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Original Article

Frequency of Peripheral Blood Eosinophilia and Factors Associated with it in Patients with Chronic Obstructive Pulmonary Disease

Namra Khalid[1*] and Talha Mahmud[1]

[1]Department of Pulmonology, Sheikh Zayed Hospital, Lahore, Pakistan

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***Corresponding Author:**
Namra Khalid
Department of Pulmonology, Sheikh Zayed Hospital, Lahore, Pakistan
drnamra25@gmail.com

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ABSTRACT

Eosinophilic COPD is a known phenotype that has specific traits and favorable response to inhaled corticosteroids. Objective is to determine how often peripheral blood eosinophilia occurs in individuals diagnosed with Chronic Obstructive Pulmonary Disease (COPD) and identify its associated demographic and clinical factors. **Objectives:** To determine the frequency of peripheral blood eosinophilia and its associated factors among patients with chronic obstructive pulmonary disease (COPD) presenting in tertiary care hospital Lahore. **Methods:** This analytical cross-sectional study was carried out within the Department of Pulmonology, Shaikh Zayed Hospital, Lahore from (September 2025 to December 2025). A total of 121 COPD patients were recruited through consecutive, non-probability sampling. Laboratory tests including blood eosinophil count, spirometry test, and serum IgE level were performed. Peripheral blood eosinophilia was defined as an absolute eosinophil count of 100 cells/µL or higher. Statistical analysis with chi-square tests and binary logistic regression was performed with SPSS version 26.0. **Results:** The frequency of peripheral blood eosinophilia was 62% (75/121). Mean age was 53.76 ± 10.77 years with 80.2% males. A strong association was observed with IgE levels: 48 (90.6%) patients with IgE >200 had peripheral blood eosinophilia, compared to 27 (39.7%) patients with IgE ≤200 (p<0.001). Binary logistic regression analysis demonstrated that, after adjusting for gender, BMI (>25 kg/m^2), smoking status, diabetes mellitus, hypertension, and ischemic heart disease, elevated IgE levels remained significantly associated with the presence of peripheral blood eosinophilia among patients with COPD. **Conclusions:** Based on the findings of this study, the frequency of peripheral blood eosinophilia among COPD patients was 62%. Gender, smoking status, and IgE levels were initially found to be associated with the presence of eosinophilia; however, after regression analysis, only elevated IgE levels remained a significant predictor of peripheral blood eosinophilia in patients with COPD.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is an umbrella term for progressive lung diseases, primarily emphysema and chronic bronchitis, which cause persistent airflow blockage. Common symptoms include breathlessness, chronic cough, and sputum production. According to global estimates, roughly 10.3% of adults aged 30–79 is affected by COPD [1, 2]. The most prevalent clinical inflammatory phenotype in COPD, according to the study, is neutrophilic; the second most common is lymphocytic; and the least common is eosinophilic. Regarding the degree of anemia, systemic inflammation, and liver function, each phenotype showed unique traits that affected patient care [3]. One study showed that 17% of the patients in that cohort who were admitted for acute exacerbation of COPD exhibited blood eosinophilia (≥300 cells/uL [4]. Patients with COPD who have blood eosinophilia respond better to inhaled corticosteroids(ICS) [5]. A meta-analysis reported that eosinophilic COPD was more frequently observed among males, ex-smokers, and individuals with higher BMI, with an association also reported with ischemic heart disease. In contrast, no significant associations were observed with age, current

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smoking status, diabetes mellitus, or hypertension [6]. It was reported in a study that COPD exacerbations in the summer had a higher percentage of eosinophilia as compared to the winter exacerbations reflecting an association with seasonal variation in this group [7]. Previous research reported an association between persistently elevated eosinophil counts (>300 cells/μL) and higher Immunoglobulin E (IgE) levels. Exacerbation rates, or the worsening of symptoms, did not differ substantially when comparing patients with elevated and normal eosinophil levels, according to the same study [8].

Although the prevalence of eosinophilia has been reported in a few local studies, there remains a substantial lack of evidence regarding the underlying determinants and predisposing factors contributing to this phenotype in the local population. Furthermore, this COPD subgroup has not been adequately characterized in terms of demographic and clinical factors. Identifying these associations will enhance the understanding of eosinophilic COPD and may contribute to more tailored and effective management strategies, particularly in guiding the appropriate use of anti-inflammatory therapies. This study aimed to determine the frequency of peripheral blood eosinophilia and its associated factors among patients with chronic obstructive pulmonary disease. So, the aim of this study was to determine the frequency peripheral blood eosinophilia and its associated factors among patients with chronic obstructive pulmonary disease (COPD) presenting in tertiary care hospital Lahore.

METHODS

This was analytical cross-sectional study carried out department of Pulmonology, Shaikh Zayed Hospital, Lahore. This three-month study (September to December 2025) was approved by the Institutional Ethical Review Committee. The number of IRB approval letter was 02-TERC/NHRC-SZH/INT-SC/880 dated 17th September 2025. A sample size calculation was performed using OpenEpi with 95% confidence level and 10% margin of error. Based on previous literature reporting 39.3% prevalence of peripheral blood eosinophilia in COPD patients [9]. The calculated sample size was 92, to get more accuracy and valid results we round off the sample size upto121 participants that were enrolled from the Outpatient Department (OPD) and indoor ward of the Pulmonology Department at Shaikh Zayed Hospital, Lahore. A consecutive sampling method, a type of non-probability technique, was employed to recruit COPD patients that fulfilled the inclusion criteria. Inclusion criteria were to enroll COPD diagnosed patients of either gender from age 40-90 years diagnosed based on clinical history and spirometry results (post bronchodilator FEV1/FVC <70%). The severity of COPD was determined using the Global Initiative for Chronic Obstructive Lung Disease criteria based on post-bronchodilator FEV1 (as a percentage of predicted) as follows: mild (GOLD 1, FEV1 80 and above), moderate (GOLD 2, FEV1 50-79), severe (GOLD 3, FEV1 30-49), To analyse, patients were additionally divided into mild/moderate (GOLD 1 2) and severe/very severe (GOLD 3 4) [10]. Spirometry was performed to confirm the diagnosis and assess this severity of chronic obstructive pulmonary disease in all participants using a calibrated spirometer. Measurements include force vital capacity, force expiatory volume in the first second and the FEV1/FVC ratio. Each participant performed atleast three acceptable and reproduce maneuvers, and the highest value were recorded for analysis. Spirometry was conducted by a train technician. Non-consenting patients, diagnosed asthmatic patients, patients with hematological malignancies or leukopenia, patients having stroke, dementia or neurological disorders impairing history-taking were excluded from the study. After taking detailed informed consent, detailed demographic data and clinical histories were obtained directly from the participants and spirometry tests were done. Five mL of blood was collected for complete blood count (CBC) to obtain absolute eosinophil count (AEC) and IgE levels. Peripheral blood eosinophilia in COPD patients has been defined using variable thresholds in different studies ranging from 100 to 300cells/uL, studies have used ≥100 cells/uL as a lower cutoff to identify eosinophilic phenotypes and improve the sensitivity. As no universal consensus exists, this study adopts ≥100 cells/uL as the operational definition [11]. Following variables were measured and recorded and divided into categories. Age and gender were taken into account. Body Mass Index (BMI) was measured and divided into 2 categories; <25 and ≥25. Smoking history was taken and further divided into current smokers, nonsmokers and Ex smokers (those who had left smoking for past 1 year). Co-morbidities, seasonal variation, inhaled steroid use exacerbations in last 1 year and IgE levels defining a high IgE level as >200 IU/ml. All relevant data was collected using a pre-designed questionnaire (Appendix 1) through face-to-face interviews with patients after providing consultation. COPD: Clinical symptoms of cough and/or shortness of breath with spirometry showing post-bronchodilator FEV1/FVC ratio <70%. Peripheral blood eosinophilia: Absolute eosinophil count ≥100 cells/μL [11].

The data were processed and analyzed with SPSS statistical software, version 26.0. Continuous data are presented as mean values accompanied by standard deviation, while categorical data are summarized as frequency counts and percentages. Relationships between categorical variables and eosinophilia were evaluated using the Chi-square test. To identify and adjust

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for confounding factors influencing eosinophilia, a binary logistic regression analysis was conducted. For all statistical tests, results were deemed significant when the p-value was 0.05 or lower.

RESULTS

A total of 121 patients with COPD were included in the final analysis. The mean age was 53.76 ± 10.77 years. The majority were male (97; 80.2%), while females accounted for 24 (19.8%). The mean body mass index (BMI) was 24.21 ± 3.26 kg/m^2, and 21 patients (17.4%) were non-smokers. Regarding comorbid conditions, diabetes mellitus, hypertension, and ischemic heart disease were present in 36 (29.8%), 61 (50.4%), and 40 (33.1%) patients, respectively. Inhaled corticosteroid use was reported in 84 patients (69.4%), while elevated IgE levels (>200) were observed in 53 (43.8%) patients. Peripheral blood eosinophilia was identified in 75 patients (62%) (Table 1).

Table 1: Descriptive Statistics of Demographic and Clinical Parameters of the Patients

Parameters		f (%)
Age (Years)		53.76 ± 10.77
Gender	Male	97 (80.2%)
	Female	24 (19.8%)
BMI (kg/m^2)		24.21 ± 3.26
Smoking Status	Ex-Smoker	23 (19%)
	Non-Smoker	21 (17.4%)
	Smoker	77 (63.6%)
DM	Yes	36 (29.8%)
	No	85 (70.2%)
Hypertension	Yes	61 (50.4%)
	No	60 (49.6%)
IHD	Yes	40 (33.1%)
	No	81 (66.9%)
Inhaled Corticosteroid	Yes	84 (69.4%)
	No	37 (30.6%)
Exacerbations (≥1 vs 0)	≥1	72 (59.5%)
	No	49 (40.5%)
IgE Level	>200	53 (43.8%)
	≤200	68 (56.2%)
Peripheral Blood Eosinophilia	Yes	75 (62%)
	No	46 (38%)

Using normality test, it was noted that, the counts of eosinophils in serum and serum IgE level were not normally distributed. So, by applying Mann Whitney U test both variables were found to be significant. The absolute eosinophil count (407.92 ± 189.33 cells/ uL) was significantly higher in patients with eosinophilia than in those without (58.04 ± 20.43 cells/ uL) ($p < 0.001$). Likewise, serum IgE levels were significantly higher in patients with eosinophilia (1061.41 ± 1167.85) than in non-eosinophilic patients (79.52 ± 50.61) ($p<0.001$) (Table 2).

Table 2: Comparison of Mean Eosinophil Counts and Ige Levels Between Eosinophilic Vs Non-Eosinophilic Groups

Variables	Peripheral Blood Eosinophil	n	Mean	Std. Deviation	Mann Whitney U test	p-value
Absolute Eosinophil/ ul	Yes	75	407.92	189.33	0.000	<0.001
	No	46	58.04	20.43		
Serum IgE levels	Yes	75	1061.41	1167.85	710.00	<0.001
	No	46	79.52	50.61		

Peripheral blood eosinophilia was observed in 30 (60%) patients aged >55 years and in 45 (63.4%) patients aged ≤55 years ($p=0.706$). Among males, 67 (69.1%) exhibited eosinophilia compared to 8 (33.3%) females, showing a statistically significant association ($p=0.001$). In terms of body mass index, eosinophilia was present in 26 (56.5%) patients with BMI ≤25 kg/m^2 and 49 (65.3%) patients with BMI >25 kg/m^2 ($p=0.332$). Among smokers, 53 (68.8%) had peripheral blood eosinophilia, whereas it was observed in 22 (50.0%) of non- and ex-smokers ($p=0.040$). In diabetic patients, eosinophilia was noted in 21 (58.3%) compared to 54 (63.5%) in non-diabetics ($p=0.590$). Similarly, 35 (57.4%) hypertensive patients had eosinophilia versus 40 (66.7%) non-hypertensives ($p=0.293$). A strong association was observed with IgE levels: 48 (90.6%) patients with IgE >200 had peripheral blood eosinophilia, compared to 27 (39.7%) patients with IgE ≤200 ($p<0.001$) (Table 3).

Table 3: Comparison of Peripheral Blood Eosinophilia Between Different Factors

Parameters		Peripheral blood eosinophilia		Total	Chi value (df)	p-value
		Yes	No			
Age Groups	>55	30 (60.0%)	20 (40.0%)	50 (100.0%)	0.142 (1)	0.706
	≤ 55	45 (63.4%)	26 (36.6%)	71 (100.0%)		
Gender	Male	67 (69.1%)	30 (30.9%)	97 (100.0%)	10.43 (1)	0.001*
	Female	8 (33.3%)	16 (66.7%)	24 (100.0%)		
BMI	>25	26 (56.5%)	20 (43.5%)	46 (100.0%)	0.939 (1)	0.332
	≤25	49 (65.3%)	26 (34.7%)	75 (100.0%)		
No of Exacerbations	≥1	46 (63.9%)	26 (36.1%)	72 (100.0%)	0.274 (1)	0.601
	No	29 (59.2%)	20 (40.8%)	49 (100.0%)		

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Smoking	Smokers	53 (68.8%)	24 (31.2%)	77 (100.0%)	4.21 (1)	0.040*
	Non & Ex-smokers	22 (50.0%)	22 (50.0%)	44 (100.0%)		
DM	Yes	21 (58.3%)	15 (41.7%)	36 (100.0%)	0.290 (1)	0.590
	No	54 (63.5%)	31 (36.5%)	85 (100.0%)		
Hypertension	Yes	35 (57.4%)	26 (42.6%)	61 (100.0%)	1.108 (1)	0.293
	No	40 (66.7%)	20 (33.3%)	60 (100.0%)		
IHD	Yes	25 (62.5%)	15 (37.5%)	40 (100.0%)	0.007 (1)	0.934
	No	50 (61.7%)	31 (38.3%)	81 (100.0%)		
Inhaled cortisteroid	Yes	55 (65.5%)	29 (34.5%)	84 (100.0%)	1.422 (1)	0.233
	No	20 (54.1%)	17 (45.9%)	37 (100.0%)		
IgE	>200	48 (90.6%)	5 (9.4%)	53 (100.0%)	32.69 (1)	<0.001*
	≤200	27 (39.7%)	41 (60.3%)	68 (100.0%)		

Binary logistic regression analysis demonstrated that, after adjusting for gender, BMI (>25 kg/m^2), smoking status, diabetes mellitus, hypertension, and ischemic heart disease, elevated IgE levels remained significantly associated with the presence of peripheral blood eosinophilia among patients with COPD. This indicates a moderate level of explanatory power for the model (Table 4).

Table 4: Factors Associated with Eosinophilia (Binary Logistic Regression)

Variables in Equation	B	S.E.	Wald	p-value	OR	95% C.I. for EXP (B)	
						Lower	Upper
Gender	-1.351	0.741	3.324	0.068	0.259	0.061	1.107
BMI (>25)	0.146	0.498	0.086	0.769	1.158	0.436	3.074
Smoking (smokers)	-0.171	0.612	0.078	0.781	0.843	0.254	2.800
IgE (>200)	2.790	0.573	23.692	0.000	16.287	5.295	50.098
DM	-.150	0.539	0.077	0.781	0.861	0.299	2.476
HTN	-1.147	0.558	4.223	0.040	0.318	0.106	0.948
IHD	0.991	0.610	2.642	0.104	2.695	0.815	8.907
Constant	-2.419	2.401	1.015	0.314	0.089	–	–

DISCUSSION

This study assessed the prevalence and associated parameters of peripheral blood eosinophilia among patients with COPD. The greater portion of the individuals studied (62%) were found to have eosinophilia, and elevated serum IgE levels emerged as the only significant independent predictor. These findings suggest that the eosinophilic phenotype is relatively common in COPD patients in this population and may be linked to underlying allergic or type 2 inflammatory pathways. Asthma is a heterogeneous disease with multiple underlying etiologies. Eosinophils constitute a minor subset of granulocytes that originate in the bone marrow, circulate in the bloodstream, and subsequently migrate into tissues [12, 13]. The prevalence reported in this study was comparable to that observed in some cohorts. According to a study conducted in Pakistan, 38.1% of individuals with COPD had eosinophilia, which is a very high frequency [14]. Previous evidence has demonstrated that blood eosinophil levels ≥300 cells/μL are associated with an increased risk of COPD exacerbations, supporting the clinical relevance of this threshold [4]. A study conducted at the pulmonology department of Saidu Group of Teaching Hospitals, Swat, aimed to evaluate how commonly blood eosinophilia occurs at the time of initial COPD diagnosis. Blood eosinophilia was observed in 52 (36.1%) patients which is similar to the results we obtained [15]. The relatively higher frequency in this cohort of our study could be due to differences in study design, eosinophil cut-off thresholds, or environmental exposures. Nevertheless, it highlights the clinical importance of recognizing the eosinophilic phenotype within local COPD populations. The significant association between raised IgE levels and eosinophilia is consistent with findings from Casanova et al. who noted persistently elevated IgE levels among COPD patients with high eosinophil counts [8]. However, according to another study, Colak Y found that a high plasma IgE was linked to an elevated risk for severe exacerbation and death from any cause, with COPD irrespective of the blood eosinophil level [16]. In another study of 75 COPD patients, Thiru found that absolute eosinophil count and IgE have a high positive connection ($p<0.05$) [17]. Another study depicted similar results that compared patients with normal IgE levels, those with raised total IgE had slightly higher blood eosinophil counts in COPD patients [18]. This association reinforces the potential role of allergic sensitization and type 2 inflammation in COPD pathophysiology. Identifying patients with such immunologic traits could help guide the use of biologic or anti-inflammatory therapies tailored to this subgroup. The lack of association between eosinophilia and exacerbation frequency also contrasts with certain international findings that linked eosinophilia with higher exacerbation risk [19]. In a local study conducted in Pakistan, they discovered a direct correlation between eosinophilia and the degree of airway blockage as measured by FEV1 [14]. Different studies revealed that elevated eosinophil in blood is closely connected with greater risk of exacerbations in COPD patients. According to Vestbo J, using inhaled corticosteroids to treat

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eosinophilic COPD also lessens exacerbations [20]. In contrast to some previous studies, no statistically significant associations were found between eosinophilia and age, gender, BMI, or smoking history. Similarly, comorbidities, disease severity, and exacerbation frequency were not correlated with eosinophil levels. The absence of a relationship between eosinophilia and ICS use might indicate variable adherence, dosing differences, or intrinsic resistance of eosinophilic inflammation to corticosteroids in some individuals. Similar to our study results, a local study conducted in Pakistan, found no statistically significant associations between eosinophilia and demographic or comorbidity profiles [13]. This variation could be due to population-specific factors, smaller sample size, as a result of the study's cross-sectional design, which does not permit conclusions about causation. Nonetheless, the results emphasize that eosinophilia in COPD may represent a distinct inflammatory phenotype rather than merely a marker of disease activity. Routine measurement of eosinophil count and serum IgE values in people with COPD could help identify those with an eosinophilic phenotype who might respond better to anti-inflammatory therapies. Recognizing this phenotype allows for a more individualized approach rather than a uniform treatment strategy for all COPD patients. This study provides locally relevant data on COPD phenotypes using both clinical and laboratory parameters. Binary logistic regression analysis demonstrated that, after adjusting for gender, BMI (>25 kg/m^2), smoking status, diabetes mellitus, hypertension, and ischemic heart disease, elevated IgE levels remained significantly associated with the presence of peripheral blood eosinophilia among COPD patients (OR 16.287, 95% CI: 5.295–50.098, p<0.001). The wide confidence interval for IgE indicates some degree of estimate instability, likely due to the relatively small sample size and the high prevalence of eosinophilia (90.6%) among patients with elevated IgE. Therefore, while the association is statistically significant, the precise magnitude of the effect should be interpreted with caution and validated in larger, multi-center studies.

The cross-sectional design limits causal interpretation, as eosinophil status and COPD were assessed at the same time and the temporal relationship between them could not be established. Seasonal variation was not systematically analyzed, and the study period from September to December 2025 limited assessment across different seasons. The use of consecutive non-probability sampling at a single tertiary-care hospital may have introduced selection bias and limits the generalizability of the findings to COPD patients in community and primary-care settings. The use of ≥100 cells/µL as the operational cutoff may have resulted in a higher observed prevalence of eosinophilia compared with studies using higher thresholds, particularly ≥300 cells/µL. Therefore, direct comparison of the prevalence observed in this study with studies using different eosinophil thresholds should be interpreted with caution. Multicentre and longitudinal studies are recommended to validate these findings, assess seasonal variation, and determine whether eosinophil levels predict treatment response and clinical outcomes.

CONCLUSIONS

Peripheral blood eosinophilia was present in 62% of COPD patients, while 38% had no eosinophilia. Elevated IgE levels (OR 16.287; p<0.001) and hypertension (OR 0.318; p=0.040) were independently associated with peripheral blood eosinophilia after adjustment for potential confounding factors. These findings indicate that eosinophilia is a common phenotype among COPD patients in this study population, with elevated IgE showing the strongest independent association. However, the findings represent associations within the studied population and do not establish a causal relationship

Authors' Contribution

Conceptualization: NK
Methodology: NK
Formal analysis: TM
Writing and Drafting: NK
Review and Editing: NK, TM

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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