The SARC-F Questionnaire: Diagnostic Overlap with Established Sarcopenia Definitions in Older German Men with Sarcopenia

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Keywords

Sarcopenia diagnostics · SARC-F · European Working Group on Sarcopenia in Older People · Foundation National Institute of Health · International Working Group on Sarcopenia · Older men · Germany

Abstract

Background: The high relevance of sarcopenia for the aging societies of most developed nations is emphasized by its recent inclusion in the ICD-10-CM (M62.84). However, diagnosing sarcopenia is a daunting task. Apart from varying definitions, the proper assessment of recognized sarcopenia criteria is time and cost consuming. A short and inexpensive screening tool may thus be welcome for clinicians and others working in the area of gerontology. Recently, a simple questionnaire was provided (SARC-F) that may adequately realize this aim. **Objective:** The purpose of this study is to compare established sarcopenia definitions (European Working Group on Sarcopenia in Older People [EWGSOP], Foundation National Institute of Health [FNIH], International Working Group on Sarcopenia [IWGS]) with the SARC-F. Our hypothesis was that the diagnostic overlap between the SARC-F and sarcopenia as determined by these recognized definitions was too low to reliably diagnose sarcopenia.

Methods: Seventy-four community-dwelling German men aged 70 years and older with established sarcopenia according to EWGSOP and/or FNIH and/or IWGS were screened with the SARC-F questionnaire. **Results:** Applying the definitions of EWGSOP, IWGS, and FNIH, 66.2, 43.2, and 50% of the cohort were classified sarcopenic, respectively. The SARC-F identified 33.5% of the cohort as sarcopenic. The predictive power of the SARC-F increased when men were classified as sarcopenic according to 2 (57.1%) or all (78.8%) sarcopenia definitions. The diagnostic overlap with the 3 sarcopenia definitions varied between 38.8% (SARC-F–FNIH) and 54.1% (SARC-F–IWGS). In comparison, the overlap of diagnosed sarcopenia ranged from 27.0% (FNIH–IWGS) to 49.0% (IWGS–EWGSOP) among the definitions themselves. Only 12.2% of the men met all 3 sarcopenia definitions. **Conclusion:** The diagnostic overlap with respect to sensitivity of the SARC-F and present sarcopenia definitions was at least as high as the range of the diagnostic overlap of these approaches themselves. Thus, although the sensitivity of the SARC-F may be debatable, for want of a better option it seems reasonable to consider the SARC-F as a first simple step within a hierarchical screening procedure. Independently of this procedure, a universally accepted mandatory sarcopenia definition along with comprehensive criteria and fixed cutoff points should be provided promptly.

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Introduction

Since October 2016, sarcopenia has been classified in the ICD-10 code as an independent condition (M62.84). However, the mandatory diagnosis of sarcopenia has been quite difficult to date. Although there is a consensus in that morphometric and functional components are more adequate for characterizing sarcopenia than the application of morphometric components alone, criteria and cutoff points vary widely between the most recognized and applied definitions [1–3]. Beyond these aspects, the present approaches to diagnose sarcopenia conflict with clinicians’ need for time-saving, inexpensive, and easy feasible screening tests. The SARC-F, a recently provided questionnaire that is based on 5 items, was repeatedly suggested as an option for rapidly diagnosing “sarcopenia” [4–7].

Thus, the primary aim of this study is to evaluate the efficacy of the SARC-F in identifying people with diagnosed sarcopenia according to recognized definitions. Our primary hypothesis was that the diagnostic overlap between the SARC-F and each of the 3 definitions was lower than the overlap among the 3 different sarcopenia definitions.

Methods

The Franconian Sarcopenic Obesity (FRANSO) study focuses on the prevalence and nonpharmacologic therapy of sarcopenia in community-dwelling men aged ≥70 years. In this contribution, we used baseline study data sampled between June and July 2016. The Institute of Medical Physics and the Institute of Biomedicine of Aging, University of Erlangen-Nuremberg (FAU), Germany, initiated the project. The study was approved by the University Ethics Committee of the FAU (Ethikantrag 67 15b). After detailed information, all the study participants gave written informed consent. The FRANSO project was registered under ClinicalTrials.gov: NCT2857660.

Participants

The screening process of the FRANSO study is described in detail elsewhere [8], so only the most important information will

be provided here. After extensive recruitment, 965 community-dwelling men aged ≥70 years living in the area of central Franconia, Germany, were eligible for the analysis of sarcopenia prevalence. Depending on which sarcopenia definition was applied, sarcopenia prevalence ranged between 3.7 and 4.9%. Seventy-four men who met at least 1 sarcopenia definition were included in the present study. Baseline characters of the participants are listed in Table 1.

Measurements

All assessments were performed by qualified research assistants using calibrated devices.

Body Composition

Height was determined using a Harpenden stadiometer (Holtain, Crymch, UK), and weight as well as total and regional fat and fat-free mass were assessed using a multi-frequency, multi-segmental BIA device (BIA; Inbody 770, Biospace Ltd., Seoul, Korea). Body mass index (BMI) was calculated as body mass/body height² (kg/m²), and skeletal muscle mass index (SMI) was calculated using appendicular skeletal muscle mass (ASMM)/body height² (kg/m²) or, when applying the FNIH definition of sarcopenia, ASMM/BMI.

Gait Velocity

Habitual gait speed was performed using the 10-m protocol recommended for research. Participants started in an upright position 3 m before the first photo sensor (HL 2-31, TagHeuer, La Chaux-de-Fonds, Switzerland), started walking, and stopped 2 m after the second photo sensor. Tests were conducted in regular shoes without walking aids. Participants were consistently started with the specification “walk at a speed just as if you were walking along the street to go to the shops.”

Hand Grip Strength

Both hands were alternately tested 3 times with a break of 30 s between tests using a Jamar hand dynamometer (Sammons Preston Inc., Bollington, IL, USA). Grip width was adjusted individually to participant hand size. Tests were performed while standing upright, arms down by the side. The standardized instruction was “squeeze as strongly as possible.” The average result of the 3 trials for the dominant and nondominant hand was included in the analysis.

Questionnaires, Interviews

General characteristics, medication, diseases, physical limitations, lifestyle with special emphasis on physical activity, exercise and nutrition [9], and pain severity and frequency at different skeletal sites were determined using a standardized questionnaire completed by all participants during the test procedures in our

Table 1. Sarcopenia criteria, cutoff points, and diagnostic approach of the EWGSOP, IWGS, and FNIH sarcopenia definitions

Definition/criteria	Gait velocity	Grip strength	SMI
EWGSOP [1]	when <0.8 m/s or (≥0.8 m/s)	<30 kg	<7.18 kg/m ^a
IWGS [2]	<1.0 m/s and	–	≤7.23 kg/m ^{2b}
FINH [3]	–	<26 kg and	<0.789 ^b

SMI, skeletal muscle mass index. ^a T-score-based approach suggested by the EWGSOP (see [8]). ^b Using the cutpoint defaults suggested by IWGS and FNIH.

laboratory. Apart from the SARC-F, we also used the abridged version of the Late Life Function and Disability Instrument (LLFDI) [10] and asked for the degree of independence and autonomy, family status, social network, and use of ambulatory nursing services.

Sarcopenia Definitions According to the Different Expert Panels

We applied the 3 recognized sarcopenia definitions listed in Table 2 that were recommended for European and US-American cohorts.

Table 1 summarizes the cutoff points according to the European Working Group on Sarcopenia in Older People (EWGSOP), Foundation National Institute of Health (FNIH), and International Working Group on Sarcopenia (IWGS) applied for this study.

In order to create an integrated, continuous score, we calculated Z-scores [11] for the 3 different sarcopenia approaches. The equation for the EWGSOP score was $Z = ((0.8 - \text{individual gait speed})/\text{standard deviation [SD] gait speed}) + ((30 - \text{individual grip strength})/\text{SD grip strength}) + ((7.18 - \text{individual value SMI})/\text{SD SMI})$. Correspondingly, the IWGS score was calculated as $Z = ((1.0 - \text{gait speed})/\text{SD gait speed}) + ((7.23 - \text{SMI})/\text{SD SMI})$ and FNIH was calculated as $((26 - \text{grip strength})/\text{SD grip strength}) + ((0.789 - \text{SMI})/\text{SD SMI})$.

SARC-F Questionnaire

The SARC-F is a 5-component questionnaire that includes the variables “strength,” “assisted walking,” “rise from a chair,” “stair climbing,” and “falls.” For each of the components, 0–2 points can be awarded. “0” indicated no difficulty or no fall within the past 1 year, “1” indicated some difficulties or 1–3 falls, and “2” indicated significant difficulties and more than 4 falls/year. In order to diagnose sarcopenia, the SARC-F was dichotomized; a score ≥ 4 total points is predictive for sarcopenia [6].

Statistical Analysis

After checking normal distribution by QQ plots and Shapiro-Wilks tests, data were given using mean values $\pm$ SD. Differences of baseline characteristics and key parameters between the groups (Tables 2, 3) were analyzed using the Welch *t* test for continuous and the χ^2 test for categorical variables. All tests were two-sided with a *p* value of <0.05 considered as statistically significant. SPSS 22.0 (SPSS Inc., Chicago, IL, USA) was used for all statistical procedures.

Results

Table 2 gives baseline characteristics of the 74 community-dwelling men aged ≥ 70 years all with diagnosed sarcopenia according to EWGSOP and/or IWGS and/or FNIH (see below), additionally structured for SARC-F status (i.e., with or without sarcopenia). With respect to the latter, the groups vary significantly. Men classified as sarcopenic by the SARC-F were older, demonstrated a more unfavorable LLFDI, and reported a lesser degree of autonomy, physical fitness, and activity. However, no significant group differences were observed for the number or severity of diseases, regular exercise participation (≥ 1 session/week), or anthropometric variables.

Applying the sarcopenia definitions of the EWGSOP, IWGS, or FNIH, 49 (66%), 37 (50%), and 32 (43%) men were classified as sarcopenic, respectively. Thirty-five percent of the men fulfilled the criteria of 2 definitions,

Table 2. Characteristics of the study participants, further grouped by sarcopenia status as classified by SARC-F

Variable	All participants (<i>n</i> = 74)	SARC-F		<i>p</i> value
		without sarcopenia (<i>n</i> = 49)	with sarcopenia (<i>n</i> = 25)	
Age, years	82.2 $\pm$ 5.6	81.2 $\pm$ 5.2	84.2 $\pm$ 5.9	0.027
Body height, cm	167.3 $\pm$ 6.6	167.8 $\pm$ 6.3	166.5 $\pm$ 7.1	0.426
Body weight, kg	71.6 $\pm$ 10.1	72.1 $\pm$ 8.9	70.5 $\pm$ 12.3	0.531
Soft lean body mass, kg	43.9 $\pm$ 4.5	44.3 $\pm$ 2.7	43.2 $\pm$ 5.8	0.373
Number of diseases	2.49 $\pm$ 1.24	2.49 $\pm$ 1.28	2.48 $\pm$ 1.20	0.975
LLFDI index ^a	2.21 $\pm$ 0.68	1.85 $\pm$ 0.41	2.92 $\pm$ 0.57	<0.001
LLFDI ALEF index ^b	2.92 $\pm$ 1.04	2.47 $\pm$ 0.85	3.80 $\pm$ 0.78	<0.001
Autonomy index ^c	2.36 $\pm$ 1.04	1.94 $\pm$ 0.77	3.2 $\pm$ 1.00	<0.001
Physical fitness index ^d	4.20 $\pm$ 1.31	4.43 $\pm$ 1.12	3.76 $\pm$ 1.56	0.037
Physical activity index ^d	3.77 $\pm$ 1.27	3.98 $\pm$ 1.16	3.36 $\pm$ 1.41	0.048
Regular exercise, % ^d	45	43	48	0.805

p value indicates differences between sarcopenia status. ^a Late Life Function and Disability Instrument (LLFDI) [10] (1: no complaints to 5: impossible). ^b LLFDI Advanced Lower Extremity Function (ALEF) [10]. ^c As assessed by personal interview. ^d As assessed by physical activity questionnaires [9]: scale from 1: very low/very bad to 7: very high/very good.

Table 3. Differences among men classified by the SARC-F for sarcopenia prevalence according to different recognized definitions and their underlying sarcopenia criteria

Variable	SARC-F:		<i>p</i> value
	without sarcopenia (<i>n</i> = 49)	with sarcopenia (<i>n</i> = 25)	
Sarcopenia according to EWGSOP, % ^a	61	76	0.204
Sarcopenia according to IWGS, % ^b	35	80	0.001
Sarcopenia according to FNIH, % ^c	39	52	0.277
EWGSOP sarcopenia Z-score	-0.35±1.07	1.34±1.22	<0.001
IWGS sarcopenia Z-score	0.35±1.74	2.07±1.77	<0.001
FNIH sarcopenia Z-score	-0.19±2.23	1.37±2.08	0.008
Habitual gait velocity, m/s	1.03±0.21	0.83±0.13	<0.001
Handgrip strength, N	27.1±5.2	23.6±4.3	0.004
SMI, kg/m ^{2d}	6.99±0.36	6.89±0.62	0.404
SMI-FNIH, kg/BMI ^e	0.783±0.115	0.764±0.95	0.242

SMI, skeletal muscle mass index. ^a Criteria included gait velocity, handgrip strength, and SMI. ^b Criteria included gait velocity and SMI. ^c Criteria included grip strength and SMI. ^d SMI according to IWGSOP and IWGS, i.e., appendicular skeletal muscle mass (kg)/height (m²). ^e SMI according to FNIH, i.e., appendicular skeletal muscle mass (kg)/body mass index (BMI) (kg/m²).

and 12% of all 13 definitions. On the other hand, the SARC-F specified 25 men (34%) as sarcopenic.

The diagnostic overlap of the SARC-F with respect to “sensitivity” to identify men diagnosed by the 3 sarcopenia definitions varied between 38.8% (SARC-F–FNIH) and 54.1% (SARC-F–IWGS). In comparison, the corresponding overlap between the 3 approaches varies from 27.0% (FNIH–IWGS) to 49% (IWGS–EWGSOP) among the definitions themselves. Vice versa, the SARC-F predicted 76, 80, and 52% of the men classified sarcopenic by at least 1 definition (EWGSOP or IWGS or FNIH approach, respectively; Table 3). With respect to men who complied with 2 or all sarcopenia definitions, 57.1 and 78.8% were also classified as sarcopenic by the SARC-F, respectively.

In summary, we clearly revised our hypothesis and concluded that the diagnostic overlap between SARC-F and recent sarcopenia definitions was comparable to these established and recognized definitions themselves.

Applying a continuous scale (Z-scores), groups with and without sarcopenia according to the SARC-F criteria differ, with significantly more unfavorable Z-scores in the SARC-F sarcopenia group (Table 3). Looking behind the covariates (i.e., SMI, gait speed, and/or grip strength) of the EWGSOP, IWGS, and FNIH definitions (Table 3), subjects classified as sarcopenic by the SARC-F score demonstrated significantly lower gait velocity

(*p* < 0.001) and handgrip strength (0.004). Although SMI calculated according to EWGSOP/IWGS (kg/m²) or FNIH (kg/BMI) was also lower in the SARC-F sarcopenia subgroup, differences were not significant (*p* ≥ 0.242).

Discussion

The aim of this study was to determine the predictive power of a simple questionnaire to diagnose sarcopenia in older men. Considering the inclusion of sarcopenia in the ICD10 and the corresponding consequences, a time-, equipment-, and expertise-saving easy screening test will be welcomed by clinicians and other healthcare providers. In a first step, we checked the diagnostic overlap of 3 recognized sarcopenia definition approaches, all of which included morphometric and functional components. In summary, the corresponding accordance was frighteningly low in our cohort of community-dwelling older men aged ≥70 years with sarcopenia according to at least 1 of these established definitions. In effect, only one-third of the cohort was identified by 2 approaches, and only 12% fulfilled the criteria of all 3 definitions. Especially the most advanced definition of the FNIH, which relied on handgrip strength assessment and applied a different SMI calculation (ASMM/BMI vs.

ASMM/m²), demonstrated a very low overlap with the approaches of the EWGSOP and IWGS (Tables 1, 3). Correspondingly, applying the SARC-F, its predictive accuracy varied considerably according to the sarcopenia approach used. That the SARC-F demonstrated the highest diagnostic overlap with the IWGS criteria is quite understandable because, similar to the functional sarcopenic component of the IWGS (“gait speed”), its screening focuses exclusively on mobility impairments and falls, factors known to highly correlate with gait speed. In contrast, since the FNIH focuses on the assessment of low grip strength as the only functional criterion, the low diagnostic overlap between the “mobility impairment-orientated” SARC-F and the (more) “clinical weakness”-derived [12] FNIH approach was quite obvious. To sum up, we confirmed the data of Woo et al. [13] and Barbosa-Silva et al. [14] for the poor sensitivity for sarcopenia classification at least when considering the selected consensus definitions as “a gold standard.” The latter however is rather debatable, at least when considering the low diagnostic overlap between these 3 “recognized definitions.”

Using a more subtle criterion than the dichotomous sarcopenia prevalence, the sarcopenia Z-score calculated using the corresponding determinants and cutoff points of the 3 definitions showed a significant discrimination ($p < 0.001$ to 0.008) of men classified by the SARC-F as sarcopenic or not. When looking behind the covariates, we almost mirror the results of Tanaka et al. [7], who also reported significant differences for gait speed and handgrip strength between men aged ≥ 65 years with and without sarcopenia according the SARC-F. The fact that the

discriminatory power was highest for gait speed ($p < 0.001$) is hardly surprising, but we also detected a significant difference for handgrip strength ($p = 0.004$). This finding could not necessarily be anticipated when considering the abovementioned lower extremity focus of the SARC and rather low variance of this parameter in this “sarcopenic” cohort. Although no significant differences (Table 3) were determined for SMI(s), the higher predictive power for the BMI-based SMI approach of the FNIH [3] might confirm the sophisticated statistical approach that considered absence/presence of weakness (... and mobility impairments [15]).

In summary, the lack of a unique mandatory definition or gold standard for sarcopenia complicates the reliable determination of the predictive power of the SARC-F. However, considering that the diagnostic overlap between the SARC-F and presently applied sarcopenia consensus definitions was higher than among these definitions themselves, this may justify the recommendation of the SARC-F as a first simple screening method for sarcopenia. Doubtful or positive results should be verified by a complete (morphometric/functional) assessment of sarcopenia, however. With respect to the latter, a universally accepted mandatory definition along with comprehensive criteria and fixed cutoff points should be provided as soon as possible.

Disclosure Statement

Wolfgang Kemmler, Cornel Sieber, Ellen Freiberger, and Simon von Stengel declare that they have no conflict of interest regarding the publication of this paper.

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