

Translation, Cross-Cultural Adaptation, Validity, and Reliability of the Persian Version of the Upper Limb Functional Index

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Abstract

Introduction: The Upper Limb Functional Index (ULFI) is a patient-reported outcome measure (PROM) designed to evaluate the functional status and level of participation of individuals with upper limb musculoskeletal disorders (ULMSDs). The purpose of this study was to translate the original ULFI into Persian (ULFI-Pr) and assess the psychometric properties of ULFI-Pr in Iranian individuals with ULMSDs. **Materials and Methods:** This cross sectional study was conducted in two stages based on standard guidelines. The ULFI was cross-culturally adapted through double forward and backward translations, and then its psychometric properties were validated. Participants (n=150) with various upper limb conditions for >12 weeks completed the ULFI and the Disabilities of the Arm, Shoulder, and Hand (DASH). Internal consistency and test-retest reliability were determined using Cronbach's Alpha and the Intraclass Correlation Coefficient (ICC). The full sample determined internal consistency, concurrent criterion validity, construct validity, and factor structure; a subgroup (n=30) determined reliability at 14 days interval. **Results:** The original ULFI was translated and cross-culturally adapted into Persian with only minor wording changes. The ULFI-Pr demonstrated high internal consistency ($\alpha = 0.93$) and test-retest reliability (ICC=0.92). The correlation between ULFI and DASH was high ($r = 0.71$) and $P < 0.001$). Construct validity was examined through exploratory factor analysis (EFA) using Maximum Likelihood Extraction with Promax rotation. The EFA demonstrated a one-factor structure that explained 38.2% of total variance. No floor or ceiling effects were observed. **Conclusion:** The ULFI-Pr can be considered a region-specific, single-factor structure PROM for the evaluation of ULMSDs for clinical and research purposes in Persian language populations.

Keywords: Factor Analysis; Patient Reported Outcomes; Persian; Upper Extremity; Validity

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Introduction

Musculoskeletal disorders of the upper extremities are considered as a significant complications affecting this region (1). These disorders manifest with symptoms such as numbness, pain, and functional impairment (2). In several countries, including Australia, Canada, the United Kingdom, Italy, and the United States, the prevalence of this disorder has been reported to exceed 41% to 53% (3). According to the findings, musculoskeletal disabilities impose treatment costs on the communities (8).

Since the upper extremities are the primary organ for doing activities related to daily performances independently, accurate assessment and appropriate treatment plan tailored to the patient's physical and mental conditions, while adhering to the

principle of patient-centered care are of great importance in occupational therapy (11). In addition, assessing the health status of individuals is a crucial criterion in the overall healthcare system. Reports provided by patients regarding their health status (4, 5) not only indicate the health and functional condition of the patient at a specific time but also reflect changes in the patient's condition as a result of therapeutic interventions, including occupational therapy interventions (6). These reports help specialists diagnose the patient's condition too (7).

In the past, clinical symptoms of musculoskeletal disorders were used to determine the health status and quality of life of patients. However, over the past two decades, a method that divides the body into three main parts upper extremities, lower extremities, and spine has been used to evaluate the functional

performances of patients with musculoskeletal disorders (8). Discussions have been held to improve the assessment of conditions based on patient reports (9-11). Although many tools are used to assess upper limb function, no reference tool exists in this field. (12-14). these tools provide guidance for therapeutic decision-making and help in assessing the impact of therapeutic rehabilitation interventions (15).

Several self-assessment tools for the assessment of the upper extremity are available for physiotherapists, occupational therapists, hand therapists, and orthopedic specialists on dedicated websites and relevant journals (23). The Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire (16-18) and Quick Dash (19) are among the most commonly used. The DASH questionnaire has high internal consistency, with a Cronbach's alpha exceeding 95% (20, 33, 14, 10), and its numerous similar options significantly aid in detecting changes (13). However, its construct validity has been challenged because of the large number of questions (22-24), and it is not influenced by emotional or psychological states (25). Another tool for assessing upper extremity function of individuals with upper extremities disorders is the Quick Dash, which comprises 11 items derived from the DASH questionnaire (26-28). This questionnaire was shorter than the DASH but was developed with less accuracy (29).

Two other self-assessment tools are also available: the Upper Extremity Functional Scale (UEFS) (30), which assesses upper extremity function and, despite having adequate validity, shows low reliability (8, 31). Another questionnaire is the UEFI questionnaire (32), which has been studied in older adults with a small sample size and is inappropriate for assessing a wide range of patients with musculoskeletal disorders. (10, 35-33). Another test for evaluating upper extremity function is the Neck and Upper Limb Index (NULI), which is specifically developed to assess the upper extremity and neck; however, due to its limitation to specific joints and conditions, it cannot be used to evaluate the entire upper extremity as a whole (36).

The ULFI questionnaire was designed by Gabel in England at 2006, and its validity and reliability have been examined in several countries such as: France- Canada, Korea, Spain, and Australia. The tool serves as a self-assessment tool for assessing upper extremity function in various musculoskeletal patients and comprises 25 questions (37). Unlike the DASH, the ULFI is shorter and can be completed quickly and easily using a straightforward scoring system (37). The ULFI has a uni-dimensional structure and has consistently reported high internal consistency across all studies (25). Today, questionnaires are used as useful and effective tools that can provide comprehensive information. However, the important issue in this regard is that

the validity and reliability of the questionnaire must first be assessed in that specific community. (39).

Given the racial, linguistic, cultural, and geographical differences in the populations of different countries, which can affect the way questionnaires are completed and the validity of the scores obtained, it is necessary to review and approve questionnaire texts that are appropriate for the social and cultural conditions of each country. (40). only through systematic and methodological execution of these processes can we ensure the uniformity of the tools used across different regions of the world and thus the comparability of the results obtained from research in various countries (41, 42). Therefore, the aim of the present study was to translate and culturally adapt the ULFI questionnaire into Persian and examine its validity and reliability in Iranian patients with upper extremity musculoskeletal disorders.

Materials and Methods

This study was conducted in two phases. After obtaining permission from the questionnaire developer the first phase included the translation and cross-cultural adaption of the ULFI into Persian. The second phase included the evaluation of the following psychometric properties: test-retest reliability, internal consistency, and validity including face, content and construct. In addition, criterion validity was evaluated using the Persian (Iranian) version of the DASH 38 as the external standard.

In the initial phase, translation and cultural adaptation were conducted, which included the following steps:

1. Translation of the Original Version: The original version was translated into Persian by two local translators (Translators 1 and 2) independently.
2. Integration of Translations: The two translations were consolidated with the inputs of the translators, researcher, and supervising professors.
3. Back Translation: The Persian version was translated into English by two other translators (Translators 3 and 4).
4. Integration of the English Version: The English version was integrated with feedback from the translators, researchers, and supervising professors.
5. Pilot Study: A pilot study was conducted.
6. Final Version Submission: The final version was sent via email to the developer of the ULFI questionnaire for getting approval.

In the first stage of the translation process, forward translation was conducted by two translators (Translators 1 and 2) who were familiar with the Persian language. After explaining the translation process to the translators, each translator

provided a translation of the test items along with a list of possible alternative translations. The translators were asked to focus more on the meaning of the translations than on the literal similarity. After preparing and documenting the translations, the translators and research team held a meeting to reach a final agreement on one version.

Upon completion of the initial translation stages, two other translators (Translators 3 and 4), who were native English speakers with sufficient knowledge of Persian, were selected to translate the Persian questionnaire back into its original language. These translators did not see the original test and translated the Persian version into English. After the backward translation, items that seemed to lack conceptual equivalence with the original source were discussed among the main research group. The translations were debated item by item by the main researchers, aiming for cultural equivalence and standardization of the test in question.

After discussion and consensus on the existing discrepancies, a final version was agreed upon. The final version was provided to users for conducting the pilot study to assess both face validity and pilot testing. For this purpose, a questionnaire was given to 15 individuals with upper extremity musculoskeletal disorders, asking them to provide feedback on the clarity and simplicity of the questionnaire using a three-option format (Yes, Somewhat, No). The face validity component of the study. Feedback from users was collected and discussed in the presence of researchers and translators, and the agreed-upon modifications were applied to the questionnaire text.

After completing this stage, the questionnaire was provided to five specialists in the field of musculoskeletal disorders to evaluate the relevance of the questions to the questionnaire's objectives. This stage was assessed using a 4-point Likert scale indicating the degree of relevance of each question, with scores indicating "somewhat relevant," "relevant," and "highly relevant." Individuals who scored 3 or 4 were considered relevant. The content validity assessment was performed at this stage.

The feedback obtained from face validity and content validity was reviewed in the presence of researchers, translators, one physiotherapist, two occupational therapists, one psychologist, and one methodologist. Ultimately, after consensus among the expert members, a final version was prepared and sent for approval to Dr. Gabel.

After the questionnaire was approved by the developer, the subsequent phase of the study, which included an evaluation of psychometric properties, was conducted.

Participants

Participants in this study were a non-probability sample of individuals with varied upper extremity musculoskeletal

disorders, selected through a convenient sampling method. A total of 150 individuals diagnosed with disorders to the upper extremities, including the shoulder, elbow, wrist, and hand, as determined by an orthopedic assessment by an Occupational therapist that were included in the study.

The eligibility criteria for participation in the study were: age ≥ 18 years; being native Iranian and fluent in the Persian language; enrolled in a rehabilitation or occupational therapy program for a hand/wrist, elbow, or shoulder injury or musculoskeletal disorder condition); symptoms duration of ≤ 12 weeks; and a diagnosis by a medical practitioner (7, 14, 32). The exclusion criteria were: upper limb involvement as a result of recent surgery of < 6 weeks, infection, tumor, cancer, or other systemic disease.

The questionnaire comprises 25 questions; thus, a sample size of 150 was deemed appropriate for the study (45).

Evaluation of Psychometric Properties

In this study, psychometric properties, including face validity, convergent validity, construct validity, reliability, internal consistency and test retest, were assessed.

Convergent Validity

The sample size for this study is based on Statistical methods for health care research book and consider 6 assessment for each question and ULFI have 25 question therefore we must assess 150 patients (40). To evaluate convergent validity, the Persian version of the ULFI scale was administered simultaneously with the DASH questionnaire to a sample of 150 individuals with upper extremity musculoskeletal disorders, and the correlation between the two was examined.

Face Validity

To assess face validity, 15 individuals with upper extremity musculoskeletal disorders provided feedback regarding the clarity and simplicity of the questionnaire using a three-option format (Yes, Somewhat, No).

Factor structure assessment via factor analysis

Factor analysis is one of the most effective methods for examining structural validity. This method serves two main purposes: 1) to discover factors without prior awareness of their existence and 2) to confirm previously identified factors. To achieve the first objective, Exploratory Factor Analysis (EFA) is used, while Confirmatory Factor Analysis (CFA) is employed for the second objective. Before conducting the factor analysis, it is essential to ensure the appropriateness of the data. Therefore, the suitability of the data for factor analysis was initially examined by assessing the significance of the correlation matrix using Bartlett's test and by evaluating the sampling adequacy index.

To assess sampling adequacy, the Kaiser-Meyer-Olkin (KMO) measure, which indicates sampling adequacy, was used. This index compares the observed correlation values with the partial correlation values. A small KMO value indicates that the correlation between pairs of variables cannot be explained by other variables, making factor analysis potentially unjustifiable. Serne and Kaiser (1977) argued that when the KMO value is greater than 0.6, factor analysis can be easily performed, and the higher this value, the more appropriate and adequate the sampling will be needed (47).

Reliability

To evaluate absolute and relative reliability, the scores obtained from each item and the overall score of the Persian version of the upper extremity performance scale were measured twice in 30 patient, two weeks apart, using the standard error of measurement (SEM) and the Intraclass Correlation Coefficient (ICC).

Absolute Reliability (SEM)

The standard error of the measurement index was calculated (51, 52). Given the inverse relationship between measurement precision and measurement error, a lower error rate indicates higher measurement accuracy of the assessment tool.

Relative Reliability (ICC)

To assess relative reliability, the ICC was calculated. An ICC of 0.7 is considered acceptable (55, 56). The correlation coefficient is classified according to Keltner, where an ICC >0.75 indicates a strong and high correlation between two items, while an ICC 0.75 suggests a moderate correlation. An ICC between 0.25 and 0.50 indicates a low correlation (54).

Internal Consistency

The most commonly reported index for evaluating internal consistency in such studies is Cronbach's alpha, which ranges from 0 to 1. The closer the value is to one, the higher the level of internal consistency of the tool being studied (53). Test-retest reliability was also conducted but on a different set of 30 patients, randomly selected from the original group, who completed the questionnaires with an interval of 3–7 days during a non-treatment period.

Statistical Analysis

This study aimed to culturally adapt the upper extremity performance scale questionnaire according to the Iranian language and culture and to evaluate the validity and reliability of the Persian version of this questionnaire in 150 patients with various musculoskeletal disorders at Akhtar Hospital in Tehran. The Kolmogorov-Smirnov test was used to assess the normality distribution of the variables. Correlation tests were employed to

examine the degree of correlation. Cronbach's alpha was calculated to assess internal consistency, and ICC were used to evaluate reliability. Data analysis was performed using SPSS version 16. A significance level of 0.05 was considered for all tests.

Results

The mean age of the participants in the study was 32 ± 5.6 years, with 50.6% being female. The average time since the injury was approximately 15 ± 3.4 months. Before conducting the main analyses, the normality of the research variables was assessed using the one-sample Kolmogorov-Smirnov test, which confirmed the normality for the research variables ($P > 0.005$).

In the process of translation and cultural adaptation, which was conducted simultaneously with the assessment of face validity, the results showed that 80% of the patients found the Persian version of the upper extremity performance scale questionnaire to be appropriate in terms of translation quality, suitability for the Iranian community, comprehensibility, and adequacy for evaluating upper extremity performance. The questionnaire items did not pose any specific difficulties for patients.

To evaluate convergent validity, the DASH questionnaire was completed along with the upper extremity performance scale in 150 patients with upper extremity musculoskeletal disorders. The results indicated a significant correlation between the total upper extremity performance scale score and the Persian version of the DASH questionnaire ($r = 0.71$, $P < 0.001$). This significant correlation with an acceptable correlation coefficient of 0.71 suggested that the upper extremity performance questionnaire assesses the same construct as the DASH questionnaire.

Results from the test-retest reliability indicated that the questionnaire scores completed by 30 patients with upper extremity musculoskeletal disorders, who completed it again after 2 weeks, showed a significant correlation. The correlation between the two sets of scores indicates the extent to which the scores can be generalized from one time point to another. The ICC was 0.92, indicating high stability and repeatability of the scores across the two assessments.

The internal consistency of the scale was assessed before factor analysis to eliminate items with low internal consistency. Based on the loop method, the reliability coefficient for all 25 items and the internal consistency of each item were determined. According to this method, if the internal consistency decreases upon removing any item, the item plays a significant role in the coherence with other items, making it a suitable question. Conversely, if removing an item increases internal consistency, it suggests that the item does not significantly contribute to coherence.

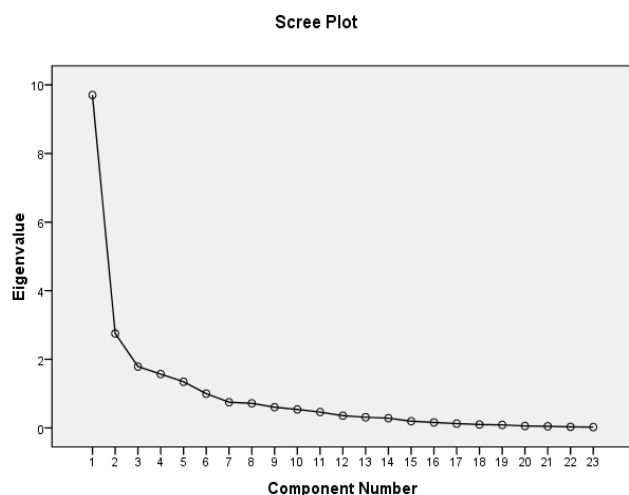


Figure 1. Extracted factors scree plot

The overall alpha value of the test without removing any items was 0.931, indicating a good level of internal consistency among the items. Two items (4 and 23) had higher alpha values than the overall scale (0.934 and 0.932, respectively); thus, they were removed from the structural validity assessment.

Results from structural validity initially showed that the KMO value was 0.719, indicating relatively high sampling adequacy. Additionally, Bartlett's test was significant at $P < 0.0001$, with 253 degrees of freedom and a chi-square value of 3491.139, indicating a significant difference between the correlation matrix of the study population and the identity matrix. After confirming the appropriateness of the data and removing unsuitable items, a factor analysis was conducted using principal component analysis. The analysis revealed five factors with eigenvalues greater than 1, explaining 74.616% of the variance. The scree plot related to the extracted factors is shown below. See Figure 1.

As shown in the plot, the first five factors are distinctly separable, while from the fifth factor onward, the plot shows a steady slope. Considering these observations, five factors were extracted. The eigenvalues for factors 1–5 before rotation were 9.704, 2.754, 1.789, 1.569, and 1.346, while after rotation, the eigenvalues were distributed more evenly among the factors: 5.333, 3.820, 2.896, 2.876, and 2.236. Each factor includes the following items:

- Factor 1: Items 19, 17, 15, 8, 7, 6, and 2
- Factor 2: Items 25, 24, 20, 18, and 10.
- Factor 3: Items 22, 18, 13, and 5.
- Factor 4: Items 3 and 2
- Factor 5: Item 1.

Discussion

Overall, the results of the current study indicated that the Persian version of the upper extremity performance scale questionnaire has good translation quality, validity, and reliability. The process of translation and cultural adaptation of the tool is one of the most important issues researchers and specialists face when studying and evaluating functional outcomes at individual and societal levels. The goal is to develop appropriate assessment scales or, if available internationally, to select suitable tools from existing options. This selection aims to identify tools that adequately address the clinical and research needs of researchers (55).

Researchers typically seek tools that cover their desired concepts as completely and accurately as possible (56). One of the most important features to consider when selecting a tool is the translation and culturally adapted version. This aspect was primarily considered by the original developer of such tools. These developer strive to avoid ambiguous, unfamiliar, unclear, and multi-meaning terms, thereby facilitating the translation and equivalence of the tool into another language (57). A clear and fluent text in these tools will allow translators to prepare initial translated versions for subsequent psychological research stages. In this study, the chosen translation process followed standard methods, resulting in noticeable quality. In other words, the forward and backward translation process and the consensus on the final version led to high-quality translation. As previously mentioned, the original version of the upper extremity performance scale questionnaire has been translated into Italian, Canadian, Australian, and Spanish languages (43, 45, 46, and 51). Therefore, the translation of this scale into Persian, along with the relatively numerous translations of this scale internationally, can be seen as another advantage of this tool. Researchers hope that the Persian translation of the upper extremity performance scale questionnaire, along with the assessment of its psychometric properties from various aspects, will enable its application for measuring upper extremity performance.

When assessing the reliability or dependability of scores obtained from a measurement tool, it is essential to consider this as one of the most critical characteristics that enable its application (58).

The time interval between the two assessments is crucial. The longer this interval, the lower the correlation, as observations depend on time. The sooner the test is repeated, the more similar will be the measurement errors. Therefore, different time intervals yield different results. The choice of time interval depends on the consistency of variables (59). Conversely, a short time interval can

lead to unrealistic reliability estimates because individuals may adjust their subsequent answers due to learning or practice (60). In this study, the retest scores of the Persian version of the upper extremity performance scale questionnaire were examined from the aforementioned aspects. To assess the first criterion, a temporal reliability study was conducted by comparing the scores of the items on the Persian version of the upper extremity performance scale questionnaire. Initially, the questionnaire was completed by 150 patients, and for retesting, it was completed again by 30 patients after a 14-day interval. This time interval was selected to prevent changes in the conditions. To evaluate the second criterion, Cronbach's alpha was calculated separately for the items in this tool. In terms of temporal and relative retest reliability, high coefficients indicate excellent retest reliability. This indicates that the upper extremity performance scale questionnaire used in this study is a reliable measure for assessing upper extremity performance in patients with upper extremity disorders.

The SEM was also calculated. The resulting test score is known as the observed score. This score was divided into two parts: the true and error scores. The assessment score reflects the trait possessed by the respondent plus the error amount. The true score cannot be observed; thus, it is assumed that the trait value remains constant and that the error is random. The final assessment score is the sum of the true and incorrect scores. Because the population parameter cannot be accurately calculated, two probable limits within which the parameter is likely to fall are calculated, known as the confidence interval. Using the standard error of measurement, the confidence interval of the true score was calculated. For example, if the SEM is 2, the confidence interval for the true score would be 22 points above and 22 points below the observed score. This means that if a person scores 8 on a test, their true score ranges from 4 to 12. The SEM significantly affects the accuracy of individual scores. Given the inverse relationship between measurement accuracy and measurement error, lower error rates enhance the measurement accuracy of the assessment tool. The results reported in this study indicate high measurement accuracy (51). In this study, the ICC for the entire questionnaire was found to be >0.9 , similar to studies conducted in France and Spain (43, 49). The assessment of the convergent validity of the questionnaire by examining the correlation between the total score of the adapted upper extremity performance scale and the DASH questionnaire indicated a significant correlation ($r=0.71$) between the item scores of the upper extremity performance scale and the item scores of the Persian version of the DASH questionnaire. In the French study, the convergent validity of the questionnaire with the DASH questionnaire was examined, and the correlation between the items of the two questionnaires was found to be very satisfactory. Therefore, the selection of the DASH

questionnaire for evaluating the questionnaire regarding convergent validity was a correct and appropriate choice (49).

Internal consistency is of great importance because it reflects the homogeneity of score variations among items in a sample at a single time point. The most commonly used index for internal consistency in such studies is Cronbach's alpha, which can range from zero to one; the closer it is to one, the higher the level of internal consistency of the tool being studied (59). Similar to the Spanish study, Cronbach's alpha was found to be >0.9 , which is a very acceptable result. The repeatability of the scores of the adapted Persian version of the questionnaire was examined using the retest method.

The most important issue in constructing a test is validity. While reliability concerns the accuracy and consistency of the test, validity measures whether the test accurately assesses what it is intended to measure. A test is valid if it accurately measures what is supposed to (58). In evaluating face validity, the main issue is the respondent's understanding of the test concept.

The face validity of each item of the Persian version of the upper extremity performance scale questionnaire was assessed by consulting 15 patients, and according to the evaluations, most individuals had no issues understanding the questions.

The primary approach to structural validity assesses how well the test measures a theoretical or trait structure. This assessment involves three general stages: first, the test developer must analyze the trait of interest carefully; second, they must consider how the trait relates to other variables; and finally, the test developer must empirically test whether the hypothesized relationships actually exist (50). To evaluate structural validity, theories about the relevant traits or variables were initially considered. The correlation of the study tool with these traits was then assessed. In this research, factor analysis was employed to examine this type of validity. The results indicated that this questionnaire could have five factors in Persian, with several questions included in each factor. Given that the factor analysis results indicated the presence of five factors in this questionnaire, it is necessary to conduct CFA in future studies to validate this number of factors. Because CFA requires a large sample size, this was one limitation of the current study; thus, it is recommended to address this in future research.

Conclusion

This study focused on the translation, localization, and evaluation of the validity and reliability of the upper extremity performance scale questionnaire for Iranian patients with musculoskeletal disorders in the upper extremities. The findings suggested that the Persian version of the upper extremity

performance scale questionnaire has good validity and reliability among Persian-speaking individuals with upper extremity musculoskeletal disorders and can serve as a suitable tool for assessing upper extremity performance.

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Ethical consideration

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Conflict of interest

None.

Authors' contributions

FM and FJ: Data duration, formal analysis, investigation, and methodology, writing, original draft. FJ and AJ: supervision, resources, and writing, original draft. All authors read and approved the final manuscript.

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