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Original Study

Cross-Cultural Adaptation and Validation of the Spanish-Language Version of the SARC-F to Assess Sarcopenia in Mexican Community-Dwelling Older Adults

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A B S T R A C T

Objectives: To cross-culturally adapt and validate the Spanish-language version of the SARC-F in Mexican community-dwelling older adults.
Design: Cross-sectional analysis of a prospective cohort.
Setting: The FraDySMex study, a 2-round evaluation of community-dwelling adults from 2 municipalities in Mexico City.
Participants: Participants were 487 men and women older than 60 years, living in the designated area in Mexico City.
Measurements: Information from questionnaires regarding demographic characteristics, comorbidities, mental status, nutritional status, dependence in activities of daily living, frailty, and quality of life. Objective measurements of muscle mass, strength and function were as follows: skeletal muscle mass index (SMI) was taken using dual-energy x-ray, grip strength using a hand dynamometer, 6-meter gait speed using a GAIT Rite instrumented walkway, peak torque and power for knee extension using a isokinetic dynamometer, lower extremity functioning measured by the Short Physical Performance Battery (SPPB), and balance using evaluation on a foam surface, with closed eyes, in the Modified Clinical Test of Sensory Integration. The SARC-F scale translated to Spanish and the consensus panels' criteria from European, international, and Asian sarcopenia working groups were applied to evaluate sarcopenia.
Results: The Spanish language version of the SARC-F scale showed reliability (Cronbach alfa = 0.641. All items in the scale correlated to the scale's total score, rho = 0.43 to 0.76), temporal consistency evaluated by test-retest (CCI = 0.80), criterion validity when compared to the consensus panels' criteria (high specificity and negative predictive values). The scale was also correlated to other measures related to sarcopenia (such as age, quality of life, self-rated health status, cognition, dependence in activities of daily living, nutritional status, depression, gait speed, grip strength, peak torque and power for knee extension, SPPB, balance, SMI, and frailty).
Conclusion: The SARC-F scale was successfully adapted to Spanish language and validated in community-dwelling Mexican older adults.

Sarcopenia is a geriatric syndrome characterized by progressive and generalized loss of skeletal muscle mass, strength, and function.[1] Regardless of the criteria applied to define sarcopenia, it has been associated with adverse outcomes, such as falls, poor quality of life, disability, and death.[2–7] It is very important to diagnose sarcopenia in clinical practice because there is increasing evidence that therapeutic interventions can improve outcomes.[8]

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However, the diagnosis of sarcopenia is not an easy task. For a long time, the condition was defined as loss of muscle mass alone. In 2010, the European Working Group on Sarcopenia in Older People (EWGSOP) recommended that the diagnostic criteria of the syndrome must contain both low muscle mass and impaired muscle function (defined either by muscle strength or physical performance).[1] In accordance with the European approach, the International Working Group on Sarcopenia (IWGS) and the Asian Working Group for Sarcopenia (AWGS) published definitions of sarcopenia covering similar criteria.[7,9] Following these recommendations in day-to-day clinical practice is not practical, as the measurement of muscle mass and function is time-consuming and requires specialized equipment.

The SARC-F questionnaire is a simple and rapid screening instrument for sarcopenia,[10] already validated in the United States, China, and Hong Kong.[11–13] Its ability to predict physical limitation is comparable to the consensus panels EWGSOP, IWGS, and AWGS.[14] The instrument includes 5 components: Strength, Assistance in walking, Rising from a chair, Climbing stairs, and Falls—all easily assessed by the primary care physician or other health care professional. It is still not validated in Spanish-speaking countries. In Mexico, because of the limited access to health services and poor socioeconomic conditions, the diagnosis of sarcopenia according to the consensus panel recommendations is beyond reach, and the SARC-F could be a reliable tool to be used in clinical practice. The present study is a cross-cultural adaptation and validation of the Spanish-language version of the SARC-F in Mexican community-dwelling older adults.

Methods

Study Population and Design

The present study is a cross-sectional analysis of data from individuals 60 years and older, participating in the FraDySMex (Frailty, Dynapenia and Sarcopenia in Mexican Adults) Study. Details of the FraDySMEx study design and participants selection can be found elsewhere.[15] In brief, it is a cohort of community-dwelling adults, mainly from 2 municipalities in the southeast of Mexico City, including individuals (1) who were able to mobilize with or without assisting devices, and (2) who were able to answer the study questionnaire for themselves or with the help of a caregiver if the Mini-Mental State Examination (MMSE) score was 10 points or less.[16] Those who were institutionalized, with decreased alertness for any cause, and those who had had any acute or chronic condition, that in the judgment of the medical staff, could affect the ability of answering the questionnaire proposed and complete the objective evaluation, were excluded. The study had a 2-round design: the first round assessed individuals from October 2014 to December 2014. In the second round, from October 2015 to December 2015, new persons were added to the cohort, and a proportion of participants in the first round were re-evaluated. In both rounds, the individuals were submitted to a series of objective evaluations by the medical staff at the Functional Evaluation Research Laboratory at Instituto Nacional de Geriatría in Mexico City. The study was approved by the Angeles Mocel General Hospital Ethics Committee and registered by the Instituto Nacional de Geriatría under the number DI-PI-002/2014. Written informed consent was obtained from all participants prior to the study.

Physical Measurements

Body composition was measured by dual-energy x-ray absorptiometry (DXA) (Hologic Discovery-WI; Hologic, Bedford, MA). The appendicular skeletal muscle mass was calculated as the sum of appendicular lean mass minus bone mineral content of both arms and legs. The skeletal muscle mass index (SMI) was then obtained dividing the appendicular skeletal muscle mass by height squared. Grip strength was measured using a hydraulic hand dynamometer (Jamar, Duluth, MN). Three measure readings were taken from each side, and the highest measure either side was considered. Gait speed was recorded in a 6-meter walk in the GAIT Rite (platinum 20) instrumented walkway (204 × 35.5 × .25 inches, sample rate 100 Hz), positioned along a straight section of the walkway. Muscle performance of knee extensors was measured using a Biodex System Pro isokinetic dynamometer (Biodex Medical System, Shirley, NY). The selected range of motion for assessment was 90°, with 90° of knee flexion for the starting position, and the angular velocity was 60°. Three measure readings were taken from each side and verbal feedback was given during the trials in order to encourage participants to move the dynamometer lever as fast and as vigorously as possible. The highest measurements of peak torque and power values for knee extension were recorded for this study. Finally, to evaluate balance, the Modified Clinical Test of Sensory Integration (m-CTSIB) (Balance System SD Operational/Service Manual; Biodex Medical Systems) was performed in each subject. It is a time test that imposes postural challenges to explore balance in a firm or foam surface, with and without vision. In the present study, we considered only the evaluation in the foam surface, with closed eyes. The Sway Index obtained in the test is the standard deviation of the stability index. The higher the Sway Index, the more unsteady the subject was during the test.

Definitions of Sarcopenia According to Different Methods

The SARC-F questionnaire includes 5 components: Strength, Assistance in walking, Rise from a chair, Climb stairs, and Falls (Appendix 1). The scale score ranges from 0 to 10 (0-2 points to each component; 0 = best to 10 = worst). Scores from 0 to 3 represent healthy status and 4+ represent sarcopenia. The translation-retranslation method was used to cross-culturally adapt the scale to the Spanish language.[17] The instrument was blindly translated to Spanish by 2 professionals, and the differences between both versions were adjusted by a multidisciplinary panel of experts consisting of a nurse, an internist, a rehabilitation doctor, and 2 geriatricians. The Spanish-language version was then retranslated to English by 2 other translators. The original scale was compared to the retranslated version by the experts' panel, without finding significant differences. The final Spanish-language version was applied to 12 older individuals not included in the present analysis, to make sure it was comprehensible and it can be seen in Appendix 1.

According with the EWGSOP, sarcopenia was defined as low muscle mass, low muscle strength and/or low physical performance. Cutoff points were defined based on the lowest quintile values of the current study population as follows: SMI $\leq$6.54 kg/m^2 for men and $\leq$5.37 kg/m^2 for women; grip strength $\leq$20 kg for men and $\leq$12 kg for women; and gait speed $\leq$0.85 m/s for men and $\leq$0.7 m/s for women.[1] The IWGS consensus defines sarcopenia as low muscle mass (SMI $\leq$7.23 kg/m^2 for men and SMI $\leq$5.67 kg/m^2 for women) and gait speed $<$1 m/s for both genders.[7] Finally, the AWGS criteria are low muscle function (grip strength $\leq$20 kg for men and $\leq$12 kg for women, ie, the lowest quintile for the current study population; and/or gait speed $\leq$0.8 m/s for both genders) plus low muscle mass (SMI $\leq$6.54 kg/m^2 for men and $\leq$5.37 kg/m^2 for women, ie, the lowest quintile for the current study population).[9]

SARC-F Reliability and Validity

SARC-F was evaluated used the following procedures: (1) the reliability was obtained by the Cronbach alpha and the correlation of each item in the questionnaire with the scale's total score; (2) the temporal consistency was evaluated by test-retest (1-week interval between the 2 measurements); (3) the criterion validity was assessed

Table 1
Characteristics of Subjects (N = 487)

Characteristic	Mean ± SD or n (%)
Age, years	73.2 ± 8.0
Sex, women	390 (80.1)
Low education, 6 years or less*	134 (27.4)
MMSE	26.6 ± 3.4
CES D-7	4.9 ± 4.9
EQ-VAS*	79.8 ± 16.0
MNA	25.3 ± 3.1
ADL	97.9 ± 5.5
IADL	4.7 ± 0.7
SPPB	8.6 ± 2.3
Charlson Comorbidity Index	1.8 ± 1.6
SMI kg/m^2*	6.3 ± 1.2
BMI kg/m^2	28.1 ± 4.6
Gait speed, cm/s*	93.4 ± 26.1
Grip strength, kg*	19.3 ± 7.1
Peak torque for knee extension, Nm*	57.2 ± 25.6
Power for knee extension, J/s*	28.9 ± 14.6
Balance (Sway Index in a foam surface with closed eyes)	4.1 ± 1.1
Frailty phenotype	0.95 ± 1.1
FRAIL scale	1.00 ± 1.06
SARC-F	1.95 ± 1.90

BMI, body mass index.
*There was 1 missing datum for education, 1 for EQ-VAS, 9 for SMI, 2 for gait speed, 12 for grip strength, 86 for peak torque for knee extension, and 89 for power for knee extension.

through the calculation of the sensibility, specificity, and positive and negative predictive values of the SARC-F in relation to sarcopenia defined according to the EWGSOP, IWGS, and AWGS; and (4) the associations between SARC-F and physical measurements, such as grip strength, gait speed, SMI, balance, and muscle performance of knee extensors (peak torque and power) were also assessed.

The SARC-F scale was also validated against other measurements related to sarcopenia, such as (1) age, (2) the 7-item Center for Epidemiologic Studies Depression Scale Short Form (CES D-7)[18] to evaluate depression, (3) the Barthel Index to assess basic activities of daily living (ADL),[19] (4) the Lawton Instrumental Activities of Daily Living Scale to assess instrumental activities of daily living (IADL),[20] (5) the Charlson comorbidity index to evaluate comorbidities,[21] (6) the Mini Nutritional Assessment (MNA) to measure nutritional status,[22] (7) the visual analog scale from the EuroQol (EQ-VAS) to assess quality of life,[23] (10) the Short Physical Performance Battery (SPPB) to evaluate lower extremity functioning,[24] and (11) and the frailty phenotype[25] and the FRAIL scale[15] to assess frailty. The total score obtained in all the scales was considered.

Statistical Analysis

Data were analyzed using PASW Statistics version 18 (SPSS, Chicago, IL). Two sample size calculations were performed according to the Pearson correlation formula. The first was calculated based on a minimum expected interrater correlation of 0.5 between the 2 SARC-F measurements. The security (Z1_a/2) value was 1.96 and the power (Z1_b) value was 0.84, which meant 29 participants were enough to prove the test. Nevertheless, a total of 68 subjects were included. The second sample size was calculated considering the lowest correlation (rho = 0.20) between SARC-F and gait speed <0.8 m/s previously reported,[12] resulting in 194 participants. However, we included 487 subjects.

Descriptive statistics are reported as means ± standard deviations for continuous variables and as frequencies for categorical variables. The SARC-F's Cronbach alpha assessed the reliability. The Spearman test was used to correlate measurements without normal distribution: (1) each item in the SARC-F with the total scale's score (internal consistency), (2) other measurements related to sarcopenia and the SARC-F total score (validation against other measurements), (3) and other measurements related to sarcopenia and each domain in the SARC-F scale. The difference between the frequencies of sarcopenia obtained by the SARC-F, EWGSOP, IWGS, and AWGS were compared using the Pearson chi-square test. As criterion validity, the sensibility, specificity, positive and negative predictive values, and positive and negative likelihood ratios of the SARC-F scale were calculated, in relation to sarcopenia defined by the 3 consensus panels. The temporal consistecy was assessed by the intraclass correlation coefficient (ICC) of the test-retest evaluation. $P < .05$ was considered statistically significant.

Table 2
Internal Consistency of the SARC-F

SARC-F Item	Correlation	*P*
Strength	0.757	.000
Assistance in walking	0.432	.000
Rise from a chair	0.619	.000
Climb stairs	0.734	.000
Falls	0.452	.000

Cronbach alpha = 0.641. The item-total score correlations were analyzed by Spearman test.

Results

The FraDySMex cohort included 606 individuals, of which 487 were 60 years and older. Of these, 284 persons were evaluated in the first round and 203 were added in the second round for this cross-sectional analysis. Participants' ages were 73.2 ± 8.0 years and 80.1% were women. Characteristics of the study population, including demographics, comorbidities, mental status, quality of life, nutritional status, dependence in activities of daily living, mobility, physical measurements, and frailty status are shown in Table 1. The SARC-F identified 95 individuals (19.5%) with sarcopenia and 392 (80.5%) without this condition. There was no need to make any substantial change in the final Spanish-language version of the SARC-F in the scale adaptation.

Reliability

Table 2 shows the internal consistency of the SARC-F. The Cronbach alpha was 0.641. All items were correlated to the scale's total score (rho ranging from 0.43 to 0.76). The SARC-F test-retest ICC was 0.80.

Validity

Table 3 shows the frequencies of sarcopenia according to the SARC-F and the 3 consensus panels. The frequency of sarcopenia was significantly different between the SARC-F, EWGSOP, the IWGS, and the AWGS definitions. The sensibility, specificity, positive and negative predictive values, and positive and negative likelihood ratios of SARC-F, in comparison with the consensus (criterion validity), are shown in Table 4.

There was a statistically significant correlation between the SARC-F total score and other measures related to sarcopenia: age, EQ-VAS,

Table 3
Frequencies of Sarcopenia Obtained by SARC-F and Different Sarcopenia Consensus

N = 487	SARC-F	EWGSOP*		IWGS*		AWGS*	
Without sarcopenia	392 (80.5)	439 (90.7)	*P* = .004	377 (79.2)	*P* = .009	429 (88.8)	*P* = .018
With sarcopenia	95 (19.5)	45 (9.3)		99 (20.8)		54 (11.2)	

The frequency differences were analyzed by Pearson chi-square test.
*There were 3 missing data for the EWGSOP, 11 for IWGS, and 4 for AWGS.

Table 4
Criterion Validity Between SARC-F and Different Sarcopenia Consensus

	Sensitivity Cutoff ≥4	Specificity Cutoff ≥4	PPV	NPV	PLR	NLR
EWGSOP*	35.6%	82.2%	17.0%	92.6%	2.00	0.78
IWGS*	28.3%	83.3%	30.8%	81.6%	1.69	0.86
AWGS*	31.5%	82.1%	18.2%	90.5%	1.76	0.83

NLR, negative likelihood ratio; NPV, negative predictive value; PLR, positive likelihood ratio; PPV, positive predictive value.
*There were 3 missing data for EWGSOP, 11 for IWGS, and 4 for AWGS.

MMSE, ADL, IADL, MNA, CES D-7, Charlson Comorbidity Index, MNA, gait speed, grip strength, peak torque and power for knee extension, SPPB, balance, SMI, frailty phenotype, and FRAIL scale. Spearman correlations ranged from −0.51 to 0.48, as seen in Table 5. When correlating these other measurements with each domain in the SARC-F scale, we found that Strength was correlated with all of them. Assistance in Walking, Rise from a Chair, and Climb Stairs were correlated with all, with the exception of SMI. Falls were correlated with CES D-7, MNA, gait speed, grip strength, peak torque and power for knee extension, SPPB, balance, SMI, and FRAIL scale. These correlations are also shown in Table 5.

Discussion

This is the first study to cross-culturally adapt and validate the Spanish-language version of the SARC-F scale, a quick and simple instrument to aid the evaluation of sarcopenia in older adults in Spanish-speaking countries, without the need of objective measurements. The scale showed convincing internal and temporal consistency reliability, and criterion validity. It was also correlated with other measurements that are associated with sarcopenia.

In the present study, the frequency of sarcopenia measured by the SARC-F was 19.5%, by the EWGSOP was 9.3%, by the IWGS was 20.8%, and by the AWGS was 11.2%. In a systematic review of studies done in various countries, the prevalence of sarcopenia in older adults living in the community, according to the EWGSOP definition, ranged from 1% to 29%.[26] In Mexico, the frequency of sarcopenia in community-living older women is 14.6% according to the EWGSOP criteria[27] and 41.1% according to the Baumgartner equation (sarcopenia defined only by low muscle mass).[28] In a cohort of community-living older adults of 70 years and older in Mexico City, the prevalence of sarcopenia according with the EWGSOP criteria (muscle mass measured by calf circumference) was 33.6%.[29]

The discrimination of sarcopenia by the Spanish-language version of the SARC-F was different from the ones obtained using the diagnostic criteria of the EWGSOP, IWGS, and AWGS. Moreover, when compared to these 3 consensus panels' criteria for sarcopenia, the SARC-F showed low sensitivity and positive predictive values, and high specificity and negative predictive values. A similar result was found in a previous study in a Taiwan Chinese population.[13] All the dimensions of the SARC-F scale are subjective whereas the consensus definitions are objective, and this difference could explain the lack of correlation between them. As the SARC-F has high specificity and negative predictive value, people classified as not having sarcopenia by the scale are probably true negatives. The likelihood ratios obtained in this study corroborate these findings in a probabilistic way. In the clinical setting, the scale can be very useful as a first-step evaluation of sarcopenia in older adults. It is a simple, reliable, and quick instrument that does not require additional measurements when it identifies subjects as not sarcopenic. With positive results, a more extensive assessment of muscle mass and function would be recommended.

The correlations between the SARC-F total score and other measures related to sarcopenia in older adults were satisfactory. The scale correlated with age, EQ-VAS, MMSE, ADL, IADL, MNA, CES D-7, Charlson Comorbidity Index, MNA, gait speed, grip strength, peak torque and power for knee extension, SPPB, balance, SMI, frailty phenotype, and FRAIL scale. A previous study in 3 different American populations found the association of sarcopenia measured by the SARC-F with IADL, SPPB, time to complete 5 rises and returns from a chair, gait speed, grip strength, and peak force for knee extension, depending on the population analyzed.[11] Similarly, in a Chinese study, a SARC-F score ≥4 was associated with grip strength, gait speed, the timed up and go test, SPPB, fear of falling, IADL, and ADL measured by the Physical Self-Maintenance Scale.[12] When evaluating the correlations of each domain of the SARC-F scale with other measures related to sarcopenia, Malmstrom and colleagues, in agreement with our study, found that IADL, SPPB, gait speed, and peak force for knee extension were associated with all the domains[11]; however, grip strength was not found to be associated with falls in this study.

There are some limitations in this study. Although this is the first study to validate the Spanish-language version of the SARC-F, it cross-culturally adapted the scale to Mexican Spanish, and some cultural language differences may be of concern when using the scale in other Spanish-speaking countries. Another limitation is that the sample is

Table 5
Validation Between the SARC-F (Each Domain and Total Score) and Other Related Measurements

	Strength		Assistance in Walking		Rise from a Chair		Climb Stairs		Falls		Total Score	
	Correlation	*P*	Correlation	*P*	Correlation	*P*	Correlation	*P*	Correlation	*P*	Correlation	*P*
Age	0.319	.000	0.204	.000	0.192	.000	0.207	.000	0.062	.174	0.320	.000
EQ-VAS	−0.225	.000	−0.187	.000	−0.227	.000	−0.207	.000	−0.070	.125	−0.291	.000
ADL	−0.250	.000	−0.281	.000	−0.201	.000	−0.266	.000	−0.070	.124	−0.281	.000
IADL	−0.325	.000	−0.352	.000	−0.226	.000	−0.272	.000	−0.060	.184	−0.331	.000
CES D-7	0.197	.000	0.136	.003	0.227	.000	0.167	.000	0.108	.017	0.251	.000
Charlson Comorbidity Index	0.200	.000	0.120	.008	0.101	.026	0.172	.000	0.071	.116	0.233	.000
MNA	−0.297	.000	−0.250	.000	−0.265	.000	−0.206	.000	−0.101	.026	−0.327	.000
Gait speed	−0.397	.000	−0.315	.000	−0.313	.000	−0.384	.000	−0.112	.013	−0.475	.000
Grip strength	−0.380	.000	−0.182	.000	−0.212	.000	−0.249	.000	−0.119	.009	−0.382	.000
Peak torque for knee extension	−0.396	.000	−0.222	.000	−0.304	.000	−0.356	.000	−0.178	.000	−0.472	.000
Power for knee extension	−0.394	.000	−0.221	.000	−0.345	.000	−0.400	.000	−0.186	.000	−0.508	.000
SPPB	−0.404	.000	−0.280	.000	−0.312	.000	−0.363	.000	−0.123	.007	−0.464	.000
Balance (Sway Index)	0.223	.000	0.119	.009	0.145	.001	0.090	.047	0.097	.032	0.230	.000
SMI	−0.121	.008	−0.028	.537	0.000	.996	0.007	.884	−0.116	.011	−0.104	.023
Frailty phenotype	0.347	.000	0.317	.000	0.266	.000	0.267	.000	0.012	.800	0.347	.000
FRAIL scale	0.345	.000	0.269	.000	0.361	.000	0.473	.000	0.103	.023	0.479	.000

The correlations were analyzed by Spearman test.

urban, and the results may not represent the National Mexican population that includes a large proportion of rural and semirural individuals. In these less protected Mexican communities, the frequency of sarcopenia may be higher than the ones found in our study. Finally, this study is a cross-sectional analysis of a prospective cohort and it was not possible to assess any predictive validity. A longitudinal study of the cohort is needed to further validate the SARC-F scale in Mexico.

In summary, the SARC-F scale was cross-culturally adapted and validated to be used in the clinical setting, in community-dwelling older adults, from Spanish-speaking countries, to aid in the diagnosis of sarcopenia. In Mexico, as the burden of sarcopenia is of big concern, the early identification of sarcopenic subjects and the implementation of preventive and targeted measures would have a positive impact.

Supplementary Data

Supplementary data related to this article can be found online at http://dx.doi.org/10.1016/j.jamda.2016.09.008.

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