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Cross-cultural adaptation, reliability and validity of the Turkish version of the Upper Limb Functional Index (ULFI)

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ABSTRACT

Study design: Clinical measurement.
Background: The Upper Limb Functional Index (ULFI) is a patient reported outcome (PRO) measure with sound clinimetric properties and clinical viability for determination of upper limb function.
Purpose-methods: The aims of this study were to cross-culturally adapt the ULFI for Turkish-speaking patients (ULFI-Tk) and investigate the reliability and validity in patients with upper limb problems. Patients (n=l02, age 49.1±16.6) with upper limb disorders were consecutively recruited. All participants completed the ULFI-Tk and the Disability of Arm, Shoulder and Hand Turkish-version (DASH-Tk) criterion at baseline and day-three.
Results: The ULFI-Tk demonstrated good internal consistency (α=0.87), moderate criterion validity (DASH-Tk:r=0.68;p<0.05), moderate reliability (ICC2:1=0.72,CI=0.58-0.80) and strong error measurement (SEM=2.94;MDC90=5.35). Exploratory factor analysis demonstrated a dual factor structure that explained 31.2% of total variance.
Conclusions: The ULFI-Tk is a reliable and valid PRO that could be used to assess upper limb musculoskeletal disorders in Turkish speaking patients
Level of evidence: Class 2.

Introduction

Upper extremity musculoskeletal disorders involve tendons, muscles, ligaments, neural tissue and in some instances may have a contributing component from the cervical spine.[1–4] The major factors affecting function are range of motion, muscle strength and pain. Functional loss related to problems with these factors can limit an individual's activities of daily living (ADL) and cause disability.[5] This in itself can be a major problem or one that leads to negative effects on an individual's health-related quality of life (HRQOL).[5–7]

The effectiveness of any treatment to the upper extremity often focuses on the evaluation of physical symptoms, including range of motion, grip strength and sensory capacity. However, these findings are unable to identify the patients' level of independence and functional capacity in ADL. For these reasons, patient reported outcome (PRO) tools that consider HRQOL, such as the SF-36 and Euro-QOL, are commonly used for supplementary assessment.[8–13]

However, these PROs are not sufficiently sensitive to accurately evaluate function related changes[9,12–15] in the upper limb. This led to the development and use of joint- or disease-specific tools[2,16,17] and more recently a move toward region-specific tools. These latter PROs consider and subsequently evaluate the upper extremity as a single kinetic chain.[2,10,14,18] The region-specific PROs have emerged as the preferred option due to their greater application across a wider variety of clinical and research conditions and situations.[19,20] They are more practical and easier to administer than physical objective clinical measures.[19] Consequently regional PROs can require fewer patients and a smaller 'number needed to treat' to detect the effectiveness of an intervention.[21,22] This self-report data indicates the clinical changes that represent the patients' perception of their function with unique information specific to their condition.[19,23]

Seven region-specific upper limb PROs developed for use in general populations were found in the literature: the Neck and Upper Limb Index (NULI),[2] the Upper Extremity Functional Index (UEFI),[24] the Upper Extremity Functional Scale (UEFS)[21] the

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Disabilities of the Arm, Shoulder, and Hand (DASH),[9,10] the DASH shortened-version QuickDASH with 11-items[25] and the QuickDASH-9 with nine-items[26] and most recently the Upper Limb Functional Index (ULFI), initially as a dichotomous tool[27] and subsequently as a three-point response option PRO.[18] In the literature there is no review on region-specific PROs. Furthermore, there is no gold standard for the assessment of upper extremity function in patients with upper limb musculoskeletal disorders.[28]

The ULFI is a self-report questionnaire designed to assess activity limitations and participation restrictions resulting from upper limb musculoskeletal disorders.[27] A study showed that the original ULFI had high internal consistency, excellent test-retest reliability, good convergent validity with the QuickDASH questionnaire and good responsiveness.[18] In addition, the ULFI was translated and culturally adapted to both Spanish and French-Canadian. Both these studies indicated the ULFI was a valid and reliable PRO with similar psychometric properties to the English language version.[29–31] The ULFI has some advantages for clinicians and patients that include a short implementation time, simple scoring and readability levels.[29] Hamasaki et al concluded in their study that the ULFI appears to be an appropriate outcome measure for health professionals working with French-speaking patients with upper limb musculoskeletal disorders in a clinical setting where the time issue is critical.[29] Similarly, in Turkey the health professional generally works in a busy clinical environment. To date the DASH is the only regional PRO cross-culturally adapted to Turkish and is shown to be preferred to other upper limb joint or condition specific tools.[16,32] Because of these reasons the ULFI was selected to be culturally adapted to Turkish as it would provide an additional PRO to the DASH for upper limb regional assessment in Turkish speaking populations.

The aims of this study were to cross-culturally adapt the ULFI for Turkish-speaking patients (ULFI-Tk) and determine the clinimetric properties of reliability, criterion validity, internal consistency, measurement error and factor structure in patients with upper limb problems. As the DASH was the only other upper extremity regional PRO available in Turkish it was concurrently investigated as the criterion standard.

Materials and methods

Subjects

Subject inclusion criteria were an age minimum of 18 years, symptoms duration of $\leq$12 weeks, providing an acute to subacute population, and being referred by a medical practitioner to the Baskent University Physical Therapy Clinic with a diagnosis of an upper limb problem. Exclusion criteria were the inability to read Turkish or respond to the questionnaires, recent surgery, infectious disease, neurological diseases, cancer or other systemic diseases that may affect the upper limb. The study was approved by the Baskent University Non-Interventional Clinical Researches Ethics Committee.

Procedure

Baseline data was collected by a physiotherapist with a minimum qualification of a PhD on the day of the patient's initial attendance. All participants were informed of the study's details and signed an informed consent. All patients were given the ULFI-Tk and DASH-Tk to complete. Patients were asked to repeat the questionnaires for test-retest reliability including an additional external 'global rating of change (GRoC)' scale at a subsequent attendance following a two day period of non-treatment.[17,31] All tests were again collected by the same physiotherapist.

Questionnaires

The *ULFI* is a single page, 25-item upper limb regional PRO with three response options: "Yes"/"Half"/"No" and scored by assigning 1 point for "Yes" 0.5 points for "Half" and 0 points for "No." The total points are added and multiplied by four to score the functional limitation, then subtracted from 100 to provide a functional status scaled from 0 (worst function) to 100 (maximum or pre-injury function). Up to two missing responses are permitted.[18,27]

The *DASH* is a 30-item PRO that evaluates impairments, activity limitations and participation restrictions for leisure activities and work. A total of 21 items evaluate difficulty with specific tasks, five items evaluate the symptoms and a single item evaluates social function, work function, sleep and confidence. Response options are scaled as 1-no difficulty, 2-mild difficulty, 3-moderate difficulty, 4-severe difficulty and 5-unable. The DASH raw scores are then multiplied by a conversion formula to produce values from 0 to 100 for each module where the higher score indicates severe functional loss. The DASH-Tk has been shown to have excellent test-retest reliability and validity and demonstrated as an adequate and useful tool for measuring functional disability in upper extremity complaints of Turkish speaking patients.[16,32]

The external GRoC is a criterion standard provided at retest to assess the presence of change during the intervening period.[33] This study used the three response option question: 'Is your condition better, the same, or worse as compared to the day of the first test?'; where the required response for inclusion in the reliability component was 'the same'.

Translation and cross-cultural adaptation

A double forward and backward translation was completed. Forward translation was performed independently by two Turkish native-language translators. This allowed detection of errors and divergent interpretations of items with ambiguous meanings. To improve idiomatic and conceptual (rather than literal) equivalence and improve reliability, one translator had knowledge of the questionnaires concepts and the study's purpose. This enabled any unexpected meanings in the original tool to be recognized. Back translation was performed blindly and independently by two English native-language speakers. The final versions were compared to the original version for inconsistencies and a pilot consensus version completed.[14,34]

Cultural adaptation

The ULFI-Tk was pilot tested on 20 patients with upper extremity musculoskeletal disorders. The participants found the questionnaire easy to understand and applicable to their conditions. Subsequent review and discussion found most of the questionnaire translated without difficulty, but some discrepancies were present due to linguistic and cultural differences. Changes were made through finer adjustments to wording that enabled a final consensus agreed format from all translators with changes compared to the English version as follows:

- Item 15 was not understood by Turkish patients and modified to an English equivalent of 'I feel physically weaker and stiffer';
- Item 20 was changed from 'I have difficulty eating and/or using utensils (knife, fork, spoon, chop sticks) with 'chop sticks' removed as this was not applicable';
- Item 21 was changed from 'I have difficulty holding and moving dense objects (e.g.: mugs, jars, cans)' to include the example of a 'tea glass.'

The final ULFI-Tk consensus version was brought into use for the validity and reliability study.

Analyses

Distribution and normality were determined by the Shapiro Wilk test (significance >0.05). *Internal consistency* was determined using Cronbach's α.[35] There were no missing responses.

Test-retest reliability was assessed using the Intraclass Correlation Coefficient 2:1 ($ICC_{2:1}$) with the repeated measures at day three at the same time of day during a period of non-treatment.[36] A prerequisite for examining test-retest reliability is stability of the condition to minimize day-to-day variability that might affect the test scores. Consequently, the three response-option GRoC external criterion standard was provided at retest to assess the presence of change during the intervening period with inclusion being the response 'the same.'

The *sensitivity or error score* was determined from the minimal detectable change at the 90% level (MDC_{90}) analysis that was performed as described by Stratford.[37] The standard error of the measurement (SEM) was calculated using the formula: $SEM = s\sqrt{(1-r)}$, where s = the mean and standard deviation (SD) of time 1 and time 2, r = the reliability coefficient for the test and Pearson's correlation coefficient between test and retest values. Thereafter the MDC_{90} was calculated using the formula: $MDC_{90} = SEM \times \sqrt{2} \times 1.65$.

The *criterion validity* between the ULFI and DASH total scores was assessed using the Pearson correlation coefficient with the criteria of poor (r = 0.20–0.40), fair (r = 0.40–0.60), moderate (0.60–0.80) and strong (0.80–1.00). The *a-priori* hypothesis was that the correlation between the DASH and ULFI would be 'moderate' (0.60–0.80).[38] *Face and content validity* were determined from the translation process and the pilot cultural-adaption study.[38]

Factor structure was assessed using exploratory factor analysis (EFA) with Maximum Likelihood Extraction (MLE) and Varimax rotation.[39,40] The three *a-priori* criteria for inclusion of the extracted factors were: Eigenvalues >1, accounting for >10% of variance and the 'point of deviation' or 'elbow' visually determined on the scree plot.[41–43] The loading coefficient absolute value suppression was set at the lower threshold of 0.30 to enable the maximum number of factor loadings to be extracted.[44]

The minimum *sample sizes* were calculated from the original ULFI study where criterion validity was determined through use of Meng's test of significance and solving for n.[45] The reliability was determined from an 80% likelihood of detecting differences between baseline and repeated measurements. Both calculations allowed for a 15% attrition with $p < 0.05$.[33] Power calculations indicated a minimum sample of $n \geq 101$ for concurrent criterion validity, $n \geq 47$ for reliability[37] and a sample >100 for factor analysis.[46]

All the analyses were conducted using Statistical Package of Social Science version 17.0, Chicago, IL. The level of significant was set at $p < 0.05$.[47]

Results

Participants

A total of 127 acute to subacute patients with upper limb musculoskeletal conditions participated. A total of 25 patients did not meet the eligibility criteria and were excluded leaving a final sample of 102 (71% female, age 49.1 ± 16.6 years; duration = 6.7 ± 4.19 weeks). The demographic characteristics and patients' diagnoses, as determined by the referring medical practitioner, are presented in Table 1. The variables used in our study were normally distributed ($p > 0.05$) however only 3.4% of ULFI-Tk responses by 23% of participants used the 'Half' response option.

Table 1
Demographic characteristics of participants

Variables	Frequency	%
Level of education		
Primary school	17	16.7
Secondary school	8	7.8
High school	28	27.5
Bachelor	49	48
Occupation		
Employee	34	33.3
Nonemployee	33	32.4
Retired	35	34.3
Diagnosis		
Adhesive capsulitis	20	19.6
Impingement syndrome[a]	20	19.6
Rotator cuff syndrome[b]	10	9.8
Lateral Epicondilitis	13	12.7
Carpal tunnel syndrome	12	11.7
Wrist or hand fracture	10	9.8
Ulnar nerve compression	5	4.9
Flexor tendon injury	5	4.9
Hand osteoarthritis	3	2.9
Olecranon bursitis	2	1.9
Dupuytrens contracture	1	0.9
Trigger finger	1	0.9

[a] Impingement: impingement of tendon or bursa within the subacromial space.
[b] Rotator cuff syndrome: symptomatic rotator cuff tendon, e.g. tendinopaty, tendionosis, tendinitis.

Internal consistency, test-retest reliability, criterion validity and error score

The *internal consistency* was high but not excessive ($\alpha = 0.88$) indicating no item redundancy. *Measurement error* from the SEM and MDC_{90} were respectively 2.94% and 5.35%.*Test-retest reliability* was moderate ($ICC_{2:1} = 0.72$; 95% CI = 0.58–0.81 – see Table 2). The reliability sample included all participants as every participant reported 'the same' on the GRoC and consequently no participants were excluded. This reported finding of no change is well recognized and not uncommon in symptomatic Turkish patients in a medical outpatients setting. The *criterion validity* between ULFI and DASH total scores was moderate ($r = 0.68$; $p < 0.05$).

Factor analysis

The correlation matrix was determined as suitable from the Kaiser-Meyer-Olkin values (0.64) and the Bartlett's Test of Sphericity ($p < 0.001$). The EFA revealed seven factors with Eigenvalues >1 where two factors accounted for >10% variance and the scree plot 'inflection' or 'elbow' occurred at the third point (Fig. 1). Together these three criteria suggested a 2-factor structure was likely where the first factor (Eigenvalue = 4.53, named 'sensation and independence') explained 18.1% of variance and the second

Table 2
ULFI-Tk test-retest reliability and internal consistency

	Internal consistency (α)	Test-retest	
		Correlation	ICC (%95 CI)
ULFI-Tk	0.877	0.837	0.717 (0.582–0.809)
ULFI-Tk factor 1	0.724	0.695	0.795 (0.697–0.892)
ULFI-Tk factor 2	0.720	0.709	0.777 (0.670–0.850)

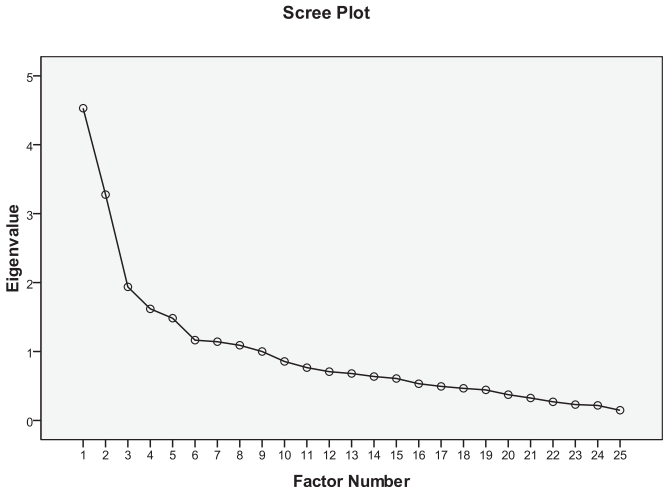

Fig. 1. Scree plot of the Eigenvalues from the EFA using MLE.

(Eigenvalue = 3.3, named 'function') explained 13.1% (Table 3). Eight items[3,5,8,12,15,17,20] loaded below the 0.30 cutoff and item 12 showed cross loading.

Discussion

The adaptation and translation occurred without difficulty and only a few items required cultural-specific changes. The results indicated the development was successful and followed the international guidelines. The adapted questionnaire is self-administered and simple to use in clinical practice for upper limb conditions. This follows similar procedures of cross-cultural adaptation in studies for different scales applied in the Turkish context.[16,17] In this study there were no missing responses, a comparable finding to both the English and Spanish ULFI studies.[18,31] The data was normalized and consequently parametric statistics obligated the factor structure be analysis with MLE rather than Principal Component Analysis (PCA). As only 23% of respondents used the 'Half' option in a total of 3.4% of all responses, the analysis was closer to that of a dichotomous data set. The original ULFI found the half-mark used in 69% of responses by 83% of participants.[18] Consequently, there appears to be a cultural difference in the use of this option. One way to overcome this and clarify if the preference for an intermediate point[48,49] is required in this Turkish population may be to provide three separate response box options. This will need to be considered in further research in both this population and others.

Table 3
Factor analysis loadings of the ULFI-Tk

Items	Factors	
	1	2
1. I stay at home most of the time	.683	.178
2. I change position frequently for comfort	.644	.392
3. I avoid heavy jobs	.024	.276
4. I rest more often	.391	.215
5. I get others to do things for me	.228	.111
6. I have pain almost all the time	.306	.070
7. I have difficulty lifting and carrying	.019	.597
8. My appetite is now different	.124	.056
9. My walking or normal recreation activity is affected	.329	.168
10. I have difficulty with normal home or family duties	.042	.554
11. I sleep less well	.744	.031
12. I need assistance with personnel care	.280	.266
13. My regular daily activities is affected (work and social)	.055	.621
14. I am more irritable or bad tempered	.419	.113
15. I feel weaker and stiffer	.465	.062
16. My transport independence is affected	.238	.075
17. I have difficulty putting my arm into a shirt sleeves or need assistance dressing	.785	.259
18. I have difficulty writing or using a keyboard or mouse	.095	.239
19. I am unable to do things at or above shoulder height	.134	.647
20. I have difficulty eating and or using utensils	.083	.184
21. I have difficulty holding and moving dense objects	.135	.374
22. I tend to drop things and or have minor accidents more frequently	.190	.955
23. I use the other arm more often	.160	.271
24. I have difficulty with buttons keys, coins, taps, containers or screw top lids	.212	.447
25. I have difficulty opening, holding pushing, or pressing	.010	.714

The Cronbach's α coefficient at 0.88 showed strong internal consistency that was not excessive, indicating no item redundancy. This was comparable to the findings in the original ($\alpha = 0.89$), the Spanish ($\alpha = 0.94$) and in the French-Canadian ($\alpha = 0.93$) adaptation studies.[27,29,31]

The ULFI-Tk test-retest reliability ($ICC_{2:1} = 0.72$) was moderate and notably below that of both the original ULFI ($ICC_{2:1} = 0.98$), Spanish versions ($ICC_{2:1} = 0.93$) and French-Canadian versions ($ICC_{2:1} = 0.92$). In our study, all participants reported 'same' on GRoC. This situation could be a reason for lower reliability. *Measurement error* from SEM and MDC_{90} were respectively 2.94% and 5.35% which is comparable to the findings of the previous studies in which it was measured.[18,27,31]

There are only two studies that have investigated criterion validity with the DASH. In this study criterion validity with DASH was moderate ($r = 0.68$), which was lower than in both the original and the French-Canadian versions ($r = 0.85$). Researchers describe some factors such as sample size and characteristics of the sample that may affect the size of r in Pearson analysis.[50–52] In this study correlation might be lower than other researchers have reported because of differences in the characteristics of the sample. While the French–Canadian study involved patients with hand and wrist injuries that were in the subacute to chronic stage, our study included acute or subacute patients with relatively equal representation of conditions from both proximal and distal aspects of the upper limb. Also this study has sample characteristic differences from the original and French-Canadian studies that include gender, disease duration, work status, culture, etc.[27,29]

The *factor analysis* in both the original and Spanish studies was exploratory and found a single dimension. The English version found the dominant factor accounted for 33.4% of variance where six additional factors had Eigenvalues >1.0, however only one had variance of >10%. Likewise, the Spanish version ULFI revealed 48% of variance explained by the primary factor where three other had Eigenvalues >1.0, but only one with variance >10%. By contrast, this study had seven factors with Eigenvalues >1.0 and two showed variance >10% that explained 31.2% of total variance. The scree plot inflection at the third point also indicated a two factor structure which corroborated these findings. There were nine items in this study that scored below 0.50 while in the original there were 14. Also, the Turkish patients felt the item on 'appetite change' was not relevant to their condition which was reflected in the low factor loading of 0.12. Item 20, 'eating and using utensils', also scored very low at 0.18. These findings together suggest a potential to reduce the total item number, a recommendation consistent with the earlier publications where a shorter 10-item tool was suggested.[18]

Sample size, particularly in relation to the factor analysis,[53] indicates it is at the lower end of the acceptable limit. It is necessary to obtain factor solutions that are adequately stable and correspond closely to and reflect the sample populations constructs and factors. A fundamental misconception is that the minimum sample size or ratio of participants to items is invariant across studies, whereas it is dependent on several aspects within any given study. This

includes the level of communality of the variables and the level of over determination of the factors.[53] Consequently, this study's sample size is acceptable and also comparable to that used in both the original and Spanish version studies and to most PRO studies where factor analysis is considered through EFA.[54–57] Turkish culture is very different from both the Anglo-Saxon and European Spanish cultures with a potential consequence that may affect reliability and factor structure. There may be other Turkish versions of the ULFI that could reflect a single factor structure – as found in the previous studies. Alternatively the use of the definitive 'Half' response option, within three dedicated separate responses, may be sufficient to change the factor structure of this current ULFI-Tk version in a new study and analysis. Either way, subsequent analysis will be required with EFA and ultimately confirmatory factor analysis in a larger population.

Study limitations and strengths

Other limitations include the lack of longitudinal data regarding other psychometric properties, particularly responsiveness. Furthermore, the lack of use of the half-mark option was not noted in the pilot trial, consequently only 23% of participants used the 'Half' response in the main study, this situation should be considered in further research and clinicians may use further point option questionnaire sheets such as three defined response sites. Another limitation of our study is the responses of the participants on the GRoC scale. All participants reported 'same' on the GRoC. Turkish physical therapy outpatients (acute to subacute) generally give responses of 'same' about their condition which could affect the findings of reliability. Though this situation is culturally well recognized it has not been reported or noted previously in the literature.

Strengths of the study included the relatively equal representation of conditions from both proximal and distal aspects of the upper limb. While in the Spanish version study the majority of patients had proximal conditions. Furthermore, this study was prospective and the participants were recruited consecutively. This study also complies with recommendations by Hamasaki et al who state that further studies will be needed for patients with acute conditions.[29] Another strength of our study was included the recruitment of patients with acute and subacute conditions. Consequently this is the first study that shows validity and reliability of the ULFI in this acute to subacute patient population.

Conclusion

The ULFI-Tk demonstrated good internal consistency, good reliability and moderate criterion validity ($r = 0.68$; $p < 0.05$) with the DASH-Tk. The ULFI-Tk demonstrated a two factor structure which may inhibit the use of a single summated score. However it is reliable demonstrates face, content and criterion validity in its present form and consists of simple and easily understood language. These findings may enable the ULFI-Tk to be used to assess upper limb musculoskeletal disorders in Turkish speaking patients.

References

1. Stock SR, Cole DC, Tugwell P, Stereiner D. Review of applicability of existing functional status measures to the study of workers with musculoskeletal disorders of neck and upper limb. *Am J Ind Med*. 1996 Jun;29:679–688.
2. Badalamente M, Coffelt L, Elfar J, et al. Measurement scales in clinical research of the upper extremity, part 1: general principles, measures of general health, pain, and patient satisfaction. *J Hand Surg Am*. 2013;38:401–406.
3. Badalamente M, Coffelt L, Elfar J, et al. Measurement scales in clinical research of the upper extremity, part 2: outcome measures in studies of the hand/wrist and shoulder/elbow. *J Hand Surg Am*. 2013;38:407–412.
4. Osborn W, Jull G. Patients with non-specific neck disorders commonly report upper limb disability. *Man Ther*. 2013;18:492–497.
5. Roh YH. Clinical evaluation of upper limb function: patient's impairment, disability and health-related quality of life. *J Exerc Rehabil*. 2013;9:400–405.
6. Ware JE. SF-36 health survey update. *Spine*. 2000;24:2130–2139.
7. Lee JY, Lim JY, Oh JH, Ko YM. Cross-cultural adaptation and clinical evaluation of a Korean version of the disabilities of arm, shoulder, and hand outcome questionnaire (K-DASH). *J Shoulder Elbow Surg*. 2008 Jul-Aug;17(4):570–574.
8. Colville RJ, Nicholson KS, Belcher HJ. Hand surgery and quality of life. *J Hand Surg Br*. 1999;24:263–266.
9. Szabo RM. Outcomes assessment in hand surgery: when are they meaningful? *J Hand Surg Am*. 2001;26:993–1002.
10. Beaton DE, Katz JN, Fossel AH, Wright JG, Tarasuk V, Bombardier C. Measuring the whole or the parts? Validity, reliability, and responsiveness of the disabilities of the arm, shoulder and hand outcome measure in different regions of the upper extremity. *J Hand Ther*. 2001;14:128–146.
11. Overend TJ, Wuori-Fearn JL, Kramer JF, et al. Reliability of a patient-rated forearm evaluation questionnaire for patients with lateral epicondylitis. *J Hand Ther*. 1999;12:31–37.
12. Chiari-Grisar C, Koller U, Stamm TA, et al. Performance of the disabilities of the arm, shoulder and hand outcome questionnaire and the Moberg picking up test in patients with finger joint arthroplasty. *Arch Phys Med Rehabil*. 2006;87:203–206.
13. Jester A, Harth A, Germann G. Measuring levels of upper-extremity disability in employed adults using the DASH Questionnaire. *J Hand Surg Am*. 2005;30:1074.
14. Davis AM, Beaton DE, Hudak P, et al. Measuring disability of the upper extremity: a rationale supporting the use of a regional outcome measure. *J Hand Ther*. 1999;12:269–274.
15. Franchignoni F, Vercelli S, Giordano A, Sartorio F, Bravini E, Ferriero G. Minimal clinically important difference of the disabilities of the arm, shoulder and hand outcome measure (DASH) and its shortened version (QuickDASH). *J Orthop Sports Phys Ther*. 2014 Jan;44(1):30–39.
16. Düger T, Yakut E, Öksüz Ç, et al. Kol, Omuz ve El Sorunları (Disabilities of the arm, shoulder and hand – DASH) Anketi Türkçe uyarlamasının güvenirliği ve geçerliği. *Fiz Rehabil*. 2006;17(3):99–107.
17. Bumin G, Tüzün EH, Tonga E. The Shoulder Pain and Disability Index (SPADI): cross-cultural adaptation, reliability, and validity of the Turkish version. *J Back Musculoskelet Rehabil*. 2008;21:57–62.
18. Gabel CP, Michener LA, Melloh M, Burkett B. Modification of the upper limb functional Index to a three-point response improves clinimetric properties. *J Hand Ther*. 2010;23:41–52.
19. Michener LA, Leggins BG. A review of self-report scales for the assessment of functional limitation and disability of the shoulder. *J Hand Ther*. 2001;14:68–76.
20. Sorensen AA, Howard D, Tan WH, Ketchersid J, Calfee RP. Minimal clinically important differences of 3 patient-rated outcomes instruments. *J Hand Surg Am*. 2013;38:641–649.
21. Pransky G, Feuerstein M, Himmelstein J, Kratz JN, Vickers- Lahti M. Measuring functional outcomes in work-related upper extremity disorders. *J Occup Environ Med*. 1997;39:1195–1202.
22. van de Ven-Stevens LA, Munneke M, Terwee CB, et al. Clinimetric properties of instruments to assess activities in patients with hand injury: a systematic review of the literature. *Arch Phys Med Rehabil*. 2009;90:151–169.
23. Terwee CB, Bot SD, de Boer MR, et al. Quality criteria were proposed for measurement properties of health status questionnaires. *J Clin Epidemiol*. 2007;60:34–42.
24. Stratford PW, Binkley JM, Stratford D. Development and initial validation of the upper extremity functional index. *Physiother Can*. 2001;52:259–267.
25. Beaton DE, Wright JG, Katz JN, Group UEC. Development of the QuickDASH: comparison of three item-reduction approaches. *J Bone Joint Surg Am*. 2005;87(5):1038–1046.
26. Gabel CP, Yelland M, Melloh M, Burkett B. A modified QuickDASH-9 provides a valid outcome instrument for upper limb function. *BMC Musculoskelet Disord*. 2010;10:161.
27. Gabel CP, Burkett B. The upper limb functional Index: development and determination of reliability, validity, and responsiveness. *J Hand Ther*. 2006;19:328–349.
28. Hamilton Clayton B, Chesworth Bert M. A Rasch-validated version of upper extremity functional Index for interval level measurement of upper extremity function. *Phys Ther*. 2013;93(11):1507–1519.
29. Hamasaki T, Demers L, Filiatrault J, Aubin G. A cross-cultural adaptation of the upper limb functional index in French Canadian. *J Hand Ther*. 2014;27:247–253.
30. Hamasaki T, Demers L, Filiatrault J. Test-retest reliability and responsiveness of a French Canadian Upper Limb Functional Index (ULFI-FC). *Disabil Rehabil*. 2014:1–7. Early online.
31. Cuesta-Vargas AI, Gabel CP. Cross-cultural adaptation, reliability and validity of the Spanish version of the upper limb functional index. *Health Qual Life Out*. 2013;11:126.
32. Kitis A, Celik E, Aslan UB, Zencir M. DASH questionnaire for the analysis of musculoskeletal symptoms in industry workers: a validity and reliability study. *Appl Ergon*. 2009;40:251–255.
33. Garrison JG, Shanley E, Thigpen C, Hegedus E, Cook C. Between-session changes predict overall perception of improvement but not functional improvement in

patients with shoulder impingement syndrome seen for physical therapy: an observational study. *Physiother Theory Pract*. 2011;27(2):137–145.
34. Muñiz J, Elosua P, Hambleton RK. International Test Commission Guidelines for test translation and adaptation: second edition. *Psicothema*. 2013;25:151–157.
35. Cronbach LJ. Coefficient alpha and the internal structure of tests. *Psychometrika*. 1951;16:297–334.
36. Shrout PE, Fleiss JL. Intraclass correlations: uses in assessing rater reliability. *Psychol Bull*. 1979;86:420–428.
37. Stratford PW. Getting more from the Literature: estimating the standard error of measurement from reliability studies. *Physiother Can*. 2004;56:27–30.
38. Özdamar K. *Statistical data analysing*. 8th ed. Kaan book; 2011.
39. de Vet HC, Adèr HJ, Terwee CB, Pouwer F. Are factor analytical techniques used appropriately in the validation of health status questionnaires? A systematic review on the quality of factor analysis of the SF-36. *Qual Life Res*. 2005;14: 1203–1218.
40. Fabrigar LR, Wegener DT, MacCallum RC, Strahan EJ. Evaluating the use of exploratory factor analysis in psychological research. *Psychol Methods*. 1999;4: 272–299.
41. Kass RA, Tinsley HEA. Factor analysis. *J Leis Res*. 1979;11:120–138.
42. de Vet HCW, Terwee CB, Mokkink LB. *Measurement in Medicine a Practical Guide*. London: Cambridge Press; 2011.
43. Costello AB, Osborne J. Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Pract Assess Res Eval*. 2005;10:1–9.
44. Nunnally JC, Bernstein IH. *Psychometric Theory*. New York: McGraw-Hill; 1994.
45. Meng X, Rosenthal R, Rubin DB. Comparing correlated correlation coefficients. *Psychol Bull*. 1992;111:172–175.
46. Terwee CB, Mokkink LB, Knol DL, Ostelo RW, Bouter LM, de Vet HC. Rating the methodological quality in systematic reviews of studies on measurement properties: a scoring system for the COSMIN checklist. *Qual Life Res*. 2012;21: 651–657.
47. Jöreskog KG, Sörbom D. *LISREL 8.80*. Chicago: Scientific Software International; 2007.
48. Albarracin D, Johnson BT, Zanna MP. *The Handbook of Attitudes*. Hillsdale, NJ: Erlbaum; 2005.
49. Newcombe R. Confidence intervals for the mean of a variable taking the values 0, 1 and 2. *Stat Med*. 2003;22:2737–2750.
50. Ogus E, Yazıcı AC, Gurbuz F. Evaluating the significance test when the correlation coefficient is different from zero in the test of hypothesis. *Commun Stat-Simul C*. 2007;36:847–854.
51. Goodwın Laura D, Leech Nancy L. Understanding Correlation: factors that affect the size of *r*. *J Exp Educ*. 2006;74(3):251–266.
52. Choi Jaehwa, Peters Michelle, Mueller Ralph O. Correlational analysis of ordinal data: from Pearson's *r* to Bayesian polychoric correlation. *Asia Pac Educ Rev*. 2010;11:459–466.
53. MacCallum RC, Widaman KF, Zhang SB, Hong SH. Sample size in factor analysis. *Psychol Methods*. 1999;4(1):84–99.
54. Franchignoni F, Giordano A, Sartorio F, et al. Suggestions for refinement of the disabilities of the arm, shoulder and hand outcome measure (DASH): a factor analysis and Rasch validation study. *Arch Phys Med Rehabil*. 2010;91: 1370–1377.
55. Franchignoni F, Vercelli S, Giordano A, et al. Minimal clinically important difference of the disabilities of the arm, shoulder and hand outcome measure (DASH) and its shortened version (QuickDASH). *J Orthop Sports Phys Ther*. 2014 Jan;44(1):30–39.
56. Melloh M, Gabel CP, Cuesta-Vargas AI. Factor analysis findings for the QuickDASH. Re: Mehta S, MacDermid JC, Carlesso LC, et al. Concurrent validation of the DASH and the QuickDASH in comparison to neck-specific scales in patients with neck pain. *Spine*. 2010;35:2150–2156.
57. Raven EE, Haverkamp D, Sierevelt IN, et al. Construct validity and reliability of the disability of arm, shoulder and hand questionnaire for upper extremity complaints in rheumatoid arthritis. *J Rheumatol*. 2008 Dec;35(12):2334–2338.

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#1. The adaptation is intended for use by patients whose primary language is
   a. Farsi
   b. Turkish
   c. Arabic
   d. Aramaic

#2. The ULFI-Tk demonstrated
   a. moderate criterion validity
   b. moderate reliability
   c. good internal consistency
   d. all of the above

#3. The ULFI is
   a. required for government approval in the UK and Medicare reimbursement in the US
   b. standard procedure in the EU
   c. a PRO
   d. an essential element of an initial evaluation

#4. The original ULFI description was authored by
   a. MacDermid
   b. Gabel
   c. Szabo
   d. Mackin

#5. Table 1 shows the demographic characteristics of the participants
   a. true
   b. false

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