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Original Research

Accuracy of SARC-F, SARC-CalF, and Ishii Test in Assessing Severe Sarcopenia in Older Adults in Nursing Homes

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Abstract

OBJECTIVES: We aimed to assess the comparative accuracy of using SARC-F, as well as the SARC-F in tandem with calf circumference (SARC-CalF) and Ishii test, to screen severe sarcopenia in older adults residing in nursing homes.

METHOD: In this cross-sectional study, the AWGS2019 criteria were used as diagnostic standards. We adopted an "exclusion" screening test, focusing on sensitivity and the negative predictive value (NPV) combined with AUC, to assess the accuracy of the screening tools.

RESULTS: We studied 199 people aged 60 and older, of whom 67 (33.7%) had severe sarcopenia, including 40 males (41.2%) and 27 females (26.5%). Among all participants, the sensitivities and NPV of SARC-F, SARC-CalF, and Ishii test were 85.1%/0.88, 68.7%/0.82, and 89.6%/0.94, respectively. For males, the SARC-F, SARC-CalF, and Ishii test sensitivities and NPV were 77.5%/0.78, 47.5%/0.7, and 85%/0.88, respectively. Among females, the SARC-F, SARC-CalF, and Ishii test sensitivities and NPV were 74.1%/0.9, 81.5%/0.92, 96.3%/0.99, respectively. There were no statistical differences between the AUCs of SARC-F or SARC-CalF for all participants or for the male or female groups; however, in terms of the AUC, the Ishii test was superior compared with the other two screening methods.

CONCLUSION: The Ishii test is more suitable for screening severe sarcopenia in older adults in nursing homes compared to SARC-F and SARC-CalF, and 130 points are recommended as the cut-off value of the Ishii test for screening severe sarcopenia.

Key words: Older adults, severe sarcopenia, SARC-F, SARC-CalF, Ishii, nursing home.

Introduction

Severe sarcopenia was formally defined in the AWGS2019 consensus update. A diagnosis of severe sarcopenia is considered if a person has decreased muscle mass along with decreased muscle strength and function (1). The prevalence of severe sarcopenia ranged from 0.2% to 34.4% in 34 studies that collated severe sarcopenia data (2). Studies showed severe sarcopenia to be an independent predictor of survival in patients with gastric cancer and esophageal cancer (3-4). Another study showed patients with severe sarcopenia had the highest risk of all-cause mortality and respiratory disease (5). Therefore, the recognition of severe sarcopenia is very important.

Currently, a diagnosis of severe sarcopenia requires special equipment, such as magnetic resonance imaging (6), dual x-ray absorptiometry (7), bioelectrical impedance analysis (8), and computer tomography (9). However, these devices are expensive, require specialized personnel to operate them. Due to limited government subsidy funds, most nursing homes can only meet the basic daily life of the elderly and typically do not possess the above expensive equipment and professional medical and technical personnel. In conclusion, there is a need to explore simple, operable, and inexpensive alternative methods for screening for severe sarcopenia that can be used in nursing homes.

At present, the most common methods for screening sarcopenia primarily involve the SARC-F, SARC-CalF, and Ishii test. SARC-F is a commonly used screening questionnaire (10), which typically includes five items; however, the sensitivity of SARC-F is low. In order to improve its sensitivity, researchers developed the SARC-CalF screening scale (11). SARC-CalF is a measurement of calf circumference (CC) and results are then combined with SARC-F. The Ishii test uses a calculation based on the measured CC, age, sex, and grip strength to provide a score that has high sensitivity and specificity (12). However, there have been no studies conducted into the accuracy of using SARC-F, SARC-CalF, and Ishii test to detect severe sarcopenia in nursing homes. Therefore, building on existing studies, we evaluated the accuracy of the three tests to ascertain if these tools are appropriate for screening severe sarcopenia in older adults in nursing homes.

Methods

Study design and patient recruitment

Senior adults (≥60 years) from two nursing homes in Zigong, Sichuan province, China, were included. The exclusion criteria omitted people with severe cognitive dysfunction or severe visual or hearing impairments that limit cooperation; acute exacerbations of chronic diseases, such as acute exacerbation of chronic obstructive pulmonary disease (AECOPD) and acute coronary syndrome; patients with NYHA grade III-IV chronic heart failure; those in long-term bed rest or complete disability; those who had received surgery to the legs, feet, or hands in the previous 3 months; people taking diuretics (with the exception of diuretics used to treat hypertension and where the dose had

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Table 1. Characteristics of the Study Population

Characteristics	Non-severe sarcopenia (n=132)	Severe sarcopenia (n=67)	P
Sex,n(%)			0.028
male	57(58.8)	40(41.2)	
female	75(73.5)	27(26.5)	
Age, year, mean(SD)	71.17(8.54)	79.07(9.04)	<0.001
BMI, kg/m^2, mean(SD)	24.09(3.87)	22.22(4.08)	0.002
Handgrip strength, kg, mean(SD)	24.61(6.91)	17.43(5.12)	<0.001
Gait speed, m/s, median	1	0.6	<0.001
ASMI, kg/m^2, mean(SD)	6.16(0.88)	5.54(0.88)	<0.001
SARC-F score, median	1	4	<0.001
SARC-CalF score, median	10	13	<0.001
Ishii test, mean(SD)	102.61(34.23)	152.92(26.31)	<0.001

Note:ASMI:appendicular skeletal muscle mass index;SARC-F:strength, assistance in walking, rising from a chair, climbing stairs, and falls;SARC-CalF:SARC-F combined with calf circumference

been stable for at least 21 days); or those with other disorders or diseases deemed unsuitable for the study by the investigator. The study design was in line with the Declaration of Helsinki, and the Institutional Review Board of the Zigong Medical Foundation (IRB number: 20191001) approved the protocol. All participants or their legal guardians provided written informed consent.

Measurement of muscle mass

The use of an Inbody 770 Body Composition Analyser (Inbody 770, Biospace China Inc.) allowed us to evaluate muscle mass. The values for appendicular skeletal muscle mass (ASM) and the amount of leg and arm muscle were used together with height to calculate the ASM index (ASMI) (kg/m^2) (1).

Measurement of muscle strength

We evaluated handgrip strength using a digital grip-strength dynamometer (Camry EH101, Camry, El Monte, CA, USA). After performing measurements on each hand, the maximum measurement was chosen for further analysis.

Measurement of physical performance

The walking speed over a 6-m distance was determined to 0.01 s. The average of two assessments was used. We set up an 8-m direct linear area, with yellow markings to show the beginning, 1st meter, 7th meter, and 8th meter. Senior adults were asked to walk from the beginning of this track to the 8th meter mark at normal speed, and experimental timing commenced at the 1 m mark (end of 0-1 m yellow track) and ended at the 7th meter (beginning of 7-8 m yellow track).

Additional measurements

The averages of two CC, height, and weight measurements were used for analysis. These values were expressed in cm (0.1 cm).

Definition of severe sarcopenia

Severe sarcopenia was defined using the 2019AWGS criteria: ASMI < 7.0 kg/m^2, grip strength < 28 kg, and walking speed < 1.0 m/s in males; and ASMI < 5.7 kg/m^2, grip strength < 18 kg, and walking speed < 1.0 m/s in females.

Statistical analyses

SPSS 23.0 (IBM Corp, NY, USA) software was utilized for all analyses. A two-sided $P < 0.05$ was the threshold of significance. Categorical variables are represented as numbers (percentages). When continuous variable data conformed to a normal distribution, they are expressed as mean ± SD; otherwise, the median is used. Various tests, including rank-sum, Pearson's chi-square, and Student's t-test, were implemented for comparison of the baseline features. In this study, we adopted an "exclusion" screening test (focusing on sensitivity and NPV) combined with area under the ROC curve(AUC) to assess the accuracy of screening tools. The area AUC was employed as a measure of the precision of the screening tools used to determine severe sarcopenia; differences across the ROC curves were examined using the DeLong method (13). We used the maximum Youden index to confirm the critical values for the above three screening tools for severe sarcopenia. The Youden index was calculated as the sum of the specificity and sensitivity of the diagnostic trial minus the base value of 1 (or 100 %) and represented the overall ability of the diagnostic tool to detect true positives and true negatives. The higher the Youden index value, the higher the overall ability of the screening tool to detect true patients versus non-patients. Then, we evaluated the corresponding specificity, sensitivity,

Table 2. Sensitivity/Specificity Analyses and ROC Models for SARC-F and SARC-CalF and Ishii test Against the AWGS 2019 Criteria for severe sarcopenia

	Sensitivity,%	Specificity, %	PPV	NPV	AUC
Total					
SARC-F≥2	85.1	55.3	0.49	0.88	0.754(0.685-0.822)[c]
SARC-Calf≥12	68.7	72	0.55	0.82	0.744(0.67-0.817)[c]
Ishii test≥130	89.6	83.3	0.73	0.94	0.891(0.845-0.937)[ab]
Male					
SARC-F≥2	77.5	54.4	0.54	0.78	0.676(0.568-0.783)[c]
SARC-Calf≥13	47.5	84.2	0.68	0.7	0.681(0.572-0.790)[c]
Ishii test≥130	85	77.2	0.72	0.88	0.829(0.746-0.911)[ab]
Female					
SARC-F≥4	74.1	85.3	0.65	0.9	0.859(0.785-0.934)[c]
SARC-Calf≥12	81.5	73.3	0.52	0.92	0.830(0.738-0.921)[c]
Ishii test ≥130	96.3	88	0.74	0.99	0.947(0.906-0.988)[ab]

Note: a. Significantly different relative to the SARC-F. b. Significantly different relative to the SARC-CalF. c. Significantly different relative to the Ishii test.

positive predictive value (PPV), and negative predictive value (NPV).

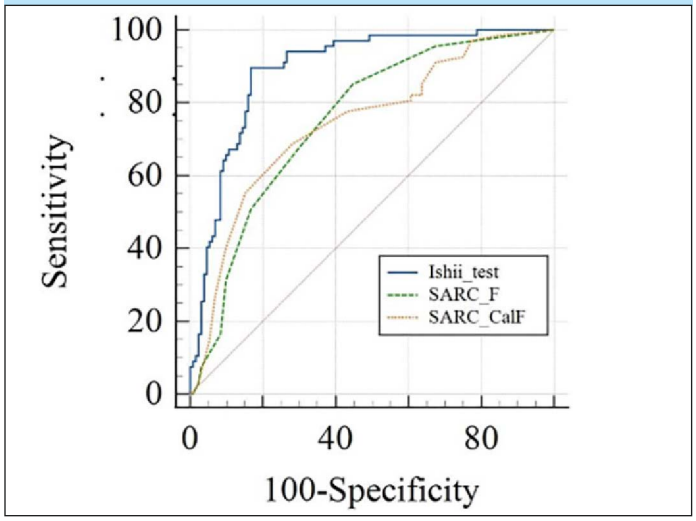
Results

We included 199 people aged 60 and older, of whom 102 were female and 97 were male. There were 67 older adults (33.7%) with severe sarcopenia, including 40 males (41.2%) and 27 females (26.5%). The prevalence of severe sarcopenia in males was higher than that in females, and the difference was statistically significant. There were statistically significant differences in age, BMI, gait speed, hand-grip strength, ASMI, SARC-F score, SARC-CalF score, and Ishii test score between the severe and non-severe sarcopenia groups, as shown in Table 1.

Among all participants, the SARC-F had an upper Youden index value of 2, and the sensitivity/NPV was 85.1%/0.88. The SARC-CalF had a maximum Youden index value of 12, and sensitivity/NPV was 68.7%/0.82. The Ishii test had an upper Youden index value of 130, and sensitivity//NPV was 89.6%/0.94. The AUCs for the SARC-F, SARC-CalF, and Ishii test were 0.754 (95% CI, 0.685-0.822), 0.744 (95% CI, 0.67-0.817), and 0.891 (95% CI, 0.845-0.937), respectively (Table 2). In order to further analyze whether there are differences in the accuracies of the above three tools for screening sarcopenia in males and females, we further analyzed the data according to gender stratification.

Among males, the SARC-F had an upper Youden index value of 2, and sensitivity/NPV was 77.5%/0.78. The SARC-CalF maximum Youden index value was 13, and the sensitivity/NPV was 47.5%/0.7. The Ishii test had an upper Youden index value of 130, and the sensitivity/NPV was 85%/0.88. The AUCs of the SARC-F, SARC-CalF, and Ishii test were 0.676 (95% CI, 0.568-0.783), 0.681 (95% CI, 0.572-0.790), and 0.829 (95% CI, 0.746-0.911), respectively. In females, the SARC-F yielded a maximum Youden index of 4, and the sensitivity/NPV was 74.1%/ 0.9. The SARC-CalF had an upper Youden index value of 12, and the sensitivity/NPV was 81.5%/0.92. The Ishii test yielded an upper Youden index value of 130, and the sensitivity/NPV was 96.3% /0.99. The AUCs of the SARC-F, SARC-CalF, and Ishii test were 0.859 (95% CI, 0.785-0.934), 0.830 (95%CI, 0.738-0.921), and 0.947 (95% CI, 0.906-0.988), respectively (Table 2). There were no statistical differences between the AUCs of SARC-F and SARC-CalF, either for all participants or for the male or female groups; however, in terms of the AUC, the Ishii test was superior compared with the other two screening methods (Figures 1-3).

Figure 1. The ROC curves of SARC-F, SARC-CalF,and Ishii test in the total study population



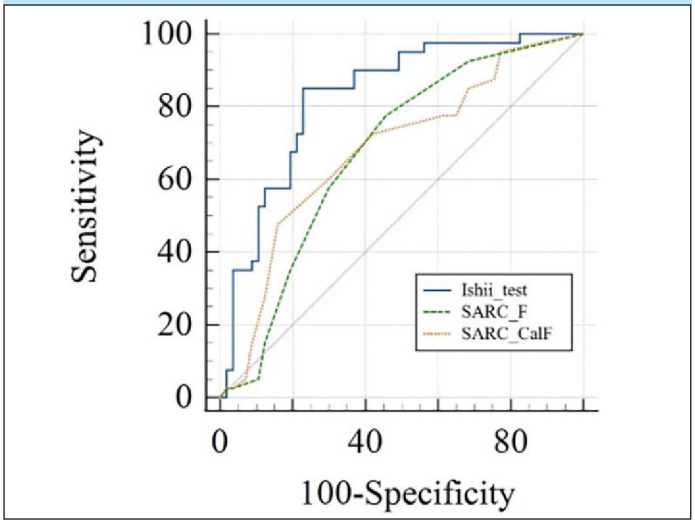
Youden index value: SARC-F=2; SARC-CalF=12; Ishii test=130

Discussion

This is the first time that the performances of SARC-F, SARC-CalF, and Ishii test screening methods for severe

sarcopenia have been examined in nursing homes based on the AWGS2019 consensus criteria. This study helps to complete the records on the accuracy of the three tests for severe sarcopenia screening in nursing homes. Our study showed the prevalence of severe sarcopenia in older adults in nursing homes was 33.7%, within the range reported in previous studies (2). However, our study showed a higher prevalence of severe sarcopenia in males than females, which differs from other research results (2). This difference may be due to inconsistencies in the inclusion criteria for the population or in the criteria used for severe sarcopenia.

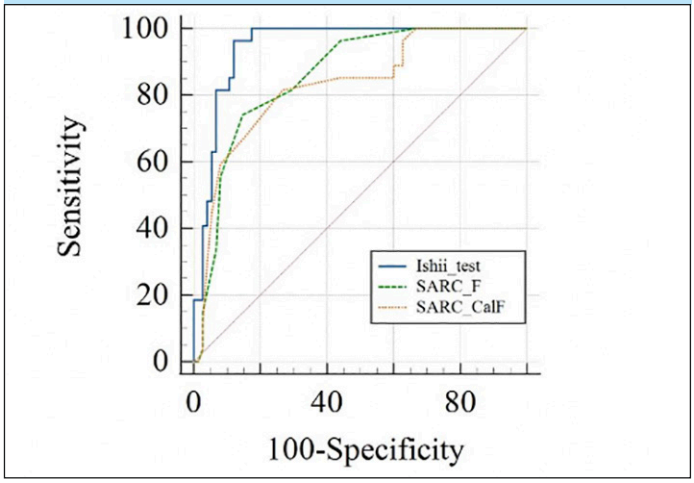
Figure 2. The ROC curves of SARC-F, SARC-CalF,and Ishii test in the males study population



Youden index value: SARC-F=2, SARC-CalF=13, Ishii test=130

In this study, we adopted an "exclusion" screening test (focusing on sensitivity and NPV) combined with AUC to assess the accuracy of the screening tools. Usually, AUC values greater than 0.8 indicate good predictive ability (14). The AUC of the Ishii test was higher than 0.8 for all participants and the male and female groups, and the AUC of the Ishii test was the highest among the screening tools. At the same time, for all participants and for males or females, the Ishii test had the highest sensitivity and NPV. Therefore, the Ishii test is suitable for screening for severe sarcopenia in nursing homes, both for the total population and separate male or female populations. The Ishii test was designed by Shinya Ishii and colleagues using European Working Group on Sarcopenia in older People criteria (12). The test, which assesses individuals for sarcopenia, involves imputing objective data on age (years), grip strength (kg), and CC (cm) into a mathematical equation. Previous studies of this screening tool have shown that it is effective for screening for sarcopenia (12, 15-17), and our research also showed it has high accuracy for severe sarcopenia diagnosis. In addition, its operation is simple and objective, thus it is worth recommending as a tool suitable for nursing homes. For females, the AUC values for SARC-F and SARC-CalF were both > 0.8. SARC-F and SARC-CalF both had high sensitivity and NPV and, hence, are effective methods of screening for severe sarcopenia in older females residing in nursing homes. However, the results of SARC-F and SARC-CalF were not ideal when screening males with severe sarcopenia. This difference may be due to differences in body muscle mass and body strength between men and women. On the other hand, men and women have different subjective feelings and provide different answers to subjective items.

Figure 3. The ROC curves of SARC-F, SARC-CalF, and Ishii test in the females study population



Youden index value: SARC-F=4; SARC-CalF=12; Ishii test=130

Previous studies have shown that SARC-F has low sensitivity as a screen for sarcopenia (18-19); however, our results showed that SARC-F has high sensitivity for detecting severe sarcopenia. SARC-F includes five components: strength, assistance walking, rising from a chair, climbing stairs, and falls, which are closely related to muscle strength and function. When older adults have non-severe sarcopenia, their muscle strength or function is decreased in one direction, and there may be only a few items that are awarded points. When both muscle strength and physical function decrease in the older adults, their condition progresses from non-severe sarcopenia to severe sarcopenia, their SARC-F score is further elevated, and the patient is more easily identified.

Our study had several limitations. Firstly, the sample size was small, and a larger cohort is required to confirm the outcomes. Secondly, we conducted the study in two similar nursing homes; therefore, the results may not be generalizable to other types of nursing homes. In our next study, we will include more types of nursing homes for analysis and validation. Thirdly, the population encompassed patients in nursing homes, and the results may not be suitable for screening other older adults in the community.

Conclusion

The Ishii test is suitable for screening severe sarcopenia in older adults in nursing homes compared to SARC-F and SARC-CalF, and 130 points are recommended as the cut-off value of the Ishii test for screening severe sarcopenia.

Declaration of conflicting interest: The authors declare that there are no conflicts of interest.

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Ethical standards: The study was conducted in accordance with the Declaration of Helsinki and the Institutional Review Board of Zigong Medical Foundation approved the study design protocol (IRB number:20191001).

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