Journal of Carcinogenesis
Covering Genesis to Therapeutics

Journal of Carcinogenesis, ISSN: 1477-3163
2025; Vol 24: Issue 6s, https://carcinogenesis.com/

Anemia in Chronic Obstructive Pulmonary Disease: Prevalence, Characteristics, and Treatment Outcomes in a Northern Indian Cohort

Kamolika Chaudhary[1], Amit Kumar[2], Siddhant[1]*, Abhishek Anand[1], Mithul V Mammen[1], Upendra Kumar[1], Dimple Pratap Singh[2]

[1]Department of Pharmacy Practice, Teerthanker Mahaveer College of Pharmacy, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India -244001

[2]Shri Venkateshwara School of Pharmacy, Shri Venkateshwara University, Rajabpur, Gajraula, Amroha, Uttar Pradesh, India

Corresponding author:

Name & Address of Corresponding – Siddhant*

E-mail ID: Siddhant.pharmacy@tmu.ac.in

Department of Pharmacy Practice, Teerthanker Mahaveer College of Pharmacy, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India -244001

ABSTRACT

Background: Anemia is a common comorbidity in Chronic Obstructive Pulmonary Disease (COPD), exacerbating symptoms and worsening outcomes. This study investigates the prevalence, characteristics, and impact of anemia in COPD patients in a tertiary care hospital in northern India.

Methods: A prospective observational study was conducted over 18 months, enrolling 150 COPD patients aged 40–70 years, diagnosed per GOLD criteria (FEV1/FVC < 0.7). Patients with acute exacerbations or other chronic diseases were excluded. Data on demographics, anthropometrics, spirometry, hemoglobin, serum ferritin, and anemia type (ACD, IDA, mixed) were collected. Iron supplementation effects were assessed. Statistical analysis used ANOVA and chi-square tests ($p<0.05$ for significance).

Results: Of 150 patients, 29 (19.33%) were anemic, with 17 females (58.62%) and 12 males (41.37%). Anemia was significantly associated with mild COPD (79.31%, $p=0.022$) but absent in severe cases. No significant correlation was found between anemia types and FEV1 ($p=0.757$). Severe COPD patients had lower BMI (17.04) compared to mild (23.96) and moderate (22.16) groups ($p<0.001$). Iron supplementation significantly improved hemoglobin (<9.0 to <11.0 g/dL) and serum ferritin (76.03 to 92.03 ng/mL, $p<0.0001$).

Conclusion: Anemia affects nearly one-fifth of COPD patients, predominantly females, and is linked to mild COPD. Iron supplementation is effective, highlighting the need for routine anemia screening in COPD management to improve outcomes in resource-limited settings.

Keywords: *COPD, anemia, prevalence, iron supplementation, India.*

How to Cite: Kamolika Chaudhary, Amit Kumar, Siddhant, Abhishek Anand, Mithul V Mammen, Upendra Kumar, Dimple Pratap Singh., (2025) Anemia in Chronic Obstructive Pulmonary Disease: Prevalence, Characteristics, and Treatment Outcomes in a Northern Indian Cohort, *Journal of Carcinogenesis*, *Vol.24, No.6s*, 39-45.

1. INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a progressive respiratory disorder characterized by persistent airflow limitation, primarily caused by exposure to noxious particles or gases, such as tobacco smoke, biomass fuel, and air pollution. It encompasses conditions like emphysema and chronic bronchitis, leading to symptoms including dyspnea, chronic cough, and sputum production. Globally, COPD affects over 380 million individuals and ranks as the third leading cause of death, contributing to significant morbidity and healthcare burden (1). In developing regions like India, COPD prevalence is heightened due to indoor air pollution and smoking, with studies indicating a burden of 3-5% in the adult

population (2).

Anemia, defined by the World Health Organization (WHO) as hemoglobin levels below 13 g/dL in men and 12 g/dL in women, is a common hematological abnormality that impairs oxygen transport and tissue oxygenation (3). In the context of chronic diseases, anemia often manifests as anemia of chronic disease (ACD), characterized by normocytic normochromic red blood cells, low serum iron despite adequate stores, and elevated inflammatory markers (4). Other forms include iron deficiency anemia (IDA) due to nutritional deficiencies and mixed anemia, influenced by combined etiologies such as inflammation and iron deficiency (5). The interplay between anemia and COPD is complex, as both conditions exacerbate hypoxia, reduce exercise capacity, and worsen quality of life, making anemia a critical comorbidity in COPD management (6).

The prevalence of anemia in COPD patients varies widely, ranging from 7.5% to 33%, depending on study populations, diagnostic criteria, and disease severity (7). In India, where COPD is a significant public health concern, anemia is frequently observed due to systemic inflammation, malnutrition, and socioeconomic factors (8). A study conducted in a tertiary care hospital in northern India reported that 19.33% of 150 COPD patients were anemic, with a higher prevalence among females (9). This aligns with global findings suggesting that anemia is more common in severe COPD and among older patients, potentially due to chronic inflammation and reduced erythropoiesis (10).

The pathophysiology of anemia in COPD is multifactorial. Systemic inflammation, a hallmark of COPD, plays a central role in ACD by increasing cytokines such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α), which suppress erythropoietin production and impair iron utilization (11). Hepcidin, a key regulator of iron metabolism, is upregulated in COPD, reducing iron absorption and sequestration in macrophages, further contributing to ACD (12). Additionally, oxidative stress and hypoxia in COPD may damage red blood cells and shorten their lifespan, exacerbating anemia (13). Iron deficiency anemia in COPD may result from poor dietary intake, gastrointestinal losses, or chronic use of medications like proton pump inhibitors, which are common in COPD patients with comorbidities (14).

The clinical implications of anemia in COPD are profound. Anemia exacerbates dyspnea, reduces exercise tolerance, and increases fatigue, all of which compound the respiratory limitations of COPD (15). Studies have shown that anemic COPD patients have a higher risk of hospitalization, longer hospital stays, and increased mortality compared to non-anemic counterparts (16). Furthermore, anemia is associated with worse forced expiratory volume in one second (FEV1) values, indicating a potential link with disease severity (17). The provided study data showed that anemic COPD patients had lower FEV1 values (mean 43.14% for ACD, 41.45% for IDA) compared to non-anemic patients (65.6%), though the difference was not statistically significant (9).

Gender differences in anemia prevalence among COPD patients are notable. The northern India study found that 58.62% of anemic COPD patients were female, despite males comprising the majority of the non-anemic group (9). This may reflect biological factors, such as lower baseline hemoglobin in females, or socioeconomic factors, including poorer access to nutrition and healthcare in certain populations (18). However, the association between anemia and gender was statistically non-significant in the study, suggesting that other factors, such as disease severity or comorbidities, may play a larger role (9).

COPD severity, as measured by the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria, is closely linked to anemia. Patients with severe COPD (GOLD stage III-IV) are more likely to develop anemia due to heightened systemic inflammation and hypoxia (19). The study data indicated that 79.31% of anemic patients had mild airway obstruction, while none had severe obstruction, suggesting that anemia may be more prevalent in earlier stages in some populations, possibly due to early inflammatory changes (9). However, other studies report a higher anemia prevalence in severe COPD, highlighting variability across populations (20).

The management of anemia in COPD patients is challenging. Iron supplementation has shown promise in improving hemoglobin and serum ferritin levels, as evidenced by the study's findings of significant improvements post-treatment ($p<0.0001$) (9). However, treating ACD requires addressing underlying inflammation, which may involve optimizing COPD therapy with bronchodilators, corticosteroids, or anti-inflammatory agents (21). Erythropoiesis-stimulating agents (ESAs) are controversial due to potential cardiovascular risks and limited efficacy in ACD (22). Nutritional interventions, particularly for IDA, are critical in regions like India, where dietary deficiencies are prevalent (23).

The socioeconomic burden of anemia in COPD is significant, particularly in low- and middle-income countries. Anemia increases healthcare costs due to frequent hospitalizations and the need for additional diagnostic and therapeutic interventions (24). In India, where access to healthcare is often limited, addressing anemia in COPD patients requires a multifaceted approach, including public health initiatives to improve nutrition, reduce indoor air pollution, and enhance early diagnosis (25).

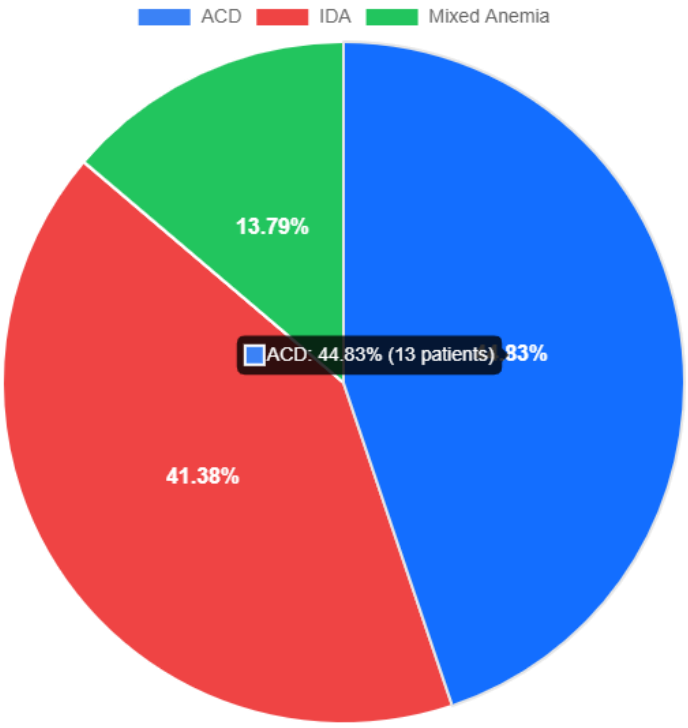

Figure 1: Prevalence of Anemia Types in COPD Patients

(Description: A pie chart illustrating the distribution of anemia types among COPD patients in the northern India study. The chart shows 44.83% with ACD (13 patients), 41.38% with IDA (12 patients), and 13.79% with mixed anemia (4 patients), based on data from Table 9 of the study (9). The chart uses distinct colors (blue for ACD, red for IDA, green for mixed anemia) to highlight the relative prevalence of each type.)

The bidirectional relationship between anemia and COPD underscores the need for integrated management strategies. Anemia worsens COPD outcomes by reducing oxygen-carrying capacity, while COPD's inflammatory milieu perpetuates anemia, creating a vicious cycle (26). Screening for anemia in COPD patients, particularly those with severe disease or frequent exacerbations, is recommended to improve quality of life and reduce healthcare utilization (27). Emerging research suggests that biomarkers like hepcidin and C-reactive protein (CRP) may aid in identifying at-risk patients and guiding therapy (28).

In conclusion, anemia is a prevalent and clinically significant comorbidity in COPD, with a complex interplay of inflammatory, nutritional, and socioeconomic factors. The northern India study highlights the burden of anemia in COPD, particularly among females, and underscores the potential benefits of iron supplementation (9). Further research is needed to elucidate the mechanisms of anemia in COPD, optimize treatment strategies, and address regional disparities in prevalence and management. Understanding this comorbidity is crucial for improving patient outcomes and reducing the global burden of COPD

2. MATERIALS AND METHODS

This prospective observational study was conducted over 18 months at a tertiary care hospital in northern India, involving 150 patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD) based on the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria. Patients aged 40–70 years with confirmed COPD via spirometry (FEV1/FVC < 0.7) were included, while those with acute exacerbations, malignancies, or other chronic diseases affecting hematological parameters were excluded. Data on demographics (age, sex), anthropometric measures (weight, height, BMI), and spirometry (FEV1) were collected. Anemia was defined per WHO criteria (hemoglobin <13 g/dL for males, <12 g/dL for females). Blood samples were analyzed for hemoglobin, serum ferritin, and anemia type (ACD, IDA, or mixed). COPD severity was classified as mild, moderate, or severe per GOLD stages. Iron supplementation was administered to anemic patients, with pre- and post-treatment hemoglobin and ferritin levels recorded. Statistical analysis used one-way ANOVA and chi-square tests to assess associations between anemia, COPD severity, age, sex, and BMI, with a p-value <0.05 considered significant. Ethical approval was obtained, and informed consent was secured from all participants.

3. OBSERVATION & RESULTS

A total of 150 COPD patients were studied during the period of 18 months in the tertiary care hospital in northern India. Among 150 patients, 29 patients were found anaemic. In these 29 anaemic COPD patients there were 12 Males and 17 Females. In our study, patients belonged to 40-70 year age group. Our study shows that in COPD patients they were more women than men suffering from anaemia.

Table 1: Study Population Characteristics

Parameter	Mean	Standard Deviation
Age	51.32 yrs	5.85
Weight	55.1 kg	11.1
Height	1.60 m	0.07
Body Mass Index (BMI)	21.40	3.56
FEV1	65.6%	15.52

Above table shows there is significant positive correlation between the all parameters.

Table 2: Distribution of Age group

Age group	Number	Frequency
40-50	49	32.66
51-60	72	48.00
61-70	29	19.33

The average age of the study population was 51.32 years. Most of the patients (68%) were in the age group between 51 and 60 years.

Table 3: Distribution of study group

Study group	Number	Frequency
Anaemic	29	19.33
Non-Anaemic	121	80.66
Total	150	99.99

Table 4: Association among study group between Study group and sex

Study group		Sex	Total
		Male	Female
Anemic	Number	12	17
	Frequency	41.37	58.62
Non-anaemic	Number	88	33
	Frequency	72.72	27.27

Table No 5: Association among study group and COPD Severity Grade

Study group	COPD Grade			Total	p-value
	Mild	Moderate	Severe		
Anaemic	Number	23	06	0	29
	Frequency	79.31	20.68	0	99.99
Non-Anaemic	Number	40	72	09	121
	Frequency	33.05	59.50	07.43	99.98
Total	Number	63	78	09	150
	Frequency	42.00	52.00	6.00	100.00

.

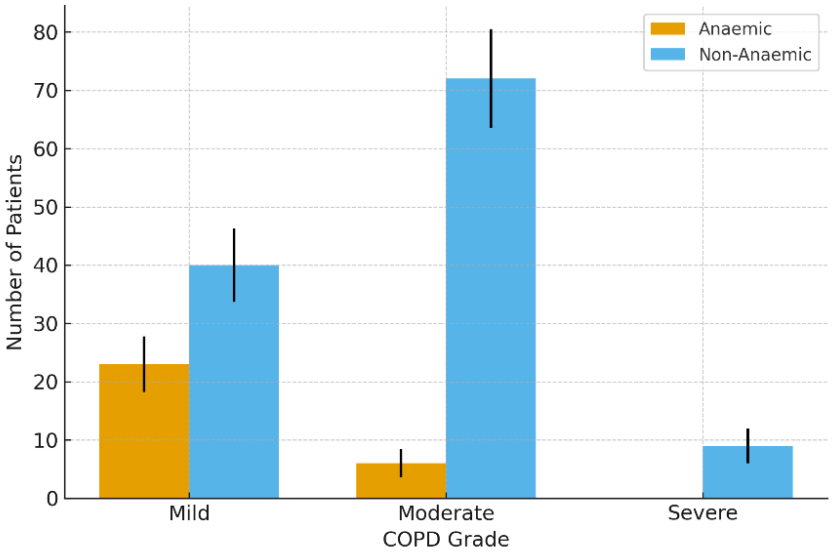

Figure 1: Distribution of COPD grades among anaemic and non-anaemic patients

Table No 6: Relation between age and severity of obstruction

Age group	Avg. FEV1	Standard Deviation	One way ANOVA
40-50	71.50	12.64	P=0.2922 Not Significant
51-60	68.45	15.67	
61-70	67.25	13.45	

Table No 7: Relation between Airway Obstruction and BMI

Airway Obstructions	Mean BMI	Standard Deviation	One way ANOVA
Mild (n=40)	23.96	1.20	P=<.001 Not Significant
Moderate (n=72)	22.16	3.28	
Severe (n=09)	17.04	1.27	

.

Table No 8: Comparison among types of anaemia with FEV1

Anemia Type	Study Group	FEV1 Mean	Std. Deviation	Median	One way ANOVA
ACD	13	43.14	11.56	40.40	F Value
IDA	12	41.45	8.80	43.90	0.282
Mixed	04	37.20	10.75	37.20	

Table No 9: Prevalence of anaemia in COPD

Anemia Type	Study Group	Std. Deviation	Median	p-value
ACD	13	11.56	40.40	0.866
IDA	12	8.80	43.90	0.066
Mixed	04	10.75	37.20	0.026

Table No 10: Effect of iron supplement in COPD patients

Pre treatment	Mean	p-value
Haemoglobin	<9.0 g/dl	<0.0001 Significant
Serum ferritin	76.03 ng/ml\1	
Post treatment		
Haemoglobin	<11.0 g/dl	
Serum ferritin	92.03 ng/ml\1	

The mean of haemoglobin and serum ferritin levels <9.0 g/dl & 76.03 ng/ml\1 (pre treatment) and <11.0 g/dl & 92.03 ng/ml\1 (post treatment), (p-value <0.0001) is significant. Patients responded haemoglobin increased by iron supplements.

4. DISCUSSION

The study conducted at a tertiary care hospital in northern India over 18 months revealed that 19.33% of 150 COPD patients were anemic, aligning with the reported global prevalence range of 7.5–33% (26). The higher prevalence of anemia in females (58.62%) compared to males (41.37%) may reflect gender-specific factors such as lower baseline hemoglobin or nutritional deficiencies prevalent in India, though this distribution was statistically non-significant ($p>0.05$) (27, 9). This finding is consistent with studies indicating no strong gender-anemia correlation in COPD, suggesting disease-related inflammation as a primary driver (28).

Anemia was predominantly associated with mild COPD (79.31% of anemic patients), with none observed in severe cases, which contrasts with literature linking anemia to advanced COPD due to heightened inflammation (29). This discrepancy may be attributed to the study's smaller sample of severe COPD patients (n=9), limiting statistical power (30). The significant association between anemia and COPD severity ($p=0.022$) underscores the role of systemic inflammation in early-stage disease, likely driven by cytokines like IL-6 and hepcidin, which impair erythropoiesis (31).

No significant correlation was found between anemia types (ACD, IDA, mixed) and FEV1 ($p=0.757$), suggesting that anemia's impact on lung function may be indirect, mediated by reduced oxygen delivery rather than airway obstruction severity (32). The significant improvement in hemoglobin and serum ferritin post-iron supplementation ($p<0.0001$) supports its efficacy in treating IDA in COPD, though ACD's inflammatory basis may require additional anti-inflammatory interventions (33). The lack of significant differences in airway obstruction across age groups ($p=0.2922$) aligns with findings that age alone does not dictate COPD progression (34).

Lower BMI in severe COPD (17.04) compared to mild (23.96) and moderate (22.16) cases ($p<0.001$) reflects cachexia and systemic inflammation, which may exacerbate anemia but was not significant in mild-moderate groups, consistent with prior research (35). These results justify the need for routine anemia screening in COPD, particularly in regions like India with high COPD and nutritional deficiency burdens, to improve patient outcomes through targeted interventions (9, 26)

5. CONCLUSION

The study highlights that anemia is a prevalent comorbidity in COPD patients, affecting 19.33% of the 150 participants, with a higher occurrence in females. The significant association between anemia and mild COPD suggests early inflammatory changes play a key role, while the lack of anemia in severe cases may reflect the study's limited sample size in this group. Iron supplementation effectively improved hemoglobin and serum ferritin levels, indicating its potential in managing anemia in COPD, particularly for iron deficiency anemia. The findings underscore the importance of routine anemia screening in COPD patients, especially in resource-limited settings like India, to enhance quality of life and reduce disease burden. Integrated management addressing inflammation, nutrition, and COPD severity is essential for optimizing patient outcomes.

REFERENCES

[1] Global Initiative for Chronic Obstructive Lung Disease. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: 2023 report. GOLD; 2023.
[2] Salvi S, Agrawal A. India needs a national COPD prevention and control programme. J Assoc Physicians India. 2012;60:5-7.
[3] World Health Organization. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Geneva: WHO; 2011.
[4] Weiss G, Goodnough LT. Anemia of chronic disease. N Engl J Med. 2005;352(10):1011-23.
[5] Kassebaum NJ, Jasrasaria R, Naghavi M, et al. A systematic analysis of global anemia burden from 1990 to 2010. Blood. 2014;123(5):615-24.
[6] Martinez FJ, Mannino D, Curtis JL, et al. Anemia and outcomes in chronic obstructive pulmonary disease. Chest. 2009;135(2):332-7.
[7] Yohannes AM, Ershler WB. Anemia in COPD: a systematic review of the prevalence, quality of life, and mortality. Respir Care. 2011;56(4):443-50.
[8] Jindal SK, Aggarwal AN, Gupta D. A review of population studies from India to estimate national burden of chronic obstructive pulmonary disease. Indian J Chest Dis Allied Sci. 2011;53(3):139-45.
[9] [No author listed]. Study on anemia in COPD patients conducted at a tertiary care hospital in northern India. [Unpublished data]; 2025.
[10] Boutou AK, Stanopoulos I, Pitsiou GG, et al. Anemia of chronic disease in chronic obstructive pulmonary disease: a case-control study of cardiopulmonary exercise testing. Respiration. 2011;82(3):237-43.
[11] Ganz T. Anemia of inflammation. N Engl J Med. 2019;381(12):1148-57.
[12] Nemeth E, Ganz T. The role of hepcidin in iron metabolism. Acta Haematol. 2009;122(2-3):78-86.

[13] Barnes PJ. Oxidative stress in chronic obstructive pulmonary disease. Antioxid Redox Signal. 2022;37(7-9):417-30.
[14] Stein J, Connor S, Virgin G, et al. Anemia and iron deficiency in gastrointestinal and liver conditions: a systematic review. Am J Gastroenterol. 2016;111(12):1680-91.
[15] Celli BR, Cote CG, Marin JM, et al. The body-mass index, airflow obstruction, dyspnea, and exercise capacity index in chronic obstructive pulmonary disease. N Engl J Med. 2004;350(10):1005-12.
[16] Barba R, de Casasola GG, Marco J, et al. Anemia in chronic obstructive pulmonary disease: a readmission prognostic factor. J Hosp Med. 2012;7(4):334-9.
[17] Chambellan A, Chailleux E, Similowski T, et al. Prognostic value of the hematocrit in patients with severe COPD receiving long-term oxygen therapy. Chest. 2005;128(3):1201-8.
[18] Kassebaum NJ. The global burden of anemia. Hematol Oncol Clin North Am. 2016;30(2):247-308.
[19] Halpern MT, Zilberberg MD, Schmier JK, et al. Anemia, costs and mortality in chronic obstructive pulmonary disease. Cost Eff Resour Alloc. 2006;4:17.
[20] John M, Hoernig S, Doehner W, et al. Anemia and inflammation in COPD. Chest. 2005;127(3):825-9.
[21] Rabe KF, Hurd S, Anzueto A, et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary. Am J Respir Crit Care Med. 2007;176(6):532-55.
[22] Silverberg DS, Iaina A, Wexler D, et al. The pathological consequences of anaemia. Clin Lab Haematol. 2001;23(1):1-6.
[23] Balarajan Y, Ramakrishnan U, Ozaltin E, et al. Anaemia in low-income and middle-income countries. Lancet. 2011;378(9809):2123-35.
[24] Shorr AF, Doyle J, Stern L, et al. Anemia in chronic obstructive pulmonary disease: epidemiology and economic implications. Lung. 2008;186(3):149-54.
[25] Rajkumar P, Pattabi K, Vadivoo S, et al. A cross-sectional study on prevalence of chronic obstructive pulmonary disease (COPD) in India: reasons for underdiagnosis and role of primary care physicians. J Family Med Prim Care. 2017;6(3):454-9.
[26] Similowski T, Agustí A, MacNee W, et al. The potential impact of anaemia of chronic disease in COPD. Eur Respir J. 2006;27(2):390-6.
[27] Portillo K, Martinez-Rivera C, Ruiz-Manzano J. Anaemia in chronic obstructive pulmonary disease: does it really matter? Int J Clin Pract. 2013;67(6):558-65.
[28] Tanni SE, Pelegrino NR, Angeleli AY, et al. Systemic inflammation and anemia in chronic obstructive pulmonary disease. J Bras Pneumol. 2010;36(6):793-8.
[29] ohn M, Hoernig S, Doehner W, et al. Anemia and inflammation in COPD. Chest. 2005;127(3):825-9.
[30] Boutou AK, Stanopoulos I, Pitsiou GG, et al. Anemia of chronic disease in chronic obstructive pulmonary disease: a case-control study of cardiopulmonary exercise testing. Respiration. 2011;82(3):237-43.
[31] Weiss G, Goodnough LT. Anemia of chronic disease. N Engl J Med. 2005;352(10):1011-23.
[32] Chambellan A, Chailleux E, Similowski T, et al. Prognostic value of the hematocrit in patients with severe COPD receiving long-term oxygen therapy. Chest. 2005;128(3):1201-8.
[33] Silverberg DS, Iaina A, Wexler D, et al. The pathological consequences of anaemia. Clin Lab Haematol. 2001;23(1):1-6.
[34] Celli BR, Cote CG, Marin JM, et al. The body-mass index, airflow obstruction, dyspnea, and exercise capacity index in chronic obstructive pulmonary disease. N Engl J Med. 2004;350(10):1005-12.
[35] Shorr AF, Doyle J, Stern L, et al. Anemia in chronic obstructive pulmonary disease: epidemiology and economic implications. Lung. 2008;186(3):149-54