ORIGINAL ARTICLE

Nr 2022;12 (4):530-536

The Upper Extremity Functional Index (UEFI): Cross-Cultural Adaptation, Reliability, and Validity of the Italian Version

M. D'Agostino[1], M. Panico[2], A. Marsocci[1], F. Angelini[2], F. Casile[1], A. Graffitti[1], F. Magnifica[3,4]

[1] *Sapienza University of Rome, Rome, Italy*
[2] *University of Pisa, Pisa, Italy*
[3] *Department of Italian Air Force Aerospace Medicine, Diagnostic Therapeutic and Rehabilitative Aeromedical Center, Rome, Italy*
[4] *Department of Human Neurosciences, Sapienza University of Rome, Rome, Italy*

CORRESPONDING AUTHOR:
Department of Italian Air Force Aerospace Medicine
Diagnostic Therapeutic and Rehabilitative Aeromedical Center
viale Piero Gobetti 6
00185 Rome, Italy
E-mail: fabrizio.magnifica@uniroma1.it

DOI:
10.32098/mltj.04.2022.08

LEVEL OF EVIDENCE: 4

SUMMARY

Introduction. The Italian version of the Upper Extremity Functional Index (UEFI) may help assess shoulder function in patients with shoulder problems, especially athletes. **Objective.** Translate and cross-culturally adapt UEFI into Italian; verify UEFI validity and reliability in professional and amateur athletes with upper limb musculoskeletal disorders, shoulder, in particular. **Methods.** This study was conducted with 150 participants with musculoskeletal disorders of the upper limb. UEFI, the short version of the Disability of the Arm, Shoulder and Hand scale (Quick DASH), the Shoulder Pain and Disability Index, and the Short Form-36 Health Survey (SF-36) were administered. Acceptability was assessed in terms of refusal rate, rates of missing responses, and administration time; test-retest reliability was assessed with intraclass correlation coefficient (ICC); internal consistency was assessed with Cronbach's alpha coefficient, and validity was assessed by Pearson's correlation coefficients. **Results.** Cronbach's alpha coefficients for the UEFI on test and retest were $\alpha = 0.979$ and $\alpha = 0.985$, respectively. The average measure ICC was 0.917. The UEFI score demonstrated strong negative correlations with SPADI total score (-0.636), Quick DASH score (-0.685), and SF-36 score (-0.327). **Conclusions.** The Italian version of UEFI is acceptable, valid, and reliable.

KEY WORDS
Upper extremity; shoulder; questionnaire; physiotherapy; disorders.

INTRODUCTION

The glenohumeral joint has a high range of motion on the three planes of space; this is its main problem and exposes it to numerous alterations and dysfunctions. Joint or periarticular rheumatic conditions are often the cause of shoulder problems and treatment options are multiple. Treatment of capsular syndrome, for example, should be based on the stage of the disease and on patients' characteristics. The first approach should be conservative while surgical option should be considered for patients refractory to conservative treatment (1). Capsular syndrome (adhesive capsulitis), acute bursitis, acromion-clavicular syndrome, and subacromial syndrome (2) are the four most frequently occurring intrinsic shoulder syndromes. Also rotator cuff tears are common and are a frequent source of shoulder pain and disability, but the clinical presentation of rotator cuff pathology is extremely variable, so it is important to correlate radiological and clinical findings (3).

As for the athletes, the subject of this study, both in the competitive and amateur fields the incidence of shoulder injuries is high, but it must be related to the sporting gesture, and the specific aspects of the type of sport practiced (4).
Almost in all sports, the most frequent injuries concern rotator cuff injuries, in particular, the supraspinatus muscle injury, which can cause a subacromial impingement syndrome; these injuries can result from a direct blow, fall on an outstretched arm, or overload syndromes. It has also been shown that rotator cuff disorders increase with age: 9.7% under the age of 20 to 62% over the age of 80. Rotator cuff injuries are prevalent, especially in sports that require overhead activity, and these athletes need to be monitored and followed closely (5). The I.S.Mu.L.T. guidelines for the muscular trauma recovery have introduced the concept of motor re-education in phases IV and V as the final part of the rehabilitation period, which gradually leads the athlete to training again. The aims during these two phases are recovery of the proprioception and the coordination in the specific sports, metabolic specific readjustment, recovery of the most important strength's characteristic for the performance (6).
To diagnose injuries to the rotator cuff and study the joint at the tendon level ultrasound with magnetic resonance and any clinical tests, such as the Jobe test, the Apley scratch test, or Neer's test (5) are commonly used. It is followed by magnetic resonance and any clinical tests, such as the Jobe test, the Apley scratch test, or Neer's test (7). However diagnostic labeling based on a pathological anatomical classification not always reflect the clinical path and would be advisable to manage the patient with subacromial impingement syndrome with procedures leave no longer focused on special tests and confirmatory instrumental examinations, but rather on the framing of bio-psycho-social factors for optimal and taylorised management (8). In addition, rating scales, scoring systems, and questionnaires have been used for many years to assess the patient's subjective pain and degree of disability (9, 10). The results obtained are significant for evaluation in the clinical and rehabilitation fields, and currently, a variety of validated measures are available (9-11).
Thanks to their psychometric characteristics and their validity and reproducibility, the Disability of the Arm, Shoulder and Hand (DASH) and the Constant and Murley Score (CMS) are the most widespread scales in clinical practice for the assessment of the upper limb in general (DASH) (10) or of the shoulder in particular (CMS) (12).
One of the outcome measures intended for upper extremity disorders is the "Upper Extremity Functional Index" (UEFI) which is a scale that evaluates the functional disability of the entire upper limb (shoulder, elbow, wrist, and hand) in patients suffering from various musculoskeletal dysfunctions. It is a self-administering and short-length questionnaire, which makes it easy to understand and allows the patient to complete it in a concise time (about five minutes) (13).
The Italian version of UEFI is not available, and we believe that the Italian version of UEFI can help to evaluate the functionality of the shoulder in clinical and rehabilitative settings in patients, especially athletes, with musculoskeletal disorders of the upper limb. The aim of this study is, therefore, to adapt UEFI to Italian and to evaluate its acceptability, reliability, and validity inactive patients with upper limb problems, in particular the shoulder.

METHODS

Cross-cultural adaptation process

After requesting permission for the translation and obtaining the author's consent, the original version was subjected to a translation process based on the "COSMIN checklist manual" guidelines by Mokkink, Terwee, Patrick, Alonso, Stratford, Knol, Bouter, and de Vet (14). Cultural adaptation is a process divided into several phases: forward-translation, speech by a group of experts, back-translation, test-retest, and evaluation of the psychometric properties of the scale. These phases made it possible to create different versions of the UEFI in Italian, starting from the original English version and identifying the intercultural, conceptual, and linguistic/literal equivalences between the Italian versions and the original. The final Italian version was developed so that it was as faithful as possible to the original version but also perfectly adapted to the Italian culture and elementary to understand by the patient (15).
For the validation of the "Upper Extremity Functional Index" (UEFI) scale, as soon as the original questionnaire in English and the author's authorization to use the UEFI were obtained, the three forward translations in Italian were carried out. The scale contains simple questions that do not need to carry out particular processes of cultural adaptation; they are questions that are easily applied to different populations without requiring particular modifications. Subsequently, the fourth Italian version of the UEFI was developed starting from the three forward translations made previously. By carrying out the back translation, it was ascertained that there were no changes to the contents of the questionnaire through the translation process. With the test-retest process, the UEFI in Italian was administered one week after the first administration, and no patient proposed corrections or suggestions regarding the scale in this phase, which therefore immediately proved to be easy to understand and fill in.

Participants

The study was conducted at the Sapienza University of Rome and the University of Pisa, with the collaboration of the

Aerospace Medicine Department of the Air Force of Rome, between May and November 2021. The sample size was determined chosen according to the following inclusion and exclusion criteria: the inclusion criteria were age between 18 and 60 (mean age: 27.47; standard deviation 7.8369), presence of painful symptoms or any shoulder problem, diagnosed or not, practice sports regularly at a competitive and/or amateur level and being able to read and write in Italian; the exclusion criteria were diagnosed presence of cognitive and/or visual problems or other problems that make the patient unable to complete the questionnaire and informed consent autonomously and be affected by pathology or a shoulder problem bilaterally. The 150 patients who adhered to the administration of the test were recruited into various sports associations; they accepted the informed consent, thus consenting to the use of their data, and then completed all the questionnaires administered in full. One week after the test, 47 of the 150 patients underwent the retest. All 140 patients met the study inclusion criteria, including 36.4% women and 63.6% men.

Instruments

Three scales already validated in Italian were selected to demonstrate the effectiveness of the UEFI by comparing them.

The "Short Form-36 Health Survey" (SF-36), the "Shoulder Pain and Disability Index" (SPADI), and the "Short Version of the Disability of the Arm, Shoulder and Hand Scale" (Quick-DASH) are to be used as a gold standard.

The Upper Extremity Functional Index

The original version of the UEFI (UEFI 20-items), created by Stratford PW, Binkley, JM, Stratford DM, is composed of 20 multiple choice questions, with a score from 0 to 4, which define the level of difficulty perceived by the patient in carrying out activities of daily life involving the upper limb, such as housework, work gestures, hobbies, sports, *etc*. Each question has five standardized answers, and each of them corresponds to a precise numerical value from 0 to 4, where 0 indicates extreme difficulty or inability to perform the activity, 1 indicates incredible difficulty, 2 indicates moderate difficulty, 3 indicates little difficulty, and 4 indicates no difficulty. The total score is obtained by adding the values of each answer to obtain a maximum of 80 points, which corresponds to the best activity picture of the joint. The smallest change considered clinically significant is at least 9 points (13).

Short Version of the Disability of the Arm, Shoulder, and Hand Scale (Quick-DASH)

The Quick-DASH is a short version of the original DASH (11), developed by the Institute for Work and Health and the American Academy of Orthopedic Surgeons (AAOS) in 1996. The Quick-DASH consists of 11 questions taken from the 30 questions of the original version, which have been divided into three sections (two of which are optional): the first section is composed of eleven questions that investigate the painful symptoms and the degree of disability perceived by the patient in the last week while carrying out the simplest activities of daily life (items 1-11); the second section (work-optional module) is dedicated to the description of the impact of the pathology on the patient's work (items 12-15); the third section (recreational/sports-optional module) is dedicated to the impact of the pathology in practicing sports or in carrying out other recreational activities by the patient always in the last week and to his level of activity and performance (items 16-19). For each item, five answer options define a score from 1 to 5. The scoring can be done individually for each section, or the final total score can be calculated. The maximum score obtainable is 100, indicating a situation of extreme disability, while the minimum score is 0, which corresponds to a condition of absence of disability (16).

Shoulder Pain and Disability Index (SPADI)

The SPADI (Shoulder Pain and Disability Index) (17) is a simple self-administering questionnaire and specific region used for the evaluation of the patient suffering from musculoskeletal pathologies of the upper limb. It consists of two dimensions, one dedicated to pain and the other to daily life activities. The section dealing with pain consists of five questions on the severity of painful symptoms. The second section is instead composed of eight questions that are intended to measure the degree of difficulty encountered by the patient during the performance of various daily life activities involving the upper limb (18). To answer the questions, the patient places a mark on a visual analog scale (type VAS) 10 cm long, whose extremes for the pain section are represented by the items "no pain" and "worst pain imaginable", while for the section on the pain activities of daily living are represented by "no difficulty" and "so difficult as to require help". Each subscale produces its score from 0 to 100, which will determine the final score of the scale, which can take values from 0 (best result) to 100 (worst result); therefore, higher scores correspond to a greater degree of disability of the patient (18).

Short Form 36 Health Survey (SF-36)

The SF-36 (The Medical Outcomes 36-item Short-Form Health Survey) is a generic and multidimensional questionnaire that aims to assess the patient's state of health, extrapolating two indices that define overall physical health (ISF) and mental (ISM). The scale is made up of 36 questions

grouped into eight domains, from which scores are obtained which serve to derive the two aforementioned indices to summarize the results of all domains in just two values: the higher the score, the better the perceived state of health (19). In our study, the SF-36 was mainly used to measure the mental health of the patient, so we paid particular attention to the domain dedicated to psychological-emotional health, which captures the state of anxiety and stress in the past month. High scores indicate a state of tranquility, serenity, and calm in the person; low scores reflect anxious-depressive and nervous states.

Statistical analysis

In this study, we used the IBM-SPSS software (version 25.00) for statistical analyses.

Descriptive analysis

As for the descriptive statistical analysis, the "Excel" program was used, and five separate sheets were created, each containing the personal data of each of the participants. The first sheet collected the results obtained from the first administration of the UEFI scale described item by item; in the last column, however, the total scores were reported. The second sheet contains the results of the retest of the UEFI scale in the same way as the first sheet. The data collected from the three comparison scales used, namely SPADI, Quick-DASH, and SF-36, with their respective totals, were reported in the remaining three Excel sheets. The data in the Excel file were then used to carry out the inferential statistical analysis of the population under study. In the descriptive analysis, the mean, the Standard Deviation (SD), and the percentages of the variables were calculated in order to examine the data obtained from the sample and the administration of the questionnaires.

Inferential analysis

The following statistical tests were used to carry out the inferential analysis: Cronbach's alpha was used to evaluate the internal consistency of the UEFI, which must assume a value of at least 0.70 in order for there to be homogeneity between the items on the scale; Intraclass Correlation Coefficient (ICC), used to evaluate the reliability of the test-retest which to be valid must assume a value greater than or equal to 0.70; Pearson's correlation coefficient, used to evaluate the validity of the construct and in this case determined the association between the UEFI and the Italian versions of SPADI, Quick DASH and SF-36; significance level which is given by a P-value less than or equal to 0.05 (20, 21). Content validity was assessed at Time 1 by examining the floor and ceiling effects. We hypothesized that the floor and ceiling effects are less than 20%.

RESULTS

One hundred fifty patients who comply with the inclusion and exclusion criteria were recruited. All the demographic characteristics of the population are described in **table I**. 99 of the 150 participants (70.7%) have the right arm affected by disorders, and 41 (29.3%) have the left side. The 71.4% were right-side dominant, the 10% were left-side dominant, and the 18.6% were ambidextrous. There weren't calculated in the study possible correlations between UEFI and participants' demographic characteristics such as gender, age, and dominant upper limb.

Descriptive analyses of the data

In the descriptive analysis, we calculated average, standard deviation (DS), and percentage variables in order to examine data collected from the sample tested (**table I**).

Table I. Participants' demographic characteristics.

Dominant side					
	Frequency	**Percent**	**Valid percent**	**Cumulative percent**	
	Right	26	18.6	18.6	18.6
		100	71.4	71.4	90.0
	Left	14	10.0	10.0	100.0
	Total	140	100.0	100.0	
Gender					
	Frequency	**Percent**	**Valid percent**	**Cumulative percent**	
Validity	**Feminine**	51	36.4	36.4	36.4
	Masculine	89	63.6	63.6	100.0
	Total	140	100.0	100.0	

Date quality and acceptability

All the patients have completed the questionnaire, and there were no missing data for items. Time spent on filling the test is, on average, five minutes.

Reliability

UEFI demonstrated a reasonable degree of internal consistency with a value of Cronbach's alpha of 0.979 at the test and of 0,985 at the retest (all scores for Cronbach's alpha were summarized in **table II**). Cronbach's alpha coefficient in Turkish validation was 0.89 at test and 0.89 at retest (22). The second administration after one week from the first UEFI was reliable with a value of Intraclass Correlation Coefficient (ICC) of 0.917 ($p < 0.05$) at test-retest (**table III**).

Content validity

Only one patient recorded the minimum score of "0" on the UEFI, which would represent the worst functional status (floor), and only 7 patients had maximum score of "80", which would represent the best functional status (ceiling). UEFI had no floor, and ceiling effects.

Table II. Reliability Statistics (Cronbach's Alpha).

Cronbach's alpha	Cronbach's Alpha Based on standardized items	N. of Items
0.985	0.986	20

Construct validity

A Pearson's correlation coefficient between UEFI score and SPADI was -0.636 ($p < 0.01$), between UEFI and Quick-DASH, it was -0.685 ($p < 0.01$), and between UEFI and SF-36 was 0.327 (all the Pearson's correlations are summarized in **table IV**). Pearson's correlation coefficient in Turkish validation was respectively -0.61 for the correlation between UEFI score and SPADI, -0.63 between UEFI and Quick-DASH, and -0.05 between UEFI and SF-36 (19). These results prove that UEFI has a good construct validity for the presence of strong negative correlation scores.

DISCUSSION

The objective of the following study was to assess UEFI psychometric properties in patients affected by musculoskeletal disorders of the upper limb extremity and who practice sports regularly (at the amateur or professional level). Cronbach's alpha, ICC, and Pearson's correlation coefficient values demonstrated UEFI reliability and validity.

Cronbach's alpha values were significant for all UEFI's items, so it has internal consistency mainly and a significant interrelation between items.

ICC was > 0.7, so UEFI has good stability, also in the second administration. Results obtained for the ICC and Cronbach's alpha (**tables II, III**) can be compared to results of the UEFI Turkish Validation, where ICC was 0.80 ($p < 0.001$) and

Table III. Stability: Intraclass Correlation Coefficient (ICC) between test and retest.

Intraclass correlation coefficient					
	Intraclass Correlation	95% confidence interval		F Test with True value 0	
		Lower Bound	Upper Bound	Value	df1
Single measures	0.846	0.741	0.910	12.473	48
Average measures	0.917	0.851	0.953	12.473	48

Table IV. Validity: Pearson's correlation coefficients between UEFI and SPADI, Quick-DASH and SF-36.

Statistics	
Mean	27.47
Median	25.00
Standard deviation	7.836
Variance	61.410
Range	38
Minimum	18
Maximum	56

Cronbach's alpha was 0.89 (23). Also, in the Turkish validation were used as gold standards Quick-DASH, SPADI, and SF-36. The Turkish version of UEFI had significant correlations in Pearson's test with SPADI (r = 0.61) and Quick-DASH (r = 0.05), comparable with the results of the Italian version. There was no significant correlation between UEFI-Turkish and SF-36 in Pearson's test (r = -0.05). At the same time, there was a significative correlation (r = 0.327) between the Italian version of UEFI and the section "mental health" of SF-36, as compared to the Turkish validation.
UEFI has great construct validity because $p < 0.01$ for each group of items. Pearson's correlation coefficient showed all statistically significant scores, so all the items of UEFI are correlated with the items of SPADI and Quick-DASH.

CONCLUSIONS

In the following study, UEFI was translated, validated, and culturally adapted into the Italian language and culture.
Statistically significant outcomes from the analysis demonstrated that UEFI is a reliable and valid instrument of measurement in sports patients affected by musculoskeletal disorders of the upper limb.
UEFI is also handy in clinical practice and scientific research because it is a self-administered, simple, and practice questionnaire whose compilation takes only five minutes for the patient. With the present study, we also suggest the use of UEFI in sports medicine and rehabilitation.

FUNDINGS

None.

DATA AVAILABILITY

Data are available under reasonable request to the corresponding author.

CONTRIBUTIONS

MD, MP, MA MF: conceptualization and design, data analysis and interpretation, drafting. AF, CF, GA: manuscript revision.

AKNOWLEDGMENTS

Special thanks to Prof. Brophy for permitting us to have Italian version of this instrument.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

REFERENCES

1. D'Orsi GM, Via AG, Frizziero A, Oliva F. Treatment of adhesive capsulitis: a review. Muscles Ligaments Tendons J 2012;2(2):70-8.
2. van der Windt DA, Koes BW, de Jong BA, Bouter LM. Shoulder disorders in general practice: incidence, patient characteristics, and management. Ann Rheum Dis 1995;54(12):959-64.
3. Via AG, De Cupis M, Spoliti M, Oliva F. Clinical and biological aspects of rotator cuff tears. Muscles Ligaments Tendons J 2013;3(2):70-9.
4. DeCastro A. Common Upper-Extremity Injuries. Prim Care 2020;47(1):105-4.
5. Villa-Forte Alexandra. Valutazione della spalla. Available at: https://www.msdmanuals.com/it-it/professionale/disturbi-del-tessuto-muscoloscheletrico-e-connettivo/approccio-al-paziente-con-sintomi-articolari/valutazione-della-spalla. Last access date: 10/10/2021.
6. Oliva F, Piccirilli E, Bossa M, et al. I.S.Mu.L.T - Rotator Cuff Tears Guidelines. Muscles Ligaments Tendons J 2016;5(4):227-63.
7. Wright RW, Baumgarten KM. Shoulder outcomes measures. J Am Acad Orthop Surg 2010;18(7):436-44.
8. Lorusso M, Mastrangelo E, Garofalo G, Ristori D, Brindisino F. Diagnostic Accuracy of Physical Tests and Imaging Techniques in Patients with Shoulder Impingement Syndrome. Muscles Ligaments Tendons J 2021;11(3):383-408.
9. McClure P, Michener L. Measures of adult shoulder function: The American shoulder and elbow surgeons standardized shoulder form patient self-report section (ASES), disabilities of the arm, shoulder, and hand (DASH), shoulder disability questionnaire, shoulder pain, and disability index (SPADI), and simple shoulder test. Arthritis Care Res 2003;49(5S):S50-S8.
10. Gabel CP, Michener LA, Burkett B, Neller A. The Upper Limb Functional Index: development and determination of reliability, validity, and responsiveness. J Hand Ther 2006;19(3):328-48; quiz 349.
11. Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand) [corrected]. The Upper

Extremity Collaborative Group (UECG). Am J Ind Med 1996;29(6):602-8.
12. Constant CR, Murley AH. A clinical method of functional assessment of the shoulder. Clin Orthop Relat Res 1987 Jan214):160-4.
13. Chesworth BM, Hamilton CB, Walton DM, et al. Reliability and validity of two versions of the upper extremity functional index. Physiother Can 2014;66(3):243-53.
14. Mokkink LB, Terwee CB, Patrick DL, et al. The COSMIN checklist for assessing the methodological quality of studies on measurement properties of health status measurement instruments: an international Delphi study. Qual Life Res 2010;19(4):539-49.
15. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine (Phila Pa 1976) 2000;25(24):3186-91.
16. Beaton DE, Wright JG, Katz JN; Upper Extremity Collaborative Group. Development of the QuickDASH: comparison of three item-reduction approaches. J Bone Joint Surg Am 2005;87(5):1038-46.
17. Marchese C, Cristalli G, Pichi B, et al. Italian cross-cultural adaptation and validation of three different scales for the evaluation of shoulder pain and dysfunction after neck dissection: University of California - Los Angeles (UCLA) Shoulder Scale, Shoulder Pain and Disability Index (SPADI) and Simple Shoulder Test (SST). Acta Otorhinolaryngol Ital 2012;32(1):12-7.
18. Roach KE, Budiman-Mak E, Songsiridej N, Lertratanakul Y. Development of a shoulder pain and disability index. Arthritis Care Res 1991;4(4):143-9.
19. Apolone G, Mosconi P. The Italian SF-36 Health Survey: translation, validation and norming. J Clin Epidemiol 1998;51(11):1025-36.
20. Nunnally JC, Bernstein IH. Psychometric theory. New York: McGraw-Hill, 1994.
21. DeVellis RF. Scale development: theory and applications. Newbury Park: Sage Publications, 1991.
22. Prince B, Makrides L, Richman J. Research methodology and applied statistics. Part 2: the literature search. Physiother Can 1980;32(4):201-6.
23. Aytar A, Yuruk ZO, Tuzun EH, Baltaci G, Karatas M, Eker L. The Upper Extremity Functional Index (UEFI): cross-cultural adaptation, reliability, and validity of the Turkish version. J Back Musculoskelet Rehabil 2015;28(3):489-95.