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Original Research

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# Ability of SARC-F to Find Probable Sarcopenia Cases in Older Adults

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## Abstract

BACKGROUND/OBJECTIVE: In 2018 EWGSOP2 has suggested low muscle strength as the primary parameter of sarcopenia. The consensus has recommended SARC-F questionnaire as a screening test to find cases with low muscle strength which has been designated as probable sarcopenia. We aimed to study the ability of SARC-F to find probable sarcopenia cases in older patients.

DESIGN: Retrospective, cross-sectional.

SETTING: Istanbul University Istanbul Faculty of Medicine.

PARTICIPANTS: A total of 456 older adults (71.1% female, mean age: 74.6±6.6 years).

MEASUREMENTS: We diagnosed probable sarcopenia by EWGSOP 2 criteria, i.e., presence of low handgrip strength (HGS). SARC-F questionnaire was performed by all participants. We used a receiver operating characteristics curve to obtain SARC-F cut-off values to detect probable sarcopenia and calculated the area under the curve and 95% confidence interval (CI).

RESULTS: We included 456 participants (71.1% female; mean age: 74.6 ± 6.6 years). Probable sarcopenia was present in 58 (12.7%). SARC-F cut-off ≥ 2 presented the best balance between sensitivity and specificity (sensitivity: 64.9% vs specificity: 67.9%) to detect probable sarcopenia [the area under the receiver operating characteristics curve (AUC) = 0.710; 95% Cl: 0.660–0.752, p< 0.001]. SARC-F with a cut-off point ≥ 1 had sensitivity 84.2% and specificity 40.5% and SARC-F ≥ 4 had high specificity 88.2% with 40.3% sensitivity.

CONCLUSION: SARC-F is a good screening tool for sarcopenia in practice. Our findings suggest SARC-F ≥ 1 cut-off point to be used as the probable sarcopenia screening tool regarding its high sensitivity. Consequently, SARC-F ≥ 4 cut-off is better to be used if one prefers to exclude probable sarcopenia.

*Key words: Sarcopenia, probable sarcopenia, screening, diagnosis, geriatric practice.*

## Introduction

Sarcopenia is a syndrome characterized by the loss of skeletal muscle mass, strength and physical performance. It is linked to a range of adverse outcomes including disability and is amenable to interventions including resistance exercise training and nutritional supplementation (1). Sarcopenia is an important geriatric syndrome due to its consequences like increased rates of functional impairment, disability, falls, and mortality (2). The European Working Group on Sarcopenia in Older People (EWGSOP) diagnostic algorithm of diagnosis of sarcopenia has been widely accepted in the clinical and research community owing to its practical recommendations and it is the most frequently used definition for sarcopenia in clinical studies (3). EWGSOP consensus has recently been updated (4). In this revised form, a muscle strength test, such as handgrip strength (HGS), is recommended at the initial assessment in diagnosing sarcopenia. Probable sarcopenia is diagnosed when handgrip strength is < 16 kg for women and < 27 kg for men provided that there are no other causes that may affect HGS measurement such as cognitive disorder, significant hand osteoarthritis, etc. Confirmation of the diagnosis of sarcopenia is provided by detection of low muscle mass or quality. It has been signified that low strength on its own should be considered enough to initiate seeking etiology and prompt interventions for sarcopenia (4). This is because the negative consequences of untreated muscle weakness, even if muscle weakness is not accompanied by low muscle mass and quality, can cause immense consequences for the individual and subsequent health care costs (5). EWGSOP2 recommends facilitation of the clinical identification of sarcopenia by incorporating the SARC-F tool as a screening measure (4). SARC-F is a 5-item questionnaire— Strength, Assistance with walking, Rising from a chair, Climbing stairs and Falls (SARC-F). Through its creation, a cumulative score of ≥ 4 is suggested as a screening threshold for sarcopenia in primary care practice (4). However, it has been reported to have low sensitivity in a variety of reports, between 4%-35% but high specificity, between 80%-98% (6-9).

Our primary aim was to examine the utility of the SARC-F tool to find probable sarcopenia cases. Secondary output was to report the prevalence of probable sarcopenia among community-dwelling older adults admitting to a geriatrics outpatient clinic of a university hospital.

## Material and Methods

This is a retrospective, cross-sectional study, including the community-dwelling outpatients presented to a university hospital's outpatient geriatrics clinic between November 2016 and March 2019. In this clinic, we perform a comprehensive geriatric assessment (CGA), including the assessment for components of sarcopenia, if the general condition of the participants and staff availability is convenient. Older adults can apply if they are ≥ 65 years of age. There is no additional requirement to attend this clinic. They may be directed from other disciplines or may apply by themselves. We collected demographic and clinical data including age,

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sex, height (cm), weight (kg), living status (alone or not), number of chronic diseases, specific co-morbidities, number of regular drugs, falls in the previous year, the Katz Index of Independence in Activities of Daily Living (ADL) and the Lawton Instrumental Activities of Daily Living Scale (IADL) measurements. The participants were asked if they did the index activity without help (1 point), with some help, or they were completely dependent (0 point). With respect to the ADL scores, 0 point represented total dependency and 6 points represented total independency. Regarding the IADL scores, 0 point represented total dependency and 8 points represented total independency (10, 11). Nutritional status was assessed by Mini Nutritional Assessment short form (MNA-SF), which indicates the presence of malnutrition, malnutrition risk, and normal nutritional state when the score is 0–7 points, 8–11 points, and > 11 points, respectively (12, 13).

We measured handgrip strength (HGS), usual gait speed (UGS), performed chair sit to stand test (CSST) and short physical performance battery (SPPB). We used Jamar hydraulic hand dynamometer for HGS evaluation. HGS was measured by the same physical therapist with a well-validated protocol (14, 15). Namely, HGS was measured in seated upright position at an armless chair with elbow flexed at 90° position. We instructed the participants to apply maximal pressure for 3 seconds. Three measurements were taken from each hand and the maximum grip strength was accepted as the HGS value. The participants that have additional problems which may affect the measurement of HGS, e.g., cognitive impairment, hand osteoarthritis, depression stroke, peripheric artery disease, or neuropathy, etc. were excluded from the measurement and the study. We considered the EWGSOP2 cut-off points for probable sarcopenia: HGS < 27 kg in men and < 16 kg in women (4). UGS was assessed at a 4-meter course. CSST and SPPB were performed as outlined elsewhere (16, 17). In the CSST, the subjects were asked to rise from a chair 5 times as fast as possible with their arms folded across their chests. The chair was of a standard height and did not have armrests. Two trials were conducted per session, and the shortest time was selected for analysis. Frailty was screened by FRAIL scale (18). SARC-F questionnaire is scored between 0–2 for each of its five items. We used Turkish validated SARC-F questionnaire which has been validated by this group recently under the leadership of European Geriatric Medicine Society (EuGMS) sarcopenia special interest group (7). A minor difference from the original SARC-F was use of 5 kg instead of 10 lbs in the first item due to its more convenient use and applicability in practice.

### *Statistical analysis*

We described numerical variables as mean ± standard deviation (SD) after assessing their normality by Kolmogorov-Smirnov test and visual histograms. Categorical variables were shown as frequencies. Chi-square test with Yates correction and Fisher's exact test were used for 2X2 contingency tables as appropriate. We restricted our analytical sample to those with complete data on probable sarcopenia, SARC-F and sarcopenia associated risk factors. Sensitivity, specificity, and positive (PPVs) and negative predictive values (NPVs) were calculated for different cut-off scores of SARC-F to screen or diagnose probable sarcopenia. We used the area under the receiver operating characteristic (ROC) curve to test the predictive accuracy to determine a suitable cut-off point in this analysis. If the area under the curve (AUC) is close to 1, the ability to predict probable sarcopenia was considered excellent diagnostic accuracy. An alpha of less than 0.05 is used as the cut off for significance. We performed statistical analyses by SPSS v 21.0 (SPSS Statistics; IBM, Armonk, NY) and MedCalc Statistical Software v 15.2 (MedCalc Software, Ostend, Belgium).

**Table 1.** Characteristics of the study population (n=456)

| | Male (n=132) | Female (n=324) |
|---|---|---|
| Age (years) | 75.6±6.49 | 74.1±6.6 |
| *Anthropometric data* | | |
| Height (cm) | 165±6.7 | 151±5.9 |
| Weight (kg) | 76.7±13.4 | 71.7±14.38 |
| BMI (kg/m$^2$) | 28.18±4.42 | 31.17±6 |
| Number of illnesses | 4.0±1.9 (4)* | 4.0±2.0 (4)* |
| Comorbidities (%) | | |
| Hypertension | 68.7 | 71.4 |
| Diabetes Mellitus | 32.1 | 35.7 |
| Congestive Heart Failure | 5.3 | 3.7 |
| COPD | 11.5 | 4.3 |
| Chronic Kidney Disease | 4.6 | 4.7 |
| Depression | 16.8 | 22.4 |
| Osteoporosis | 8.4 | 23 |
| Number of drugs | 6.25±3.86 (6)* | 6.03±3.45 (5)* |
| Falls in past year | 31.8% | 45.4% |
| ADL score | 5.78±0.45 (6)* | 5.61±0.93 (6)* |
| IADL score | 6.76±2 (8)* | 6.86±1.9 (8)* |
| *Nutritional status (MNA)* | | |
| Malnutrition | 21.9% | 25% |
| Normal nutrition | 78.1% | 75% |
| FRAIL score | 0.86±1.14 (0)* | 1.39±1.22 (1)* |
| Frailty | 24.2% | 46.9% |
| Hand grip strength (kg) | 33.5±7.4 | 21.2±5.3 |
| Gait speed (m/s) | 0.97±0.2 (1)* | 0.86±0.2 (0.89)* |
| Chair sit to stand | 11.9±4.2 (11)* | 13.4±5.07 (11.9)* |
| SPPB | 10.7±2.01 (11)* | 9.67±2.44 (10)* |
| SARC-F total score | 0.99±1.52 (0)* [0-7]** | 1.84±1.98 (1)* [0-8]** |

*: median; **: [minimum-maximum value]; BMI: Body Mass Index; COPD: Chronic Obstructive Pulmonary Disease; ADL: Activities in Daily Living; IADL: Instrumental Activities in Daily Living; MNA: Mini-Nutritional Assessment; Slow usual gait speed time: <=0.8 m/s; SPPB: short physical performance battery; The SPPB score categories are 0 – 6 (low score), 7 – 9 (middle score), and 10 – 12 (high score) points

## Results

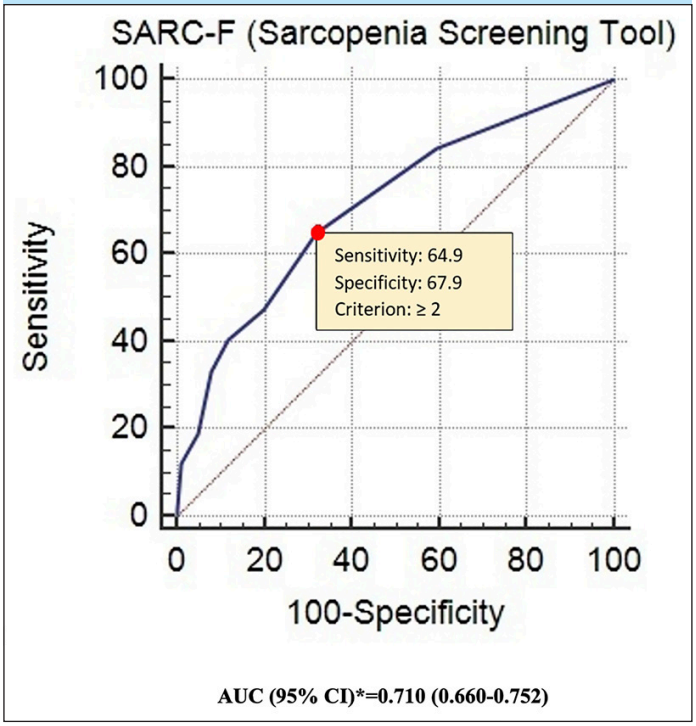
Four hundred fifty-six participants who met the inclusion criteria were included. 324 (71.1%) of them were women. The mean age was 74.6 ± 6.6 years. The mean BMI was 28.18±4.42 kg/m$^2$ and 31.17 ±6 kg/m$^2$ in males and females, respectively. We outlined the characteristics of the study population in Table 1.

**Table 2.** Criterion values and coordinates of the ROC curve

| Criterion | Sensitivity | 95% CI | Specificity | 95% CI | +LR | -LR |
|---|---|---|---|---|---|---|
| ≥0 | 100.00 | 93.7-100.0 | 0.00 | 0.0-0.9 | 1.00 | |
| >0 | 84.21 | 72.1-92.5 | 40.51 | 35.6-45.6 | 1.42 | 0.39 |
| >1 | 64.91 | 51.1-77.1 | 67.95 | 63.1-72.6 | 2.03 | 0.52 |
| >2 | 47.37 | 34.0-61.0 | 80.00 | 75.7-83.9 | 2.37 | 0.66 |
| >3 | 40.35 | 27.6-54.2 | 88.21 | 84.6-91.2 | 3.42 | 0.68 |
| >4 | 33.33 | 21.4-47.1 | 92.05 | 88.9-94.5 | 4.19 | 0.72 |
| >5 | 19.30 | 10.0-31.9 | 95.13 | 92.5-97.0 | 3.96 | 0.85 |
| >6 | 12.28 | 5.1-23.7 | 98.72 | 97.0-99.6 | 9.58 | 0.89 |
| >7 | 1.75 | 0.04-9.4 | 99.74 | 98.6-100.0 | 6.84 | 0.98 |
| >8 | 0.00 | 0.0-6.3 | 100.00 | 99.1-100.0 | | 1.00 |

95%CI: 95% confidence interval; + LR: Positive Likelihood Ratio; - LR: Negative Likelihood Ratio

**Figure 1.** Receiver operating characteristic curve (ROC) analysis of the SARC-F cut-off ≥2 to detect probable sarcopenia. AUC (95% CI)*=0.710 (0.660-0.752)




*AUC: Area under the curve, CI: Confidence Interval

Probable sarcopenia was present in 58 (12.7%) participants. Male participants had a higher prevalence of probable sarcopenia (19.7% vs 9.8% in males and females, respectively; p=0.008). Mean±SD measured grip strengths were 33.5±7.4 kg and 21.2±5.3 kg in men and women, respectively.

The SARC-F score (median values in parenthesis) was 0.99±1.52 (0) and 1.84±1.98 (1) in males and females respectively. SARC-F cut-off ≥1 had a sensitivity of 84.2% and specificity of 40.5% to screen probable sarcopenia. The positive predictive value (PPV) was 17.1% and the negative predictive value (NPV) was found to be 94.6%. SARC-F cut-off ≥ 2 showed the best balance between sensitivity and specificity (sensitivity: 64.9% vs specificity: 67.9%) (AUC=0.710; 95% Cl: 0.660-0.752) corresponding to the cut-off for identifying probable sarcopenia (Figure 1). The PPV was 22.8% and the NPV was found to be 93.0%. On the other hand, a SARC-F cut-off score ≥4 performed best to diagnose probable sarcopenia with considerably high specificity (88.2%) but low-to moderate sensitivity (40.3%). The PPV was 30.1% and the NPV was found to be 91.0%. We outlined the performance of the SARC-F in the diagnosis of probable sarcopenia in Table 2, Table 3 and Figure 1.

## Discussion

We found that, the SARC-F tool with a cut of point of four or above, proposed for sarcopenia case finding, had high specificity (88.2%), but low sensitivity (40.3%), for probable sarcopenia. In comparison, a SARC-F cut point of one or above increased sensitivity (84.2%) whilst its specificity significantly decreased (40.5%). The SARC-F cut point of two or above presented the best balance between sensitivity (64.9%) and specificity (67.9%) to detect probable sarcopenia. The low sensitivity indicates the low capacity of a screening tool to detect subjects having sarcopenia. The high specificity points out that this questionnaire is able to determine the absence of sarcopenia with great accuracy. Accordingly, our study put forwards that a SARC-F score of ≥ 1 is better to be used for screening, i.e. sarcopenia case finding and SARC-F ≥ 4 to exclude probable sarcopenia. In a recent study, a SARC-F cut point of four or above has been proven to offer a 15% sensitivity and 99% specificity as a diagnostic tool for probable sarcopenia. Additionally, they have found a SARC-F cut point of one or above increased sensitivity (65%) and reasonable specificity (72%) (19). Therefore, they do not recommend the SARC-F score of 4 and above for detecting probable sarcopenia in their population. Also, other recent meta-analysis including 7 studies on 12,800 subjects found the integrated sensitivity of the SARC-F to be 21% with a specificity of 90% (6), which further proves the low sensitivity of the SARC-F in diagnosing sarcopenia. Consequently, our results are similar to the literature.

Identifying older adults with sarcopenia in clinical practice

**Table 3.** The sensitivity, specificity, NPVs, and PPVs of SARC-F

| | Cut-off | Diagnosis | Sensitivity(%)(95%CI) | Specificity(%)(95%CI) | PPV(%) | NPV(%) |
|---|---|---|---|---|---|---|
| SARC-F | ≥1** | Probable sarcopenia | 84.2 (72.1-92.5) | 40.5 (35.6-45.6) | 17.1 | 94.6 |
| | ≥2† | | 64.9 (51.1-77.1) | 67.9 (63.1-72.6) | 22.8 | 93.0 |
| | ≥4†† | | 40.3 (27.6-54.2) | 88.2 (84.6-91.2) | 30.1 | 91.0 |

*PPV: Positive Predictive Value, NPV: Negative Predictive Value; **Cut-off ≥ 1, we suggest for screening of probable sarcopenia; †Cut-off ≥ 2, represented the best balance between sensitivity and specificity; ††Cut-off≥ 4, we suggest for diagnosis of probable sarcopenia.

is an important task, because it may allow for implementing therapeutic strategies to impede the progression toward disability and other adverse health outcomes. SARC-F is a very practical tool with established performance to predict the adverse outcomes of sarcopenia and suggested to be one of the best tools to evaluate sarcopenia in practice (4). Its specificity however was very high, suggesting its high utility as a screening tool for selecting subjects, who should undergo further testing for confirming a diagnosis of sarcopenia, is sufficient. In this study we investigated the prevalence of probable sarcopenia and to understand the performance of SARC-F to find cases and has shown that, a lower SARC-F threshold ( ≥ 1) has increased ability of SARC-F to find sarcopenia cases very significantly.

In our study, the probable sarcopenia prevalence was 12.7%. The concept of probable sarcopenia is very new and hence the studies reporting its prevalence is somewhat limited (19-25). It has been reported between 5.3-73% (19-25). This wide range seems to be due to patient population characteristics in different studies and the ethnic, cultural, life-style differences as well. For example, in a study conducted with men aged 85-89 years, probable sarcopenia was present in 73% (22). Our study population was composed of relatively young individuals with less prevalent co-morbidities such as heart failure, chronic kidney failure, etc. (Table 1). Therefore, the prevalence of probable sarcopenia was at a lower rate. This study suggests that probable sarcopenia is significantly prevalent among older adults living in the community who are relatively healthier than a standard geriatric patient.

Our study has some limitations and strengths. Because it is a retrospective analysis, the study population, who applied to the outpatient geriatric clinic of the university hospital, was not randomly selected community-dwelling older adults. Therefore, they couldn't represent the older adults living in the community. On the other hand, this study has been one of the few studies that reported the prevalence of probable sarcopenia. To the best of our knowledge, this study is the only study that examined the ability of SARC-F to find probable sarcopenia cases with different cut-offs. We used Turkish validated SARC-F test representing another strength of this study.

We conclude that SARC-F questionnaire seems to be a very good screening tool when a lower cut-off (≥ 1) is used and a good tool to exclude probable sarcopenia when ≥ 4 cut-off is used. In addition, probable sarcopenia is considerably prevalent among participants that apply to geriatric outpatient clinics in Turkey. Studies in different populations (i.e. nursing homes, long term care) and other populations are needed to give insight for utility of SARC-F in screening and excluding probable sarcopenia in those specific settings and populations.

*Statement of Authorship:* Mehmet Akif Karan: Supervision, Reviewing and Editing. Cihan Kilic: Data curation. Duygu Erbas Sacar: Writing- Original draft preparation, Writing- Reviewing and Editing. Gulistan Bahat: Conceptualization, Methodology, Software, Validation, Writing- Reviewing and Editing, Supervision.

*Sponsor's role:* None.

*Conflict of interest:* There are no other relationships/conditions/circumstances that present a potential conflict of interest.

*Ethical standards:* The study was conducted according to guidelines in the Declaration of Helsinki. The study was approved from the local ethic committee (No:1707).

*This study was presented as a 'poster presentation' in 15th EuGMS Congress held in Kraków, Poland in 2019.

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