Section: General Medicine

Original Research Article

ASSESSMENT OF NUTRITIONAL STATUS IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE PATIENTS AND ITS CORRELATION WITH DISEASE SEVERITY: A HOSPITAL-BASED CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is a progressive respiratory disorder characterized by persistent airflow limitation and systemic manifestations. Malnutrition is a significant but often under-recognized factor that adversely affects disease progression, functional capacity, and outcomes.
Aim: To assess the nutritional status of patients with COPD and determine its correlation with disease severity.
Materials and Methods: This hospital-based observational cross-sectional study was conducted in the Department of General Medicine, PES Institute of Medical Sciences and Research, Kuppam, over 18 months. A total of 116 patients with COPD were enrolled by purposive sampling. Nutritional status was assessed using anthropometric parameters (body mass index [BMI], mid-arm circumference [MAC], mid-arm muscle circumference [MAMC], triceps skinfold thickness), the Subjective Global Assessment (SGA), and the Mini Nutritional Assessment (MNA). Post-bronchodilator spirometry was performed and disease severity graded per GOLD (2025) criteria. Data were analyzed using SPSS, with chi-square and correlation tests applied as appropriate; $p<0.05$ was considered significant.
Results: Grade III (GOLD) was the most common severity category (43.1%), and most patients were aged 51–60 years. Females predominated (88.8%). Mean muscle wasting scores declined from 20.6±3.6 (Grade I) to 16.4±3.2 (Grade IV) (p=0.04), and MAC declined from 24±2.3 cm to 18±2.1 cm (p=0.03). Body weight and BMI likewise fell progressively with severity (p=0.03 and p=0.04, respectively). Malnutrition on MNA and SGA increased markedly in Grades III–IV, and correlation analysis showed strong negative associations between COPD severity and muscle wasting (r=-0.98), MAC (r=-0.99), and weight (r=-0.97), all $p<0.05$.
Conclusion: Malnutrition is common among COPD patients and worsens progressively with increasing disease severity. Routine nutritional screening using simple anthropometric measures alongside validated tools such as SGA and MNA should be incorporated into standard COPD care to enable early identification and intervention.

Keywords: Chronic obstructive pulmonary disease; malnutrition; nutritional assessment; body mass index; mid-arm circumference; GOLD criteria.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a progressive, chronic respiratory disorder characterized by persistent airflow limitation and a chronic inflammatory response in the airways and lungs, and it remains a leading cause of morbidity and mortality worldwide.[1] Beyond its pulmonary effects, COPD has systemic consequences that affect multiple organ systems, among which malnutrition and altered body composition are frequently observed but often under-recognized despite their substantial impact on outcomes.

Malnutrition in COPD arises from increased energy expenditure due to the heightened work of breathing, chronic systemic inflammation, hormonal and metabolic alterations, and reduced dietary intake caused by dyspnea, early satiety, and fatigue.[2] Its consequences include reduced respiratory muscle strength, decreased exercise tolerance, impaired immune function, and greater susceptibility to infection, all of which contribute to increased hospitalization and mortality. Maintaining adequate nutritional status is therefore critical to the clinical course and quality of life of COPD patients.

Body mass index (BMI) has traditionally served as a simple marker of nutritional status, but it does not distinguish between lean body mass, fat mass, and body water, and so may fail to identify muscle wasting or sarcopenia in patients with an apparently normal BMI.[3] Anthropometric measures such as mid-arm circumference (MAC) and mid-arm muscle circumference (MAMC) provide additional information on body composition and muscle stores,[4] while validated tools such as the Subjective Global Assessment (SGA) and Mini Nutritional Assessment (MNA) allow a more comprehensive, clinically practical evaluation of nutritional status.

There remains a paucity of studies assessing nutritional status using a combination of anthropometric measures and validated screening tools in Indian COPD populations, where variations in diet, socioeconomic status, and healthcare access may influence the prevalence and severity of malnutrition.[5] The present study was therefore designed to assess the nutritional status of patients with COPD using anthropometric measurements and validated nutritional assessment tools, and to examine how these parameters vary with disease severity graded according to GOLD criteria.

Aims and Objectives

Aim: To assess the nutritional status of patients with COPD and to determine its correlation with disease severity.

Objectives

1. To evaluate the nutritional status of patients with COPD using anthropometric parameters, the Subjective Global Assessment, and the Mini Nutritional Assessment.
2. To correlate nutritional status with disease severity based on Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria.

MATERIALS AND METHODS

Study Design, Setting, and Duration

This was a hospital-based observational cross-sectional study conducted in the Department of General Medicine, PES Institute of Medical Sciences and Research (PESIMSR), Kuppam, Andhra Pradesh — a tertiary care teaching institution — over a period of 18 months, in coordination with the Pulmonary Medicine unit.

Study Population and Sampling

All patients diagnosed with COPD attending the Department of General Medicine during the study period were eligible. A purposive sampling method was used, with consecutive enrolment of consenting patients meeting the inclusion criteria until the target sample size was reached. A total of 116 patients were recruited, based on feasibility and the expected prevalence of malnutrition in this hospital setting.

Inclusion and Exclusion Criteria

Patients of either sex and any age with COPD diagnosed by GOLD criteria, willing to give informed consent and to undergo anthropometric measurement, nutritional assessment, and spirometry, were included. Patients with malignancy, malabsorption syndromes, chronic liver disease, chronic kidney disease, significant heart disease, or chronic infections including tuberculosis were excluded, to ensure that observed malnutrition could be attributed primarily to COPD.

Nutritional Assessment

Anthropometric measurements included BMI (weight in kilograms divided by height in metres squared), MAC (measured at the midpoint of the upper arm using a non-stretchable tape), triceps skinfold thickness (TSF, measured with calibrated calipers), and MAMC, calculated as MAC − (π × TSF). These parameters provided complementary information on fat and lean muscle reserves. Nutritional status was additionally classified using the SGA (well-nourished, moderately malnourished, or severely malnourished, based on history and physical examination) and the MNA (scored 0–30, with ≥24 indicating normal nutritional status, 17–23.5 indicating risk of malnutrition, and <17 indicating malnutrition).

Pulmonary Function Assessment and Severity Grading

Spirometry was performed according to American Thoracic Society/European Respiratory Society standards,[6] with a minimum of three acceptable and reproducible manoeuvres recorded. Bronchodilator reversibility testing was performed using inhaled salbutamol (400 µg), with post-bronchodilator values used for diagnosis and grading. A post-bronchodilator FEV_1 /FVC ratio <0.70 confirmed persistent airflow obstruction. Disease severity was graded per GOLD (2025) criteria based on post-bronchodilator FEV_1 (% predicted): GOLD 1 (mild, ≥80%), GOLD 2 (moderate, 50–79%), GOLD 3 (severe, 30–49%), and GOLD 4 (very severe, <30%).[7]

Statistical Analysis

Data were entered and analyzed using SPSS software. Descriptive statistics (mean, standard deviation, frequencies) summarized baseline characteristics. Chi-square tests compared categorical variables, and appropriate parametric or non-parametric tests compared continuous variables across GOLD grades. Correlation between COPD severity and nutritional parameters was assessed using correlation coefficients. A p-value <0.05 was considered statistically significant.

Ethical Considerations

Ethical clearance was obtained from the Institutional Human Ethics Committee of PESIMSR, Kuppam. Written informed consent was obtained from all participants, and the study adhered to the principles of the Declaration of Helsinki, including confidentiality, voluntary participation, and the right to withdraw at any time without affecting standard care.

RESULTS

Of the 116 patients enrolled, the severity distribution by GOLD grade was: Grade I, 21 (18.1%); Grade II, 34 (29.3%); Grade III, 50 (43.1%); and Grade IV, 11 (9.5%), with Grade III being the most common category.

Demographic Characteristics

The majority of patients across all GOLD grades belonged to the 51–60-year age group. Mean age was 53.2±10.4 years in Grade I, 48.6±11.5 years in Grade II, 49.7±10.8 years in Grade III, and 51.2±10.6 years in Grade IV, a difference that was statistically significant (p=0.04) but without a linear trend with severity. Females predominated markedly across all grades — 103 of 116 patients (88.8%) were female and 13 (11.2%) were male — an association that was statistically significant (p=0.04).

Table 1: Mean age across GOLD grades

	Grade I	Grade II	Grade III	Grade IV	F value	P value
Mean age ± SD (years)	53.2±10.4	48.6±11.5	49.7±10.8	51.2±10.6	34.7	0.04

Table 2: Gender distribution across GOLD grades

Gender	Grade I	Grade II	Grade III	Grade IV	P value
Male	2	3	6	2	
Female	19	31	44	9	0.04
Total	21	34	50	11	

Anthropometric and Nutritional Parameters

Muscle wasting scores declined progressively from 20.6±3.6 in Grade I to 16.4±3.2 in Grade IV (p=0.04). MAC decreased from 24±2.3 cm in Grade I to 18±2.1 cm in Grade IV (p=0.03). Mean body weight fell from 64±12.6 kg in Grade I to 57±11.2 kg in Grade IV (p=0.03). Underweight prevalence rose markedly across grades, while overweight patients were seen only in earlier stages (p=0.04).

Table 3: Muscle wasting and mid-arm circumference across GOLD grades

Parameter	Grade I	Grade II	Grade III	Grade IV	P value
Muscle wasting (mean±SD)	20.6±3.6	18.8±3.2	17.3±2.9	16.4±3.2	0.04
Mid-arm circumference, cm (mean±SD)	24±2.3	21±2.4	20±1.3	18±2.1	0.03
Body weight, kg (mean±SD)	64±12.6	60±11.3	59±10.7	57±11.2	0.03

Table 4: BMI category distribution across GOLD grades

BMI category	Grade I	Grade II	Grade III	Grade IV	P value
Underweight	3	15	28	7	
Healthy	15	17	22	4	0.04
Overweight	3	2	0	0	
Obese	0	0	0	0	

Nutritional Screening (MNA and SGA)

On MNA, the proportion of patients classified as malnourished increased with GOLD severity, most notably in Grades III and IV (p=0.03). Similarly, SGA-defined severe malnutrition increased from 4.8% in Grade I to 36.4% in Grade IV (p=0.04).

Table 5: Mini Nutritional Assessment (MNA) category across GOLD grades

MNA category	Grade I	Grade II	Grade III	Grade IV	P value
Normal nutritional status	14	16	20	3	
At risk of malnutrition	5	15	18	4	0.03
Malnourished	2	3	12	4	

Table 6: Subjective Global Assessment (SGA) grade across GOLD grades

SGA grade	Grade I	Grade II	Grade III	Grade IV	P value
Well-nourished	13	15	18	2	
Moderately malnourished	7	16	19	5	0.04
Severely malnourished	1	3	13	4	

Systemic Clinical Features

Edema and ascites were both significantly more common with increasing COPD severity (p=0.02 and p=0.03, respectively), being most frequent in Grade IV (edema 54.5%; ascites 63.6%), reflecting the systemic impact of advanced disease.

Correlation Analysis

COPD severity showed only a weak, non-significant positive correlation with age (r=+0.21, p>0.05). In contrast, COPD severity correlated strongly and negatively with muscle wasting (r=-0.98, p<0.05), mid-arm circumference (r=-0.99, p<0.05), and body weight (r=-0.97, p<0.05), indicating that nutritional depletion tracks closely with worsening airflow limitation.

Table 7: Correlation of COPD severity with age and nutritional parameters

Variable pair	r value	P value	Interpretation
COPD grade vs. Age	+0.21	>0.05	Weak positive, not significant
COPD grade vs. Muscle wasting	-0.98	<0.05	Strong negative correlation
COPD grade vs. Mid-arm circumference	-0.99	<0.05	Very strong negative correlation
COPD grade vs. Body weight	-0.97	<0.05	Strong negative correlation

DISCUSSION

COPD is increasingly recognized not merely as a disease of airflow obstruction but as a chronic systemic inflammatory disorder with multisystem involvement. Persistent exposure to noxious particles and gases triggers airway inflammation, oxidative stress, and protease–antiprotease imbalance, while a sustained systemic inflammatory response — with elevated circulating cytokines such as TNF-α, IL-6, and C-reactive protein — promotes catabolism, muscle protein breakdown, and anorexia.[8] Skeletal muscle dysfunction, loss of fat-free mass, and protein-energy malnutrition are thus best understood as central components of disease progression rather than incidental comorbidities.

Age and Disease Severity

Although mean age differed significantly across GOLD grades in this cohort, there was no linear relationship between age and severity, consistent with the findings of Gupta et al. and of Jagmohan et al., who similarly reported nutritional depletion and lung function impairment that tracked with systemic inflammation and metabolic stress rather than chronological age.[9,10] This suggests that in an individual patient, disease severity is more strongly determined by the intensity of exposure, host susceptibility, and systemic catabolic processes than by age alone, and that nutritional decline should be actively screened for even in middle-aged patients.

Gender Distribution

Females predominated markedly in the present cohort (88.8%), in contrast to the male predominance reported by Jagmohan et al. and Habibech et al., but consistent with reports from populations with substantial biomass-fuel and household air pollution exposure, where women who perform most cooking-related tasks carry a disproportionate exposure burden.[10,11] Chronic undernutrition, gender disparities in food allocation, and lower baseline muscle mass may additionally predispose women to more severe nutritional compromise once COPD develops, as also observed by Bhakare et al. in an all-female COPD cohort.[12] The wide variation in reported sex ratios across studies likely reflects differences in local exposure patterns (tobacco versus biomass), case ascertainment, and inclusion criteria, and underscores the need for a high index of suspicion for COPD — and for routine nutritional screening — in non-smoking women in similar settings.

Nutritional Status and Disease Severity

The progressive decline in BMI, MAC, and the increasing prevalence of malnutrition with advancing GOLD grade observed here mirrors the findings of Tandon et al., who reported malnutrition in 47.2% of COPD patients and a strong correlation between MNA score and disease severity (R^2=0.622, p=0.01).[13] Singh et al. similarly found that MUAC identified a substantially higher burden of malnutrition (73%) than BMI (42%), suggesting that BMI alone underestimates true nutritional compromise by failing to distinguish fat mass from lean muscle mass — an observation directly supported by the significant decline in MAC seen in the present study (p=0.03).[14] Priya et al. similarly reported significant positive correlations between FEV_1 (% predicted) and BMI, MNA, and MAC (all p<0.001), reinforcing the association between nutritional status and pulmonary function.[15] Mechanistically, this decline reflects a persistent negative energy balance driven by increased work of breathing and reduced intake, compounded by systemic inflammation-driven catabolism and loss of fat-free mass.

Muscle Wasting and Anthropometric Decline

The progressive reduction in muscle mass observed in the present study, reflected by declining MAC and worsening muscle-wasting scores, corroborates the large cross-sectional series of Jagmohan et al. (n=435), which found significant declines in BMI, MAC, MAMC, and TSF with increasing GOLD category (p<0.001).[10] Gupta et al. similarly reported reduced BMI and MUAC in hospitalized patients with acute exacerbations, with a negative correlation between BMI and length of hospital stay, while Yılmaz et al. linked inadequate protein intake to reduced fat-free mass index in moderate-to-severe COPD.[16,17] Collectively, these findings support skeletal muscle depletion as a consistent and clinically significant extrapulmonary manifestation of advancing COPD.

Nutritional Assessment Tools (MNA and SGA)

The significant worsening of MNA and SGA scores with increasing severity observed in this study aligns with Chaudhary et al., who reported a strong inverse correlation between BMI and SGA (r=-0.713, p<0.001), and with Bhakare et al., who found a significant negative correlation between MNA score and COPD severity (r=-0.253, p<0.01).[12,18] Yuceege et al. further demonstrated that both tools correlate well with anthropometric parameters and disease severity, supporting their complementary use.[19] While anthropometric measures provide objective data, SGA and MNA capture dietary intake, functional capacity, and physical findings, making them more sensitive for early and comprehensive detection of malnutrition.

Systemic Manifestations and Clinical Outcomes

The higher prevalence of edema and ascites in advanced GOLD grades in the present study parallels reports of adverse clinical outcomes associated with malnutrition, including the substantially longer hospital stays reported by Tandon et al. in malnourished versus well-nourished patients (17.3±7.0 vs. 6.8±3.5 days) and the association between hypoalbuminemia and acute respiratory failure described by Chen et al.[13,20] These findings collectively reinforce that nutritional depletion is not merely a comorbidity but a determinant of clinical course and healthcare burden in COPD.

Limitations

1. Single-center design with a relatively limited sample size, which may limit generalizability; multicentric studies with larger cohorts would strengthen external validity.
2. The cross-sectional design precludes establishing a causal relationship between nutritional deterioration and COPD progression; longitudinal follow-up would be needed to clarify directionality.
3. Advanced body composition techniques such as DEXA or CT-based muscle mass evaluation were not performed; the study relied on anthropometric measurements, which may not precisely differentiate fat mass from lean muscle mass.

CONCLUSION

Malnutrition is highly prevalent among patients with COPD and worsens progressively with increasing disease severity. In this cohort, anthropometric decline, worsening MNA and SGA classification, and increasing systemic manifestations (edema, ascites) were all significantly associated with advancing GOLD grade, while age showed no consistent relationship with severity. These findings support incorporating routine, low-cost nutritional screening — using BMI, MAC, MNA, and SGA — into standard COPD management, with early identification and timely nutritional intervention as part of a multidisciplinary approach to improve functional status and reduce disease burden.

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