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TANAFFOS

New Insights on the Relationship Between Body Composition and COPD in Iranian Patients

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Background: Chronic Obstructive Pulmonary Disease (COPD) is a multifaceted respiratory illness with significant systemic effects, notably changes in body composition like muscle atrophy and depletion of fat-free mass (FFM). Such alterations are associated with diminished physical performance, increased exacerbation frequency, and heightened mortality. In the Middle Eastern context, the interplay between body composition and COPD severity remains inadequately explored. This study investigates the correlation between body composition and COPD severity among Iranian patients, emphasizing anthropometric markers as predictors of disease outcomes.

Materials and Methods: A cross-sectional analysis was conducted involving 184 COPD patients at Dr. Masih Daneshvari Hospital, Tehran. Anthropometric measurements included BMI, triceps skinfold thickness (TSF), mid-upper arm circumference (MUAC), and thigh circumference. Disease severity was evaluated through spirometry and the modified Medical Research Council (mMRC) dyspnea scale. Correlations between these parameters and pulmonary function (FEV1) were assessed using Spearman's correlation and regression analyses.

Results: Positive associations were identified between FEV1 and BMI ($p=0.001$), TSF ($p=0.004$), MUAC ($p<0.001$), and thigh circumference ($p=0.008$), indicating that greater anthropometric values predict superior lung function. Negative correlations with mMRC scores highlighted reduced dyspnea severity in participants with healthier body composition. Overweight patients exhibited better spirometric outcomes and fewer exacerbations compared to those underweight.

Conclusion: Anthropometric indices such as BMI and MUAC are instrumental in evaluating COPD severity and guiding individualized management strategies. Further research should validate these findings across broader populations and employ advanced diagnostic tools.

Keywords: COPD Severity, mMRC, BMI, TSF, MUAC, Body composition

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a preventable and treatable condition characterized by persistent respiratory symptoms and airflow limitation resulting from airway and/or alveolar abnormalities (1). Such changes are often due to exposure to harmful particles or gases, primarily from smoking and air pollution, and are compounded by genetic susceptibility (2). Beyond pulmonary effects, COPD frequently leads to extrapulmonary manifestations, including systemic inflammation, muscle wasting, and nutritional deficiencies, all of which can significantly impact disease severity, prognosis, and quality of life. In recent years, the role of body composition in COPD has received growing attention (3). Body composition abnormalities, particularly reductions in fat-free mass (FFM) and skeletal muscle, have been shown to correlate with worse outcomes, such as decreased physical function, higher hospitalization rates, and increased mortality (4). These changes not only reflect the physical deterioration seen in COPD but also exacerbate symptoms by reducing respiratory muscle strength and endurance (5). While body mass index (BMI) has traditionally been used to assess weight-related health risks, it does not distinguish between fat and muscle mass and may therefore be limited in evaluating COPD patients accurately (6). Thus, alternative metrics like the fat-free mass index (FFMI) and specific anthropometric measures, such as mid-upper arm circumference (MUAC) and triceps skinfold thickness (TSF), are emerging as more precise indicators of health and functional status in COPD (7). For example, studies have shown that low FFMI is a predictor of poor outcomes in COPD, including reduced exercise capacity and survival (8). Interestingly, a growing body of research suggests that a higher BMI, which is typically considered harmful, may actually provide a protective effect in COPD patients, a phenomenon referred to as the "obesity paradox" (9).

Some researchers speculate that higher fat reserves could support better survival in chronic illnesses by serving as an energy buffer during catabolic stress. However, the mechanisms driving this paradox and its broader implications remain subjects of ongoing investigation, and findings have been inconsistent across different populations (10,11). Given the limited research on body composition and COPD in Middle Eastern populations, this study aims to assess the association between various anthropometric indices and COPD severity in a sample of Iranian patients. By exploring these associations, we aim to determine whether body composition might serve as a modifiable factor in COPD management and thereby inform targeted interventions to improve patient outcomes.

MATERIALS AND METHODS

Study Design and Population

This study employed a cross-sectional observational design to explore the relationship between body composition and chronic obstructive pulmonary disease (COPD) severity among Iranian patients. The study was conducted at Dr. Masih Daneshvari Hospital in Tehran, Iran, a leading center for respiratory diseases. Participants were recruited based on a diagnosis of COPD according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines. To ensure data reliability, patients with recent exacerbations (within the past two months) or coexisting severe conditions (e.g., liver or kidney disease, cachexia, or cardiac comorbidities) were excluded from the study.

Sample Selection

The study included 184 individuals diagnosed with COPD, ranging from 18 to 75 years of age. To be eligible, participants had to have documented airflow limitation and a stable disease condition, which helped minimize the impact of acute exacerbations on their body composition and respiratory function. While the researchers aimed for a gender-balanced cohort, they observed a higher proportion of male participants, which reflects the increased prevalence of COPD among men in the local region. All participants provided written informed consent after receiving a comprehensive explanation of the study's objectives and procedures

Data Collection

We collected demographic data and medical histories through structured interviews and questionnaires. Data on quality of life and respiratory symptoms were also gathered, enabling a comprehensive view of each patient’s health profile.

Body Composition Assessment

Anthropometric measures were taken by trained technicians to minimize measurement variability. Body weight was measured using a calibrated beam scale with subjects barefoot and in lightweight clothing, while height was recorded to the nearest 0.5 cm with a stadiometer. Body mass index (BMI) was subsequently calculated (kg/m^2), and participants were categorized into three groups: underweight (BMI < 18.5), normal (18.5 ≤ BMI < 25), and overweight (BMI ≥ 25). Additional assessments included:

Triceps Skinfold Thickness (TSF): Measured using an adipometer to capture subcutaneous fat levels, recorded in millimeters.

Mid-Upper Arm Circumference (MUAC): Measured with a plastic tape measure on the right arm, providing insights into muscle and fat composition in the upper body.

Thigh Circumference: Measured at the midpoint between the inguinal fold and the top of the patella, as a marker for lower limb muscle mass.

Respiratory Function and Dyspnea Assessment

Lung function was evaluated using standardized spirometry to measure forced expiratory volume in one second (FEV1) and forced vital capacity (FVC). Severity classifications were based on FEV1 values, as defined by the GOLD guidelines: mild (FEV1 > 80%), moderate (50% ≤ FEV1 < 80%), severe (30% ≤ FEV1 < 50%), and very severe (FEV1 < 30%). Dyspnea severity was assessed using the modified Medical Research Council (mMRC) scale, providing a subjective measure of breathlessness that correlates with functional capacity in COPD patients.

Statistical Analysis

Data were analyzed using SPSS version 22 for Windows. Descriptive statistics were used to summarize demographic and clinical variables. Associations between continuous variables were examined with Spearman's correlation, while group comparisons were conducted using nonparametric tests (Mann-Whitney U and Kruskal-Wallis tests) due to the data's non-normal distribution. To enhance interpretability and rigor, p-values < 0.05 were considered statistically significant. Additional regression analyses were performed to adjust for potential confounders, such as age, gender, and smoking history, ensuring the robustness of findings linking body composition indices with COPD severity.

Ethical Considerations

This study was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences (IR.SBMU.NRITLD.REC.1397.067). All participants were informed of the study's purpose, methods, and potential risks, with assurances of confidentiality and the right to withdraw at any time. Written informed consent was obtained from each participant in adherence with the Declaration of Helsinki.

RESULTS

This study involved 184 participants diagnosed with COPD. Most participants (88.6%) were male, with an average age of 60.6±11.5 years. The number of male participants was over four times higher than the number of female participants. The youngest and oldest participants were 34 and 91, respectively, with a median age of 61. In this study, the participants' average body mass index (BMI) was 25.4±5.1. Among them, 9.8% were underweight, 34.8% had a normal weight, and 52.7% were classified as overweight. Regarding lung function, 12.0%, 29.9%, 39.1%, and 19.0% of patients had very severe, severe, moderate, and mild FEV1, respectively. Based on the mMRC questionnaire, 8.2%, 59.2%, 25.5%, and 7.1% of participants reported shortness of breath at levels 1, 2, 3, and 4, respectively. Table 1 provides a detailed overview of the characteristics of the subjects. During the study, the average number of COPD exacerbations per patient was 0.7±0.7, with 30% of patients experiencing one COPD exacerbation, 54.3% experiencing two COPD exacerbations, and 10.3% experiencing three COPD exacerbations. Our findings highlight the noteworthy correlation between BMI and FEV1 as well as the Medical Research Council (mMRC) scale. The observed p-values of 0.001 and 0.019 for FEV1 and MRC indicate a statistically significant association between these variables. In addition to the relationship between BMI and lung function, the study also revealed a substantial connection between thigh circumference and FEV1 (P=0.007) and MRC (P = 0.014). This implies that individuals with larger thigh circumferences tended to have higher FEV1 values and improved MRC scores .These findings contribute to understanding the relationship between anthropometric measurements and respiratory health. Specifically, they suggest that BMI and thigh circumference play a role in determining lung function and functional capacity. The findings from the study demonstrated a notable association between FEV1 and TSF (P=0.004) as well as MUAC (P<0.001). Furthermore, there was a significant correlation between weight and FEV1 (P=0.008), as shown in Table 2. These findings shed light on the significant impact of TSF and MUAC on lung function, as the FEV1 directly reflects. Moreover, the results from the Spearman correlation analysis revealed a significant negative association between BMI, TSF, MUAC, thigh circumference, and weight mMRC scale. This suggests that individuals with higher BMI, TSF, MUAC, thigh circumference, and weight tend to have lower mMRC scores, indicating better respiratory function and lower levels of breathlessness. On the other hand, the correlation analysis also demonstrated a positive relationship between BMI, TSF, MUAC, thigh circumference, and weight with FEV1. In other words, participants with higher BMI, TSF, MUAC, thigh circumference, and weight tended to exhibit greater FEV1 values, indicating better lung function and a higher capacity for air expulsion (Figure 1).

Table 1. Demographic characteristics of the patients

	Mean ± SD	(Min, Q2, Max)
Age	60.6 ± 11.5	(34, 61, 91)
BMI	25.4 ± 5.1	(14.2, 25.3, 40.6)
Weight	70.3 ± 15.4	(33, 70, 120)
TSF	14.4 ± 8.9	(2, 14, 49)
MUAC	25.7 ± 4.0	(16, 26, 43)
Thigh's circumference	39.6 ± 6.6	(23, 40, 69)
FEV1	57.4 ± 23.6	(11, 57, 132)
Count (%)		
Duration of COPD	2-3 years	45(24.5)
	≤ 2 years	139(75.5)
Smoke	Yes	79 (42.9)
	No	35 (19.0)
	Positive history	70 (38.0)
Opium	Yes	69 (37.5)
	No	80 (43.5)
	Positive history	32 (17.4)
Hookah	Yes	6 (3.3)
	No	177 (96.2)
Baking bread	Yes	9 (4.9)
	No	132 (71.7)
Use of oxygen at home	Yes	8 (4.3)
	No	176 (95.7)
BIPAP	Yes	2 (1.1)
	No	182 (98.9)

(-): Negative correlation, FEV1: ForcedEexpiratory Volume in one second, TSF: Triceps Skinfolds (TSF), MUAC: The Circumference of the Middle-Upper part of the right arm

Table 2. The association between body indexes and COPD symptoms

		MRC				**Number of exacerbations**				**FEV1_**			
		1.00	2.00	3.00	4.00	0	1	2	3	Very S.	Severe	Moderate	Mild
BMICOD	Underweight	0	7 (38.9)	7 (38.9)	4 (22.2)	0	3 (16.7)	11 (61.1)	4 (22.2)	7 (38.9)	7 (38.9)	3 (16.7)	1 (5.6)
	Normal	6 (9.4)	33 (51.6)	21 (32.8)	4 (6.3)	5 (7.8)	16 (25.0)	35 (54.7)	8 (12.5)	6 (9.4)	25(39.1)	19 (29.7)	14(21.9)
	Overweight	9 (9.3)	65 (67.0)	18 (18.6)	5 (5.2)	4 (4.2)	35 (36.5)	50 (52.1)	7 (7.3)	9 (9.3)	21(21.6)	47 (48.9)	20(20.6)
	PV	0.019				0.059b				0.001			
TSF_CO	<=25p	3 (5.6)	28 (51.9)	16 (29.6)	7 (13.0)	1 (1.9)	18 (33.3)	25 (46.3)	10 (18.5)	11(20.4)	22(40.7)	12 (22.2)	9 (16.7)
	>25p	12 (9.2)	81 (62.3)	31 (23.8)	6 (4.6)	8 (6.2)	37 (28.7)	75 (58.1)	9 (7.0)	11 (8.5)	33(25.4)	60 (46.2)	26(20.0)
	PV	0.133				0.299a				0.004			
MUAC_CO	<=25p	2 (3.8)	25 (48.1)	16 (30.8)	9 (17.3)	2 (3.8)	14 (26.9)	26 (50.0)	10 (19.2)	13(25.0)	20(38.5)	14 (26.9)	5 (9.6)
	>25p	13 (9.8)	84 (63.6)	31 (23.5)	4 (3.0)	7 (5.3)	41 (31.3)	74 (56.5)	9 (6.9)	9 (6.8)	35(26.5)	58 (43.9)	30(22.7)
	PV	0.002				0.113a				<0.001			
weight_ CO	<=25p	1 (2.2)	24 (53.3)	14 (31.1)	6 (13.3)	2 (4.4)	9 (20.0)	27 (60.0)	7 (15.6)	16(35.6)	10(22.2)	6 (13.3)	16(35.6)
	>25p	14 (10.4)	81 (60.4)	32 (23.9)	7 (5.2)	7 (5.3)	45 (33.8)	69 (51.9)	12 (9.0)	37(27.6)	59(44.0)	29 (21.6)	37(27.6)
	PV	0.080				0.061a				<0.001			
Thigh's circumference	<=25p	2 (4.0)	25 (50.0)	15 (30.0)	8 (16.0)	2 (4.0)	12 (24.0)	29 (58.0)	7 (14.0)	12(24.0)	17(34.0)	13 (26.0)	8 (16.0)
	>25p	13 (9.8)	83 (62.4)	32 (24.1)	5 (3.8)	7 (5.3)	42 (31.8)	71 (53.8)	12 (9.1)	10 (7.5)	38(28.6)	58 (43.6)	27(20.3)
	PV	0.014				0.188a				0.008			

a: Mann-Whitney Test, b: Kruskal-Wallis Test, (-): Negative correlation, FEV1: Forced Expiratory Volume in one second, TSF: Triceps Skinfolds (TSF), MUAC: The Circumference of the Middle-Upper part of the right arm

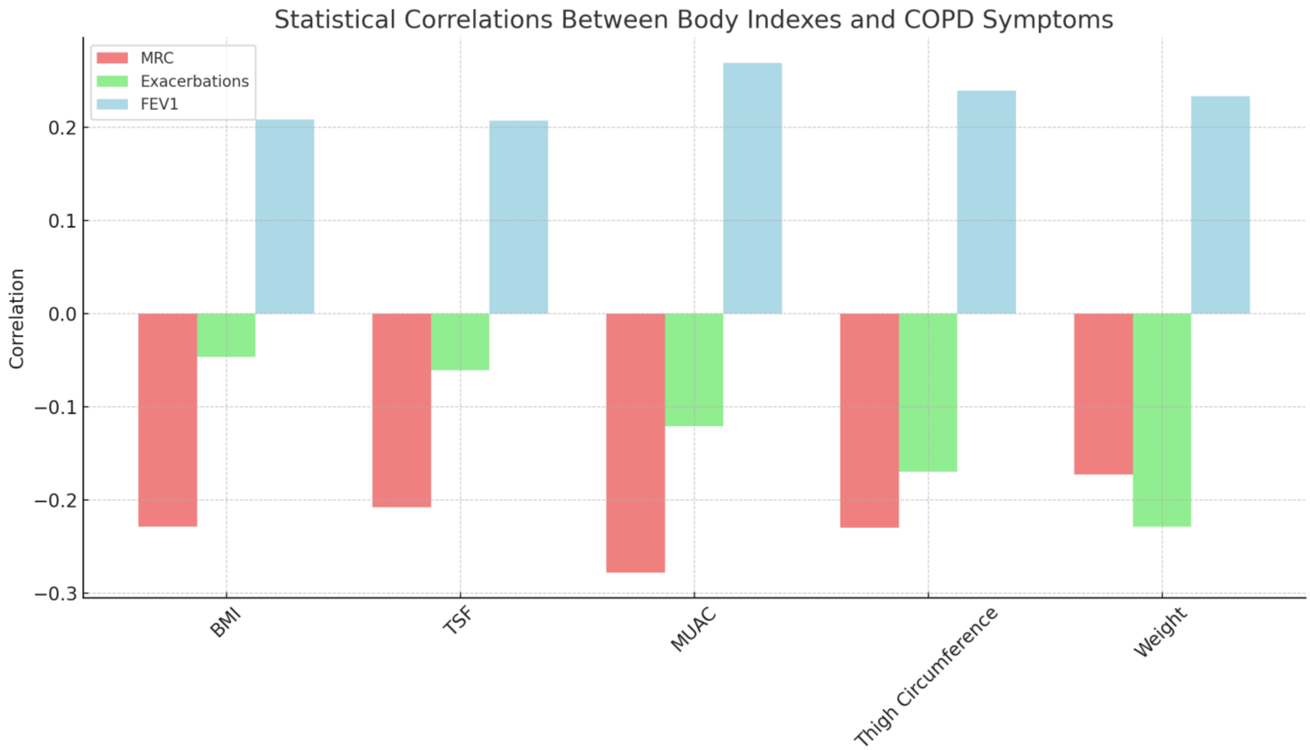

Figure 1. Spearman correlation coefficients between anthropometric indices (BMI, TSF, MUAC, thigh circumference, weight) and mMRC score, exacerbation frequency, and FEV1

DISCUSSION

Our study has uncovered a crucial link between body composition, pulmonary function, and the severity of dyspnea in patients diagnosed with COPD. In our investigation, we analyzed the body composition of a group of COPD patients to determine how different elements, such as muscle mass and fat mass, impact their lung function and level of dyspnea. Our results demonstrate a significant positive correlation between body composition and pulmonary function, with patients exhibiting better muscle mass and lower fat mass experiencing improved lung function. According to the results of the present study, a significant number of participants were overweight. 52.7% of the participants had a BMI that fell above the healthy range for their height and age group. According to research, there is a significant difference in the prevalence of overweight individuals within the studied population. This is evidenced by a higher percentage compared to rates found among Filipino individuals (32%) and Asians as a whole (6-10%) (13, 14, 15). Research has shown that individuals at risk of developing COPD may benefit from being slightly overweight, as it can improve lung function. In agreement with our findings, this notion is reinforced by a separate study that highlights how mild obesity, with a BMI greater than 30 kg/m^2, can lower mortality rates and enhance spirometry parameters (FEV1 and FVC) in COPD patients (16,17). Contrary to the results obtained in our study, Gologanu's research findings indicated no significant correlations between body composition parameters and FEV1 (4). However, our findings revealed notable correlations between specific body composition parameters and FEV1. These discrepancies may be attributed to various factors, including sample size, demographic differences, and study design variations. Further research with larger sample sizes and diverse populations may help clarify the precise relationship between body composition parameters and lung function. In contrast to the findings of our study, Alqarni et al. did not observe any significant links between spirometry parameters and BMI (18). Our research revealed a distinct relationship between these two factors. The discrepancy between our findings and Alqarni's study may stem from several factors. Firstly, variations in the study populations could influence the outcomes. Age, gender, ethnicity, and overall health status can significantly impact the relationship between BMI and spirometry. Additionally, differences in study design, methodologies, and statistical analysis techniques can influence the results and lead to contrasting conclusions. Furthermore, we found a significant association between FEV1 and TSF ($P = 0.004$), as well as MUAC ($P < 0.001$).

These findings suggest a possibility of direct impact of TSF and MUAC on lung function, as measured by FEV1. This sheds light on the potential influence of body composition on respiratory health. However, the study of Sharma et al. (19) showed no significant correlation between TSF or MUAC and FEV1 levels. According to our findings, a majority of individuals (67%) were found to be overweight and had an mMRC score of 2 (Table 3). A significant proportion of the patients with COPD in our study had mild to moderate COPD based on airflow obstruction criteria (67.0%), which is consistent with the findings of van den Bemt et al. (76.0%) and Steuten et al. (78.0%) (16,17). Additionally, the prevalence of low BMI was almost similar to that observed in the study conducted by van den Bemt et al., where they reported 11.7% (16). When looking at the body composition parameters, as BMI, TSF, MUAC, thigh circumference, and weight decreased, the number of COPD exacerbations and mMRC increased. Our results showed that spirometric indices were significantly lower in patients with standard body composition variables. According to the available evidence, a low BMI is associated with an increased mortality rate and poorer life quality, similar to our findings (20). Similar to Eisner et al.'s study (21), our study also demonstrated that body composition abnormalities were associated with an increase in the number of COPD exacerbations and an increase in the severity of COPD. According to the study results among our underweighted COPD subjects, the frequency of stage 2 of COPD severity was higher than in the previous study by Mohsen et al. (22), which showed that stage 4 of COPD was more frequent. On the other hand, contrary to the expected results, our findings illustrated that patients with two COPD exacerbations had a BMI, TSF, MUAC, and thigh circumference greater than individuals with fewer than two exacerbations. This finding was similar to the results of Gaona-Aria et al. (23).

It is crucial to consider the limitations of any study when interpreting results. Our study, conducted on a sizable sample from diverse backgrounds, demonstrated a strong correlation between spirometry and BMI. However, further research is needed to explore the potential factors influencing these associations to obtain a more comprehensive understanding.

Limitation

This study has several important limitations that should be considered in interpreting the findings. First, as a cross-sectional study, it captures only a single time-point in the relationship between body composition and COPD severity, thus limiting any conclusions about causation. Longitudinal research is required to clarify how shifts in body composition might impact disease progression over time. Second, this study was conducted in a single medical center in Tehran, Iran, which may limit the generalizability of our findings to other populations with varied ethnic, genetic, and environmental backgrounds. Future studies should seek to include more geographically and culturally diverse samples to validate these results across broader patient populations.

Additionally, while practical, body composition measures such as TSF and MUAC may be susceptible to minor inaccuracies due to inter-observer variability. Employing more advanced measurement techniques, such as dual-energy X-ray absorptiometry (DEXA), could yield greater precision but was not feasible within this study.

Lastly, by excluding patients with comorbidities such as liver or kidney disease, we controlled for confounding factors, but this may also limit the applicability of our findings to the broader COPD population, many of whom manage multiple comorbidities. Future research should investigate these relationships in a more inclusive cohort to enhance clinical relevance and applicability.

CONCLUSION

Our findings emphasize the significant connection between body composition and the severity of COPD. Tracking anthropometric measurements, such as BMI and TSF, is crucial for effective management of COPD. A thorough understanding of how body composition—its structure, distribution, and changes over time—affects the progression and prognosis of COPD can lead to more informed clinical assessments. These accessible indicators can serve as reliable tools for comparing and studying the disease's effects on patients, offering insights into both current disease status and future risks. Moreover, investigating the impact of body composition changes on COPD could drive the development of innovative diagnostic techniques and treatment strategies. This research could not only assist in more personalized management of COPD patients but also help alleviate symptoms, slow disease progression, and improve overall quality of life. Ultimately, it holds the potential to shape future therapeutic approaches and foster novel research methodologies for the treatment of COPD, improving clinical outcomes and the understanding of this complex disease.

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Conflict of Interest

There is no conflict of interest to declare.

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