Association Between Appendicular Muscle Mass and Physical Activity in Male Patients with COPD: A Cross-sectional Analysis

Yu Jin Im[1], Sunga Kong[2], Hye Yun Park[3], Jong Geol Do[1*]

1. Department of Physical and Rehabilitation Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Republic of Korea
2. Department of Clinical Research Design and Evaluation, SAIHST, Sungkyunkwan University, Republic of Korea
3. Division of Pulmonary and Critical Care Medicine, Department of Internal Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Republic of Korea

Background and Aims

- Chronic obstructive pulmonary disease (COPD) represents a significant global health challenge, characterized by progressive airflow limitation and substantial quality of life impairment.
- Skeletal muscle wasting is a notable extrapulmonary manifestation in COPD patients
- Low appendicular skeletal muscle mass (ASM) associated with poor outcomes.
- However, the relationship between ASM and physical activity levels remains unclear.
- This study aimed to investigate the association between ASM and daily physical activity levels in male COPD patients.

Methods

- Study design: Prospective cross-sectional study
- Study population: 89 male COPD patients (recruited from April 2022 to June 2024)
- Body composition analysis using bioelectrical impedance analysis
  - **Low ASM** was defined as appendicular skeletal muscle mass index < 7.0 kg/m^2 for male
- Physical activity level measurement: Wrist-worn accelerometers for one consecutive week

Results

- Among 89 participants, 17 (19.1%) had low ASM.
- The low ASM group showed significantly lower forced expiratory volume in one second, higher BODE (Body-mass index, Obstruction, Dyspnea and Exercise) index, and greater modified medical research council dyspnea scale (Table 1).
- Daily step count and moderate-to-vigorous physical activity time per day were significantly lower in the low ASM group (Table 2).

Table 1. Baseline characteristics of the study participants

Variables	Total group (N=89)	Low ASM group (N=17)	Normal ASM group (N=72)	p-value
Age (year), mean ± SD	68.8 ± 7.6	70.3 ± 5.61	68.4 ± 8.0	0.37
Height (cm), mean ± SD	166.0 ± 4.7	165.1 ± 4.6	166.2 ± 4.8	0.39
Weight (kg), mean ± SD	64.9 ± 9.5	54.2 ± 7.3	67.4 ± 8.1	**<0.001**
BMI category, n (%)				**<0.001**
Underweight (<18.5)	5 (5.6)	4 (25.5)	1 (1.4)	
Normal (18.5–25.0)	54 (60.7)	13 (76.5)	41 (56.9)	
Overweight (≥25.0)	30 (33.7)	0 (0.0)	30 (41.7)	
ASMI (kg/m^2), mean ± SD	7.8 ± 1.0	6.4 ± 0.4	8.2 ± 0.8	**<0.001**
Smoking quantity (pack-year), mean ± SD	39.2 (24.4)	49.6 (25.7)	37.8 (23.6)	0.05
mMRC grade, n (%)				**<0.001**
0 or 1	49 (55.1)	3 (17.6)	46 (63.9)	
2 or higher	40 (44.9)	14 (82.4)	26 (36.1)	
COPD Assessment Test, mean ± SD	15.2 ± 8.3	18.65 ± 8.7	14.4 ± 8.0	0.07
FEV1 (%), mean ± SD	50.6 ± 13.2	37.6 ± 14.2	53.7 ± 10.9	**<0.001**
BODE index total score, mean ± SD	2.5 ± 2.2	5.1 ± 2.4	2.0 ± 1.7	**<0.001**

Abbreviation: SD, standard deviation; BMI, body mass index; ASMI, appendicular skeletal muscle mass index; IQR, interquartile range. mMRC, modified medical research council dyspnea scale; FEV1, forced expiratory volume in one second.

Table 2. Physical function capacity and daily physical activity level by group

Variable	Total group	Low ASM group	Normal ASM group	p-value
6-minute walk test	N=89	N=17	N=72	
Total walking distance (m), mean ± SD	459.2 ± 113.0	352.3 ± 139.6	484.5 ± 89.8	**0.001**
Resting SpO$_2$ (%), median [IQR]	96.0 [95.0–97.0]	96.0 [94.0–98.0]	96.0 [95.0–97.0]	0.80
ΔSpO$_2$ (%), mean ± SD	6.3 ± 4.7	9.9 ± 5.6	5.4 ± 4.0	**<0.001**
Hand grip strength	N=88	N=16	N=72	
Low muscle strength (< 28 kgf), n (%)	39 (44.3)	10 (62.5)	29 (40.3)	0.16
5 times sit-to-stand	N=87	N=16	N=71	
Low physical performance (≥12 sec), n (%)	11 (12.6)	5 (31.2)	6 (8.4)	**0.03**
30 sec sit-to-stand	N=89	N=17	N=72	
Low physical performance (≤17), n (%)	64 (71.9)	13 (76.5)	51 (70.8)	0.81
Daily physical activity level	N=79	N=14	N=65	
Step count (n/day), median [IQR]	7823.5 [4765.0–10608.3]	2920.7 [2400.7–4567.4]	8237.6 [5861.5–11238.0]	**<0.001**
MVPA time (min/day), median [IQR]	48.6 [21.0–76.3]	19.9 [8.1—46.8]	50.14 [25.9–77.2]	**0.01**

Abbreviation: SD, standard deviation; SpO2, oxygen saturation; IQR, interquartile range; MVPA, moderate to vigorous physical activity.

Table 3. Univariable and multivariable logistic regression analysis for risk factors of low appendicular skeletal muscle mass

	Univariable		Multivariable	
	OR (95% CI)	p-value	aOR (95% CI)	p-value
Age (year)	1.04 (0.96 to 1.14)	0.38		
Smoking quantity (pack-year)	1.02 (1.00 to 1.05)	0.04	**1.06 (1.02 to 1.11)**	**0.007**
CAT total score	1.09 (1.01 to 1.17)	0.02		
FEV$_1$ (%)	0.90 (0.85 to 0.95)	<0.001		
6-minute walk test				
Total walking distance, per 10m increase	0.91 (0.86 to 0.96)	<0.001		
Decline in SpO$_2$ (%)	1.21 (1.08 to 1.38)	0.003	**1.18 (1.03 to 1.36)**	**0.02**
Daily physical activity level				
Step counts, per 100 steps increase	0.97 (0.94 to 0.99)	0.002	**0.95 (0.92 to 0.98)**	**0.001**
MVPA time, per 1minute increase	0.98 (0.95 to 1.00)	0.05		

- Multivariable logistic regression analysis identified cumulative smoking exposure, oxygen desaturation during 6MWT, and daily step count as independently associated with low ASM (Table 3).

Conclusion

- **Low ASM in male COPD patients was associated with severe airflow limitation, exercise intolerance, and markedly reduced physical activity levels.**
- Routine assessment of body composition should be integrated into COPD management.
- Early intervention targeting both respiratory symptoms and physical activity may be necessary to prevent muscle loss in COPD patients.

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