

TRANSLATION AND VALIDATION OF THE SPANISH VERSION OF THE SARC-F QUESTIONNAIRE TO ASSESS SARCOPENIA IN OLDER PEOPLE

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Abstract: *Objectives:* The revised European consensus on sarcopenia definition and diagnosis (EWGSOP2) includes the SARC-F questionnaire, the most valid and consistent sarcopenia screening tool, as the mandatory first step. Our aim was the translation, cross-cultural adaptation, and validation of the SARC-F questionnaire as a culturally-responsive Spanish-language version for the European population. *Study design:* Cross-sectional descriptive study, applying the two-step WHO methodology for translation and cross-cultural adaptation of health questionnaires, and harmonization with the Mexican-Spanish version. European Union Geriatric Medicine Society recommendations for SARC-F validation in European languages were considered. *Participants:* Outpatient clinics of a university hospital. Inclusion criteria: stable, ambulatory (including aids), community-dwelling population ≥ 65 years old. *Main outcome measures:* The self-reported 5-item SARC-F questionnaire was administered; scores ≥ 4 indicated sarcopenia. Sensitivity, specificity, accuracy-likelihood ratios, predictive values, and kappa statistics were calculated and consecutively compared with European Working Group on Sarcopenia in Older People (EWGSOP) and EWGSOP2 criteria. *Results:* This Spanish version, administered in an average 70s, has adequate internal consistency (Cronbach $\alpha=0.779$). For the validation study, 90 (43.3%) of 208 potentially eligible subjects (81.4 ± 5.9 years old, 75.6% women) were included. SARC-F identified 51 (56.7%) subjects with sarcopenia and 39 (43.3%) without the disease. Prevalence was 17.8% per EWGSOP and 25.6% per EWGSOP2 (58% accuracy and fair agreement: *sensitivity*, 78.3%; *specificity*, 50.8%). *Conclusions:* SARC-F is a feasible tool, suitable for bedside assessment in community-dwelling older patients. Wide diffusion of this culturally-responsive SARC-F Spanish version is expected as EWGSOP2 is adopted and sarcopenia assessment is broadly implemented in Spain.

Key words: SARC-F, spanish, validation, sarcopenia, screening, muscle mass.

Abbreviations: EuGMS: European Union Geriatric Medicine Society; EWGSOP: European Working Group on Sarcopenia in Older People; EWGSOP2: Revised European consensus on definition and diagnosis; GLIM: Global Leadership Initiative; LR+: Positive likelihood ratio; NPV: Negative predictive value; PPV: Positive predictive value (PPV); SIG: Special Interest Group; STARD: Standards for Reporting of Diagnostic Accuracy Studies; WHO: World Health Organization.

Introduction

Sarcopenia is a nutrition-related disease (1, 2) produced by age, muscle disuse, and chronic conditions (2-4). It has been related to clinical adverse outcomes, like three-fold risk of functional decline, an impaired quality of life, a higher rate of falls, higher incidence of hospital admissions, and four-fold mortality risk, with a higher effect in older patients (5), but also present from earlier stages of adult life and postmenopausal age (1, 4).

The reversible nature of sarcopenia and its global health burden make it mandatory to detect the disease as soon as

possible (1, 3, 4, 6). The International Conference on Frailty and Sarcopenia Research Task Force (7), the European Menopause and Andropause Society (EMAS) and Australian Menopause Society (AMS), and the European Union Geriatric Medicine Society (EuGMS), among other scientific societies, have followed the strategy proposed by the World Health Organization (WHO) in its World report on Ageing and Health (8) (http://apps.who.int/iris/bitstream/10665/186463/1/9789240694811_eng.pdf?ua=1). Aiming to enhance a healthy aging process, the EuGMS has promoted the Special Interest Group (SIG) on sarcopenia, which is synchronizing the efforts of clinicians and researchers towards

the implementation of sarcopenia assessment from research into clinical practice (9). Among the SIG initiatives, the revised European consensus on definition and diagnosis (EWGSOP2) (1, 4) and the project of translation, validation, and cross-cultural adaptation of the SARC-F questionnaire into different world languages (10) are highlighted.

The SARC-F (11) is a self-reported 5-item questionnaire that has been shown to be the most valid and consistent screening tool for sarcopenia (11, 12), being incorporated into the EWGSOP2 as a mandatory first step in the diagnosis of sarcopenia (1). The SARC-F questionnaire is focused on the priorities and health perceptions of patients, incident adverse outcomes, and physical limitations (11, 12).

As a self-reported questionnaire, the cornerstone of SARC-F is the health professional's full understanding of the content of the patient's message, in order to set older patients' priorities and goals for care within an individual patient trajectory. The SIG on sarcopenia has taken the lead on the translation, validation, and cross-cultural adaptation of the SARC-F questionnaire into different world languages, providing indications and instructions for those centers considering project participation (10).

The SARC-F questionnaire has been translated to Mexican Spanish (13), spoken by 120 million people. However, there are meaningful differences between Spanish speaking communities in culture, economics, education, religion, medical environment, and healthcare delivery systems. Differences in grammatical structure and local expressions can be difficult for other Spanish speakers to understand, particularly in older age group.

The availability of a conceptual and cross-cultural translation of the questionnaire that can be used and understood in Spanish-speaking regions throughout the world is crucial to assess sarcopenia using EWGSOP2 criteria. Our study aimed to translate, adapt, and validate the English version of the SARC-F questionnaire for community-dwelling older adults in Spain. The overall goal is to facilitate early identification of older Spanish-speaking patients at risk of sarcopenia worldwide in order to implement an effective treatment approach (14).

Methods

Design

This is a cross sectional descriptive analysis of community-dwelling Spanish-speaking patients after their discharge from postacute care, reported according to the Standards for Reporting of Diagnostic Accuracy Studies (STARD) (Supplemental material 1 and Figure 1). The process of translation and validation of instruments developed by WHO(15) and the methodological report from the EuGMS SIG on Sarcopenia (10) recommend a two-phase procedure: Phase 1, translation and culturally-responsive conceptual-cultural adaptation of the SARC-F questionnaire for the European Spanish-speaking population, and Phase 2, the validation

process.

Setting

For phase 1, to perform the pre-testing and inter-rater reliability steps, healthy volunteers were recruited from visitors to a community-university hospital. For phase 2, the study was conducted during an 18-month period in an outpatient clinic focused on comprehensive geriatric assessment, as part of the follow-up of consecutive postacute patients (16) at least 6 months after being discharged from a postacute care unit focused on geriatric rehabilitation, in the same community-university hospital.

Population

For phase 1, two different populations were assessed. For the pre-test step, 10 older adults (≥ 65 years; 5 men and 5 women) were recruited in order to assess comprehension and cultural relevance of the questionnaire. They responded to the questions and completed a debriefing interview. Volunteers were included if they meet the WHO requirements (15): free of acute conditions affecting functionality and of significant cognitive problems hindering comprehension of the questionnaire.

A second population was recruited for the "inter-rater reliability" and "test-retest reliability" steps". In the same settings described above, an additional (non-duplicated) 20 older adults (10 men and 10 women) were selected and their responses of the SARC-F questionnaire were used to calculate the "inter-rater reliability" and "test-retest reliability" steps. All were free of acute conditions and significant cognitive problems.

For phase 2, clinical validation of the SARC-F questionnaire, the inclusion criteria were community-dwelling older adults (≥ 65 years old) able to understand the aim and purpose of the study and walk independently or with aids in safety conditions. Bed-bound patients were excluded (10).

Main outcome measures

The main outcomes for analysis were the metrological assessments that determine the diagnostic properties and the overall value of an assessment method: sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), diagnostic accuracy index, and positive likelihood ratio (LR+). Results of the SARC-F questionnaire were compared with the most frequently used and acknowledged diagnostic approaches as the reference standards: diagnosis of sarcopenia as defined by the EWGSOP(14) and the EWGSOP2 (1).

The cut-off points for validity of an assessment method were set (17, 18) and the concordance between the SARC-F questionnaire and EWGSOP and EWGSOP2 were consecutively determined with kappa (k) statistics (17, 19).

SARC-F questionnaire

The SARC-F questionnaire is based on the assessment of five domains: strength, walking across a room, rising from a

TRANSLATION & VALIDATION OF THE SPANISH VERSION OF THE SARC-F QUESTIONNAIRE TO ASSESS SARCOPENIA

Table 1
Characteristics of patients (n= 90)

	Total sample (n= 90)	Sarcopenia (EWGSOP)	Without sarcopenia (EWGSOP)	p	Sarcopenia (EWGSOP2)	Without sarcopenia (EWGSOP2)	p
Age (years)	81.4 (5.9)	81.5 (7.4)	81.3 (5.6)	0.890	82.9 (7.5)	80.8 (5.2)	0.227
Sex (M:F, % women)	22:68 (75.6%)	3:13 (14.4%)	19:55 (61.1%)	0.410	3:20 (22.2%)	19:48 (53.3%)	0.114
Barthel index (/100)	81.1 (20.6)	67.9 (30.0)	83.9 (16.8)	0.054	72.9 (26.3)	83.8 (17.5)	0.073
Lawton index (/8)	5 (2.7)	4.3 (3.6)	5.2 (2.5)	0.346	4.6 (3.3)	5.2 (2.5)	0.445
Body mass index (m/kg ²)	28.1 (6.4)	24.0 (3.7)	29.0 (6.5)	0.003	25.5 (9.2)	29.0 (4.9)	0.023
Handgrip strenght (kg)	16.0 (7.9)	11.7 (8.3)	17.0 (7.6)	0.001	12.5 (7.0)	17.3 (7.9)	0.013
Handgrip strenght (% ref.)	82.7 (35.9)	57.0 (31.9)	88.2 (34.4)	0.001	67.4 (31.3)	87.9 (36.1)	0.018
Fat-free mass (Kg)	40.1 (12.1)	13.8 (1.5)	16.8 (3.1)	<0.001	29.7 (5.7)	43.7 (11.7)	<0.001
Fat-free mass (% ref.)	93.3 (20.6)	82.8 (7.2)	114.5 (107.0)	0.241	70.4 (7.4)	101.1 (17.6)	<0.001
Gait speed (m/s)	0.66 (0.31)	0.6 (2.4)	0.7 (0.3)	0.752	0.6 (0.3)	0.7 (0.3)	0.509
SARC-F	3.8 (2.3)	5.9 (2.4)	3.3 (2.0)	<0.001	5.6 (2.2)	3.2 (2.0)	<0.001

(*) Frequencies are expressed in absolute numbers and percentages in parenthesis. Quantitative variables are expressed with mean and standard deviation; BMI: Body mass index; EWGSOP: European Working Group Sarcopenia in Older People (Cruz-Jentoft et al., 2010); EWGSOP2: Revised European consensus on definition and diagnosis (Cruz-Jentoft et al., 2018).

chair, climbing stairs, and number of falls in the last year. Each item is scored at one of three subjective levels of difficulty. A SARC-F score ≥ 4 indicates impaired physical function, identifying individuals who may have sarcopenia (11, 12).

Procedure for the translation, cross-cultural adaptation, and harmonization with the Spanish-Mexican version (Supplemental material 2)

Validation of the translation

Diagnosis of sarcopenia

The best-acknowledged definitions of sarcopenia were applied: the EWGSOP definition and the revised EWGSOP2 criteria (1). Muscle strength was assessed by handgrip strength, measured by a hand-held dynamometer (JAMAR, Nottinghamshire, UK) (20), expressed in kilograms and in percentage of normal population, and compared with reference values (21). Patients performed a maximum voluntary isometric contraction of finger flexor muscles. The highest value of three reproducible maneuvers (<10% variability between values) was used for analysis. EWGSOP and EWGSOP2 cut-off points were used respectively. Fat-free mass index (FFMI) was measured by bioimpedance (Bodystat 1500, Bodystat Ltd., Isle of Man, British Isles) in kilograms, as previously described (22). Values of FFM were divided by height² to obtain the FFMI.

Physical performance was assessed with gait speed in the 4-m walk test in patients able to walk at admission. For the purpose of this analysis, low walking speed was defined as walking slower than 0.8 m/s (23, 24).

SARC-F questionnaire was administered by trained medical specialists in Geriatric Medicine; neither this team nor the

health professionals doing the sarcopenia measurements had access to clinical information about the EWGSOP and EWGSOP2 results. There were no missing data on the SARC-F and the sarcopenia measurements.

Sample size calculation

The EuGMS sample size recommendation for SARC-F validation studies of at least 50-100 community-living men and women ≥ 65 years old in each country was followed (10).

Statistical analysis

Descriptive analysis of the sample applied percentages and frequency distributions for categorical variables and means (SD) for quantitative continuous variables. Univariate analysis was performed using Chi-square, Fisher exact or Student t tests, depending on the variables analyzed. Sensitivity, specificity, PPV, NPV, LR+, and accuracy index were described in percentages. To perform the “pre-test” step, quantitative observation and assessment were performed. Reliability (internal consistency) was assessed by the SARC-F Cronbach alpha. The assumption of normality was analyzed through normal probability graphs and using the Kolmogorov-Smirnov test corrected by the Lilliefors test. Concordance between the first and second raters, the test-retest reliability, and agreement between SARC-F and both EWGSOP criteria were determined with kappa (k) statistics. The cut-off points for reliability were set as follows: k <0, no agreement; 0-0.20, poor agreement; 0.21-0.40, fair agreement; 0.41-0.60, moderate agreement; 0.61-0.80 substantial agreement; 0.81-1, almost perfect agreement. A good concordance was considered if k value >0.6 (17, 19). P-value of p <0.05 was considered as statistically significant. Statistical analysis was performed using IBM SPSS Statistics

22 (IBM Corporation, SPSS, INC., Chicago, IL, USA).

Ethics

National and international research ethics guidelines were followed, including the Deontological Code of Ethics, Declaration of Helsinki, Spain's confidentiality law concerning personal data (Ley Orgánica 15/1999, 13 December, Protección de Datos de Carácter Personal), and the General Data Protection Regulation (GDPR) (EU) 2016/679 of the European Parliament and Council, dated 27 April 2016. The protocol was approved by the Ethics Committee (CEIC Parc de Salut Mar, ref. 2017/7210/I) and written consent was obtained from all participants.

Results

Spanish translation and cross cultural adaptation of SARC-F questionnaire.

Pretest. Inter-rater reliability and test-retest reliability steps (Supplemental file 3). Harmonization (Supplemental material 4) SARC-F questionnaire Spanish version (Supplemental material 5)

Spanish validation of SARC-F questionnaire

The flow of participants through the study is shown in a STARD diagram (Figure 1). From 208 potentially eligible subjects in the study period, 90 patients (81.4 ± 5.9 years old, 75.6% women) fulfilled inclusion criteria and 51 (56.7%) patients scored ≥4 in the SARC-F questionnaire. Table 1 shows the general and geriatric assessment results in the whole sample, and in patients with and without sarcopenia according to both EWGSOP and EWGSOP2 criteria. Table 2 shows Spearman correlation coefficients between the SARC-F total score and each individual item. Internal consistency (reliability) by Cronbach alpha was 0.779.

Table 2

Internal consistency of the Spanish version of the SARC-F questionnaire

SARC-F Item	Correlation	p-value
Strength	0.793	<0.001
Assistance in walking	0.749	<0.001
Rise from a chair	0.838	<0.001
Climb stairs	0.747	<0.001
Falls	0.300	0.006

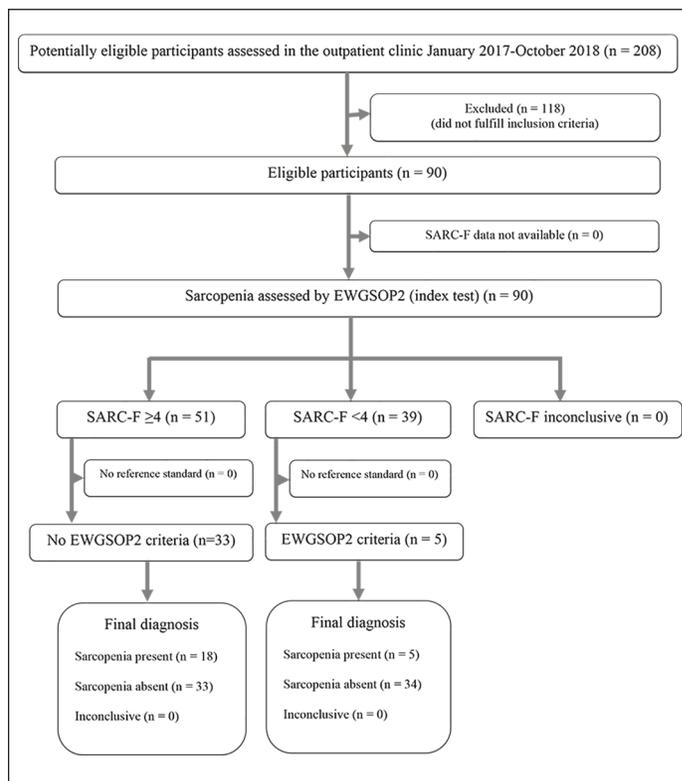
Cronbach alpha= 0.779. The item-total score correlations were analyzed by Spearman test.

The prevalence of sarcopenia was 17.8% according to EWGSOP criteria, and 25.6% when EWGSOP2 criteria were applied. Table 3 shows the distribution of patients with and without sarcopenia according to SARC-F (≥4), EWGSOP,

and EWGSOP2 criteria; the SARC-F questionnaire identified 13 of the 16 patients with sarcopenia according to EWGSOP, and 18 of the 23 patients according to EWGSOP2. Table 4 summarizes the values of sensitivity, specificity, PPV, NPV, accuracy, and LR+ statistics for the SARC-F questionnaire, using EWGSOP and EWGSOP2 criteria consecutively as the reference standards. Sensitivity and specificity of the SARC-F questionnaire according to EWGSOP criteria were 81.3% and 48.7% respectively, indicating poor validity; sensitivity and specificity of SARC-F questionnaire according to EWGSOP2 criteria were 78.3% and 50.8% respectively, indicating fair validity. Moreover, EWGSOP2 criteria showed a higher accuracy than EWGSOP (58 vs.54). The agreement between SARC-F and EWGSOP criteria was poor (k= 0.161), and between SARC-F and EWGSOP2 criteria was fair (k= 0.207). The highest accuracy (58%) was obtained for EWGSOP2, with sensitivity of 78.3% and specificity 50.8% (fair agreement).

Figure 1

STARD diagram to report flow of participants through the study (Bossuyt et al., 2015)



The correlation coefficients between the SARC-F (and each domain separately) and other clinical and functional measurements (age, basic and instrumental daily life activities, body composition, handgrip strength and physical performance) are shown in Table 5. There were no missing data and no adverse events derived from the administration of the tests were described.

TRANSLATION & VALIDATION OF THE SPANISH VERSION OF THE SARC-F QUESTIONNAIRE TO ASSESS SARCOPENIA

Table 3

Contingency table showing sample distribution according to the Spanish version of the SARC-F questionnaire, EWGSOP, and EWGSOP2 criteria (n= 90)

		EWGSOP criteria			p-value
		Sarcopenia	Without sarcopenia	Total	
SARC-F	Sarcopenia (≥4)	13	38	51*	p< 0.029
	Without sarcopenia (<4)	3	36	39	
Total		16 (17.8)**	74	90	
		EWGSOP2 criteria			p-value
		Sarcopenia	Without sarcopenia	Total	
SARC-F	Sarcopenia (≥4)	18	33	51*	p< 0.015
	Without sarcopenia (<4)	5	34	39	
Total		23 (25.6)***	67	90	

EWGSOP: European Working Group on Sarcopenia in Older People; EWGSOP2: Revised European consensus on definition and diagnosis; (*) Patients positively screened for sarcopenia by the Spanish version of the SARC-F questionnaire SARC-F; (**) Patients fulfilling EWGSOP criteria; (***) Patients fulfilling EWGSOP2 criteria.

Table 4

Criterion validity between the Spanish version of the SARC-F questionnaire, the EWGSOP, and the EWGSOP2 criteria

Spanish version of the SARC-F questionnaire						
	Se (%)	Sp (%)	PPV (%)	NPV (%)	Accuracy (%)	LR+
EWGSOP	81.3	48.7	25.5	92.3	54	2.14
EWGSOP2	78.3	50.8	35.3	87.2	58	2.4

EWGSOP: European Working Group on Sarcopenia in Older People; EWGSOP2: Revised European consensus on definition and diagnosis; LR+: positive likelihood ratio; NPV: negative predictive value; PPV: positive predictive value; Se: sensitivity; Sp: specificity.

Table 5

Validation between the Spanish version of the SARC-F questionnaire (each domain and total score) and other related measurements

	Strength		Assistance in walking		Rise from a chair		Climb stairs		Falls		Total score	
	Correlation	p-value	Correlation	p-value	Correlation	p-value	Correlation	p-value	Correlation	p-value	Correlation	p-value
Age (years)	0.374	<0.001	0.206	0.060	0.275	0.011	0.231	0.035	-0.094	0.395	0.284	0.007
Barthel index (/100)	-0.513	<0.001	-0.405	<0.001	-0.605	<0.001	-0.521	<0.001	-0.174	0.114	-0.648	<0.001
Lawton index (/8)	-0.491	<0.001	-0.341	0.002	-0.526	<0.001	-0.447	<0.001	-0.274	0.012	-0.583	<0.001
Body mass index (m/kg2)	-0.339	0.002	-0.110	0.322	-0.158	0.152	-0.260	0.018	0.026	0.814	-0.252	0.017
Handgrip strenght (kg)	-0.384	<0.001	-0.095	0.390	-0.327	0.002	-0.340	0.002	-0.043	0.700	-0.348	0.001
Handgrip strenght (% reference value)	-0.285	0.009	-0.075	0.497	-0.292	0.007	-0.274	0.012	-0.140	0.203	-0.308	0.003
Fat-free mass (Kg)	-0.389	<0.001	-0.212	0.052	-0.250	0.022	-0.408	<0.001	0.076	0.492	-0.365	<0.001
Fat-free mass (% reference value)	-0.466	<0.001	-0.308	0.004	-0.260	0.017	-0.400	<0.001	-0.027	0.806	-0.439	<0.001
Gait speed (m/s)	-0.457	<0.001	-0.190	0.083	-0.356	0.001	-0.385	<0.001	-0.147	0.181	-0.439	<0.001

Discussion

This study carried out the translation, cross-cultural adaptation, and validation of the SARC-F questionnaire to Spanish. The descriptor given to the current translation is in line with the names of other versions such as Brazilian Portuguese

(25) and Portuguese (in process of validation). The Mexican Spanish version of SARC-F is sensitive to the Mexican context and ensures its proper understanding by Mexican-Spanish speakers; however, the harmonization process highlighted the need of adapting expressions to make them more culturally responsive for the Spanish population. Similarly, the eventual

translation of SARC-F into Colombian or Argentinian Spanish languages might deserve further discussions (26).

The revised EWGSOP2 criteria incorporate, as a mandatory first step, the screening of sarcopenia by the SARC-F questionnaire validated into native languages; therefore, the SARC-F Spanish questionnaire is expected to be applied extensively in the upcoming years given that EWGSOP2 is acknowledged worldwide as a major milestone in sarcopenia.

Among the different screening methods, the most important is this simple 5-item SARC-F questionnaire, which has been shown to predict poor functional outcomes and mortality (6) (11). Its administration has been highly recommended for an early identification of sarcopenia in clinical settings and it is in process of translation into several languages worldwide (6). Originally developed in English (11), it has been already translated into Brazilian Portuguese (25), Chinese (27), Japanese (28), Korean (29), Mexican Spanish (13); translations into other languages such as Farsi, Hebrew, and Puerto Rican/Caribbean Spanish are in process of publication. Translations into the different European languages has been encouraged by EuGMS, involving specialists in Geriatric Medicine from the European Academy for Medicine of Ageing (EAMA) fellowship program. A French version (Belgium-France) has been just published (30) and the Catalan, Czech, Dutch, German, Norwegian, Polish, and Portuguese versions are in process.

As with other world languages, there are meaningful differences between the Spanish of Spain, Puerto Rican/Caribbean Spanish, and Mexican Spanish due to the diverse environments in culture, economics, education, religion, medicine, and healthcare delivery systems; they are the same language, but have different contexts. Native speakers value their languages very highly; therefore, preparation and validation of the questionnaire for use in as many languages as possible is imperative.

There was also a controversial cross-cultural adaptation about the 10 lbs. weight used for assessment of muscle mass in the original English version, as the Mexican Spanish version translated them literally from lb. into Kg, as 4.5 Kg ($0.45359 \text{ Kg} \times 10 = 4.5 \text{ Kg}$). Although this weight is familiar and used in daily life in the United Kingdom, United States, Puerto Rico, Guatemala, Cuba, Ecuador and Panamá, it is seldom used in other countries. The EuGMS SIG on sarcopenia assessment was crucial in highlighting the need of finding a balance between maximal optimization of the harmonization process with the Mexican Spanish version and providing a logical and useful tool for daily life. The 5 kg weight used in the final version was discussed and adopted as the most intuitive and understandable adaptation for the Spanish version because the 5 Kg size is widely used and involved in instrumental activities of daily living, such as shopping, cooking and cleaning; it is the common large size for bottled water, liquid cleaning products, and pet food. The appropriateness of this cross-cultural adaptation was observed from the beginning of the translation

phase with the 10 healthy volunteers (pretest step): all subjects easily identified these tasks in their daily life and spontaneously identified a familiar object weighing 5 Kg weight before self-reporting their perception of their own physical abilities or limitations.

A good screening method must be inexpensive, easy to administer, and minimally invasive; for confident use in clinical practice, assessment methods must also be reliable and valid. Reliability mainly involves good accuracy and precision. In our study, SARC-F accuracy was 0.58. Sensitivity and specificity are the main metrological proprieties of validity that reveal the likelihood of false positives and negatives. Screening methods should be highly sensitive (e.g. high probability of detecting sarcopenia) and as specific as possible (high probability that subjects without sarcopenia will screen negative). In geriatric care, sensitivity of a test becomes particularly important to discard the diagnosis of a disabling disease. On the other hand, good specificity is important to confirm diagnosis and allow early and targeted interventions.

One of the strengths of our study is the validation of the SARC-F questionnaire by using the recently revised European consensus on definition and diagnosis (EWGSOP2) criteria, which incorporates the findings in sarcopenia research during the last decade (1). This strength might counteract the main limitation of our study, which is the lack of available values of appendicular lean mass due to the model of bioimpedance analysis used, and therefore the impossibility to apply the operational definitions of sarcopenia previously developed by the International Working Group on Sarcopenia (IWGS), the Society of Sarcopenia, Cachexia and Wasting disorders, and the Foundation of NIH Sarcopenia Project. A very limited use of these definitions has been reported in Europe (30) and to the authors' knowledge, there are no published data on their use in the target population where the questionnaire is expected to be administered. The second strength of our study is the rigorous procedure followed in the translation and cross-cultural adaptation according to the guidelines developed by WHO; finally, our Spanish version has the additional value of being rigorously harmonized with the Spanish Mexican version (13).

The SARC-F questionnaire is a feasible tool, suitable for bedside assessment in community-dwelling older patients. This culturally-responsive SARC-F Spanish version eases the implementation of the assessment of sarcopenia in Spain and a wide diffusion is expected. Further studies are required to validate the SARC-F questionnaire in all European languages. The availability of SARC-F in European languages, as part of the EWGSOP2 for sarcopenia assessment, is aligned with the implementation of emerging research into clinical practice (Acting-Research philosophy) (9); It involves crucial implications for research, clinical practice, and policy towards a better aging process/optimal aging.

TRANSLATION & VALIDATION OF THE SPANISH VERSION OF THE SARC-F QUESTIONNAIRE TO ASSESS SARCOPENIA

Conclusions

SARC-F, the most valid and consistent screening tool for sarcopenia was translated into Spanish. The translation and cross-cultural adaptation procedure followed WHO recommendations and a harmonization with the Mexican Spanish version was performed.

The validation of the Spanish version of the SARC-F questionnaire applied the EWGSOP2 criteria, which incorporates the findings in sarcopenia research during the last decade. As this screening is mandatory to apply EWGSOP2, wide diffusion of the Spanish version of the questionnaire is expected. It involves crucial implications for research, clinical practice, and policy towards optimal aging.

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References

1. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T, et al. Sarcopenia: revised European consensus on definition and diagnosis. *Age Ageing*. 2018 Oct 12;1–16.
2. Cederholm T, Jensen GL, Correia MITD, Gonzalez MC, Fukushima R, Higashiguchi T, et al. GLIM criteria for the diagnosis of malnutrition - A consensus report from the global clinical nutrition community. *Clin Nutr*. 2018 Sep 3;
3. Anker SD, Morley JE, von Haehling S. Welcome to the ICD-10 code for sarcopenia. *J Cachexia Sarcopenia Muscle*. 2016 Dec;7(5):512–4.
4. Sánchez-Rodríguez D, Annweiler C, Cederholm T. A translational approach for the clinical application of recently updated definitions of malnutrition (GLIM) and sarcopenia (EWGSOP2). *Maturitas*. Elsevier; 2018 Nov 22;
5. Beaudart C, Zaaia M, Pasleau F, Reginster J-Y, Bruyère O. Health Outcomes of Sarcopenia: A Systematic Review and Meta-Analysis. Wright JM, editor. *PLoS One*. 2017 Jan 17;12(1):e0169548.
6. Locquet M, Beaudart C, Reginster J-Y, Petermans J, Bruyère O. Comparison of the performance of five screening methods for sarcopenia. *Clin Epidemiol*. 2018 Dec;10:71–82.
7. Vellas B, Fielding RA, Bens C, Bernabei R, Cawthon PM, Cederholm T, et al. Implications of ICD-10 for Sarcopenia Clinical Practice and Clinical Trials: Report by the International Conference on Frailty and Sarcopenia Research Task Force. *J frailty aging*. 2018;7(1):2–9.
8. World Health Organisation. Global strategy and action plan on ageing and health (2016–2020). World Heal Organ. 2016;
9. Beauchet O, Fantino B, Annweiler C. The ‘Action-Research’ philosophy: from bedside to bench, to bedside again. *Int J Clin Pract*. 2012 May;66(5):517–517.
10. Bahat G, Yilmaz O, Oren MM, Karan MA, Reginster JY, Bruyère O, et al. Cross-cultural adaptation and validation of the SARC-F to assess sarcopenia: methodological report from European Union Geriatric Medicine Society Sarcopenia Special Interest Group. *Eur Geriatr Med*. Springer International Publishing; 2018 Feb 21;9(1):23–8.
11. Malmstrom TK, Morley JE. SARC-F: a simple questionnaire to rapidly diagnose sarcopenia. *J Am Med Dir Assoc*. 2013 Aug;14(8):531–2.
12. Malmstrom TK, Miller DK, Simonsick EM, Ferrucci L, Morley JE. SARC-F: A symptom score to predict persons with sarcopenia at risk for poor functional outcomes. *J Cachexia Sarcopenia Muscle*. 2016 Mar;7(1):28–36.
13. Parra-Rodríguez L, Szejf C, García-González AI, Malmstrom TK, Cruz-Arenas E, Rosas-Carrasco O. Cross-Cultural Adaptation and Validation of the Spanish-Language Version of the SARC-F to Assess Sarcopenia in Mexican Community-Dwelling Older Adults. *J Am Med Dir Assoc*. 2016 Dec 1;17(12):1142–6.
14. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, et al. Sarcopenia: European consensus on definition and diagnosis. *Age Ageing*. 2010;39(April):412–23.
15. WHO | Process of translation and adaptation of instruments. WHO. World Health Organization; 2010;
16. Sánchez-Rodríguez D, Marco E, Miralles R, Guillén-Solà A, Vázquez-Ibar O, Escalada F, et al. Does gait speed contribute to sarcopenia case-finding in a postacute rehabilitation setting? *Arch Gerontol Geriatr*. 2015 May 29;61(2):176–81.
17. Baek M-H, Heo Y-R. Evaluation of the efficacy of nutritional screening tools to predict malnutrition in the elderly at a geriatric care hospital. *Nutr Res Pract*. 2015 Dec;9(6):637–43.
18. Van Bokhorst-de van der Schueren MAE, Guaitoli PR, Jansma EP, de Vet HCW. Nutrition screening tools: does one size fit all? A systematic review of screening tools for the hospital setting. *Clin Nutr*. 2014 Feb;33(1):39–58.
19. Landis JR, Koch GG. An application of hierarchical kappa-type statistics in the assessment of majority agreement among multiple observers. *Biometrics*. 1977 Jun;33(2):363–74.
20. Roberts HC, Denison HJ, Martin HJ, Patel HP, Syddall H, Cooper C, et al. A review of the measurement of grip strength in clinical and epidemiological studies: towards a standardised approach. *Age Ageing*. 2011 Jul;40(4):423–9.
21. Luna-Heredia E, Martín-Peña G, Ruiz-Galiana J. Handgrip dynamometry in healthy adults. *Clin Nutr*. 2005;24:250–8.
22. Deurenberg P, van der Kooy K, Evers P, Hulshof T. Assessment of body composition by bioelectrical impedance in a population aged greater than 60 y. *Am J Clin Nutr*. 1990 Jan;51(1):3–6.
23. Sánchez-Rodríguez D, Marco E, Ronquillo-Moreno N, Miralles R, Mojal S, Vázquez-Ibar O, et al. The PSSMAR study. Postacute sarcopenia: Supplementation with β -hydroxyMethylbutyrate after resistance training: Study protocol of a randomized, double-blind controlled trial. *Maturitas*. 2016 Dec;94:117–24.
24. Lauretani F, Russo CR, Bandinelli S, Bartali B, Cavazzini C, Di Iorio A, et al. Age-associated changes in skeletal muscles and their effect on mobility: an operational diagnosis of sarcopenia. *J Appl Physiol*. 2003 Nov 10;95(5):1851–60.
25. Barbosa-Silva TG, Menezes AMB, Bielemann RM, Malmstrom TK, Gonzalez MC. Enhancing SARC-F: Improving Sarcopenia Screening in the Clinical Practice. *J Am Med Dir Assoc*. 2016 Dec 1;17(12):1136–41.
26. Cervantes I, Bonet JM, General S, Rodríguez-Ponga R, Director De Gabinete S, María Martínez J, et al. EL ESPAÑOL UNA LENGUA. 2009. 2009–2009 p.
27. Cao L, Chen S, Zou C, Ding X, Gao L, Liao Z, et al. A pilot study of the SARC-F scale on screening sarcopenia and physical disability in the Chinese older people. *J Nutr Heal Aging*. 2014 Mar 29;18(3):277–83.
28. Ida S, Murata K, Nakadachi D, Ishihara Y, Imataka K, Uchida A, 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 Oct 10;29(5):935–42.
29. 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*. Elsevier; 2018 Jan 1;19(1):40–45.e1.
30. Beaudart C, Locquet M, Bornheim S, Reginster J-Y, Bruyère O. French translation and validation of the sarcopenia screening tool SARC-F. *Eur Geriatr Med*. 2018 Feb 21;9(1):29–37.