Original Article

Metabolic Syndrome in Patients with Chronic Obstructive Pulmonary Disease

Mushahid Ali[1], Pireh[2], Syed Zulfiquar Ali Shah[3], Muhammad Kashif Shaikh[4], Rabia Anis[5], Sidra Ghori[6]

[1,3,4,5]Liaquat University of Medical and Health Sciences (LUMHS) Jamshoro; [2]Liaquat University Hospital, Hyderabad / Jamshoro; [6]Indus Medical College, Tando Muhammad Khan

Corresponding Author: Dr. Syed Zulfiquar Ali Shah, Assistant Professor, Department of Medicine, Liaquat University of Medical and Health Sciences (LUMHS) Jamshoro **Email:** zulfikar229@hotmail.com

Abstract

Background: People with chronic obstructive pulmonary disease (COPD) often have metabolic syndrome (MetS), which raises the risk of heart problems.

Objective: To assess the prevalence of metabolic syndrome among patients diagnosed with COPD at Liaquat University Hospital, Hyderabad/Jamshoro.

Methods: The department of medicine at Liaquat University Hospital in Hyderabad conducted this cross-sectional observational study from October 1, 2024, to March 31, 2025. Patients aged 35 to 70 years, of either gender, who fulfilled the diagnostic criteria for COPD, were included. Each participant underwent a comprehensive clinical assessment to screen for features suggestive of metabolic syndrome. Descriptive statistics were used to analyses the data that was gathered. Whereas categorical variables were summed up as frequencies and percentages, continuous variables were displayed as means with standard deviations.

Results: Out of the 146 patients enrolled in the study, 90 (61.6%) were identified as having metabolic syndrome. The statistical analysis demonstrated meaningful associations between metabolic syndrome and factors like age ($p = 0.04$), gender ($p = 0.05$), place of residence ($p < 0.01$), smoking habits ($p = 0.05$), obesity ($p < 0.01$), magnesium deficiency ($p < 0.01$), calcium deficiency ($p < 0.01$), diabetes mellitus ($p < 0.01$), elevated C-reactive protein ($p = 0.01$), increased ESR ($p < 0.01$), and pulmonary hypertension ($p = 0.01$). Conversely, no significant association was found between metabolic syndrome and factors like educational level ($p = 0.48$), occupation ($p = 0.52$), or vitamin D deficiency ($p = 0.06$).

Conclusion: The study highlights a high prevalence of metabolic syndrome among COPD patients, emphasizing the need for routine metabolic assessment in this group to reduce the risk of further health complications.

Keywords: Chronic obstructive pulmonary disease, metabolic syndrome, insulin resistance syndrome

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Introduction

Chronic obstructive pulmonary disease (COPD) continues to pose a major public health concern worldwide, being a leading contributor to both sickness and death.[1] Unlike several other illnesses, the occurrence of COPD is steadily increasing, making it one of the few diseases with a rising mortality trend. Projections indicated that by the year 2020, COPD would become the third most common cause of death globally.[2] COPD is a widespread yet preventable and manageable illness. It is marked by a long-standing restriction in airflow, which progressively worsens over time, often due to chronic inflammation caused by exposure to harmful particles or gases.[3] Flare-ups (exacerbations) and other coexisting health conditions tend to complicate the course of COPD, making disease management more challenging.[4] Therefore, a thorough care plan for COPD should always include an evaluation for these associated conditions, as they are linked to higher hospitalization rates, increased mortality.[5,6]

The Metabolic Syndrome responsible for atherosclerotic cardiovascular disease, type 2 diabetes mellitus and chronic kidney disease,[7] and it includes central obesity, abnormal lipid profiles, high blood pressure, elevated blood sugar, and a tendency toward blood clotting and inflammation.[8] Research has shown a particularly high prevalence of abdominal obesity (72%) and hypertension (66%) among individuals with MetS. Additionally, about 53% of affected patients had high blood sugar, 62% had raised triglyceride levels, and 54% exhibited low levels of HDL cholesterol.[9]A key factor driving the development of MetS is insulin resistance, which is often accompanied by increased insulin production by the body.[10] Emerging evidence suggests that COPD is not just a lung disease it is often accompanied by syst-

emic effects, with MetS being one of the most notable.[11] Several studies have documented a link between the two conditions, indicating that MetS can independently worsen COPD by exacerbating symptoms, reducing lung function, and increasing the risk of complications like pulmonary hypertension and respiratory failure.[12-14] Interestingly, many patients with COPD tend to succumb to these coexisting illnesses rather than COPD itself.[15] Reported rates of MetS among COPD patients vary across studies, ranging from 42% to nearly 60%.[16-19]

With this in mind, our study intended to find out whether or not MetS is among COPD patients in our community of patients at a tertiary institution hospital. The goal was to provide relevant data that could help refine screening and management strategies. Understanding how frequently MetS occurs alongside COPD in our patient community could guide early interventions, inform treatment plans, and potentially prevent serious, life-threatening complications linked to metabolic syndrome.

Methods

After receiving approval from the CPSP research evaluation unit (REU), a six-month cross-sectional descriptive study was conducted (from October 1, 2024, to March 31, 2025) at the medicine ward of Liaquat University Hospital in Hyderabad. Patients who fulfilled the inclusion requirements and gave their informed consent were recruited for the study.

Eligible participants were men and women aged between 35 and 70 years who presented through the emergency department with symptoms such as shortness of breath, fatigue, or tiredness lasting for at least three days. These patients were later confirmed to have Chronic Obstructive Pulmonary Disease (COPD) based on spirometry findings specifically, a post-bronchodilator FEV_1/FVC ratio of less than 0.7 along with an FEV_1 below 80%, indicating airflow limitation.

Certain groups were excluded to minimize confounding factors. These included individuals with known malignancies (including lung, bone, or breast cancer), chronic liver or kidney failure, malabsorption disorders, and those undergoing chemotherapy, lipid-lowering treatment, or immunesuppressive therapy. Patients with hematological cancers (like leukemia or lymphoma), active pulmonary tuberculosis, or a history of alcohol abuse were also excluded, as were pregnant or breastfeeding women and those already taking vitamin or mineral supplements.

Other exclusion criteria involved patients on long-term oxygen therapy, those with unstable respiratory status (oxygen saturation below 80% at rest), and individuals with a history of asthma, previous lung surgeries, or severe comorbid conditions such as advanced heart failure, recent heart attacks, or strokes. Following enrollment, participants were evaluated for Metabolic Syndrome (MetS) when a patient met at least three of the following five conditions:

HDL cholesterol less than 40 mg/dL in men or less than 50 mg/dL in women

Fasting blood sugar of 100 mg/dL or higher

Triglyceride levels of 150 mg/dL or above

Blood pressure readings of 130/85 mm Hg or higher

Waist circumference of 80 cm or more in women, assessed using a standardized measurement method.

With a CI of 95% and an 8% margin of error, the earlier estimated rate of 42.1% for MetS amongst COPD patients was used to compute the sample size,[16] which came out to be 146 participants. Using non-probability successive sampling, patients were chosen.

Data collection was a collaborative effort by the research team. This involved gathering clinical history (including symptoms and smoking status), recording vital signs, measuring waist circumference, drawing blood samples, and maintaining detailed records on a pre-designed data collection form. Waist circumference was measured by locating the upper border of the right iliac crest, placing a measuring tape horizontally around the abdomen, ensuring the tape was snug but not compressing the skin, and recording the measurement at the end of a normal breath out. All laboratory analyses were carried out by a senior pathologist with over five years of professional experience. The research team covered all expenses related to the study. Variables considered included demographic and clinical factors such as age, gender, urban or rural residence, smoking status, obesity, vitamin D deficiency, low magnesium and calcium levels, diabetes, raised erythrocyte sedimentation rate (ESR), elevated C-reactive protein (CRP), presence of pulmonary

hypertension, educational background, occupation, and the presence of metabolic syndrome.

The statistical analysis was performed using SPSS software. Categorical variables like gender, residence, smoking status, and presence of metabolic syndrome were summarized as frequencies and percentages. We used the Shapiro-Wilk test to see if the continuous data was normal. For numbers including age, length of symptoms, and body mass index (BMI), we generated means and standard deviations or medians with interquartile ranges when they were needed.

We stratified depending on the variables listed above to see how they affected outcomes and to account for any factors that might have confused the results. The Chi-square test or Fisher's exact test were used for categorical variables after stratification. A p-value of < 0.05 was used to determine statistical significance.

Results

Over the six-month study period, a total of 146 patients diagnosed with COPD aged between 35 and 70 years and of either gender were enrolled after presenting with complaints of shortness of breath, fatigue, and tiredness. The clinical and demographical detail of the study participants are outlined in Table 1.

Table 1: *The Baseline Characteristics and Clinical Profiles of the Participants*

Parameter	Frequency (n=146)	Percentage (%)
Age (yrs)		
35-39	14	9.6
40-49	56	38.4
50-59	49	33.6
60-70	27	18.5
Gender		
Male	65	44.5
Female	81	55.5
Residence		
Urban	76	52.1
Rural	70	47.9
Educational Status		
Illiterate	31	21.2
Primary	30	20.5
Middle	36	24.7
Secondary	27	18.5
Higher	22	15.1
Occupation		
Housewife	62	42.5
Employed	29	19.9
Unemployed	28	19.2
Businessman	27	18.5
Smoking		
Yes	72	50.0
No	43	29.5
Ex-smoker	30	20.5
Obesity		
Yes	93	63.7
No	53	36.3
Hypomagnesemia		
Yes	88	60.3
No	58	39.7
Hypocalcemia		
Yes	91	62.3
No	55	37.7
Vitamin D Deficiency		
Yes	87	59.6
No	59	40.4
Diabetes Mellitus		
Yes	86	58.9
No	60	41.1
Raised C-Reactive Protein		
Yes	82	56.2
No	64	43.8
Raised ESR		
Yes	86	58.1
No	62	41.9
Pulmonary Hypertension		
Yes	91	62.3
No	55	37.7
Metabolic Syndrome		
Yes	90	61.6
No	56	38.3

The average age recorded was 48.29 ± 11.47 years, with a mean HbA1c of 7.81 ± 2.11%, and a mean Body Mass Index (BMI) of 32.72 ± 4.51 kg/m². The distribution patterns of these variables, assessed through skewness and kurtosis analysis, were age: skewness -0.05, kurtosis -0.54, HbA1c: skewness 8.34, kurtosis 104.6 and BMI: skewness -0.53, kurtosis -0.63. The median values recorded were 51 years for age, 7.7% for HbA1c, and 31 kg/m² for BMI. According to the Shapiro-Wilk test for normality, the p-values were 0.05 for age, and <0.01 for both HbA1c and BMI, indicating that age was on the threshold of normal distribution, while HbA1c and BMI significantly deviated from normality.

Table 2: *Metabolic Syndrome Across Demographic and Clinical Factors*

Metabolic Syndrome n = 146 (%)				
Age (years)	**Yes**	**No**	**Total**	**P-value**
35-39	7 (7.8%)	7 (12.5%)	14 (9.6%)	0.04*
40-49	34 (37.8%)	22 (39.3%)	56 (38.4%)	
50-59	37 (41.1%)	12 (21.4%)	49 (33.6%)	
60-70	12 (13.3%)	15 (26.8%)	27 (18.5%)	
Gender				
Male	35 (38.9%)	30 (53.6%)	65 (44.5%)	0.05*
Female	55 (61.1%)	26 (46.4%)	81 (55.5%)	
Residence				
Urban	59 (65.6%)	17 (30.4%)	76 (52.1%)	<0.01*
Rural	31 (34.4%)	39 (69.6%)	70 (47.9%)	
Educational Status				
Illiterate	22 (24.4%)	09 (16.1%)	31 (21.2%)	0.48**
Primary	21 (23.3%)	09 (16.1%)	30 (20.5%)	
Middle	20 (22.2%)	16 (28.6%)	36 (24.7%)	
Secondary	15 (16.7%)	12 (21.4%)	27 (18.5%)	
Higher	12 (13.3%)	10 (17.9%)	22 (15.1%)	
Occupation				
Housewife	34 (37.8%)	28 (50.0%)	62 (42.5%)	0.52
Employed	20 (22.2%)	09 (16.1%)	29 (19.9%)	
Unemployed	18 (20.0%)	10 (17.9%)	28 (19.2%)	
Businessman	18 (20.0%)	09 (16.1%)	27 (18.5%)	
Smoking				
Yes	52 (57.8%)	21 (37.5%)	73 (50.0%)	0.05*
No	23 (25.6%)	20 (35.7%)	43 (29.5%)	
Ex-smoker	15 (16.7%)	15 (26.8%)	30 (20.5%)	
Obesity				
Yes	67 (74.4%)	26 (46.4%)	93 (63.7%)	<0.01*
No	23 (25.6%)	30 (53.6%)	53 (36.3%)	
Hypomagnesemia				
Yes	63 (70.0%)	25 (44.6%)	88 (60.3%)	<0.01*
No	27 (30.0%)	31 (55.4%)	58 (39.7%)	
Hypocalcemia				
Yes	69 (76.7%)	22 (39.3%)	91 (62.3%)	<0.01*
No	21 (23.3%)	34 (60.7%)	55 (37.7%)	
Vitamin D Deficiency				
Yes	59 (65.6%)	28 (50.0%)	87 (59.6%)	0.06**
No	31 (34.4%)	28 (50.0%)	59 (40.4%)	
Diabetes Mellitus				
Yes	61 (67.8%)	25 (44.6%)	86 (58.9%)	<0.01*
No	29 (32.2%)	31 (55.4%)	60 (41.1%)	
Raised C-Reactive Protein				
Yes	58 (64.4%)	24 (42.9%)	82 (56.2%)	0.01*
No	32 (35.6%)	32 (57.1%)	64 (43.8%)	
Raised ESR				
Yes	61 (67.8%)	21 (37.5%)	82 (56.2%)	<0.01*
No	29 (32.2%)	35 (62.5%)	64 (43.8%)	
Pulmonary Hypertension				
Yes	63 (70.0%)	28 (50.0%)	91 (62.3%)	0.01*
No	27 (30.0%)	28 (50.0%)	55 (37.7%)	

*Statistically significant;

**Statistically non-significant

Table 2 presents the stratification of COPD patients based on variables such as age, gender, place of residence (urban/rural), smoking status, obesity, low magnesium and calcium levels, vitamin D deficiency, diabetes, raised erythrocyte sedimentation rate (ESR), elevated C-reactive protein (CRP), pulmonary hypertension, occupation, education level, and the presence of metabolic syndrome. Statistical analysis revealed significant associations between metabolic syndrome and several The statistical analysis showed a meaningful relationship between metabolic syndrome and several factors, including age ($p = 0.04$), gender ($p= 0.05$), place of residence ($p < 0.01$), smoking habits ($p=0.05$), obesity ($p < 0.01$), low magnesium levels ($p < 0.01$), low calcium levels ($p < 0.01$), diabetes mellitus ($p < 0.01$), increased C-reactive protein ($p= 0.01$), elevated ESR ($p < 0.01$), and pulmonary hypertension ($p = 0.01$). On the other hand, no significant link was found between metabolic syndrome and factors such as education level ($p = 0.48$), occupation ($p = 0.52$), or vitamin D deficiency ($p = 0.06$).

Discussion:

Chronic Obstructive Pulmonary Disease (COPD) is a persistent respiratory illness that impairs breathing and has far-reaching effects on a person's overall health. In recent years, increasing research has highlighted the frequent coexistence of COPD with metabolic syndrome (MetS) a combination of health issues such as high blood pressure, abnormal cholesterol levels, increased waist circumference, and resistance to insulin. These metabolic abnormalities not only add to the health burden of individuals with COPD but may also play a role in accelerating disease progression and influencing clinical outcomes.[20]

Our findings align with the notion that COPD is far more than just a respiratory condition. The presence of metabolic syndrome in these patients points towards a significant systemic involvement. The chronic inflammation seen in COPD seems to act as a common link between the pulmonary disease and metabolic derangements. Low-grade, persistent inflammation may trigger insulin resistance, disrupt lipid metabolism, and promote atherosclerosis, setting the stage for metabolic syndrome. This inflammatory connection highlights the importance of viewing COPD through a broader lens as a multisystem disease rather than isolated lung pathology.[21]

In our study, a considerable proportion of COPD patients were found to have metabolic syndrome. This observation mirrors previous studies from various regions, confirming that MetS is a common comorbidity in COPD populations globally. The prevalence appears higher among individuals with severe airflow limitation and those with longer disease duration. Factors such as sedentary lifestyle, chronic hypoxia, and prolonged use of corticosteroids in COPD management may further increase the risk of developing metabolic syndrome in these patients.

Obesity, a key component of MetS, showed a noteworthy association with COPD in our analysis. Contrary to the traditional view that COPD leads to weight loss and muscle wasting, an increasing number of patients now present with overweight or obesity. This shift may reflect changing lifestyle patterns, physical inactivity, or even steroid-induced weight gain. Abdominal obesity, in particular, is concerning because it plays a central role in the development of insulin resistance and cardiovascular diseases. Moreover, excess body fat can mechanically restrict breathing and worsen respiratory symptoms, creating a vicious cycle of inactivity and metabolic risk.[22]

Hypertension and dyslipidemia were also significantly prevalent among COPD patients in our study. These conditions contribute to a higher cardiovascular risk, which is already elevated in COPD due to systemic inflammation and oxidative stress. High blood pressure can exacerbate right heart strain, especially in cases of pulmonary hypertension secondary to COPD. Similarly, lipid abnormalities, particularly elevated triglycerides and low HDL cholesterol, are closely linked with vascular complications.[23] These findings emphasize the need for routine cardiovascular risk assessment in COPD management.

Insulin resistance, another hallmark of metabolic syndrome, poses additional challenges in COPD care. It not only predisposes individuals to type 2 diabetes but may also influence lung function. Some research suggests that insulin resistance could contribute to airflow limitation through mechanisms like systemic inflammation and endothelial dysfunction. Although the exact pathways remain unclear, the interplay between metabolic abnormalities and lung health deserves further exploration.[24]

An interesting aspect we observed was the correlation between smoking status and metabolic syndrome in COPD patients. While smoking is a well-known risk factor for both COPD and cardiovascular disease, its relationship with metabolic syndrome is complex. Some studies suggest that smoking may exacerbate insulin resistance and lipid abnormalities, while others report mixed results. Our findings indicate that smokers with COPD are indeed at higher risk of metabolic disturbances, underscoring the multifaceted harm caused by tobacco use. Smoking cessation remains a cornerstone not only for respiratory health but also for reducing metabolic and cardiovascular risks.[25]

Gender and age also appeared to influence the prevalence of metabolic syndrome among COPD patients. Middle-aged and older adults, especially women, showed higher rates of MetS.[26]This may be due to hormonal changes, lifestyle factors, or even differences in fat distribution patterns between men and women. These demographic insights highlight the importance of personalized care approaches in

COPD management, considering individual risk profiles beyond just pulmonary function tests.

Our study reinforces the concept of comprehensive care in COPD one that looks beyond the lungs to address metabolic health, cardiovascular risks, and lifestyle modifications. Regular screening for components of metabolic syndrome, such as waist circumference, blood pressure, lipid profile, and blood glucose levels, should become a standard part of COPD management protocols. Early identification and management of MetS can potentially reduce complications, improve quality of life, and even slow down disease progression.

It is important to recognize the limitations of this study. As a cross-sectional study, it only reflects an association between COPD and metabolic syndrome and does not prove a cause-and-effect relationship. The relatively small sample size and the short study duration further limit the ability to assess any long-term implications of this association. To clarify whether metabolic changes are a risk factor for developing COPD or emerge as a result of the disease itself, long-term follow-up studies are essential. Moreover, factors such as dietary habits, physical activity, use of medications, and socioeconomic background which were not thoroughly explored in this study may play a significant role and should be considered in future research. Including these aspects would not only enhance the strength of the findings but also improve their applicability to broader patient populations.

Conclusion:

Among the 146 COPD patients included in the study, 90 individuals (61.6%) were diagnosed with metabolic syndrome. There was a strong link between metabolic syndrome and a number of factors, such as age ($p = 0.04$), gender ($p = 0.05$), living in a city or the country ($p < 0.01$), smoking ($p = 0.05$), being obese ($p < 0.01$), having low magnesium levels ($p < 0.01$), having low calcium levels ($p < 0.01$), having diabetes ($p < 0.01$), having high C-reactive protein ($p = 0.01$), having high erythrocyte sedimentation rate ($p < 0.01$), and having high pulmonary hypertension ($p = 0.01$). But there was no statistically significant link between metabolic syndrome and educational attainment ($p = 0.48$), employment ($p = 0.52$), or vitamin D deficits ($p = 0.06$). These findings point to a strong link between COPD and metabolic syndrome, highlighting the need for a comprehensive, patient-centered care approach. Addressing metabolic issues alongside respiratory management may help lower disease burden and improve patient outcomes. Moving forward, research should aim to uncover the biological connections between these conditions and evaluate strategies that tackle both respiratory and metabolic health together.

Ethical Permission: The Research Evaluation Unit, CPSP approved this study vide Ref No. CPSP/REU/MED-2024-164-22570.

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Authors' contribution:

MA: Acquisition of data
P: Concept & design of study
SZAS: Analysis & interpretation, drafting the article and final approval of the version to be published
MKS: Revising critically for important intellectual contents
RA: Acquisition of data
SG: Drafting the article and finalizing the manuscript

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