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Assessment of the Relationship Between Sarcopenia and Body Composition, Nutrition, Physical Performance, and Functional Status in Older Adults

Yaşlılarda Sarkopeni ile Vücut Kompozisyonu, Beslenme, Fiziksel Performans ve Fonksiyonel Durum Arasındaki İlişkinin Değerlendirilmesi

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Abstract

Objective: The aim of this study was to evaluate the presence of sarcopenia in elderly patients and to examine its relationship with body composition, nutritional status, muscle strength and physical performance.
Materials and Methods: In this cross sectional study, patients aged 60 and older who attended the physical medicine and rehabilitation outpatient clinic of a university hospital between June 2018 and June 2019 were enrolled. Demographic and anthropometric data were collected. Sarcopenia was screened using the SARC F questionnaire (score ≥4), while muscle mass was evaluated by bioelectrical impedance analysis. Functional parameters were assessed using hand grip strength, a 4 meter gait speed test, the chair sit to stand test (CSST), balance tests, and the short physical performance battery. Nutritional status was evaluated using the full mini nutritional assessment, and physical activity was measured using the Turkish version of the physical activity scale for the elderly.
Results: The overall prevalence of sarcopenia was 41.0%, with no significant gender differences. SARC F scores were significantly associated with several physical performance measures, notably balance and chair stand test performance. Logistic regression analysis demonstrated that better balance and CSST performance were inversely associated with high SARC F scores, while a higher body mass index increased the likelihood of a high SARC F score.
Conclusion: Although the SARC F questionnaire effectively identifies key characteristics of sarcopenia and correlates with certain functional measures, its utility as a standalone diagnostic tool remains limited. Comprehensive assessment including muscle mass and strength evaluations is recommended for a definitive diagnosis.
Keywords: Body composition, geriatrics, nutrition assessment, physical performance, sarcopenia

Öz

Amaç: Bu çalışmanın amacı, yaşlı hastalarda sarkopeni varlığını değerlendirmek ve bunun vücut kompozisyonu, beslenme durumu, kas kuvveti ve fiziksel performans ile ilişkisini incelemektir.
Gereç ve Yöntem: Kesitsel olarak planlanan bu çalışmaya, Haziran 2018 ile Haziran 2019 tarihleri arasında bir üniversite hastanesinin fiziksel tıp ve rehabilitasyon polikliniğine başvuran 60 yaş ve üzeri hastalar dahil edilmiştir. Katılımcıların demografik ve antropometrik verileri kaydedilmiştir. Sarkopeni taraması SARC-F anketi (skor ≥4) ile yapılmış; kas kütlesi, biyoyelektrik impedans analizi ile değerlendirilmiştir. Fonksiyonel parametreler el kavrama kuvveti, 4 metrelik yürüme hızı testi, sandalyeden otur-kalk testi, denge testleri ve kısa fiziksel performans bataryası ile ölçülmüştür. Beslenme durumu, mini nutrisyonel değerlendirme tam formu ile değerlendirilmiş; fiziksel aktivite düzeyi ise yaşlılar için fiziksel aktivite ölçeğinin Türkçe versiyonu kullanılarak belirlenmiştir.

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Bulgular: Sarkopeni prevalansı genel olarak %41,0 olarak saptanmış olup, cinsiyetler arasında anlamlı bir fark bulunmamıştır. SARC-F skorları, özellikle denge ve sandalyeden kalkma testi performansı olmak üzere, çeşitli fiziksel performans ölçütleriyle anlamlı ilişki göstermiştir. Lojistik regresyon analizinde, daha iyi denge ve sandalyeden otur-kalk testi performansının yüksek SARC-F skoru ile ters orantılı olduğu; daha yüksek vücut kitle indeksinin ise yüksek SARC-F skoru ile ilişkili olduğu bulunmuştur.
Sonuçlar: SARC-F anketi, sarkopeninin temel özelliklerini belirlemede etkili olmakla birlikte, tek başına tanısal bir araç olarak kullanımı sınırlıdır. Kesin tanı için kas kütlesi ve kas kuvveti değerlendirmelerini içeren kapsamlı bir yaklaşım önerilmektedir.
Anahtar kelimeler: Vücut kompozisyonu, geriatri, beslenme değerlendirmesi, fiziksel performans, sarkopeni

Introduction

Sarcopenia is an age-related muscle mass decline that may be accompanied by loss of muscle strength and/or function (1). Although the first naming made by Rosenberg meant a decrease in muscle mass (2), the concept of "sarcopenia" has now become much more comprehensive (1,3). In addition to the decrease in muscle mass, loss of muscle strength, decrease in functionality and balance problems observed in the geriatric population are discussed within the scope of sarcopenia as a result of this approach (1,3). Besides the elements assessed within the context of sarcopenia, additional concerns that warrant attention include factors contributing to sarcopenia like malnutrition, chronic diseases, and mental problems (3,4). Regardless of the etiology and subsequent consequences, sarcopenia is an increasingly important concern in the geriatric population (1,3,4).

The concept of sarcopenia is being increasingly encountered in both clinical practice and research, spanning beyond the realm of geriatrics to encompass various other medical specialties (5-7). Inter/multidisciplinary approaches and consensuses aim to better define sarcopenia (8,9). The European Working Group on Sarcopenia in Older People 2 (EWGSOP2) published a consensus in 2019. This consensus presented an algorithm for the diagnosis of sarcopenia that addresses muscle strength, muscle quality, and physical performance (8). According to this algorithm, grip strength and chair stand test for muscle strength; the use of dual-energy X-ray absorptiometry, bioelectrical impedance analysis (BIA), computed tomography and magnetic resonance imaging for muscle quality was recommended. In order to determine the severity of sarcopenia, physical performance tests the short physical performance battery (SPPB), timed-up and go test and 4-meters walk test were recommended (8). First, muscle strength (e.g., grip strength) is assessed if the initial screening is positive or if there is clinical suspicion. The presence of muscle weakness raises suspicion of sarcopenia, prompting further evaluation. Subsequently, skeletal muscle mass is measured, and a reduction confirms the diagnosis of sarcopenia. Severe sarcopenia is identified when decreased physical performance (e.g., gait speed) is observed alongside reduced muscle strength and skeletal muscle mass (10).

Although these assessments are necessary for a detailed examination, a short and inexpensive test is needed for clinicians and their patients. The SARC-F, used by EWGSOP and many other study groups, was developed to screen for sarcopenia and identify people at risk (11). The Turkish validity study of this short questionnaire, which takes its name from the initials of its 5 components (strength, assistance with walking, rise from a chair, climb stairs and falls), has been previously conducted (12). Many factors such as chronic inflammatory diseases, endocrine disorders, advanced organ failure, malnutrition, hospitalization and sedentary life can cause the development of sarcopenia (13,14). All these related factors can manifest variously in different populations (15,16). According to recent studies, it is thought that the process of decrease in muscle mass and progression to sarcopenia, which is thought to accelerate from the age of 40, should be emphasized starting from the age of 60 (8,16,17). There are few sarcopenia-focused studies evaluating Turkish patients over the age of 60 (17-20). Although the number of these studies is increasing day by day, there is a need for studies that consider geriatric patients in multiple aspects such as body composition, physical performance and nutritional status (12,13,21).

Our study differs from previous research in that it includes individuals over the age of 60 and patients who applied to a physical medicine and rehabilitation (PMR) center. While current literature commonly focuses on individuals over the age of 65 and the general elderly population, our study is distinctive in its inclusion criteria (13,14). Moreover, it stands out as a multidisciplinary effort in which physicians and dietitians collaborated to evaluate sarcopenia alongside parameters such as muscle strength, physical function, body composition, and nutritional status (22).

The aim of this study was to evaluate the prevalence of sarcopenia in patients over 60 years of age with SARC-F and EWGSOP criteria and to investigate the relationship between SARC-F scores and body composition and nutritional parameters, muscle strength, functional status and physical performance scores.

Materials and Methods

Study Design and Population

The study was conducted at the PMR outpatient clinic of a university hospital and was a single-center, cross-sectional observational study. Certain stages, such as body composition and nutritional evaluation, were performed at the nutrition and dietetics department of the same university. Patients aged 60 and over who applied to the outpatient PMR clinic for any reason between June 2018 and June 2019 were included in the study. Exclusion criteria were as follows: not being literate in Turkish, having a terminal stage chronic disease, unable to walk, having a cognitive disorder, having a diagnosis of severe or advanced psychological disease, and using electronic or metallic implants such as a pacemaker. Consent was obtained from all participants, and all evaluations were conducted by competent physicians and dietitians in their respective fields. The study was approved by the Ethical Committee of Hacettepe University (approval no: GO 18/294-07, date: 20.03.2018).

Demographic and anthropometric data comprising age, gender, body weight (kg), height (m), mid-upper arm circumference (MUAC, cm), and calf circumference (CC, cm) were recorded. Clinical data containing previously diagnosed medical conditions, medicine usage, smoking and alcohol consumption were questioned and recorded.

Anthropometric Measurements and Body Composition

All measurements were conducted by a trained dietitian using standardized techniques: the height was measured using a standard stadiometer (Seca, Marsden, UK) while the participant was standing barefoot on the Frankfurt plane. Body mass index (BMI, kg/m²) was calculated using weight and height measurements. MUAC and CC were measured using a non-stretched measuring tape with an accuracy of 0.1 cm (23). According to the World Health Organization (24), BMI was classified into four categories: "underweight" (<18.50 kg/m²), "normal weight" (18.50-24.99 kg/m²), "overweight" (25.00–29.99 kg/m²), and "obese" (>30.00 kg/m²).

Handgrip strength was measured using a digital handgrip dynamometer (Takei TKK-5401, Japan). The measurement was performed three times on the dominant hand while the participant was in a standing position, and the mean value of these measurements was recorded. Hand grip strength (HGS) measures the maximal voluntary force of the hand muscles and is a reliable indicator of overall muscle strength (25).

Body weight, fat mass, fat-free mass, body fat percentage, and total body water were determined using a multi-frequency bioelectrical impedance analyzer (Tanita MC980, Tokyo, Japan). Measurements were conducted in the early morning after a fasting period of at least 4 hours, following urination 30 minutes prior to the procedure. Participants were barefoot during the measurement to ensure proper contact with the device's electrodes.

Fat-free mass was evaluated using two methods: either through height adjustment (m²) according to guidelines such as EWGSOP2, the International Working Group on Sarcopenia, and the Society on Sarcopenia, Cachexia, and Wasting Disorders, or by utilizing BMI, as proposed in the Foundation for the National Institutes of Health definition (8,9,26).

Questionnaire Assessments

The SARC-F questionnaire was administered to all patients. This questionnaire consists of five questions and evaluates muscle strength, need for assistance in walking, rising up from a chair, climbing stairs, and falls (11). Each component is scored between 0-2, and the total score of the SARC-F query varies between 0-10. Scores ≥4 are predictive of sarcopenia and are reported as an indicator of poor prognosis, emphasizing the need for further detailed examination in these elderly people (27).

The SPPB is a validated composite tool used to assess lower extremity function in older adults. It comprises three primary components: a balance test, a gait speed test, and a chair stand test. Each component is scored individually, and the sum of these scores provides an overall measure of physical performance. Each of the three tests is scored on a scale from 0 to 4, with a higher score representing better performance. The individual scores are summed to produce a total SPPB score ranging from 0 (worst performance) to 12 (best performance). This composite score provides an overall assessment of lower extremity function and has been shown to predict adverse outcomes such as disability, hospitalization, and mortality (28).

In the Balance test, participants are asked to maintain three standing positions of increasing difficulty: the side-by-side stand, the semi-tandem stand, and the tandem stand. Each position is held for up to 10 seconds (28). The ability to maintain these positions without losing balance is indicative of static balance capacity. The balance test helps identify individuals at risk for falls and is a critical component of overall physical function (29).

The Gait Speed test measures the time required for a participant to walk a set distance, typically 4 meters, at their usual walking pace. The test is performed twice, and the best time is recorded. Gait speed serves as a proxy for mobility, muscle strength, and overall functional status, with slower speeds being associated with increased risk of disability and mortality (30).

The full version of the mini nutritional assessment (MNA) was utilized for the nutritional assessment (31). This 18-item assessment comprises two stages: an initial screening employing the MNA-Short Form, encompassing 6 items, followed by a supplementary 12-item evaluation. A total score ≥24 indicates normal nutritional status, 17-23.5 signifies an elevated risk of malnutrition, and <17 indicates the presence of malnutrition (31). MNA is a scale that includes anthropometric measurements (BMI, mid-arm and calf circumference) and main questions about nutrition and is widely and reliably used in the Turkish elderly population (19).

Additionally, the Turkish version of the physical activity scale for the elderly scale was used to evaluate physical activity in elderly patients (32).

HGS, 4-meter gait speed test, chair sit-to-stand test, balance test, and SPPB were used as functional parameters (12,33,34).

Sarcopenia was diagnosed according to the criteria established by the European Working Group on Sarcopenia in Older People (EWGSOP). According to EWGSOP, sarcopenia is defined by the presence of low muscle mass combined with low muscle strength or low physical performance. Low muscle mass was determined using the skeletal muscle mass index (appendicular skeletal muscle mass/height²) evaluated by BIA (Tanita MC980, Tokyo, Japan), with cut-off points established as <8.87 kg/m² for men and <6.42 kg/m² for women. Low muscle strength was accepted as handgrip strength measured with a hand dynamometer (Takei TKK-5401, Japan), with cut-off values of <30 kg for men and <20 kg for women. Low physical performance was defined by a 4-meter gait speed test, with a speed of <0.8 m/s (35).

Statistical Analysis

The statistical evaluation of the data was completed using SPSS version 25 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed using the Shapiro-Wilk test. Continuous data were expressed as mean ± standard deviation, while categorical variables were reported as frequencies and percentages. Comparisons between groups were performed using the Student's t-test for normally distributed data or the Mann-Whitney U test for non-parametric data. Categorical variables were analyzed using the chi-square test. Pearson's or Spearman's correlation coefficients were calculated to evaluate relationships between variables, depending on data distribution. Logistic regression analysis was performed to identify independent predictors of high SARCF scores (≥4). A two-tailed p-value of <0.05 was considered statistically significant.

Results

Demographic Characteristics of Patients

The demographic characteristics of the patient population revealed notable trends (Table 1). The mean age was significantly higher in males (68.9±6.6 years) compared to females (65.3±4.5 years) (p=0.044). While there was no significant difference in BMI between genders (p=0.065), females had a slightly higher mean BMI (31.5±5.3 kg/m²) compared to males (28.5±5.6 kg/m²).

Regarding lifestyle factors, the proportion of former smokers was notably higher among males (73.0%) compared to females (40.0%). Alcohol consumption was infrequent in both genders, with no significant difference observed (p=0.738).

When considering chronic disease prevalence, no significant gender disparity was observed (p=0.283). However, females exhibited a slightly higher prevalence of having three or more chronic conditions (28.6%) compared to males (6.7%). The occurrence of falls was more frequent among males (26.7%) than females (9.5%) (p=0.063).

Table 1. Demographic characteristics of patients

Characteristics	Female (n=63)	Male (n=15)	All patients (n=78)	p
Age (years), $\bar{x}$ ± SD	65.3±4.5	68.9±6.6	66.1±5.1	**0.044***
BMI (kg/m²), $\bar{x}$ ± SD	31.5±5.3	28.5±5.6	30.9±5.4	0.065
SARC-F, $\bar{x}$ ± SD	2.2±1.9	1.9±1.8	2.1±1.9	0.605
Smoking status, n (%)				0.058
Current	8 (12.7)	4 (26.7)	12 (15.4)	
Former	46 (73.0)	6 (40.0)	52 (66.7)	
Never	7 (11.1)	4 (26.7)	11 (14.1)	
Alcohol consumption, n (%)				0.738
Yes	3 (4.8)	1 (6.7)	4 (5.1)	
No	58 (92.1)	13 (86.7)	71 (91.0)	
Chronic disease number, n (%)				0.283
None	12 (19.0)	2 (13.3)	14 (17.9)	
1 to 2	21 (33.3)	6 (40.0)	27 (34.6)	
≥3	18 (28.6)	1 (6.7)	19 (24.4)	
Falls, n (%)				0.063
Yes	6 (9.5)	4 (26.7)	10 (12.8)	
No	55 (87.3)	10 (66.7)	65 (83.3)	
SARC-F, n (%)				0.818
<4	52 (82.5)	12 (80.0)	64 (82.1)	
≥4	11 (17.5)	3 (20.0)	14 (17.9)	
EWGSOP, n (%)				0.891
Sarcopenia (+)	26 (41.3)	6 (40.0)	32 (41.0)	
Sarcopenia (-)	37 (58.7)	9 (60.0)	46 (59.0)	

BMI: Body mass index, EWGSOP: The European working group on sarcopenia in older people.
Data were presented as mean ± standard deviation ($\bar{x}$ ± sd) or number (percentage).
p-values refer to comparison between the two groups by the Mann-Whitney U non-parametric test for quantitative variables, and by the chi-square test or Fisher's exact tests for qualitative variables (*p<0.05)

Regarding sarcopenia diagnosis, based on the EWGSOP criteria, 41.3% of females and 40.0% of males were identified as sarcopenic (p=0.891). The SARC-F score distribution showed no significant differences, with 82.5% of females and 80.0% of males scoring below 4, indicating a similar low-risk distribution (p=0.818).

Bioimpedance Analysis and Muscle Strength Variables by Sarcopenia Presence

Body composition and muscle strength data were analyzed based on SARC-F scores (Table 2). Among females, those with SARC-F scores ≥4 had significantly higher BMI (34.8±4.9 kg/m²) than those with scores <4 (30.8±5.1 kg/m²) (p=0.030). A similar trend was observed in the combined analysis of both genders (p=0.048). However, body fat percentage, fat-free mass, and MUAC did not show significant differences by SARC-F scores across genders.

Grip strength was slightly lower in females with SARC-F scores ≥4 (17.8±4.8 kg) compared to those with scores <4 (20.6±4.5 kg), though the difference was not statistically significant (p=0.088). Similarly, CC and fat-free mass indices did not vary significantly by SARC-F categories.

Nutritional, Physical Performance, and Balance Measures

Nutritional and physical performance measures also showed variability based on SARC-F scores (Table 3). The chair stand test was significantly associated with sarcopenia, as individuals with SARC-F scores ≥4 demonstrated higher scores in both the overall population (p=0.004) and the male subgroup (p=0.004). Similarly, balance test scores were significantly lower in those with SARC-F scores ≥4 (3.5±0.8) compared to those scoring <4 (3.9±0.5) (p=0.014).

The SPPB total score was significantly lower in the SARC-F ≥4 group (8.3±1.8) compared to the <4 group (12.6±2.3) (p=0.008). Nutritional scores, as measured by the MNA, did not differ significantly by SARC-F score in either gender or the overall sample.

Correlations Between SARC-F Scores and Clinical Parameters

Correlation analysis revealed significant associations between SARC-F scores and specific clinical parameters (Table 4). In females, higher SARC-F scores correlated negatively with

Table 2. The values of bioimpedance analysis and muscle strength variables according to the presence of sarcopenia

	Male			Female			Total		
	SARCF <4	**SARCF ≥4**	**p**	**SARCF <4**	**SARCF ≥4**	**p**	**SARCF <4**	**SARCF ≥4**	**p**
BMI (kg/m²)	28.2±6.1	29.6±4.1	0.633	30.8±5.1	34.8±4.9	**0.030**	30.3±5.3	33.7±5.1	**0.048***
Body fat (%)	27.2±9.7	27.3±3.8	0.840	36.9±5.8	39.6±3.4	0.145	35.1±7.6	36.9±6.2	0.387
Fat-free mass (kg)	55.3±9.3	65.3±1.2	0.136	45.1±6.1	46.7±5.9	0.478	47.1±7.9	50.7±9.5	0.264
Fat-free mass/weight (kg/m²)	20.1±2.7	21.5±2.0	0.448	19.3±2.4	20.3±2.6	0.227	19.4±2.4	20.5±2.4	0.119
Fat-free mass/BMI (m²)	2.0±0.3	2.2±0.3	0.448	1.5±0.2	1.4±0.2	0.078	1.6±0.3	1.5±0.4	0.342
MUAC (cm)	29.3±5.5	30.3±1.5	0.840	30.3±4.6	32.1±3.5	0.194	30.1±4.8	31.7±3.2	0.207
Calf circumference (cm)	37.3±3.9	38.3±3.2	0.734	37.3±4.7	37.7±3.8	0.612	37.3±4.7	37.8±3.6	0.582
Grip strength (kg)	33.5±7.9	37.7±6.9	0.448	20.6±4.5	17.8±4.8	0.088	23.2±7.3	22.1±9.8	0.348

BMI: Body mass index, MUAC: Mid-upper arm circumference.
Data were presented as mean ± standard deviation, ***p<0.05**

Table 3. The scores of nutrition, falls and physical performance, and balance tests according to the presence of sarcopenia in both female and male patients

	Male			Female			Total		
	SARCF <4	**SARCF ≥4**	**p**	**SARCF <4**	**SARCF ≥4**	**p**	**SARCF <4**	**SARCF ≥4**	**p**
MNA	24.3±2.5	27.8±7.5	0.633	24.5±2.9	23.8±2.3	0.380	24.4±2.8	24.6±4.0	0.569
PASE total score	69.5±28.2	40.6±25.3	0.088	69.5±29.0	75.0±37.9	0.935	69.5±28.6	67.6±37.6	0.522
4 m gait speed test (m/s)	0.8±0.4	0.7±0.05	1.000	0.6±0.2	0.6±0.2	0.638	0.7±0.3	0.6±0.2	0.694
Chair stand test	0.2±0.4	1.3±0.6	**0.004***	0.3±0.5	1.1±0.7	0.089	0.3±0.5	1.1±0.7	**0.004***
Balance test	4.0±0.0	3.3±1.2	0.448	3.8±0.5	3.6±0.8	0.068	3.9±0.5	3.5±0.8	**0.014***
SBBP total score	8.8±1.5	5.3±2.9	**0.018***	8.2±1.8	14.6±26.2	0.069	8.3±1.8	12.6±23.4	**0.008***
SARCF total score	1.2±1.0	4.7±1.2	**0.004***	1.5±1.2	5.3±1.3	**0.001***	1.4±1.2	5.1±1.2	**0.001***

MNA: Mini nutritional assessment, PASE: The physical activity scale for the elderly, SBBP: Short physical performance battery.
Data were presented as mean ± standard deviation, ***p<0.05**

grip strength (r=-0.424, p=0.001), balance test scores (r=-0.265, p=0.037), and chair stand test performance (r=-0.397, p=0.001). Body fat percentage and MUAC positively correlated with SARC-F scores (p=0.029).

Among males, significant negative correlations were observed between SARC-F scores and the SPPB total score (r=-0.522, p=0.046). However, other measures such as grip strength and body composition parameters did not demonstrate strong associations.

Logistic Regression Analysis of Sarcopenia Risk Factors

Logistic regression analysis identified key predictors of high SARC-F scores (≥4) (Table 5). Each unit increase in balance test score decreased the likelihood of scoring ≥4 on the SARC-F by approximately 60% [odds ratio (OR): 0.421, p=0.041]. Similarly, an improvement in chair stand test performance reduced this likelihood by 70% (OR: 0.326, p=0.008). In contrast, a one-unit increase in BMI was associated with a 13% higher likelihood of a high SARC-F score (OR: 1.134, p=0.041).

Discussion

This study evaluated the prevalence of sarcopenia in Turkish geriatric patients using the SARC-F questionnaire and examined its correlations with body composition, nutritional status, muscle strength, and physical performance. Our study demonstrates that the SARC-F can fulfill its primary purpose of screening for sarcopenia in Turkish older adults; however, it has limitations both in this context and in the detailed assessment of sarcopenia. The overall sarcopenia prevalence of 41.0% in our study population is consistent with previous reports in similar elderly cohorts, thereby highlighting the clinical significance of sarcopenia in aging demographics (8). According to the EWGSOP2 criteria reported in a meta-analysis (16), the prevalence of sarcopenia among individuals over the age of 60 ranges between 10% and 27%. Since our study included patients who presented to the PMR clinic for various reasons, unlike the general population, detecting higher rates seems plausible. According to the SARC-F, the prevalence of sarcopenia in our study was determined to be 17.9%. Although the SARC-F appears to provide a more accurate rate, it was insufficient to

Table 4. Correlation between nutrition and physical performance test scores, anthropometric measurements with SARC-F total score

	Male		Female	
	r	p	r	p
MNA	-0.306	0.267	-0.246	0.054
SBBP total score	-0.522	**0.046***	-0.319	**0.011***
PASE total score	-0.308	0.284	-0.157	0.224
4 m gait speed test	-0.172	0.557	-0.038	0.772
Chair stand test	-0.480	0.070	-0.397	**0.001***
Balance test	-0.443	0.098	-0.265	**0.037***
Body fat (%)	0.084	0.766	0.278	**0.029***
Fat-free mass (kg)	0.258	0.354	0.109	0.400
Fat-free mass/weight (kg/m^2)	-0.037	0.897	0.206	0.109
Fat-free mass/BMI (m^2)	0.164	0.558	-0.281	**0.027***
MUAC (cm)	-0.181	0.519	0.280	**0.029***
Calf circumference (cm)	-0.151	0.591	0.244	0.058
Grip strength (kg)	-0.146	0.603	-0.424	**0.001***

MNA: Mini nutritional assessment, SBBP: Short physical performance battery, PASE: The physical activity scale for the elderly, BMI: Body mass index, MUAC: Mid-upper arm circumference, r: correlation coefficient, **(*p<0.05)**

Table 5. Logistic regression analysis

Variables	SARC-F total score							
	≥4					<4 (reference)		
	B	OR	%95 CI	p		OR	%95 CI	p
Balance score	-0.864	0.421	0.18-0.97	**0.041***		1	-	-
Chair stand test	-1.122	0.326	0.14-0.75	**0.008***		1	-	-
BMI (kg/m^2)	0.126	1.134	1.01-1.28	**0.041***		1	-	-

Hosmer and Lemeshow (p) >0.05 (all models), OR: Odds ratio, CI: Confidence interval, BMI: Body mass index predict the prevalence of sarcopenia determined according to the EWGSOP2 criteria, which offer a more comprehensive assessment. At the time of our study, the EWGSOP2 criteria had not yet been published, and because SARC-F was developed prior to that update, we compared it against the original 2010 EWGSOP criteria. We believe that SARC-F, introduced in 2013, should be evaluated according to the 2010 standards rather than the 2019 revision. Nonetheless, our findings suggest that SARC-F may still have certain limitations (8,11,35).

The SARC-F questionnaire demonstrated significant associations with several physical performance measures, particularly balance and the chair sit-to-stand test. These findings reinforce the utility of SARC-F as an initial screening tool that captures aspects of functional impairment associated with sarcopenia. However, the absence of strong correlations with certain parameters such as grip strength and specific body composition measures suggests that SARC-F alone may not fully capture the complexity of sarcopenia. This is in line with previous studies (36) which indicate that while SARC-F is effective in screening for mobility limitations, a comprehensive evaluation requires additional assessments.

In this study, the negative correlation between SARC-F scores and handgrip strength scores, particularly in women, emphasizes the role of muscle strength in the diagnosis of sarcopenia (11,37). The absence of significant changes in fat-free mass or nutritional assessment scores (e.g., MNA), which are critical aspects of sarcopenia, raises questions about whether the SARC-F accurately measures sarcopenia. Moreover, muscle mass and strength between modest association in comparison to specific standards like the EWGSOP supports earlier concerns that the SARC-F may lack the sensitivity required for a precise diagnosis (38). Contrary to findings in the literature, parameters such as calf circumference, handgrip strength, and muscle mass did not differ significantly between the groups classified according to SARC-F. This outcome may be attributed to the unpredictable characteristics of the study population and the small sample size, particularly among male participants.

An important finding of this study, that participants with a SARC-F score of 4 and above exhibited impaired physical performance, supports previous findings that the SARC-F does not directly measure muscle mass but instead evaluates functional parameters (37). Also, these findings support the recommendations of the EWGSOP to apply more sensitive diagnostic methods (e.g. grip strength measurements or bioimpedance analysis) after the use of SARC-F as a first-stage screening tool (27,39). On the other hand, the association between high SARC-F scores and high BMI highlights the importance of body composition in the diagnosis of sarcopenia. The results suggest that individuals with high BMI are more likely to have higher SARC-F scores due to the confounding effects of obesity. This finding is consistent with previous research suggesting that obesity obscures muscle wasting, complicating the diagnosis of sarcopenia (40). For this reason, recent studies have proposed the use of methods such as ultrasonography to detect sarcopenia and sarcopenic obesity or to assess body composition (41,42).

Our logistic regression analysis further revealed that each unit improvement in balance and chair stand performance significantly reduced the odds of a high SARC-F score, whereas an increase in BMI was associated with an elevated risk. These results suggest that impaired balance and reduced lower extremity strength are key determinants of functional decline in sarcopenia, and they underscore the interplay between obesity and muscle function in this population.

Study Limitations

Despite the strengths of our study, including the comprehensive assessment of both physical performance and nutritional status, several limitations must be acknowledged. The cross-sectional design limits the ability to draw causal inferences, and the study's single-center nature may affect the generalizability of the findings. We consider the fact that our study was not conducted on community-based elderly as a distinguishing feature rather than a limitation, and we believe it contributes to the literature. However, we would like to emphasize the need for larger studies on patients aged 60 and over who apply to rehabilitation clinics, as the small sample size may have influenced some parameters. Our study includes patients over the age of 60 who presented to the PMR outpatient clinic with various complaints. Individuals over the age of 60 who present to the PMR outpatient clinic appear to be more prone to sarcopenia, and the findings of our study support this observation. The fact that we evaluated individuals aged over 60 rather than over 65 demonstrates an earlier stage of impact in this population, which constitutes a significant strength of our study. Furthermore, another notable strength of our research is the comprehensive and multidimensional evaluation of the individuals included in the study.

Conclusion

Sarcopenia is a condition that should be addressed multidimensionally, such as muscle strength, physical function, and nutrition. Although the SARC-F questionnaire is a practical and cost-effective screening tool for sarcopenia in elderly Turkish patients, its diagnostic accuracy is limited when used in isolation. Integrating the SARC-F with objective measures of muscle mass and strength may provide a more robust framework for early diagnosis and management of sarcopenia in clinical practice.

Ethics

Ethics Committee Approval: The study was approved by the Ethical Committee of Hacettepe University (approval no: GO 18/294-07, date: 20.03.2018).

Informed Consent: Consent was obtained from all participants, and all evaluations were conducted by competent physicians and dietitians in their respective fields.

Footnotes

Authorship Contributions

Surgical and Medical Practices: Y.D., Concept: Y.D., P.B., P.B., Y.G.K., Design: Y.D., P.B., P.B., Y.G.K., Data Collection or Processing: Y.D.,

S.Ö., N.K.H., S.K., Analysis or Interpretation: Y.D., P.B., P.B., S.Ö., N.K.H., S.K., Y.G.K., Literature Search: Y.D., P.B., S.Ö., Writing: Y.D., P.B., S.Ö.

Conflict of Interest: One of the authors of this article (Y.G.K.) is a member of the Editorial Board of this journal. She was completely blinded to the peer review process of the article. The other authors declared that they have no conflict of interest.

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