European Journal of Clinical Pharmacy
Print ISSN: 2385-409X **Online ISSN**: 3105-0409
Website: https://farmclin.com/

Original Research Article

Hematological Profile and Inflammatory Markers in Patients with Chronic Obstructive Pulmonary Disease: A Cross-Sectional Study from Peshawar, Pakistan

Article History:

Name of Author:
Dr Zahid Ullah Khan[1], Dr Khalil Ullah[2], Dr Nigar Ahmad[3], Dr Zeyad Khan[4], Dr Muhammed Shehzad Ali Sidiqui[5] and Dr Muhammad Irfan[6]

Affiliation: *[1]Assistant Professor, Emergency Medicine Department, MTI-Lady Reading Hospital Peshawar, Pakistan.*
[2]Assistant Professor, Emergency Medicine Department, MTI-Lady Reading Hospital Peshawar, Pakistan.
[3]Demonstrator, Biochemistry Department, Khyber Medical College, Peshawar, Pakistan.
[4]Postgraduate Resident Emergency Medicine Department, MTI-Lady Reading Hospital Peshawar, Pakistan.
[5]Postgraduate Resident, Emergency Medicine Department, MTI-Lady Reading Hospital Peshawar, Pakistan.
[6]Medical Officer, Emergency Medicine Department, MTI-Lady Reading Hospital Peshawar, Pakistan.

Corresponding Author:
Dr Khalil Ullah

Received: 10-10-2025
Revised: 28-10-2025
Accepted: 18-11-2025
Published: 30-11-2025

Abstract: ***Background***: Chronic Obstructive Pulmonary Disease (COPD) is a progressive inflammatory disorder with significant systemic involvement. Hematological abnormalities reflecting chronic inflammation may contribute to disease severity and poor outcomes, yet local data from Pakistan remain limited. ***Objective***: To evaluate the hematological and clinical profiles of patients with COPD and to assess the association of blood-based inflammatory markers with disease severity. ***Methods***: The study is observational observational research in a hospital setting that was carried out at Lady Reading Hospital, Peshawar, between June and December of 2023. Adult participants who had undergone spirometry to verify COPD were recruited. Demographic and clinical data were obtained, and there was the classification of disease severity by GOLD criteria. Complete blood count parameters such as hemoglobin, total leukocyte count, and the platelets and neutrophil-lymphocyte ratio (NLR) in venous blood were examined. Analysis of data was done with the use of SPSS version 26.0. ***Results***: There were 120 patients in total with a preponderance of males and high rate of smoking past. Later stages of COPD were related to significantly reduced hemoglobin levels and increased total leukocyte count, neutrophil percentage, and NLR. There was a decrease in lymphocytes in severe disease, which is a marker of immune dysregulation and an increase in systemic inflammation. ***Conclusion***: Hematological changes, especially anemia and high levels of inflammatory indices are closely related to the severity of COPD. Resource-limited COPD patients can be supported with simple blood-based biomarkers like NC in the determination of risk and overall clinical evaluation.

Keywords: Chronic Obstructive Pulmonary Disease; Hematological Profile; Systemic Inflammation; Neutrophil-to-Lymphocyte Ratio; Disease Severity.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a treatable, preventable, and progressive respiratory health condition that is accompanied by a permanent airflow obstruction and chronic airway and lung inflammation (Celli et al., 2022; Rodrigues et al., 2021). It has become one of the major causes of morbidity and mortality across the globe and a

significant burden to the public health, especially in low and middle-income countries (LMICs) (Adeloye et al., 2022; Rossaki et al., 2021). At the global level, COPD is expected to be the third cause of death, and widespread aging, further tobacco exposure, and pollution are the main drivers (Prasad, 2020).

The traditional view of COPD as a disease limiting itself to the lungs is outdated, but it is now clearly considered to be a multisystem disorder (Buttery et al., 2021; Houben-Wilke et al., 2018). Besides respiratory dysfunction, COPD patients often have systemic manifestations such as skeletal muscle impairment, cardiovascular disease, metabolic disordination, osteoporosis, and anemia (Dos Santos et al., 2022; Jha et al., 2023). These parenchymal effects mostly operate through chronic systemic inflammation, oxidative damage and immune scandal which are no longer contained in the pulmonary compartment but may affect the overall disease prognosis and survival (Barnes, 2020).

Exposure to toxic substances such as tobacco smoke is one of the most significant factors in the pathogenesis of COPD (Hikichi et al., 2019). Smoking causes long-term airway inflammation, with neutrophilic infiltration, macrophage activation, and enhanced release of proteolytic enzymes and cytokine resulting in airway remodelling and parenchymal destruction (Hikichi et al., 2019; Hou et al., 2019). Other exposures in the LMICs, including biomass fuel burning, work-related dusts, and air pollution in cities, only intensify the inflammatory load and severity of the diseases (van Gemert et al., 2018; Ortiz-Quintero et al., 2022). They not only influence the lung architecture and functioning but also facilitate immune system activation throughout the body.

Hematological changes in COPD are undergoing a revolution of being crucial indicators of disease activity and prognosis (Ramya et al., 2023). Chronic inflammation influences the functions of bone marrow, erythropoiesis, and leukocytosis and imposes abnormalities, including anemia, leukocytosis, neutrophilia, and lymphopenia (Bruserud et al., 2022). COPD is especially exposed to anemia of chronic disease, which is related to low oxygen-carrying capacity, dyspnea, exercise impairment, frequent hospitalization, and high mortality (Putcha et al., 2018). Mechanisms of anemia in COPD involve cytokines-mediated inhibition of erythropoietin, iron homeostasis and the nutritional deficiency (Marques et al., 2022; Pizzini et al., 2020).

Concurrently, leukocyte-based inflammatory marker has also been forthcoming in its ability to capture systemic activation of immune in COPD (Hu et al., 2023). Neutrophils play a role in the pathophysiology of COPD and have been involved in the development of airways obstruction and emphysema via the production of proteases, elastases, and reactive oxygen products (Butler et al., 2018). On the contrary, immune exhaustion and vulnerability to infections with disease progression into advanced stages have been connected with lymphocyte-depleting effects. The neutrophil-to-lymphocyte ratio (NLR) is a simple and inexpensive marker based on a standard complete blood count, that has become a bright biomarker of disease severity, exacerbation threat, and mortality in COPD (Pascual-Gonzalez et al., 2018).

Traditionally, spirometric measurements, including forced expiratory volume in one second (FEV 1), are the basis of clinical evaluation of COPD (Kakavas et al., 2021). But the heterogeneity of the disease and the systemic involvement cannot be entirely assessed through spirometry alone. Recent views note the relevance of multidimensional assessment models which include symptoms, exacerbation history, comorbidities, and systemic biomarkers (Maldonado-Franco et al., 2023). The concept of including hematological parameters into the daily COPD screening could help increase risk stratification and personal patient care (Ramya et al., 2023).

South Asia, and specifically Pakistan, is under the pressure of COPD; this is characterized by high smoking rates, exposure to biomass, in combination with low access to early diagnostic services, resulting in a late appearance of the disease and severe stages (Shetty et al., 2021). Nevertheless, the local information regarding the hematological and clinical characteristics of COPD patients is scarce. Knowledge about local trends in disease shapes is important in generating region-specific management strategies and enhancing the results in resource-limited environments.

Hence the current research was aimed at assessing the hematological and clinical features in patients with COPD who reported to a tertiary care facility in Pakistan. This study intends to shed some light on the systemic inflammatory and hematological burden of COPD by analyzing the relationship between hemoglobin, total leukocyte count, differential counts, and neutrophil-to-lymphocyte ratios in relation to disease severity. The discovery of easy to find biomarkers could aid in the early identification of high-risk patients and could be used to allow more individualized and deep approaches at COPD management.

METHODOLOGY

The study was an observational hospital-based study at Lady Reading Hospital in Peshawar and conducted during the six months between June 2023 and December 2023. The paper sought to determine the hematological and clinical characteristics of patients with Chronic Obstructive Pulmonary Disease

(COPD). The research was approved by the institutional review board and all participants given written informed consent before enrolling in the study. The study involved patients aged ≥40 years with a confirmed clinical and spirometric study of COPD, according to the GOLD criteria (post-bronchodilator FEV1/FVC < 0.70). Heat-resistant acute infections, malignancy, hematological conditions and autoimmune disorders, acute blood transfusion in the past, or any chronic inflammatory conditions were also excluded to eliminate confounding effects on hematological parameters.

Demographic and clinical data such as age, gender, smoking history, occupational exposure, duration of disease, comorbidities, as well as the severity of symptoms were collected in a structured proforma. Clinical evaluation involved measuring dyspnea by way of the Modified Medical Research Council (mMRC) scale and severity of the disease based on GOLD staging. Findings of vital signs and physical examination were documented in all participants.

Aseptic venous blood samples (35-5mL) were gathered and analyzed at the hospital laboratory. Parameters of complete blood count (CBC) such as hemoglobin, total leukocyte count, differential leukocyte count, platelets count, red cell indices (MCV, MCH, MCHC) and inflammatory markers, neutrophil-to-lymphocyte ratio (NLR) were assessed by an automated hematology analyzer.

Data were analyzed and entered in the version SPSS 26.0. Continuous variables were given in mean ± standard deviation and categorical variables in frequencies and percentages. The independent t-test or ANOVA was used to compare the groups of COPD severity with the quantitative variables, and the chi-square test was applied to compare the groups with the qualitative variables. The level of statistically significance was set to 0.05.

RESULTS

The study included 120 COPD patients. The average age of the participants was 61.4 years with a male predominance of 8.7 years. Majority of the patients were former or present smokers. Patients were grouped as mild, moderate, severe, and very severe COPD based on GOLD criteria.

Table 1. Demographic Characteristics of Study Participants (n = 120)

VARIABLE	FREQUENCY (N)	PERCENTAGE (%)
GENDER		
MALE	82	68.3
FEMALE	38	31.7
SMOKING STATUS		
CURRENT SMOKER	54	45.0
EX-SMOKER	46	38.3
NON-SMOKER	20	16.7
MEAN AGE (YEARS)	61.4 ± 8.7	—
MEAN DISEASE DURATION	6.2 ± 3.1 yrs	—

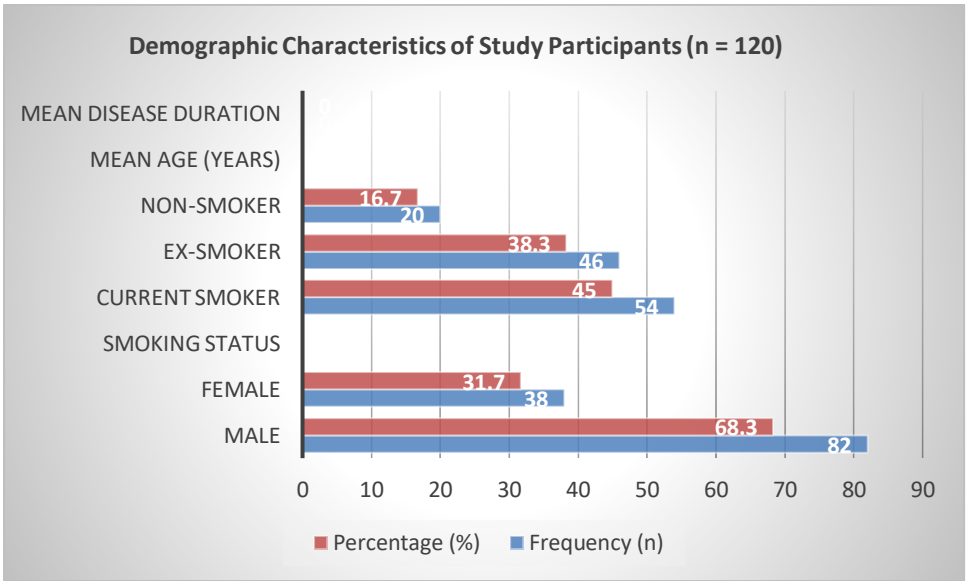

Table 2. Clinical Severity of COPD Based on GOLD Staging

GOLD STAGE	N	PERCENTAGE (%)
MILD (STAGE I)	18	15.0
MODERATE (II)	44	36.7
SEVERE (III)	36	30.0
VERY SEVERE (IV)	22	18.3

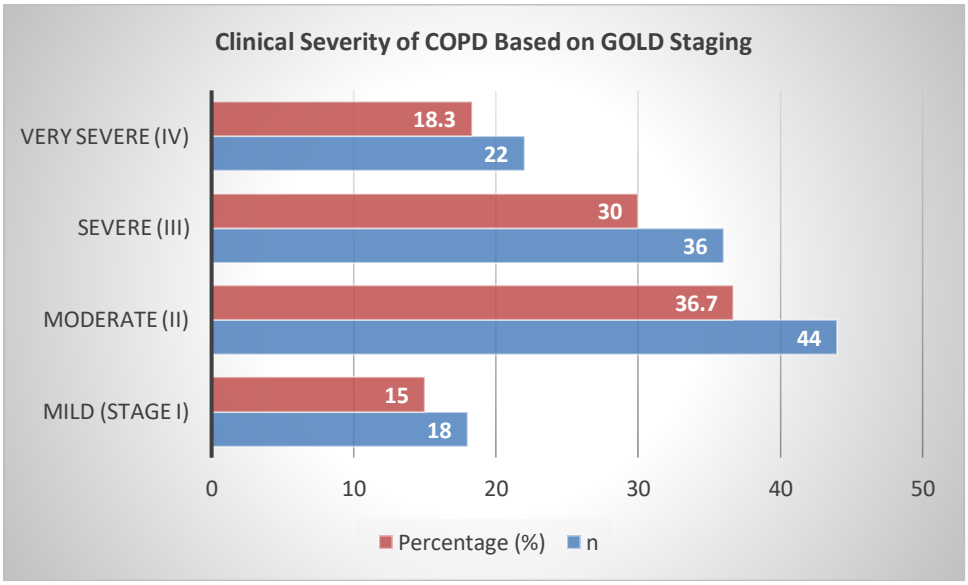

Table 3. Hematological Parameters of COPD Patients

PARAMETER	MEAN ± SD
HEMOGLOBIN (G/DL)	12.1 ± 1.9
TOTAL LEUKOCYTE COUNT (×10⁹/L)	9.6 ± 2.8
NEUTROPHILS (%)	68.4 ± 9.2
LYMPHOCYTES (%)	21.3 ± 6.8
PLATELETS (×10⁹/L)	287 ± 74
MCV (FL)	84.6 ± 7.3
MCH (PG)	27.8 ± 3.1
MCHC (G/DL)	32.9 ± 1.4
NLR	3.6 ± 1.5

Table 4. Comparison of Hematological Parameters Across COPD Severity

PARAMETER	MILD/MODERATE (N=62)	SEVERE/VERY SEVERE (N=58)	P-VALUE
HEMOGLOBIN	12.9 ± 1.7	11.2 ± 1.8	0.002*
TLC	8.7 ± 2.3	10.6 ± 3.0	0.001*
NEUTROPHILS %	64.9 ± 8.4	71.8 ± 9.0	0.004*
LYMPHOCYTES %	24.1 ± 6.5	18.3 ± 5.9	0.001*
NLR	2.8 ± 1.2	4.5 ± 1.6	<0.001*

*Statistically significant

Key Findings Summary

- Severe COPD patients had significantly lower hemoglobin levels
- Inflammatory markers (TLC, NLR) increased with disease severity
- Neutrophil predominance and lymphopenia were seen in advanced stages

DISCUSSION

This paper presents a detailed hematological and clinical representation of patients with Chronic Obstructive Pulmonary Disease (COPD) who attended a tertiary care hospital in Pakistan. The results have shown that the deterioration of COPD severity is linked to progressive systemic inflammation, which is expressed through the changes in leukocyte indices and hemoglobin (Ramya et al., 2023). These findings support the idea that COPD is

not a pulmonary disease but a multisystem inflammatory condition, and hematological processes play a crucial role in the condition (Buttery et al., 2021).

An important finding of our research was the fact that patients with severe and very severe COPD had a significantly lower hemoglobin level. COPD-related anemia is a comorbid condition that has come to be a significant issue, which leads to lack of tolerance to exercise, progressive dyspnea, and worsening quality of life (Putcha et al., 2018). Past population-based investigations cited anemia rates ranging between 10-33 percent in COPD, more prevalent in terminal stages of the disease (Pizzini et al., 2020). The low hemoglobin of our cohort probably indicates chronic inflammation, poor response to erythropoietin, and nutritional deficiencies, which are characteristic of long-term COPD (Marques et al., 2022).

We have also discovered that total leukocyte count (TLC) and neutrophile percentage were significantly increased in the patient with severe disease whereas there was reduction in lymphocyte percentages. It is a neutrophil-dominated approach that supports the contribution of innate immune activation to COPD development (Butler et al., 2018). Neutrophils play a role in remodeling the airways and parenchymal destruction by releasing proteases and reactive oxygen species (Hikichi et al., 2019). In severe COPD, lymphopenia has been found to indicate immune exhaustion and has been linked to increased vulnerability to infections and a high risk of death (Hu et al., 2023).

A specific strong disease severity maker that became apparent in our population is the neutrophil-to-lymphocyte ratio (NLR). NLR values were significantly high among patients with severe and very severe COPD compared to patients with mild/moderate disease. This aligns with the prior studies that reported NLR as an effective, low-cost biomarker of both systemic inflammation and prognosis in COPD (Pascual-Gonzalez et al., 2018). Frequent exacerbations, hospitalizations, and mortality have also been associated with high NLR suggesting its possible applicability in standard clinical risk stratification (Hu et al., 2023).

The high prevalence of smoking history (p= +1.87) and the predomination of male patients in our study is in line with regional epidemiological trends (Shetty et al., 2021). Tobacco smoking is still the best risk factor in COPD and one that has been central in fueling both pulmonary and skin inflammation (Hikichi et al., 2019). Suggestive occupational exposures and the biomass-fuel consumption typical of low-and-middle-income countries could also enhance the inflammatory load and add to the problems with hematology (van Gemert et al., 2018).

Our results are consistent with the rising literature that indicates that hematological parameters must be incorporated into COPD evaluation systems (Ramya et al., 2023). The disease complexity cannot be entirely reflected by the use of traditional spirometric measurements (Kakavas et al., 2021). The use of systemic biomarkers, like hemoglobin and NLR, can assist in better prognostication and enable clinicians to recognize high-risk patients earlier (Pascual-Gonzalez et al., 2018).

This paper is limited in several ways, notwithstanding its merits. Single-center design and relatively small sample size might be a poor generalizability. Furthermore, the cross-sectional design does not allow causal implications between the alterations in the hematology and the disease progression. A longitudinal study involving larger cohorts of participants and operating across multiple centers would be necessary to understand the possibility of subverting or resolving systemic inflammation or curing anemia as a way to optimize COPD clinical outcomes (Bruserud et al., 2022).

To sum up, this research proves that COPD at an advanced stage is linked to severe changes in hematology, especially the development of anemia, neutrophilia, lymphopenia, and increased NLR. These results confirm the involvement of systemic inflammation in the pathophysiology of COPD (Barnes, 2020) and the promise of simple blood-based markers in the disease monitoring and risk stratification (Ramya et al., 2023).

CONCLUSION

This paper puts forward the point that Chronic Obstructive Pulmonary Disease is not a purely pulmonary disease but also a systemic inflammatory disease that has substantial hematological implications. Advanced COPD patients showed reduced hemoglobin levels and significant alterations in leukocytes indices, especially elevated neutrophil-to-lymphocyte ratio and the decrease in lymphocytes, indicating higher levels of inflammatory response and immune deregulation. These hematological changes had close links with the severity of the disease and can have an impact on deteriorated clinical outcomes, such as higher symptom burden and risk of hospitalization. The results confirm the importance of using uncomplicated routinely accessible parameters of the blood as a part of the overall assessment of COPD patients. Within resource-constrained contexts, these convenient biomarkers can become a viable solution in terms of early detection of high-risk people and better disease management. Preliminary longitudinal and multicenter research is required to validate these relationships and to clarify on whether multimodal management of anemia and systemic inflammation can positively impact prognosis and

quality of life of COPD patients.

REFERENCES:

1. Celli, B., Fabbri, L., Criner, G., Martinez, F. J., Mannino, D., Vogelmeier, C., ... & Agusti, A. (2022). Definition and nomenclature of chronic obstructive pulmonary disease: time for its revision. American journal of respiratory and critical care medicine, 206(11), 1317-1325.
2. Rodrigues, S. D. O., Cunha, C. M. C. D., Soares, G. M. V., Silva, P. L., Silva, A. R., & Goncalves-de-Albuquerque, C. F. (2021). Mechanisms, pathophysiology and currently proposed treatments of chronic obstructive pulmonary disease. *Pharmaceuticals*, *14*(10), 979.
3. Adeloye, D., Song, P., Zhu, Y., Campbell, H., Sheikh, A., & Rudan, I. (2022). Global, regional, and national prevalence of, and risk factors for, chronic obstructive pulmonary disease (COPD) in 2019: a systematic review and modelling analysis. The Lancet Respiratory Medicine, 10(5), 447-458.
4. Rossaki, F. M., Hurst, J. R., van Gemert, F., Kirenga, B. J., Williams, S., Khoo, E. M., ... & van Boven, J. F. (2021). Strategies for the prevention, diagnosis and treatment of COPD in low-and middle-income countries: the importance of primary care. Expert review of respiratory medicine, 15(12), 1563-1577.
5. PRASAD, B. (2020). Chronic obstructive pulmonary disease (COPD). International Journal of Pharmacy Research & Technology (IJPRT), 10(1), 67-71.
6. Buttery, S. C., Zysman, M., Vikjord, S. A., Hopkinson, N. S., Jenkins, C., & Vanfleteren, L. E. (2021). Contemporary perspectives in COPD: patient burden, the role of gender and trajectories of multimorbidity. Respirology, 26(5), 419-441.
7. Houben-Wilke, S., Augustin, I. M., Vercoulen, J. H., van Ranst, D., bij de Vaate, E., Wempe, J. B., ... & Franssen, F. M. (2018). COPD stands for complex obstructive pulmonary disease. European Respiratory Review, 27(148).
8. Dos Santos, N. C., Miravitlles, M., Camelier, A. A., De Almeida, V. D. C., Maciel, R. R. B. T., & Camelier, F. W. R. (2022). Prevalence and impact of comorbidities in individuals with chronic obstructive pulmonary disease: a systematic review. Tuberculosis and respiratory diseases, 85(3), 205.
9. Jha, S. S., Kumar, M., Agrawal, P. K., & Thakur, D. K. (2023). Osteoporosis in Asthma and COPD. Indian Journal of Orthopaedics, 57(Suppl 1), 200-208.
10. Barnes, P. J. (2020). Oxidative stress-based therapeutics in COPD. Redox biology, 33, 101544.
11. Hikichi, M., Mizumura, K., Maruoka, S., & Gon, Y. (2019). Pathogenesis of chronic obstructive pulmonary disease (COPD) induced by cigarette smoke. Journal of thoracic disease, 11(Suppl 17), S2129.
12. Hou, W., Hu, S., Li, C., Ma, H., Wang, Q., Meng, G., ... & Zhang, J. (2019). Cigarette smoke induced lung barrier dysfunction, EMT, and tissue remodeling: a possible link between COPD and lung cancer. BioMed research international, 2019(1), 2025636.
13. van Gemert, F. A., Kirenga, B. J., Gebremariam, T. H., Nyale, G., de Jong, C., & van der Molen, T. (2018). The complications of treating chronic obstructive pulmonary disease in low income countries of sub-Saharan Africa. Expert review of respiratory medicine, 12(3), 227-237.
14. Ortiz-Quintero, B., Martínez-Espinosa, I., & Pérez-Padilla, R. (2022). Mechanisms of lung damage and development of COPD due to household biomass-smoke exposure: inflammation, oxidative stress, MicroRNAs, and gene polymorphisms. Cells, 12(1), 67.
15. Ramya, P. A., Mohapatra, M. M., Saka, V. K., Kar, R., Chakkalakkoombil, S. V., & Vemuri, M. B. (2023). Haematological and inflammatory biomarkers among stable COPD and acute exacerbations of COPD patients. Sultan Qaboos University Medical Journal, 23(2), 239.
16. Bruserud, Ø., Vo, A. K., & Rekvam, H. (2022). Hematopoiesis, Inflammation and Aging—The Biological Background and Clinical Impact of Anemia and Increased C-Reactive Protein Levels on Elderly Individuals. Journal of clinical medicine, 11(3), 706.
17. Putcha, N., Fawzy, A., Paul, G. G., Lambert, A. A., Psoter, K. J., Sidhaye, V. K., ... & Hansel, N. N. (2018). Anemia and adverse outcomes in a chronic obstructive pulmonary disease population with a high burden of comorbidities. An analysis from SPIROMICS. Annals of the American Thoracic Society, 15(6), 710-717.
18. Marques, O., Weiss, G., & Muckenthaler, M. U. (2022). The role of iron in chronic inflammatory diseases: from mechanisms to treatment options in anemia of inflammation. Blood, The Journal of the American Society of Hematology, 140(19), 2011-2023.
19. Pizzini, A., Aichner, M., Sonnweber, T., Tancevski, I., Weiss, G., & Löffler-Ragg, J. (2020). The Significance of iron deficiency

and anemia in a real-life COPD cohort. International Journal of Medical Sciences, 17(14), 2232.

20. Hu, H. S., Wang, Z., Jian, L. Y., Zhao, L. M., & Liu, X. D. (2023). Optimizing inhaled corticosteroid use in patients with chronic obstructive pulmonary disease: assessing blood eosinophils, neutrophil–to–lymphocyte ratio, and mortality outcomes in US adults. Frontiers in immunology, 14, 1230766.
21. Butler, A., Walton, G. M., & Sapey, E. (2018). Neutrophilic inflammation in the pathogenesis of chronic obstructive pulmonary disease. COPD: Journal of Chronic Obstructive Pulmonary Disease, 15(4), 392-404.
22. Pascual-Gonzalez, Y., Lopez-Sanchez, M., Dorca, J., & Santos, S. (2018). Defining the role of neutrophil-to-lymphocyte ratio in COPD: a systematic literature review. International journal of chronic obstructive pulmonary disease, 3651-3662.
23. Kakavas, S., Kotsiou, O. S., Perlikos, F., Mermiri, M., Mavrovounis, G., Gourgoulianis, K., & Pantazopoulos, I. (2021). Pulmonary function testing in COPD: looking beyond the curtain of FEV1. NPJ primary care respiratory medicine, 31(1), 23.
24. Maldonado-Franco, A., Giraldo-Cadavid, L. F., Tuta-Quintero, E., Bastidas Goyes, A. R., & Botero-Rosas, D. A. (2023). The challenges of spirometric diagnosis of COPD. Canadian Respiratory Journal, 2023(1), 6991493.
25. Shetty, B. S. P., D'Souza, G., & Padukudru Anand, M. (2021). Effect of indoor air pollution on chronic obstructive pulmonary disease (COPD) deaths in Southern Asia—a systematic review and meta-analysis. Toxics, 9(4), 85.

