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

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Abstract: *Background: Chronic Obstructive Pulmonary Disease (COPD) is a systemic inflammatory disease frequently associated with comorbidities like Metabolic Syndrome (MS), which may worsen clinical outcomes. Aim: To determine prevalence of MS in COPD patients and its association with severity of Airflow obstruction. Objective: To determine the prevalence of MS in COPD patients and assess its relationship with disease severity based on GOLD spirometric classification. Methods: This cross-sectional study was conducted on 100 spirometry-confirmed COPD patients at a teritiary care centre in a semi urban area, from September 2023 to February 2024. MS was diagnosed using modified NCEP ATP III criteria. Demographic, clinical, and biochemical profiles were collected and analyzed. Results: MS was present in 48% of patients, with significantly higher prevalence in females (62.5%) than males (41.1%). Most MS patients belonged to GOLD stage II. Though FEV_1 was slightly higher in MS patients, the difference was not statistically significant. Conclusion: Metabolic Syndrome is prevalent among COPD patients, especially in women and those with moderate disease. Routine screening and early intervention may improve outcomes.*

Keywords: COPD, Metabolic Syndrome, GOLD Classification, Spirometry, Comorbidities

1. Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a major public health concern worldwide, ranking among the leading causes of morbidity and mortality. Characterized by persistent airflow limitation and chronic inflammation, COPD is increasingly recognized as a systemic illness with various comorbidities. Comorbidities are common at any severity of COPD. MS is one of the comorbidities seen commonly in COPD patients which can impact the risk of hospitalizations and prognosis in them

MS is defined as cluster of five components: High Blood pressure, High triglyceride level (TG), low high density lipoprotein cholesterol (HDL), Abdominal obesity (WC) and Blood glucose level (FBS). MS significantly increase the risk for cardiovascular diseases.

Definition of MS was based on modified NCEP ATP III criteria proposed by the AHA/NHLBI (2005), which included 3 or more of following parameters to ascertain the presence of MS

Parameters	
Abdominal obesity/waist circumference (WC)	Men (90cm), Women (80cm)
Triglyceride (TG)	150mg/di or more, or on treatment for elevated TG levels
Blood pressure	
SBP	130mmhg or more
DBP	85mmhg or more
FBS	110mg/dl or more
HDL	<40mg/dl in Men and <50mg/dl in Women or drug treatment for reduced HDL levels

Severity of COPD according to GOLD guidelines

	Severity	FEV1/FVC	PREDICTEDFEV1
Gold 1	Mild COPD	<0.7	>=80%
Gold 2	Moderate COPD	<0.7	50%>= FEV1<80%
Gold 3	Severe COPD	<0.7	30%>= FEV1 <50%
Gold 4	Very Severe COPD	<0.7	<30%

COPD and MS share overlapping risk factors such as aging, smoking, inactivity, and systemic inflammation. Their coexistence not only increases the disease burden but also complicates disease management. Despite the growing body of literature, MS remains underdiagnosed in COPD, particularly in developing countries. Prevalence of MS in people with COPD has been estimated to be between 21%-53%. If MS are detected early, and managed risk of hospitalization can be minimized

This study was conducted to estimate the prevalence of MS in COPD patients and evaluate its association with airflow obstruction severity.

2. Materials and Methods

It is a Hospital-based cross-sectional study done on 100 spirometry confirmed COPD patients from September 2023 to February 2024 after taking informed consent.

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Data Collection: Demographic data, BMI, waist circumference, blood pressure, and smoking history were recorded. Biochemical tests included fasting glucose, HDL, and triglycerides done. Spirometry done in all these patients to confirm the diagnosis and grade the severity of disease

Data collected was analyzed using SPSS v26. Continuous variables were expressed as mean ± SD. p<0.05 was considered statistically significant.

Inclusion Criteria:
- Age ≥ 40 years
- Diagnosed COPD (post-bronchodilator $FEV_1/FVC < 0.70$)
- Clinically stable

Exclusion Criteria:
- Any chronic lung disease other than COPD (Asthma, interstitial lung disease, active tuberculosis infection)
- Systemic corticosteroid therapy for other conditions causing Metabolic syndrome
- Severe comorbid illnesses other than Diabetes, Hypertension

3. Results

Demographic Characteristics:
The study included 100 COPD patients: 68 males and 32 females. The mean age of patients with MS was 58.65 ± 9.39 years, slightly lower than those without MS (59.38 ± 8.06 years), although the difference was not statistically significant.

Gender	Number of Patients
Male	68 (68%)
Female	36 (36%)
Total	100

Age Group	Number of Patients	% Of Patients
45-54	24	24%
55-64	30	30%
65-74	30	30%
>=75	16	16%

Prevalence of Metabolic Syndrome:
MS was diagnosed in 48 out of 100 patients, of which 28 were males and 20 were females. 20 (62.5%) out of 36 females included in study detected with MS and 28(41.1%) out of 68 males included had MS. Thus, MS was significantly more common among females.

Demographic and functional profile	COPD with MS (Mean ± SD / n, %)	COPD without MS (Mean ± SD / n, %)	t	Total (Mean ± SD / n, %)
No of cases	48 (48%)	52 (52%)	—	100 (100%)
Sex (Male)	28 (41.1%)	40 (58.9%)	—	68 (68%)
(Female)	12 (62.5%)	20 (37.5%)	—	32 (32%)
Age	58.65 ± 9.39	59.38 ± 8.060	0.743	59.71 ± 8.925
FEV1%	46.7 ± 9.7	45.6 ± 12.7	0.486	46.77 ± 11.79
Waist circumference (cm)	89.96 ± 7.74	78.71 ± 6.52	7.775	84.73 ± 9.43
SBP (mmHg)	134.73 ± 11.95	114.71 ± 12.37	8.174	124.23 ± 12.87
DBP (mmHg)	81.24 ± 9.46	72.84 ± 6.65	5.094	76.74 ± 7.95
FBS (mg/dl)	111.98 ± 19.22	92.58 ± 8.50	6.262	101.08 ± 16.74
Serum TG (mg/dl)	163.89 ± 17.78	140.62 ± 11.51	7.873	149.25 ± 19.64
Serum HDL (mg/dl)	38.80 ± 6.59	48.58 ± 5.96	-5.321	44.69 ± 8.42

Prevalence of MS found to be more among females 20 of 32(62.5%) than in males 28 of 68(41.1%). All components of MS except TG levels was found to be higher among females. Among the components of MS,when compared b/w males and females the WC and HDL levels were found to be statistically significant

Components of MS	Male (n, %)	Female (n, %)	Chi-square	Total (n, %)
Increased waist circumference	24 (35.3%)	23 (71.9%)	11.698	47 (47%)
High glucose level	18 (26.5%)	11 (34.4%)	0.66	29 (29%)
High BP	31 (45.6%)	20 (62.5%)	2.49	51 (51%)
High Serum TG	37 (54.4%)	9 (28.1%)	0.581	46 (46%)
Low HDL level	26 (38.2%)	25 (78.1%)	13.855	51 (51%)
Metabolic syndrome	35 (51.5%)	20 (62.5%)	1.07	55 (55%)

GOLD Staging and MS Prevalence:
Most patients with MS were classified under GOLD stage II (44.6%) (moderate airflow limitation), suggesting a peak prevalence in this group. The number of MS cases progressively declined in stages III and IV. Few MS patients

were identified in stage IV, potentially due to weight loss and cachexia in advanced COPD, which would have mask the diagnostic criteria for MS.

Gold stage	Metabolic Syndrome					
	Present		Absent		Total	
Stage 1	11	23.40%	14	26.40%	25	25%
Stage 2	21	44.60%	20	37.70%	41	41%
Stage 3	11	23.40%	14	26.40%	25	25%
Stage 4	4	8.50%	5	9.40%	9	9%

Pulmonary Function:
The mean post-bronchodilator FEV_1 in patients with MS was 46.7 ± 9.7%, compared to 45.6 ± 12.7% in those without MS. Although the FEV_1 was marginally higher in MS patients, the difference was not statistically significant.

4. Discussion

This study demonstrates that metabolic syndrome is highly prevalent among COPD patients, affecting nearly half of the study population. The prevalence observed here (48%) aligns with previously reported values from both Indian and

global literature, including studies by Sahoo et al. (42.1%), Acharyya et al. (44%), and Díez-Manglano et al. (42.9%).

A higher prevalence of MS in females observed in our study is consistent with other reports. Hormonal and lifestyle differences, along with increased visceral adiposity, may contribute to this gender disparity. Notably, all MS components—except triglycerides—were worse among females, with WC and HDL levels showing significant differences.

Interestingly, patients with MS had slightly better FEV_1 values compared to those without MS. This could reflect the inverse relationship between disease severity and body weight observed in advanced COPD. As the disease progresses, weight loss becomes prominent due to increased energy expenditure and muscle wasting, potentially leading to underdiagnosis of MS in severe cases.

Systemic inflammation is a key feature in both MS and COPD, and may explain their overlap. Elevated levels of inflammatory cytokines such as TNF-alpha, IL-6, and CRP have been implicated in the pathogenesis of both conditions. It is therefore plausible that chronic systemic inflammation links the two diseases and contributes to their progression

Clinical implications of MS in COPD are substantial. MS has been associated with increased risk of cardiovascular events, more frequent exacerbations, longer hospital stays, and worse overall prognosis. Screening for MS in COPD patients offers an opportunity for early intervention through lifestyle modification, pharmacological management, and integrated care.

5. Conclusion

Metabolic syndrome is a common and clinically significant comorbidity in patients with COPD, affecting individuals across all stages of the disease. It is more prevalent among women and in patients with moderate airflow limitation. The coexistence of MS may affect COPD outcomes and increase healthcare burden through frequent exacerbations and hospitalizations.

Routine screening for MS should be incorporated into the clinical evaluation of all COPD patients, regardless of disease stage. Early diagnosis and management of metabolic risk factors can potentially improve long-term outcomes and quality of life.

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