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Translation and validation of the Korean version of the Sarcopenia Quality of Life (SarQoL-K®) questionnaire and applicability with the SARC-F screening tool

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Abstract

Purpose The purpose of this paper was to translate and validate into the Korea language and setting the Sarcopenia Quality of Life (SarQoL®) questionnaire.

Methods The participants consisted of 450 individuals in Namgaram-2 cohort who were followed up in 2019–2020. The study participants were divided into four groups: (1) SARC-F < 4, (2) SARC-F ≥ 4 and robust grip strength, (3) SARC-F ≥ 4, low grip strength, robust muscle mass, (4) SARC-F ≥ 4, low grip strength, and low muscle mass. To assess construct validity, population with sarcopenia-associated symptoms (SARC-F ≥ 4) apart from the Korean SarQoL (SarQoL-K®) completed the Korean versions of two generic questionnaires, the Short Form-36 and the EuroQoL 5-dimension. To validate the Korean SarQoL®, we assessed its validity (discriminative power, construct validity), reliability (internal consistency, test–retest reliability), and floor/ceiling effects.

Results The SarQoL-K® questionnaire was translated without major difficulties. The mean SarQoL-K scores were 72.9 (95%, CI; 71.2–74.6) in SARC-F < 4, 54.6 (95%, CI; 50.7–58.3) in SARC-F ≥ 4 and robust grip strength, 47.0 (95%, CI; 43.8–50.1) in SARC-F ≥ 4, low grip strength, robust muscle mass, 46.6 (95%, CI; 43.0–50.1) in SARC-F ≥ 4, low grip strength, and low muscle mass. The results indicated good discriminative power across each four groups ($p < 0.001$), high internal consistency (Cronbach's alpha of 0.866), and excellent test–retest reliability (ICC = 0.977, 95% CI 0.975–0.979). No floor- or ceiling-effects were observed.

Conclusions This is the first study to confirm the reliability and validity of the Korean version of the SarQoL®. We demonstrated that the population with sarcopenia-associated symptoms (determined using the SARC-F questionnaire) has a lower quality of life.

Keywords Cross cultural adaptation · Korea · Sarcopenia · Quality of life

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Introduction

Recent studies have shown that the population of the world is rapidly aging. The proportion of people aged 65 and over exceeded 7% of the total population in 2000 and 14.2% in 2017. In particular, aging is progressing faster in rural area [1, 2].

Sarcopenia is a condition characterized by a progressive and general loss of skeletal muscle mass and strength leading to increased risk of adverse effects such as physical disabilities and death [3, 4]. Therefore, the progression of sarcopenia is associated with a strong decline in the quality of life. In addition, a thorough assessment of patients with sarcopenia should provide information that impacts the health-related quality of life of the patient [5, 6].

To understand the needs of elderly patients and patients with sarcopenia, it is important and necessary to assess the quality of life through an appropriate questionnaire [7]. Until recently, the quality of life of patients with sarcopenia was measured using general quality of life tools because there were no clear, validated patient questionnaire tools to evaluate the quality of life of patients with sarcopenia [5, 7, 8].

In 2015, Beaudart et al. [9] developed the first quality of life assessment questionnaire for sarcopenia, the SarQoL®. Since then, studies have been published from many countries to demonstrating the validity of the SarQoL® [10–14]. Changes were made to the diagnostic criteria for sarcopenia in 2019 [15].

The purpose of this paper was to translate and validate into the Korea language and setting the Sarcopenia Quality of Life (SarQoL®) questionnaire.

Materials and methods

Participants

The participants included 450 individuals in the Namgaram-2 cohort who were followed up until February 2020. The Namgaram-2 cohort was designed to study the relationship between musculoskeletal disorders and limitations in daily activity in the elderly and is composed of elderly people over 65 years old in six rural area [16, 17]. They have no cognitive impairment and who are not currently suffering from cancer, stroke, or myocardial infarction. The assessment of cognitive function was based on the cutoffs for the MMSE taking into consideration education and age. A total of 1010 participants were registered during the first period from March 2016 to December 2018, and the follow-up investigations started in March 2019. Several surveys (SarQoL-K®, SARC-F, SF-36, EQ-5D) have been applied to this study during the second follow-up phase. All surveys were conducted on a one-on-one basis after trained researchers interviewed the subjects, explained the content of the survey, and obtained written informed consent from the subjects.

In addition, this study was approved by the Institutional Review Board of Gyeongsang National University (approval number: GIRB-A19-0031).

Korean translation of the SarQoL

The first main step of this study consisted of the translation process, which was based on the guidelines formulated by Beaton et al., and was conducted in 5 stages. First, the questionnaire was independently translated from English to Korean by two bilingual translators, both native Korean speakers. Second, the two translators cooperatively produced a synthesis of the initial translations. In the third phase, two bilingual translators independently translated the synthesis version of the questionnaire back into English. Next, an expert committee composed of 3 translators, a methodologist, and a linguist, compared the different translations and created the prefinal version of the questionnaire.

In the final phase, the prefinal version of the questionnaire was administered to 10 subjects who were afterwards interviewed about the questionnaire's comprehensibility and the language used in the questionnaire. The feedback from these interviews was presented to the key investigators, who decided on the need for modifications and established the final version of the SarQoL-K® questionnaire.

Assessment of sarcopenia

The European Working Group on Sarcopenia in Older People 2 (EWGSOP2) updated the definition of sarcopenia. This updated definition of sarcopenia incorporates the following: low muscle strength as the first key determinant of diagnosis, and advice on using the SARC-F questionnaire or clinical suspicion to assess sarcopenia-associated symptoms to identify individuals at risk of sarcopenia. Furthermore, the EWGSOP2 recommended a pathway of Find-Assess-Confirm-Severity.

We validated the SarQoL-K® with the EWSGOP2 criteria [15], and case finding (SARC-F $\geq$ 4), assessment (muscle strength) and confirmation (skeletal muscle mass) were performed. The SARC-F questionnaire assesses 5 components: Strength, assistance in walking, rising from a chair, climbing stairs, and falls [18]. Hand grip strength was measured using an analogue dynamometer (TK 5001 Grip-A, Takei, Tokyo, Japan). In a standing position, the shoulder was aligned with the torso, with the elbow fully extended, with the wrist maintaining a neutral

position (0°), and the grip with maximal strength was measured. Using the deadweight force standard specified by the Korea Research Institute of Standards and Science (KRISS), 4 calibrations were performed with a unit of 5 kgf loaded up to 70 kgf. A jig conforming to the deadweight force standard was applied so that the weight could be loaded consistently [19]. After measuring three times on both sides (right and left), the highest grip strength was selected. EWSGOP2 recommended using either dual-energy X-ray absorptiometry (DEXA) or multifrequency bioelectrical impedance analysis (BIA) in usual clinical care, both height-adjusted, for measuring muscle mass in sarcopenia diagnosis, we assessed by using bioelectrical impedance analysis (BIA; InBody 720, Biospace Co., Ltd., Seoul, Korea).

The cutoff for the SARC-F was 4 points or more, and hand grip strength was classified as "robust" if over 28 kg for men or 18 kg for women. Low muscle mass was classified as a height-adjusted skeletal muscle mass index (SMI) value < 5.7 kg/m^2 for women and < 7.0 kg/m^2 for men [20].

Based on the evaluations, subjects were first classified by SARC_F score into one group with less than 4 points and the other group with 4 points or more (suspected sarcopenia). The group with 4 points or more was further divided into those that retained their grip power and those with a reduced grip strength (probable sarcopenia). In total, the study group was divided into the following four groups: (1) SARC-F < 4, (2) SARC-F ≥ 4 and robust grip strength, (3) SARC-F ≥ 4, low grip strength, and robust muscle mass, and (4) SARC-F ≥ 4, low grip strength, and low muscle mass (confirmed sarcopenia) (Fig. 1).

Psychometric testing of the Korean SarQoL

Verification of the psychometric properties of the Korean version of the SarQoL was conducted according to the original developer's instructions. The validation on SarQoL questionnaire was assessed per measurement property according to the COnsensus-based Standards for the selection of health Measurements Instruments (COSMIN) checklist [21]. Specifically, the internal consistency, test–retest reliability, floor- and ceiling-effects, discriminative power, and validity (construct validity) were determined. The internal consistency was measured with Cronbach's alpha, additionally, the correlation between the total SarQoL-K® value and each domain was analyzed.

Only participants (namely, sarcopenia patients) with SARC-F > 4, low grip strength and low muscle mass were eligible for the test–retest. The intraclass correlation coefficient (ICC) was used to test the reliability between the first and retest overall scores of the SarQoL-K® questionnaire and between the individual domain scores of the SarQoL-K®.

Floor- and ceiling-effects were defined as a high percentage of the population having the lowest or the highest score, respectively. Floor- or ceiling-effects greater than 15% were considered to be significant [22].

Discriminative power was evaluated by comparing the total score and the individual domain scores of the SarQoL® questionnaire between the four groups of subjects. Specifically, the mean scores of the group with a SARC-F score of less than 4 points, the group with a SARC-F score of 4 or more points with hand grip strength maintained in the normal range, the group with a SARC-F score of 4 or more points with decreased hand grip strength, and the group with a SARC-F score of 4 or more points with decreased

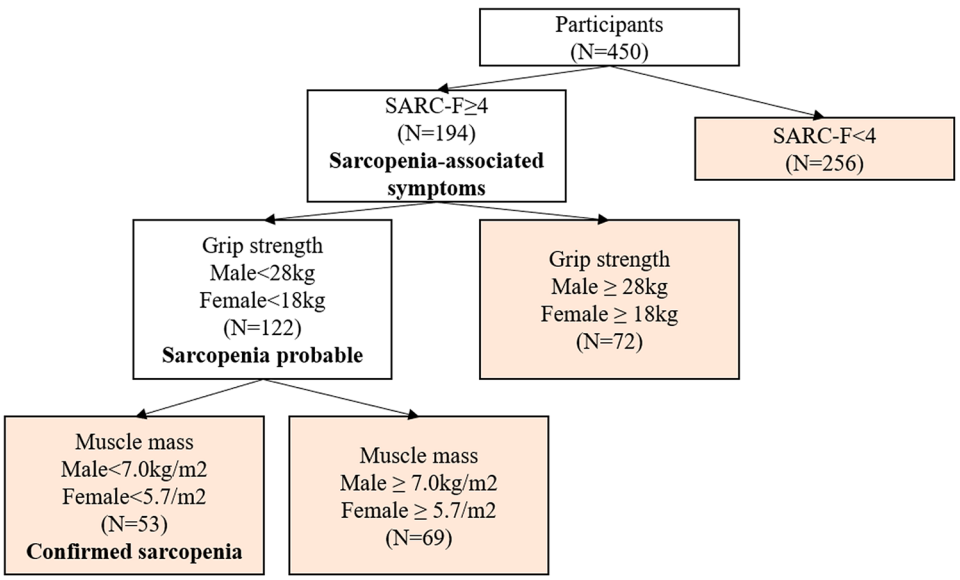

Fig. 1 Flowchart of this study

hand grip strength and decreased skeletal muscle mass were evaluated.

Construct validity was assessed using convergent validity and divergent validity. In both cases, spearman's rank correlation was performed on subjects with SARC-F scores of 4 or more ($n = 194$). For convergent validity, correlation analyses were performed for the similar domains of the SarQoL-K® and SF-36 (physical functioning, role physical, general health, pain, and vitality) and the EQ-5D-3L total (utility score), mobility, and usual activities domains. Divergent validity was analyzed using the correlations between the SF-36 emotional wellbeing domain and the EQ-5D-3L dimensions of self-care, pain/discomfort, and anxiety/depression [10, 11].

Materials

The SF-36 questionnaire [23] is composed of 36 items measuring health-related quality of life (HRQOL). In this study, the physical functioning, role limitation due to physical, general health, body pain, and vitality domains were used for convergent validity, and only emotional wellbeing domain item was examined for divergent validity. In the elderly, answering too many questions at one time can lead to poor concentration and lower the validity of the study. Therefore, 30 of the 36 questions were included in the study, excluding 3 questions regarding limitations due to emotional problems, 2 questions regarding social functioning, and 1 question regarding health change. The EQ-5D questionnaire [24] records the level of self-reported problems in five domains (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression), with each domain having three levels: no problems, some problems, and extreme problems.

The SarQoL® questionnaire consists of 22 questions encompassing 7 domains and 55 items, and is self-administered [9]. The 7 domains of health-related quality of life covered in the questionnaire are: "Physical and Mental Health", "Locomotion", "Body Composition", "Functionality", "Activities of Daily Living", "Leisure Activities" and "Fears". Most questions (19 out of 22) use a Likert scale of frequency or intensity among which the respondents choose the answer most applicable to them. Results are presented as numerical scores between 0 and 100, both for the individual domains and for the Overall score. More information on the SarQoL® questionnaire can be found on www.sarqol.org.

Data analysis

Internal consistency was confirmed using Cronbach's alpha coefficient, and test–retest reliability between the first and the second scores of the SarQoL-K® questionnaire was confirmed using the ICC (two-way random effects, absolute agreement, singe rater/measurement) [13]. Cronbach's alpha and ICC were considered to indicate good reliability at values of 0.7 or more [25].

Normality of continuous variables was tested using the Kolmogorov–Smirnov test. The normal distribution consists of 95% confidence intervals using the mean and standard error, the analysis also compared the averages of the four groups using analysis of variance (ANOVA). Tukey's test was used for *post-hoc* analysis, and frequency analysis was performed using the chi-square test.

Correlations between the total SarQoL-K® value and each domain were analyzed using Pearson's correlation coefficients. However, the correlation between the SF-36 and EQ-5D was analyzed using spearman's rank correlation coefficient.

All analyses were performed using SAS software, version 9.3, and statistical significance was met at $p < 0.05$.

Results

Characteristics of the study sample

The Korean SarQoL® was used to survey a total of 450 people. The mean age was 73.9 ± 6.6 years, the majority of participants were women (339 (87.7%)), and 275 (61.1%) were living alone. In the SARC-F questionnaire, 194 (43.1%) had sarcopenia-associated symptoms (SARC-F ≥ 4). In addition, 122 of those 194 (62.9%) had reduced hand grip strength, and 53 out of the 122 (43.4%) with reduced hand grip strength had a loss of skeletal muscle mass. Finally, 122 (27.1%) of all subjects were identified as having sarcopenia probable, and 53 (11.8%) of subjects had confirmed sarcopenia (Table 1; Fig. 1).

Psychometric properties of the SarQoL-K®

The total SarQoL-K® mean values of the four groups were significantly different ($p < 0.001$) (Table 2). There were also significant differences in the *post hoc* test values between the group with a SARC-F score less than 4 (72.9) and in the 3 groups with a SARC-F score 4 or more (54.6, 47.0, and 46.6) ($p < 0.001$). In the 3 groups with SARC-F scores 4 or more, there were statistically significant differences between the group in which hand grip strength was maintained and each of the two groups in which hand grip strength was reduced ($p = 0.022$, $p = 0.013$). There was no difference in SarQoL-K® values between the two groups with reduced grip strength (robust muscle mass and low muscle mass). The trends were similar in each domain.

In all subjects, the SarQoL-K® values were significantly lower in total and six domains (except fears) for the group with a SARC-F score of four or more than the three groups with a SARC-F score of less than four. The fears domain

Table 1 Characteristics of the participants unit: *N* (%)

Variable	All		Group								
			SARC < 4		SARC_F ≥ 4 (Suspected sarcopenia)						
					Grip strength(robust)		Grip strength (Low) (Sarcopenia probable)				
							Muscle mass (robust)		Muscle mass (Low) (Confirmed sarcopenia)		*p*
Age											
Mean ± sd	73.9 ± 6.57		72.0 ± 5.82		74.1 ± 6.23		76.7 ± 6.13		79.1 ± 7.08		< 0.001
Sex											
Men	51	(11.3)	38	(74.5)	5	(9.8)	2	(3.9)	6	(11.8)	0.002
Women	399	(87.7)	218	(54.6)	68	(17.0)	67	(16.8)	47	(11.8)	
Living alone											
No	175	(38.9)	138	(78.9)	22	(12.6)	15	(8.6)	0	(0.0)	< 0.001
Yes	275	(61.1)	118	(42.9)	50	(18.2)	54	(19.6)	53	(19.3)	
Educational level											
~ 6 years	301	(66.9)	141	(46.8)	56	(18.6)	57	(18.9)	47	(15.6)	< 0.001
7 ~ years	149	(33.1)	115	(77.2)	16	(10.7)	12	(8.1)	6	(4.0)	
Smoking											
No	439	(97.6)	247	(56.3)	70	(15.9)	69	(15.7)	53	(12.1)	0.229
Yes	11	(2.4)	9	(81.8)	2	(18.2)	0	(0.0)	0	(0.0)	
Total	450	(100.0)	256	(56.9)	72	(16.0)	69	(15.3)	53	(11.8)	

was significantly different in the group with reduced muscle strength.

The internal consistency measured using Cronbach's alpha was excellent with a value or 0.866. Additionally, there were significant correlations with all domains in the correlation analysis between the total SarQoL-K® value and each domain values (Table 3). Although leisure activities ($r = 0.322$, $p = 0.002$) and fear ($r = 0.652$, $p < 0.001$) showed low or medium correlation coefficients, the correlation coefficients for all other areas were high, ranging from 0.823 to 0.925 ($p < 0.001$).

The results of the construct validity analyses are all presented in Table 3. In general, good correlations were found across the SarQoL-K® with both the SF-36 subscales and the EQ-5D questionnaire. When comparing domains similar to the SarQoL-K® (convergent validity) using the SF-36 and EQ-5D questionnaires, the Spearman's rho correlations were 0.326 and 0.807 ($p < 0.001$ for both) for the SF-36 vitality and physical functioning subscales, respectively, and − 0.429 ($p < 0.001$) and 0.468 ($p < 0.001$) for the EQ-5D usual activities and utility scores, respectively. When comparing different domains (divergent validity), weaker correlations were found between the SarQoL-K® and the two questionnaires. In particular, the correlation between the SarQoL-K® and the SF-36 emotional wellbeing domain was − 0.058, whereas the correlations between the SarQoL-K® and EQ-5D were all low, ranging between − 0.072 (anxiety/depression) and − 0.284 (pain).

Results of test–retest reliability of only 53 patients with SARC-F ≥ 4, low grip strength and low muscle mass. The agreement between the test and retest of the SarQoL-K® overall score was excellent (ICC = 0.977, 95% CI 0.975–0.979). For the individual domains, ICCs ranged from 0.840 to 0.993, with the lowest ICC being found for the domain leisure (ICC = 0.840, 95% CI 0.720–0.910) (Table 4). There was no floor- or ceiling-effect observed, as no subjects presented with either the lowest score or the highest score in the SarQoL-K® questionnaire.

Discussion

The principle finding of this study was that the newly translated Korean SarQoL (R) questionnaire demonstrated itself to be a valid and reliable instrument for measuring quality of life in older people diagnosed with the EWGSOP2 algorithm for sarcopenia. The process of cross-cultural adaptation was completed with no major issues arising, resulting in a thorough, complete, and comprehensible SarQoL-K®. The validity of the SarQoL-K® (available for download at the official site https://www.sarqol.org/sites/sarqol/files/SarQo

Table 2 Discriminative power of the Korean SarQoL

SarQoL® questionnaire	All ($N=450$)		SARC < 4 ($N=256$)		SARC_F ≥ 4 (Suspected sarcopenia)						p
					Grip strength (robust) ($N=72$)		Grip strength (Low) (Probable sarcopenia)				
							Muscle mass (robust) ($N=69$)		Muscle mass (Low) (Confirmed sarcopenia) ($N=53$)		
	Mean (sd)	95% CL	Mean	95% CL	Mean	95% CL	Mean	95% CL	Mean	95% CL	
D1—physical and mental health	58.5	(56.7–60.2)	67.5	(65.5–69.5)	50.2	(45.9–54.5)	46.0	(42.4–49.5)	42.6	(39.5–45.7)	< 0.0001
D2—locomotion	60.5	(58.1–63.0)	73.0	(70.3–75.7)	47.6	(42.0–53.3)	46.5	(40.4–52.6)	38.7	(34.7–43.1)	< 0.0001
D3—body composition	58.8	(56.9–60.7)	68.9	(66.8–71.0)	50.4	(46.0–54.7)	46.7	(43.5–50.0)	37.2	(35.0–39.3)	< 0.0001
D4—functionality	66.1	(64.3–68.0)	75.8	(73.8–77.8)	57.5	(53.1–61.9)	50.8	(48.5–55.0)	51.4	(47.5–55.3)	< 0.0001
D5—activities of daily living	63.2	(61.3–65.1)	74.3	(72.4–76.3)	56.1	(52.1–60.0)	45.5	(41.9–49.2)	42.4	(37.7–47.0)	< 0.0001
D6—leisure activities	54.0	(51.9–56.1)	57.2	(54.4–59.9)	49.9	(44.7–55.0)	48.4	(42.9–54.0)	51.4	(44.7–58.2)	0.007
D7—fears	81.2	(79.4–82.7)	86.0	(84.1–87.9)	81.9	(79.3–84.9)	71.7	(67.9–75.6)	69.6	(66.7–72.5)	< 0.0001
Total score	62.9	(61.2–64.6)	72.9	(71.2–74.6)	54.6	(50.7–58.3)	47.0	(43.8–50.1)	46.6	(43.0–50.1)	< 0.0001

Group*	D1 (physical and mental health)	D2 (locomotion)	D3 (body composition)	D4 (functionality)	D5 (activities of daily living)	D6 (leisure activities)	D7 (fears)	Total score
A vs B	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.068	0.139	< 0.0001
A vs C	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.073	< 0.0001	< 0.0001
A vs D	< 0.0001	0.001	< 0.0001	< 0.0001	< 0.0001	0.474	0.002	< 0.0001
B vs C	0.324	0.128	0.422	0.131	0.014	0.808	0.013	0.042
B vs D	0.205	0.933	0.035	0.334	0.021	0.824	0.029	0.013
C vs D	0.593	0.340	0.146	0.912	0.606	0.708	0.703	0.955

Post-hoc analysis results (p value) by turkey method

*A: SARC < 4, B: SARC_F ≥ 4 and Grip strength (robust): C: SARC_F ≥ 4, Grip strength (low) and Muscle mass (robust): D: SARC_F ≥ 4, Grip strength (low) and Muscle mass (low)

Table 3 Correlations of the total score of the Korean SarQoL questionnaire with individual domains of the Korean SarQoL, the SF-36 questionnaire, and the EQ-5D questionnaire

	Correlations coefficient	95% Confidence interval	*p* value
Domain-total correlations			
D1—physical and mental health*	0.875	(0.852–0.895)	< 0.001
D2—locomotion*	0.891	(0.870–0.909)	< 0.001
D3—body composition*	0.823	(0.791–0.851)	< 0.001
D4—functionality*	0.890	(0.869–0.908)	< 0.001
D5—activities of daily living*	0.925	(0.911–0.937)	< 0.001
D6—leisure activities*	0.322	(0.237–0.403)	0.002
D7—fears*	0.652	(0.596–0.702)	< 0.001
Convergent validity†			
SF-36 Physical functioning	0.807	(0.772–0.837)	< 0.0001
SF-36 Vitality	0.326	(0.240–0.406)	< 0.0001
SF-36 Body pain	0.724	(0.677–0.765)	< 0.0001
SF-36 General Health	0.607	(0.545–0.662)	< 0.0001
SF-36 Role limitation due to physical	0.765	(0.724–0.801)	< 0.0001
EQ-5D Utility score	0.468	(0.393–0.538)	< 0.0001
EQ-5D Mobility	− 0.446	(− 0.517–− 0.351)	< 0.0001
EQ-5D Usual activities	− 0.429	(− 0.502–− 0.351)	< 0.0001
Divergent validity†			
SF-36 emotional wellbeing	− 0.058	(− 0.150–0.034)	0.217
EQ-5D Self-care	− 0.120	(− 0.200–0.012)	0.231
EQ-5D Pain-discomfort	− 0.287	(− 0.355–− 0213)	0.045
EQ- 5D Anxiety-depression	− 0.072	(− 0.149–0.016)	0.478

*Pearson's correlations (scores of the SarQoL® questionnaire normally distributed)

†Spearman's correlations (data of the SF-36 and the EQ-5D questionnaires not normally distributed)

Table 4 Test–retest reliability of the Korean SarQoL questionnaire using intraclass correlation coefficient

	ICC	95% Confidence Interval	*p* value
Total	0.977	(0.975–0.979)	< 0.001
D1—physical and mental health	0.966	(0.950–0.980)	< 0.001
D2—locomotion	0.993	(0.990–0.997)	< 0.001
D3—body composition	0.981	(0.970–0.990)	< 0.001
D4—functionality	0.991	(0.986–0.996)	< 0.001
D5—activities of daily living	0.981	(0.960–0.990)	< 0.001
D6—leisure activities	0.860	(0.740–0.930)	< 0.001
D7—fears	0.960	(0.920–0.980)	< 0.001
ICC—intraclass coefficient correlation			

L%20Korean.pdf) was tested in 450 subjects and was analyzed using the latest validation procedures.

In general, the process of cultural adaptation is important because assessment of quality of life reflects cultural and ethnic characteristics. In the present study, the SarQoL® questionnaire proved to be very useful in cross-cultural translation for Koreans.

Among the domains of the SarQoL-K®, discriminative power was significantly lower in the group with a SARC-F score of 4 points or more (sarcopenia-associated symptoms) compared to the groups with a SARC-F score of less than 4 points (robust group), except fears domain. The mean scores in the domain for fear were statistically significantly lower in the group that reduced hand grip strength (sarcopenia probable) compared to the group with maintained hand grip strength. The results of this study are a little bit different from previous studies that have analyzed discriminative power according to the presence or absence of sarcopenia. Specifically, we found that cases with sarcopenia-associated symptoms measured only using the SARC-F survey had a significantly lower SarQoL-K® overall score. In addition, there were significant effects on quality of life due to

a reduction of grip strength and muscle mass in cases of sarcopenia-associated symptoms. In the seven domains, the SarQoL-K® value was significantly lowest in the sarcopenia group in the four domains of physical and mental health, locomotion, body composition, activities of daily living, and the muscle strength and muscle mass reduction in the group with sarcopenia-associated symptoms was more dangerous.

Both the internal consistency and the test–retest reliability analysis showed excellent results, indicating that the tool's results are highly reproducible. This trend showed similar results in other SarQoL® validity studies [10–14]. Therefore, irrespective of the language the questionnaire is conducted in, the reliability of the SarQoL® is high.

The correlation analysis conducted to verify the validity of the construct showed a high correlation between the SF-36 questionnaire and the EQ5D questionnaire. However, there was a low but statistically significant correlation with the EQ5D item related to pain (correlation coefficient = − 0.287). Considering previous studies demonstrating that sarcopenia is associated with pain in knee arthritis [26], the pain parameter may be related to knee arthritis pain. However, patients with sarcopenia and knee OA need to be confirmed later.

The most clinically significant finding in this study was the confirmed validity of the SARC-F questionnaire, which could be used primarily in the community. The diagnosis of sarcopenia in a non-hospital, community population should first be confirmed through the questionnaire before evaluating muscle strength or muscle mass. For this purpose, the EWGSOP2 [15] and AWGS-2019 [20] were recently released. SarQoL® scores were significantly lowered in the group with a SARC-F score of 4 or more, even in the group that had no decrease in hand grip and muscle mass. This result provides additional evidence of the feasibility of using the SARC-F questionnaires in the community. SARC-F has a low-to-moderate sensitivity and a very high specificity to predict low muscle strength [27]. As such, SARC-F will mostly detect group with sarcopenia-associated symptoms. When the population are identified by the SARC-F questionnaire, active intervention should be conducted in anticipation of a decrease in health-related QOL.

There was limitation in this study. The subjects may not have been an accurate sample representing the Korean elderly. However, there were no problems in the cross-cultural adaptation process of the Korean version. Additional large-scale studies are needed to verify the characteristics of the entire Korean elderly population as they relate to the SarQoL®.

In conclusion, this is the first study to demonstrate that the population with risk of sarcopenia (determined using the SARC-F questionnaire) has a lower quality of life. In addition, we confirmed the reliability and validity of the Korean version of the SarQoL®.

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Compliance with ethical standards

Conflict of interest All authors declare that they have no conflict of interest.

References

1. Statistics Korea. (2019). Statics Korea, 2018. https://kostat.go.kr/portal/korea/kor/nw/1/1/index.board?bmode=read&aSeq=370779.
2. Chang, A. Y., Skirbekk, V. F., Tyrovolas, S., Kassebaum, N. J., & Dieleman, J. L. (2019). Measuring population ageing: An analysis of the Global Burden of Disease Study 2017. *Lancet Public Health, 4*(3), e159–e167.
3. Fried, L. P., Tangen, C. M., Walston, J., et al. (2001). Frailty in older adults: Evidence for a phenotype. *Journals of Gerontology. Series A, Biological Sciences and Medical Sciences, 56*(3), M146–M156.
4. Ferrucci, L., Guralnik, J. M., Studenski, S., Fried, L. P., Cutler, G. B., Jr., Walston, J. D., et al. (2004). Designing randomized, controlled trials aimed at preventing or delaying functional decline and disability in frail, older persons: A consensus report. *Journal of the American Geriatrics Society, 52*(4), 625–634.
5. Han, E. S., Lee, Y., & Kim, J. (2014). Association of cognitive impairment with frailty in community-dwelling older adults. *International Psychogeriatrics, 26*(1), 155–163.
6. Bunt, S., Steverink, N., Olthof, J., van der Schans, C. P., & Hobbelen, J. S. M. (2017). Social frailty in older adults: A scoping review. *European Journal of Ageing, 14*(3), 323–334.
7. Jeong, H. S., Lee, D. W., Park, K. H., Lee, Y. K., Bae, S. H., Kang, M. J., et al. (2013). Clinical factors related to frailty estimated by the Korean frailty index. *Journal of the Korean Geriatrics Society, 17*(2), 71–78.
8. Makizako, H., Shimada, H., Doi, T., Tsutsumimoto, K., & Suzuki, T. (2015). Impact of physical frailty on disability in community-dwelling older adults: A prospective cohort study. *British Medical Journal Open, 5*(9), e008462.
9. Beaudart, C., Biver, E., Reginster, J. Y., Rizzoli, R., Rolland, Y., Bautmans, I., et al. (2015). Development of a self-administrated quality of life questionnaire for sarcopenia in elderly subjects: The SarQoL. *Age and Ageing, 44*(6), 960–966.
10. Beaudart, C., Edwards, M., Moss, C., Reginster, J. Y., Moon, R., Parsons, C., et al. (2017). English translation and validation of the SarQoL ®, a quality of life questionnaire specific for sarcopenia. *Age and Ageing, 46*(2), 271–276.
11. Konstantynowicz, J., Abramowicz, P., Glinkowski, W., Taranta, E., Marcinowicz, L., Dymitrowicz, M., et al. (2018). Polish validation of the SarQoL®, a quality of life questionnaire specific to sarcopenia. *Journal of Clinical Medicine, 7*(10), 323.
12. Fábrega-Cuadros, R., Martínez-Amat, A., Cruz-Díaz, D., Aibar-Almazán, A., & Hita-Contreras, F. (2020). Psychometric properties of the Spanish version of the sarcopenia and quality of life, a quality of life questionnaire specific for sarcopenia. *Calcified Tissue International, 106*(3), 274–282.
13. Tsekoura, M., Billis, E., Gliatis, J., Tsepis, E., Matzaroglou, C., Sakkas, G. K., et al. (2020). Cross cultural adaptation of the Greek sarcopenia quality of life (SarQoL) questionnaire. *Disability and Rehabilitation, 42*(7), 1006–1012.

14. Geerinck, A., Scheppers, A., Beaudart, C., Bruyère, O., Vandenbussche, W., Bautmans, R., et al. (2018). Translation and validation of the Dutch SarQoL®, a quality of life questionnaire specific to sarcopenia. *Journal of Musculoskeletal and Neuronal Interactions, 18*(4), 463–472.
15. Cruz-Jentoft, A. J., Bahat, G., Bauer, J., et al. (2019). Sarcopenia: Revised European consensus on definition and diagnosis. *Age and Ageing, 48*(1), 16–31.
16. Choi, Y. S., Kim, M. J., Lee, G. Y., Seo, Y. M., Seo, A. R., Kim, B., et al. (2019). The Association between frailty and disability among the elderly in rural areas of Korea. *International Journal of Environmental Research and Public Health, 16*(14), 2481.
17. Yoo, J. I., Kim, M. J., Na, J. B., Chun, Y. H., Park, Y. J., Park, Y., et al. (2018). Relationship between endothelial function and skeletal muscle strength in community dwelling elderly women. *Journal of Cachexia, Sarcopenia and Muscle, 9*(6), 1034–1041.
18. Kim, S., Kim, M., & Won, C. W. (2018). Validation of the Korean version of the SARC-F questionnaire to assess sarcopenia: Korean frailty and aging cohort study. *Journal of American Medical Directors Association, 19*(1), 40–45.e1.
19. Ha, Y. C., Yoo, J. I., Park, Y. J., Lee, C. H., & Park, K. S. (2018). Measurement of uncertainty using standardized protocol of hand grip strength measurement in patients with sarcopenia. *Journal of Bone Metabolism, 25*(4), 243–249.
20. Chen, L. K., Woo, J., Assantachai, P., Auyeung, T. W., Chou, M. Y., Iijima, K., et al. (2020). Asian Working Group for Sarcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. *J Am Med Dir Assoc., 21*(3), 300–307.e2.
21. Mokkink, L. B., Terwee, C. B., Patrick, D. L., Alonso, J., Stratford, P. W., Knol, D. L., et al. (2010). The COSMIN study reached international consensus on taxonomy, terminology, and definitions of measurement properties for health-related patient-reported outcomes. *Journal of Clinical Epidemiology, 63*(7), 737–745.
22. Terwee, C. B., Bot, S. D. M., de Boer, M. R., Windt, D. A., Knol, D. L., Dekker, J., et al. (2007). Quality criteria were proposed for measurement properties of health status questionnaires. *Journal of Clinical Epidemiology, 60*(1), 34–42.
23. Syddall, H. E., Martin, H. J., Harwood, R. H., Cooper, C., & Aihie, S. A. (2009). The SF-36: A simple, effective measure of mobility-disability for epidemiological studies. *Journal of Nutrition, Health and Aging, 13*(1), 57–62.
24. Rabin, R., & de Charro, F. (2001). EQ-5D: A measure of health status from the EuroQol Group. *Annals of Medicine, 33*(5), 337–343.
25. Munro, B. (2005). *Statistical methods for health care research* (5th ed., pp. 239–259). Philadelphia: Lippincott Williams and Wilkins.
26. Shorter, E., Sannicandro, A. J., Poulet, B., & Goljanek-Whysall, K. (2019). Skeletal muscle wasting and its relationship with osteoarthritis: A mini-review of mechanisms and current interventions. *Current Rheumatology Reports, 21*(8), 40.
27. Bahat, G., Yilmaz, O., Kılıç, C., Oren, M. M., & Karan, M. A. (2018). Performance of SARC-F in regard to sarcopenia definitions, muscle mass and functional measures. *Journal of Nutrition, Health and Aging, 22*(8), 898–903.