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Screening Sarcopenia in Rural Community-Dwelling Older Adults in Korea

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Abstract

Purpose: *Several screening tools have been developed to identify sarcopenia in rural community-dwelling older adults. We aimed to compare the diagnostic accuracy of two such tools, namely the SARC-F and SARC-CalF assessments.* ***Methods:*** *This cross-sectional study on 388 community-dwelling older adults comprised 254 women and 134 men with a mean age of 77.8 ± 6.26 year in Korea. We assessed muscle mass, muscle strength, and physical performance using a bioimpedance analysis device, hydraulic hand dynamometer, and 4 m gait speed test, respectively. Three widely-used diagnostic criteria [the Asian Working Group for Sarcopenia (AWGS), European Working Group on Sarcopenia in Older People, and the International Working Group on Sarcopenia] were applied. Sensitivity and specificity analyses were performed on the SARC-CalF and SARC-F tests. We used receiver-operating characteristic curves and the area under the curves (AUCs) to compare the diagnostic accuracy of the assessments with regard to sarcopenia.* ***Results:*** *An analysis using four sets of diagnostic criteria showed that the prevalence of sarcopenia was 27.6% to 41.0%. Using the AWGS 2019 criteria as a reference standard, the SARC-CalF had a sensitivity of 83.02% and a specificity of 53.71% in the entire study population, whereas the SARC-F had a sensitivity of 79.87% and a specificity of 41.92%. The AUCs for the SARC-CalF and SARC-F tests were 0.725 (95% confidence interval 0.678–0.769) and 0.645 (95% confidence interval 0.595–0.693), respectively (p<001). In the analyses using the other three diagnostic criteria, similarity was also confirmed.* ***Conclusion:*** *SARC-CalF showed better sensitivity than did SARC-F when diagnosing sarcopenia in rural community-dwelling older adults. Further studies are needed to verify this finding in different populations.*

Keywords: *Older adults, Sarcopenia, Screening, Sensitivity, Specificity, Validation*

1. Introduction

According to Korean statistics from 2019 on older adults, the population aged 65 and over accounts for 14.9% of the total population. This number is expected to increase to 43.9% in 2060, thus making Korea the most super-aged society [1]. The increasing proportion of older adults is accompanied by a growing interest in geriatric diseases. The prevention and treatment of sarcopenia are of particular interest, as the disease is considered an important risk factor for geriatric syndrome [2]. Sarcopenia is a state in which skeletal muscle gradually decreases as aging progresses, resulting in atrophy, strength loss, and decreased muscle quality [3]. A decrease in muscle mass results in a loss of muscle strength, which, in turn, increases the risks of functional

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degradation, hospitalization, and mortality [4]. When assessing sarcopenia, most rural community-dwelling older adults have walking problems and chronic arthritis, and the risk of falls is very high due to space restrictions [4]; hence, a quick and accurate diagnostic tool is needed for this population.

According to the current consensus within the European Working Group on Sarcopenia in Older People (EWGSOP), Asian Working Group for Sarcopenia (AWGS), and International Working Group on Sarcopenia (IWGS), the diagnosis of the condition depends on the diagnostic devices used (e.g., computer tomography, magnetic resonance tomography, or dual energy X-ray absorptiometry). Moreover, these tests are both costly and time-consuming for the elderly members of the community, and access to testing is often limited [3,5-7]. Therefore, a simple method of screening for sarcopenia that does not require specialized equipment is needed.

Several methods have been developed for screening sarcopenia [8-9]. The EWGSOP recommends using SARC-F questionnaires due to their convenience [10], as these rely on self-reporting to determine the presence of symptoms characteristic of sarcopenia in the community as well as clinical environments. As the first of the screening questionnaires, the SARC-F has been recognized as a valid means of assessing sarcopenia in various populations since its development in 2013 [8].

Previous studies have reported that the SARC-F has a high specificity regarding the detection of muscle attenuation in elderly people living in rural communities [11-14]. Unfortunately, it is not a perfect testing tool due to its low sensitivity [11,14]. Consequently, its use in actual clinical cases is limited. In a study by Yang et al. [15], 384 elderly patients in Chengdu, China met the highest criteria identified by the AWGS, and although, the specificity of the SARC-F questionnaire was 93.7%, the sensitivity was only 17.9%. Meanwhile, Barbosa-Silva et al. [16] developed the "SARC-CalF" screening tool, combining SARC-F with calf circumference (CC) measurements. They reported that this additional measurement significantly improved the sensitivity and overall diagnostic accuracy of the SARC-F. Yang et al. [15] found that applying the SARC-CalF assessment improved the sensitivity from 17.9% to 47.5% while still maintaining 92.0% specificity. Recently, Kim and Won [17] suggested that use of SARC-CalF to screen for sarcopenia may be more effective than the SARC-F questionnaire alone in community-dwelling older adults aged 70 to 84 years.

In light of the above, this study was conducted to assess and compare the suitability of the SARC-F and SARC-CalF screening tools for rural community-dwelling older adults in Korea.

2. Material and Methods

2.1 Study Design

This diagnostic accuracy study aimed to evaluate the sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, and area under the receiving operator characteristic curve (AUC) of the SARC-F and SARC-CalF screening tools when used for sarcopenia screening in rural community-dwelling older adults.

2.2 Participants and Recruitment

We recruited rural community-dwelling older adults using an advertisement at a hospital located in Hamyang, a rural county of Korea. The inclusion criteria were an age of over 60 years, being a resident of the community, and having the ability to walk independently. The exclusion criteria were confirmed by the following indicators of physical frailty: a pacemaker; severe cardiac, pulmonary, or musculoskeletal disorders; and severe cognitive impairment.

Cognitive function was measured using the Korean version of the mini-mental state examination (MMSE-K) [18], and older adults with severe cognitive impairment were screened. The anthropometric variables of all participants were also evaluated. The height of the patients was measured with a portable extensometer (InLab550; Biospace Co., Ltd, Seoul, Korea) equipped with an ultrasonic sensor. The height was measured to the nearest 0.5 cm and weight to the nearest 0.1 kg. Body mass index (BMI) was calculated as the ratio of the weight to the square of the height (kg/m^2). This study was approved by the Ethics Committee of the Gyeongsang National University, and written informed consent was obtained from all of the participants.

2.3 Instruments

In this study, an indicator that can indirectly measure sarcopenia defined by AWGS was chosen as a variable. Muscle mass was measured using the skeletal muscle mass index (SMI). Hand grip strength (HGS) using a Jamar hydraulic hand dynamometer (Patterson Medical Products, Inc., Cincinnati, OH, USA), and physical performance using the 4 m gait speed (GS) test.

2.3.1 Muscle Mass Index

Bioelectrical impedance was obtained using an InBody 720 (Biospace Co., Ltd, Seoul, Korea) set to frequencies of 5, 50, 250, and 500 kHz. Bioelectrical impedance measures body composition by quantifying electrical resistance, which means a very weak current passes throughout the body, thereby determining the proportions of skeletal muscle and body fat mass. This device uses eight tactile electrodes: one on each thumb and palm and one on each of the anterior and posterior aspects of the soles of both feet. The participant stands with the soles of their feet in contact with the foot electrodes while holding the other electrodes with both hands. The SMI was calculated by dividing the skeletal muscle mass by the square of the height (kg/m^2), and low muscle mass was defined as an SMI of < 7.0 kg/m^2 and < 5.7 kg/m^2 in men and women, respectively [19].

2.3.2 Hand Grip Strength

HGS was measured with a CAMRY hand grip dynamometer (CAMRY EH101; Henqi, Guangdong, China). Two rounds of measurement were performed for hand grip strength. The test was performed with one hand at a time. After a three-minute break, the second round of measurement began. The strength of each hand was measured twice in an alternating manner. The highest values measured were used for the analysis [20]. Muscle strength was considered low when the results were below the cutoff values of 26 kg and 18 kg in men and women, respectively.

2.3.3 Gait Speed (GS)

Physical performance was measured using a 4 m GS test. The participants were instructed to walk a straight 4 m course marked on the floor. There were no obstacles, and the participants were instructed to walk at their usual GS. They could use a walking aid, such as a cane, if necessary. Participants were given two opportunities each. A raw score consisting of the number of seconds required to walk 4 m in each of the two tests was recorded, and the best result was used for each patient. The cutoff values for sarcopenia were < 0.8 m/s in both men and women during the GS test.

2.4 Screening Tools for Sarcopenia

Trained nurses interviewed the participants and completed the SARC-F questionnaires. For the SARC-CalF assessment, trained nurses measured CC using a millimeter-graded tape. To measure the CC, participants were asked to lie in the supine position with their left knee raised. The relationship of the calf to the thigh was maintained at a right angle. The SARC-F and SARC-CalF scales have been presented in Supplementary Table 2. A SARC-F score ≥ 4 or SARC-CalF score of ≥ 11 was considered to be indicative of sarcopenia [8,14,16]. The inter-rater reliability and test-rest reliability was tested by intraclass correlation coefficient (ICC) provided that SARC-F and SARC-CalF total scores were normally distributed. Inter-rater reliability of all observers' first and second measurements was compared separately and results showed a perfect reliability for both measurements (ICC: 0.90-0.99, $p<0.001$).

2.5 Data Collection

Data were collected through questionnaires and physical examinations conducted between October 2019 and March 2020. Out of the 400 recruited participants, 12 were excluded due to missing data. Hence, the data of 388 patients were collected and analyzed. Trained clinical research assistants visited all of the participants in person and collected data. The clinical research assistants would record sociodemographic characteristics, such as sex and age, and clinical data, such as walking aids and cognitive function, using a general questionnaire. We obtained approval from the institutional review board of Gyeongsang National University in Jinju, South Gyeongsang Province, prior to conducting this study. We provided the participants with a full explanation of the necessity and purpose of the research, its benefits, their freedom to cease participation, the data collection methods involved, and the amount of time the study would take to complete. We asked the participants to voluntarily answer the self-reported survey after providing us with written consent.

2.6 Statistical Analysis

All statistical analyses were performed using SPSS 20.0 (IBM Corp, Armonk, NY) and MedCalc Statistical Software version 15.2 (MedCalc Software bvba, Ostend, Belgium). In terms of the categorical variables, the data were presented as numbers (percentages), and the differences between the groups were compared using chi-squared tests (or Fisher's exact test when the expected cell count was < 5). The data of the continuous variables with normal distributions were presented as the mean and standard deviation, and the differences between the groups were compared using one-way analysis of variance. The data of the continuous variables with skewed distributions were presented as the median and interquartile range, and the differences between the groups were compared using the Mann-Whitney U test. Using the AWGS criteria as a reference, we evaluated the sensitivity, specificity, positive likelihood ratio, and negative likelihood ratio of the SARC-F and SARC-CalF assessments with regard to the detection of sarcopenia. We also used the receiver-operating characteristic (ROC) curve to compare the overall diagnostic accuracy of the assessment tools. We then calculated the AUCs and 95% confidence intervals (CI). The differences between the ROC curves were compared using the method described in DeLong et al.'s study [21]. Since previous studies revealed sex differences regarding sarcopenia [22,23], we stratified the data accordingly.

3. Results

3.1 Participant Characteristics

We included 134 men and 254 women in this study. The mean age of the entire study population was 77.80±6.26 years. Men were not significantly older than women (mean age: 77.09 vs. 78.17 years, p=0.117). Unsurprisingly, the men had significantly greater calf circumferences and appendicular skeletal muscle mass than did the women, although the latter had a higher gait speed and greater hand grip strength (Table 1).

3.2 Prevalence of Sarcopenia

The mean SARC-F and SARC-CalF scores of the entire study population were 4.04 and 11.06, respectively. According to their SARC-F and SARC-CalF scores, the prevalence of sarcopenia was 67.0% and 67.8%, respectively. According to the AWGS 2014, AWGS 2019, EWGSOP, and IWGS criteria, the prevalence of sarcopenia ranged from 27.6% to 38.4% (Table 1). Sarcopenia was more prevalent in women than in men regardless of the criteria used, and all of the differences were significant except for when the AWGS 2019 criteria were applied (Table 1).

3.3 Comparison of SARC-F and SARC-CalF in the study population

Table 2 shows the sensitivity, specificity, and AUC of the SARC-F and SARC-CalF tests in the entire study population, using different diagnostic criteria as the reference standard. Regardless of which reference standard was used, the SARC-CalF showed better sensitivity and similar specificity when compared to SARC-F. For example, using the AWGS 2019 criteria as the reference standard, the sensitivities of SARC-F and SARC-CalF were 79.87% and 83.02%, respectively, and the specificities were 41.92% and 53.71%, respectively. The ROC curves of the SARC-F and SARC-CalF tests using different reference standards are presented in Figure 1. When using the AWGS 2019 criteria, the AUCs of SARC-CalF and SARC-F were 0.645 (95% CI 0.595–0.693) and 0.725 (95% CI 0.678–0.769), respectively (p< 0.001). This finding suggests that the SARC-CalF test was a more suitable screening tool for sarcopenia than was the SARC-F. Using the other three reference standards, similar results were obtained (Table 2 and Figure 1).

Table 1. Characteristics of the Study Population

Characteristics	Total (n=388) n(%) or M±SD	Men (n=134) n(%) or M±SD	Women (n=254) n(%) or M±SD	p value
Age(year)	77.80±6.26	77.09±6.69	78.17±6.00	0.117
Body mass index(kg/m²)	23.45±3.85	23.37±3.11	23.49±4.20	0.772
Calf circumference(cm)	31.64±3.25	32.42±2.74	31.24±3.43	<0.001
Gait speed(m/s)	0.41±0.31	0.36±0.23	0.44±0.35	0.033
Hand strength(kg)	10.66±4.40	9.38±3.85	11.34±4.52	<0.001
Appendicular skeletal muscle mass(kg)	0.23±0.95	7.06±0.75	5.79±0.73	<0.001
Body fat mass	17.91±6.33	17.61±6.38	18.07±6.31	0.492
SARC-F score	4.04±2.62	2.94±2.57	4.62±2.46	<0.001
SARC-CalF score	11.66±5.49	10.48±5.68	12.33±5.29	0.001
SARC-F classification				
Non-sarcopenia	128(33.0)	72(53.7)	56(22.0)	<0.001
Sarcopenia	260(67.0)	62(43.3)	198(78.0_	
SARC-CalF classification				
Non-sarcopenia	125(32.2)	57(42.5)	68(26.8)	0.002
Sarcopenia	263(67.8)	77(57.5)	186(73.2)	
AWGS 2014 classification				
Non-sarcopenia	266(68.6)	80(59.7)	186(7.32)	0.006
Sarcopenia	122(31.4)	54(40.3)	68(26.8)	
AWGS 2019 classification				
Non-sarcopenia	229(59.0)	80(59.7)	149(58.7)	0.843
Sarcopenia	159(41.0)	54(40.3)	105(41.3)	
EWGSOP classification				
Non-sarcopenia	239(61.6)	21(15.7)	218(85.8)	<0.001
Sarcopenia	149(38.4)	113(84.3)	36(14.2)	
IWGS classification				
Non-sarcopenia	281(72.4)	128(95.5)	153(60.2)	<0.001
Sarcopenia	107(27.6)	6(4.5)	101(39.8)	

Note. AUC, area under the curve; AWGS, Asian Working Group for Sarcopenia; EWGSOP, European Working Group on Sarcopenia in Older People; IWGS=International Working Group on Sarcopenia; SARC-F=simple 5-item questionnaire for sarcopenia screening; SARC-CalF=SARC-F combined with calf circumference.

Table 2. Sensitivity/Specificity Analyses and Receiver Operating Curve Models for SARC-F and SARC-CalF Validation against Different Sarcopenia Definitions in the Whole Study Population

	Sensitivity(%)	Specificity(%)	+LR	-LR	AUC	p value
AWGS 2014						
SARC-F	81.97 (74.0-88.3)	39.85 (33.9-46.0)	1.36 (1.2-1.5)	0.45 (0.4-0.7)	0.622 (0.571-0.670)	<0.001
SARC-Calf	86.07 (78.6-91.7)	50.00 (43.8-56.2)	1.72 (1.5-2.0)	0.28 (0.2-0.4)	0.701 (0.652-0.746)	
AWGS 2019						
SARC-F	79.87 (72.8-85.8)	41.92 (35.5-48.6)	1.38 (1.2-1.6)	0.48 (0.3-0.7)	0.645 (0.595-0.693)	<0.001
SARC-Calf	83.02 (76.3-88.5)	53.71 (47.0-60.3)	1.79 (1.5-2.0)	0.32 (0.2-0.5)	0.725 (0.678-0.769)	
EWGSOP						
SARC-F	46.98 (38.8-55.3)	75.73 (69.8-81.0)	1.94 (1.5-2.6)	0.70 (0.6-0.8)	0.648 (0.598-0.695)	<0.001
SARC-Calf	76.51	38.08	1.24	0.62	0.581	

	(68.9-83.1)	(31.9-44.6)	(1.1-1.4)	(0.4-0.9)	(0.530-0.631)	
IWGS						
SARC-F	55.14 (45.2-64.8)	69.40 (63.6-74.7)	1.80 (1.4-2.3)	0.65 (0.5-0.8)	0.668 (0.618-0.714)	<0.001
SARC-Calf	95.52 (85.8-96.7)	41.64 (35.8-47.6)	1.59 (1.4-1.8)	0.18 (0.09-0.4)	0.722 (0.675-0.766)	

Note. AUC, area under the curve; AWGS, Asian Working Group for Sarcopenia; EWGSOP, European Working Group on Sarcope nia in Older People; IWGS=International Working Group on Sarcopenia; SARC-F=simple 5-item questionnaire for sarcopenia screening; SARC-CalF=SARC-F combined with calf circumference; +LR=positive likelihood ratio; -LR=negative likelihood ratio.

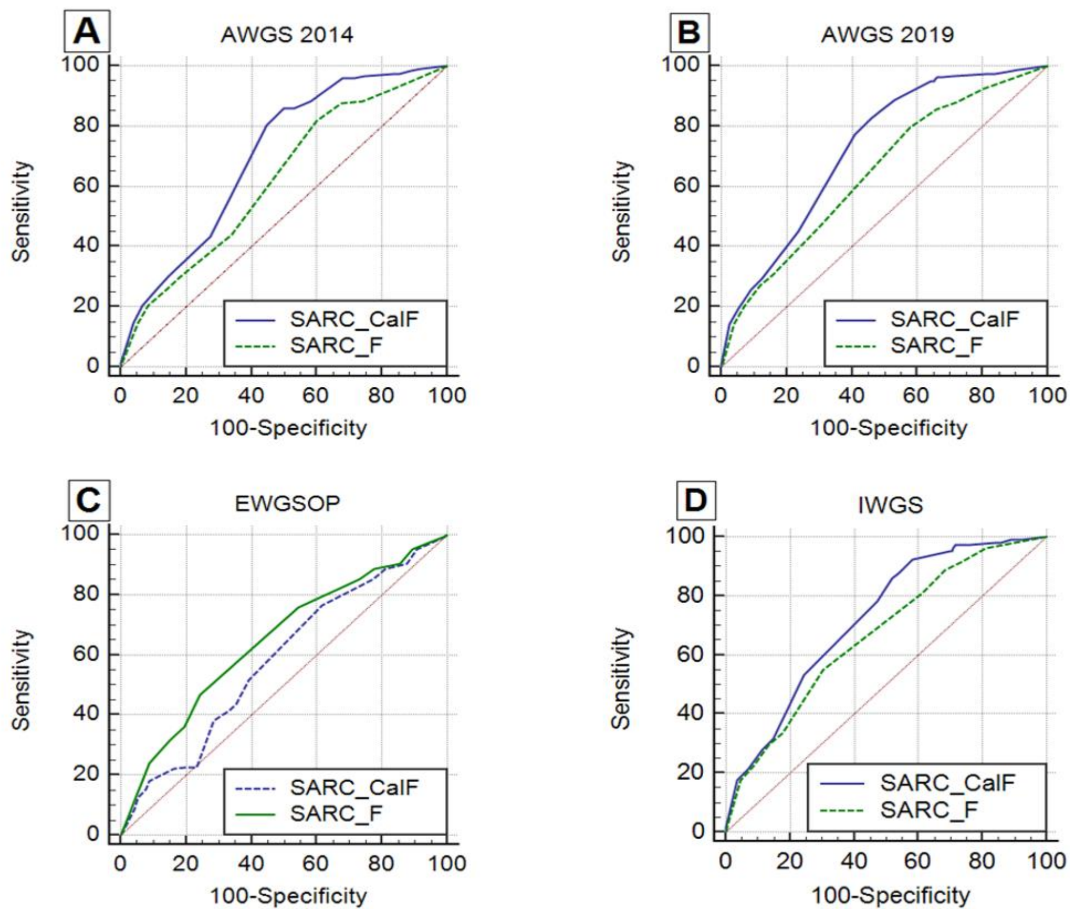

Figure 1. The ROC curves of SARC-F and SARC-CalF against different reference standards in the whole study population: (A) AWGS 2014 criteria; (B) AWGS 2019 criteria; (C) EWGSOP criteria; and (D) IWGS criteria.

3.4 Comparison of SARC-F and SARC-CalF in Men

Table 3 shows the sensitivity, specificity, and AUC of the SARC-F and SARC-CalF tests in men, using different diagnostic criteria as the reference standard. Regardless of which reference standard was used, the SARC-CalF test showed similar sensitivity and specificity when compared with the SARC-F test. For example, when using the AWGS 2014 criteria as the reference standard, the sensitivities of SARC-F and SARC-CalF were 75.93% and 74.07%, respectively, and the specificities were 73.75% and 80.00%, respectively. The ROC curves of the SARC-F and SARC-CalF tests in men using different reference standards have been presented in Figure 2. When using the AWGS 2014 criteria, the AUCs of the SARC-CalF and SARC-F tests were 0.765 (95% CI 0.684–0.834) and 0.808 (95% CI 0.731–0.871), respectively; however, the difference was not significant (p=0.06). Nonetheless, when using the EWGSOP and IWGS criteria, the AUC of the SARC-CalF was significantly better than that of the SARC-F (Table 3 and Figure 2).

3.5 Comparison of SARC-F and SARC-CalF in Women

Table 4 shows the sensitivity, specificity, and AUC of the SARC-F and SARC-CalF tests in women, using different diagnostic criteria as the reference standard. Regardless of the reference standard used, SARC-CalF showed similar sensitivity to SARC-F. For example, using the AWGS 2014 criteria as the reference standard, the sensitivities of the SARC-F and SARC-CalF tests were 92.65% and 91.18%, respectively, and the specificities were 21.51% and 41.94%, respectively. The ROC curves of the SARC-F and SARC-CalF tests in women using different reference standards are presented in Figure 3. Using the AWGS 2014 criteria, the AUCs of the SARC-CalF and SARC-F tests were 0.581 (95% CI 0.518–0.642) and 0.672 (95% CI, 0.611–0.730), respectively ($p < 0.001$). Using the other three criteria, we obtained similar results (Table 4 and Figure 3).

Table 3. Sensitivity/Specificity Analyses and Receiver Operating Curve Models for SARC-F and SARC-CalF Validation against Different Sarcopenia Definitions in Men

	Sensitivity(%)	Specificity(%)	+LR	-LR	AUC	p value
AWGS 2014						
SARC-F	75.93 (62.4-86.5)	73.75 (62.7-83.0)	2.89 (1.9-4.3)	0.33 (0.2-0.7)	0.765 (0.684-0.834)	0.06
SARC-Calf	74.07 (60.3-85.0)	80.00 (69.6-88.1)	3.70(2.3-5.9)	0.32 (0.2-0.5)	0.808 (0.731-0.871)	
AWGS 2019						
SARC-F	75.93 (62.4-86.5)	73.75 (62.7-83.0)	2.89 (1.9-4.3)	0.33 (0.2-0.5)	0.765 (0.684-0.834)	0.06
SARC-Calf	74.07 (60.3-85.0)	80.00 (69.6-88.1)	3.70 (2.3-5.9)	0.32 (0.2-0.5)	0.808 (0.731-0.871)	
EWGSOP						
SARC-F	60.18 (50.5-69.3)	80.95 (58.1-94.6)	3.16 (1.3-7.7)	0.49 (0.4-0.7)	0.775 (0.695-0.843)	0.01
SARC-Calf	56.64 (47.0-65.9)	90.48 (69.6-98.8)	5.95 (1.6-22.4)	0.48 (0.4-0.6)	0.812 (0.736-0.874)	
IWGS						
SARC-F	66.67 (22.3-95.7)	92.19 (86.1-96.2)	8.53 (3.8-19.4)	0.36 (0.1-1.1)	0.815 (0.739-0.877)	<0.001
SARC-Calf	66.67 (22.3-95.7)	92.19 (86.1-96.2)	8.53 (3.8-19.4)	0.36 (0.1-1.1)	0.836 (0.762-0.894)	

Note. AUC, area under the curve; AWGS, Asian Working Group for Sarcopenia; EWGSOP, European Working Group on Sarcopenia in Older People; IWGS=International Working Group on Sarcopenia; SARC-F=simple 5-item questionnaire for sarcopenia screening; SARC-CalF=SARC-F combined with calf circumference; +LR=positive likelihood ratio; -LR=negative likelihood ratio.

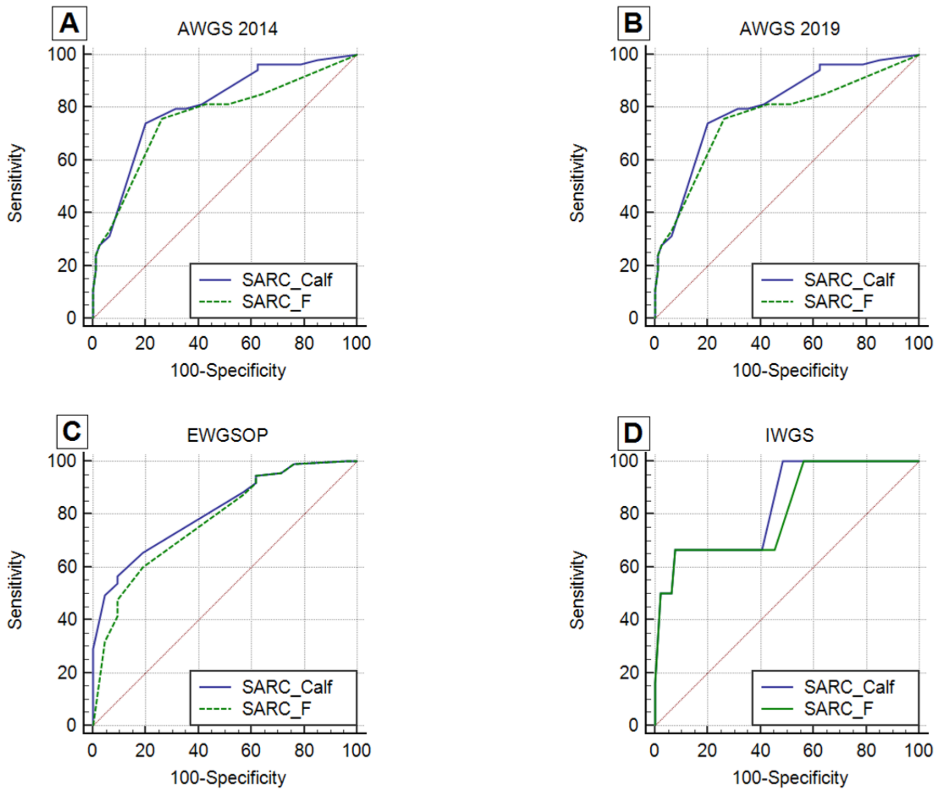

Figure 2. The ROC curves of SARC-F and SARC-CalF against different reference standards in men: (A) AWGS 2014 criteria; (B) AWGS 2019 criteria; (C) EWGSOP criteria; and (D) IWGS criteria

Table 4. Sensitivity/Specificity Analyses and Receiver Operating Curve Models for SARC-F and SARC-CalF Validation against Different Sarcopenia Definitions in Women

	Sensitivity(%)	Specificity(%)	+LR	-LR	AUC	p value
AWGS 2014						
SARC-F	92.65 (83.7-97.6)	21.51 (15.8-28.1)	1.18 (1.1-1.3)	0.34 (0.1-0.8)	0.581 (0.518-0.642)	<0.001
SARC-CalF	91.18 (81.8-96.7)	41.94 (34.8-49.4)	1.57 (1.4-1.8)	0.21 (0.10-0.5)	0.672 (0.611-0.730)	
AWGS 2019						
SARC-F	28.57 (20.2-38.2)	82.55 (75.5-88.3)	1.64 (1.0-2.6)	0.87 (0.8-1.0)	0.583 (0.520-0.645)	<0.001
SARC-CalF	92.38 (85.5-96.7)	40.27 (32.3-48.6)	1.55 (1.3-1.8)	0.19 (0.09-0.4)	0.682 (0.621-0.739)	
EWGSOP						
SARC-F	100.00 (90.3-100.0)	20.64 (15.5-26.6)	1.26 (1.2-1.3)	0.00	0.628 (0.565-0.687)	<0.001
SARC-CalF	97.22 (85.5-99.9)	38.07 (31.6-44.9)	1.57 (1.4-1.8)	0.073 (0.01-0.5)	0.691 (0.630-0.747)	
IWGS						
SARC-F	54.46 (44.2-64.4)	56.21 (48.0-64.2)	1.24 (1.0-1.6)	0.81 (0.6-1.0)	0.580 (0.516-0.641)	<0.001
SARC-CalF	92.08 (85.0-96.5)	39.22 (31.4-47.4)	1.51 (1.3-1.7)	0.20 (0.1-0.4)	0.675 (0.614-0.732)	

Note. AUC, area under the curve; AWGS, Asian Working Group for Sarcopenia; EWGSOP, European Working Group on Sarcopenia in Older People; IWGS=International Working Group on Sarcopenia; SARC-F=simple 5-item questionnaire for sarcopenia screening; SARC-CalF=SARC-F combined with calf circumference; +LR=positive likelihood ratio; -LR=negative likelihood ratio.

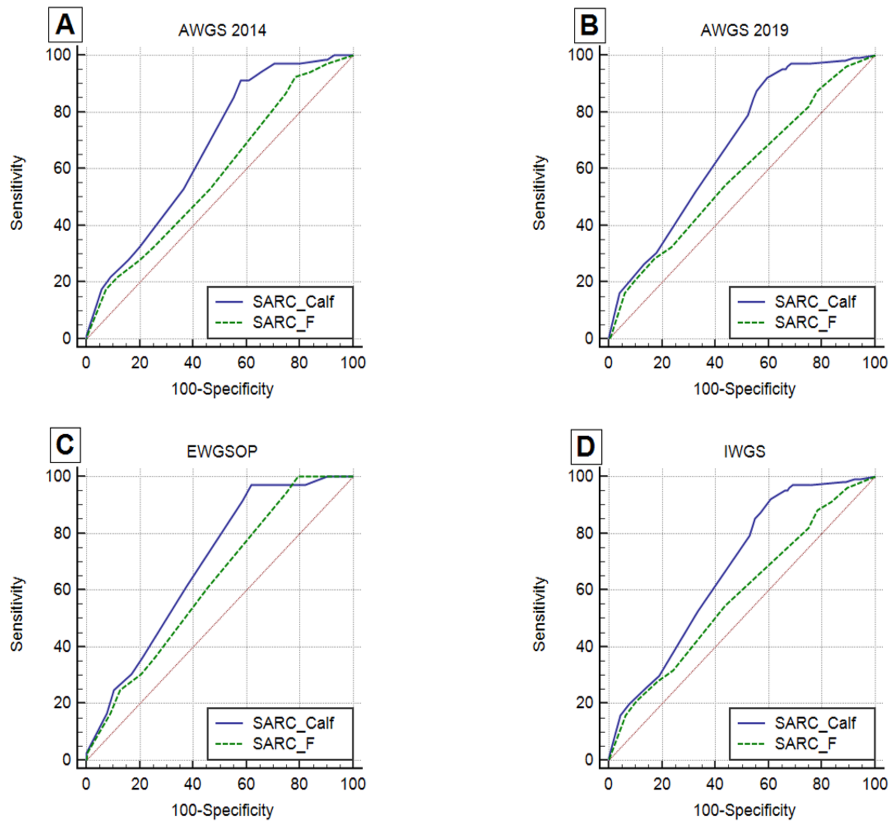

Figure 3. The ROC curves of SARC-F and SARC-CalF against different reference standards in women: (A) AWGS 2014 criteria; (B) AWGS 2019 criteria; (C) EWGSOP criteria; and (D) IWGS criteria

4. Discussion

In older people, sarcopenia profoundly impacts physical function, disability status, quality of life, and healthcare costs. Moreover, it has been strongly associated with mortality rates [24]. Therefore, it is important to accurately diagnose sarcopenia in the elderly. In particular, diagnostic tests of proximal decreasing may be limited by cost, time, and geographical proximity for the elderly living in rural communities [25]; therefore, diagnostic tools are needed to measure proximal decreasing quickly and easily.

In the study of Barbosa-Silva et al. [16], the specificity of SARC-F and SARC-CalF was 84.2% and 82.9%, respectively, and in the study of Yang et al. [25], the specificity was 98.1% and 94.7%, which was higher than the results of this study. This difference might be due to the fact that when the diagnostic criteria become strict, the sensitivity is lowered and the specificity is increased. Also, the time and cost could be reduced by re-testing using diagnostic tools with high sensitivity and low specificity according to the disease characteristics of the older adults, and even if it is diagnosed as a false positive for sarcopenia, it could be benefited by actively coping with sarcopenia in advance [26].

SARC-F screening predicts side-effects related to sarcopenia in the elderly, such as dysfunction, hospitalization, use of emergency care, quality of life, and mortality, and is widely used to support sarcopenia treatment [27-29]. While its diagnostic accuracy and specificity are excellent, the sensitivity is comparatively low, thus increasing the risk of missed diagnoses in patients with sarcopenia [29]. However, the SARC-CalF test appeared to mitigate the low sensitivity of SARC-F [16]. The SARC-CalF test, like its predecessor, is a five-item assessment comprising a series of tests, including muscle strength, assisted walking, rising from a chair, climbing stairs, and falls, but with the addition of a calf circumference measurement [16]. In this study, the sensitivities of the SARC-F and SARC-CalF tests were 79.87% and 83.02%, respectively. Moreover, when using the AWGS criteria as a reference standard, the specificities of SARC-F and SARC-CalF were 41.92% and 53.71%, respectively. In a study by Barbosa-Silva et al. [16] on community-dwelling elderly people, the sensitivities of the SARC-F and SARC-CalF tests were 33.3% and 66.7%, respectively, when the EWGSOP criteria were used as a reference standard. In another report by Yang et al. [25], the sensitivity of the SARC-F and SARC-CalF tests were 29.5% and 60.7%, respectively, according to the AWGS criteria. These findings support those of our research. However, in a study on older people living in Turkish communities [29], the SARC-CalF showed improved specificity and diagnostic accuracy with no difference in sensitivity. This was thought to be because the number of subjects was different, and the criteria for diagnosing sarcopenia based on calf circumference differed in terms of their ancestry and sex. Therefore, the establishment of international standards is necessary, and in the future, research should verify the suitability of the SARC-CalF test in various populations and environments.

Based on the four diagnostic criteria, the prevalence of sarcopenia in rural community-dwelling older adults was 27.6–41.0%. Two other studies on elderly people living in such communities found that the prevalence of sarcopenia was between 11.7–25% and 1.9–9.2% [25,29], respectively. In our study, the characteristics of the subjects resulted in musculoskeletal disorders in various parts of the body, such as the shoulders and hips, due to bending their hips for extended periods of time while working in the fields or during sitting [30]. In fact, their exposure to health promotion as a concept, formal exercise for the purpose of preventing musculoskeletal diseases, and healthcare providers has been minimal due to a lack of infrastructure to assist them in this regard [31]. Sufficient levels of muscle mass and strength are required to maintain proper physical function and to live a healthy and independent life. Decreases in muscle strength lead to a vicious cycle wherein a reduced ability to perform daily activities causes muscles and bones to deteriorate more quickly [32]. In particular, preventive management has been reported to be of great importance, especially because sarcopenia and muscle contraction dysfunctions are related to the aging process and can lead to hospitalization, fractures, and deaths. [33,34]. Therefore, customized interventions for the early detection of sarcopenia among the elderly living in rural areas are required.

The prevalence of sarcopenia, defined as low muscle mass with low hand grip strength and/or slow gait speed, were significantly higher when the AWGS 2019 criteria were applied (40.3% in men and 41.3% in women) than when the AWGS 2014 criteria were applied (40.3% in men and 26.8% in women). This study demonstrated that in rural community-dwelling older adults, the SARC-CalF test had a significantly higher sensitivity and diagnostic accuracy than did SARC-F when diagnosing sarcopenia according to the AWGS 2019 guidelines [35]. These findings are similar to those of previous studies that used the AWGS 2014 and EWGSOP diagnostic criteria [15,16].

Typically, muscle mass is measured by dual-energy X-ray absorptiometry (DEXA), computed tomography, magnetic resonance imaging, and bioelectrical impedance analysis (BIA). BIA is calculated by dividing the appendicular skeletal muscle mass (ASM) by the square of the height [36] or weight and multiplying the result by 100 [37]. BIA is widely used because it is a safe and cost-effective method for preventing radiation exposure and measuring body composition [38]. In our study, muscle mass was calculated by dividing the quantity of ASM by the square of the height, meaning that muscle mass, strength, and function were taken into account in all sarcopenia diagnoses. Therefore, it is difficult to accurately compare the two studies, as the methods of measuring muscle mass and the method of applying the variable to diagnose sarcopenia are different.

In general, an AUC greater than 0.9 is indicative of a high level of accuracy, a result between 0.7–0.9 represents a moderate level of accuracy, and a low accuracy is an AUC between 0.5–0.7, and a chance result is any result lower than 0.5 [39]. In this study, the AUC of the SARC-F test was 0.645 (95% CI 0.595–0.693), and the AUC of the SARC-CalF test was 0.725 (95% CI 0.678–0.769) as per the AWGS 2019 criteria ($p <$ 0.001). We found that, although the AUC was not particularly high, it was higher in the SARC-CalF test than in the SARC-F test when using all of the criteria except for those of the EWGSOP. These findings reflected those of previous research [16,25,29]. Our study observed a slightly lower level of accuracy because the participants were older and from different regions. These factors are thought to have affected the accuracy of the results, as older people visiting hospitals usually have at least one source of physical discomfort. Therefore, additional research is needed to address this confounding variable and its impact on accuracy.

The study was conducted with a limited number of participants, all of whom were older adults living in rural Korea. Therefore, our findings may have limited possibilities for generalization; however, this study confirms that the diagnosis of muscle sarcopenia can be effectively made without the use of X-ray imaging, using muscle mass measurements made with a BIA device. Since our participants live in a rural community, BIA is more practical and less expensive than X-ray (to which exposure can be harmful), computed tomography, magnetic resonance imaging, or DEXA [40-42]. In addition, BIA has been proven to be comparable to DEXA in terms of accuracy [43] and is recommended by the EWGSOP and AWGS as an alternative option for measuring muscle mass. Regarding the ability to generalize the results from this particular community, care should be taken when comparing our findings to those of residents of special nursing homes, other rural communities, and urban areas. In the future, research should be conducted to confirm the validity of these screening tests in community-dwelling older adults from various regions.

5. Conclusions and Implications

In conclusion, our findings suggest that the SARC-F and SARC-CalF tests showed adequate specificity and diagnostic accuracy. The SARC-CalF test showed better sensitivity than did the SARC-F test when diagnosing sarcopenia in rural community-dwelling older adults. Moreover, the SARC-CalF test had significantly better sensitivity and overall diagnostic accuracy than did the SARC-F for screening sarcopenia in this population. Hence, the SARC-CalF test may serve as a rapid screening tool for sarcopenia in this community. Further studies are needed to verify this finding in different populations.

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Competing interests

The authors declare that they have no competing interests.

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