CLINICAL SCIENCE OF NUTRITION
Clin Sci Nutr. 2025;Early View:1-9
Research Article
DOI: 10.62210/ClinSciNutr.2025.107

Comparison of SARC-F and SARC-CalF in predicting low muscle strength measurement according to different diagnostic criteria in hospitalized older patients

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Cite this article as: Kangalgil M, Ulusoy H, Bayramoğlu U, Yüksel S. Comparison of SARC-F and SARC-CalF in predicting low muscle strength measurement according to different diagnostic criteria in hospitalized older patients. *Clin Sci Nutr*. 2025;Early View:1-9.

ABSTRACT

Objective: Sarcopenia is a highly prevalent syndrome in hospitalized older patients and is associated with adverse clinical outcomes. The management of sarcopenia depends on the use of appropriate screening and diagnostic tools. The aim of this study was to evaluate the performance of sarcopenia risk screening methods for predicting low muscle strength based on different diagnostic criteria.

Methods: This retrospective study included hospitalized patients over 65 years of age. Three commonly used diagnostic criteria European Working Group on Sarcopenia in the Elderly, Asian Working Group on Sarcopenia, Sarcopenia Definition and Outcomes Consortium and population-based criteria were applied as reference standards. The sensitivity and specificity of the SARC-F and SARC-CalF tools were evaluated based on low handgrip strength as defined by the different reference criteria.

Results: A total of 364 patients with a median age of 74 (12) years and the main reasons for hospitalization were surgery (37.1%) and oncological diseases (20.6%) were included in the study. According to different reference criteria, the SARC-F tool has a sensitivity of 80.2-85.8% and a specificity of 53.7-70.6%. The sensitivity and specificity of the SARC-CalF tool was 70.7-76.2% and 46.1-58.8%, respectively. The sensitivity of both tools was lower among surgical patients and those who were well-nourished.

Conclusions: The SARC-F tool demonstrates higher sensitivity in assessing low muscle strength in hospitalized older patients. However, further research is needed to identify the most appropriate sarcopenia risk assessment method, particularly according to the patient's characteristics.

Keywords: sarcopenia, older adults, muscle strength

Introduction

Sarcopenia is a complex nutritional disorder[1] which is associated with poor health outcomes such as functional dependency, falls, fractures and mortality.[2-4] Although the pathophysiological mechanisms have not been fully elucidated, the pathogenesis of sarcopenia is multifactorial and includes age, hormonal imbalance,

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Received: February 26, 2025 **Accepted:** June 22, 2025
Published: August 15, 2025

This study was presented as an oral presentation at the 14th KEPAN congress.

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chronic inflammation, redox imbalance, and mitochondrial disfunction.[5] The prevalence of sarcopenia among older adults' ranges from 18% to 66% in different patient groups.[6]

Early detection and diagnosis of sarcopenia is important, but sarcopenia is often underdiagnosed in clinical practice.[7] Several working groups have proposed current definitions of sarcopenia, including the Asian Working Group for Sarcopenia (AWGS), the European Working Group for Sarcopenia in Older Persons (EWGSOP2); and the Sarcopenia Definitions and Outcomes Consortium (SDOC).[8-10] Previous studies have reported poor agreement between different criteria used in the diagnosis of sarcopenia.[11,12]

Screening methods are the first step in the nutritional care process, which is of great importance in the diagnosis of sarcopenia. The detection of sarcopenia requires reliable measurement of muscle strength and muscle mass using valid, reproducible, cost-effective and highly sensitive tools.[13] The SARC-F (Simple Questionnaire for Rapid Diagnosis of Sarcopenia) has been developed as a possible rapid diagnostic test for sarcopenia.[14] The SARC-F questionnaire is a practical self-report tool that can be easily used in health care settings to identify potential cases of sarcopenia and determine whether individuals require further assessment.[15] Previous studies on the clinical validity and cultural adaptation of the SARC-F tool in different countries have reported that it is a valid tool with low sensitivity and high specificity in determining the risk of sarcopenia.[16-18] Anthropometric measurements are important assessment methods that can be used to determine nutritional status, diagnose nutritional disorders and monitor medical nutrition therapy in older patients.[19] Some studies have suggested including calf circumference in diagnostic algorithms for sarcopenia and SARC-CalF was developed to improve the sarcopenia screening performance of SARC-F by including calf circumference measurement.[20-22] Previous studies reported that SARC-CalF significantly enhances the sensitivity and overall diagnostic accuracy of SARC-F for screening sarcopenia in various older populations.[23,24]

Main Points

- Screening methods play a crucial role in the diagnosis of sarcopenia.
- The diagnostic accuracy of sarcopenia risk screening tools is strongly influenced by the characteristics of the patient population.
- The SARC-F tool demonstrates higher sensitivity for sarcopenia risk screening in hospitalized older patients.

The second step in the sarcopenia diagnostic algorithm, following screening for sarcopenia risk, is the assessment of muscle strength, which typically requires a chair stand test or hand dynamometer.[9] The measurement of handgrip strength, a singular indicator of overall muscle strength, has been widely adopted as a useful and prognostically significant parameter, especially for older adults.[25] However, the cut-off values for handgrip strength used in the diagnosis of sarcopenia vary across different consensus groups and handgrip strength measurement may not always be feasible in clinical practice.[26] These variations in protocols may lead to discrepancies in handgrip strength measurements, potentially impacting the accuracy of sarcopenia screening.[27]

Interestingly, to date, no specific study has been conducted to evaluate the performance of SARC-F and SARC-CalF in identifying a low handgrip strength in hospitalized patients with different characteristics. The aim of this study was to assess the performance of the SARC-F and SARC-CalF tools in predicting low handgrip strength according to various diagnostic criteria for sarcopenia in hospitalized older patients.

Method

Study population

This retrospective study was conducted between June 2022 and 2024 with older patients referred to the nutritional support team from inpatient clinics of a university hospital. Patients were excluded from advanced dementia, presence of delirium or confusion, multiorgan failure and comatose state based on medical record documentation, patients treated in the intensive care unit and palliative care unit and a disease/condition that prevented reliable anthropometric and handgrip strength measurements (primary neuromuscular disease, limb amputation, etc.). The Strengthening the Reporting of Observational Studies in Epidemiology statement was used to organize and report the results.[28] The study protocol was approved by the local ethics committee (approval number: 2024/83).

Demographics and clinical characteristics

Demographics and clinical data, including age, sex, primary admission categories and comorbidity status were recorded. The age-adjusted burden of chronic diseases of the patients was determined with the Charlson Comorbidity Index (CCI).[29]

Nutritional assessment and anthropometric measurements

Anthropometric measurements and nutritional assessment were performed by a dietitian. Nutritional status was assessed using the Mini Nutritional Assessment (MNA). An MNA score <17 was classified as malnutrition, a score between 17 and 23.5 as at risk of malnutrition, and a score > 24 as indicating normal nutritional status.[30] The MNA is a comprehensive assessment method recommended for the diagnosis of malnutrition in older patients.[31]

Body weight and height were measured with light clothes and without shoes using a scale and stadiometer available at the hospital, and body mass index (BMI, kg/m^2) was calculated. Mid-arm circumference (MAC, cm) was measured on a fully relaxed upper arm, using inelastic tape, marking the midpoint between the acromion and olecranon protrusion. Calf circumference (CC, cm) was measured in the largest circumference of the leg.

Sarcopenia risk assessment

SARC-F and SARC-CalF tools were used for sarcopenia risk assessment, respectively. SARC-F questionnaire includes five components: strength, assistance walking, rise from a chair, climb stairs, and falls. Each component of SARC-F scores 0-2 points, with a total score ranging from 0 to 10.[32] The SARC-CalF consists of the five components of the SARC-F in addition to measuring calf circumference. The first five items are scored in the same as the SARC-F. Calf circumference component is scored as 0 point if the calf circumference measurement is >34 cm for males and >33 cm for females and as 10 points if the calf circumference measurement is ≤34 cm for males and ≤33 cm for females.[22]A total score of SARC-F ≥ 4 and a total score of SARC-CalF ≥11 indicate risk for sarcopenia, respectively.[14,22]

Muscle strength

Muscle strength was assessed using handgrip strength with a hand dynamometer. Patients were positioned as recommended by the American Society of Hand Therapists, in a sitting position with the arms bent 90 degrees at the elbow and shoulder joints.[33] The dominant hand was measured three times, however, if a condition affected the reliability of the measurement such as vascular access in the dominant hand, the non-dominant hand was preferred. To ensure measurement reliability, the hand was allowed to rest for one minute between measurements and the average value of the measurements was recorded.

The EWGSOP2 and AWGS cut-off points for low hand grip strength were <27 kg and <28 kg in men and <16 kg and <18 kg in women, respectively.[8,9] SDOC criteria for low hand grip strength was <35.5 kg in men and <20 kg in women.[10] The country-specific handgrip strength cut-off points were determined as <32 kg for men and <22 kg for women (Table 1).[34]

Statistical analysis

Data were analyzed using SPSS software (version 23, IBM). The normality of the data was evaluated using the Kolmogorov-Smirnov test and histogram graphs. Descriptive data is reported as means ± standard deviations, median and interquartile range, or percentages, as appropriate. Differences between categorical variables were determined by Chi-square test. Continuous variables were analyzed using independent samples t-test or Mann–Whitney U test, as appropriate. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) of each criterion was calculated with a contingency table. Sensitivity and specificity were classified as poor if <50%, fair if >50% and <80%, good if ≥80%. All statistical tests were considered statistically significant at p value <0.05.

Table 1. Cut-off values to define low handgrip strength

	EWGSOP2	AWGS	SDOC	Specific
Low handgrip strength				
Male	<27 kg	<28 kg	<35.5 kg	<32 kg
Female	<16 kg	<18 kg	<20 kg	<22 kg

Results

A total of 483 patients who underwent sarcopenia risk assessment and handgrip strength measurements were initially screened for eligibility during the study period. Of these, 97 patients did not have a nutritional assessment, 16 patients did not have anthropometric measurements, and 6 patients were excluded from the treated with intensive care unit, and the remaining 364 patients were included in the study, and the characteristics of the study population are shown in Table 2. Participants were predominately male (65.1%) with a median (IQR) age of 74 (12) years. The most common primary hospitalization diagnoses were surgery (37.1%) and oncological diseases (20.6%).

Table 2. Demographic and clinical parameters

	Total
Age, years, median (IQR)	74 (12)
Sex, n (%)	
Male	237 (65.1)
Female	127 (34.9)
Hospital clinic, n (%)	
Surgery	163 (44.8)
Medical	201 (55.2)
CCI, median (IQR)	6 (2)
Admission diagnoses, n (%)	
Neurologic	61 (16.8)
Surgery	135 (37.1)
Oncology	75 (20.6)
Respiratory	30 (8.2)
Other	63 (17.3)
Nutritional status, n (%)	
Normal nutritional status	92 (25.3)
Malnutrition risk	97 (26.6)
Malnutrition	175 (48.1)
Anthropometric measurements	
BMI, kg/m^2, median (IQR)	24.1 (6.8)
Handgrip strength (kg), median (IQR)	13.9 (13.7)
Calf circumference, cm, median (IQR)	31.5 (5.8)
Mid-arm circumference, cm, mean±SD	26.1±4.7

* Metabolic, endocrine, gastrointestinal, cardiac, renal, and infectious disease.

The prevalence of low muscle strength according to EWGSOP2, AWGS, SDOC and community-based criteria is 81.6-95.9%. The sensitivity and specificity of SARC-F was 85.8% and 53.7% for EWGSOP2, 84.7% and 54.4% for AWGS, 80.2% and 60% for SDOC, and 80.9% and 70.6% for population-based criteria (Table 3). The sensitivity and specificity of SARC-CalF was 76.2% and 58.8% for EWGSOP2, 75% and 56.5% for AWGS, 70.7% and 46.1% for SDOC, and 70.9% and 50% for population-based criteria (Table 4).

Discussion

As sarcopenia is a predictor of adverse clinical outcomes in hospitalized older patients, early detection through appropriate screening and early intervention is of critical importance. The variability of cut-off values for handgrip strength used in sarcopenia screening may be attributed to cultural, social and lifestyle differences among individuals. The lack of a consensus on the assessment of handgrip strength in epidemiological studies also contributes significantly to the variability.[27] Therefore, data are needed to determine the most appropriate cut-off points for handgrip strength measurement and the most appropriate screening tool in the sarcopenia diagnostic algorithm in hospitalized patients.

Several sarcopenia screening tools are available, but the most widely used tool in clinical practice is the SARC-F. Studies investigating the usefulness of SARC-F in the detection of sarcopenia have reported conflicting results. In a meta-analysis of older patients living in the community, in hospitals, and in nursing homes, SARC-F was found to have a low-moderate sensitivity of 36% and a high specificity of 87%.[35] Similarly, in a recent meta-analysis of community-dwelling, nursing home, and hospitalized older adults, the SARC-F score was reported to have low sensitivity and high specificity.[36] Otherwise, there are very few studies to determine the usefulness of SARC-F in the detection of sarcopenia in hospitalized patients. In 115 patients with hip fracture, the sensitivity and specificity of SARC-F tool as a screening method for sarcopenia ranged from 86% to 95% and 40% to 56%, respectively, depending on the reference criteria.[37] Dedeyne et al.[38] reported that the SARC-F showed good sensitivity (83-84%) and poor specificity (19-20%) to identify geriatric rehabilitation inpatients at risk for sarcopenia according to EWGSOP2 and AWGS definitions. Consistent with previous studies, the present study according to different reference standards, the sensitivity of SARC-F ranged from 80.2-

Table 3. Sensitivity and specificity of SARC-F score according to handgrip strength in different sarcopenia consensus definitions

	Low muscle strength-EWGSOP2			
SARC-F ≥ 4	**Sensitivity (%)**	**Specificity (%)**	**PPV (%)**	**NPV (%)**
Total population	85.8%	53.7%	89.2%	46.1%
Nutritional status				
Normal nutritional status	75.4%	74.2%	85.2%	60.5%
Malnutrition risk/malnutrition	88.5%	36.1%	90.1%	32.5%
Hospital clinic				
Surgery	79.6%	53.3%	88.3%	37.2%
Medical	90.8%	54.0%	89.7%	57.1%
	Low muscle strength -AWGS			
Total population	84.7%	54.4%	90.1%	39.7%
Nutritional status				
Normal nutritional status	72.3%	74.0%	87.0%	52.6%
Malnutrition risk/malnutrition	88.0%	36.7%	91.8%	27.5%
Hospital clinic				
Surgery	78.9%	56%	90.8%	32.5%
Medical	89.3%	53.1%	90.9%	48.6%
	Low muscle strength -SDOC			
Total population	80.2%	60%	97.9%	11.5%
Nutritional status				
Normal nutritional status	60.5%	66.7%	96.3%	10.5%
Malnutrition risk/malnutrition	86.7%	55.5%	98.3%	12.5%
Hospital clinic				
Surgery	75.6%	71.4%	98.3%	11.6%
Medical	83.9%	50%	97.6%	11.4%
	Low muscle strength -Population based			
Total population	80.9%	70.6%	98.2%	15.3%
Nutritional status				
Normal nutritional status	62.9%	72.7%	94.4%	21.0%
Malnutrition risk/malnutrition	86.5%	66.7%	99.1%	10.0%
Hospital clinic				
Surgery	76.5%	70%	97.5%	16.3%
Medical	84.5%	71.4%	98.8%	14.3%

85.8% and the specificity ranged from 53.7-70.6% for the low muscle strength, whereas the sensitivity of SARC-F was lower in surgical and well-nourished patients. One of the most important reasons for the differences between studies may be that diagnostic accuracy depends on patient characteristics such as disease severity, stage and comorbidity.[39] Moreover, given the heterogeneity of hospitalized patients and the varied in the causes of sarcopenia development, it is obvious that a significant gap in this field.

Table 4. Sensitivity and specificity of SARC-CalF score according to handgrip strength in different sarcopenia consensus definitions

	Low muscle strength -EWGSOP2			
SARC-CALF ≥ 11	**Sensitivity (%)**	**Specificity (%)**	**PPV (%)**	**NPV (%)**
Total population	76.2%	58.8%	89.5%	34.9%
Nutritional status				
Normal nutritional status	70.6%	71.4%	80%	60%
Malnutrition risk/malnutrition	77.1%	50%	91.2%	24.6%
Hospital clinic				
Surgery	74.5%	54.5%	87.5%	33.3%
Medical	77.3%	62.1%	90.8%	36%
	Low muscle strength -AWGS			
Total population	75%	56.5%	90%	30.2%
Nutritional status				
Normal nutritional status	70.6%	71.4%	80%	60%
Malnutrition risk/malnutrition	75.7%	44%	91.8%	18%
Hospital clinic				
Surgery	73.9%	55%	88.7%	30.5%
Medical	75.7%	57.7%	90.8%	30%
	Low muscle strength -SDOC			
Total population	70.7%	46.1%	96.5%	7%
Nutritional status				
Normal nutritional status	56%	60%	93.3%	12%
Malnutrition risk/malnutrition	74%	37.5%	97%	4.9%
Hospital clinic				
Surgery	70%	50%	96.2%	8.3%
Medical	71.2%	42.8%	96.7%	6%
	Low muscle strength -Population based			
Total population	70.9%	50%	96.5%	8.1%
Nutritional status				
Normal nutritional status	56.5%	55.5%	86.7%	20%
Malnutrition risk/malnutrition	73.9%	40%	98.2%	3.3%
Hospital clinic				
Surgery	70.1%	44.4%	93.7%	11.1%
Medical	71.5%	60%	98.3%	6%

SARC-CalF, as an updated version of SARC-F, includes the inclusion of calf circumference measurement in SARC-F. In this study, the sensitivity and specificity of SARC-CalF were found to be 70.9-76.2% and 46.1-58.8%, respectively. Previous studies have shown that the diagnostic accuracy of CARC-CalF is higher than SARC-F in different hospitalized patient population.[40,41] In contrast to, in a study with hospitalized older patients with reported that SARC-F tool is more appropriate for use in a sarcopenia screening algorithm.[42] Likewise, in the community-dwelling older adult population, SARC-CalF did not show superiority over SARC-F for sensitivity analyses.[43] However, the different results of the studies are closely related to the obesity status of the included older patients, as SARC-CalF may make it difficult to detect sarcopenic obesity and edema. Moreover, the original cut-off points for calf circumference in SARC-CalF are 34 and 33 cm for men and women respectively.[22] However, these cut-off points differ from the sarcopenia risk levels recommended for use in different patient populations.[34,44] Therefore, future studies are needed to evaluate the diagnostic accuracy of the cut-off points in the SARC-CalF tool by revising them for different patient populations. Some studies have reported that the diagnostic capacity of sarcopenia improved when the cut-off point of SARC-F and SARC-CalF were used differently from the original study.[45,46] However, differences in references for diagnosis of sarcopenia, the use of different cut-offs for SARC-F and SARC-CalF scores and the heterogeneity of the population should be considered.

The study has several limitations. First, a causal association could not be established due to the retrospective observational design. Also, the study patients were referred to the nutrition support team, and approximately 75% of the study population consisted of patients with nutritional risk or malnutrition. Considering that nutritional risk and malnutrition are risk factors for sarcopenia[47,48] this may have led to overestimation of sarcopenia the prevalence of sarcopenia and limit the generalizability of our findings. Finally, our study included geriatric patients with a wide range of disease types and severities, and an acute illness may cause a temporary decline in handgrip strength in an older adult.

Based on the results of our study, it can be concluded that the SARC-F tool predicts the occurrence of low muscle strength with greater accuracy in hospitalized older patients. However, further research is needed to determine the most appropriate sarcopenia risk assessment method, especially according to the patient's characteristics. Considering the impact of sarcopenia on clinical outcomes, its tendency to increase with age and disease burden, and its high prevalence, research in different countries should be focused on developing effective screening strategies and establishing reliable criteria.

Ethical approval

This study has been approved by the Scientific Research Ethics Committee of Karadeniz Technical University Health Sciences (approval number: 2024/83 and date: 03.06.2024).

Author contribution

The authors declare contribution to the paper as follows: Study conception and design: MK, HU; data collection: MK, UB, SY; analysis and interpretation of results: MK, UB, SY; draft manuscript preparation: MK, HU. All authors reviewed the results and approved the final version of the article.

Source of funding

The authors declare the study received no funding.

Conflict of interest

The authors declare that there is no conflict of interest.

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