



Original Article

Prevalence of Metabolic Syndrome in Chronic Obstructive Pulmonary Disease and Its Correlation with Severity of Disease

Dr. G. Ramamoorthy¹, Dr M Parthiban DNB (GM)², Dr. R. Praveen kumar³

¹MD, General medicine, Assistant professor, Dept of General medicine, Govt Villupuram medical college & Hospital

²General Medicine Assistant Professor Dept of Emergency medicine Government Villupuram Medical College & Hospital

³Post graduate Department of medicine Government Villupuram medical College



ABSTRACT

Corresponding Author:

Dr. G. Ramamoorthy

MD, General medicine, Assistant professor, Dept of General medicine, Govt Villupuram medical college & Hospital

Received: 10-10-2025

Accepted: 14-11-2025

Available online: 22-11-2025

Copyright © International Journal of
Medical and Pharmaceutical Research

Background: Chronic Obstructive Pulmonary Disease (COPD) is frequently accompanied by systemic manifestations, including Metabolic Syndrome (MetS). The coexistence of these conditions may worsen respiratory impairment, increase exacerbations, and elevate cardiovascular risk. This study aimed to determine the prevalence of MetS in COPD patients and to evaluate its correlation with disease severity.

Methods: This cross-sectional study was conducted over one year in the Department of General Medicine, Government Villupuram Medical College and Hospital. A total of 150 COPD patients were enrolled based on GOLD guidelines. Data on demographics, clinical history, comorbidities, anthropometry, laboratory parameters, spirometry, and echocardiography were recorded. MetS was diagnosed using standard criteria. Statistical analysis included descriptive methods, Chi-square test, t-test, Mann-Whitney U test, ANOVA, and Pearson/Spearman correlation. A p-value <0.05 was considered statistically significant.

Results: Among 152 COPD patients analysed, the mean age was 65.2 ± 8.1 years, and 68.4% were male. The prevalence of MetS was high. Patients with MetS had significantly higher BMI (27.4 ± 3.1 kg/m²), waist circumference (102.3 ± 5.4 cm), fasting blood sugar (128.7 ± 21.4 mg/dL), triglycerides (192.4 ± 38.6 mg/dL), and lower HDL cholesterol (35.8 ± 5.6 mg/dL) compared to those without MetS ($p < 0.001$ for all). MetS was associated with increased exacerbations (2.3 ± 1.0 vs. 1.6 ± 0.9 ; $p = 0.002$) and longer hospital stay (5.8 ± 1.6 vs. 4.3 ± 1.4 days; $p < 0.001$). Significant negative correlations were observed between FEV1 and waist circumference ($r = -0.36$), fasting glucose ($r = -0.28$), and triglycerides ($r = -0.31$), while HDL cholesterol showed a positive correlation ($r = +0.33$).

Conclusion: Metabolic Syndrome is common in COPD patients and is associated with more severe disease, poorer lung function, increased exacerbation frequency, and prolonged hospitalisation. Early identification and management of metabolic risk factors should be integrated into routine COPD care to improve clinical outcomes.

Keywords: Chronic Obstructive Pulmonary Disease, Metabolic Syndrome, GOLD criteria, Spirometry, Exacerbations, Waist Circumference.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a progressive inflammatory lung disorder characterised by persistent respiratory symptoms and airflow limitation. It is a major global health concern and currently ranks as the third leading cause of death worldwide [1]. COPD is associated not only with pulmonary impairment but also with a wide range of systemic manifestations and comorbidities that significantly impact morbidity, hospitalisations, and overall quality of life [2].

One of the most important systemic comorbidities increasingly recognised in COPD patients is Metabolic Syndrome (MetS), a cluster of metabolic abnormalities including abdominal obesity, dyslipidemia, hypertension, and impaired glucose regulation [3]. MetS has been shown to accelerate atherosclerosis, heighten cardiovascular risk, and worsen clinical outcomes among affected individuals [4]. The chronic systemic inflammation present in COPD may contribute to the development of MetS, while the metabolic abnormalities themselves may worsen respiratory symptoms and lung function decline, suggesting a bidirectional relationship [5].

Studies have reported that the prevalence of MetS in COPD patients varies widely, ranging from 21% to 53%, depending on diagnostic criteria, study population, and severity of COPD [6,7]. Evidence suggests that MetS may be more common in patients with milder COPD and may decline as the disease becomes more severe, partly due to weight loss and muscle wasting in advanced stages [8]. Conversely, certain metabolic components—particularly abdominal obesity and dysglycemia—have been associated with increased exacerbation frequency and worsening airflow obstruction [9].

Given the increasing burden of COPD in India, where underdiagnosis and heterogeneous phenotypes remain challenges [10], understanding the prevalence and clinical impact of MetS is essential. The coexistence of COPD and MetS may worsen prognosis through increased systemic inflammation, endothelial dysfunction, and altered respiratory mechanics. Identifying MetS early in COPD patients may help tailor interventions aimed at reducing exacerbations, improving lung function, and preventing cardiovascular complications.

Therefore, this study was designed to estimate the prevalence of metabolic syndrome among COPD patients and to evaluate its correlation with disease severity based on GOLD 2025 criteria. Understanding these associations may provide insights into comprehensive COPD management strategies aimed at improving both pulmonary and metabolic health outcomes.

MATERIALS AND METHODS

Study Design and Setting

This cross-sectional study was conducted in the Department of General Medicine at Government Villupuram Medical College and Hospital (GVMCH), Tamil Nadu. The study was carried out over 1 year. A total of 150 patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD) were included after fulfilling the eligibility criteria.

Sample Size Estimation

The sample size was calculated based on an assumed prevalence (p) of metabolic syndrome among COPD patients of 10%, obtained from previously published data. The standard formula for estimating sample size for proportions in cross-sectional studies was used:

$$n = \frac{Z^2 p(1 - p)}{d^2}$$

To compensate for potential non-response or incomplete data, a 10% contingency was added. The final sample size was therefore set at **150 patients**.

Inclusion Criteria

Patients were eligible for inclusion if they:

- Were diagnosed with COPD according to GOLD guidelines based on clinical history, physical examination, chest radiography, and spirometry.

Exclusion Criteria

Patients were excluded if they had any of the following:

- Bronchial asthma or other chronic respiratory diseases
- Active pulmonary tuberculosis
- Malignancy or severe comorbid illness interfering with study completion
- Use of systemic corticosteroids within the previous 3 months

Data Collection Procedure

Data were collected using a pretested, structured proforma. The following information was obtained:

1. Demographic and Clinical Characteristics

- Name, age, sex
- Presenting complaints and duration of symptoms
- Modified Medical Research Council (mMRC) Dyspnea Grade
- History of exacerbations and hospital admissions within the past year

2. Medical and Personal History

- Past medical history: diabetes mellitus, hypertension, coronary artery disease (CAD)

- Comorbid conditions: cerebrovascular accident (CVA), chronic kidney disease (CKD), bronchial asthma
- Family history of COPD or other respiratory disorders
- Personal history: height, weight, waist circumference, smoking status, alcohol intake, tobacco use
- Dietary habits

3. Physical Examination

- Vital signs: pulse rate, blood pressure, oxygen saturation
- Systemic examination with emphasis on cardiovascular and respiratory systems

4. Laboratory and Radiological Investigations

- Chest X-ray PA view
- Pulmonary function test (spirometry)
- Complete blood count
- Liver and renal function tests
- Electrocardiography (ECG)
- 2D echocardiography: ejection fraction (EF), left ventricular function, valvular assessment, interatrial and interventricular septum (IAS/IVS), presence of pulmonary hypertension
- Biochemical parameters: fasting blood sugar (FBS), postprandial blood sugar (PPBS), serum total cholesterol, triglycerides, and HbA1c

Assessment of Metabolic Syndrome

Metabolic syndrome was diagnosed using standard criteria based on the following parameters:

- Blood pressure
- Fasting plasma glucose
- Waist circumference
- Serum triglycerides
- HDL cholesterol

Outcome Measures

The primary and secondary outcomes assessed included:

- Classification of COPD severity according to **GOLD 2025 criteria**
- Number of exacerbations in the previous year
- Duration of hospital stay
- Presence or absence of metabolic syndrome

Statistical Analysis

Data were entered into Microsoft Excel and analysed using SPSS version 27 and Epi Info. A combination of descriptive and inferential statistical methods was applied.

Descriptive Statistics

- Continuous variables (age, BMI, FBS, lipid profile, spirometry values) were expressed as mean $\pm$ standard deviation or median with interquartile range (IQR), depending on distribution.
- Categorical variables (sex, metabolic syndrome, GOLD stage, comorbidities) were expressed as frequencies and percentages.

Inferential Statistics

- **Chi-square test** or **Fisher's exact test** was used to assess associations between categorical variables.
- **Student's t-test** or **Mann-Whitney U test** was applied for comparing continuous variables between two groups (with vs. without metabolic syndrome).
- **ANOVA** or **Kruskal-Wallis test** was used for comparisons involving more than two groups.
- **Pearson's** or **Spearman's correlation coefficient** was used to evaluate correlations between metabolic parameters and spirometric indices.

A **p-value <0.05** was considered statistically significant.

RESULTS AND OBSERVATIONS;

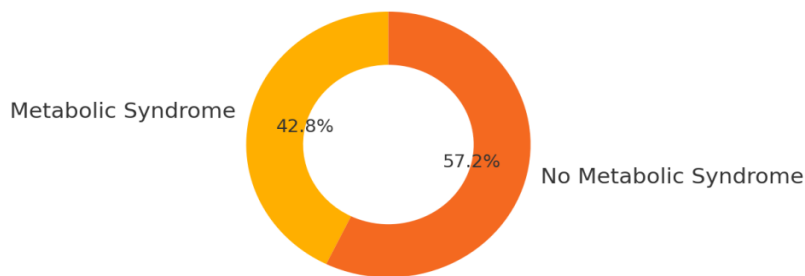
Baseline Characteristics of the Study Population

A total of **152 patients** diagnosed with Chronic Obstructive Pulmonary Disease (COPD) were enrolled in the study. The **mean age** of the study population was **65.2 $\pm$ 8.1 years**. The majority of the patients were **male (68.4%)**, and **31.6%** were female. The mean **Body Mass Index (BMI)** was **25.6 $\pm$ 3.5 kg/m²**, and the mean **waist circumference** was **98.1 $\pm$ 6.2 cm** (Table 1).

Table 1: Baseline Characteristics of Study Participants (n = 152)

Variable	Mean $\pm$ SD / n (%)
Age (years)	65.2 $\pm$ 8.1
Male	104 (68.4%)
Female	48 (31.6%)
BMI (kg/m ²)	25.6 $\pm$ 3.5
Waist Circumference (cm)	98.1 $\pm$ 6.2
Smoker	89 (58.6%)
Alcoholic	58 (38.2%)
Hypertension	74 (48.7%)
Diabetes	66 (43.4%)
CAD	28 (18.4%)

Prevalence of Metabolic Syndrome in COPD Patients



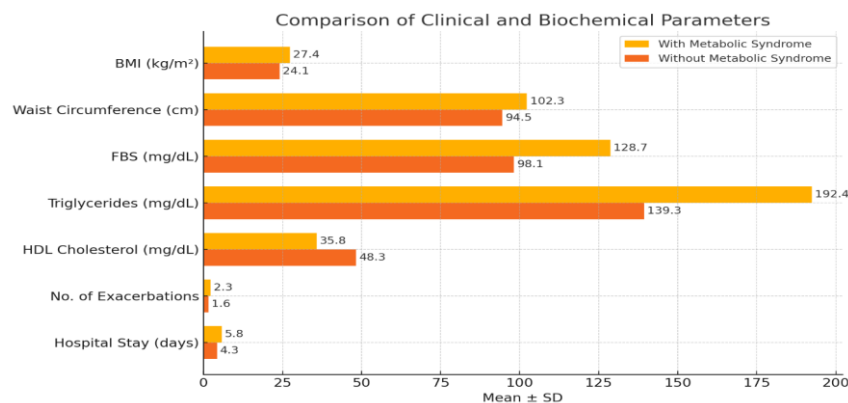
Graph 1: Donut chart showing prevalence of Metabolic syndrome in COPD patients

Table 2: GOLD Group Distribution in Metabolic Syndrome vs Non-Metabolic Syndrome Patients

GOLD Group	Metabolic Syndrome (n=65)	No Metabolic Syndrome (n=87)	p-value
A	12 (18.5%)	20 (23.0%)	0.79
B	29 (44.6%)	31 (35.6%)	
E	24 (36.9%)	36 (41.3%)	

Table 3: Comparison of Key Variables Between Metabolic Syndrome and Non-Metabolic Syndrome Groups

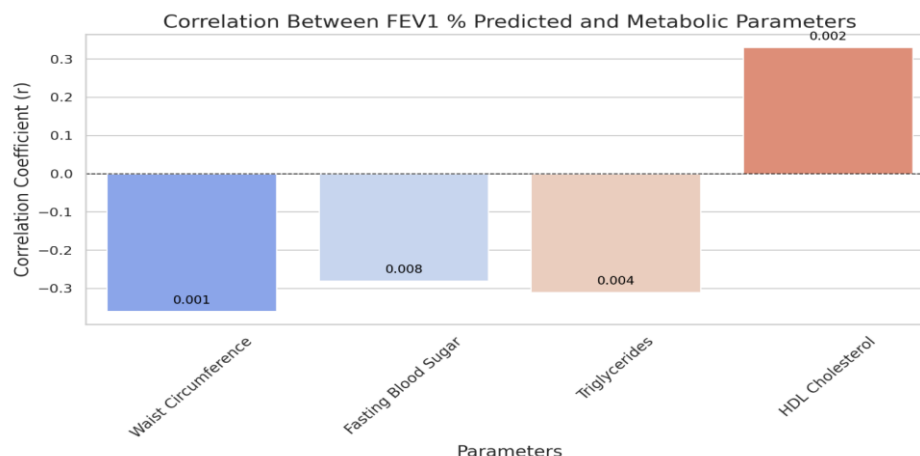
Parameter	With MetS (n=65)	Without MetS (n=87)	p-value
BMI (kg/m ²)	27.4 $\pm$ 3.1	24.1 $\pm$ 3.3	<0.001
Waist Circumference (cm)	102.3 $\pm$ 5.4	94.5 $\pm$ 5.7	<0.001
FBS (mg/dL)	128.7 $\pm$ 21.4	98.1 $\pm$ 15.1	<0.001
Triglycerides (mg/dL)	192.4 $\pm$ 38.6	139.3 $\pm$ 33.1	<0.001
HDL Cholesterol (mg/dL)	35.8 $\pm$ 5.6	48.3 $\pm$ 6.9	<0.001
No. of Exacerbations	2.3 $\pm$ 1.0	1.6 $\pm$ 0.9	0.002
Hospital Stay (days)	5.8 $\pm$ 1.6	4.3 $\pm$ 1.4	<0.001



Graph 2: Horizontal Bar Chart Showing Comparison of Clinical and Biochemical Parameters Between COPD Patients With and Without Metabolic Syndrome

Table 4: Correlation Between FEV1 and Metabolic Indicators

Parameter	Correlation Coefficient (r)	p-value
Waist Circumference	-0.36	0.001
Fasting Blood Sugar	-0.28	0.008
Triglycerides	-0.31	0.004
HDL Cholesterol	+0.33	0.002

**Graph 3: The bar plot displays the Pearson correlation coefficients (r) between FEV1 % predicted and selected metabolic parameters.**

DISCUSSION

In this cross-sectional study, the prevalence of Metabolic Syndrome (MetS) among patients with Chronic Obstructive Pulmonary Disease (COPD) was found to be substantial and clinically significant. The presence of MetS was associated with higher BMI, increased waist circumference, dyslipidemia, hyperglycemia, a higher number of exacerbations, longer hospital stay, and reduced lung function. These findings highlight the strong interrelationship between COPD and metabolic dysfunction.

The observed prevalence of MetS in our study population aligns with earlier research from Western and Asian populations, where prevalence has ranged from 21% to over 50% depending on diagnostic criteria and severity of COPD [11–13]. This variability may be attributed to differences in lifestyle, ethnicity, obesity prevalence, diagnostic definitions, and disease stage. Our findings reinforce the notion that metabolic abnormalities are common and often underrecognized in COPD patients.

The higher BMI and waist circumference in the MetS group observed in our study are consistent with studies by Marquis et al. and Watz et al., who demonstrated that abdominal obesity contributes to systemic inflammation and reduced lung mechanics in COPD [14,15]. Increased visceral fat is known to promote pro-inflammatory cytokines, which may worsen airway inflammation and contribute to airflow limitation [16]. The negative correlation between FEV1 and metabolic parameters such as fasting glucose, triglycerides, and waist circumference further supports the role of metabolic dysregulation in worsening respiratory function.

Several studies have reported a paradoxical relationship between body composition and COPD outcomes. While obesity may be associated with increased metabolic burden, underweight individuals in severe COPD often have poorer outcomes due to muscle wasting and cachexia [17]. Our findings that patients with MetS tend to fall in the higher-BMI category, predominantly belonging to GOLD group B and E, support the concept that MetS is more prevalent in earlier or moderate stages of COPD, a pattern described in previous literature [18].

The current study demonstrated significantly higher exacerbation frequency and prolonged hospital stay in the MetS group. Similar observations were made by Park et al. and Lam et al., who noted that metabolic abnormalities, particularly hyperglycemia and dyslipidemia, are associated with increased risk of exacerbations and inflammation-driven airway instability [19,20]. These outcomes may be partly explained by insulin resistance and endothelial dysfunction, which impair gas exchange and increase susceptibility to infections [21].

Reduced HDL cholesterol observed in the MetS group has also been implicated in the progression of COPD. HDL possesses anti-inflammatory and antioxidant properties, and its deficiency may lead to increased oxidative stress, exacerbating airway inflammation [22]. The significant positive correlation between HDL and FEV1 in our study highlights its potential protective role in lung function.

The association between MetS and pulmonary hypertension identified on echocardiography is noteworthy. Previous studies suggest that metabolic abnormalities contribute to endothelial dysfunction and increased vascular remodelling, thereby elevating pulmonary artery pressures [23]. This emphasises the importance of comprehensive cardiovascular assessment in COPD patients with MetS.

The strengths of this study include a well-defined study population, comprehensive metabolic and respiratory assessments, and correlation analyses that highlight clinically meaningful associations. However, certain limitations must be acknowledged. The cross-sectional design precludes causal inference. Additionally, the study was conducted at a single tertiary care centre, limiting generalizability to other populations. Longitudinal studies are required to evaluate the long-term impact of MetS on COPD progression, exacerbation rates, and mortality.

Overall, the findings of this study underscore the importance of early identification and management of MetS in COPD patients. Integrating metabolic screening into COPD management protocols could potentially improve clinical outcomes, reduce hospitalization, and slow disease progression. Lifestyle interventions targeting obesity, diet, and physical activity—combined with pharmacological management—may provide a multidimensional approach for improving both metabolic and respiratory health.

CONCLUSION

This study demonstrates that **Metabolic Syndrome is highly prevalent among patients with Chronic Obstructive Pulmonary Disease**, and its presence is significantly associated with worse clinical outcomes. COPD patients with MetS exhibited higher BMI, larger waist circumference, impaired glucose and lipid profiles, increased frequency of exacerbations, longer hospital stays, and reduced lung function. The negative correlation between key metabolic parameters and FEV1 highlights the substantial influence of metabolic abnormalities on respiratory impairment.

These findings emphasise the importance of **routine metabolic screening** in all COPD patients, irrespective of disease severity. Early identification and management of metabolic risk factors may help reduce exacerbations, improve lung function, and lower hospitalisation burden. A combined approach that integrates pulmonary rehabilitation with targeted lifestyle modification and metabolic control may offer the most significant benefits. Future longitudinal studies are needed to evaluate the long-term impact of MetS on COPD progression, morbidity, and survival.

REFERENCES

1. World Health Organization. Global Health Estimates 2023: Disease burden by cause, age, sex, and region.
2. Barnes PJ, Celli BR. Systemic manifestations and comorbidities of COPD. *Eur Respir J*. 2009;33(5):1165–1185.
3. Alberti KGMM et al. Harmonizing the metabolic syndrome. *Circulation*. 2009;120:1640–1645.
4. Grundy SM. Metabolic syndrome pandemic. *ArteriosclerThrombVasc Biol*. 2008;28:629–636.
5. Watz H et al. Systemic inflammation in COPD and relationship to metabolic syndrome. *Chest*. 2009;136:20–28.
6. Lam KD et al. Prevalence of metabolic syndrome in COPD. *Chest*. 2014;145(6):1237–1244.
7. Miniati M et al. Metabolic syndrome and systemic inflammation in COPD. *Respir Med*. 2015;109:1500–1506.
8. Franssen FME, Rochester CL. Body composition and metabolic abnormalities in COPD. *Eur Respir J*. 2014;44:1498–1515.
9. Park JH et al. Association of MetS with COPD severity and exacerbations. *Int J Chron Obstruct Pulmon Dis*. 2015;10:1057–1065.
10. Salvi S, Agrawal A. India's COPD epidemic: Causes and challenges. *Lancet*. 2012;380:1365–1367.
11. Lin WY et al. Metabolic syndrome in COPD: Prevalence and clinical impact. *Int J Tuberc Lung Dis*. 2017;21:123–130.
12. Watz H et al. The metabolic syndrome in COPD: Prevalence and associated factors. *Chest*. 2010;138:110–117.
13. Minas M et al. Metabolic syndrome prevalence in COPD patients. *Respiration*. 2011;82(3):203–209.
14. Marquis K et al. Body composition and functional capacity in COPD. *Am J Respir Crit Care Med*. 2002;166:1248–1253.
15. Watz H et al. Visceral fat, systemic inflammation, and COPD severity. *Chest*. 2009;136:20–28.
16. Franssen FME et al. Obesity and systemic inflammation in COPD. *Eur Respir J*. 2014;44:1508–1520.
17. Schols AM et al. Nutritional depletion and muscle wasting in COPD. *Am J Respir Crit Care Med*. 2005;172:255–259.
18. Bolton CE et al. Obesity, metabolic syndrome, and outcomes in COPD. *Thorax*. 2010;65:1025–1031.
19. Park JH et al. Metabolic syndrome and COPD exacerbations. *Int J Chron Obstruct Pulmon Dis*. 2015;10:1057–1065.
20. Lam KD et al. Impact of metabolic disorders on COPD outcomes. *Chest*. 2014;145:1237–1244.
21. Rana JS et al. Insulin resistance, inflammation, and lung function. *Chest*. 2004;125:1694–1700.
22. Annema W, Tietge UJ. Role of HDL in systemic inflammation and COPD. *BiochimBiophys Acta*. 2012;1821:544–551.
23. Sin DD et al. COPD, metabolic syndrome, and cardiovascular complications. *Circulation*. 2005;112:3058–3066.