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ARTHROSCOPY AND SPORTS MEDICINE

Translation, cross-cultural adaptation and validation of the Turkish version of the Lower Extremity Functional Scale on patients with knee injuries

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Abstract
Introduction The Lower Extremity Functional Scale is a widely used questionnaire to evaluate the functional impairment in lower extremities. To date, the Lower Extremity Functional Scale has not been translated into Turkish. The aim of this study is to translate and culturally adapt the Lower Extremity Functional Scale into a Turkish version, and evaluate the psychometric properties of this version in patients with knee injuries.
Materials and methods The translation of the English version of the Lower Extremity Functional Scale into a Turkish version was performed using standard guidelines. Validity and reliability of Turkish version were tested in 134 patients with knee injuries. Association level between other outcomes measures (Kujala Patellofemoral Score, the Western Ontario and McMaster Universities Osteoarthritis Index, Lysholm Knee Scoring Scale and a Visual Analog Scale) and Turkish version of the Lower Extremity Functional Scale was analyzed to assess validation. Participants completed the questionnaire at baseline and after 2 days to test reliability.
Results The Turkish version of the Lower Extremity Functional Scale was showed a high degree of internal consistency (Cronbach $\alpha = 0.93$). ICCs were 0.96 and no floor or ceiling effects. The Lower Extremity Functional Scale had a high level of association with the Kujala Patellofemoral Score ($r = 0.82$), Lysholm Knee Scoring Scale ($r = 0.80$) and the Western Ontario and McMaster Universities Osteoarthritis Index scores ($r = 0.69$) (all, $p < 0.05$).
Conclusion The Turkish version of the Lower Extremity Functional Scale is a valid and reliable questionnaire that can be used to evaluate functional status in Turkish speaking patients with different knee disorders.
Level of evidence: III.

Keywords Cross cultural adaptation · Lower extremity functional scale · Reliability · Validity · Turkish

Introduction

Imaging and clinical physical examination are conceived insufficient to determine the functional level of an individual following injury or surgery. Accurate evaluation of functional level has been shown to be value for rehabilitation to help provide an idea about the treatment and recovery of patient's disabilities [1–3]. Therefore, for functional evaluation, functional tests and patient-reported outcomes are commonly used [4].

Numerous self-report measures on physical function are available for the evaluation of patients with knee pathologies. However, most of these questionnaires have been developed in English [5]. Before a questionnaire can be used in other countries where people speak different languages, it should be translated and culturally adapted [1, 6]. A few questionnaires to assess knee function have been translated into Turkish and validated including, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) [7], Lysholm Knee Scale [8] and the Kujala

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Patellofemoral Score [9]. These knee-joint specific questionnaires are useful to provide information. However, these instruments lack generic questions to assess the functional status and changes of the entire lower limb while knee injuries are present [1, 4]. Also these outcome measures have many items requiring time to complete [10].

Lower Extremity Function Scale (LEFS) was developed in 1999 by Binkley et al. and aimed to easily evaluate the functional status of patients with musculoskeletal dysfunction affecting the lower extremities [11]. LEFS is formed by 20 items; each had five possible numeric response categories (0–4). The total score ranges from 0 to 80, with higher scores are regarded as better functional status. It has been shown as a competitive alternative to the other knee specific questionnaires because the LEFS can diversify pain and functioning. It also detects changes in functional level immediately after surgery [12].

Since the LEFS is currently not available in Turkish, the primary purpose of this study was to translate and culturally adapt the original English version of the LEFS into Turkish version and to assess the validity and reliability of this instrument in patients with knee injuries.

Materials and methods

Translation procedure

All patients signed written informed consent form and an approval was provided by a University Ethics Committee.

The LEFS was translated from its original English version into Turkish according to a standardized procedure described by Guillemin et al. [13] and Beaton et al. [14]. The procedure includes four steps. First, for forward translation two native Turkish speakers translated the LEFS independent of each other into Turkish. One translator was familiar with medical terminology and the other was not (T1, T2). Afterwards, both initial translations were combined and one final version was formed. In second step, combined final version of questionnaire was translated back into English by two independent professional translators who were unfamiliar with both questionnaire and health care terminology (BT1, BT2) to ensure a consistent translation of the English version of the instrument. In third step, a meeting was organized with a research committee composed of three physiotherapists, an orthopedic surgeon, all translators, a language expert and authors. During the meeting, the research committee evaluated all versions of LEFS (T1, T2, BT1, BT2) to ensure that translations reflect Turkish cultural characteristics and discrepancies. They also analyzed the questionnaire methodologically and grammatically. Then they approved a pre-final version of LEFS. 20 patients with a variety of knee injuries completed this pre-final version to assess LEFS's clinical performance and clarity in a manner to match the original version. Subjects with a medical diagnosis of a knee injury by an orthopedic surgeon, also with an ability to read and write Turkish were included to the study. Those who did not understand the questions and have other systematic, neurological or lower extremity musculoskeletal pathology except knee injury were excluded. All 20 patients were asked whether they could clearly understand the questions and interpret them correctly. The answers were discussed among the authors and a final Turkish version of LEFS was formed.

Participants and testing

Turkish version of WOMAC, Kujala Patellofemoral Score, Lysholm Knee Scoring Scale and a Visual Analog Scale (VAS) for pain, in addition to the Turkish version of LEFS were completed by 134 patients with a variety of knee pathologies. The inclusion and the exclusion criteria were the same as the pretest stage.

Reliability

The LEFS-Turkish was applied two times by a physiotherapist to determine test–retest reliability. On the first day of assessment the physiotherapist collected demographic data and patients answered LEFS-Turkish. For intra-rater reliability, LEFS-Turkish was re-applied 48 h later. Between two assessments, no treatment was provided to minimize clinical differences.

Validity

Construct validity was assessed by determining correlation between LEFS-Turkish and knee injury specific scales called WOMAC [7], Lysholm Knee Scale [8] and the Kujala Patellofemoral Score [9] because no known gold standard for measure of function exists.

WOMAC is a disease-specific scale designed to evaluate patients with knee osteoarthritis. It consists of 24 items which measure physical function (17 items), pain (five items) and stiffness (two items). Each item in this questionnaire was rated from 0 to 4. Therefore, the maximum score in WOMAC is 20 points for pain, 8 points for stiffness, and 68 points for physical function. Higher scores represents worse symptoms; greater functional difficulty in physical function subscale for example [7, 12].

The Kujala Patellofemoral Score was developed to evaluate subjective symptoms and functional limitations in patellofemoral disorders. This score includes 13 questions examining pain during functional activities or prolonged sitting and also examining whether there are a normal

patellar movements. The total score ranges from 0 to 100, the higher scores indicating better functional status [9, 15].

The Lysholm Knee Scoring Scale is designed to evaluate patients after knee ligament injury and includes eight items. It can be used in different knee disorders because it is not a disease-specific instrument. The total score ranges from 0 to 100 (worst to best symptoms, respectively), with 25 points refers to pain, 10 to swelling, 25 to instability, 15 to locking, 10 to stair climbing, and 5 points each to limping, use of a support, and squatting [8, 16].

Statistical analysis

We assessed the Kaiser–Meyer–Olkin measure of sampling adequacy and the Barlett test of sphericity, to ensure sampling adequacy. Reliability was assessed with Cronbach alpha, split half test and test–retest method. Floor and ceiling effects were determined by calculating the rate of participants that obtained the lowest (0) or highest (80) scores and were considered present if more than 15 % of the participants achieved the highest or lowest score [17]. Validity was assessed by explanatory factorial analysis of the LEFS scores obtained at the first meeting. Principal components analysis was performed with varimax rotation if it was necessary. The number of potential factors was suggested by scree plot, eugen value cut-off >1.0, and ≥10 % variance. Convergent and divergent validity was assessed with correlation between pain at rest, activity, Kujala patellofemoral score, Lysholm Scoring Scale, WOMAC pain, stiffness, physical function, total score and LEFS score.

Results

Sample

Our research sample consists of 134 patients with knee injuries. Demographic and some clinical characteristics of the participants were as follows; the mean age 33.6 ± 13.6 years, mean educational year 14.0 ± 3.7, mean duration of illness 9.3 ± 10.3 months and 66.4 % ($n = 89$) man (Tables 1, 2).

In our analysis, Cronbach Alpha for 0.93 ($n = 134$, alpha = 0.05 accepted) was calculated as power 1.0, power factor analysis was calculated 0.94, respectively (population RMSEA—root mean square error of approximation = 0.08, null hypothesed RMSEA = 0.005, $Df = 170$ and $n = 134$ accepted).

Reliability

The Cronbach Alfa was used for internal consistency analysis of the LEFS and was determined as $r = 0.93$ (95 % CI 0.91, 0.94) for the entire test. The split-half reliability of the scale (Spearman–Brown corrected) was 0.85. The test–retest method was used to determine the reliability of the scale, and the LEFS was given again for this purpose about 48 h after the first test to all patients from among the participants and we found that test–retest correlation of the scale was to be $r = 0.97$ ($p < 0.001$) (Fig. 1). Intraclass correlation coefficient ($ICCs_{2,1}$) was found 0.96 (95 % CI 0.93–0.98 $p < 0.001$). Floor (0 %) and ceiling (0 %) effects were not detected (Fig. 2).

Table 1 Descriptive data for patients ($n = 134$)

	n	Mean ± SD
Age (years)	134	33.6 ± 13.6
BMI (kg/m^2)	134	20.34
Educational year (years)	134	14.0 ± 3.7
Duration of illness (months)	134	9.3 ± 10.3
	n	(%)
Sex (male/female)	89/45	66.4/33.6

Table 2 Knee pathologies in patients participating the study

Knee pathologies	*N*	%
Fractures around the knee	3	2.2
ACL rupture- reconstruction	12	9.0
Meniscus repair—menisectomy	8	6.0
ACL reconstruction + meniscus repair	59	44.0
Patellofemoral syndrome	22	16.4
Meniscopathy	22	16.4
Osteoarthritis	7	5.2
Medial patellofemoral ligament reconstruction	1	0.7
Total	134	100.0

ACL anterior cruciate ligament

Validity analysis

The measure of psychometric adequacy suggested that the LEFS correlation matrix was suitable for factor analysis for the sample. The Barlett test of sphericity indicated that the LEFS items were interdependent: χ^2 (190) = 2071.1, $p < 0.001$. The Kaiser–Meyer–Olkin measure of sample adequacy was 0.87.

In the explanatory factor analysis, the number of factors explaining 10 % of the total variance and the above was determined by scree plot. Accordingly, the scale was found to contain two factors. These two dimensions could explain 59.3 % of the total variance. According to varimax

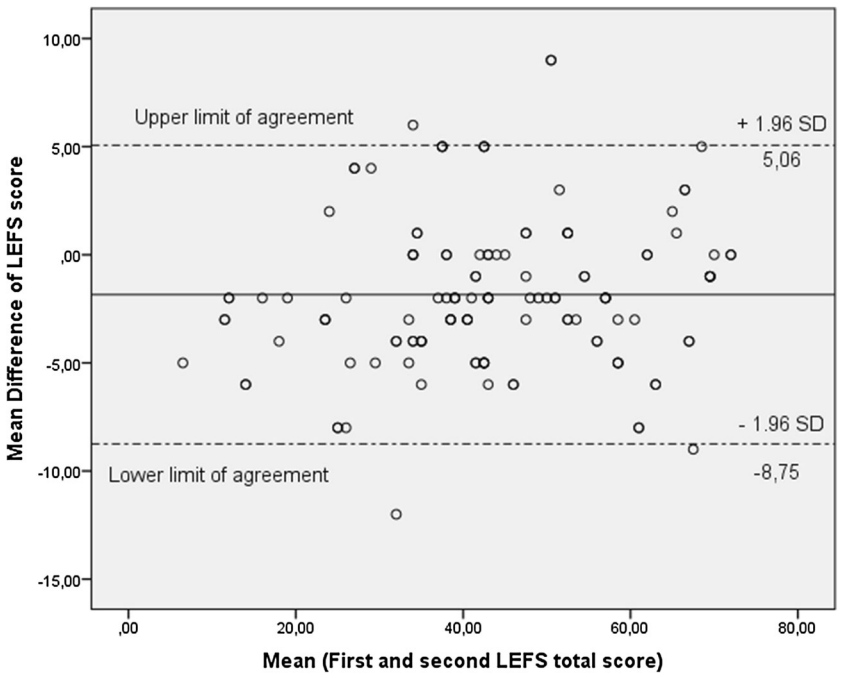

Fig. 1 Bland–Altman plot visualising the agreement for test–retest with the limits marked as mean difference ±SD in a 80-point scale

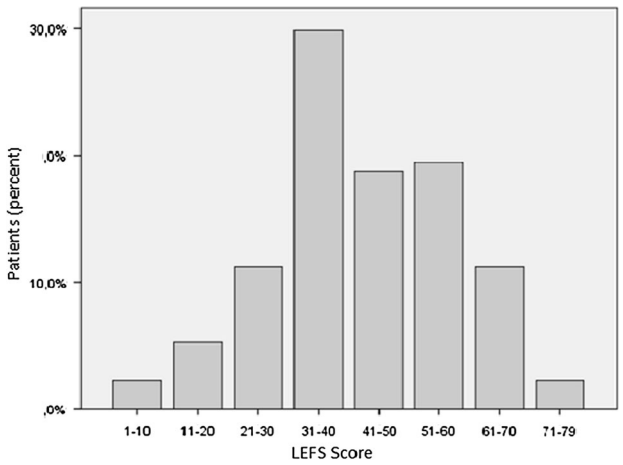

Fig. 2 Distribution of LEFS scores for the first testing occasion ($n = 134$)

rotation, first factor are composed of 1, 3, 4, 5, 7, 8, 10, 11, 13, 15 and 20 questions; second factor consisted of 16, 17, 18 and 19 questions. Loading factors in 2, 6, 9, 12 and 14 questions which was similar in both factors, were removed from the scale.

There was a negative and moderate correlation between LEFS total score and pain at rest and activity for divergant validity. When we examined the correlations for convergant validiy, there was a positive and strong correlation with Kujala patellofemoral score, Lysholm Knee Scoring Scale. Similarly, we found a positive and moderate-to-strong correlation with the WOMAC scores (Tables 3, 4).

Discussion

Until now, there was no validated Turkish version of the LEFS, so the aim of this study was to cross-culturally adapt the original version of the LEFS to be used with Turkish-speaking patients with knee injuries and to evaluate its psychometrics properties. The results of the current study showed that the LEFS-Turkish is a reliable, internal consistent and valid questionnaire with no ceiling or floor effects to determine functional status of patients with various knee pathologies.

A precise approach to what will be the sample size is still not occurred in the validity and reliability study. Indeed, a study of 114 recent research studies examining the validity and reliability has been shown to be calculated at a rate of less than 10 % of the sample size. These studies also did not receive any explanation of the method section where nearly half are shown for reference only. The other studies is often suggested in the exploratory factor analysis item number of the ratio it is used. This ratio varies between 1.2 and 20 (18). In the present study, this ratio is 6.7 and this ratio is higher than the rate used in many studies. Furthermore, the theoretical basis is still debated, and this calculations indicate that there is enough power to run.

No difficulties were experienced in translating the instrument and the back translation complied very well with the original version. In Turkish version, only minor modification was the change of the measurement unit length system to kilometers. Similar to the Brazilian and

Table 3 Descriptive data for all outcome measures ($n = 134$)

	n	Min	Maximum	Mean	SD
LEFS[t] (0–80)	134	4.0	72.0	42.7	15.5
Pain (rest)	134	0	8.0	1.9	2.3
Pain (activiy)	134	0	10.0	4.9	2.7
Kujala Patellofemoral Score	134	16.0	93.0	52.8	16.9
Lysholm Knee Scoring Scale	134	23.0	100.0	63.3	17.2
WOMAC (pain)	134	0	16.0	5.8	3.3
WOMAC (stiffness)	134	0	6.0	2.3	1.5
WOMAC (functioning)	134	1.0	71.0	26.8	16.1
WOMAC total	134	4.0	78.0	34.8	19.5

WOMAC Western Ontario and McMaster Universities Osteoarthritis Index

Table 4 Convergent validity, correlations between LEFS and other scales

	Pain (rest)	Pain (activity)	KPS	LKSS	WOMAC (pain)	WOMAC (stiffness)	WOMAC (func.)	WOMAC total
LEFS								
r	-0.470^{**}	-0.462^{**}	0.823^{**}	0.806^{*}	-0.642^{**}	-0.480^{**}	-0.691^{**}	-0.697^{**}
p	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

KPS Kujala Patellofemoral Score, *LKSS* Lysholm Knee Scoring Scale, *WOMAC* Western Ontario and McMaster Universities Osteoarthritis Index

** $p < 0.05$

Dutch versions, the authors maintained the self-reported format of the original version, and presented two measurement systems [4, 5]. For the sake of clarity of the questionnaire to the Turkish culture, these adaptations were made in the 11th and 12th questions. In question 11, "walking two blocks" was described as walking approximately 500 m and also in question 12, "walking a mile" described as walking approximately 1500 m in parenthesis. Despite these adding's, the question 12 was removed from the scale. This may be due to failure to understand the distance of 1.5 km by Turkish society. In addition, questions 2 (recreational activities), 6 (squatting), 9 (performing heavy activities) and 14 (standing 1 h) were also removed from the scale as a result of analysis. This may be because patients participated in this study were composed of sedentary individuals; so these activities may be perceived in the same difficulty and the load factor may have been the equivalent of these questions.

Concerning the psychometric properties of the Turkish LEFS, Cronbach's α was 0.93, indicating a high internal consistency. Compared with others available versions, the results are similar in the original, which showed a Cronbach's α of 0.96, or the Italian, Dutch and Spanish versions with a Cronbach's α of 0.96, 0.94 and 0.98, respectively [5, 11, 19, 20].

The high test–retest reliability was demonstrated by the ICC in this study. The result of test–retest reliability obtained in this study is slightly better than in the original (ICCs = 0.86) [11], and similar to Spanish (ICCs = 0.99) [18], Italian (ICCs = 0.91) [19], Brazilian (ICCs = 0.96) [4], Persian (ICCs = 0.97) [21] and Brazilian Portuguese (ICCs = 0.96) [1] versions of LEFS. Therefore, the Turkish version may be considered as a reliable tool.

The construct validity of the Turkish LEFS was demonstrated by its high correlation with the Kujala Patellofemoral Score, Lysholm Knee Scoring Scale and negative moderate-high correlation with WOMAC-pain, WOMAC function and WOMAC-total scores, and its negative moderate correlation with the pain at rest, pain at activity and WOMAC-stiffness scores. As expected, the strength of the association between LEFS and other scales which includes questions about function (the Kujala Patellofemoral Score, Lysholm Knee Scoring Scale and WOMAC scores (totals score and function domain)) were higher than the level of association between the LEFS and the stiffness and pain domains of the WOMAC. The high correlation values with the Kujala Patellofemoral Score and Lysholm Knee Scoring Scale may be related to the injury characteristics of the individuals participated to the study.

The absence of floor or ceiling effect confirms the content validity of the Turkish version of the LEFS. Therefore, these findings provide support for the validity of the Turkish LEFS to assess function of the lower extremities for a variety of knee conditions.

There are already a few knee-specific questionnaires translated into Turkish, such as the WOMAC and the

Lysholm Knee Scale; however, the assessment of function that includes the entire lower extremity can also supply valuable information when multiple joints are involved. Given the established psychometric properties of the original LEFS, we were translated and adapt the LEFS into a Turkish and established the psychometric properties of this version on patients with knee injuries. Similarly, Hoogeboom et al. [5] made Dutch version of the LEFS in patients with hip and knee osteoarthritis and Metsavalt et al. [1] made Brazilian Portuguese version in patients with knee injuries. Also Watson et al. [22] have validated the original English version of the LEFS for patients with anterior knee pain.

Several potential limitations are associated with the present study. Originally the LEFS has been developed as an assessment tool that could be used for all kinds of conditions of the lower extremity however we included only patients with knee disorders. The exclusion of other conditions blocks the generalizability of our findings to other complaints of the lower limb. In addition, the validity and reliability of the Turkish version of LEFS were demonstrated over a short period (2 days) and there is lack of responsiveness assessment of the scale. Further investigations are needed to document the measurement properties of the Turkish version of LEFS in patients with other lower extremity musculoskeletal dysfunction. Also, an evaluation of its other measurement properties, such as responsiveness, would be of great value.

Conclusion

It was found that the Turkish version of the LEFS has good internal consistency, reliability and constructs validity. Therefore, the use of the Turkish LEFS can be recommended as an outcome measure for functional evaluation in patients with knee disorders.

Compliance with ethical standards

Conflict of interest None.

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