

Spanish Version of the Anterior Cruciate Ligament–Quality of Life Questionnaire

Translation, Cross-cultural Adaptation, and Validation

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Background: The Anterior Cruciate Ligament–Quality of Life (ACL-QOL) questionnaire is a patient-reported outcome measure used to assess the effect of an anterior cruciate ligament (ACL) injury on the lives of patients. It was originally written in English, which may affect its use when completed by nonnative English speakers.

Purpose: To translate and adapt the ACL-QOL to Spanish and provide evidence of its psychometric properties.

Study Design: Cohort study (diagnosis); Level of evidence, 2.

Methods: A total of 183 patients with an ACL injury from 4 Catalan hospitals were included: 99 patients who had undergone ACL reconstruction (ACLR) completed the Spanish version of the ACL-QOL (ACL-QOL-Sp) twice (mean interval, 15.2 days) in 2 weeks for test-retest reliability, and 84 patients completed the ACL-QOL-Sp, the Lysholm knee scoring scale, the Knee injury and Osteoarthritis Outcome Score (KOOS), Tegner Activity Scale, and the 12-item Short Form Health Survey (SF-12) before and at 4 and 9 months after ACLR to assess responsiveness. The association between the ACL-QOL-Sp and the other outcome measures was evaluated with the Spearman correlation coefficient.

Results: The ACL-QOL-Sp showed good internal consistency (Cronbach alpha = 0.96) and test-retest reliability (intraclass correlation coefficient = 0.97). The standard error of measurement was 3.6, also suggesting the precision of measurements. The smallest detectable change was 9.98 in 94% of patients. No association was found between the ACL-QOL-Sp score and the Tegner score or SF-12 mental component summary score; however, a moderate correlation was found with the overall KOOS score ($r = -0.545$), Lysholm score ($r = 0.509$), and SF-12 physical component summary score ($r = 0.607$). The correlation ranged from weak for the KOOS-Symptoms subscore ($r = -0.290$) to moderate for the KOOS–Quality of Life subscore ($r = -0.698$). No ceiling or floor effects were observed. The ACL-QOL-Sp showed a moderate effect size (0.73) at 4 months but a large effect size (1.70) at 9 months.

Conclusion: The ACL-QOL-Sp showed adequate internal consistency, test-retest reliability, and responsiveness in evaluating quality of life after ACLR in Spanish-speaking patients.

Keywords: anterior Cruciate Ligament–Quality of Life (ACL-QOL) questionnaire; knee; validity; reliability; ACL reconstruction; Spanish version

After an anterior cruciate ligament (ACL) injury, it is important to assess its physical and psychological consequences to make the best clinical decision regarding treatment options, especially in cases of an ACL rupture. For this purpose, there are different tools that allow patients to express both the perception of their health status and the impact that the injury has had on their self-confidence,

satisfaction, and quality of life.^{10,33} In the management of ACL injuries, clinicians can use patient-reported outcome measures (PROMs) to better understand the evolution of expected outcomes and associated patient-related factors. Both in the context of surgical and nonsurgical treatment, these tools allow specific decisions to be made to optimize the rehabilitation process under a biopsychosocial approach, considering each patient's condition and expectations for recovery.^{7,27} Several questionnaires assess quality of life, pain, and/or disability, most of which are self-administered.¹¹

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Most PROMs have been developed and validated in English, and only a few questionnaires have been translated into and validated in Spanish.¹³ Translated versions of questionnaires are needed to collect data from respondents with different cultural and linguistic backgrounds than the population for which the questionnaire was initially developed, especially when focusing on the subjective aspects of patients.⁵ Moreover, researchers should provide evidence that the translated versions are the result of rigorous cultural adaptation and translation, confirming that the constructs assessed are equivalent and have comparable psychometric properties to the original questionnaire.³⁴

The key knee-related PROMs that have been translated into Spanish are the Knee injury and Osteoarthritis Outcome Score (KOOS),³⁵ the Lower Extremity Functional Scale,⁹ the Knee Society Clinical Rating System,² the 36-item or 12-item Short Form Health Survey (SF-36 or SF-12, respectively),³⁶ and the Oxford Knee Score.²² The KOOS was designed to assess patients after trauma or those affected by primary osteoarthritis who were highly handicapped.³⁵ The Knee Society Clinical Rating System is widely used at the international level for knee arthroplasty but is not designed for ACL interventions.² The Lower Extremity Functional Scale assesses the global function of the lower limb, and the SF-12 evaluates the patient's health profile (global psychosocial characteristics) without a direct relationship to a specific injury or illness.^{9,16,30} Although these questionnaires are valid for assessing patients' perception of their health status and how it affects their environment, none of them specifically assesses the quality of life of patients who experience an ACL injury.

Other self-reported knee questionnaires that have been translated into Spanish are the Victorian Institute of Sport Assessment questionnaire for patients with patellar tendinopathy¹⁵ and the Kujala score for patellofemoral pain.¹² However, they do not assess the signs and symptoms that patients who have undergone ACL reconstruction (ACLR) usually show. Finally, other measures have been used in different international studies with Spanish-speaking populations, but they have not been previously validated in Spanish: the Lysholm knee scoring scale, which assesses the perception of pain and instability in knee injuries, and the Tegner activity scale, which classifies the patient's level of occupational or competitive activities without considering the psychosocial effects.^{6,20}

The Anterior Cruciate Ligament–Quality of Life (ACL-QOL) questionnaire is a disease-specific PROM that can be used before and after the operative and nonoperative treatment of patients with ACL deficiencies.²³ It is used to assess the effect of an ACL injury on patients' daily lives. Currently, there are 2 translated versions: the Turkish and the Brazilian Portuguese.^{17,32} In both cases, they have shown good reliability and sensitivity.

The aims of this study were to translate and adapt the ACL-QOL to Spanish and to provide evidence of its psychometric properties: internal consistency, test-retest reliability, agreement, construct validity, ceiling and floor effects, and responsiveness.

METHODS

Study Design and Participants

The study protocol received ethics committee approval, and all study participants provided written informed consent. We reviewed the records of 250 consecutive patients who had been seen for a unilateral ACL injury with or without a meniscal and/or osteochondral lesion (up to grade 2) at 4 Catalan (Spain) hospitals between 2015 and 2019. Participants with concomitant knee injuries, previous surgery in the same or contralateral knee, grade ≥ 3 osteochondral injuries or arthritis, and ACLR with an allograft were excluded. Patients were classified into 2 groups: those who had undergone ACLR within the past 2 years (group A) and those who had not yet undergone ACLR (group B). Patients in group B were followed from preoperatively to 4 and 9 months postoperatively. All surgical procedures were performed at the collaborating hospitals using 1 of 2 standard autograft types: quadruple-stranded semitendinosus and gracilis (hamstring tendon) or bone–patellar tendon–bone.

The study outline and flow diagram of patients are shown in Figure 1, and characteristics of the final sample ($n = 183$) are summarized in Table 1.

ACL-QOL Questionnaire

The ACL-QOL is a self-administered scale composed of 32 items divided into 5 domains: symptoms and physical complaints (5 items), work-related concerns (4 items), recreational activity and sport participation or competition

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Ethical approval for this study was obtained from Fundació Unió Catalana d'Hospitals (No. CEIC 16/54).

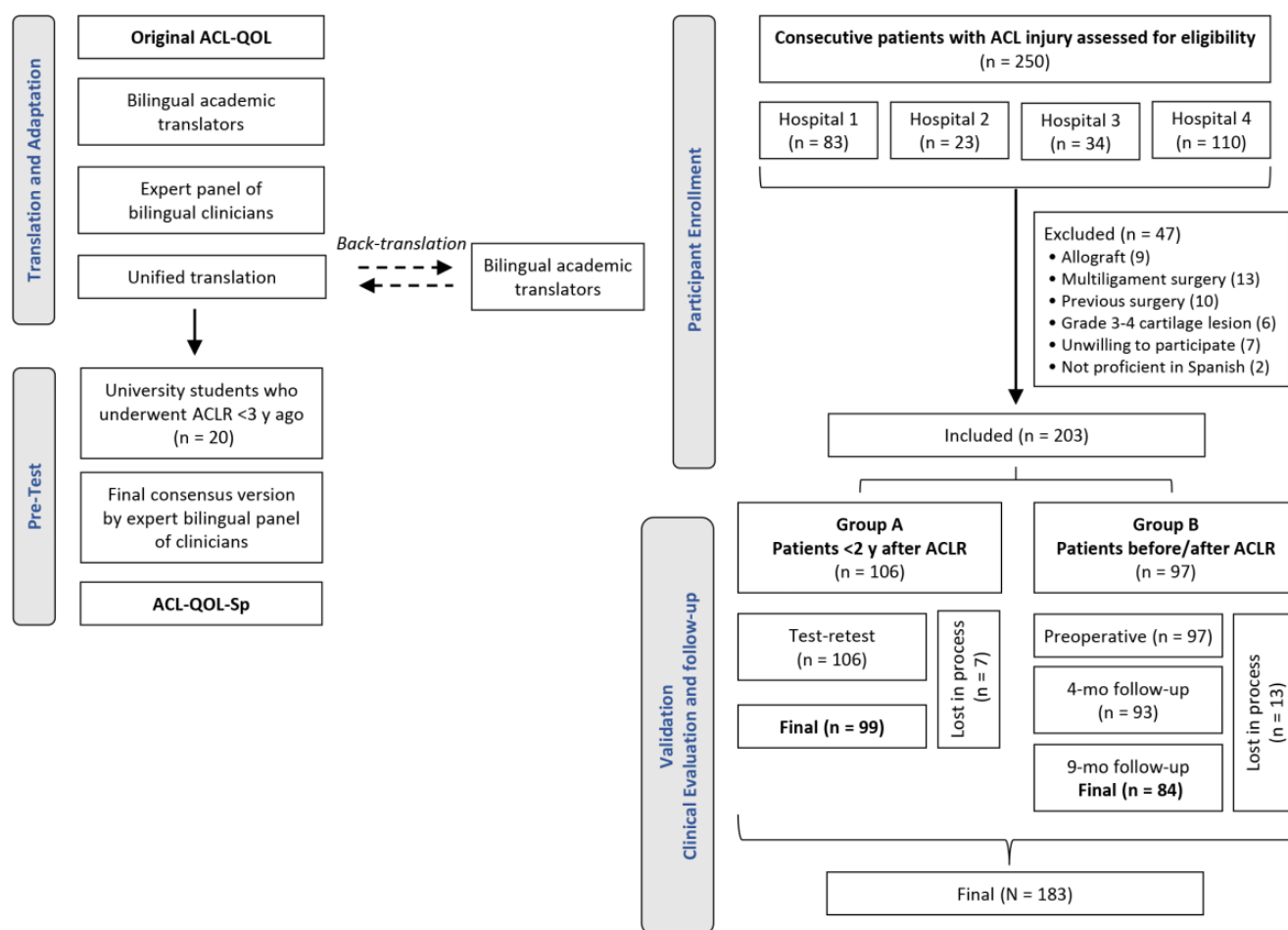


Figure 1. Study outline and patient flow diagram. ACL, anterior cruciate ligament; ACL-QOL, Anterior Cruciate Ligament-Quality of Life questionnaire; ACL-QOL-Sp, Spanish version of the Anterior Cruciate Ligament-Quality of Life questionnaire; ACLR, anterior cruciate ligament reconstruction.

TABLE 1
Baseline Characteristics of Study Population^a

	Group A (n = 99)	Group B (n = 84)
Male sex, n (%)	62 (62.6)	60 (71.4)
Age, mean ± SD (range), y	29.0 ± 7.9 (16-49)	28.5 ± 10.2 (16-48)
Body mass index, mean ± SD, kg/m ²	23.1 ± 2.6	23.5 ± 2.7
Time from surgery, median (range), mo	12 (2-28)	—
Hours of activity, median (range)	6 (3-40)	6 (0-28)
Tegner score, median (range)	6 (4-9)	7 (4-9)
Type of graft, n (%)		
Bone-patellar tendon-bone	61 (61.6)	56 (66.7)
Hamstring tendon	38 (38.4)	28 (33.3)

^aGroup A: patients with previous anterior cruciate ligament reconstruction; group B: patients with anterior cruciate ligament injury who had to undergo surgery. The dash indicates an area not applicable.

(12 items), lifestyle (6 items), and social and emotional aspects (5 items). Each domain has a proportional value according to the number of questions and is assessed with a 100-mm visual analog scale. A higher score indicates a better quality of life.²³ Although the ACL-QOL was designed for chronic ACL impairments, in this study, it was used in patients before ACLR, after surgery during rehabilitation, and after recovery from surgery.

Translation and Cross-cultural Adaptation of the ACL-QOL

The internationally validated method of forward-back translation was used to translate and adapt the ACL-QOL to Spanish.²⁶ Specifically, 2 bilingual, native Spanish speakers from the language department of our university independently translated the questionnaire from English to Spanish. Both versions were evaluated by a bilingual health sciences team consisting of an orthopaedic surgeon with expertise in ACLR (R.S.), an expert in biomechanics and sports science (C.E.-M.), and a clinical psychologist with expertise in chronic pain and cognitive-behavioral

therapy (T.E.-M.). In the first version, some conceptual errors related to medical terminology were pointed out and corrected, resulting in the first draft of the Spanish version. Then, back translation into English was independently performed by native English speakers without prior knowledge of the original version. Finally, the Spanish-to-English back translation was compared with the original English version of the ACL-QOL, reproducing 90% of it. The remaining 10% was reformulated to address semantic and conceptual differences between the 2 versions by a consensus of the 5 bilingual translators. This was based on the comments collected during pretesting with 20 university students who had undergone ACLR within the previous 3 years. They were asked to identify any semantic concerns, difficulties with the wording, and problems in completing the questionnaire. All 5 translators and an expert in research methodology (J.R.-M.) performed the analysis.

The cross-cultural adaptations were made according to cultural norms that could be extrapolated to other Spanish-speaking countries, and 2 of the 20 pretest students were from other Spanish-speaking countries. The header of the third domain of the questionnaire (recreational activity and sport participation or competition) was difficult to translate into Spanish. Therefore, we adapted it to the 3 subpopulations that may experience an ACL injury while participating in physical activity: leisure, practice, and competition. In addition, “go full out” was replaced by “giving 100.” “Hobby activities” was used in question 17, which is a concept more common in the Spanish culture. Finally, a version was unanimously approved, becoming the final Spanish version of the ACL-QOL (ACL-QOL-Sp; Supplemental Figure S1).

Outcome Measures Used for Comparison

There were 4 other PROMs used to evaluate the validity of the ACL-QOL-Sp: the KOOS, Lysholm knee scoring scale, Tegner activity scale, and SF-12.

Knee injury and Osteoarthritis Outcome Score. The KOOS was developed to assess knee injuries and is valid for patients undergoing ACL surgery.²⁸ It consists of 42 items in a Likert format (0-5) and evaluates 5 dimensions: pain, symptoms, activities of daily living, sports and recreational activities, and knee-related quality of life. Subscale scores are calculated as the sum of the items included. A higher total score (0-100) indicates greater functional independence.⁸ In our study, we used a validated Spanish version of the KOOS.³⁵

Lysholm Knee Scoring Scale. The Lysholm knee scoring scale was developed to evaluate knee ligament surgery, with a special emphasis on instability symptoms. It consists of 8 items: limping, locking, pain, stair climbing, use of supports, instability, swelling, and squatting. The score (0-100) allows the classification of impairments into different levels. Higher scores (≥ 95) indicate that the knee does not cause problems in any situation. Lower scores (< 65) indicate severe impairments in activities of daily living. This scale is one of the most popular subjective assessments after ACLR, along with the Tegner activity scale.^{3,6}

Tegner Activity Scale. The Tegner activity scale is used to assess lifestyle and physical activity levels. Scores (0-10)

are considered to evaluate the level (no activity, recreational activity, and amateur or professional activity) and the type of sport in relation to potential stress on the knee.

12-Item Short Form Health Survey. The SF-12 consists of 12 questions addressing 8 health domains: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health. A higher score (0-100) indicates a better quality of life.³⁸ The scores are summarized into 2 categories: physical component summary (PCS) and mental component summary (MCS). The SF-12 is valid and reliable, with internal consistency estimates above 0.70 and significant correlations between the SF-12 and SF-36 versions. In our study, we used the validated Spanish version of the SF-12.^{36,37}

Evaluation

In November 2016, the patients in group A completed the ACL-QOL-Sp twice in 2 weeks for the evaluation of test-retest reliability. Patients in group B instead completed the questionnaire preoperatively and at 4 and 9 months postoperatively from September 2016 onward. LimeSurvey software (Version 2.00+ [Build 131206]; LimeSurvey GmbH) was used to collect the data. The software was programmed to send reminders every 5 days. Patients who had not responded within 15 days were contacted by telephone. Patients who either could not be contacted or did not respond were excluded.

Statistical Analysis

We used Stata/IC (Version 15; StataCorp) to analyze internal consistency, test-retest reliability, agreement, construct validity, ceiling and floor effects, and responsiveness. A confidence level of 95% was established for interval estimation.

Internal Consistency, Test-Retest Reliability, and Agreement. Internal consistency for the overall ACL-QOL-Sp as well as for each domain was evaluated with the Cronbach alpha in both groups A and B (preoperatively and at 4 and 9 months for group B). Test-retest reliability (intrarater reliability) was assessed by the absolute-agreement intraclass correlation coefficient (ICC) for the overall ACL-QOL-Sp and for each domain.¹ Agreement was evaluated using the smallest detectable change (SDC), defined as $1.96 \times \sqrt{2SEM}$, where SEM is the standard error of measurement. SEM was computed as $SD \times \sqrt{(1 - ICC)}$, where SD is the standard deviation of the total score calculated with both test and retest values.

Construct Validity. Both convergent and discriminant validity were assessed in group B using the Spearman correlation coefficient. Regarding convergent validity, positive and statistically significant correlations between the overall ACL-QOL-Sp score and the SF-12 and Lysholm scores were expected. Discriminant validity was assessed between the overall ACL-QOL-Sp score and some variables, for which no significant correlation was expected (age, hours of activity, and time from surgery).

Ceiling and Floor Effects. Ceiling and floor effects were analyzed in group A by calculating the percentage of participants with lower and higher scores (≤ 10 th and ≥ 90 th

TABLE 2
Test-Retest Reliability and Internal Consistency of ACL-QOL-Sp^a

	ICC (95% CI) Group A (n = 106)	Cronbach α (1-Sided 95% CI)	
		Group A (n = 99)	Group B (n = 84) ^b
ACL-QOL-Sp domain			
Symptoms and physical complaints	0.88 (0.83-0.92)	0.83 (≥0.78)	—
Work-related concerns	0.94 (0.90-0.96)	0.81 (≥0.75)	—
Recreational activity and sport participation or competition	0.96 (0.92-0.98)	0.94 (≥0.92)	—
Lifestyle	0.91 (0.87-0.94)	0.83 (≥0.79)	—
Social and emotional aspects	0.92 (0.88-0.95)	0.86 (≥0.82)	—
Overall ACL-QOL-Sp	0.97 (0.94-0.99)	0.96 (≥0.95)	Preoperative: 0.94 (≥0.92) 4 mo: 0.94 (≥0.92) 9 mo: 0.98 (≥0.98)

^aGroup A: had undergone anterior cruciate ligament reconstruction; group B: had not yet undergone anterior cruciate ligament reconstruction. Seven patients did not complete the retest for personal reasons unrelated to the study. Dashes indicate areas not applicable. ACL-QOL-Sp, Spanish version of the Anterior Cruciate Ligament–Quality of Life questionnaire; ICC, intraclass correlation coefficient.

^bIn group B, the sample sizes for the overall ACL-QOL-Sp were as follows: preoperatively (n = 97), 4-month follow-up (n = 93), and 9-month follow-up (n = 84).

percentiles, respectively) for the overall ACL-QOL-Sp and for each domain. These effects were considered present at ≥15%.

Responsiveness. The standardized response mean was calculated in group B to evaluate responsiveness as a measure of effect size (ES). A value <0.2 is considered trivial; 0.2-0.5, small; >0.5-0.8, moderate; and >0.8, large.

RESULTS

Internal Consistency and Test-Retest Reliability

Internal consistency and test-retest reliability results are shown in Table 2. In group A, the Cronbach alpha for the overall ACL-QOL-Sp was excellent, ranging from 0.81 to 0.94 for the different domains. In group B, the Cronbach alpha remained stable both preoperatively and postoperatively (at 4 and 9 months), ranging from 0.94 to 0.98.

The ICC for the overall ACL-QOL-Sp indicated excellent test-retest reliability, ranging from 0.88 to 0.96 for the different domains. The test-retest interval averaged 15.2 ± 3.5 days. Our results showed good internal consistency and test-retest reliability.

Agreement

The SEM for this sample was 3.6, a minimal value in comparison to the standard deviation (20.6) of the total score. The ICC and SEM results suggested high reliability and precision of the measurements for the studied sample. The SDC was 9.98, and the proportion of patients with a smaller test-retest difference was 94%.

Construct Validity

Spearman correlation coefficients between the ACL-QOL-Sp, other outcome measures, and other variables are reported in Tables 3 and 4. A significant moderate

TABLE 3
Correlation Between ACL-QOL-Sp and Other Outcome Scores^a

	Score, Mean ± SD	Spearman r (95% CI)
Overall KOOS	38.7 ± 14.9	-0.545 (-0.712 to -0.319)
Symptoms	10.6 ± 5.8	-0.290 (-0.522 to -0.018)
Pain	11.7 ± 6.1	-0.515 (-0.691 to -0.281)
Activities of Daily Living	17.0 ± 12.0	-0.372 (-0.586 to -0.110)
Sports and Recreational Activities	14.6 ± 4.5	-0.572 (-0.731 to -0.355)
Quality of Life	11.2 ± 2.5	-0.698 (-0.816 to -0.525)
Lysholm	49.8 ± 21.0	0.509 (0.274 to 0.686)
Tegner	6.7 ± 1.4	0.006 (-0.292 to 0.302)
SF-12 PCS	42.2 ± 8.4	0.607 (0.400 to 0.755)
SF-12 MCS	46.9 ± 8.2	0.154 (-0.124 to 0.410)

^aAssessed in group B (n = 84). ACL-QOL-Sp, Spanish version of the Anterior Cruciate Ligament–Quality of Life questionnaire; KOOS, Knee injury and Osteoarthritis Outcome Score; MCS, mental component summary; PCS, physical component summary; SF-12, 12-item Short Form Health Survey.

relationship was observed with the overall KOOS, Lysholm, and SF-12 PCS scores. A low-to-moderate significantly negative relationship was found with different KOOS subscale scores (r = -0.290 to -0.698). No significant relationship was found with the Tegner score, SF-12 MCS score, patient age, hours of activity, or time from surgery.

Additionally, to verify that none of the instruments that we used performed poorly in our study, we assessed the internal consistency of the KOOS, Lysholm knee scoring scale, and SF-12 and obtained adequate Cronbach alpha values (overall KOOS: 0.95 [ranging from 0.74 for KOOS–Quality of Life to 0.94 for KOOS–Activities of Daily Living]; Lysholm: 0.77; SF-12 PCS: 0.79; and SF-12 MCS: 0.77).

Ceiling and Floor Effects

No floor or ceiling effects were found, and the proportions of patients with scores in the ≤ 10 th percentile or ≥ 90 th percentile for the overall ACL-QOL-Sp and for all the domains were acceptable ($< 15\%$) (Table 5).

Responsiveness

The overall ACL-QOL-Sp score showed a moderate ES at 4 months and a large ES at 9 months postoperatively. The ES values are shown in Table 6.

TABLE 4
Correlation Between ACL-QOL-Sp and Patient/Surgical Variables^a

	Spearman <i>r</i> (95% CI)
Patient age	-0.035 (-0.329 to 0.264)
Hours of activity	0.035 (-0.265 to 0.328)
Time from surgery	0.092 (-0.211 to 0.379)

^aAssessed in group B (n = 84). ACL-QOL-Sp, Spanish version of the Anterior Cruciate Ligament–Quality of Life questionnaire.

DISCUSSION

This study demonstrates that the ACL-QOL-Sp had adequate internal consistency, test-retest reliability, and agreement and provides evidence of its validity. The construct validity was acceptable for both the floor and ceiling effects, and the responsiveness was adequate, ranging from moderate to large.

The study on the original version of the ACL-QOL did not assess either internal consistency or test-retest reliability.²³ The Spanish version was administered both preoperatively and postoperatively (at 4 and 9 months), obtaining excellent internal consistency. It was shown to be stable over time, similar to the results obtained by Lafave et al¹⁸ for the original version of the ACL-QOL at 6, 12, and 24 months postoperatively. Previous studies of other versions have also reported excellent internal consistency.^{17,32} Regarding test-retest reliability, Mohtadi and Lafave et al¹⁸ administered the retest at 2 weeks. On the contrary, the retest of the Brazilian version was administered within 5 to 8 days.³² It has been argued that administering a retest in less than 8 days increases the reliability; however, this could be caused by the recall effect.³² In our study, the test-retest interval averaged 15 days, as recommended by Kinikli et al.¹⁷

TABLE 5
Floor and Ceiling Effects of ACL-QOL-Sp^a

	Floor Effect		Ceiling Effect	
	Score ≤ 10 th Percentile	n (%)	Score ≥ 90 th Percentile	n (%)
ACL-QOL-Sp domain				
Symptoms and physical complaints	44	10 (10.1)	94	10 (10.1)
Work-related concerns	38	8 (11.1)	94	10 (12.7)
Recreational activity and sport participation or competition	27.5	8 (14.8)	86.7	4 (7.0)
Lifestyle	36.7	10 (10.1)	95	12 (11.2)
Social and emotional aspects	25	11 (11.1)	90	11 (10.3)
Overall ACL-QOL-Sp	37.1	6 (13.6)	89	5 (10.9)

^aAssessed in group A (n = 99). In each dimension, only individuals between the 10th and 90th percentiles are included, which is why the total is not 99 for all dimensions. ACL-QOL-Sp, Spanish version of the Anterior Cruciate Ligament–Quality of Life questionnaire.

TABLE 6
Responsiveness of ACL-QOL-Sp^a

	Score, Mean \pm SD			Effect Size (95% CI)	
	Preoperative	4 mo	9 mo	4 mo	9 mo
ACL-QOL-Sp domain					
Symptoms and physical complaints	44.0 \pm 19.0	56.9 \pm 15.8	79.8 \pm 18.8	0.65 (0.41-0.88)	1.91 (1.63-2.19) ^b
Work-related concerns	32.6 \pm 20.4	49.4 \pm 19.4	74.3 \pm 24.8	0.88 (0.57-0.99) ^b	2.04 (1.70-2.30) ^b
Recreational activity and sport participation or competition	18.8 \pm 16.2	26.8 \pm 16.6	57.4 \pm 27.9	0.57 (0.27-0.88)	3.20 (1.95-3.64) ^b
Lifestyle	33.1 \pm 16.0	44.0 \pm 16.2	67.4 \pm 22.8	0.65 (0.43-0.88)	2.11 (1.87-2.70) ^b
Social and emotional aspects	33.2 \pm 20.0	40.4 \pm 17.7	67.0 \pm 16.9	0.34 (0.13-0.54)	1.68 (1.43-1.93) ^b
Overall ACL-QOL-Sp	29.9 \pm 15.4	38.4 \pm 13.0	61.6 \pm 25.0	0.73 (0.46-0.99)	1.70 (0.80-1.97) ^b

^aAssessed in group B: preoperatively (n = 97), 4-month follow-up (n = 93), and 9-month follow-up (n = 84). ACL-QOL-Sp, Spanish version of the Anterior Cruciate Ligament–Quality of Life questionnaire.

^bModerate (> 0.5) to large (> 0.8).

The ICC of the ACL-QOL-Sp was considered to be excellent regarding the 5 domains of the questionnaire. These results are very similar to the Turkish version and slightly better than the Brazilian version.^{17,32}

The SEM measures stability over time; therefore, these results can be safely generalized to other populations. The SDC is an essential benchmark for interpreting score changes. Previous evaluations of the original ACL-QOL questionnaire have reported an SEM of 6.1.¹⁸ The SEM and SDC results from this study are similar to those reported for the Turkish version (3.1 and 8.7, respectively).¹⁷ Agreement for the ACL-QOL-Sp was excellent. We reported a difference between the test-retest that was lower than the SDC value.

For clinical use, Lafave et al¹⁸ recommended that the SDC should be 12.1. This is slightly higher than the SDC for the Spanish and Turkish versions.¹⁷ Finally, Silva et al³² obtained an SEM of 4.7 and SDC of 13.2 for the Brazilian version. These differences derive from the heterogeneity of the study populations and possibly from subtle variations in the translations and cultural diversity.²⁵

Similar to previous studies, we assessed the correlations between the ACL-QOL-Sp and other questionnaires.^{14,18} The extended version of the SF-36 questionnaire has been used in previous studies.^{17,32} However, the Spanish version of the SF-12 reproduces the summary scores of the SF-36 without a significant loss of information.^{16,30} Moreover, in the Spanish version of the SF-12, the results of the 8 domains are very similar to those of the Brazilian version.³² Consistent with some studies, no relationship was found between the ACL-QOL-Sp and age, hours of activity, time from surgery, and Tegner score.^{4,24} On the contrary, other studies found that hours of physical activity and the Tegner score may have a moderate positive correlation with the overall ACL-QOL score (the higher the score, the better the results obtained).^{19,39} Future studies could benefit from a larger sample size, with greater variability in the hours of physical activity.²⁹ Also, in the current study, there were no ceiling and floor effects, although the “recreational activity and sport participation or competition” domain reported a floor value very close to 15%.

In our study, a moderate ES was found at 4 months postoperatively, increasing at 9 months postoperatively. Other studies have shown different results: at 4 months, the Turkish version presented a significantly higher value (ES = 2.12), whereas Lafave et al¹⁸ reported a lower value (ES = 0.61). The results at 9 months cannot be compared with the Turkish version collected at 2 years postoperatively (ES = 0.97). The change in ES from moderate to large between 4 and 9 months may be explained by a greater change in the quality of life during that time. We anticipate that at 4 months postoperatively, patients would have unlikely returned to sport, but at 9 months, their quality of life would have returned to normal in most cases. Data suggest that at 4 months after the intervention, the test's sensitivity was lower because of the greater influence of surgery. At 9 months, the patients' social determinants of health and self-motivation would be more important,

achieving a greater heterogeneity in the results.⁴⁰ Considering the ES, the sample size was adequate.²¹

The ACL-QOL-Sp is the third translation and cross-cultural adaptation of the original English version of the ACL-QOL. It had similar psychometric properties to the Turkish and Brazilian versions. This tool will allow clinicians and researchers in Spanish-speaking areas to obtain a general and patient-focused understanding, finally facilitating comparisons of different surgical techniques and rehabilitation protocols.³¹

Limitations

A multicenter study has intrinsic limitations, such as different surgical teams and research personnel and potentially different patient populations. However, it is precisely the heterogeneity inherent to clinical reality that favors its external validity; thus, generalization of the results would be more pragmatic.

Another limitation is that considering that the sample population was Spanish, the results might not be extrapolated to the Spanish-speaking populations of other countries. Therefore, this questionnaire should be cautiously administered until other studies provide evidence of its adequate performance in Spanish-speaking populations outside of Spain. Also, this cross-cultural and psychometric evaluation focused on patients who underwent ACLR and were being evaluated at baseline and short-term follow-up. Therefore, the results could be limited to patients in similar circumstances rather than to those who are treated nonsurgically.

Finally, most PROMs, whether or not they are unidimensional, tend to reduce the number of questions because of the risk of redundancy: for example, the SF-36 to the SF-12 and SF-8 or the full version of the Anterior Cruciate Ligament–Return to Sport after Injury scale to a brief 6-item version of the scale. This suggests that in the future, there may be a proposal to reduce the ACL-QOL. Regrettably, despite being a multicenter study, the sample size was not sufficient to perform a factor analysis and evaluate the validity of the internal structure. Therefore, we could not conduct an analysis to propose a shortened version. Future studies may address this possibility.

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CONCLUSION

The ACL-QOL-Sp showed adequate internal consistency, test-retest reliability, and responsiveness in evaluating quality of life after ACLR in Spanish-speaking patients.

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REFERENCES

1. Alghadir AH, Anwer S, Iqbal A, Iqbal ZA. Test-retest reliability, validity, and minimum detectable change of visual analog, numerical rating, and verbal rating scales for measurement of osteoarthritic knee pain. *J Pain Res.* 2018;11:851-856.
2. Ares O, Castellet E, Maculé F, et al. Translation and validation of 'The Knee Society Clinical Rating System' into Spanish. *Knee Surg Sports Traumatol Arthrosc.* 2013;21(11):2618-2624.
3. Arroyo-Morales M, Martín-Alguacil J, Lozano-Lozano M, et al. The Lysholm score: cross cultural validation and evaluation of psychometric properties of the Spanish version. *PLoS One.* 2019;14(8):e0221376.
4. Beaudoin A, Ogborn D, McRae S, et al. No differences found in long-term outcomes of a randomized controlled trial comparing ipsilateral versus contralateral hamstring graft in ACL reconstruction. *Knee Surg Sports Traumatol Arthrosc.* 2022;30(11):3718-3725.
5. Boparai JK, Singh S, Kathuria P. How to design and validate a questionnaire: a guide. *Curr Clin Pharmacol.* 2018;13(4):210-215.
6. Briggs KK, Lysholm J, Tegner Y, Rodkey WG, Kocher MS, Steadman JR. The reliability, validity, and responsiveness of the Lysholm score and Tegner activity scale for anterior cruciate ligament injuries of the knee: 25 years later. *Am J Sports Med.* 2009;37(5):890-897.
7. Chan DKC, Lee ASY, Hagger MS, Mok KM, Yung PS. Social psychological aspects of ACL injury prevention and rehabilitation: an integrated model for behavioral adherence. *Asia Pac J Sports Med Arthrosc Rehabil Technol.* 2017;10:17-20.
8. Collins NJ, Prinsen CA, Christensen R, Bartels EM, Terwee CB, Roos EM. Knee injury and Osteoarthritis Outcome Score (KOOS): systematic review and meta-analysis of measurement properties. *Osteoarthritis Cartilage.* 2016;24(8):1317-1329.
9. Cruz-Díaz D, Lomas-Vega R, Osuna-Pérez MC, Hita-Contreras F, Fernández AD, Martínez-Amat A. The Spanish Lower Extremity Functional Scale: a reliable, valid and responsive questionnaire to assess musculoskeletal disorders in the lower extremity. *Disabil Rehabil.* 2014;36(23):2005-2011.
10. Filbay SR, Ackerman IN, Russell TG, Crossley KM. Return to sport matters: longer-term quality of life after ACL reconstruction in people with knee difficulties. *Scand J Med Sci Sports.* 2017;27(5):514-524.
11. Gagnier JJ, Shen Y, Huang H. Psychometric properties of patient-reported outcome measures for use in patients with anterior cruciate ligament injuries: a systematic review. *JBJS Rev.* 2018;6(4):e5.
12. Gil-Gámez J, Pecos-Martín D, Kujala UM, et al. Validation and cultural adaptation of "Kujala score" in Spanish. *Knee Surg Sports Traumatol Arthrosc.* 2016;24(9):2845-2853.
13. Gómez-Valero S, García-Pérez F, Flórez-García MT, Miangolarra-Page JC. A systematic review of self-administered questionnaires for the functional assessment of patients with knee disabilities adapted into Spanish. *Rev Esp Cir Ortop Traumatol.* 2017;61(2):96-103.
14. Grant JA, Mohtadi NGH. Two- to 4-year follow-up to a comparison of home versus physical therapy-supervised rehabilitation programs after anterior cruciate ligament reconstruction. *Am J Sports Med.* 2010;38(7):1389-1394.
15. Hernandez-Sanchez S, Hidalgo MD, Gomez A. Cross-cultural adaptation of VISA-P score for patellar tendinopathy in Spanish population. *J Orthop Sports Phys Ther.* 2011;41(8):581-591.
16. Jenkinson C, Layte R, Jenkinson D, et al. A shorter form health survey: can the SF-12 replicate results from the SF-36 in longitudinal studies? *J Public Health Med.* 1997;19(2):179-186.
17. Kinikli GI, Celik D, Yuksel I, Atay OA. Turkish version of the Anterior Cruciate Ligament Quality of Life questionnaire. *Knee Surg Sports Traumatol Arthrosc.* 2015;23(8):2367-2375.
18. Lafave MR, Hiemstra L, Kerslake S, Heard M, Buchko G. Validity, reliability, and responsiveness of the Anterior Cruciate Ligament Quality of Life measure: a continuation of its overall validation. *Clin J Sport Med.* 2017;27(1):57-63.
19. Leiter JR, Gourlay R, McRae S, de Korompay N, MacDonald PB. Long-term follow-up of ACL reconstruction with hamstring autograft. *Knee Surg Sports Traumatol Arthrosc.* 2014;22(5):1061-1069.
20. Lysholm J, Gillquist J. Evaluation of knee ligament surgery results with special emphasis on use of a scoring scale. *Am J Sports Med.* 1982;10(3):150-154.
21. Marien M, Lafave MR, Hiemstra LA, Heard SM, Buchko GM, Kerslake S. Validity, responsiveness, and reliability of the ACL-QOL in an adolescent population. *J Pediatr Orthop.* 2021;41(10):e917-e922.
22. Martín-Fernández J, García-Maroto R, Sánchez-Jiménez FJ, et al. Validation of the Spanish version of the Oxford Knee Score and assessment of its utility to characterize quality of life of patients suffering from knee osteoarthritis: a multicentric study. *Health Qual Life Outcomes.* 2017;15(1):186.
23. Mohtadi N. Development and validation of the quality of life outcome measure (questionnaire) for chronic anterior cruciate ligament deficiency. *Am J Sports Med.* 1998;26(3):350-359.
24. Mohtadi NG, Chan DS. A randomized clinical trial comparing patellar tendon, hamstring tendon, and double-bundle ACL reconstructions: patient-reported and clinical outcomes at 5-year follow-up. *J Bone Joint Surg Am.* 2019;101(11):949-960.
25. Palmieri PA, Leyva-Moral JM, Camacho-Rodríguez DE, et al. Hospital survey on patient safety culture (HSOPSC): a multi-method approach for target-language instrument translation, adaptation, and validation to improve the equivalence of meaning for cross-cultural research. *BMC Nurs.* 2020;19:23.
26. Prinsen CAC, Mokkink LB, Bouter LM, et al. COSMIN guideline for systematic reviews of patient-reported outcome measures. *Qual Life Res.* 2018;27(5):1147-1157.
27. Rodríguez-Roiz JM, Sastre-Solsona S, Popescu D, Montañana-Burillo J, Combalia-Aleu A. The relationship between ACL reconstruction and meniscal repair: quality of life, sports return, and meniscal failure rate: 2- to 12-year follow-up. *J Orthop Surg Res.* 2020;15(1):361.
28. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynon BD. Knee injury and Osteoarthritis Outcome Score (KOOS): development of a self-administered outcome measure. *J Orthop Sports Phys Ther.* 1998;28(2):88-96.
29. Sánchez Romero EA, Lim T, Alonso Pérez JL, Castaldo M, Martínez Lozano P, Villafañe JH. Identifying clinical and MRI characteristics associated with quality of life in patients with anterior cruciate ligament injury: prognostic factors for long-term. *Int J Environ Res Public Health.* 2021;18(23):12845.
30. Schmidt S, Vilagut G, Garin O, et al. [Reference guidelines for the 12-item Short-Form Health Survey version 2 based on the Catalan general population]. *Med Clin (Barc).* 2012;139(14):613-625.
31. Sharma S, Jensen MP. Cross-cultural adaptations of patient-reported outcome measures can be very useful. *Ann Phys Rehabil Med.* 2021;64(1):101325.
32. Silva LO, Mendes LMR, Lima POP, Almeida GPL. Translation, cross-adaptation and measurement properties of the Brazilian version of the ACL-RSI scale and ACL-QoL questionnaire in patients with anterior cruciate ligament reconstruction. *Braz J Phys Ther.* 2018;22(2):127-134.
33. Truong LK, Mosewich AD, Holt CJ, Le CY, Miciak M, Whittaker JL. Psychological, social and contextual factors across recovery stages

- following a sport-related knee injury: a scoping review. *Br J Sports Med.* 2020;54(19):1149-1156.
34. Tsang S, Royse CF, Terkawi AS. Guidelines for developing, translating, and validating a questionnaire in perioperative and pain medicine. *Saudi J Anaesth.* 2017;11(suppl 1):80-89.
 35. Vaquero J, Longo UG, Forriol F, Martinelli N, Vethencourt R, Denaro V. Reliability, validity and responsiveness of the Spanish version of the Knee injury and Osteoarthritis Outcome Score (KOOS) in patients with chondral lesion of the knee. *Knee Surg Sports Traumatol Arthrosc.* 2014;22(1):104-108.
 36. Vilagut G, Ferrer M, Rajmil L, et al. [The Spanish version of the Short Form 36 Health Survey: a decade of experience and new developments]. *Gac Sanit.* 2005;19(2):135-150.
 37. Vilagut G, Valderas JM, Ferrer M, Garin O, López-García E, Alonso J. [Interpretation of SF-36 and SF-12 questionnaires in Spain: physical and mental components]. *Med Clin (Barc).* 2008;130(19):726-735.
 38. Ware JE, Kosinski M, Keller SD. A 12-item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care.* 1996;34(3):220-233.
 39. Webster KE, Feller JA, Kimp AJ, Whitehead TS. Low rates of return to preinjury sport after bilateral anterior cruciate ligament reconstruction. *Am J Sports Med.* 2019;47(2):334-338.
 40. Zhou M, Thayer WM, Bridges JFP. Using latent class analysis to model preference heterogeneity in health: a systematic review. *Pharmacoeconomics.* 2018;36:175-187.