RESEARCH PAPER

# To Assess the Relationship of Mid Upper Arm Circumference with Disease Severity and Prognosis Among Patients with Chronic Obstructive Pulmonary Disease

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## ABSTRACT

**Background:** Chronic Obstructive Pulmonary Disease (COPD) extends beyond pulmonary dysfunction, incorporating systemic manifestations such as skeletal muscle wasting and malnutrition. Mid-upper arm circumference (MUAC) has been proposed as a practical prognostic indicator, potentially superior to body mass index (BMI). The study aimed to evaluate the relationship between MUAC and COPD severity, and to assess its prognostic utility in comparison with BMI and functional indices.

**Methods:** A prospective observational study was conducted among 100 spirometry-confirmed COPD patients in a tertiary care center. Anthropometric parameters (MUAC, BMI), functional measures (6-minute walk test [6MWT], sit-to-stand test [STST], single breath count test [SBCT]), and clinical indices (BODE index) were recorded. Associations were analyzed using Spearman's correlation; $p < 0.05$ was considered statistically significant.

**Results:** The cohort was predominantly male (79%), with most patients in moderate (47%) and severe (36%) stages. Low BMI (<21 kg/m²) showed a significant association with disease severity ($p = 0.024$). Similarly, reduced MUAC (<27 cm) correlated strongly with higher COPD severity ($p = 0.002$). However, MUAC did not significantly correlate with $FEV_1$% ($p = 0.096$) or BODE index ($p = 0.737$). Functional capacity, particularly 6MWT, demonstrated a strong association with $FEV_1$% ($p = 3.11\times10^{-5}$). Survival showed a robust correlation with BODE index ($p < 0.001$).

**Conclusion:** MUAC is a sensitive marker of nutritional depletion and correlates with COPD severity, although its direct relationship with pulmonary function remains limited. Functional measures outperform isolated anthropometric indices in prognostication. Integrating MUAC with multidimensional tools may enhance early risk stratification and clinical management.

**Keyword:** *COPD; MUAC; BMI; malnutrition; BODE index; 6MWT; disease severity; prognosis.*
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## INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is increasingly conceptualized as a systemic disorder rather than a purely respiratory condition. While airflow limitation defines its diagnosis, extrapulmonary manifestations—particularly skeletal muscle wasting—substantially influence disease trajectory. Malnutrition, reported in up to 40% of patients, contributes to diminished exercise capacity, frequent exacerbations, and elevated mortality. [1,2,3]

Although body mass index (BMI) has traditionally been used to evaluate nutritional status, it fails to distinguish between fat and lean mass. This limitation becomes clinically relevant in COPD, where muscle depletion may occur despite preserved body weight. Mid-upper arm circumference (MUAC), by contrast, provides a more direct reflection of peripheral muscle mass. Emerging evidence suggests that MUAC may outperform BMI in predicting severity and survival. [4,5,6]

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Despite this, its role remains inconsistently defined across populations. The present study, therefore, examines the relationship between MUAC, disease severity, and prognosis, while situating it alongside functional and multidimensional indices.

## METHODS

This prospective observational study was conducted over six months in a tertiary care hospital. A total of 100 patients aged >40 years with spirometry-confirmed COPD (post-bronchodilator $FEV_1/FVC$ <0.70) were included. Clinically stable patients who provided informed consent were enrolled. Patients with comorbid conditions affecting nutritional status, including diabetes mellitus, thyroid disorders, tuberculosis, chronic kidney disease, and coronary artery disease, were excluded. Demographic details such as age, gender, and smoking status (current, ex-smoker, never smoker) were recorded. Anthropometric assessment included body mass index (BMI) and mid-upper arm circumference (MUAC), measured using standard techniques. Functional evaluation was performed using the six-minute walk test (6MWT), sit-to-stand test (STST), and single breath count test (SBCT). Disease severity was assessed using spirometry and the BODE index, along with MMRC dyspnea grading. Serum albumin was measured as a nutritional marker. Data were analyzed using IBM SPSS version 23.0. Categorical variables were expressed as frequencies and percentages, continuous variables as mean ± SD, and associations were tested using Spearman's correlation. A p-value <0.05 was considered statistically significant.

## RESULTS

**Table 1:** Age Distribution of Study Population

| Age Group (years) | Frequency (n) | Percentage (%) |
|---|---|---|
| 40–50 | 15 | 15.0 |
| 50–60 | 34 | 34.0 |
| 60–70 | 11 | 11.0 |
| 70–80 | 20 | 20.0 |
| 80–85 | 3 | 3.0 |

The age distribution demonstrated a non-uniform pattern, with a clear concentration in the middle decades of life. The largest proportion of patients belonged to the 50–60-year group (34%), followed by 70–80 years (20%) and 40–50 years (15%). The study population was predominantly male 79% and 21% females. A substantial proportion of patients had a history of tobacco exposure. Ex-smokers constituted the largest subgroup (53%), followed by current smokers (23%), while 24% had never smoked. This distribution reinforces the strong association between smoking and COPD development, even though a notable fraction of patients were non-smokers.

**Table 2:** Disease Severity Distribution

| Severity | n (%) |
|---|---|
| Mild | 6 (6.0) |
| Moderate | 47 (47.0) |
| Severe | 36 (36.0) |
| Very Severe | 11 (11.0) |

Most patients presented with moderate to severe disease. Nearly half of the cohort (47%) fell into the moderate category, while 36% had severe COPD. Mild disease was relatively uncommon (6%), suggesting delayed clinical presentation or diagnosis.

**Table 4:** Correlation of Variables with BODE Index

| Variable | Correlation Coefficient (r) | p-value |
|---|---|---|
| 6MWT | –0.08 | 0.472 |
| MUAC | 0.03 | 0.737 |
| Serum Albumin | 0.09 | 0.338 |
| 4-year Survival Rate | –0.82 | $1.91 \times 10^{-15}$ |

The correlation analysis demonstrated that individual parameters such as 6-minute walk test (6MWT), MUAC, and serum albumin did not exhibit statistically significant relationships with the BODE index. The correlation coefficients were weak and close to zero, indicating minimal linear association. In contrast, the 4-year survival rate showed a strong inverse correlation with the BODE index ($r = –0.82$, $p < 0.001$). This suggests that higher BODE scores are associated with markedly reduced survival, emphasizing the prognostic strength of composite indices.

**Table 4:** Association of BMI and MUAC with COPD Severity

| BMI Category | Mild | Moderate | Severe | Very Severe | $\chi^2$ | p-value |
|---|---|---|---|---|---|---|
| <21 | 4 | 11 | 14 | 1 | 17.35 | 0.024 |
| ≥21 | 2 | 36 | 22 | 10 | | |
| <27 cm | 1 | 14 | 14 | 1 | 34.52 | 0.002 |
| ≥27 cm | 5 | 33 | 22 | 10 | | |

Anthropometric indicators demonstrated statistically significant associations with disease severity. Patients with BMI <21 kg/m² were more frequently represented in severe disease categories (p = 0.024). A stronger association was observed with MUAC, where reduced circumference (<27 cm) showed a highly significant relationship with advanced COPD (p = 0.002).

The Pearson correlation coefficient (r = 0.0326) indicated a weak positive relationship overall, suggesting that although statistically directional, the strength of association between variables remains limited.

## DISCUSSION

The present study offers a nuanced examination of anthropometric and functional determinants of disease severity in COPD, with particular emphasis on MUAC as a surrogate marker of muscle mass. The findings suggest that while nutritional depletion is closely aligned with disease progression, its relationship with pulmonary mechanics is neither direct nor uniformly linear.

A central observation was the significant association between reduced MUAC and COPD severity (p = 0.002). This aligns closely with the findings of **Thirunavukkarasu et al.**, [7] who reported a comparable level of statistical significance, reinforcing the premise that peripheral muscle wasting intensifies with advancing disease. Similarly, **Emami Ardestani et al.** [8] demonstrated a strong correlation between MUAC and $FEV_1$% predicted (p < 0.001), suggesting that declining muscle mass parallels deteriorating lung function. However, in the present study, MUAC did not show a statistically significant correlation with $FEV_1$% (p = 0.096). This apparent discrepancy may reflect differences in study design or population characteristics; more importantly, it suggests that MUAC may capture cumulative systemic decline rather than instantaneous spirometric impairment.

Further support emerges from **Toppo et al.**, [9] who identified a negative correlation between MUAC and COPD grade (r = –0.334, p = 0.003). The progressive increase in low MUAC prevalence across disease stages observed in prior literature is mirrored in our cohort. Additionally, **Priya et al.** [10] reported a moderate positive correlation between mid-arm circumference and $FEV_1$% (r = 0.38, p = 0.001), noting a marked increase in patients with MUAC <22 cm in advanced COPD. These converging lines of evidence underscore the biological plausibility that muscle wasting is intrinsically linked to disease progression.

BMI, although significant (p = 0.024), appeared less sensitive than MUAC in detecting nutritional impairment. This observation is consistent with **Schols et al.**, [11] who highlighted that fat-free mass depletion may occur even in individuals with normal BMI. Indeed, the presence of sarcopenia in weight-stable patients complicates reliance on BMI as a standalone metric. **Ho et al.** [12] further emphasized this distinction, demonstrating that low MUAC (<23.5 cm) carried a higher hazard ratio for mortality (HR = 3.09) compared to low BMI (HR = 2.78). Collectively, these findings position MUAC as a more refined indicator of metabolic and functional reserve.

The functional dimension of COPD, as reflected by exercise capacity, emerged as a dominant correlate of disease severity. The strong association between 6MWT and $FEV_1$% ($p = 3.11 \times 10^{-5}$) suggests that functional limitation integrates multiple physiological systems—respiratory, cardiovascular, and musculoskeletal. This integrative nature likely explains why functional indices outperform isolated anthropometric measures. **Matkovic et al.** [13] similarly observed that reduced walking distance correlates with decreased MUAC, linking muscle mass depletion to diminished physical performance.

Interestingly, the present study did not find significant correlations between MUAC, serum albumin, or 6MWT with the BODE index. This finding contrasts with some earlier reports but may be explained by the multidimensional composition of the BODE index itself. By incorporating BMI, airflow obstruction, dyspnea, and exercise capacity, the index reflects a composite disease burden that cannot be adequately captured by a single parameter. Nevertheless, the strong inverse correlation between BODE index and 4-year survival (r ≈ –0.82, p < 0.001) reaffirms its prognostic robustness.

From a mechanistic perspective, muscle wasting in COPD is driven by a convergence of factors—systemic inflammation, oxidative stress, hypoxia, and anabolic insufficiency. These processes disrupt protein synthesis and promote catabolism, leading to progressive sarcopenia. Consequently, MUAC, as a proxy for muscle mass, indirectly reflects these systemic alterations. However, because these processes evolve over time, MUAC may not exhibit immediate correspondence with dynamic lung function indices.

## CONCLUSION

In conclusion, this study demonstrates that mid-upper arm circumference (MUAC) is a practical and sensitive indicator of nutritional depletion in patients with COPD and shows a significant association with disease severity. Although MUAC did not correlate directly with spirometric indices or the BODE index, it reflects underlying muscle wasting that contributes to disease progression. Functional parameters, particularly the 6-minute walk test, showed stronger associations with pulmonary function, while the BODE index remained a robust predictor of survival. Integrating MUAC with functional and multidimensional assessments may improve early identification of high-risk patients and guide targeted clinical management strategies.

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