J. Phys. Ther. Sci. 33: 241–245, 2021

The Journal of Physical Therapy Science

Original Article

Changes in the screening efficacy of lower calf circumference, SARC-F score, and SARC-CalF score following update from AWGS 2014 to 2019 sarcopenia diagnostic criteria in community-dwelling older adults

Akihiro Ito, RPT[1)*], Masahiro Ishizaka, RPT[1)], Kaoru Kobayashi, RPT[1)], Yohei Sawaya, RPT[1)], Tsuyoshi Hara, RPT[1)], Yoshihisa Nagasaka, RPT[1)], Akihiro Yakabi, RPT[1)], Miyoko Watanabe, RPT[1)], Akira Kubo, RPT[1)]

[1)] *Department of Physical Therapy, School of Health Science, International University of Health and Welfare: 2600-1 Kitakanemaru, Otawara-shi, Tochigi 324-8501, Japan*

Abstract. [Purpose] To identify changes in the efficacy of the Asia Working Group for Sarcopenia (AWGS) screening tools and the differences between the different screening tools following the updates from the AWGS 2014 to 2019 criteria for community-dwelling older adults. [Participants and Methods] We included 139 community-dwelling older adults aged ≥65 years. We assessed the lower calf circumference, SARC-F score, SARC-CalF score, skeletal muscle mass, grip strength, and gait speed. Moreover, we investigated the sensitivity, specificity, likelihood ratios, and area under the ROC curve of the lower calf circumference, SARC-F score, and SARC-CalF score using the AWGS 2014 and 2019 criteria for sarcopenia diagnosis. [Results] The prevalences of sarcopenia were 10.8% and 12.9%, and 5.0% using the AWGS 2014 and 2019, and 2019 severe sarcopenia diagnostic criteria, respectively. Using AWGS 2014 criteria, the sensitivity and specificity of lower calf circumference, SARC-F score, and SARC-CalF score, were 86.7% and 62.1%, 13.3% and 91.9%, and 66.7% and 80.6%, respectively. Using AWGS 2019 criteria, the sensitivity and specificity of lower calf circumference, SARC-F score, and SARC-CalF score were 83.3% and 62.8%, 11.1% and 91.7%, and 66.7% and 81.8%, respectively. Using AWGS 2019 severe sarcopenia criteria, the sensitivity and specificity of lower calf circumference, SARC-F score, and SARC-CalF score were 100% and 59.8%, 14.3% and 91.7%, and 71.4% and 78.0%, respectively. [Conclusion] All screening tools used in AWGS 2014 and 2019 were similar in terms of efficacy; however, the AWGS 2019 severe sarcopenia criteria had different characteristics.

Key words: Sarcopenia, Screening, Community-dwelling older adults

(This article was submitted Oct. 12, 2020, and was accepted Dec. 7, 2020)

INTRODUCTION

Sarcopenia has been proposed as a term for the age-related loss of skeletal muscle mass[1)]. Subsequent reports suggested that muscle strength was significantly reduced compared to skeletal muscle mass, and that the reduction in muscle strength was associated with functional disability and death[2–4)]. The European Working Group on Sarcopenia in Older People (EWGSOP) currently reported an increase in the number of people with altered grip strengths and walking speeds. The concept is defined to include poor physical performance[5)]. Following the EWGS report, the International Working Group on Sarcopenia[6)], the Asian Working Group for Sarcopenia (AWGS)[7)], and the United States Foundation of National Institutes

*Corresponding author. Akihiro Ito (E-mail: i.akihiro@iuhw.ac.jp)

of Health[8] developed region-specific standards, including race, for the evaluation of sarcopenia in the elderly. In 2018, the EWGS updated its definition[9], and the AWGS followed suit in 2019[10]. The AWGS 2019 established a definition of severe sarcopenia, and reviewed the evaluation indicators. The use of AWGS criteria is currently recommended for sarcopenia diagnosis in Japan.

The community-based diagnosis of sarcopenia involves patients who are unknowingly living with sarcopenia or pre-sarcopenia. In order to detect, maintain, and improve sarcopenia at an early stage, it is important to select an easily-measurable and clinically-validated screening index. AWGS 2019 includes lower calf circumference, SARC-F score, and SARC-CalF score as screening tools for sarcopenia diagnosis. Lower calf circumference can be measured using a measuring tape; moreover, it varies with skeletal muscle strength, body size, and nutritional status[11]. The SARC-F is a questionnaire designed to diagnose sarcopenia using simple questions on muscle function that eliminate need for muscle mass measurement[12]. The SARC-CalF was created to improve the abovementioned screening effect by adding the lower calf circumference to the SARC-F score and relating it to anthropometric measurements[13].

A previous study on sarcopenia screening in community-dwelling older adults in China, compared the sensitivity of SARC-F score and SARC-CalF score using AWGS 2014 criteria[14].

The results of this study showed a greater sensitivity of the SARC-CalF score compared to that of the SARC-F score. However, the change in efficacy of each tool with the update from AWGS 2014 to 2019 criteria remains unclear. Moreover, the method of comparison of the three sarcopenia screening tools, including the SARC-CalF score, SARC-F score, and lower calf circumference, remain unelucidated.

Given the need for adjusting future screening tests and developing new screening tools, we aimed to evaluate and compare the changes in the efficacy of the three sarcopenia screening tools following the update from AWGS 2014 to 2019 criteria, in a community-based elderly population in Japan.

PARTICIPANTS AND METHODS

We conducted a cross-sectional study on community-based elderly people aged at least 65 years. They were recruited through publicity organized by the Ohtawara city authorities, Tochigi Prefecture, and voluntarily participated in a long-term care prevention project sponsored by the city in the 2019 fiscal year. We excluded participants who were unable to complete the questionnaire unaided, were unable to walk, and had factors that precluded assessment by the impedance method, such as the presence of a cardiac pacemaker or joint prosthesis. The study was explained to the participants, after which, they gave their written informed consent. This study was conducted with the approval of the Ethics Review Committee of the International University of Health and Welfare (Approval No. 18-Io-158).

Grip strength was measured in the standing position using a Smedley-type grip strength meter (Digital Grip Force Transducer Grip D-TKK5401, Takei Instrument Co). The grip strength was measured for the left and right upper limbs, and the higher measured value was considered as the definitive grip strength value. A 4-meter walk and 2-meter runway were prepared, and participants walked at a normal speed. The skeletal muscle mass index (SMI) was calculated using the formula SMI=limb muscle mass (kg) / (height [m])^2. The limb skeletal muscle mass was measured using the bioelectrical impedance analysis (BIA) method with a multi-frequency body composition analyzer (MC-780A, Tanita).

Lower calf circumference was measured in the sitting position using a measuring tape. The greatest lower calf bulge was measured twice, and the higher of the two values was used. SARC-F is a 5-point questionnaire consisting of strength, assistance in walking, rising from a chair, climbing stairs, and falls. Each item has a score range of 0 to 2, giving a total score range of 0 to 10. The Japanese version of the SARC-F was used in this study, and the participants filled out the form. SARC-CalF added the lower calf circumference to the SARC-F components. The SARC-CalF score was calculated by adding 10 points to the SARC-F score when the lower calf circumference was below the cutoff value.

Sarcopenia was diagnosed if the lower calf circumference was <34 cm in males and 33 cm in females, if the SARC-F score was at least 4/10, or if the SARC-CalF score was at least 11/20. The 2014 and 2019 AWGS criteria were used for the definitive diagnosis of sarcopenia.

According to the 2014 AWGS criteria, sarcopenia was diagnosed if the grip strength was <26 kg in males and <18 kg in females, or if the gait speed was <0.8 m/s. Moreover, SMI was measured by BIA, and sarcopenia was diagnosed if SMI was <7.0 kg/m^2 in males and <5.7 kg/m^2 in females. The 2019 AWGS criteria for sarcopenia diagnosis were as follows: muscle strength <28 kg for males and <18 kg for females with grip strength or physical function <1.0 m/s of walking speed and SMI <7.0 kg/m^2 for males and <5.7 kg/m^2 for females. Low SMI, low muscle mass index, and low physical function were diagnosed as severe sarcopenia.

The sensitivity, specificity, positive likelihood ratio, and negative likelihood ratio were calculated from each screening result for sarcopenia diagnosis. Multinomial logistic regression analysis was used to calculate the area under the receiver operating characteristic (ROC) curve (AUC) of each screening test based on the presence or absence of sarcopenia.

Statistical analysis was performed using SPSS Statistics version 25.0 for Windows (IBM Corp., Armonk, NY, USA), and the significance level was set at 0.05.

Table 1. The nature of screening for each sarcopenia diagnostic criterion

		Sensitivity (%)	Specificity (%)	Positive likelihood ratio	Negative likelihood ratio	AUC (95%IC)
AWGS2014	Calf circumference	86.7	62.1	2.3	0.2	0.56 (0.43–0.70)
	SARC-F	13.3	91.9	1.7	0.9	0.50 (0.34–0.67)
	SARC-CalF	66.7	80.6	3.4	0.4	0.51 (0.36–0.67)
AWGS2019	Calf circumference	83.3	62.8	2.2	0.3	0.60 (0.47–0.73)
	SARC-F	11.1	91.7	1.3	0.9	0.50 (0.36–0.65)
	SARC-CalF	66.7	81.8	3.7	0.4	0.53 (0.40–0.67)
AWGS2019 severe	Calf circumference	100.0	59.8	2.5		0.81 (0.73–0.88)
	SARC-F	14.3	91.7	1.7	0.9	0.70 (0.48–0.93)
	SARC-CalF	71.4	78.0	3.3	0.4	0.86 (0.76–0.95)

RESULTS

We included 139 participants (25 males and 114 females), with age, height, and weight 76.7 ± 6.6 years, 151.9 ± 8.5 cm, and 54.1 ± 9.8 kg, respectively. The prevalences of sarcopenia calculated using the AWGS 2014 and 2019, and 2019 severe sarcopenia criteria were 10.8% and 12.9%, and 5.0%, respectively. The characteristics of the screening tests (sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, and AUC) for each criterion are shown in Table 1. Lower calf circumference had the highest sensitivity (range, 80–100%) and the lowest specificity (range, 50–60%). For SARC-F, sensitivity was low in the 10th percentile whereas specificity was high in the 90th percentile. The sensitivity of the SARC-CalF score was higher than that of the SARC-F score (range, 60–70%), whereas the specificity of the SARC-CalF score was higher than that of the lower calf circumference (range, 70–80%). A comparison of AWGS 2014 and 2019, and 2019 severe sarcopenia criteria showed that the AWGS 2019 had a higher sensitivity and a lower specificity than those of the lower calf circumference and SARC-CalF score. Positive likelihood ratios ranged from 1 to 4, whereas negative likelihood ratios ranged from 0.2 to 0.9. The AUC ranged from 0.5 to 0.6 and 0.7 to 0.9, respectively, for the AWGS 2014 and 2019 criteria for severe sarcopenia (Fig. 1).

DISCUSSION

We compared the change in efficacy of the screening tools—lower calf circumference, SARC-F score, and SARC-CalF score—with the update of sarcopenia criteria from AWGS 2014 to 2019 in community-dwelling older adults.

First, the prevalences of sarcopenia in community-dwelling older adults included in this study were 10.8% and 12.9%, and 5.0% using the AWGS 2014 and 2019, and 2019 severe sarcopenia criteria, respectively. This was slightly higher than the prevalence of 8.6% among elderly females living in a Japanese community as reported by Kusama et al.[15] using the AWGS 2014 criteria. This was probably because the mean age of the participants in our study was higher than that of those in the previous study (73.1 years for the non-sarcopenia group and 75.0 years for the sarcopenia group). Moreover, our survey was conducted in a rural area (population density 207 people/km^2), whereas their study was conducted in an urban area (population density 12,224 people/km^2).

There was no significant change in the sensitivities of the three screening tools using the AWGS 2014 and 2019 criteria; however, the AWGS 2019 criteria showed a slight decrease in the sensitivity of the lower calf circumference and SARC-F score. Conversely, there was an increase in sensitivity and a decrease in specificity of the lower calf circumference and SARC-CalF score using the AWGS 2019 criteria of severe sarcopenia, which was different when the AWGS 2014 and 2019 criteria were used. Severe sarcopenia is a newly defined criterion in the AWGS 2019, and is one in which muscle strength, physical function, and muscle mass are all reduced. In AWGS 2019 criteria for severe sarcopenia, there was a significant increase in the sensitivity of the lower calf circumference, and a mild increase in the sensitivity of SARC-CalF score, suggesting that the inclusion of the lower calf circumference may be important in screening for severe sarcopenia. This new finding shows the importance of lower calf circumference measurement in severe sarcopenia screening.

Regarding the sensitivity and specificity of each screening method, Kawakami et al.[16] and Kusama et al.[15] reported a high specificity for calf circumference using similar criteria (<34 cm for males and <33 cm for females). However, the results of the previous research differed from those of previous studies. Lower calf circumference has been reported to reflect skeletal muscle mass and nutritional status; however, it can neither be used to assess muscle quality nor exclude the effects of adipose tissue and edema[17, 18]. Moreover, the difference in the sensitivity of the lower calf circumference might have been because the lower calf circumference measurement was performed in the sitting position in the previous study, whereas in previous studies, it was performed in the standing or supine position.

The SARC-F score was developed by Malmstrom et al.[12] in 2013 for easy and rapid sarcopenia diagnosis. Moreover, Ida

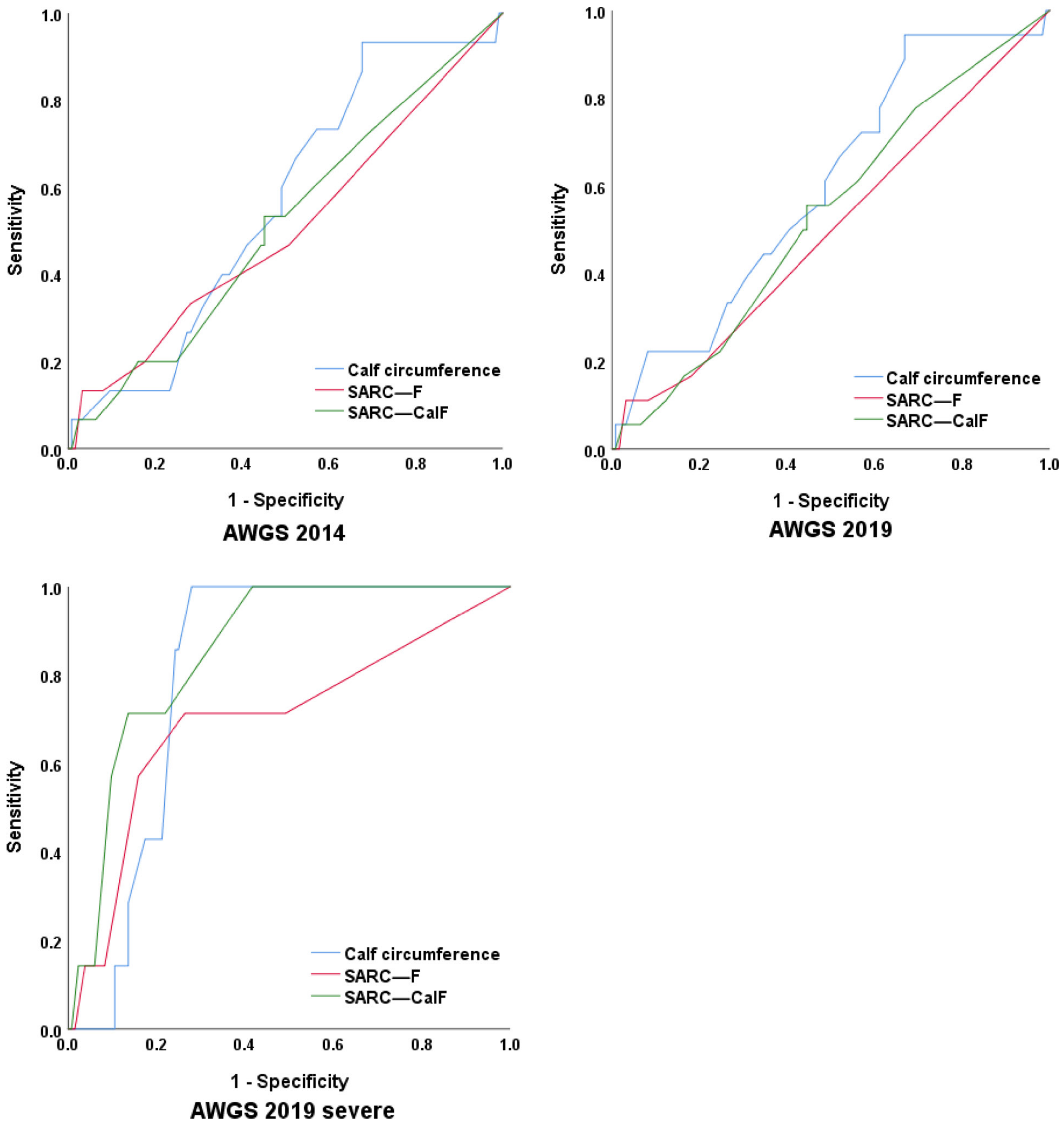

Fig. 1. ROC curves of calf circumference, SARC-F score, SARC-CalF score for AWGS 2014 and 2019 and 2019 severe sarcopenia criteria.

et al.[19] and Tanaka et al.[20] developed a Japanese version.

Screening with the SARC-F score both in Japan and abroad has been reported to have a low sensitivity and high specificity[21, 22], which is in line with the findings of the present study.

The SARC-CalF score was developed as a means of compensating for the low sensitivity of the SARC-F score by incorporating the lower calf circumference[14]. Akin to previous study findings, the present study showed an increase in sensitivity compared to that of the SARC-F score.

Concerning the likelihood ratios, the positive and negative likelihood ratios were neither >10 nor <0.1, respectively.

With respect to the AUC, the predictive power was low in AWGS 2014 and 2019 criteria, ranging from 0.5 to 0.6, which was similar to that in previous studies[21, 23]. The predictive power of the AUC was moderate, ranging from 0.7 to 0.9, in AWGS 2019 criteria for severe sarcopenia diagnosis.

The limitations of this study are as follows. First, the number of participants was relatively small. Second, participants actively participated in long-term care insurance projects and, therefore, were able to maintain physical function. Third, the study was conducted in a part of Japan. Fourth, the lower calf circumference measurement was neither able to assess muscle quality nor exclude the effects of adipose tissue and edema. Lastly, we were unable to examine the effects of different measurement limb positions on sarcopenia screening. Further studies are warranted to improve these methods, survey patients with sarcopenia, and examine more screening methods.

This study identified changes in the efficacy of the three screening tools with an upgrade in the sarcopenia diagnosis criteria from AWGS 2014 to 2019.

Given that screening tools are used, prior to diagnostic testing, on people suspected to have sarcopenia, the change in sarcopenia diagnostic criteria should enhance the diagnosis of sarcopenia and the identification of persons without sarcopenia. Therefore, it is important to understand the characteristics of each screening test before performing surgery, and this study comparing three screening tests against multiple sarcopenia criteria is informative.

Conflict of interest

The authors declare no conflicts of interest associated with this manuscript.

REFERENCES

1) Rosenberg IH: Summary comments; Epidemiologic and methodologic problems in determining nutritional status of older persons. Proceedings of a Conference. Am J Clin Nutr, 1989, 50: 1231–1233. [CrossRef]
2) Goodpaster BH, Park SW, Harris TB, et al.: The loss of skeletal muscle strength, mass, and quality in older adults: the health, aging and body composition study. J Gerontol A Biol Sci Med Sci, 2006, 61: 1059–1064. [Medline] [CrossRef]
3) Newman AB, Kupelian V, Visser M, et al.: Strength, but not muscle mass, is associated with mortality in the health, aging and body composition study cohort. J Gerontol A Biol Sci Med Sci, 2006, 61: 72–77. [Medline] [CrossRef]
4) Clark BC, Manini TM: Sarcopenia =/= dynapenia. J Gerontol A Biol Sci Med Sci, 2008, 63: 829–834. [Medline] [CrossRef]
5) Cruz-Jentoft AJ, Baeyens JP, Bauer JM, et al. European Working Group on Sarcopenia in Older People: Sarcopenia: European consensus on definition and diagnosis: report of the European working group on sarcopenia in older people. Age Ageing, 2010, 39: 412–423. [Medline] [CrossRef]
6) Fielding RA, Vellas B, Evans WJ, et al. International Working Group on Sarcopenia: Sarcopenia: an undiagnosed condition in older adults. Current consensus definition: prevalence, etiology, and consequences. International working group on sarcopenia. J Am Med Dir Assoc, 2011, 12: 249–256. [Medline] [CrossRef]
7) Chen LK, Liu LK, Woo J, et al.: Sarcopenia in Asia: consensus report of the Asian working group for sarcopenia. J Am Med Dir Assoc, 2014, 15: 95–101. [Medline] [CrossRef]
8) Studenski SA, Peters KW, Alley DE, et al.: The FNIH sarcopenia project: rationale, study description, conference recommendations, and final estimates. J Gerontol A Biol Sci Med Sci, 2014, 69: 547–558. [Medline] [CrossRef]
9) Cruz-Jentoft AJ, Bahat G, Bauer J, et al.: Sarcopenia: revised European consensus on definition and diagnosis. Age Aging, 2010, 39: 412–423. [CrossRef]
10) Chen LK, Woo J, Assantachai P, et al.: Asian working group for sarcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. J Am Med Dir Assoc, 2020, 21: 300–307.e2. [Medline] [CrossRef]
11) Bonnefoy M, Jauffret M, Kostka T, et al.: Usefulness of calf circumference measurement in assessing the nutritional state of hospitalized elderly people. Gerontology, 2002, 48: 162–169. [Medline] [CrossRef]
12) Malmstrom TK, Morley JE: SARC-F: a simple questionnaire to rapidly diagnose sarcopenia. J Am Med Dir Assoc, 2013, 14: 531–532. [Medline] [CrossRef]
13) Barbosa-Silva TG, Menezes AM, Bielemann RM, et al. Grupo de Estudos em Composição Corporal e Nutrição (COCONUT): Enhancing SARC-F: improving sarcopenia screening in the clinical practice. J Am Med Dir Assoc, 2016, 17: 1136–1141. [Medline] [CrossRef]
14) Yang M, Hu X, Xie L, et al.: Screening sarcopenia in community-dwelling older adults: SARC-F vs. SARC-F Combined with Calf Circumference (SARC-CalF). J Am Med Dir Assoc, 2018, 19: 277.e1–277.e8. [Medline] [CrossRef]
15) Kusaka S, Takahashi T, Hiyama Y, et al.: Thigh and calf circumference for sarcopenia screening in community-dwelling elderly women. J Gerontol Geriatr, 2017, 8: 103–107.
16) Kawakami R, Murakami H, Sanada K, et al.: Calf circumference as a surrogate marker of muscle mass for diagnosing sarcopenia in Japanese men and women. Geriatr Gerontol Int, 2015, 15: 969–976. [Medline] [CrossRef]
17) Ishida Y, Maeda K, Nonogaki T, et al.: Impact of edema on length of calf circumference in older adults. Geriatr Gerontol Int, 2019, 19: 993–998. [Medline] [CrossRef]
18) Kuyumcu ME, Halil M, Kara Ö, et al.: Ultrasonographic evaluation of the calf muscle mass and architecture in elderly patients with and without sarcopenia. Arch Gerontol Geriatr, 2016, 65: 218–224. [Medline] [CrossRef]
19) Ida S, Murata K, Nakadachi D, et al.: Development of a Japanese version of the SARC-F for diabetic patients: an examination of reliability and validity. Aging Clin Exp Res, 2017, 29: 935–942. [Medline] [CrossRef]
20) Tanaka S, Kamiya K, Hamazaki N, et al.: Utility of SARC-F for assessing physical function in elderly patients with cardiovascular disease. J Am Med Dir Assoc, 2017, 18: 176–181. [Medline] [CrossRef]
21) Woo J, Leung J, Morley JE: Validating the SARC-F: a suitable community screening tool for sarcopenia? J Am Med Dir Assoc, 2014, 15: 630–634. [Medline] [CrossRef]
22) Ida S, Kaneko R, Murata K: SARC-F for screening of sarcopenia among older adults: a meta-analysis of screening test accuracy. J Am Med Dir Assoc, 2018, 19: 685–689. [Medline] [CrossRef]
23) Kim S, Kim M, Won CW: Validation of the Korean version of the SARC-F questionnaire to assess sarcopenia: Korean frailty and aging cohort study. J Am Med Dir Assoc, 2018, 19: 40–45.e1. [Medline] [CrossRef]