RESEARCH ARTICLE

Cross-cultural Adaptation, Validation, and Reliability of the Persian version of the Toronto Extremity Salvage Score (TESS) for Lower Extremity

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Abstract

Objectives: The Toronto Extremity Salvage Score for the lower extremity (LE-TESS) is a commonly used patient-reported outcome measure (PROM) designed to assess physical disability in patients following lower limb salvage surgery for bone or soft tissue tumors. Although the TESS has been widely translated and culturally adapted for clinical and research purposes in many countries, it has not yet been translated into Persian (Farsi) or validated for use in Iranian society. This study aims to provide a validated and reliable Persian version of the TESS questionnaire.

Methods: The LE-TESS questionnaire was adapted for the Iranian (Persian) society in accordance with international translation and cultural adaptation guidelines. The reliability and validity of the Persian LE-TESS were assessed in patients referred to Shafa Yahyaeian Hospital who underwent lower limb salvage procedures for malignant tumors between 2016 and 2022. Cronbach's alpha was used to measure internal consistency, and test-retest reliability was assessed within two weeks to calculate the intraclass correlation coefficient (ICC). Construct validity was evaluated using Spearman's rank correlation with the Short Form-36.

Results: In this study, 31 patients (54.8% male) were included, with a mean age of 26.16 ± 9.61 years. The internal consistency evaluated by Cronbach's alpha was 0.887, and the intraclass correlation coefficient (ICC) assessed by the test-retest reliability was 0.872. This research's SEM and MDC 0.95 values were as much as 11.63 and 32.23, respectively. The construct validity analysis revealed a strong correlation between the Persian LE-TESS and the SF-36.

Conclusion: The Persian version of the LE-TESS demonstrated reliability and validity in assessing the physical function of patients who underwent lower limb salvage surgery for bone and soft tissue tumors.

Level of evidence: IV

Keywords: Cross-cultural adaptation, Persian language, Reliability, TESS, Toronto extremity salvage score, Translation, Validity

Introduction

Musculoskeletal tumors, such as sarcomas, commonly affect long bones and soft tissues, particularly the lower extremities.[1,2] Patients with bone sarcomas are typically treated with limb amputation surgery.[3] However, with the development of surgical and adjuvant therapies, clinicians have increasingly favored limb-salvage procedures for these tumors.[4] Compared to amputation, limb-salvage surgery results in fewer negative impacts on function, quality of life, and cosmetic outcomes.[5] Furthermore, limb-salvage surgery has a survival rate comparable to that of limb amputation.[6]

These patients often experience significant physical disability as a result of their treatment. It is essential to evaluate function in patients who have undergone various

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surgical techniques for musculoskeletal cancers, particularly those with lower extremity sarcomas, such as limb-sparing or amputation surgeries.[7] Hematologic malignancies, including acute lymphoblastic leukemia (ALL) and bone tumors, are recognized as potential causes of acute limping in children.[8] Physical function following lower limb tumor surgery is one of the most important parameters for assessing the effectiveness of limb salvage procedures. To optimize clinical care, surgeons use patient-reported outcome measures (PROMs) to evaluate patients' pain and functional status. One of the most commonly used patient-reported outcome measures (PROMs) to assess quality of life and functional performance after orthopedic surgeries is the Short Form-36 (SF-36) questionnaire, which includes questions about health perception, emotional state, activity level, pain, and other aspects of well-being.[9] However, the SF-36 is a general and nonspecific tool.

On the other hand, the Toronto Extremity Salvage Score (TESS) is a valid and reliable tool used to assess physical disability in patients following surgery for extremity sarcoma.[10–12] In addition to the original English version, the TESS has been translated, cross-culturally adapted, and validated in various languages, including Egyptian,[13] Greek,[14] and Turkish.[15]

The use of valid Persian translations of questionnaires in all orthopedic sections has gained attention in recent years. For example, the Persian version of the P-FJS in THA is used to assess function. In various orthopedic sections, specific questionnaires for each area are utilized.[16]

For instance, in the study by Duy Nguyen Anh Tran and colleagues, Bostman's scoring questionnaire was used to evaluate knee function in cases of patellar rupture.[17]

Despite the widespread use of the LE-TESS in Iran for both clinical and research purposes, the questionnaire has neither been translated into Persian nor validated for use in Iranian society. This study aimed to address this gap by translating and culturally adapting the LE-TESS for the lower extremities into Persian and validating its use among Iranian patients who have undergone surgery for bone or soft tissue tumors of the extremities.

Materials and Methods

This study was approved by the Research Ethics Committee of Iran University of Medical Sciences (IR.IUMS.REC.1401.529). Informed consent was obtained from all patients, and for patients under 18 years of age, consent was obtained from their parents or legal guardians. Permission was also obtained via email from the publisher of the Toronto Extremity Salvage Score (TESS) (University of Musculoskeletal Oncology Unit, University of Toronto, and Mount Sinai Hospital) to translate the TESS.

The Toronto Extremity Salvage Score (TESS)

The LE-TESS questionnaire evaluates explicitly the performance of patients with tumors who have undergone limb salvage procedures in the lower extremities. This questionnaire consists of 30 questions, each with six response options: "impossible to do," "extremely difficult," "moderately difficult," "a little bit difficult," "not at all difficult," and "This task does not apply to me" (which is selected if the item is not a typical activity for that individual). Each question is scored from 0 to 5 points. Based on the raw score, a final score ranging from 0 to 100 points is calculated. Higher scores indicate fewer functional limitations.[9,15]

Short Form-36 Health Questionnaire (SF-36)

The Short Form Health Survey (SF-36) is one of the most widely used questionnaires for assessing health-related quality of life. It measures health across eight categories, including physical functioning (10 items), role limitations due to physical problems (4 items), bodily pain (2 items), vitality (4 items), general health perception (5 items), social functioning (2 items), role limitations due to emotional issues (3 items), and mental health (5 items).[19]

For each category, the questionnaire provides a score ranging from 0 (worst) to 100 (best). The Short Form Health Survey (SF-36) has already been translated and validated for use in assessing health-related quality of life in Iranian society.[20]

Translation and Cross-Cultural Adaptation

According to the internationally recognized "Guidelines for the Process of Cross-Cultural Adaptation of Self-Report Measures," the questionnaire underwent six stages of translation and cultural adaptation.[21]

Stage 1. The original English version of the questionnaire was translated by two independent Persian translators who were native Persian speakers. The first translator was an experienced orthopedic surgeon with a comprehensive understanding of the respondent's context, as well as academic and clinical perspectives. The second translator, an English teacher, was not familiar with the medical aspects of the scale.

Stage 2. The two translations were discussed and analyzed by the translators and researchers. Some conceptual discrepancies were identified during the meeting. The two versions were then merged to create a clarified, relevant, concise, and consistent version of the original English questionnaire.

Stage 3. The finalized translation was retranslated into English by two independent native English translators who had no prior knowledge of or access to the original English version. This process involved assessing whether the translated version conveyed the same content as the original.

Stage 4. A meeting consisting of researchers, methodologists, translators, and orthopedic surgeons reviewed all the translations and transcripts, comparing discrepancies in both translation and content. After discussing the inconsistencies and making necessary cultural adjustments, a pre-final version of the questionnaire was created.

Stage 5. Testing of the Prefinal Version – Ten patients (with equal sex distribution) who met the study's eligibility criteria completed the questionnaire and were interviewed to describe their understanding of each question and their answers.

Stage 6. All forms and translations were submitted to ensure comprehensive records of the adaptation process. The researchers and orthopedic surgeons reviewed and revised the questions to finalize the Persian version of the LE-TESS.

Patients

The study population included patients who underwent limb salvage procedures for malignant tumors of the lower limb at Shafa Yahyaeian Hospital (a single university-based hospital) from 2016 to 2022 and were referred for follow-up treatment in 2022. We included patients who were native Persian speakers, aged 16 years or older, and had undergone surgical therapy for bone or soft tissue sarcoma at least six months before entering the study. The exclusion criteria consisted of patients with neurological conditions, neuromuscular disorders, acute rheumatic disease, or cognitive impairment.

Reliability

An instrument's reliability refers to its ability to consistently produce the same result over time and across different settings.[21] The reliability of the LE-TESS was assessed using measures of internal consistency and stability. Internal consistency was evaluated by calculating Cronbach's alpha coefficient. A level of consistency is considered adequate when the alpha value exceeds 0.70.[22]

For stability assessment, the intraclass correlation coefficient (ICC) was calculated using the test-retest reliability method. A higher ICC indicates a higher level of reliability for the LE-TESS questionnaire. Test-retest reliability was assessed by having 31 patients complete the questionnaire twice within two weeks.[23] During this period, the patients did not receive any additional interim treatment. The ICC ranges from 0 (totally unreliable) to 1 (totally reliable). An ICC ≥ 0.80 was defined as excellent reliability.[24]

Validity

Validation is a crucial parameter for determining whether an instrument effectively aligns with its intended purpose. In the context of Patient-Reported Outcome Measures (PROMs), content validity plays a key role in determining whether the instrument accurately represents the construct it is designed to measure.[25]

To assess the content validity of a patient-reported outcome measure (PROM), it is essential to evaluate its relevance, comprehensiveness, and comprehensibility within the context of the target population and healthcare professionals.[26]

Construct validity refers to the degree of consistency between an instrument's scores and the specific attributes it is intended to measure.[25] Construct validity can be established by evaluating the instrument's correlation with other tools designed to measure a similar construct, a concept known as convergent validity.[26] The construct validity of the Persian LE-TESS was assessed using Spearman's correlation coefficient between the TESS and the relevant dimensions of the SF-36.

Statistical analysis

SPSS 22.0 for Windows was used to perform the statistical analysis. A p-value < 0.05 was considered statistically significant. The Shapiro–Wilk test confirmed that the data were normally distributed. Spearman's correlation was used to assess the relationship between the LE-TESS and SF-36 scores. Test-retest reliability was analyzed using the intraclass correlation coefficient (ICC) with a two-way random effects model.[26]

Additionally, the standard error of measurement (SEM) was used to assess the stability of responses. Taking the SEM into account, the minimal detectable change at the 95% confidence level (MDC95%) was calculated. The formulas used for these calculations are as follows:[28]: $SEM=SD\sqrt{(1-ICC)}$ $MDC95\%=1.96SEM\sqrt{2}$

Results

A total of 31 patients who met the inclusion criteria participated in this study. The average age of the participants was 26.16 ± 9.61 years, with a minimum age of 16 years and a maximum age of 56 years. Seventeen patients (54.8%) were male, and the most common pathology among the participants was osteosarcoma, which accounted for 38.7% (12 patients), followed by Ewing sarcoma, which accounted for 32.3% (10 patients) [Table 1].

Table 1 summarizes the demographic characteristics of these included 16 males and 3 females with a mean age of 34 years (age range: 19-69 years) and a mean follow-up of 35 months (13-105).

Table 1. Baseline Characteristics of the Patients

Characteristics	Patients (n = 31)
Age (Year)	
Mean (SD)	26.16 ± 9.61
Gender, N (%)	
Male	17 (54.8)
Female	14 (45.2)
Tomur Location, N (%)	
Proximal Tibia	7 (22.6)
Hip	6 (19.4)
Femur	4 (12.9)
Distal Tibia	2 (6.5)
Distal Femur	11 (35.5)
Tibia	1 (3.2)

Table 1. Continued	
Pathology, N (%)	
Osteosarcoma	12 (38.7)
MFH	1 (3.2)
Ewing Sarcoma	10 (32.3)
Chondrosarcoma	3 (9.7)
Adamantinoma	1 (3.2)
Metastasis	2 (6.5)
Clear Cell Chondrosarcoma	2 (6.5)
Type Of Procedure	
Tumor Prosthesis Application	14 (45.2)
Osteoarticular Allograft Fixation	3 (9.7)
Intercalary Allograft Fixation	7 (22.6)
Allograft-prosthetic composite (APC)	7 (22.6)

The mean score of the Persian version of the LE-TESS questionnaire was 104.35 (±17.18). "Getting up from kneeling" was regarded as the most challenging activity (mean score: 1.52) in the TESS questionnaire [Table 2]. Patients reported that they did not apply to the following items: “Participating in sexual activities” (n=21, 67.7%), “Driving” (n=7, 22.5%), “Working the usual number of hours” (n=14, 45.1%), and “Gardening” (n=11, 35.4%).

Table 2. The frequency of answering the questions of the LE-TESS questionnaire in the order of the most challenging situation

Question	Mean	SD	Sum
1- Getting up from kneeling	1.52	1.029	47
2- Completing usual duties at work	2.16	2.099	67
3- Participating in sexual activities	2.03	2.496	63
4- Kneeling	2.29	1.465	71
5- Gardening	2.29	2.02	71
6- Working the usual number of hours	2.29	2.116	71
7- Participating in my usual sporting activities	2.58	1.608	80
8- Walking up or down hills or a ramp	2.87	1.284	89
9- Heavy chores such as vacuuming and moving furniture	2.90	1.350	90
10- Bending to pick something up off the floor	3.13	1.118	97
11- Driving	3.19	1.990	99
12- Walking downstairs	3.55	1.028	110
13- Walking upstairs	3.55	1.091	110
14- Sitting	3.71	1.101	115
15- Walking outdoors	3.87	1.056	120
16- Putting on a pair of socks or stockings	3.9	1.24	121
17-Showering	4.58	0.886	123
18- Light household chores such as tidying and dusting	3.97	1.602	123
19- Preparing meals	3.97	1.581	123
20- Putting on a pair of trousers	4	1.033	124
21- Going shopping	4.06	1.063	126
22- Putting on shoes	4.19	0.91	130
23- Participating in my usual leisure activities	4.19	1.250	130
24- Getting in and out of a car	4.23	1.023	131
25- Standing	4.39	.919	136
26- Socializing with friends and family	4.42	1.177	137
27- Walking within the house	4.48	.851	139
28- Rising from a chair	4.71	0.783	146
29- Getting in and out of the bath	4.81	0.601	149
30- Getting out of bed	4.81	0.601	149

Translation and Cross-Cultural Adaptation

The prefinal Persian version of the LE-TESS was comprehensive during the testing phase (Stage 5), indicating that it was straightforward for native Persian-speaking patients undergoing lower limb salvage surgery. No significant differences were found between the forward and backward translations and the original TESS.

Reliability

The internal consistency was good, with a Cronbach's alpha of R = 0.887 for the Persian version of the TESS. The Spearman rank correlation coefficients between each item and the total score (excluding that item) ranged from 0.038 to 0.664 for the Persian version of the LE-TESS.

The test-retest reliability was strong, with an intraclass correlation coefficient (ICC) of 0.872 (95% confidence interval [CI]: 0.79–0.92) for the Persian version of the LE-TESS. The SEM and MDC 0.95 values for this study were 11.63 and 32.23, respectively.

Validity

Table 3 displays the average scores of the patients in the study for the eight SF-36 dimensions, as well as the physical and mental component scores (PCS/MCS) [Table 3].

In this case, the construct validity of the Persian LE-TESS was assessed by calculating the Spearman rank correlation coefficient between the Persian LE-TESS score and the scores on the SF-36 dimensions, as well as the physical and mental components of the SF-36. The results showed a strong correlation between the Persian LE-TESS score and the SF-36 dimensions of emotional well-being, social functioning, vitality, and the physical component of health. A moderate correlation was found between the Persian LE-TESS score and the SF-36 dimensions of emotional role limitation, bodily pain, mental health, general health, physical functioning, and mental health. The correlation with physical role limitations was weak [Table 4].

Table 3. The average scores of the patients in the study for the eight SF-36 dimensions.

SF-36 dimension	Mean ±SD	Range	Max	Min
Mental health	69.26±22.48	84	129	96
Role limitations: physical	72.58±18.65	50	50	100
Social functioning	68.55±27.36	88	13	100
Role limitations: emotional	61.29±32.32	100	0	100
Vitality	69.84±25.57	95	5	100
Bodily pain	80.66±17.43	60	40	100
General health	75.40±12.755	54	43	96
Physical functioning	70.97±14.10	65	30	95
Physical component score	299.6±52.31	203.75	177.50	381.25
Mental component score	268.93±89.60	319.2	67.8	387

Table 4. Correlation between SF36 Components and LE-TESS questionnaire

Components	Lower Bound	Upper Bound	R	P Value
Emotional Wellbeing	0.171	0.769	0.553	0.001
Role limitations: physical	-0.256	0.465	0.102	0.587
Social functioning	0.349	0.836	0.616	0.000
Role limitations: emotional	0.079	0.633	0.390	0.030
Vitality	0.313	0.802	0.625	0.000
Bodily pain	0.000	0.665	0.268	0.145
General health	-0.155	0.623	0.261	0.155
Physical functioning	-0.134	0.612	0.145	0.268
Physical component score	0.216	0.814	0.580	0.001
Mental component score	-0.142	0.594	0.253	0.169

Discussion

The TESS for lower extremities is one of the most commonly used patient-reported outcome measures (PROMs) in Iran for evaluating patient function following surgery for bone and soft tissue tumors of the lower extremities. However, no validated Persian version is currently available. In this study, the TESS for lower extremities (TESS-LE) was translated and culturally adapted into Persian. The Persian version was validated among patients who had undergone surgical treatment for bone or soft tissue tumors of the extremities.

The Persian version of the LE-TESS demonstrates high internal consistency and test-retest reliability, comparable to those of other translated and validated versions of the TESS[13–15] as well as the original version of the TESS.[10]

The Persian version of the TESS (LE-TESS) offers significant utility in both clinical and research settings, providing a

standardized tool for assessing functional outcomes in patients who have undergone extremity tumor surgery. In clinical practice, the Persian TESS can be used for pre- and post-surgical evaluations to determine the effectiveness of treatments and assess physical disability, such as in limb-salvage surgery. It can also be used during follow-up visits to monitor recovery and identify functional deficits that may require targeted rehabilitation. By tailoring physical therapy plans based on patient-reported outcomes, the Persian TESS can play a crucial role in optimizing individual patient care.

The Persian TESS is a reliable tool for evaluating functional outcomes, enabling comparisons across studies and different surgical approaches, which can also serve as a benchmark for validating other patient-reported outcome measures (PROMs) in Persian-speaking populations. Moreover, its application in comparative studies, such as evaluating limb-salvage surgery versus amputation, would further enhance its utility and broaden its scope.

Integrating the Persian TESS into clinical practice, research, and healthcare systems can facilitate its widespread adoption, thereby improving the assessment of treatment outcomes and enhancing overall patient care in Persian-speaking populations with extremity sarcomas.

In this study, the validity of the Persian TESS was assessed by comparing its results with those of the SF-36 scale, a method that aligns with many other translations and cross-cultural adaptations of the TESS into various languages.[14,28] However, the original questionnaire[9] along with some other language versions[29–32] utilized the Musculoskeletal Tumor Society (MSTS) score[30] to assess the validity of the questionnaire. The reason for selecting the SF-36 for comparison with the LE-TESS in this study is that the SF-36 is a patient-reported outcome measure (PROM), whereas the MSTS is a physician-reported outcome measure. Consequently, the SF-36 is more suitable for comparison with the LE-TESS, as both are patient-reported. Additionally, the SF-36 has been translated into Persian, whereas the MSTS questionnaire has not. Moreover, the MSTS is disease-specific; had it been used in this study, it would have provided additional information. However, physicians in our clinic do not regularly complete it as part of routine patient care. The SF-36 and Persian LE-TESS demonstrated strong correlations with expected dimensions, such as physical and social functioning, as the LE-TESS was specifically developed to measure physical function.

Six tasks were determined to be nonapplicable for patients with lower extremity conditions, similar to those outlined by Davis et al.[10] These tasks included 'gardening and yard work,' 'participating in sexual activities,' 'driving,' and 'working the usual number of hours.

A limitation of this study may be the small patient population, which was derived from a single center, potentially influencing the results. The center receives patient referrals from all hospitals across Iran for individuals who underwent salvage surgery. However, the overall population of patients who underwent salvage surgery for bone and soft tissue tumors in the lower extremities was generally low. This was further exacerbated by the ongoing global COVID-19 pandemic, which led to the cancellation of patient visits and the loss of participants. In several studies,[15,33] the TESS was validated in other languages with a similar number of participants, making the inclusion of 31 patients in this study reasonable.

Conclusion

In conclusion, the Persian version of the LE-TESS has demonstrated both reliability and validity in assessing the physical function of patients who have undergone lower limb salvage surgery for bone and soft tissue tumors. The Persian version of the LE-TESS is suitable for use in future studies of orthopedic oncology within the Iranian (Persian) community.

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Declaration of Informed Consent: There is no information (names, initials, hospital identification numbers, or photographs) in the submitted manuscript that can be used to identify patients.

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