

SARCOPENIA AND SPONDYLOARTHRITIS ACTIVITY AND FUNCTIONAL ASSESSMENT

S. A. Tabra, A. A. El Shintenawy, M. H. Abu-Zaid, E. Elshintenawy

Department of Rheumatology and Rehabilitation, Tanta University, Faculty of Medicine – Egypt

Abstract. Background: Sarcopenia is a progressive loss of muscle mass and strength; this may cause increased morbidity and mortality. Rheumatic diseases as spondyloarthropathies have greater risks of developing sarcopenia. **Objectives:** To assess sarcopenia in Egyptian patients with psoriatic arthritis (PSA) and axial spondyloarthritis (axSPA) and investigate the relation between sarcopenia and different factors. **Methods:** This study included 56 PSA (Group I), 58 axSPA patients (Group II), and 60 healthy controls (Group III). Demographic data were collected, and disease activity was assessed using Disease Activity Index for Psoriatic Arthritis (DAPSA) score for PSA patients and ASDAS-CRP (Ankylosing Spondylitis Disease Activity Score) for axSPA patients. Functional assessment was done using Bath ankylosing spondylitis functional index (BASFI) for axSPA patients and Health Assessment Questionnaire (HAQ) for PSA patients. Sarcopenia was assessed by measuring muscle mass, muscle strength, and physical performance. **Results:** There was no significant difference between study groups regarding age and BMI. None of the studied patients had definite sarcopenia, twelve PSA patients (21.43%), and fifteen axSPA patients (25.86%) had probable sarcopenia, while seven PSA and five axSPA patients had pre-sarcopenia. We found significant differences between PSA and controls regarding muscle quantity, muscle strength, and muscle performance, while we found significant differences between axSPA and controls regarding muscle strength, and muscle performance. The risk of probable sarcopenia in axSPA patients increased with increasing age and ASDAS-CRP, and in PSA patients it increased with increasing age, DAPSA and HAQ. **Conclusions:** Probable sarcopenia was significantly increased in PsA and axSPA. Our analysis suggests that age and disease activity were associated with the development of sarcopenia in PSA and axSPA.

Key words: psoriatic arthritis, axial spondyloarthritis, sarcopenia, disease activity

INTRODUCTION

Sarcopenia is characterized by a gradual and widespread loss of muscle mass, a deterioration in muscle function, and a decrease in physical performance that raises the risk of frailty, disability, and death. While sarcopenia was previously considered an age-related disease, it is now recognized that chronic inflammatory conditions can also lead to secondary sarcopenia [1].

Several diagnostic criteria for sarcopenia with different outcome thresholds have been developed [2, 3, 4, 5]. Recently, according to the updated definition of the European Working Group on Sarcopenia in Older People (EWGSOP2), low muscle strength as a mandatory criterion for probable sarcopenia and sarcopenia is defined as the combination of low muscle strength and low muscle quantity or quality. Sarcopenia is classified as severe when reduced muscle strength, low muscle quantity/quality, and low physical performance have been observed [6].

Loss of muscle mass has different theories for its pathogenesis but proinflammatory cytokines are

involved in its pathogenesis. TNF and other inflammatory cytokines are believed to cause muscle catabolism [7].

Spondyloarthropathy is a group of chronic inflammatory rheumatic diseases, which share some of the clinical symptoms and genetic basis [8].

Few research evaluated secondary sarcopenia in rheumatic disorders; studies on sarcopenia in SPA are few and showed conflicting results due to the use of differing diagnostic criteria for sarcopenia in SpA. They evaluate muscle mass index without taking into consideration physical performance or muscle strength [9, 10, 11, 12].

The aim of this study was to assess sarcopenia in Egyptian patients with psoriatic arthritis and axial spondyloarthritis and investigate the relation between sarcopenia and different factors.

MATERIALS AND METHODS

A case-control study was conducted at a single center (as cross-sectional study design makes it possible to investigate multiple risk factors at once).

Setting

Patients were recruited from the Rheumatology and Rehabilitation Department outpatient clinic, *** University Hospitals.

Patients

The study included 60 adult patients who fulfilled CASPAR [13] criteria for PsA, 60 axial spondyloarthritis patients who fulfilled ASAS classification criteria [14], and 60 healthy volunteers matched for age and gender. "A total of 60 is required to achieve 80% study power at 95% confidence level with a margin of error equal to 5%". Patients who have other dermatological or rheumatological disorders, immobilization for a period longer than 15 days in the last 6 months, other possible causes of secondary sarcopenia as malnutrition, diabetes, chronic kidney disease, chronic obstructive pulmonary disease, heart failure, and recent steroid therapy (over the last three months) were excluded from the study.

Duration of the study was thirteen months (from March 2023 to March 2024).

Ethics approval and consent to participate

This study has been approved by the institution's ethics board with permission number 36264PR161/3/23 and is in accordance with the Declaration of Helsinki's ethical principles as well as the ethical standards of the *** Faculty of Medicine. Informed consent was taken from each patient according to the local ethical commission.

Clinical assessment

Demographic data and a thorough medication history were recorded. The activity of PSA was estimated using the Disease Activity Index for Psoriatic Arthritis (DAPSA) score [15], which is a numerical summation of 66 swollen and 68 tender joint counts, pain, patient global assessment (PGA), and C-reactive protein (CRP (mg/dL)). Levels of disease activity were divided into four categories: remission (0-4), low disease activity (5-14), moderate disease activity (15-28), and high disease activity (>28). Disease Activity in axial spondyloarthritis patients was assessed using AS-DAS-CRP [16]. Level of activity was divided into inactive disease (< 1.3), low disease activity (1.3-2.1), high disease activity (2.1-3.5), and very high disease activity (> 3.5). Functional assessment was done using the Bath ankylosing spondylitis functional index (BASFI) [17] for AS patients and the Health Assessment Questionnaire (HAQ) [18]. for PSA patients.

Assessment of sarcopenia:

Sarcopenia was defined as low muscle mass and reduced skeletal muscle strength, probable

sarcopenia was defined as low muscle strength, while severe sarcopenia was defined as low muscle mass, reduced skeletal muscle strength, and low physical performance according to the European Working Group on Sarcopenia in Older People 2 [6]. Low muscle mass alone without muscle strength or physical performance impairment was considered pre-sarcopenia [2].

a. Muscle strength:

- During the examination, the subjects remained seated, with their hands firmly gripping the dynamometer and their elbows bent at 90 degrees. Three measurements were collected with each arm for a total of six, with brief breaks in between. The patients should be asked to squeeze as firmly and tightly as they can for 3-5 seconds for each of the 6 trials; the highest measurement of the 6 trials is recorded as the final result [19]. Muscle strength of handgrip was considered low if it was less than 27.0 kg for men and less than 16.0 kg for women according to the European Working Group on Sarcopenia in Older People 2 [20].

- Chair stand test: participants were asked to stand up from their chairs once and cross their arms across their chests. If the result was positive, they were instructed to rise and sit down again five times as quickly as they could. The duration needed to perform five rises was timed, starting when they were seated and instructed to begin, and ending when they had stood up straight for the fifth time. It is considered abnormal if the result is more than 15 seconds for five rises [21].

b. Muscle quantity by Lee equation: Skeletal muscle (kg) = $0.244 \times \text{body weight (kg)} + 7.80 \times \text{height (m)} - 0.098 \times \text{age (y)} + 6.6 \times \text{sex} + \text{race} - 3.3$. (where female = 0 and male = 1; race = 0 [White and Hispanic], race = 1.4 [Black] and race = - 1.2 [Asian]). The Egyptian race is considered white according to the federal government.

Muscle mass index (MMI) can be obtained by a simple formula: muscle mass/ height².

Low muscle quantity is considered if it is less than 7.0 kg/m² in men and less than 5.5 kg/m² in women [22].

c. Physical performance was assessed using gait speed [23]. A 4-meter track was used to time the patients' movements; the stopwatch started when the patient's foot touched the first marker and stopped when it crossed the second. A gait speed of ≤ 0.8 m/s was considered slow, according to the European Working Group on Sarcopenia in Older People 2 (EWGSOP2).

Laboratory assessment:

Routine laboratory assessment: erythrocyte sedimentation rate (ESR) by Westergren method and CRP.

Statistical analysis

SPSS version 20 was used for statistical analysis of the data [24]. Numbers and percentages were used to describe the qualitative data. The Kolmogorov–Smirnov and Shapiro–Wilk tests were used to verify the normality of distribution. The mean, standard deviation, median, and inter-quartile range (IQR) were used to characterize the quantitative data. The categorical data were compared using the chi-square test. Student t-test was used to compare two groups for normally distributed quantitative variables while ANOVA test was used for normally distributed quantitative variables to compare between more than two groups and the post hoc test for pairwise comparisons. On the other hand, Mann–Whitney test was used to compare two groups for not normally distributed quantitative variables. Kruskal–Wallis test was used to compare more than two groups for not normally distributed quantitative variables. Correlation between variables was done by Pearson’s correlation coefficient. For evaluation of the factors associated with

probable sarcopenia the univariate and multivariate analyses were done (only covariates showing a p-value < 0.05 at univariate analysis were included in the multivariate logistic regression analysis). P values less than 0.05 was considered statistically significant.

RESULTS

One hundred and fourteen patients had completed this study (56 PSA patients and 58 axSPA patients), beside 60 healthy controls. 50% of PSA patients were males, while 88% of axSPA patients were males. There was no significant difference between PSA patients, axSPA patients, and controls regarding age and BMI. Eight PSA patients were in remission, twenty in low disease activity, and twenty-eight were in moderate disease activity, while no one was in high disease activity. Regarding axSPA, 10 patients were inactive, 31 had low disease activity, 13 in high disease activity, while 4 patients had very high disease activity.

Seventy-one percent of PSA patients were receiving bDMARDs, while all axSPA patients were receiving bDMARDs. The demographic and disease-related characteristics of the patients and controls were mentioned in Table 1.

Table 1. Demographic and disease-related characteristics of the patients and controls

	PSA patients (56)		axSPA patients (58)		Controls (60)		P value
	Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)	
Age (years)	39.11 ± 6.95	39.5 (5)	40.66 ± 6.96	41 (5)	40.72 ± 10.74	42 (11)	0.35
Sex: (male/female)	28/28		51/7		24/36		< 0.0001*
BMI	28.1 ± 2.46	27.72 (3.66)	27.14 ± 2.99	27.15 (3.58)	26.92 ± 3.64	25.96 (5.21)	0.078
Duration of disease (ys)	5.78 ± 2.75	5.5 (4)	10.31 ± 6.84	15 (6)	NA	NA	< 0.0001*
Smoking: (yes/no)	11/45		9/49		9/51		0.77
Comorbidities (yes/no)	18/38 Single: 11 Multiple: 7		9/49 Single: 7 Multiple: 2		NA		
Disease activity	DAPSA: (N of patients) • Remission:8 • Low disease activity:20 • Moderate disease activity:28 • High disease activity:0		ASDAS-CRP: (N of patients) • Inactive:10 • Low disease activity:31 • High disease activity:13 • Very high disease activity:4		NA		
Functional assessment	HAQ:1.21 ± 0.47	1.35(0.7)	BASFI: 4.8 ± 1.19	5 (1.48)			
Treatment received: csDMARDs bDMARDs	16 40		0 58		NA NA		

BMI body mass index, PSA psoriatic arthritis, axSPA axial spondyloarthritis, csDMARDs conventional synthetic disease modifying antirheumatic drugs, bDMARDs biologic disease modifying antirheumatic drugs. DAPSA Disease Activity Index for Psoriatic Arthritis, ASDAS: Ankylosing Spondylitis Disease Activity Score, HAQ: health assessment questionnaire, BASFI: Bath ankylosing spondylitis functional index. IQR: Interquartile range.

Significant p value if < 0.05*

None of the studied patients had sarcopenia, twelve PSA patients (21.43%) and fifteen axSPA patients (25.86%) had probable sarcopenia (defined as low muscle strength), while low physical performance (assessed by gait speed) was found in 8 PSA patients, and 6 axSPA patients. Seven PSA, and five axSPA patients had pre-sarcopenia.

By using ANOVA, and Post Hoc Tukey evaluation in normally distributed quantitative variables and using Kruskal–Wallis test with Post Hoc test for not normally distributed quantitative variables, we found significant differences between PSA patients and controls regarding muscle quantity using the Lee equation, muscle strength (using chair stand test, and hand grip), and muscle performance using gait speed test. While we found significant differences between axSPA patients and controls regarding muscle strength using the chair stand test, and muscle performance using the gait speed test. Sarcopenia assessment in patients and controls was mentioned in Table 2 in detail.

Regarding PsA group, we found a significant correlation between muscle power and both DAP-

SA and HAQ (dynamometer measurements were significantly negatively correlated with DAPSA and HAQ “ $r = -0.39, -0.32$ correspondingly” and chair stand test duration was significantly positively correlated with DAPSA and HAQ “ $r = 0.69, 0.58$ correspondingly”). Also, gait speed was significantly negatively correlated with DAPSA “ $r = -0.66$ ”.

Regarding AxSPA group, we found a significant positive correlation between chair stand test duration and both ASDAS and BASFI “ $r = 0.64, 0.32$ correspondingly”. Also, gait speed was significantly negatively correlated with BASFI “ $r = -0.28$ ”.

When comparing PSA patients who had probable sarcopenia with those without probable sarcopenia, we found that the PSA patients with probable sarcopenia had significantly older age, higher disease activity, higher ESR and CRP, higher HAQ measurements, lower muscle mass indices, and slower gait speed. Regarding axSPA, we found that patients with probable sarcopenia had significantly older age, higher disease activity, and slower gait speed (Table 3, 4).

Table 2. Sarcopenia assessment in patients and controls

	PSA patients (56)		axSPA patients (58)		Controls (60)		P value	
	Mean $\pm$ SD	Median (IQR)	Mean $\pm$ SD	Median (IQR)	Mean $\pm$ SD	Median (IQR)	ANOVA or Kruskal–Wallis	Post Hoc
Muscle Mass Index (kg/m ²)	9.19 $\pm$ 3.55	11.27 (1.89)	10.55 $\pm$ 3.94	11.1 (1.15)	11.52 $\pm$ 3.92	9.9 (2.45)	0.0051*	GI:GII 0.301 GI:GIII 0.0035* GII:GIII 0.169
Hand grip strength (by dynamometer)	19.63 $\pm$ 2.67	20 (3)	24.67 $\pm$ 18.94	30 (24.5)	27.64 $\pm$ 9.38	26 (10.25)	< 0.0001*	GI:GII < 0.0001* GI:GIII < 0.0001* GII:GIII 0.065
Chair stand test (sec)	14.6 $\pm$ 4.97	13.5 (3.5)	16.43 $\pm$ 5.35	15 (6.75)	9.08 $\pm$ 1.81	9 (2.5)	< 0.0001*	GI:GII 0.566 GI:GIII < 0.0001* GII:GIII < 0.0001*
Gait speed (m/s)	0.98 $\pm$ 0.19	1 (0.2)	1.03 $\pm$ 0.24	1 (0.28)	1.22 $\pm$ 0.38	1.05 (0.4)	< 0.0001*	GI:GII 0.556 GI:GIII < 0.0001* GII:GIII 0.0011*

PSA psoriatic arthritis, axSPA axial spondyloarthritis, IQR: Interquartile range.
Significant p value if < 0.05*

Table 3. Comparison of PSA patients with or without probable sarcopenia

	PSA patients without probable sarcopenia (44)		PSA patients with probable sarcopenia (12)		P
	Mean $\pm$ SD	Median (IQR)	Mean $\pm$ SD	Median (IQR)	
Age	37.72 $\pm$ 6.54	38 (6)	46.0 $\pm$ 3.71	48 (8)	0.023*
Sex (M/F)	24/20		4/8		0.193
Duration	5.86 $\pm$ 2.84	5 (3.25)	6.0 $\pm$ 2.56	6 (6)	0.992
BMI	28.96 $\pm$ 3.81	27.7 (7.59)	27.27 $\pm$ 1.17	27.76 (2.62)	0.13
ESR	28.55 $\pm$ 11.49	28 (10)	42.67 $\pm$ 2.15	43 (5)	0.005*
CRP	5.72 $\pm$ 6.01	4 (3)	8.66 $\pm$ 0.98	8 (2)	< 0.0001*
DAPSA	5.36 $\pm$ 4.17	4 (1)	11.67 $\pm$ 4.38	13 (10)	< 0.0001*
HAQ	1.17 $\pm$ 0.36	1 (0.6)	1.63 $\pm$ 0.35	1.6 (0.33)	0.0009*
MMI	10.93 $\pm$ 1.36	11.22 (0.94)	10.08 $\pm$ 1.36	9.6 (2.85)	0.0168*
Gait speed	1.03 $\pm$ 0.15	1 (0.3)	0.77 $\pm$ 0.17	0.7 (0.4)	0.0003*

BMI body mass index, PSA psoriatic arthritis, axSPA axial spondyloarthritis, DAPSA Disease Activity Index for Psoriatic Arthritis, ASDAS: Ankylosing Spondylitis Disease Activity Score, HAQ: health assessment questionnaire, MMI: muscle mass index, ESR: erythrocyte sedimentation rate, CRP: C-reactive protein, IQR: Interquartile range.
Significant p value if < 0.05*

Table 4. Comparison of axSPA patients with or without probable sarcopenia

	axSPA patients without probable sarcopenia (43)		axSPA patients with probable sarcopenia (15)		P
	Mean $\pm$ SD	Median (IQR)	Mean $\pm$ SD	Median (IQR)	
Age	39.33 $\pm$ 6.24	41 (5)	44.47 $\pm$ 7.73	44 (7)	0.0125*
Sex (M/F)	40/3		12/3		0.153
Duration	10.0 $\pm$ 7.33	8 (8)	11.2 $\pm$ 5.44	9 (10)	0.332
BMI	26.94 $\pm$ 2.81	26.8 (3.5)	27.69 $\pm$ 3.52	28.6 (4.4)	0.409
ESR	27.47 $\pm$ 13.79	28 (25)	37.93 $\pm$ 19.5	34 (15)	0.089
CRP	6.84 $\pm$ 4.9	5 (5.5)	8.16 $\pm$ 5.1	7 (2.6)	0.327
ASDAS-CRP	2.1 $\pm$ 0.88	2.1 (1)	2.74 $\pm$ 1.06	2.55 (1.3)	0.034*
BASFI	4.65 $\pm$ 1.27	4.6 (1.8)	5.22 $\pm$ 0.83	5 (0.5)	0.112
MMI	10.19 $\pm$ 1.23	10.87 (0.53)	10.5 $\pm$ 1.42	10.8 (1.86)	0.873
Gait speed	1.03 $\pm$ 0.15	1 (0.25)	0.77 $\pm$ 0.17	0.9 (0.15)	0.014*

BMI body mass index, PSA psoriatic arthritis, axSPA axial spondyloarthritis, DAPSA Disease Activity Index for Psoriatic Arthritis, ASDAS: Ankylosing Spondylitis Disease Activity Score, HAQ: health assessment questionnaire, ESR: erythrocyte sedimentation rate, CRP: C-reactive protein, IQR: Interquartile range.

Significant p value if $< 0.05^*$

To evaluate risk factors associated with probable sarcopenia in PSA & axSPA patients using the univariate analysis, the risk of probable sarcopenia in axSPA patients increased with increasing age and ASDAS-CRP, and in PSA patients it increased with increasing age, DAPSA, and HAQ. At multivariate analysis, increased age and disease activity were associated with an increased risk of probable sarcopenia in both axSPA and PSA patients (Table 5).

DISCUSSION

This study evaluated the presence of sarcopenia in seronegative spondyloarthropathy patients. Probable sarcopenia was found in twelve PSA patients

(21.43%), and fifteen axSPA patients (25.86%). Seven PSA and five axSPA patients had pre-sarcopenia. There was a significant correlation between chair stand test and disease activity and functional status in both PSA and axSPA patients. Gait speed was significantly negatively correlated with DAPSA in PSA patients and with BASFI in axSPA patients.

In a recent study of a patient with AS was shown that none of patients fulfilled the definition of sarcopenia according to EWGSOP2 as none of patients had both a low muscle mass and strength. However, 8.3% of patients had low muscle strength, 8.3% of patients had decreased muscle mass and low gait speed was found in 55% of the patients [25].

Table 5. Variables associated with sarcopenia in SPA patients

	Univariate		multivariate	
	OR (95% CI)	P	OR (95% CI)	p
PSA				
Age	1.337 (1.134-1.567)	0.001*	1.305 (1.696-1.553)	0.003*
Sex	2.4 (0.629- 9.156)	0.2		
DAPSA	1.267 (1.107-1.451)	0.001*	1.387 (1.075-1.788)	0.012*
CRP	1.086 (0.979-1.204)	0.118		
HAQ	38.797 (3.518-427.87)	0.003*	52.807 (0.797-3500.442)	0.064
duration	1.018 (0.807-1.284)	0.878		
axSPA				
Age	1.139 (1.020-1.272)	0.021*	1.147 (1.023-1.285)	0.019*
Sex	4.848 (0.942-24.968)	0.59		
ASDAS-CRP	1.986 (1.044-3.781)	0.037*	1.929 (1.053-3.532)	0.033*
CRP	1.052(0.94-1.177)	0.194		
BASFI	1.525 (0.902-2.567)	0.115		
Duration	1.076 (0.997-1.160)	0.58		

PSA psoriatic arthritis, axSPA axial spondyloarthritis, DAPSA Disease Activity Index for Psoriatic Arthritis, ASDAS: Ankylosing Spondylitis Disease Activity Score, HAQ: health assessment questionnaire, CRP: C-reactive protein.

Significant p value if $< 0.05^*$

Öztürk Ö et al. reported that pre-sarcopenia can occur frequently in axSpA patients. 43.6% of patients with axial spondyloarthritis had pre-sarcopenia and no patients had sarcopenia [26].

Merle B et al. reported that 21% out of 103 SpA patients had probable sarcopenia and 5% had sarcopenia.[27].

Aguiar R et al. found that there was a significant difference regarding muscle mass index (using Lee's equation) between patients with spondyloarthritis and healthy controls and sarcopenia was more common in patients compared to controls (61.7% vs 43.3%) [9].

Barone M et al. reported that the prevalence of sarcopenia was 20% in AS patients and PsA patients. Age and disability were the factors that affect sarcopenia, and the prevalence of sarcopenia was not significantly different in patients with activity when compared to those with remission [10].

Another study, utilizing a different methodological approach (DXA and handgrip strength or physical performance test), on North African AS patients revealed a greater rate of sarcopenia (34.3%) [11].

The difference in results between studies may be attributed to the use of different definitions of probable sarcopenia and sarcopenia (EWGSOP1 vs EWGSOP2) and different methods for assessment. The increased proportion of SPA patients with decreased muscle strength without affection of muscle mass support that decreased muscle strength can occur as an earlier consequence of disuse due to joint inflammation, pain, enthesitis, and stiffness [27].

A decrease in muscle strength may be explained by several factors, such as systemic inflammation or fatigue. Loss of strength is also related to inactivity or disuse [28].

Regarding physical performance, in patients with longstanding r-axSpA gait is slower and they have a shorter stride length than healthy individuals, which can be explained by increased rigidity of the spine [29].

It was reported that CRP and disease activity were significantly higher in SPA patients with probable sarcopenia than patients without probable sarcopenia while physical performance (assessed by gait speed) was lower in SPA patients with probable sarcopenia than patients without probable sarcopenia [27].

Another research evaluated the area of the paravertebral muscles and the degree of fatty infiltration of lumbar erector spinae and multifidus muscles using MRI in axSpA patients and patients with chronic low back pain, and the authors found that fatty infil-

tration, a sign of muscle degeneration, was markedly observed in ankylosing spondylitis patients and is associated with radiographic changes and suggest that the inflammation may have a role multifidus sarcopenia [30].

Regarding secondary sarcopenia, there are still a lot of unanswered questions. One of them relates to the underlying mechanisms: inflammation plays a crucial role, but since various diseases are caused by various cytokine profiles, the function of some specific inflammatory mediators is yet unknown. Also, another explanation may be attributed to reduced physical activity, especially in axSPA, resulting in muscle disuse, and be related to nutritional deficiencies and hormonal disturbances such as alterations in insulin-like growth factor-1 (IGF-1), testosterone, and cortisol levels, which can influence muscle mass and strength [11].

Limitations of this study include a small number of the sample. In addition, the assessment of the inflammatory activity was based on disease scores instead of measuring the pro-inflammatory cytokines, which are more objective. Further, this is a single-center case-control study, so in the future, multicentric, prospective studies are required to support the data in this study.

CONCLUSION

Probable sarcopenia was significantly increased in PsA and axSPA. Our analysis suggests that age and disease activity were associated with the development of sarcopenia in PSA and axSPA. This implies that muscle strength may be a prominent characteristic of probable secondary sarcopenia.

Statements and Declarations

The corresponding author's declaration that the material has not been published before.

Ethics approval. *This study has been approved by the institution's ethics board with permission number 36264PR161/3/23 and is in accordance with the Declaration of Helsinki's ethical principles as well as the ethical standards of the Tanta Faculty of Medicine. According to the local ethical commission, informed consent was received from each patient. Every patient file included a code number that incorporated the results of all investigations, ensuring the privacy of all patient data.*

Consent to participate/publication: Not applicable.

Conflicts of interest The Authors declare no funding and no any conflict of interest.

Availability of data and material. *The data will be available upon reasonable request.*

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Authors' contributions. All authors designed the study protocol. Samar abd Alhamed Tabra formulated the idea of the manuscript. Aya A El Shintenawy and Esraa Elshintenawy monitored the progress and collected the data. Samar abd Alhamed Tabra and Mohammed Hassan Abu-Zaid formulated the results. All authors contributed to drafting the manuscript and have read and approved the final version of the manuscript.

References

1. Tournadre A, Vial G, Capel F et al. Sarcopenia. Joint Bone Spine. 2019;86(3):309-314. doi: 10.1016/j.jbspin.2018;08.001.
2. Cruz-Jentoft AJ, Baeyens JP, Bauer JM et al. Sarcopenia: European consensus on definition and diagnosis: report of the European working group on Sarcopenia in older people. Age Ageing 2010; 39(4):412-423.
3. An HJ, Tizaoui K, Terrazzino S et al. Sarcopenia in autoimmune and rheumatic diseases: a comprehensive review. Int J Mol Sci 2020; 21(16):5678.
4. Bhasin S, Trivison TG, Manini TM et al. Sarcopenia definition: the position statements of the Sarcopenia definition and outcomes consortium. J Am Geriatr Soc. 2020; 68(7):1410-1418.
5. El Miedany Y, El Gaafary M, Gadallah N et al. Sarcopenia in Egypt: epidemiology of sarcopenia risk among older adults presenting with fragility fractures – an initiative by the Egyptian Academy of Bone Health. Egypt Rheumatol Rehabil. 2023;50, 62.
6. Cruz-Jentoft AJ, Bahat G, Bauer J et al. Writing Group for the European Working Group on Sarcopenia in Older People 2 (EWGSOP2), and the Extended Group for EWGSOP2 Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing. 2019;48(4):601.
7. Targo ska-St pniak B, Majdan M. Associations between parameters of nutritional status and disease activity in patients with rheumatoid arthritis. Pol Arch Med Wewn 2011; 121: 122-128.
8. Saraux A, Guillemin F, Guggenbuhl P et al. Prevalence of spondyloarthropathies in France: 2001. Ann Rheum Dis 2005;64(10):1431-1435.
9. Aguiar R, Sequeira J, Meirinhos T et al. SARCOSPA – Sarcopenia in spondyloarthritis patients. Acta Reumatol Port 2014;39(4):322-326.
10. Barone M, Viggiani MT, Anelli MG et al. Sarcopenia in Patients with Rheumatic Diseases: Prevalence and Associated Risk Factors. J Clin Med. 2018;1,7(12):504. doi: 10.3390/jcm7120504.
11. El Maghraoui A, Ebo'o FB, Sadni S et al. Is there a relation between pre-sarcopenia, sarcopenia, cachexia and osteoporosis in patients with ankylosing spondylitis? BMC Musculoskelet Disord 2016;17:268 doi: 10.1186/s12891-016-1155-z.
12. Krajewska-Wlodarczyk M, Owczarczyk-Saczonek A, Placek W. Changes in body composition and bone mineral density in postmenopausal women with psoriatic arthritis. Reumatologia 2017;55(5):215-221.
13. Taylor W, Gladman D, Helliwell P et al. CASPAR Study Group. Classification criteria for psoriatic arthritis: development of new criteria from a large international study. Arthritis Rheum. 2006;54(8):2665-73. DOI: 10.1002/art.21972.
14. Rudwaleit M, van der Heijde D, Landewé R et al. The development of Assessment of SpondyloArthritis international Society classification criteria for axial spondyloarthritis (part II): validation and final selection Annals of the Rheumatic Diseases. 2009;68:777-783.
15. Schoels M, Aletaha D, Funovits J et al. Application of the DAREA/DAPSA score for assessment of disease activity in psoriatic arthritis. Ann Rheum Dis. 2010;69(3),1441-1447. DOI: 10.1136/ard.2009.122259.
16. Van der Heijde D, Lie E, Kvien TK et al. Assessment of SpondyloArthritis international Society (ASAS). ASDAS, a highly discriminatory ASAS-endorsed disease activity score in patients with ankylosing spondylitis. Ann Rheum Dis. 2009;68(12):1811-8. doi: 10.1136/ard.2008.100826.
17. Calin A, Garrett S, Whitelock H et al. A new approach to defining functional ability in ankylosing spondylitis: the development of the Bath Ankylosing Spondylitis Functional Index. J Rheumatol, 1994;21:2281-5.
18. Anderson J, Sayles H, Curtis JR et al. Converting modified health assessment questionnaire (HAQ), multidimensional HAQ, and HAQII scores into original HAQ scores using models developed with a large cohort of rheumatoid arthritis patients. Arthritis Care Res (Hoboken). 2010;62(10):1481-8. doi: 10.1002/acr.20265.
19. Roberts HC, Denison HJ, Martin HJ et al. A review of the measurement of grip strength in clinical and epidemiological studies: towards a standardised approach. Age Ageing. 2011;40(4):423-9. doi: 10.1093/ageing/afr051.
20. Dodds RM, Syddall HE, Cooper R et al. Grip strength across the life course: normative data from twelve British studies. PLoS One. 2014;4;9(12):e113637. doi: 10.1371/journal.pone.0113637.
21. Dodds RM, Murray JC, Granic A et al. Prevalence and factors associated with poor performance in the 5-chair stand test: findings from the Cognitive Function and Ageing Study II and proposed Newcastle protocol for use in the assessment of sarcopenia. J Cachexia Sarcopenia Muscle. 2021;12(2):308-318. doi: 10.1002/jcsm.12660.
22. Lee RC, Wang Z, Heo M et al. Total-body skeletal muscle mass: development and cross-validation of anthropometric prediction models. Am J Clin Nutr. 2000;72(3):796-803. doi: 10.1093/ajcn/72.3.796.
23. Cruz-Jentoft AJ, Bahat G, Bauer J et al Writing Group for the European Working Group on Sarcopenia in Older People 2 (EWGSOP2), and the Extended Group for EWGSOP2. Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing. 2019;1;48(1):16-31. doi: 10.1093/ageing/afy169.
24. Kirkpatrick LA, Feeney BC. A simple guide to IBM SPSS statistics for version 20.0 student ed. Wadsworth, Cengage Learning, Belmont, 2013.
25. Neto A, Pinheiro Torres R et al. Muscle dysfunction in axial spondylarthritis: the MyoSpA study. Clin Exp Rheumatol. 2022;40(2):267-273. doi: 10.55563/clinexprheumatol/9ljng7.
26. Öztürk Ö, Feyzioğlu Ö, Şahin D et al. AB1809-HPR determination of PRE-sarcopenia in patients with axial spondyloarthritis Annals of the Rheumatic Diseases. 2023;82:2137.
27. Merle B, Cottard M, Sornay-Rendu E et al. Spondyloarthritis and Sarcopenia: Prevalence of Probable Sarcopenia and its Impact on Disease Burden: The Saspar Study. Calcif Tissue Int. 2023;112(6):647-655. doi: 10.1007/s00223-023-01074-3.

28. Sahin N, Ozcan E, Baskent A et al. Isokinetic evaluation of ankle muscle strength and fatigue in patients with ankylosing spondylitis. *Eur J Phys Rehabil Med.* 2011;47(3):399-405.
29. Valido A, Crespo CL, Pimentel-Santos FM. Muscle Evaluation in Axial Spondyloarthritis-The Evidence for Sarcopenia. *Front Med (Lausanne).* 2019;18,6:219. doi: 10.3389/fmed.2019.00219.
30. Teneva T, Georgiev T. Evaluation of paravertebral muscle atrophy and fatty degeneration in patients with axial spondyloarthritis. *Rheumatology (Bulgaria),* 2020; 28(3), 25-38. <https://doi.org/10.35465/28.3.2020.pp25-38>.

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✉ *Correspondence address:*

Assoc. Prof. Mohammed Hassan Abu-Zaid
Rheumatology and Rehabilitation
Faculty of Medicine

Tanta University – Egypt

e-mail: drmhassan113@yahoo.com

ORCID Id: <https://orcid.org/0000-0001-8436-8598>

Mobile: +201006773622