

ORIGINAL RESEARCH

Association between SARC-F as a self-report screening tool for sarcopenia and muscle strength, physical performance, daily activity, patient-reported outcomes and body composition in patients with spondyloarthritis

Julia Kononenko ^{1,2} Marius Bedei ^{1,2} Bjoern Buehring ^{2,3}
David Kiefer ^{1,2,4} Imke Redeker ^{1,2} Xenofon Baraliakos ^{1,2} Uta Kiltz ^{1,2}

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For numbered affiliations see end of article.

Correspondence to

Dr Uta Kiltz;
uta.kiltz@elisabethgruppe.de

ABSTRACT

Background This study aimed to explore the association of the sarcopenia questionnaire Strength, Assistance with walking, Rise from a chair, Climb stairs, Falls (SARC-F) with muscle strength, physical performance, daily activity, patient-reported outcomes (PROs) and body composition in patients with axial spondyloarthritis (axSpA) and psoriatic arthritis (PsA).

Methods In this cross-sectional study, patient and disease characteristics including physical function, performance measures and body composition assessed by dual-energy X-ray absorptiometry (DXA) were analysed. Variables were compared between patients with a SARC-F score ≥ 4 and < 4 , higher versus lower sarcopenia risk. Linear regression examined associations, adjusted for age and sex.

Results Overall, 54 of 213 patients with SpA (65.7% axSpA, 34.3% PsA) had a SARC-F score ≥ 4 (24.4%). DXA identified sarcopenia and sarcopenic obesity in 4 patients each (7.7%). Patients with SARC-F scores ≥ 4 were older, predominantly female or obese, had longer disease duration, higher disease activity, lower physical performance, decreased muscle strength and daily activity and more unfavourable body composition. Total SARC-F score was consistently associated with muscle strength, physical performance, PROs and DXA components. Higher body mass index and patient global assessment were independently associated with higher SARC-F scores. The SARC-F ≥ 4 threshold showed moderate specificity (76%) but low sensitivity (50%) for DXA-defined sarcopenia, with a high negative predictive value (97%).

Conclusions SARC-F was significantly associated with disease activity, muscle strength and physical performance, but showed limited ability to identify DXA-defined sarcopenia. Further research is needed to clarify its clinical utility for risk stratification in rheumatic diseases.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Previous studies have highlighted the role of the Strength, Assistance with walking, Rise from a chair, Climb stairs, Falls (SARC-F) tool in identifying sarcopenia risk. The prevalence of sarcopenia in spondyloarthritis (SpA) is highly variable and is associated with various negative outcomes, reflecting the complex and multifactorial impact of inflammatory rheumatic diseases on body composition.

WHAT THIS STUDY ADDS

⇒ SARC-F scores were consistently associated with disease activity, muscle strength and physical performance in SpA.
⇒ SARC-F ≥ 4 showed low sensitivity but moderate specificity and high negative predictive value for dual-energy X-ray absorptiometry (DXA)-defined sarcopenia, highlighting its limited diagnostic performance for muscle mass-based definitions.
⇒ SARC-F identified patients with functional impairment and unfavourable body composition profiles, supporting its role in risk stratification rather than diagnosis.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Combining SARC-F with DXA-based body composition assessment may improve identification of patients at risk for sarcopenia in SpA.
⇒ This integrated approach could facilitate early identification and management of patients at risk for muscle loss and functional deterioration.

INTRODUCTION

Patients with inflammatory rheumatic musculoskeletal disease (iRMDs) are at increased risk of developing sarcopenia, which is increasingly recognised as a significant health

concern.¹ Moreover, it imposes a significant but modifiable economic burden on both individuals and governments.² While global data on sarcopenia-related costs are lacking, the total cost of hospitalisation for sarcopenia patients in the USA was US\$40.4 billion from 1999 to 2004.³

Sarcopenia has been widely studied in the elderly population, where it is linked to adverse outcomes such as falls, functional decline, frailty and mortality.⁴ Sarcopenia, characterised by a loss of muscle mass and function, is associated with increased disability and reduced health-related quality of life. Initially considered an age-related condition, sarcopenia is now recognised as prevalent in younger patients with iRMDs. Sarcopenia is most extensively studied in patients with rheumatoid arthritis (RA), where its prevalence ranges from 10.1% to 45.1%.⁵ In contrast, sarcopenia is less studied in axial spondyloarthritis (axSpA) and psoriatic arthritis (PsA), with reported prevalence varying between 4% and 25%, depending on diagnostic criteria and study methods.^{6,7} In a systematic literature review, it was found that in patients with SpA, both disease activity and structural damage contribute to impairment in physical performance, which is significantly lower compared with the general population.⁸

Physical inactivity and sedentary behaviour were identified as risk factors for developing sarcopenia in iRMD patients.⁹ Additionally, treatments such as glucocorticoids or disease-modifying antirheumatic drugs (DMARDs) may exacerbate muscle loss and impair muscle performance. Among RA patients, sarcopenia affected 30.2%–37.1%, and glucocorticoids were more common in sarcopenic individuals (42.4% vs 25.0%, $p < 0.001$), whereas biological DMARDs were independently linked to sarcopenia and conventional DMARDs (csDMARDs) were inversely related.^{10,11} Thus, these factors highlight the multifactorial aetiology of sarcopenia in iRMDs, which extends beyond age-related mechanisms and underscores the importance of early identification and intervention.

Sarcopenia is being defined by various criteria, with the most commonly used being from the European Working Group on Sarcopenia in Older People (EWGSOP1 and EWGSOP2) and the Foundation for the National Institutes of Health (FNIH). EWGSOP 1 criteria primarily focus on low muscle mass,¹² while EWGSOP 2 emphasises muscle strength as the main diagnostic factor, alongside muscle mass and physical performance.¹³ FNIH emphasises muscle strength and lean mass, with adjustments for body size.¹⁴ Thus, assessment of body composition plays a central role in the evaluation of sarcopenia. Two primary methods are commonly employed for evaluating body composition: dual-energy X-ray absorptiometry (DXA) and bioimpedance analysis (BIA). While BIA devices are more portable and cheaper to buy, DXA is considered a gold standard for accurately assessing muscle mass in sarcopenia.¹⁵

In iRMDs, the distribution of bone, muscle and fat mass (FM) is influenced by a complex interplay of inflammatory processes and impaired physical function, reflecting

the multidimensional nature of body composition.¹⁶ Around 50% of patients with iRMDs experience changes, often with reduced physical performance.¹⁷ In radiographic axSpA, a 12% decrease in muscle mass is linked to muscle strength reduction.¹⁸ PsA patients show higher total body fat, visceral fat and sarcopenia compared with controls,^{19,20} with those having severe disease activity also exhibiting higher body mass index (BMI) than those in remission.²¹

The Strength, Assistance with walking, Rise from a chair, Climb stairs, Falls (SARC-F) is a self-reported screening tool that helps identify individuals at risk of sarcopenia, consisting of five questions assessing strength, mobility and falls risk.²² It has been used to identify sarcopenia in various patient groups, including patients with chronic obstructive pulmonary disease, cardiovascular disease and diabetes.^{23–25} While it shows moderate sensitivity (27%–39%) and high specificity (86%–91%) with EWGSOP2 criteria in these groups,²⁶ its utility in iRMDs, including SpA, requires further validation.

This study aimed to explore the association of the SARC-F questionnaire with muscle strength, physical performance, daily activity, patient-reported outcomes (PROs) and DXA-derived body composition in patients with axSpA and PsA. Further, we sought to examine whether higher SARC-F scores reflect a broader burden of functional impairment and adverse body composition phenotypes by comparing clinical and functional characteristics between patients with SARC-F scores ≥ 4 and < 4 . Finally, we explored clinical factors independently associated with higher SARC-F scores.

METHODS

Study design

This prospective, monocentric cross-sectional study included adult patients with the clinical diagnosis of axSpA or PsA. The study was conducted and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology guidelines for cross-sectional studies.

Patients and setting

Patients with a diagnosis of axSpA or PsA were enrolled prospectively between September 2023 and April 2024. Patients were recruited from the rheumatology outpatient clinic of a tertiary university rheumatology centre (Rheumazentrum Ruhrgebiet, Herne, Germany), and all consecutive patients meeting the inclusion criteria during routine visits were screened and invited to participate. Patients were eligible when receiving treatment with non-steroidal anti-inflammatory drugs (NSAIDs), csDMARDs or tumour necrosis factor inhibitors (TNFi). Patients undergoing treatment with interleukin-17 inhibitors or Janus kinase inhibitors were excluded, as were those with severe physical impairments that limited participation, insufficient language skills, cognitive or psychiatric comorbidities, pregnancy or a body weight exceeding 130 kg.

Assessments

Clinical data

Baseline data including demographic and clinical data such as age, sex, BMI and symptom duration, and C reactive protein (CRP) levels were assessed. Medications were grouped into categories, including NSAIDs, csDMARDs and TNFi.

Disease status

Disease status was assessed using the patient's and physician global assessment (PGA (PhGA), disease activity scores (Ankylosing Spondylitis Disease Activity Score (ASDAS-CRP)²⁷ for axSpA or Disease Activity score for Psoriatic Arthritis (DAPSA) for PsA²⁸). The PGA is a self-reported tool where patients rate their overall disease activity on a scale from 0 (no activity) to 10 (severe activity). The ASDAS-CRP combines four clinical measures—back pain, PGA, peripheral joint involvement and CRP levels—with higher scores indicating greater severity of disease activity. The DAPSA is a composite score that incorporates joint counts (swollen and tender), patient and PGAs, and CRP levels, with higher scores reflecting greater disease activity and severity of PsA.

Physical function

Physical function was assessed with the Bath Ankylosing Spondylitis Functional Index (BASFI) and the Health Assessment Questionnaire (HAQ). The BASFI is a disease-specific self-report tool for patients with axSpA, consisting of 10 questions about daily activities performed in the last 7 days without assistance (eg, putting on socks, picking up items from the floor, reaching a high shelf).²⁹ Responses are rated on a Numeric Rating Scale (NRS) from 0 (no limitation) to 10 (severe limitation), and the mean score represents the patient's physical function, with 0 indicating no limitation and 10 indicating severe limitation. The HAQ, used for patients with PsA, includes eight questions about activities of daily living, rated on an NRS from 0 to 3.³⁰ Both tools do not have validated cut-offs for differentiating impaired versus non-impaired physical function.

Functional status

Functional status was evaluated across three distinct but interrelated domains: muscle strength, physical performance and daily physical activity. These domains capture different aspects of functional capacity—muscle strength represents the maximal force-generating capacity of muscle; physical performance reflects the integrated ability to perform mobility-related tasks; and daily physical activity indicates the actual level of activity performed in everyday life. Assessing all three provides a comprehensive understanding of functional impairment beyond isolated muscle mass measurements.

Muscle strength

Muscle strength was measured as hand grip using a hand-held dynamometer.³¹ Impaired grip strength was defined as 27 kg in men and 16 kg in women.³¹

Physical performance

Physical performance was measured using gait speed (measured in m/s) and the Short Physical Performance Battery (SPPB). Gait speed, an established predictor of disability and adverse health outcomes in older adults and rheumatologic populations, was assessed over a 4 m course. Values <0.8 m/s were considered as indicative of impaired physical performance. The SPPB is recommended by EWGSOP as a standard tool for both research and clinical practice,¹³ including three components: standing balance, chair rise test and gait speed. Each task is scored on a scale from 0 to 4 (0=worst, 4=best), with a composite score calculated as the sum of the component scores, ranging from 0 to 12 (0=worst, 12=best), with values equal to or less than 8 points considered indicative of physical performance deterioration.³²

Daily physical activity

Daily physical activity was assessed as a self-report with the modified Short QUestionnaire to Assess Health-enhancing physical activity (mSQUASH).^{33 34} The mSQUASH provides a summary of daily physical activity by calculating the total minutes of activity across various domains, including commuting, work, household, leisure and sports. Higher scores indicate greater physical activity levels.

SARC-F questionnaire

SARC-F questionnaire consists of five domains: muscle strength, assistance with walking, chair rise, stair climbing and falls. Each domain is scored from 0 to 2 points, where 0 indicates no difficulty, 1 represents some difficulty and 2 indicates significant difficulty or inability to perform the task. The total score is calculated by summing the scores across all five domains, resulting in a range from 0 to 10. Higher scores reflect worse physical status, with a total score of ≥ 4 suggesting a high risk of sarcopenia.

Body composition

The body composition measurements were performed using a Prodigy densitometer (GE/Lunar, Madison, Wisconsin, USA). All assessments followed the manufacturer's standardised protocol to ensure precision and consistency. The measurements were carried out by trained radiological technical assistants and evaluated by a study physician certified in DXA interpretation. Key parameters, including the FM index (FMI) and appendicular lean mass (ALM) index (ALMI), were recorded. The FMI was calculated as FM divided by height squared (kg/m^2), which evaluated adiposity. The ALMI was calculated by normalising ALM to height squared (kg/m^2), offering a measure of muscle mass relative to body size and aiding in sarcopenia diagnosis. Additionally, the ALMI/BMI ratio was used to assess muscle proportion in the context of body mass. Sarcopenia was defined according to the DXA-based criterion using ALM adjusted for BMI (ALM/BMI), with cut-offs <0.789 for men and <0.512 for women, as proposed by

the FNIH Sarcopenia Project.¹⁴ Obesity was defined as a body fat percentage of $\geq 30\%$ in male patients or $\geq 40\%$ in female patients, as measured by DXA. Patients who met the criteria for both sarcopenia and obesity were categorised as sarcopenic obese.

Statistical analysis

Descriptive statistics were reported as mean (SD) for continuous variables and frequencies (%) for categorical variables. Comparisons between groups were performed using χ^2 or Fisher's exact test for categorical variables and Mann-Whitney U test for continuous variables, as appropriate. The normality of continuous variables was assessed using the Shapiro-Wilk test. Missing values were handled by pairwise deletion.

Pearson correlation coefficients were calculated to evaluate the relationships between the SARC-F score and measures of muscle strength, physical performance, daily activity, PROs and DXA parameters. Prior to the analysis, we hypothesised the magnitude and direction of correlations. Correlation coefficients were interpreted as follows: low if ≤ 0.30 , moderate if >0.30 and ≤ 0.50 , high if >0.50 and <0.80 and very high if ≥ 0.80 .³⁵

Furthermore, univariable and multivariable linear regression analyses were conducted to examine the association between the SARC-F total score (dependent variable) and various patient characteristics (independent variables). The multivariable models were adjusted for potential confounders, including age and sex. Regression coefficients (β), 95% CI and p values were reported. The significance level was set at $p < 0.05$.

Finally, agreement between the SARC-F (cut-off ≥ 4) and DXA-based definitions of sarcopenia and sarcopenic obesity was assessed using 2×2 contingency tables. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and overall diagnostic accuracy were calculated according to standard formulas. Statistical analyses were performed using SPSS (IBM, USA) V.22. The authors used ChatGPT (OpenAI, San Francisco, California, USA) for assistance with language editing, data presentation and verification of statistical logic. All analyses and conclusions were made by the authors.

RESULTS

Patients' characteristics

A total of 213 patients (140 (65.7%) axSpA, and 73 (34.3%) PsA) were included in the study. Patients had a mean age of 50.3 (13.3) years and a mean disease duration of 10.7 (11.6) years, and were obese with a mean BMI of 28.6 (5.5) kg/m^2 . The mean CRP level was 0.4 (0.8) mg/dL . Regarding treatments, 119 patients (55.9%) were on NSAIDs (41 (19.2%) of them as monotherapy), 127 (59.6%) on TNFi (18 (14.2%) of them in combination with csDMARD therapy) and 62 (29.1%) on csDMARDs.

Patients had moderate to high disease activity (ASDAS 2.2 (1.0) in axSpA and DAPSA 12.6 (10.1) in PsA),

functional impairment (BASFI 3.3 (2.6), HAQ 1.2 (0.7)), reduced muscle strength (37.5 (17.7) kg), but preserved physical performance (SPPB 10.4 (1.8), gait speed 1.4 m/s (0.4) and a mean daily activity (mSQUASH score) of 8590 (4864)) (table 1).

In DXA, 115 patients (54%), 8 (3.8%) and 6 (2.8%) were classified as obese, sarcopenic and sarcopenic obesity, respectively. In the overall cohort, the mean ALM was 7.9 (1.3) kg/m^2 , FMI was 10.5 (4.4) kg/m^2 and ALM/BMI was 0.9 (0.2).

Data stratified by axSpA and PsA

Patients with axSpA were younger (48.4 vs 54.0 years, $p=0.03$) and had a longer disease duration (12.4 vs 7.3 years, $p=0.02$) compared with PsA. CRP levels were low in both groups (axSpA 0.5 vs PsA 0.3 mg/dL , $p=0.049$). TNFi use was more common in axSpA patients (65.7% vs 47.9%, $p=0.01$), while csDMARD use predominated in PsA patients (67.1% vs 9.3%, $p<0.001$). In terms of physical performance and body composition, axSpA patients had higher hand grip strength (39.5 vs 33.7 kg, $p=0.005$), lower FMI (10.0 vs 11.3 kg/m^2 , $p=0.04$) and a higher ALM/BMI ratio (0.9 vs 0.8, $p=0.004$) compared with PsA patients. Other variables, including BMI, symptom onset, PGA and SPPB scores, were similar between the groups.

SARC-F scores

Mean SARC-F score was 1.9 (2.2) in axSpA and 2.3 (2.3) in PsA, with no difference between the groups ($p=0.3$). A total of 52 patients (24.4%) had a SARC-F score of ≥ 4 . Patients with a SARC-F score ≥ 4 were older, had a longer disease duration, later symptom onset, higher BMI, higher disease activity, worse physical function and were more often females compared with patients with SARC-F <4 (table 1). A higher proportion of patients with SARC-F ≥ 4 used NSAIDs compared with those with lower scores (88.5% vs 45.3%), although this difference did not reach statistical significance ($p=0.06$). The proportion of patients with axSpA and PsA was similar across the SARC-F groups. No differences were observed for treatment pattern in both groups (table 1).

Differences were observed in various functional assessment domains between the SARC-F groups. The SARC-F ≥ 4 group had lower muscle strength (28.2 (12.5) kg vs 40.5 (14.1) kg), performance scores (SPPB (8.6 (1.7) vs 11.0 (1.3)) and daily activity (6370 (4946) vs 9293 (4636)) compared with the SARC-F <4 group (table 1). Differences in gait speed were minimal (1.0 (0.3) vs 1.5 (0.3)). In terms of body composition, the SARC-F ≥ 4 group had a higher prevalence of sarcopenic obesity (7.7% vs 1.2%, $p=0.01$) and obesity (67.3% vs 49.7%, $p=0.02$) compared with SARC-F <4 group, while there was only a trend to more prevalent cases of sarcopenia in patients SARC-F ≥ 4 group (7.7% vs 2.5%). ALMI showed no difference between the groups. In contrast, FMI was higher (12.9 (5.4) kg/m^2 vs 9.7 (3.7) kg/m^2) and the ALM/BMI ratio was lower (0.8 (0.2) vs 0.9 (0.2)) in patients with SARC-F ≥ 4 (see table 1).

Table 1 Patient's characteristics stratified for high (≥ 4) vs low (< 4) SARC-F scores

	Overall (N=213)	SARC-F score ≥ 4 (n=52)	SARC-F score < 4 (n=161)
Demographics and disease characteristics			
Age (years)	50.3 (13.3)	55.6 (9.6)	48.6 (13.9)
Sex, male; n (%)	120 (56.3)	21 (40.4)	99 (61.5)
Diagnosis; n (%)			
axSpA	140 (65.7)	32 (61.5)	108 (67.1)
PsA	73 (34.3)	20 (38.5)	53 (32.9)
BMI (kg/m ²)	28.6 (5.5)	31.1 (6.8)	27.8 (4.8)
CRP (mg/dL)	0.4 (0.8)	0.5 (0.6)	0.4 (0.9)
Disease duration (years)	10.7 (11.6)	14.5 (14.3)	9.4 (10.3)
iRMD symptom onset (years)	17.2 (14.7)	24.1 (16.0)	14.9 (13.5)
NSAID (all patients); n (%)	119 (55.9)	46 (88.5)	73 (45.3)
TNFi; n (%)	127 (59.6)	32 (61.5)	95 (59.0)
csDMARD; n (%)	62 (29.1)	17 (32.7)	45 (28.0)
Assessment			
PGA (0–10)	3.8 (2.6)	6.5 (1.6)	3 (2.3)
PhGA (0–10)	1.8 (1.3)	2.9 (1.2)	1.4 (1.2)
ASDAS* (0–10)	2.2 (1.0)	3.1 (0.7)	1.9 (0.9)
DAPSA† (0–164)	12.6 (10.1)	21.5 (7.0)	9.1 (8.9)
BASFI* (0–10)	3.3 (2.6)	6.7 (1.8)	2.2 (1.9)
HAQ‡ (0–3)	1.2 (0.7)	2.1 (0.3)	0.8 (0.4)
Grip strength (kg)	37.5 (17.7)	28.2 (12.5)	40.5 (14.1)
Gait speed (m/s)	1.4 (0.4)	1.0 (0.3)	1.5 (0.3)
SPPB (0–12)	10.4 (1.8)	8.6 (1.7)	11.0 (1.3)
mSQUASH	8590 (4864)	6370 (4946)	9293 (4636)
Body composition DXA			
Obesity§; n (%)	115 (54)	35 (67.3)	80 (49.7)
Sarcopenia§; n (%)	8 (3.8)	4 (7.7)	4 (2.5)
Sarcopenic obesity; n (%)	6 (2.8)	4 (7.7)	2 (1.2)
ALMI (kg/m ²)	7.9 (1.3)	7.8 (1.2)	7.9 (1.3)
FMI (kg/m ²)	10.5 (4.4)	12.9 (5.4)	9.7 (3.7)
ALM/BMI (kg/BMI)	0.9 (0.2)	0.8 (0.2)	0.9 (0.2)

*Only for axSpA.

†Only for PsA.

‡Definition of obesity: Obesity was defined using body fat percentage thresholds measured by DXA: $\geq 30\%$ for male patients and $\geq 40\%$ for female patients.§Sarcopenia is defined as low ALM/BMI (< 0.789 men; < 0.512 women) according to the FNIH Sarcopenia Project.¹⁴

ALM/BMI, appendicular lean mass divided by body mass index; ALMI, appendicular lean mass index; ASDAS, Ankylosing Spondylitis Disease Activity Score; axSpA, axial spondyloarthritis; BASFI, Bath Ankylosing Spondylitis Functional Index; CRP, C reactive protein; csDMARD, conventional synthetic disease-modifying antirheumatic drugs; DAPSA, Disease Activity Score for Psoriatic Arthritis; DXA, dual-energy X-ray absorptiometry; FMI, fat mass index; FNIH, Foundation for the National Institutes of Health; HAQ, Health Assessment Questionnaire; iRMD, inflammatory rheumatic musculoskeletal disease; mSQUASH, modified Short QQuestionnaire to Assess Health-enhancing Physical Activity; NSAID, non-steroidal anti-inflammatory drugs; PGA, patient's global assessment; PhGA, physician's global assessment; PsA, psoriatic arthritis; SARC-F, Strength, Assistance with walking, Rise from a chair, Climb stairs, Falls; SPPB, Short Physical Performance Battery; TNFi, tumour necrosis factor inhibitor.

Among patients with SARC-F scores ≥ 4 , 7.7% were classified as sarcopenic and 7.7% as sarcopenic obese according to DXA. Half of all DXA-defined sarcopenic patients and two-thirds of those with sarcopenic

Table 2 Agreement between SARC-F threshold and DXA-defined sarcopenia and sarcopenic obesity

(A) DXA-defined Sarcopenia			
	Sarcopenia* (DXA+)	No Sarcopenia (DXA-)	Total
SARC-F ≥ 4	4	48	52
SARC-F < 4	4	157	161
Total	8	205	213
Sensitivity: 4/8 (50.0%), Specificity: 157/205 (76.6%), PPV: 4/52 (7.7%), NPV: 157/161 (97.5%), Accuracy: 162/213 (76.1%)			
(B) DXA-defined Sarcopenic obesity			
	Sarcopenic obesity (DXA+)	No Sarcopenic obesity (DXA-)	Total
SARC-F ≥ 4	4	48	52
SARC-F < 4	2	159	161
Total	6	207	213
Sensitivity: 4/6 (66.7%), Specificity: 159/207 (76.8%), PPV: 4/52 (7.7%), NPV: 159/161 (98.7%), Accuracy: 163/213 (76.5%)			
*Sarcopenia is defined as low ALM/BMI (< 0.789 men; < 0.512 women) according to the FNIH Sarcopenia Project. ALM/BMI, appendicular lean mass divided by body mass index; DXA, dual-energy X-ray absorptiometry; FNIH, Foundation for the National Institutes of Health; NPV, negative predictive value; PPV, positive predictive value; SARC-F, Strength, Assistance with walking, Rise from a chair, Climb stairs, Falls.			

obesity had a SARC-F ≥ 4 . The SARC-F threshold showed moderate specificity (77% for both sarcopenia and sarcopenic obesity) but low sensitivity (50 and 67%, respectively). A high NPV (98 and 99%) but poor PPV (both 8%) was noted, resulting in an overall diagnostic accuracy of about 76% (table 2).

Association between SARC-F score and outcomes

The SARC-F total score showed significant correlations with almost all outcomes except ALMI (table 3). Positive associations were observed for age, BMI, symptom duration, PGA, ASDAS, DAPSA, BASFI, HAQ and FMI ($r=0.2$ to $r=0.9$, all $p<0.01$), while negative associations were found for SPPB, gait speed, hand grip strength, mSQUASH and ALM/BMI ($r=-0.7$ to $r=-0.3$, all $p<0.01$). For patients with SARC-F < 4 , associations showed a similar pattern between variables listed above but with a weaker magnitude of association. While SARC-F ≥ 4 scores showed a weak negative association for SPPB ($r=-0.3$, $p<0.05$) and gait speed ($r=-0.3$, $p<0.05$), they exhibited a moderate positive correlation with BASFI ($r=0.5$, $p<0.01$) (table 3).

Factors associated with total SARC-F scores

The associations between clinical characteristics and SARC-F total score are summarised in table 4. Univariable analysis revealed significant associations with age,

Table 3 Correlation between SARC-F scores and outcomes

Characteristic	SARC-F total score	SARC-F score ≥ 4	SARC-F score < 4
Age (years)	0.3	0.1	0.2
BMI (kg/m ²)	0.3	0.2	0.2
iRMD symptom duration (years)	0.2	0.03	0.03
PGA	0.7	0.2	0.5
ASDAS	0.6	0.1	0.5
DAPSA	0.6	-0.1	0.3
BASFI	0.8	0.5	0.7
HAQ	0.9	0.2	0.6
Grip strength (kg)	-0.4	-0.1	-0.3
Gait speed (m/s)	-0.7	-0.3	-0.5
SPPB (total score)	-0.7	-0.3	-0.5
mSQUASH	-0.3	-0.2	-0.1
ALMI (kg/m ²)	-0.05	0.2	-0.1
FMI (kg/m ²)	0.4	0.3	0.3
ALM/BMI (kg/BMI)	-0.4	-0.2	-0.3

ALM/BMI, Appendicular lean mass divided by body mass index; ALMI, appendicular lean mass index; ASDAS, Ankylosing Spondylitis Disease Activity Score; BASFI, Bath Ankylosing Spondylitis Functional Index; DAPSA, Disease Activity Score for Psoriatic Arthritis; FMI, fat mass index; HAQ, Health Assessment Questionnaire; iRMD, inflammatory rheumatic musculoskeletal disease; mSQUASH, modified Short Questionnaire to Assess Health-enhancing Physical Activity; PGA, patient's global assessment; SARC-F, Strength, Assistance with walking, Rise from a chair, Climb stairs, Falls; SPPB, Short Physical Performance Battery.

gender, BMI, symptom duration, PGA and mSQUASH (all $p < 0.05$). Of note, diagnosis (axSpA/PsA) did not show a significant association.

In multivariable analysis, significant predictors of the SARC-F total score included BMI (β : 0.050, 95% CI 0.007 to 0.09) and PGA (β : 0.465, 95% CI 0.382 to 0.55), both $p < 0.05$, while other variables, including age, gender, symptom duration, diagnosis and mSQUASH, were not significantly associated.

DISCUSSION

In this study, we evaluated the performance of the SARC-F questionnaire as a screening tool for sarcopenia and sarcopenic obesity in patients with axSpA and PsA. Overall, 24.4% of patients had a SARC-F score ≥ 4 , and these patients were older, predominantly female, and more frequently obese, with longer symptom duration, higher disease activity, reduced muscle strength, daily activity and lower physical performance, suggesting a cumulative effect of ageing and chronic inflammation on muscle strength and function is consistent with prior findings linking elevated SARC-F scores to weakness and disability.^{22 36} The total SARC-F score also correlated significantly with objective measures of muscle strength, physical performance, PROs and body composition. Correlation strengths were interpreted conservatively, as several associations fell within the moderate range rather than indicating strong effects. Effect sizes should therefore be interpreted with caution. Using the cut-off of ≥ 4 , SARC-F demonstrated moderate specificity, low sensitivity, but high NPV for detecting DXA-defined sarcopenia or sarcopenic obesity. Thus, while the questionnaire effectively identified patients with a higher burden of disease and functional decline, underscoring its limitations as a standalone diagnostic tool in individuals with iRMD.

A key methodological consideration is the conceptual overlap between several SARC-F items and the outcome measures used in this study. The SARC-F explicitly assesses difficulties in walking, chair rise, stair climbing and falls, which closely mirror components of physical performance tests (SPPB, gait speed) and functional

Table 4 Associations between SARC-F total score and clinical characteristics of SpA patients

Characteristic	Univariable analysis			Multivariable analysis		
	β	95% CI	P value	β	95% CI	P value
Age (years)	0.51	0.032 to 0.071	$< 0.01^*$	0.016	-0.002 to 0.035	0.088
Gender	0.965	0.344 to 1.581	0.002*	0.442	-0.003 to 0.876	0.055
BMI (kg/m ²)	0.125	0.072 to 0.179	0.001*	0.050	0.007 to 0.09	0.016*
Diagnosis (axSpA/PsA)	0.368	-0.251 to 1.014	0.239	0.062	-0.449 to 0.523	0.797
iRMD symptom duration (years)	0.038	0.018 to 0.058	0.004*	0.014	-0.005 to 0.034	0.138
PGA	0.551	0.467 to 0.644	0.001*	0.465	0.382 to 0.55	0.001*
mSQUASH	0	0 to -6.77	0.001*	-4605	-9520 to 1823	0.061

*Correlation is significant ($p < 0.05$).

axSpA, axial SpA; BMI, body mass index; iRMD, inflammatory rheumatic musculoskeletal disease; mSQUASH, modified Short Questionnaire to Assess Health-enhancing Physical Activity; PGA, patient's global assessment; PSA, psoriatic arthritis; SARC-F, Strength, Assistance with walking, Rise from a chair, Climb stairs, Falls; SpA, spondyloarthritis; β , unstandardised regression coefficient.

PROs (BASFI, HAQ). Consequently, part of the observed associations is likely driven by shared constructs rather than independent relationships. While this overlap does not invalidate the findings, it limits the interpretation of correlation coefficients as indicators of screening or diagnostic performance and underscores that the SARC-F primarily reflects perceived functional impairment and disability burden.

We identified BMI and PGA as variables independently associated with higher SARC-F, highlighting the potential role of obesity and subjective disease burden in functional impairment and increased sarcopenia risk. Importantly, these associations should not be interpreted as causal determinants of sarcopenia risk but rather as indicators of overall disease and functional burden reflected by higher SARC-F scores. Interestingly, higher BMI independently predicted worse SARC-F scores, suggesting prevalent sarcopenic obesity in this population. This contrasts with the classic view of sarcopenia as a low-weight condition but aligns with reports that obesity can mask muscle loss³⁷ and high muscle fat infiltration predicts poor health outcomes such as falls and disability. Excess adipose tissue promotes chronic inflammation and metabolic dysregulation, which impair muscle quality and function even in heavier individuals.^{38,39} Higher BMI was independently associated with worse SARC-F scores, suggesting sarcopenic obesity as a clinical flag, whereas previous studies observed either low BMI as a risk factor or inconsistent findings.^{39,40} PGA also remained a strong predictor, indicating that patients who feel worse overall tend to have worse muscle health. Importantly, these associations were not confined to the dichotomous cut-off at 4 points. Linear analyses demonstrated that even small increases in SARC-F scores were associated with higher disease activity, decreased muscle strength and daily activity, lower physical performance (reflected by reduced SPPB but preserved gait speed), and an abnormal body composition phenotype. This aligns with the concept that chronic inflammation in SpA may contribute to early muscle decline.^{5,40} Taken together, increasing SARC-F scores mirrored increasing disease and disability burden, supporting the view that sarcopenia in SpA is multifactorial, driven by age, systemic inflammation, inactivity and obesity.^{1,5,9}

The higher prevalence of NSAID use among patients with SARC-F scores ≥ 4 warrants consideration. NSAID use may serve as a proxy for pain burden and active disease, both of which can directly influence self-reported functional limitations captured by the SARC-F. In addition, disease activity was assessed using diagnosis-specific indices (ASDAS for axSpA and DAPSA for PsA). While appropriate within each diagnosis, this heterogeneity represents a methodological limitation when interpreting pooled analyses across the combined cohort and may contribute to residual confounding.

DXA was applied to quantify body composition objectively. DXA is an established method for assessing ALM,¹³ thereby complementing functional and PROs with objective measures of muscle mass. Importantly, in our cohort, the SARC-F score correlated with FMI and the ALM/BMI ratio, but not with absolute ALMI, underlining its closer link to muscle quality relative to body size rather than to lean mass alone. The relatively low prevalence of sarcopenia by DXA criteria (3.8%) contrasted with the substantially higher proportion of patients identified as at risk by SARC-F, supporting the view that SARC-F may capture early functional decline before measurable muscle mass loss is detected.

Although the SARC-F questionnaire showed moderate specificity, its sensitivity for detecting DXA-defined sarcopenia or sarcopenic obesity was low. This indicates that while the tool effectively excludes sarcopenia in most patients, it may fail to identify some affected individuals. The high NPV but low PPV supports its role as a risk stratification tool rather than a diagnostic instrument, highlighting the need for confirmatory DXA assessment in patients with high SARC-F scores.

Given the very low prevalence of DXA-defined sarcopenia in this cohort, sensitivity, PPV and overall accuracy estimates should be interpreted as exploratory and are statistically unstable. PPV and NPV are highly prevalence-dependent; therefore, the high NPV observed here largely reflects the low prevalence rather than the intrinsic screening performance of SARC-F.

Applying the cut-off of SARC-F ≥ 4 revealed marked differences in body composition, with significantly higher prevalence of sarcopenic obesity and general obesity, as well as less favourable FMI and ALM/BMI profiles. By contrast, absolute ALMI and the prevalence of sarcopenia did not differ significantly, and functional outcomes were not consistently distinguished. These patterns illustrate both the strengths and the limitations of the ≥ 4 threshold: while it identifies patients with combined obesity-related risk, it appears less sensitive to early or isolated deficits in muscle mass or performance.

We found no significant difference in sarcopenia risk between patients with axSpA and PsA. This observation aligns with a recent meta-analysis, which reported a nearly identical prevalence of $\sim 20\%$ sarcopenia in both axSpA and PsA.⁷

In contrast, the prevalence of DXA-defined sarcopenia in our cohort was considerably lower (3.8%). This discrepancy likely reflects methodological and population-specific factors—particularly the younger age of our participants, the outpatient setting and the use of the stringent FNIH criteria, which yield lower prevalence estimates compared with EWGSOP-based definitions.⁴¹ Nevertheless, the consistent associations with clinical variables suggest that SARC-F captures early functional decline preceding measurable muscle mass loss.

Overall, our results support the view that sarcopenia risk in axSpA and PsA is determined by common systemic

and lifestyle-related mechanisms—including chronic inflammation, ageing, obesity and inactivity—rather than by the specific disease subtype.^{1 5 7}

The SARC-F tool is endorsed by the EWGSOP2 as a frontline screening instrument for sarcopenia risk in older adults. Evidence from meta-analyses consistently demonstrates high specificity (86%–91%) despite low to moderate sensitivity (27%–39%),²⁶ making it effective for excluding individuals without sarcopenia risk. Its ease of use, requiring no equipment and relying on patient self-report, makes it highly practical in rheumatology clinics. Importantly, in this study, all patients underwent DXA-based body composition assessment, which, when combined with performance measures and PROs, allowed for a robust multidimensional evaluation of sarcopenia risk in SpA.

Our findings have clear implications for practice. The strong linear associations of the SARC-F with functional assessment domains suggest that clinicians should screen for muscle loss and function in all SpA patients, not just those above an arbitrary SARC-F cut-off. Routine use of the SARC-F combined with simple performance measures, such as hand-grip strength or the SPPB, may help identify patients at early risk, whereas DXA should be reserved for those with high SARC-F scores or signs of functional decline.

Interventions known to improve sarcopenia outcomes—notably resistance exercise combined with nutritional support—are widely recommended. Guidance documents and reviews emphasise their potential to enhance muscle strength, mass and function in vulnerable populations.^{2 42} Recommending physiotherapy, weight control and adequate protein intake may help preserve muscle and function in SpA. Furthermore, tight inflammatory control—via DMARDs or biologics—might indirectly reduce muscle wasting by attenuating catabolic effects of chronic inflammation.^{5 43 44}

Our study has some limitations. This cross-sectional design precludes causal inference, and small subgroup sizes may limit generalisability. The use of PROs may introduce reporting bias, and several outcomes are conceptually related to SARC-F items. In addition, disease activity was assessed using diagnosis-specific indices (ASDAS for axSpA and DAPSA for PsA), and correlation analyses were performed using Pearson coefficients despite several variables being ordinal and bounded, which may limit the interpretation of pooled analyses and effect size estimates. Furthermore, patients receiving IL-17 or JAK inhibitors, as well as those with severe disability or higher body weight, were excluded, potentially resulting in a study population with comparatively less severe or refractory disease. Finally, our cohort was younger than typical geriatric populations in which sarcopenia has been extensively studied, which may partly explain the low prevalence of DXA-defined sarcopenia observed. Future longitudinal studies with larger and

more diverse samples are needed to clarify temporal relationships and treatment effects on sarcopenia in SpA.

CONCLUSIONS

This study demonstrates that higher SARC-F scores are consistently associated with greater disease burden, impaired muscle strength, reduced physical performance and unfavourable body composition profiles in patients with SpA. However, the SARC-F showed limited ability to identify DXA-defined sarcopenia or sarcopenic obesity, with low sensitivity but moderate specificity and high NPV in this relatively young outpatient cohort assessed using stringent FNIH criteria. These findings support the role of SARC-F as a tool to identify patients with functional impairment and increased sarcopenia risk rather than as a diagnostic instrument. A nuanced, multi-dimensional approach integrating functional assessment, body composition analysis and disease control appears warranted in routine SpA care.

Author affiliations

¹Rheumatology, Rheumazentrum Ruhrgebiet, Herne, Germany

²Ruhr Universitaet Bochum, Bochum, Germany

³Bergisches-Rheumazentrum, Wuppertal, Germany

⁴Private Practice Rheumatology, Hattingen, Germany

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ORCID iDs

Julia Kononenko <https://orcid.org/0000-0003-3365-4273>

Marius Bedei <https://orcid.org/0009-0000-0991-6347>

Bjoern Buehring <https://orcid.org/0000-0003-3841-624X>

David Kiefer <https://orcid.org/0000-0003-1602-7649>

Imke Redeker <https://orcid.org/0000-0003-3377-2683>

Xenofon Baraliakos <https://orcid.org/0000-0002-9475-9362>

Uta Kiltz <https://orcid.org/0000-0001-5668-4497>

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