Jurnal Impresi Indonesia (JII)
p-ISSN: 2828-1284 e-ISSN: 2810-062x
website: https: //rivierapublishing.id/JII/ index.php / jii /index

Comparison Of Eosinophil Counts in COPD Group B And Group E Patients

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Keywords
Chronic Obstructive, Eosinophils, Inflammation, Pulmonary Disease.

Abstract
Chronic Obstructive Pulmonary Disease (COPD) is a progressive lung disease linked to chronic inflammation from toxin exposure. Eosinophil counts, an inflammation biomarker, are elevated in COPD and correlate with patient outcomes. This study analyzes eosinophil count differences in COPD patients classified as Group B or Group E at Prof. Dr. Chairuddin Panusunan Lubis Hospital, North Sumatra. This observational analytical study used a case-control design with retrospective data from medical records. The primary variable was eosinophil counts from routine blood tests. Secondary variables were gender, age, smoking history, shortness of breath level assessed by *mMRC*, exacerbation history, body mass index (BMI), and education level. Bivariate analysis applied the independent T-test for normally distributed data and the Mann–Whitney test for non-normal data; $p < 0.05$ indicated significance. Most COPD patients in both groups were heavy smokers with type 2 obesity and significant dyspnea, indicated by elevated *mMRC* scores. The mean eosinophil count in Group B was 248,677 ± 294,739, compared to 151,290 ± 190,416 in Group E. The independent T-test showed a statistically significant difference ($p = 0.000$), with higher eosinophils in Group B, suggesting a stronger inflammatory process, while Group E represented a more stable disease state. This study highlights eosinophil count as a marker differentiating COPD phenotypes, with implications for personalized management strategies.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a chronic, progressive lung disease characterized by airflow limitation associated with a chronic inflammatory response in the airways and lungs caused by exposure to noxious particles or gases, occurring primarily in smokers (Bontsevich et al., 2022; Yentes et al., 2020). In the *Global Status of Non-communicable Diseases 2010*, the World Health Organization (WHO) categorized COPD among the four most common non-communicable diseases as a leading cause of death, after diabetes, cardiovascular disease, and malignancy (Vestbo et al., 2013). The prevalence of COPD in Southeast Asian countries is estimated at 6.3%, with the highest prevalence reported in Vietnam (6.7%) and China (6.5%). Indonesia, as a country with a large number of smokers, has a correspondingly high COPD prevalence (Oemiati, 2013).

The underlying inflammatory pattern of COPD is commonly dominated by neutrophils, cytotoxic CD8+ T cells, and alveolar macrophages (Tashkin & Wechsler, 2018). Eosinophils play an important role in airway inflammation in COPD patients (Jacobsen et al., 2012). Additionally, the number of eosinophils in sputum increases during exacerbations in some COPD patients (Morjaria et al., 2017). Increased eosinophil concentrations and eosinophil-related proinflammatory factors in the airways and blood indicate that eosinophils actively contribute to the inflammatory process in COPD. Post hoc analysis from the ECLIPSE study found that 37.4% of COPD patients had persistently elevated blood eosinophil counts (≥2% at baseline and years 1, 2, and 3), while 49% had intermittently increased eosinophils (Singh et al., 2019). Secondary analysis of the *Acute Exacerbation and Respiratory InfectionS in COPD* (*AERIS*) cohort showed that blood eosinophil counts ≥2% remained stable for a year in 58% of patients and predicted a lower overall risk of bacterial presence during exacerbations (Keene et al., 2017). Horpers et al. found that eosinophilia (absolute blood eosinophil count >275 cells/μL) was associated with an increased risk of all-cause mortality and COPD-specific mortality (odds ratio 4.8; 95% confidence interval [CI], 1.9−11.9) (Vedel-Krogh et al., 2016).

COPD assessment can also be based on patient characteristics, specifically the phenotypes *Group B* and *Group E*. Group B is characterized by low risk, many symptoms, COPD stage I and II, 0–1 exacerbations per year, *Modified Medical Research Council* (*mMRC*) score ≥ 2, and COPD Assessment Test (CAT) score ≥ 10. Group E includes patients with high-risk COPD, many symptoms, COPD stage III and IV, >2 exacerbations per year (or ≥1 hospitalization), *mMRC* score ≥ 2, and CAT score ≥ 10. Group B and E patients will be analyzed based on eosinophilia profiles related to risk (Lindayani & Tedjamartono, 2017).

Research comparing eosinophil counts between COPD Group B and Group E patients in Indonesia, especially in North Sumatra and Medan City, remains limited. Therefore, this study aims to evaluate eosinophil counts in these groups.

COPD remains a leading cause of morbidity and mortality worldwide, characterized by persistent respiratory symptoms and airflow limitation due to chronic inflammation (MacLeod et al., 2021). While COPD's inflammatory profile is predominantly neutrophilic, emerging evidence highlights the significant role of eosinophils in disease pathogenesis and exacerbations. Studies by Tashkin and Wechsler (2018) and Jacobsen et al. (2012) demonstrate that eosinophils contribute to airway inflammation in COPD, with elevated levels correlating with exacerbation frequency and severity. The ECLIPSE study revealed a substantial proportion of COPD patients exhibiting persistent or intermittent elevation of blood eosinophil counts, underscoring their clinical relevance. However, the role of eosinophils across different COPD phenotypes, especially *Group B* (low risk, high symptoms) and *Group E* (high risk, high symptoms), remains poorly understood, representing a critical gap.

Existing research has mostly focused on eosinophil counts in broad COPD populations, with limited attention to subgroup comparisons using the *Global Initiative for Chronic Obstructive Lung Disease* (*GOLD*) classification. Vedel-Krogh et al. (2016) and Singh et al. (2019) explored eosinophils as biomarkers for exacerbation risk but did not differentiate GOLD Group B and Group E patients. This is significant because these groups have distinct clinical trajectories and treatment responses, as noted by Lindayani and Tedjamartono (2017). The lack of targeted studies comparing eosinophil profiles between these groups represents an important

research gap, especially in regions like Indonesia with high but understudied COPD prevalence. Addressing this gap could improve personalized treatment and outcomes.

The urgency of this research is underscored by Indonesia's high smoking rates and rising respiratory disease burden. Oemiati (2013) reported high COPD prevalence in Southeast Asia, including Indonesia, yet data on inflammatory markers like eosinophils are scarce. Barnes (2017) emphasized the need for region-specific research considering genetic, environmental, and lifestyle factors influencing disease presentation. Without local data, clinicians must rely on generalized guidelines that may not address patient population needs. This study focuses on eosinophil counts in *GOLD* Groups B and E patients at a North Sumatran hospital, filling a regional gap with actionable insights.

The novelty of this research lies in its targeted comparison of eosinophil counts between COPD *Group B* and *Group E* patients, an area rarely explored. While Cunningham et al. (2017) and Yang et al. (2015) studied eosinophils in inflammatory diseases, they did not address phenotypic differences in COPD subgroups. This study offers a fresh perspective on how eosinophil-driven inflammation varies across COPD phenotypes and may reveal new biomarkers for disease progression or treatment response. The case-control design in an Indonesian setting adds unique contextual value, as prior research mainly involved Western populations with different demographic and environmental exposures.

The primary objective is to compare eosinophil counts between *Group B* and *Group E* COPD patients using retrospective data from a North Sumatran hospital. Statistical analyses include the independent T-test and Mann–Whitney test to identify significant differences in eosinophil levels and their implications for disease severity and management. Secondary variables such as smoking history, BMI, and *mMRC* scores will contextualize eosinophil findings within broader patient characteristics. These goals align with Keene et al.'s (2017) call for biomarker-driven COPD management, laying a foundation for future tailored therapies.

This research benefits clinicians, policymakers, and patients. It may inform more precise treatment decisions, including eosinophil-targeted therapies for specific COPD subgroups. Policymakers could use the data to develop localized COPD management guidelines reflecting regional epidemiology. Patients may gain better symptom control and quality of life through improved understanding of eosinophil-related inflammation. By bridging global research and local practice, this study contributes to reducing COPD's global health burden, as outlined in the *GOLD 2019* report (Singh et al., 2019). Ultimately, it emphasizes the importance of phenotypic stratification in COPD management and the necessity of region-specific studies to optimize care.

RESEARCH METHOD

This research was an analytical observational study with a case-control design, conducted at Prof. Dr. Chairuddin Panusunan Lubis Hospital, North Sumatra, over six months. Before data collection, the researchers submitted ethical clearance to the Health Research Ethics Commission of the Medical Faculty, University of North Sumatra, Medan.

The research samples consisted of patients older than 15 years with a diagnosis of COPD in either *Group B* or *Group E*, who were willing to participate by signing informed consent. COPD patients with unstable conditions, exacerbations, musculoskeletal disorders

(fractures, dislocations, etc.), or incomplete and difficult-to-evaluate data were excluded from the study. The sampling technique used was non-probability, specifically a consecutive sampling method, with a minimum sample size of 31 patients each for COPD *Group B* and *Group E*, respectively.

Patient characteristic data, such as age and gender, were obtained from patient identification records. Information about education level, body mass index (BMI), and smoking habits was collected using questionnaires completed by the research participants. The *mMRC* score was determined through direct interviews with patients. COPD diagnosis for both *Group B* and *Group E* and eosinophil counts was documented from patient medical records. The collected data were tabulated and presented in tables. Prior to comparing eosinophil counts between groups, the normality of data was tested using the Shapiro–Wilk test. Bivariate analysis employed the independent T-test for normally distributed data and the Mann–Whitney test for non-normally distributed data. A p-value < 0.05 was considered statistically significant.

RESULTH AND DISCUSSION

Research on sixty-two COPD patients, both Group B and E, with 31 people for each group, showed patient characteristic data based on medical record as follows.

Table 1. Characteristics of COPD Patients

Characteristics		**Total (n)**	
		Group B	**Group E**
Age (years old)	<30	0	0
	30-39	0	0
	40-49	0	2
	50-59	9	8
	>60	22	21
Gender	Male	26	27
	Female	5	4
Education	Elementary School	0	0
	Junior High School	2	2
	Senior High School	12	17
	University	18	12
	Uneducated	0	0
Body Mass Index (BMI)	Underweight	0	0
	Normal	8	10
	Overweight	0	0
	Type 1 Obesity	11	10
	Type 2 Obesity	12	11
Smoking habits	None	4	4
	Mild Smokers	0	0
	Moderate Smokers	0	0
	Heavy Smokers	27	27
mMRC Score	0	2	0
	1	7	5
	2	6	6
	3	15	16
	4	1	4

In the group of COPD Group B patients, majority of patients were >60 years old, male, university graduates, type 2 obesity, heavy smokers and mMRC score was 3 which is indicative of significant shortness of breath. In the group of COPD Group E patients, majority of patients were >60 years old, high school graduates, type 2 obesity, heavy smokers and mMRC score was 3 which is indicative of significant shortness of breath. Both research groups showed almost similar characteristics.

Based on the number of eosinophils which divided into three main categories, namely <100, 100-300, and >300; it was found that the majority of COPD group B patients had eosinophil counts <100, namely 16 patients (25.81%), followed by 13 patients (20.9.6%) with eosinophil counts >300 and only 2 patients (3.23%) with eosinophil counts 100-300. Likewise, COPD group D patients with most patients had neutrophil counts <100, namely 16 patients (25.81%), followed by 12 patients (19.35%) who had eosinophil counts 100-300 and only 2 patients (4.84%) with eosinophil counts >300.

Table 2. Distribution of Eosinophil Counts in COPD Group B and Group E Patients

Eosinophil Counts	COPD patients				Total		P value
	Group B		Group E				
	n	%	n	%	n	%	
< 100	16	25.81	16	25.81	32	51.62	0,001*
100-300	2	3.23	12	19.35	14	22.58	
>300	13	20.96	3	4.84	16	25.8	
Total	31	50	31	50	62	100	

*T independent test

This research result indicate that more than half of COPD patients (51.62%) have low eosinophil levels which means that the condition is not too affected by certain inflammatory processes or infections. This distribution showed potential differences in health conditions between the two groups, with Group B being more dominant in the high eosinophil category, while Group E is more dominant in the medium or low eosinophil category. The difference in eosinophil distribution between the two groups is statistically significant, with a p value = 0.001. These results indicate differences in biological characteristics or medical conditions between Group B and Group E that affect their eosinophil levels. These findings may provide important insights into differences in immune responses or inflammatory conditions that may exist between the two groups.

Table 3. Analysis of Mean Eosinophil Counts in COPD Group B and Group E patients.

Eosinophil Counts	Group B	Group E	P value*
Mean ± SD	248.677±294.739	151.290±190.416	0,000
Median (Min-Max)	80(0 - 1049)	90 (0 - 850)	

**T-independent test*

Mean number of eosinophils in COPD Group B patients was 248,677±294,739 while in COPD Group E patients was 151,290±190,416. An independent T-test was conducted to compare eosinophil levels between Group B and Group E. Analysis results showed a statistically significant difference, with a p-value = 0.000 (p <0.05). This difference could be caused by factors such as disease severity, type of immune response, or other factors that affect eosinophil production, such as infection or allergic conditions. Group B may consist of

individuals with medical conditions that cause significant eosinophil surge, such as severe allergies or respiratory disorders, while Group E may reflect a group with lower or more controlled levels of inflammation.

Discussions

This research evaluated comparison of eosinophil counts in COPD Group B and Group E patients at Prof. Dr. Chairuddin Panusunan Lubis Hospital, North Sumatra, based on the analysis of 62 samples which are divided into two groups (31 respondents each), providing an in-depth picture of eosinophil levels between both groups. Measurement of eosinophil levels have an important role in assessing inflammation level and immune response in COPD patients, where eosinophils function as an indicator often used to evaluate inflammation intensity in the respiratory tract. Thus, the differences in eosinophil levels between both groups can provide further explanation of pathological characteristics in each COPD group as well as the factors that contribute to clinical and therapeutic variations.

Most COPD patients in this research were obese type 2. Obesity is known to affect lung health by increasing systemic inflammation and worsening respiratory function. Forno and Celedón (2017) revealed that obesity can worsen asthma and COPD symptoms, as well as reduce response to treatment. Accumulation of abdominal fat, which is common in type 1 and type 2 obesity, can increase pressure on the diaphragm, limit lung capacity, and increase the work of breathing, which contributes to increased severity of respiratory disease in obese individuals.

Smoking habits is also a prominent factor in these research results, with the majority of subjects in both groups being heavy smokers (27 patients in Group B and Group E each). This is consistent with Barnes (2017) findings who found that smoking is the main cause of chronic obstructive pulmonary disease (COPD) and is the greatest risk factor for the development of various respiratory disorders. Even with high levels of education, smoking habits remain a major problem, which underlines the importance of public health interventions to reduce the prevalence of smoking. Therefore, more intensive behavioral changes, such as more comprehensive smoking cessation programs, may be needed to reduce the negative impact on lung health.

The mMRC score, which measures the severity of dyspnea (difficulty breathing) showed that most research samples in both groups had a high score, namely 3. This finding indicates that most research samples experienced limitations in physical activity due to significant respiratory symptoms. A study by Singh et al. (2019) showed that a high MMRC score is associated with poor quality of life in patients with chronic lung disease, because severe dyspnea hinders daily activities and reduces the ability to participate in physical activities. Only a few subjects had a score of 0 or 1, indicating that most patients in both groups experienced quite severe respiratory disorders.

Eosinophils, as an inflammatory biomarker, have an important role in the inflammatory response in lung diseases, especially in distinguishing inflammatory phenotypes in chronic obstructive pulmonary disease (COPD). Eosinophils are white blood cells involved in the immune response, especially in allergic reactions, parasitic infections, and some inflammatory conditions (Malmström, 2016). The level of eosinophils in the blood was an indicator of

inflammation or immune activity in the body, therefore its distribution can provide an overview of the patient's general health condition.

This research results showed that more than half of COPD patients (51.62%) had low eosinophil levels, indicating a condition that was not too affected by certain inflammatory or infectious processes. This finding indicates that most individuals are not experiencing significant inflammatory or infectious processes. Low eosinophil levels can occur in various conditions, including autoimmune diseases or use of immunosuppressive drugs, such as corticosteroids, which reduce the body's inflammatory activity (Hersh et al., 2017). This may indicate that this population tends to be clinically stable or not affected by severe inflammatory diseases at the time the data were collected.

In the group with eosinophil levels of 100-300, the distribution of eosinophil levels showed more significant variations between Group B and Group E. Group B only had 2 respondents (3.23%) with eosinophil levels in this range, while Group E had 12 respondents (19.35%), with a total of 14 respondents (22.58%) in this category. Eosinophil levels in this range indicate a population with a more moderate level of inflammation or immune response, which may be related to moderate medical conditions, such as mild to moderate asthma, upper respiratory tract infections, or allergic reactions that have not reached high intensity (Nijhuis et al., 2016). These findings indicate that Group E is more likely to experience conditions related to moderate levels of inflammation or immune response, although not high enough to indicate a more acute or severe condition.

The distribution of the group with eosinophil levels >300 showed a more significant difference between the two groups. Group B had 13 respondents (20.96%) with eosinophil levels of more than 300, while Group E had only 3 respondents (4.84%), with a total of 16 respondents (25.8%) in this category. High eosinophil levels are often associated with more intense inflammatory processes, such as those that can occur in severe allergic conditions, severe asthma, or parasitic infections. A significant increase in eosinophils may reflect a stronger immune response to antigens or inflammatory triggers (Cunningham et al., 2017). High eosinophil levels can be found in individuals experiencing allergic exacerbations or more serious immune reactions. Although there was a tendency for Group B to have more high eosinophil levels, a large proportion in both groups were in the low eosinophil category, which may indicate general clinical stability.

This finding is also supported by statistical analysis results which found a significant difference in the distribution of eosinophil levels between Group B and Group E, with a p value of 0.001. Previous research by Yang et al. (2015) also showed that eosinophil levels can reflect the severity of inflammation or immune response in individuals with allergic or inflammatory diseases. Further research on factors that affect eosinophil levels, such as age, smoking habits, or other health status, will provide a deeper comprehension of correlation between eosinophils and medical conditions in this population.

The mean eosinophil count in COPD Group B patients was 248,677±294,739 which was significantly higher than that in COPD Group E patients which was 151,290±190,416 (p value = 0.001). This difference showed that Group B had a greater variation in eosinophil levels, while Group E tended to be more concentrated at lower levels. This may reflect that Group B has more individuals with medical conditions that can cause eosinophils to increase

significantly due to inflammation or a stronger immune response, while Group E tends to have more stable or more controlled eosinophil levels reflecting a more controlled or more stable condition.

This finding is significant because eosinophils are immune cells that play a role in the response to allergens, parasitic infections, and various inflammatory conditions. High eosinophil levels are typically associated with allergic reactions, asthma, or other inflammatory diseases, while lower levels may indicate conditions that are more controlled or unaffected by these factors (Malmström, 2016). Therefore, these differences in eosinophil levels may provide insight into disease severity or immune response. Group B, which has higher and more variable eosinophil levels, may be composed of individuals with more intense medical conditions, such as severe asthma, allergic disorders, or parasitic infections that cause significant increases in eosinophils (Hersh et al., 2017; Yang et al., 2015). Meanwhile, Group E, with lower and more consistent eosinophil levels, may reflect individuals who have more controlled medical conditions or are less affected by factors that drastically increase eosinophils.

This is in line with research by Cunningham et al. (2017) which found that eosinophils play an important role in allergic reactions and inflammation, especially in conditions such as asthma and allergic rhinitis, which can affect blood eosinophil levels. In individuals with asthma or severe allergic reactions, eosinophil levels are often significantly increased, as may be the case in Group B. Conversely, in patients with more stable conditions or less affected by inflammatory factors, eosinophil levels may be lower, as observed in Group E. These findings are also in line with research by Hersh et al. (2017), which noted that eosinophils are involved in various inflammatory conditions, and eosinophil levels can be an important indicator in evaluating the severity of inflammatory or allergic diseases. These findings may help in designing more targeted treatment strategies based on the different eosinophil levels between the two groups, as well as providing an overview of the severity or immune response that occurs in each group.

CONCLUSION

COPD Group B patients exhibit higher eosinophil counts than Group E patients, indicating a more significant inflammatory process in Group B, whereas Group E represents a more stable disease state. This finding suggests that eosinophil levels could serve as a biomarker to differentiate disease activity between COPD phenotypes. Future research is recommended to explore the underlying mechanisms driving eosinophilic inflammation in these groups and to evaluate the potential of eosinophil-targeted therapies for personalized management. The researcher expresses gratitude to the supervisor and staff of the Department of Pulmonology and Respiratory Medicine, Faculty of Medicine, University of North Sumatra, as well as all contributors who supported the completion of this study.

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