic inflammatory response, which plays a central role in disease progression and adverse clinical outcomes. In the present study, both neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) were significantly elevated in patients with severe AECOPD, highlighting their utility as prognostic inflammatory markers.

Neutrophilic inflammation is a hallmark of COPD exacerbations, driven by increased recruitment and activation of neutrophils in response to infectious and non-infectious triggers. Activated neutrophils release proteolytic enzymes and reactive oxygen species, contributing to airway damage and worsening airflow limitation [13,14]. Simultaneously, stress-induced lymphopenia reflects immune dysregulation and poor host response, thereby amplifying the prognostic significance of NLR [15].

Several studies have demonstrated that elevated NLR is associated with increased disease severity, need for intensive care, and higher mortality in patients with AECOPD [16–18]. Our findings are consistent with these observations, as patients with severe exacerbations and ICU admissions exhibited significantly higher NLR values compared to those with mild and moderate disease.

Platelets are increasingly recognized as active participants in inflammatory and immune processes beyond their traditional

hemostatic role. In COPD, platelet activation contributes to endothelial dysfunction, microvascular thrombosis, and systemic inflammation, particularly during acute exacerbations [19]. Elevated PLR has been associated with worse outcomes in chronic inflammatory conditions and has been proposed as a marker of disease severity in respiratory illnesses [20].

In the present study, PLR was significantly higher in patients with severe AECOPD, although its prognostic strength was comparatively lower than that of NLR. This finding aligns with previous reports suggesting that while PLR reflects inflammatory burden, NLR may be a more sensitive indicator of acute systemic inflammation [21].

Persistent systemic inflammation has been shown to increase susceptibility to frequent exacerbations and accelerate disease progression in COPD patients [22]. The use of simple hematological indices such as NLR and PLR offers a practical approach for early risk stratification, especially in resource-limited settings where advanced biomarkers may not be readily available.

Current international guidelines emphasize the importance of early identification of high-risk AECOPD patients to optimize management and reduce morbidity and mortality [23]. Incorporating NLR and PLR into routine clinical assessment may assist clinicians in predicting disease severity and anticipating adverse outcomes.

The findings of this study are further supported by emerging evidence highlighting the role of systemic inflammatory biomarkers in predicting exacerbation frequency, hospital stay, and overall prognosis in COPD [24,25]. However, larger multicentric studies with longitudinal follow-up are required to establish standardized cutoff values and validate their routine clinical application.

Conclusion

NLR and PLR are valuable, inexpensive inflammatory markers that correlate significantly with disease severity in patients with AECOPD. Among the two, NLR demonstrates superior prognostic utility. Routine use of these indices may aid in early risk stratification and clinical decision-making.

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