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Accuracy of SARC-F and SARC-CalF for sarcopenia screening in older women from southern Brazil

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ABSTRACT

Objectives: The aim of this study was to verify the accuracy of the SARC-F and the SARC-CalF as screening tools for sarcopenia in community-dwelling older women ≥60 y of age.
Methods: This was a cross-sectional study evaluating a convenience sample of women ≥60 y of age, living in Southern Brazil. Sarcopenia was defined according to the criteria proposed in the latest European Working Group on Sarcopenia in Older People consensus (EWGSOP2). Appendicular muscle mass was assessed by dual-energy x-ray absorptiometry. Muscle strength was measured by handheld dynamometry, and physical performance through the 4-m gait speed test. The SARC-F questionnaire and SARC-CalF score for sarcopenia screening were also applied.
Results: We evaluated 288 participants, with a mean age of 67.6 ± 5.8 y. The frequency of probable and confirmed sarcopenia in the sample was 7.3% and 2.1%, respectively. The frequency of risk for sarcopenia assessed by the SARC-F was 4.5% and SARC-CalF 22.2%. Despite the excellent specificity (95.4%) demonstrated by the SARC-F, its sensitivity in identifying confirmed cases was null, whereas the SARC-CalF showed high sensitivity (83.3%) and good specificity (79%).
Conclusion: The present study findings suggested that SARC-CalF may be able to outperform SARC-F as a sarcopenia screening tool in women ≥60 y of age even under the new EWGSOP2 criteria, the main determinant of which is strength as observed in studies based on the previous definition.

Introduction

Sarcopenia is a progressive and generalized skeletal muscle disorder associated with an increased likelihood of adverse outcomes, such as falls, fractures, physical disability, and mortality in older individuals [1].

In 2010, the European Working Group on Sarcopenia in Older People (EWGSOP) defined sarcopenia as the presence of low muscle mass associated with loss of strength and/or impaired muscle performance [1]. This definition was recently been updated by the same group (EWGSOP2), with the isolated finding of loss of strength being sufficient to establish the condition called *probable sarcopenia*, and when accompanied by low muscle mass, the diagnosis of sarcopenia is considered confirmed. Furthermore, according to the latest consensus, physical performance is no longer considered a diagnostic criterion, but rather related to disease severity [2].

In terms of public health, sarcopenia is a syndrome of considerable prevalence, having a significant effect on the overall health of

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those affected. Nevertheless, it continues to be underrecognized and underdiagnosed in clinical practice, which underlines the importance of having available a simple and easy-to-apply screening tool in primary health care [3].

The screening tool most widely used and accepted by the leading societies until now is the SARC-F [2,4–6], a questionnaire developed in 2013 for sarcopenia screening. The SARC-F has been translated and validated for different populations [7–13], generally presenting good specificity, although associated with low sensitivity for disease screening [8,14].

In 2016, Barbosa-Silva et al. proposed a modified version of the SARC-F in an attempt to improve its performance, called the SARC-F + CC (or SARC-CalF score) [8]. The score has been suggested as a potentially interesting alternative to the SARC-F, aimed at improving its sensitivity by incorporating an anthropometric measurement as a marker of muscle mass (calf circumference [CC]) into the muscle functionality domains assessed by the original questionnaire [3,5,8,14–17].

To our knowledge, there are no studies that have simultaneously evaluated the performance of the two tools under the new definition of sarcopenia, as proposed by the EWGSOP2. Accordingly, the aim of the present study was to verify the accuracy of the SARC-F and SARC-CalF for sarcopenia screening, with reference to the new definition proposed by the EWGSOP2 in community-dwelling older women.

Methods

A cross-sectional study was performed with 291 community-dwelling older women, who were referred for clinical investigation to a diagnostic imaging clinic in the city of Palmeira das Missões, located in the northwest region of Rio Grande do Sul, Brazil. The women underwent a bone density scan by means of dual-energy x-ray absorptiometry (DXA). Data collection took place from July 2016 to April 2017, and from January to July 2018. Women not meeting the required physical conditions to perform the tests, or those who did not feel physically well enough to respond to the questions applied by the interviewer were excluded. A full-body DXA scan was conducted in addition to the densitometry protocols for later evaluation of body composition.

Sample characteristics

Participants responded to a questionnaire applied by the interviewer regarding sociodemographic data (age, marital status, education, occupation, skin color); smoking; and previous diagnosis of dyslipidemia, diabetes mellitus, or systemic arterial hypertension.

The Brazilian Association of Research Companies (ABEP) [18] questionnaire was applied to evaluate socioeconomic status, which considers the possession of some consumer goods, educational level of the head of household, and access to public services. Individuals were then classified into five social classes, ranging from class A (those with greater purchasing power) to class E (those with lower purchasing power).

Level of physical activity was assessed using the International Physical Activity Questionnaire (IPAQ) short form [19], and for classification purposes, the time spent in intensive activities was multiplied by 2. Those older women reporting <150 min/wk of physical activity were considered inactive [20].

Anthropometric measurements

Weight was measured using a calibrated mechanical anthropometric scale (110 CH, Welmy, São Paulo, Brazil), with the women barefoot and wearing only a hospital gown. Height was measured using the anthropometric scale metal stadiometer, with participants in an upright position, arms hanging at their sides, heels together, and occipital and gluteal regions touching the upright ruler of the scale. Body mass index (BMI) was classified according to the World Health Organization [21] values as underweight (<18.5 kg/m^2); normal weight (18.5–24.9 kg/m^2); overweight (25–29.9 kg/m^2); and obese (≥30 kg/m^2).

The CC was measured with an inelastic tape measure (Cerscorf, Porto Alegre, Brazil), with the participant standing with legs relaxed and ~20 cm apart. The measurement was performed in the horizontal plane at the widest CC of the right leg [22]. CC values ≤33 cm were considered low, according to validated values for this population [23].

The body composition of participants was assessed through a full-body DXA scan (GE Lunar DPX-NT 150951; General Electric Health Care, Madison, WI, USA). The examinations were performed on participants after a 30-min rest period, wearing a hospital gown only and stripped of any metallic objects. The appendicular lean mass index was calculated as the sum of the lower limb and upper limb lean mass tissue (kg)/height (m^2). In accordance with a previous publication based on a similar population, appendicular lean mass index values ≤5.62 kg/m^2 were considered to be indicative of low appendicular lean mass [23].

Muscle strength was measured using a digital hand dynamometer (EH 101, Camry, Guangdong, China) following the methods proposed by Roberts et al. [24]. Three measurements were taken for each hand, alternating sides, with the participant in a seated position. The maximum grip score identified from the six measurements (maximum force) was adopted. Handgrip values ≤16 kg were considered low [2].

Muscle performance was assessed using the 4-m gait speed test, which was applied twice. The test times were noted and converted into gait speed (m/s), adopting the best test execution time. Values ≤0.8 m/s were considered low [25].

SARC-F questionnaire

The SARC-F is a questionnaire designed for screening sarcopenia in the older individuals and addresses five domains: strength, walking aids, difficulty getting up from a chair, difficulty climbing stairs, and falls [7]. Each domain has a question and the answer is scored from 0 to 2 points per domain. The (Brazilian) Portuguese-translated version [8] of the SARC-F questionnaire was applied, for which it has been established that a score ≥6 would be suggestive of sarcopenia [26].

In addition to the SARC-F, the SARC-CalF score was applied, which was also developed by the same authors as the translated version questionnaire [8]. This derivation of the original questionnaire is based on incorporation of the CC measurement as an evaluation criterion (weight 10) and assigning a cutoff point to identify the risk for sarcopenia in a specifically determined population. Therefore, women with a CC measurement of ≤33 cm (suggestive of low muscle mass) received a 10-point increase on the original SARC-F score. The SARC-CalF score ranges from 0 to 20 points, and individuals with a score ≥11 are considered at risk for sarcopenia.

Sarcopenia diagnosis

Sarcopenia was diagnosed according to the criteria of muscle strength, muscle mass. and physical performance, as proposed by the EWGSOP2. The women were initially placed into one of four categories: no sarcopenia (adequate muscle strength and mass); probable sarcopenia (low muscle strength but adequate muscle mass); confirmed sarcopenia (low muscle strength and mass, adequate physical performance); and severe sarcopenia (low muscle strength and mass, and poor physical performance) [2]. For analytical purposes, the participants were subsequently classified in relation to the presence ("confirmed sarcopenia" or "severe sarcopenia") or no presence ("without sarcopenia" or "probable sarcopenia") of the syndrome.

Statistical analysis and ethical aspects

Data were analyzed using the software SPSS version 21 (IBM, Armonk, NY, USA). The Kolmogorov–Smirnov test was used to verify data distribution normality. Quantitative variables with normal distribution were described as mean + SD, and categorical variables as absolute and relative frequencies. The accuracy of the screening tools was evaluated through sensitivity–specificity analysis.

The Research Ethics Committee of the Federal University of Santa Maria previously approved the research protocol. All precepts of the National Health Council Resolution No. 466/12 were followed. All individuals participated on a voluntary basis and gave consent through completion and signing of the informed consent form.

Results

In all, 291 women were invited to participate, of which 3 were excluded, leaving a final sample of 288 participants, with a mean age of 67.6 ± 5.8 y.

The sociodemographic characteristics of the sample are described in Table 1. The majority of the sample was formed of women 60 to 69 y of age, living with a partner, white, retired, and belonging to socioeconomic class C. The most frequent category of schooling was 4 to 8 y of study.

The majority of the sample had overweight/obesity (68.4%), hypertension (63.2%), and was physically inactive (51%); however, the majority was non-smokers (72.6%), did not have diagnosed dyslipidemia (62.8%) or diabetes (84%). Regarding the muscular and physical performance characteristics, they had, mainly,

Table 1
Sociodemographic characteristics of the participants (N = 288)

Variables	n	%
Age, y		
60–69	187	64.9
70–79	91	31.6
≥80	10	3.5
Marital status		
With partner	173	60.1
Without partner	115	39.9
Schooling, y of study		
<4	104	36.1
4–8	127	44.1
>8	57	19.8
Occupation		
Working	9	3.1
Home-based	11	3.8
Retired	268	93.1
Socioeconomic status class		
A/B	47	16.3
C	174	60.4
D/E	67	23.3
Ethnicity		
White	198	68.8
Non-white	90	31.2

adequate CC (70.5%), handgrip strength (71.5%), and gait speed (70.8%; Table 2).

In line with the EWGSOP2 criteria, 21 participants (7.3%) presented probable sarcopenia, 1 (0.3%) confirmed sarcopenia, and 5 (1.7%) severe sarcopenia. The frequency of sarcopenia risk was 4.5% and 22.2%, according to SARC-F and SARC-CalF, respectively. Sarcopenia was identified in 6 (2.1%) of the participants. The SARC-F identified 4.5% of patients at risk for sarcopenia, whereas the SARC-CalF identified 64 (22.2% of the sample; Table 3).

None of the patients with confirmed sarcopenia were identified by the SARC-F, whereas 5 of 6 were identified by the SARC-CalF (sensitivity: 83.3%; Table 4).

Table 2
Clinical, lifestyle, anthropometric, and muscular (muscle mass, strength, and performance) characteristics of the participants (N = 288)

Variables	n	%
Physical activity*		
Active	141	49
Inactive	147	51
Smoking status		
Non-smoker	209	72.6
Ex-smoker	60	20.8
Smoker	19	6.6
Dyslipidemia		
No	181	62.8
Yes	107	37.2
Diabetes		
No	242	84
Yes	46	16
Hypertension		
No	106	36.8
Yes	182	63.2
BMI†		
Underweight	3	1
Normal weight	88	30.6
Overweight	111	38.5
Obese	86	29.9
Calf circumference‡		
Low	85	29.5
Adequate	203	70.5
Gait speed§		
Slow	84	29.2
Adequate	204	70.8
Handgrip strength‖		
Low	82	28.5
Adequate	206	71.5

BMI, body mass index
*Cutoff point (inactivity): <150 min/week.
†<18.5 kg/m^2: underweight, 18.5–24.9 kg/m^2: normal weight, 25–29.9 kg/m^2: overweight, >30 kg/m^2: obese.
‡Cutoff point (low calf circumference): ≤33 cm.
§Cutoff point (slow walk): <0.8 m/s.
‖Cutoff point (low strength): <16 kg.

Discussion

The prognostic ability of the SARC-F questionnaire applied to the evaluated sample presented null sensitivity, with an excellent specificity and negative predictive value. In comparison, the SARC-CalF score demonstrated high sensitivity, with no significant loss in terms of specificity and negative predictive value.

A suitable screening method for use in clinical practice should preferably be inexpensive, practical, and safe. Ideally, it should identify individuals who are positive for the proposed outcome (high sensitivity), while maintaining the ability to avoid subsequent costly and potentially unnecessary diagnostic investigations by pointing out lower-risk individuals (high specificity) [27].

Previous SARC-F validation studies have shown it to have relatively low sensitivity and high specificity, suggesting its potential for excluding the presence of sarcopenia, but at the same time, showing its limitation as a disease detection tool [28]. A meta-analysis in 2018 by Ida et al. [29] that evaluated the screening capacity of the SARC-F involving 12 800 individuals, found low sensitivity and high specificity, as did Woo et al. [9] in a study of 4000 community-dwelling older people in Hong Kong, in which the sensitivity and specificity of the SARC-F were 9.9% and 94.4%, respectively, corroborating our findings.

The performance of the SARC-CalF as a screening tool for sarcopenia in the present study was superior to that presented by the SARC-F, considering the diagnostic criteria proposed by the EWGSOP2. These findings are reinforced by previous studies that proposed the same comparative performance analysis between the tools [16], although using the preceding consensus criteria. Barbosa-Silva et al. demonstrated the SARC-CalF to have higher sensitivity and greater accuracy for sarcopenia screening than the

Table 3
Performance of the sarcopenia screening tools in the evaluated participants (N = 288)

Tool	Sarcopenia (EWGSOP2)		
	Yes	No	Total
SARC-F*			
Yes	0	13	13
No	6	269	275
SARC-CalF†			
Yes	5	59	64
No	1	223	224

*Cutoff point (risk for sarcopenia): ≥6.
†Cutoff point (risk for sarcopenia): ≥11.

Table 4
Sensitivity/Specificity of the evaluated sarcopenia screening tools (N = 288)

Parameters	SARC-F*	SARC−F + CC†
Sensitivity	0 (0–0)	83.3 (53.5–100)
Specificity	95.4 (92.9–97.8)	79 (74.3–83.8)
Positive predictive value	0 (0–0)	7.8 (1.2–14.4)
Negative predictive value	97.8 (96.1–99.5)	99.6 (98.7–100)

*Cutoff point (risk for sarcopenia): ≥6.
†Cutoff point (risk for sarcopenia): ≥11.

SARC-F [8]. Yang et al., in a Chinese study, also observed a significant improvement in diagnostic sensitivity with the SARC-CalF [3]. Furthermore, research by Lim et al. in Singapore, involving the application of both tools to a sample of 193 older individuals, revealed a screening sensitivity of 7.7% by the original questionnaire, whereas the derived score reached values of 63.5% for the parameter in question [30].

Even in the only study in which no significant difference in sensitivity was observed between the two tools, the association of calf measurement with the questionnaire showed significant improvement in sarcopenia screening accuracy for all the measures evaluated [14]. A similar conclusion was reached by Mohd Nawi et al. in a recent review [31], by stating that sensitivity increases with the SARC-CalF, improving the diagnostic accuracy when compared with the SARC-F.

To the best of our knowledge, there are few studies evaluating SARC-F performance under the newly proposed EWGSOP2 diagnostic criteria, and none as yet that have evaluated SARC-CalF. Our review of the literature found three published articles combining the SARC-F and EWGSOP2, and none that used SARC-CalF with this consensus.

Two of the aforementioned studies showed low sensitivity (<50%) and good specificity (>85%) [32,33], and only one study showed sensitivity of 78.3% and specificity 50.8%; however, this study was not with DXA [27].

The sensitivity values described in the studies are apparently higher than previously reported for the SARC-F questionnaire. However, a comparison of performance between the tools cannot yet be elucidated as there are no studies that have conducted this same analysis with the SARC-CalF.

One of the limitations of the present study was the small number of participants with sarcopenia in the sample. Also, the fact that only women were evaluated must be considered when interpreting the presented findings. Finally, the DXA exams were requested for clinical reasons, which may have influenced the sample in differing forms. Having access to medical care and complex exams could reflect better access to health services than the general population, but also having an exam performed for disease investigation may suggest a sicker sample.

There were some strengths of our research that should be highlighted. Low muscle mass was diagnosed from DXA with appropriate cutoff points for the population evaluated (as recommended in the EWGSOP2). This study was also the first to evaluate SARC-CalF performance considering the new EWGSOP2 diagnostic criteria, and the first comparative study of the SARC-F and SARC-CalF considering the EWGSOP2, besides being the first study to present the application of the EWGSOP2 in a Latin American population. Despite the promising results found in this study, their validity will need to be confirmed in subsequent studies.

Conclusion

In the present sample, the SARC-F questionnaire could not be considered a good screening tool for sarcopenia, as defined by the EWGSOP2. However, a significant improvement in its accuracy was observed when associated with CC (in the form of the SARC-CalF score), in agreement with previously published studies in which the former EWGSOP definition was used.

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