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Translation and cross-cultural adaptation of the anterior cruciate ligament-return to sport after injury (ACL-RSI) scale into Turkish

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Abstract
Purpose To translate and culturally adapt the anterior cruciate ligament-return to sport after injury (ACL-RSI) scale into Turkish (ACL-RSI-Tr) and examine and evaluate the psychometric properties of the Turkish version in individuals who have undergone anterior cruciate ligament (ACL) reconstruction.
Methods The ACL-RSI was forward- and back-translated, culturally adapted and validated on ninety-three Turkish individuals who had undergone ACL reconstruction (5 females, 88 males; age 28.7 ± 8.6 years; body mass 80.1 ± 13.9 kg; height 178.8 ± 6.9 cm; body mass index 25.0 ± 3.7 kg/m^2). All patients completed the translated ACL-RSI, Tampa Scale of Kinesiophobia (TSK), Knee injury and Osteoarthritis Outcome Score (KOOS) and International Knee Documentary Committee (IKDC) and Lysholm questionnaires. We then analysed the internal consistency, reliability and validity of the newly formed ACL-RSI-Tr scale.
Results The ACL-RSI-Tr showed good internal consistency (Cronbach's alpha 0.86) and test–retest reliability (ICC 0.92) and was significantly correlated with the KOOS 'quality of life' ($r = 0.58$, $p < 0.002$), 'symptoms and stiffness' ($r = 0.35$, $p = 0.001$), 'pain' ($r = 0.49$, $p < 0.001$), 'sports' ($r = 0.44$, $p < 0.001$) and 'daily life' ($r = 0.42$, $p < 0.001$) subscales. The ACL-RSI-Tr also correlated significantly with the TSK ($r = -0.45$, $p < 0.001$), Lysholm ($r = 0.45$, $p < 0.001$) and IKDC ($r = 0.44$, $p < 0.001$) scores.
Conclusions The Turkish version of the ACL-RSI scale was valid, discriminant, consistent and reliable in patients who had undergone ACL reconstruction. This score could be useful to evaluate the effect of psychological factors on return to sport following ACL surgery.
Level of evidence Diagnostic study, Level I.

Keywords Anterior cruciate ligament · Knee joint · Patient-reported outcomes · Return to sport

Introduction

The decision to return to sport (RTS) following anterior cruciate ligament reconstruction (ACLR) depends upon physical, psychological and demographical factors associated with the individual patients involved [14]. In the past, physical performance tests to evaluate side-to-side asymmetries were the primary clinical focus, and readiness for RTS was often assessed by a patient's ability to achieve a score of 85 % or greater in the limb symmetry index [4, 24]. However, a recent meta-analysis demonstrated that only 64 % of patients were permitted to RTS following ACLR, although approximately 90 % of these patients achieved successful outcomes in physical performance assessments [4]. This mismatch between RTS rates and physical performance outcomes following ACLR has been partly attributed to psychological factors. Ardern et al. [3] demonstrated an association between psychological factors and RTS rate following ACL injury. Fear of reinjury is also one of the most challenging psychological factors following ACL injuries [2, 9, 12], and in a previous study, up to 24 % of ACLR patients failed to RTS because of their fear

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of reinjury [12]. Webster et al. [25] developed and validated a scale of 12 factors, written in English, the ACL Return to Sports after Injury (ACL-RSI) scale, which evaluates emotions, confidence in performance and risk appraisal of athletes in relation to RTS following ACL injury and/or surgery. This scale was subsequently validated in Swedish, French and Dutch populations of patients undergoing ACLR [6, 13, 20]. Furthermore, the ACL-RSI was shown to discriminate between patients who RTS and those who do not following ACLR [25]. Finally, Muller et al. [17] showed that the ACL-RSI scale was the strongest predictive parameter for RTS when considered 6 months following ACLR.

As a consequence, a Turkish version of the ACL-RSI would be very useful for evaluating the impact of psychological factors upon RTS on in the Turkish-speaking population of patients undergoing ACL reconstruction. The primary aim of this study was to translate the ACL-RSI from English to Turkish in order that the scale could be used in Turkish populations. The secondary aim was to evaluate a variety of parameters of the Turkish ACL-RSI in order to determine the reliability and validity of the scale within the Turkish context.

Materials and methods

Translation and cross-cultural adaptation

Translation and cross-cultural adaptation of the ACL-RSI scale was performed in five stages according to the method described by Beaton et al. [5]. In the first stage, two Turkish individuals with a good command of English were responsible for the literal and conceptual translation of the original ACL-RSI scale. The informed translator was a physical therapist, and the noninformed translator was an engineer. Both translators spoke Turkish as their mother tongue but also spoke fluent English. In the second stage, both the English version and Turkish translation were compared and reviewed by a bilingual individual who highlighted any conceptual errors or inconsistencies in the translations in order to establish the first Turkish translation. In the third stage, two native English speakers with a good command of Turkish, and who were unaware of the purpose of the study and had no access to the original English version, were asked separately to translate the finalised Turkish version back into English. In the fourth stage, the back-translated version of the ACL-RSI Turkish (ACL-RSI-Tr) scale was compared to the initial English version of the ACL-RSI scale by a committee consisting of a methodologist, a language professional and the four translators. The committee evaluated the four translations and finalised the Turkish version of the ACL-RSI scale. In the final stage, preliminary testing was performed to determine comprehension of the Turkish version. Preliminary testing was conducted on 10 patients (9 male, 1 female; mean ± SD age 29.1 ± 5.2 years; body mass index [BMI] 23.8 ± 5.2 kg/m^2) who fulfilled the eligibility criteria of the study in order to determine whether the patients had any difficulties in understanding the questions. Patients were also asked for recommendations as to how to revise the questions if necessary.

Participants

Participants had all undergone unilateral ACLR. Eligibility criteria were as follows: (1) 15 years of age or older; (2) ACLR using hamstring tendon autograft (HTG), patellar tendon autograft (PTG) or allograft, (3) pre-injury Tegner activity score of at least 5 and (4) able to reach at least 6 months after surgery and had the ability to read and write in Turkish. Patients with bilateral ACLR, ACLR revision, multi-ligament reconstruction, meniscus and cartilage repair were excluded from the study.

Physical therapists administered all questionnaires to the patients in random order. In order to investigate test–retest reliability, the patients were also asked to complete the ACL-RSI-Tr again 7–14 days after their first attempt.

Patient-reported outcomes measures

The original ACL-RSI scale was developed into three RTS subscales: emotions, confidence in one's performance and evaluation of risk appraisal. The scale consists of 12 questions evaluated with a visual analogical scale (VAS) from 0 to 100 with 10-point increments [25]. The total score is calculated by taking a percentage of the total scores for the 12 questions. A high score was indicative of a positive psychological response.

Reference questionnaires were translated to Turkish, and their measurement properties tested with good results. These properties included the validated Turkish version of the Tampa Scale of Kinesiophobia (TSK) [26], the Knee injury and Osteoarthritis Outcome Score (KOOS) [18], the Lysholm score [7] and the International Knee Documentation Committee subjective knee form (IKDC) [8].

Collectively, this series of tests provides valuable information for clinical management. The TSK is used to measure fear of reinjury, movement and physical activity. Total scores for the TSK range from 17 to 68, with high scores signifying high levels of fear [11]. A previous study showed that a higher TSK score was associated with a failure to RTS following ACL injury [12].

The KOOS score evaluates subjective knee function and has five subscales evaluating symptoms, pain, function in daily life, and function during sport and recreational

activity and knee-related quality of life. The score for each subscale ranges from 0 to 100, where a score of 100 indicates good knee function [19].

The Lysholm score is an eight-item questionnaire designed to evaluate patients following knee ligament injury. This is scored on a 100-point scale from 0 (worst symptoms) to 100 (best symptoms), with 25 points attributed to pain, 15 to locking, 10 to swelling, 25 to instability, 10 to stair climbing and 5 points each to limping, use of a support and squatting [21].

Finally, the IKDC subjective knee form is used to measure symptoms, function and sports activity for people with knee disorders, including ligamentous and meniscal injuries, osteoarthritis and patellofemoral dysfunction. This form contains 18 selected items designed to measure symptoms which allows clinicians to assess pain, stiffness, swelling, joint locking and joint instability, while other items designed to measure knee function evaluate the ability to perform activities associated with daily living. Total IKDC score ranges from 0 to 100, with 100 indicating the absence of symptoms and higher levels of knee function [10].

This study was approved by the Ethics Committee of Hacettepe University (GO 14/540).

Statistical analysis

Descriptive analyses are reported as means, standard deviations and percentages. Internal consistency was estimated using Cronbach's alpha test, which indicates homogeneity between items within a questionnaire. A Cronbach's alpha value ranging from 0.70 to 0.95 was considered to be adequate [22]. In order to determine test–retest reliability of the ACL-RSI-Tr, we calculated the intraclass correlation coefficient with corresponding 95 % confidence intervals (Cis) between the first and second administration of the ACL-RSI-Tr. Values of 0.4 or greater were considered satisfactory ($r = 0.81$–1.0, excellent; 0.61–0.80, very good; 0.41–0.60, good; 0.21–0.40, fair; and 0.00–0.20, poor) [16].

Construct validity was evaluated by correlating ACL-RSI-Tr with TSK, KOOS, Lysholm and the IKDC scores. Analysis was carried out with Pearson's correlation test, and results expressed as 'strong' ($r > 0.5$), 'medium' ($0.5 < r < 0.3$) or 'small' ($r < 0.3$). Structural validity of the ACL-RSI-Tr was tested by exploratory factor analysis using principal component analyses with varimax rotation. Content validity was assessed by analysing score distribution and the occurrence of ceiling and floor effects. The proportion (%) of patients who obtained the lowest (0) or highest (10) score for each question in the ACL-RSI-Tr questionnaire was documented. Descriptive statistics (mean values, standard deviations and quartiles) were then calculated in order to determine distribution and ceiling/floor effects. Floor and ceiling effects were considered to be relevant if greater than 15 % of the patients achieved a score at the limits of the scale [22]. The Student's t test was used to assess discriminant validity.

Finally, sample size estimation was performed in accordance with previous suggestions, 2–20 subjects per item of the ACL-RSI scale [1]. Statistical significance was set at $p < 0.05$. All analyses were performed with IBM SPSS Statistics 21.0 software.

Results

Cross-cultural adaptation

The Turkish translation of the ACL-RSI and subsequent English back-translation did not lead to any major linguistic problems. No changes were made after preliminary testing, and all patients stated that the questions were clear.

Study participants

Although 127 patients were evaluated, only 106 patients were eligible in terms of the inclusion criteria assigned to this study. Five patients declined to participate, and eight patients provided incomplete answers on their questionnaires. Ninety-three participants (5 females, 88 males; age 28.7 ± 8.59 years; body mass 80.1 ± 13.96 kg; height 178.8 ± 6.97 cm; body mass index 25.0 ± 3.74 kg/m^2; time after surgery to evaluation 13.6 ± 11.0 months) were included in the final analysis. Among these patients, pre-injury Tegner activity level was 7.3 ± 1.4 (range: 5–10). Ninety-four percent of the patients incurred a noncontact mechanism of injury mechanism, while 6 % incurred contact injuries. In total, 21.5 % of patients had undergone patellar tendon autograft, while 78.5 % had undergone hamstring tendon autograft reconstruction. Furthermore, 40.8 % of patients returned to the same level, 21.1 % of patients returned to a lower level and 38.1 % of patients were not able to return to sports.

Internal consistency

Internal consistency of the translated scale based upon strength of the correlation among the 12 items under consideration was 'excellent' with a Cronbach's alpha index of 0.88.

Reliability

Mean ACL-RSI-Tr score was 53.6 ± 21.6 when first recorded and rose to 56.1 ± 21.8 upon the second attempt.

Table 1 Correlation between ACL-RSI-Tr scores and other outcome measures

	ACL-RSI	IKDC	KOOS symptoms	KOOS pain	KOOS ADL	KOOS sport	KOOS QoL	TSK	Lysholm
Mean ± SD	53.5 ± 21.6	79.9 ± 14.8	80.3 ± 14.1	86.4 ± 12.9	92.6 ± 12.2	74.2 ± 21.4	60.4 ± 21.7	37.7 ± 5.9	94.5 ± 8
r value	–	0.44	0.36	0.49	0.42	0.45	0.58	−0.45	0.45
p value	–	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

ACL-RSI anterior cruciate ligament-return to sport after injury, *IKDC* international knee documentary committee, *KOOS* knee injury and osteoarthritis outcome score, *ADL* activity of daily living, *QoL* quality of life, *TSK* Tampa scale of Kinesiophobia

The test–retest assessment indicated excellent reliability, with an ICC of 0.92 (95 % CI 0.62–0.89).

Construct validity

Principal component analysis showed one underlying factor of the ACL-RSI-Tr with an explained variance of 61.8 % and an eigenvalue of 7.4. The ACL-RSI-Tr also had a significant positive correlation with IKDC, KOOS and Lysholm scales, but was negatively correlated with TSK ($p < 0.05$, Table 1).

Discriminant validity

The ACL-RSI-Tr scale was significantly different between patients who returned to sports (the same level and lower level) and those who did not return to sports ($p = 0.02$). Furthermore, patients who returned to sports scored higher on the ACL-RSI-Tr (62.4 ± 18.9) when compared to patients who did not return to sports (51.7 ± 22.9).

Floor and ceiling effects

Floor and ceiling effects for each question and the overall score were acceptable. The floor effect corresponding to patients with a score of 0 for each question varied between 3.2 and 14 %. The ceiling effect, corresponding to the proportion (%) of patients with a score of 10 for each question, varied between 3.2 and 14.7 %.

Discussion

The most important finding of this study was that the Turkish version of the ACL-RSI was an internally consistent, valid and reliable questionnaire for patients who had undergone ACLR. According to factor analysis, three subgroups (emotions, confidence in performance and risk appraisal) of the ACL-RSI-Tr could not be separated and it therefore primarily evaluates one dimension in a manner which was consistent with the findings of previous studies [13, 25]. Tripp et al. [23] suggested that the performance of athletes was related to negative emotions and that a fear of reinjury was related to a lower rate of return to sport. Consequently, it might be difficult to evaluate the three subgroups of the ACL-RSI separately. In the present study, we observed excellent correlation among the 12 items considered on the ACL-RSI-Tr scale. Internal consistency of the ACL-RSI-Tr, using the Cronbach alpha index, was 0.88 which is considered excellent. Furthermore, the ACL-RSI-Tr was comparable to English (0.96) [25], Swedish (0.95) [13], French (0.96) [6] and Dutch (0.94) [20] versions. Test–retest reliability for the ACL-RSI-Tr was also excellent and concurred with previous studies [6, 13, 20].

In recent studies, the validity of the ACL-RSI scale has been investigated by determining its specific relationship with IKDC, Lysholm, Tampa Kinesiophobia scale, KOOS and ACL quality of life scores, Knee Self Efficacy Scale and the Multidimensional Health Locus of Control (MHLC) forms [6, 13, 25]. In these previous studies, the highest levels of correlation were between the KOOS quality of life subscale ($r = 0.64$) [6] and ACL quality of life participation ($r = 0.85$) [13], with the lowest level of correlation observed between the KOOS symptom/stiffness subscale ($r = 0.22$) [6] and the MHLC form ($r = 0.29$) [13]. In the present study, construct validity was determined by analysing the relationship between the ACL-RSI-Tr and IKDC, Lysholm, TSK and KOOS scores. Correlation between the ACL-RSI-Tr and IKDC was good ($r = 0.44$, $p < 0.001$) and similar to the findings published previously for the French [6] and Dutch [20] versions. A lower IKDC score was previously shown to be related with a lower rate of return to sport. As with ACL-RSI [25], the IKDC score was identified as a useful tool to identify individuals who would not be able to return to sport following ACLR [14, 15].

When compared to the findings of the present study ($r = 0.58$, $p < 0.001$), previous studies reported a higher correlation between ACL-RSI and the KOOS quality of life subscale (Swedish version $r = 0.72$, $p < 0.001$; French version $r = 0.64$, $p < 0.001$) [6, 13], although the Dutch version reported similar results to our own study ($r = 0.40$, $p < 0.001$) [20]. The differences between these international studies may be due to the time elapsed (TE) after

ACL surgery. TE after ACLR was 13.6 months in our study and was 9.5 months in the Dutch version, but was approximately 42 months in the Swedish version. The KOOS is intended to be used for knee injuries which can result in post-traumatic osteoarthritis [19]. As the TE was greater in Kvist et al.'s study [13], the osteoarthritic changes in the knee cartilage might be more evident in their participants and may have led to a higher correlation between KOOS and ACL-RSI score.

Correlation between the ACL-RSI-Tr and TSK ($r = -0.45$, $p < 0.001$) and Lysholm ($r = 0.45$, $p < 0.001$) scores were also good and consistent with the Dutch (Tampa $r = -0.46$, $p < 0.001$) and French (Lysholm $r = 0.44$, $p < 0.001$) [6] versions. Kvist et al. [12] reported that individuals who could not return to sport had higher TSK scores following ACLR. The significant correlation between the ACL-RSI scale and other questionnaires suggests that psychological aspects are as important as knee function and quality of life in determining return to sport following ACLR. Consistent with previous studies [6, 13], the ACL-RSI-Tr score was higher in patients who returned to sport when compared to those who did not return to sport that confirmed the discriminant validity of the scale.

In day-to-day clinical practice, the ACL-RSI-Tr will help Turkish clinicians to use a standardised and reliable instrument to identify ACL reconstructed individuals who will find return to sport difficult as a result of psychological factors. Evaluating psychological factors is important in enabling the detection of patients who also need psychological intervention in parallel with physical therapy.

There are some limitations of the present study. As the participants were mainly male, the findings of our study might not be representative for female patients. However, there is no evidence in the literature to show that females exhibit different psychological responses in terms of return to sport following ACL injury. In addition, only patients with ACL reconstruction were included in the present study. Further studies are now required in order to test for the generalisability of the ACL-RSI-Tr scale in patients with ACL deficiency.

Conclusion

The Turkish version of the ACL-RSI scale was found to be valid, consistent and reliable in patients who had undergone ACL reconstruction. This score is likely to prove very useful in evaluating the effect of psychological factors upon return to sport following ACL reconstruction.

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Compliance with ethical standards

Conflict of interest None.

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