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PSYCHOMETRIC PROPERTIES OF THE UPPER EXTREMITY FUNCTIONAL INDEX (UEFI): A SYSTEMATIC REVIEW

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Abstract: Upper Extremity Functional Index (UEFI) is a region-specific Patient Reported Outcome Measure (PROM) to evaluate upper extremities functions. The clinical utility of all available versions of UEFI is still unknown, and the psychometric properties of all versions of UEFI are still questioned. This study aimed to (1) systematically review the clinical utility of all available versions of the UEFI and (2) investigate the psychometric properties of all available versions of UEFI. A systematic search was conducted using SCOPUS, WEB OF SCIENCE, PUBMED, CINAHL, MEDLINE and AMED databases. The search terms used were ("Upper Extremity Functional Index" OR "UEFI") and ("Psychometric properties" or "Reliability" or "Validity" or "Responsiveness"). The search process used a traditional four-stage screening method and PRISMA guidelines to select the included studies according to the inclusion and exclusion criteria. The UEFI was utilised in five populations: musculoskeletal disorder, breast cancer, post-operative, stroke, and burn, whereby it was mainly used in the musculoskeletal disorder population. All available versions of UEFI were proven valid and reliable for the musculoskeletal disorder population and breast cancer population. UEFI-15 is recommended among all versions of UEFI as it is unidimensional and supported by Rasch analysis to assess upper extremity function.

Keywords: Upper Extremity Functional Index, psychometric properties.

Introduction

Healthcare delivery in the twenty-first century is progressively moving forward to optimise patient outcomes at a reasonable cost (Dacombe *et al.*, 2016; Aljathlani *et al.*, 2022). Appropriate outcome measures are needed to measure the effectiveness of the intervention. Applying Patient-Reported Outcome Measures (PROMs) could be helpful in collecting information regarding patients' day-to-day experience with a specific condition (Wells *et al.*, 2011). Clinicians have widely used PROMs in healthcare systems because they focus more on assessing the patient's functional abilities rather than physical ones (Black, 2013). Outcomes measures of the patient's current upper extremities function are most likely more important to the patient than the clinical measures such as range of motion and muscle power of the upper extremities as most of them are more concerned for their upper extremities' functions (Guclu-Gunduz *et al.*, 2012).

Therefore, validated and reliable PROMs are needed to measure patients' improvement and progression over the course of intervention (Dacombe *et al.*, 2016). The Disabilities of the Arm, Shoulder and Hand (DASH) was the most common PROM used in musculoskeletal disorder populations due to its excellent psychometric properties (Armijo-Olivo *et al.*, 2016). Upper Extremity Functional Index (UEFI) is a region-specific PROM that evaluates activity limitations in the upper extremity, which have been reported to have excellent

psychometric properties in musculoskeletal disorders similar to the DASH (Alnahdi *et al.*, 2021).

A study reported that UEFI is easy to administer and only takes five minutes to complete (Arumugam *et al.*, 2018). Patients need to rate their functional ability of upper extremities on a four-point Likert's scale, with zero indicating extreme difficulty and four indicating no difficulty (Arumugam *et al.*, 2018). The original UEFI was developed by Stratford (2001) and was modified to UEFI-15 by Hamilton *et al.* (2013). Rasch-analysis supported the UEFI-15 to measure upper extremity function for participants with upper extremity musculoskeletal disorders, while Rasch-analysis did not support the UEFI (Hamilton *et al.*, 2013). UEFI has been translated cross-culturally into the Arabic version by Aljathlani *et al.,* (2021) and the Turkish version by Aytar *et al.* (2015). Although the original version of UEFI was reported to have excellent psychometric properties in musculoskeletal disorder conditions, the other version of UEFI was still questioned (Alnahdi *et al.*, 2021).

The psychometric properties refer to the PROMs' validity, reliability, and responsiveness (Shah *et al.*, 2016). The term "reliability" was invented by Spearman (1961), which is defined as the assessment of the accuracy and stability of a test result (Carrozzino *et al.*, 2021). Validity refers to the degree to which an instrument measures what it was designed to measure and not anything else (Frost *et al.*, 2007). The term "Responsiveness" is the only aspect of sensitivity that responds to the change of a scale (Carrozzino *et al.*, 2021).

The clinical utility of the original version of UEFI was known to be mainly used in assessing upper extremity functions in musculoskeletal only. Thus, examining the clinical utility of UEFI may provide evidence for clinicians, especially occupational therapists who treat patients with upper extremity function problems. Identifying each version of UEFI's validity, reliability and responsiveness in a specific clinical population or research setting is very important as data from PROMs is directly reported by patients without interpretation by clinicians or anyone else regarding the patient's current condition (Weldring *et al.*, 2013). Therefore, this study aimed to (1) systematically review the clinical utility of all available versions of the UEFI and (2) investigate the psychometric properties of available versions of the UEFI.

Methods

Study Design

This systematic review examined the clinical utility of the UEFI and investigated the psychometric properties of the available version of the UEFI. PRISMA guideline was used for this systematic review to optimise the quality of reporting and reduce bias (Selcuk, 2019).

Search Strategy

A comprehensive search has been conducted using SCOPUS, WEB OF SCIENCE, PUBMED, CINAHL, MEDLINE and AMED databases. The search terms used were ("Upper Extremity Functional Index" or "UEFI") and ("Psychometric properties or Reliability or Validity or Responsiveness") for each of the databases listed above. The search limits were set for studies published from 2012 – 2022 only to search for up-to-date studies. The search process used a traditional four-stage screening method and PRISMA guidelines to select the relevant studies according to the inclusion and exclusion criteria. When there was doubt about a study's appropriateness for inclusion, a discussion with the senior authors was done to achieve consensus. Stage 1, where the record is removed before screening to eliminate duplicate studies. Stage 2, where all the studies were screened. The studies that were irrelevant to the topic area and non-English language studies were excluded. Stage 3, where studies sought retrieval. Stage 4, the full-text studies were assessed for eligibility to fit the inclusion and exclusion criteria. Figure 1 depicts the summary of the search strategy and the 4-stage screening process. The first author performed the search independently.

Study Selection

The included studies in this review were selected based on the inclusion and exclusion criteria set for this review. Inclusion criteria for this review are (1) a fully published study that used UEFI as an outcome measure; (2) published in the English language; (3) described the psychometric properties of UEFI. Exclusion criteria for this review are (1) Published studies on children populations; (2) Thesis/ grey literature; (3) Abstract; (4) Case report; (5) Accepted manuscript. The first author did the study selection. When there was doubt about a study's appropriateness for inclusion, a discussion was done with senior authors to achieve a consensus.

Data Extraction

After the screening process, all the included studies are summarised. The author, study design, clinical population, intervention, number of participants and other outcome measures were extracted from the included studies. Data extracted was done by the first author. When there was doubt regarding the data extraction, a discussion was done with senior authors to achieve a consensus.

The included studies' quality assessment was done using the Crowe Critical Appraisal Tool (CCAT) and the total score was given to each study. The form and user guidelines of the CCAT were utilised together to ensure the reliability and validity of the score (Crowe, 2013). CCAT was chosen to critically appraise all the included studies as CCAT could critically appraise all types of research design (Crowe, 2013). The first and last authors did the quality assessment.

Results

Search Results

The search results from SCOPUS, WEB OF SCIENCE, PUBMED, CINAHL, MEDLINE and AMED database, followed by the 4-stage screening process, showed that 20 studies had been included in this review (see Figure 1).

All the 20 included studies' characteristics were extracted and presented in Table 1. Studies included in this review have various study designs, clinical populations, interventions, participants, and other additional outcome measures. Heterogeneity of the type of study design, clinical population, intervention, number of participants and other outcome measures used cause lead to unable to perform a meta-analysis.

Results from the quality assessment done using the CCAT are presented in Table 1. Most of the included studies obtained high scores using the CCAT. However, only four included studies obtained average scores.

Clinical utility of Upper Extremity Functional Index

The UEFI was utilised in five populations. The most frequent population was the musculoskeletal disorder with nine included studies utilising the UEFI, two included studies utilising the UEFI-15, one included a study utilising the UEFI Turkish version, and one utilised the UEFI Arabic version. Three included studies utilised UEFI in the breast cancer population. Two included studies in the post-operative populations utilised the UEFI. Two included studies in the stroke population utilised the UEFI. Finally, one included study utilised the UEFI in the burn population (see Table 2).

Psychometric properties of UEFI version

Table 3 shows a summary of the psychometric evidence of the UEFI available version in terms of reliability, validity and responsiveness. The UEFI and UEFI-15 versions show consistent test-retest reliability results (ICC = 0.94). Convergent validity for both the UEFI and UEFI-15 versions was supported by their strong correlation with the Upper Extremity Functional Scale (UEFS) $\geq$ 0.6. Finally, responsiveness for both the UEFI and UEFI-15 versions are similar, UEFI (0.57) and UEFI-15 (0.58).

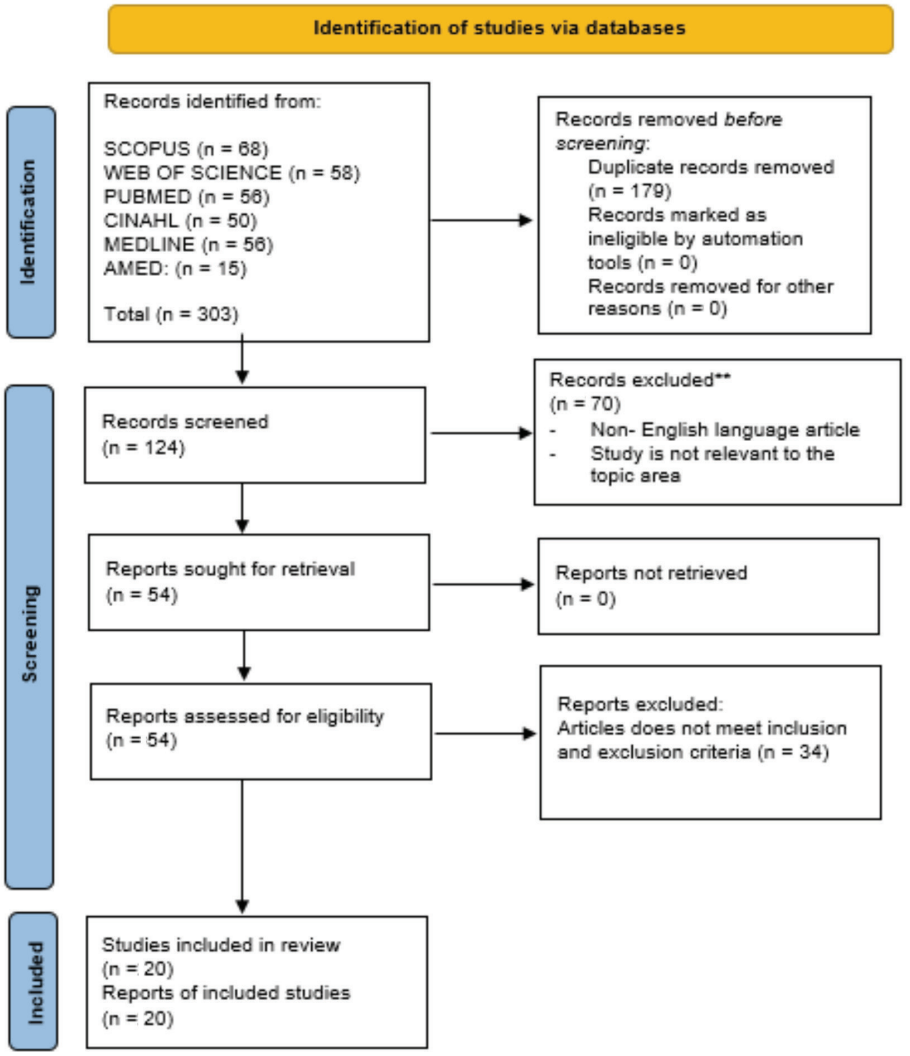

Figure 1: Summary of the search strategy and 4-stage screening process using the 2020 PRISMA Flowchart

Internal consistency and test-retest reliability for UEFI Turkish version indicate good reliability. Internal consistency of the UEFI Turkish version was Cronbach's alpha = 0.89. Test-retest reliability for the UEFI Turkish version was (ICC = 0.80). The UEFI Turkish version has no floor and ceiling effects with strong negative correlations with the Shoulder Pain and Disability Index (SPADI) (r = -0.6). As for the UEFI Arabic version, Internal consistency and test-retest reliability were excellent. Internal consistency of the UEFI Arabic version was Cronbach's alpha = 0.96. Test-retest reliability for the UEFI Arabic version was (ICC = 0.92). The UEFI Arabic version has no floor and ceiling effects with strong negative correlations with the Disability of the Arm, Shoulder and Hand (DASH) (r = -0.95).

Table 1: Details of the Studies Included in the Review

Author	Study Design	Clinical Population	Intervention	Number of Participants	Other Outcome Measures Used	CROWE Critical Appraisal (Total %)
Heidar Abady *et al.* (2017)	Prospective longitudinal study	Patients with a shoulder problem	McKenzie's system of Mechanical Diagnosis and Therapy (MDT)	93	NPRS	93
Chandrappa *et al.* (2020)	Retrospective study	Patients with small-to-moderate palatal defects reconstructed with RAFF	Radial Artery Free Forearm Flap (RAFF)	7	PSAS and donor limb sensory testing.	68
Roussel *et al.* (2021)	Longitudinal study	Individuals with phenotypes of DM1	-	23	MIMS, Mini-BESTest , DM1-Activ and LEFS	95
Balcı *et al.* (2016)	Cross-sectional comparative studies	Patients with hemiparesis	-	40	Quick DASH, Simple Shoulder Test, VAS and Semmes-Weinstein monofilaments.	65
Aarthi *et al.* (2021)	Pre and post-Quasi-experimental study without comparative group	Patients with sub-acute stroke	Mirror therapy and modified constraint-induced movement therapy (mCIMT)	30	FMA-UE	75
Novakov (2021)	Cross-sectional study	Women who are undergoing radiation therapy	-	64	DASS-21, FAS, QOLBC, AAQ II	75
Aslam *et al.* (2021)	Quasi-experimental study	Patient with Tennis Elbow at the Kanaan physiotherapy and spine clinic	Extracorporeal Shock Wave Therapy for Tennis Elbow	50	Pain and maximal grip strength	98
Lai *et al.* (2016)	Prospective observational study	Patients with breast cancer	Prospective Surveillance Model (PSM) of Rehabilitation for Breast Cancer Patients	120	QuickDASH	85

Kuttikat *et al.* (2017)	A prospective, observational cohort study	Patients with Chronic upper and lower limb Complex Regional Pain Syndrome (CRPS)	-	47	BPI-sf, NLS, HADS	80
Basdelioglu *et al.* (2020)	Retrospective study	Patients who underwent pseudoarthrosis surgery	Platelet-rich plasma on fracture healing in long-bone pseudoarthrosis	24	LEFS	93
Rae *et al.* (2020)	Single-arm retrospective observational study	Patients with frozen shoulder	Hydrodistension and physiotherapy	90	SPADI and VAS	98
Kolmus *et al.* (2012)	Prospective randomised study	Adults with axillary burns	Splinting	52	BSHS-B questionnaire and GST.	98
Kingston *et al.* (2010)	A retrospective, exploratory study	Patients who had experienced a traumatic hand injury	-	65	-	100
Bell *et al.* (2011)	A descriptive cross-sectional retrospective study	Adult patients who received treatment for a traumatic hand injury	-	498	-	100
Kayabinar *et al.* (2021)	Quasi-experimental study	Teachers that conduct online education during the pandemic	Preventive telerehabilitation for musculoskeletal problems	40	CMDQ, ProFitMap-Neck questionnaire, ODI, BAI, BDI and WLBS	95
Novakov *et al.* (2021)	Cross-sectional study	Women who will be undergoing radiation therapy	-	64	QOL-BC, DASS-21 and MOS-SSS	90
Aljathlani *et al.* (2022)	Cross-sectional study	Patients with upper extremity musculoskeletal disorder	-	109	DASH, GAF, NPRS, RAND-36 and GRC	100
Aytar *et al.* (2015)	Cross-sectional study	Patients with shoulder impingement syndrome (SAIS)	-	93	-	100
Hamilton *et al.* (2013)	Secondary analysis study	Patients with a musculoskeletal disorder	-	239	-	100
Chesworth *et al.* (2014)	prospective longitudinal study	Patient with upper extremities dysfunction	-	17	-	100

Note: (-) not available

Table 2: Clinical utility of the UEFI version in the group of populations

Populations	UEFI	UEFI-15	UEFI Turkish version	UEFI Arabic version
Musculoskeletal disorder	• Heidar Abady *et al.* (2017) • Roussel *et al.* (2021) • Aslam *et al.* (2021) • Kuttikat *et al.* (2017) • Rae *et al.* (2020) • Kingston *et al.* (2010) • Bell *et al.* (2011) • Kayabinar *et al.* (2021) • Chesworth *et al.* (2014)	• Hamilton *et al.* (2013) • Chesworth *et al.* (2014)	• Aytar *et al.* (2015)	• Aljathlani *et al.* (2022)
Breast cancer	• Novakov *et al.* (2021) • Novakov (2021) • Lai *et al.* (2016)			
Post-operative	• Chandrappa *et al.* (2020) • Basdelioglu *et al.* (2020)			
Stroke	• Balcı *et al.* (2016) • Aarthi *et al.* (2021)			
Burn	• Kolmus *et al.* (2012)			

Table 3: Summary of Psychometric properties of UEFI version

	Reliability		Validity			Responsiveness
	Internal Consistency (Cronbach's Alpha)	Test-re-test Reliability (ICC)	Content Validity	Construct Validity	Convergent Validity	
UEFI (Chesworth *et al.*, 2014)	-	0.94	-	-	≥0.6	0.57
UEFI-15 (Chesworth *et al.*, 2014)	-	0.94	-	-	≥0.6	0.58
UEFI Turkish version (Aytar *et al.*, 2015)	0.89	0.80	No floor and ceiling effects	Strong negative correlations with the SPADI (r = -0.6)	-	-
UEFI Arabic version (Aljathlani *et al.*, 2022)	0.96	0.92	No floor and ceiling effects	Strong negative correlations with DASH (r = -0.95)	-	-

Note: (-) not available

Discussion

This study aimed to (1) systematically review the clinical utility of all available versions of the UEFI and (2) investigate the psychometric properties of available versions of the UEFI. The results indicate that 13, 4, 2, 2 and 1 studies clinically utilised UEFI for the musculoskeletal disorder breast cancer, post-operative, stroke and burn populations, respectively. The results answered the first research questions of this review, whereby UEFI was not used only in the musculoskeletal populations, but also in other populations such as breast cancer, post-operative, stroke and burn. Results from this review may provide evidence for researchers and clinicians who plan to utilise UEFI in the populations stated above. To our knowledge, this is the first review investigating the clinical utility of all available versions of UEFI.

The results from this review highlight that all the available versions of UEFI were valid and reliable in the musculoskeletal disorder and breast cancer population, which answered the second research question of this review. However, results from this review showed that there was no evidence found in this review that UEFI was proven valid in the post-operative, stroke and burn populations. Findings from this review on the psychometric properties of UEFI may provide evidence for researchers and clinicians on the validity and reliability of all available versions of UEFI. Although UEFI was only proven valid in the musculoskeletal and breast cancer populations, UEFI also had been used in various clinical populations due to it being easy to administer and time-saving (Arumugam *et al.*, 2018). Future studies are needed to investigate the validity and reliability of UEFI to be clinically utilised in the post-operative, stroke and burn populations. The Rasch analysis did not support the validity of the original UEFI (Hamilton *et al.*, 2013). The UEFI-15 was the most recommended among other versions of UEFI as it is unidimensional: it only measures the upper extremity function and is supported by the Rasch analysis (Chesworth *et al.*, 2014).

The UEFI Arabic version has a higher internal consistency (Cronbach's alpha = 0.96) than the UEFI Turkish version (Cronbach's alpha = 0.89). Both Turkish and Arabic versions of UEFI have excellent internal consistency above 0.8 Cronbach's alpha value (Tavakol *et al.*, 2011). Both UEFI and UEFI-15 have a higher value of test-re-test reliability (ICC = 0.94) than the other versions, where the UEFI Arabic versions value of test-re-test reliability is (ICC = 0.94) and ICC = 0.80 for UEFI Turkish version. However, four versions of UEFI show excellent test-re-test reliability as all their ICC values were above 0.75 (Koo *et al.*, 2016). Both UEFI Turkish and Arabic version shows no floor and ceiling effects. UEFI Arabic version shows strong negative correlations with DASH (r = -0.95), while UEFI Turkish versions also show strong negative correlations with the SPADI (r = -0.6). Both versions show negative correlations between -1.0 to -0.6, which indicates strong negative correlations (Akoglu, 2018). UEFI and UEFI0-15 show a strong correlation with the Upper Extremity Functional Scale (UEFS) $\geq$ 0.6, as supported by Carlson *et al.* (2012); values 0.6-0.79 indicates strong correlations. Only UEFI and UEFI-15 have evidence of responsiveness which shows a similar acceptable value of responsiveness between UEFI and UEFI-15.

UEFI was used in the musculoskeletal disorder population to evaluate patients' perception of their upper extremity function (Hamilton *et al.*, 2013). Aytar *et al.* (2015) and Chesworth *et al.* (2014) support that all UEFI versions were proven valid and reliable for the musculoskeletal disorder population. The Disabilities of the Arm, Shoulder and Hand (DASH) were the most common PROMs used in the musculoskeletal disorder populations that were proven valid and reliable (Armijo-Olivo *et al.*, 2016). DASH and UEFI were reported to have a similar correlation between changes in scores and global ratings in the musculoskeletal disorder populations (Lehman *et al.*, 2010).

According to Novakov *et al.* (2021), UEFI was also one of the PROMs used in breast

cancer populations as an outcomes measure to measure upper extremities functions. Binkley *et al.* (2018) support that the UEFI's original version was proven valid and reliable in the breast cancer population. UEFI has also been used as one of the outcome measures to assess upper extremity function in the breast cancer population in a validation study of the Turkish version of the lymphedema breast cancer questionnaire (Dogan *et al.*, 2022).

Chandrappa *et al.* (2020) reported that UEFI had been used as an outcome measure in post-operative upper extremities patients. Post-operative upper extremities patients usually associate with pain and discomfort on the operation site, which affects their upper extremities function (Shim *et al.*, 2018). UEFI was used to evaluate postoperative upper extremities function and assess any improvement after a few weeks of rehabilitation (Mahdavian Delavary *et al.*, 2012). UEFI has also been used as an outcomes measure in stroke populations (Balcı *et al.*, 2016). UEFI may benefit stroke patients and clinicians to identify changes in the patient's upper extremities functions on the affected limbs (Aarthi *et al.*, 2021).

A study by Kolmus *et al.* (2012) reported that UEFI had been used in Burn populations to assess the affected upper extremities functions. Burn injury in the upper extremity may result in complications such as hypertrophic scar affecting the Range of Motion (ROM) on the joints, which may reduce the affected upper extremity function (Pruitt *et al.*, 2012). Therefore, UEFI is used in the burn population to assess upper extremity function and any improvement post-rehabilitation (Evers *et al.*, 2010).

One of this review's limitations was that it only included English language studies in the selection process. The second limitation of this review was that it only used six (6) databases for the search process of the included studies. The third limitation of this review was that the study selection only was done by the first author. Future research should consider studies published in other languages to be included in the review. Thus, more numbers of possible included studies can be found in the future review. Besides, more databases need to be used for a comprehensive search, so there are higher chances of having more studies in the review. Finally, in future, study selection should be made by all authors to reduce the potential of bias and improve the rigour of findings.

Conclusion

The clinical utility of UEFI is primarily used in the musculoskeletal disorder population. UEFI is also used in breast cancer, post-operative, stroke and burn populations to assess upper extremity functions. All available UEFI version was proven reliable and valid. UEFI-15 is recommended among all versions of UEFI as it is unidimensional and was supported by Rasch analysis. This review highlights the evidence of the UEFI's clinical utility and psychometric properties. This study suggests that all available versions of UEFI have excellent psychometric properties and can be used with various populations. Future cross-cultural translation and validation of UEFI or UEFI-15 into other languages are needed to avoid any pitfalls that threaten validity.

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References

Aarthi, C., S, J. A., Kaviraja, N., Yuvarani, G., Tharani, G., & Kaviraja, K. (2021). Effects of mirror therapy vs modified constraint-induced movement therapy on the upper extremity in subacute stroke patients. *Bangladesh Journal of Medical Science, 20*(2), 323-329. https://doi.org/10.3329/bjms.v20i2.51542

Akoglu, H. (2018). User's guide to correlation coefficients. *Turkish Journal of Emergency Medicine, 18*(3), 91-93. https://doi.org/10.1016/j.tjem.2018.08.001

Aljathlani, M. F., Alshammari, M. O., Alsuwaygh, M. A., Al-Mutairi, M. S., Aljassir, F. F., Bindawas, S. M., & Alnahdi, A. H. (2022). Cross-cultural adaptation and validation of the Arabic version of the upper extremity functional index. *Disabil Rehabil, 44*(19), 5656-5662. https://doi.org/10.1080/09638288.2021.1947396

Alnahdi, A. H., & Albarrati, A. (2021). The upper extremity functional index: Reliability and validity in patients with chronic obstructive pulmonary disease. *International Journal Environmental Research and Public Health, 18*(20), 10608. https://doi.org/10.3390/ijerph182010608

Armijo-Olivo, S., Woodhouse, L. J., Steenstra, I. A., & Gross, D. P. (2016). Predictive value of the DASH tool for predicting a return to work of injured workers with musculoskeletal disorders of the upper extremity. *Occupational & Environmental Medicine, 73*(12), 807-815. https://doi.org/10.1136/oemed-2016-103791

Arumugam, V., & MacDermid, J. C. (2018). Clinimetrics: Upper extremity functional index. *Journal of Physiotherapy, 64*(2), 125. https://doi.org/10.1016/j.jphys.2018.01.003

Aslam, Z., Zafar, A., Anwar, N., Hayat, M. K., Rana, H., Arslan, M., & Khalid, K. (2021). Extracorporeal shock wave therapy for tennis elbow; a double-blinded randomized clinical trial comparing two different energy levels. *Medical Forum Monthly, 32*(7).

Aytar, A., Yuruk, Z. O., Tuzun, E. H., Baltaci, G., Karatas, M., & Eker, L. (2015). The Upper Extremity Functional Index (UEFI): Cross-cultural adaptation, reliability, and validity of the Turkish version. *Journal of Back and Musculoskeletal Rehabilitation, 28*(3), 489-495. https://doi.org/10.3233/BMR-140545

Balcı, N. C., Dogru, E., Aytar, A., Gokmen, O., & Depreli, O. (2016). Comparison of upper extremity function, pain, and tactile sense between the unaffected side of hemiparetic patients and healthy subjects. *Journal of Physical Therapy Science, 28(7)*.

Basdelioglu, K., Meric, G., Sargin, S., Atik, A., Ulusal, A. E., & Akseki, D. (2020). The effect of platelet-rich plasma on fracture healing in long-bone pseudoarthrosis. *European Journal of Orthopaedic Surgery & Traumatology, 30*(8), 1481-1486. https://doi.org/10.1007/s00590-020-02730-2

Bell, J., Gray, M., & Kingston, G. (2011). The longer-term functional impact of a traumatic hand injury on people living in a regional metropolitan Australian location. *International Journal of Therapy and Rehabilitation 18*, 370-381.

Binkley, J. M., Stratford, P., Kirkpatrick, S., Farley, C. R., Okoli, J., & Gabram, S. (2018). Estimating the reliability and validity of the upper extremity functional index in women after breast cancer surgery. *Clinical Breast Cancer, 18*(6), e1261-e1267. https://doi.org/10.1016/j.clbc.2018.02.008

Black, N. (2013). Patient-reported outcome measures could help transform healthcare. *BMJ, 346*.

Carlson, K. D., & Herdman, A. O. (2012). Understanding the impact of convergent validity on research results. *Organizational Research Methods, 15*(1), 17-32.

Carrozzino, D., Patierno, C., Guidi, J., Berrocal Montiel, C., Cao, J., Charlson, M. E., Christensen, K. S., Concato, J., De Las Cuevas, C., de Leon, J., Eory, A., Fleck, M. P., Furukawa, T. A., Horwitz, R. I., Nierenberg, A. A., Rafanelli, C., Wang, H., Wise, T. N., Sonino, N., & Fava, G. A. (2021). Clinimetric criteria for patient-reported outcome measures. *Psychother Psychosom, 90*(4), 222-232. https://doi.org/10.1159/000516599

Chandrappa, A. B., Batth, R. S., Vasudevan, S., Yellambalase, A. N. R., Kumar, P. N., Reddy, S., & Seles, J. N. (2020). Assessment of functional recovery and subjective donor-site morbidity following radial forearm flap reconstruction in small- to moderate-sized palatal defects. *Craniomaxillofac*

Trauma Reconstr, 13(1), 71-77. https://doi.org/10.1177/1943387520904879

Chesworth, B. M., Hamilton, C. B., Walton, D. M., Benoit, M., Blake, T. A., Bredy, H., Burns, C., Chan, L., Frey, E., Gillies, G., Gravelle, T., Ho, R., Holmes, R., Lavallee, R. L., MacKinnon, M., Merchant, A. J., Sherman, T., Spears, K., & Yardley, D. (2014). Reliability and validity of two versions of the upper extremity functional index. *Physiotherapy Canada, 66*(3), 243-253. https://doi.org/10.3138/ptc.2013-45

Crowe, M. (2013). *Crowe critical appraisal tool (CCAT) user guide*. Conchra House.

Dacombe, P. J., Amirfeyz, R., & Davis, T. (2016). Patient-reported outcome measures for hand and wrist trauma: Is there sufficient evidence of reliability, validity, and responsiveness? *Hand, 11(1)*, 11-21. https://doi.org/10.1177%2F1558944715614855

Dogan, H., Abakay, H., Guc, A., & Karaca, H. (2022). An important tool in lymphedema management: Validation of the Turkish version of the lymphedema breast cancer questionnaire. *Disability and Rehabilitation, 44*(21), 6424-6431. https://doi.org/10.1080/09638288.2021.1963852

Evers, L. H., Bhavsar, D., & Mailander, P. (2010). The biology of burn injury. *Experimental Dermatology, 19*(9), 777-783. https://doi.org/10.1111/j.1600-0625.2010.01105.x

Frost, M. H., Reeve, B. B., Liepa, A. M., Stauffer, J. W., Hays, R. D., & Group, M. F. P. R. O. C. M. (2007). What is sufficient evidence for the reliability and validity of patient-reported outcome measures? *Value in Health, 10*, S94-S105.

Guclu-Gunduz, A., Citaker, S., Nazliel, B., & Irkec, C. (2012). Upper extremity function and its relation with hand sensation and upper extremity strength in patients with multiple sclerosis. *NeuroRehabilitation, 30*(4), 369-374. https://doi.org/10.3233/NRE-2012-0768

Hamilton, C. B., & Chesworth, B. M. (2013). A Rasch-validated version of the upper extremity functional index for interval-level measurement of upper extremity function. *Physical Theraphy, 93*(11), 1507-1519. https://doi.org/10.2522/ptj.20130041

Heidar Abady, A., Rosedale, R., Chesworth, B. M., Rotondi, M. A., & Overend, T. J. (2017). Application of the McKenzie system of Mechanical Diagnosis and Therapy (MDT) in patients with shoulder pain; prospective longitudinal study. *Journal of Manual & Manipulative Therapy, 25*(5), 235-243. https://doi.org/10.1080/10669817.2017.1313929

Kayabinar, E., Kayabinar, B., Onal, B., Zengin, H. Y., & Kose, N. (2021). The musculoskeletal problems and psychosocial status of teachers giving online education during the COVID-19 pandemic and preventive telerehabilitation for musculoskeletal problems. *Work, 68*(1), 33-43. https://doi.org/10.3233/WOR-203357

Kingston, G., Tanner, B., & Gray, M. A. (2010). The functional impact of a traumatic hand injury on people who live in rural and remote locations. *Disability and Rehabilitation, 32*(4), 326-335. https://doi.org/10.3109/09638280903114410

Kolmus, A. M., Holland, A. E., Byrne, M. J., & Cleland, H. J. (2012). The effects of splinting on shoulder function in adult burns. *Burns, 38*(5), 638-644. https://doi.org/10.1016/j.burns.2012.01.010

Koo, T. K., & Li, M. Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of Chiropractic Medicine, 15*(2), 155-163. https://doi.org/10.1016/j.jcm.2016.02.012

Kuttikat, A., Shaikh, M., Oomatia, A., Parker, R., & Shenker, N. (2017). Novel signs and their clinical utility in diagnosing Complex Regional Pain Syndrome (CRPS): A prospective observational cohort study. *Clinical Journal of Pain, 33*(6), 496-502.

https://doi.org/10.1097/AJP.0000000000000434

Lai, L., Binkley, J., Jones, V., Kirkpatrick, S., Furbish, C., Stratford, P., Thompson, W., Sidhu, A., Farley, C., Okoli, J., Beech, D., & Gabram, S. (2016). Implementing the Prospective Surveillance Model (PSM) of rehabilitation for breast cancer patients with 1-Year postoperative follow-up, a prospective, observational study. *Annals of Surgical Oncology, 23*(10), 3379-3384. https://doi.org/10.1245/s10434-016-5315-z

Lehman, L. A., Sindhu, B. S., Shechtman, O., Romero, S., & Velozo, C. A. (2010, Jan-Mar). A comparison of the ability of two upper extremity assessments to measure the change in function. *Journal Hand Theraphy, 23*(1), 31-40. https://doi.org/10.1016/j.jht.2009.09.006

Mahdavian Delavary, B., van der Veer, W. M., Ferreira, J. A., & Niessen, F. B. (2012). Formation of hypertrophic scars: Evolution and susceptibility. *Journal of Plastic Surgery and Hand Surgery, 46*(2), 95-101. https://doi.org/10.3109/2000656X.2012.669184

Novakov, I. (2021). Emotional state, fatigue, functional status and quality of life in breast cancer: Exploring the moderating role of psychological inflexibility. *Psychology, Health & Medicine, 26*(7), 877-886. https://doi.org/10.1080/13548506.2020.1842896

Novakov, I., Popovic-Petrovic, S., Ilincic-Zlatar, S., Tatic, M., & Sevo, M. (2021). What contributes the most to the breast cancer patient's quality of life during the therapy - clinical factors, functional and affective state or social support? *Vojnosanitetski pregled, 78*(4), 445-455. https://doi.org/10.2298/vsp190501024n

Pruitt, B. A., Wolf, S. E., & Mason, A. D. (2012). Epidemiological, demographic, and outcome characteristics of burn injury. *Total Burn Care, 4*, 15-45.

Rae, G. C., Clark, J., Wright, M., & Chesterton, P. (2020, Mar). The effectiveness of hydrodistension and physiotherapy following previously failed conservative management of frozen shoulder in a UK primary care centre. *Musculoskeletal Care, 18*(1), 37-45. https://doi.org/10.1002/msc. 1438

Roussel, M. P., Fiset, M. M., Gauthier, L., Lavoie, C., McNicoll, E., Pouliot, L., Gagnon, C., & Duchesne, E. (2021). Assessment of muscular strength and functional capacity in the juvenile and adult myotonic dystrophy type 1 population: a 3-year follow-up study. *Journal of Neurology, 268*(11), 4221-4237. https://doi.org/10.1007/s00415-021-10533-6

Selcuk, A. A. (2019, Mar). A guide for systematic reviews: PRISMA. *Turk Arch Otorhinolaryngol, 57*(1), 57-58. https://doi.org/10.5152/tao.2019.4058

Shah, H. A., Dritsaki, M., Pink, J., & Petrou, S. (2016). Psychometric properties of Patient Reported Outcome Measures (PROMs) in patients diagnosed with Acute Respiratory Distress Syndrome (ARDS). *Health and Quality of Life Outcomes, 14*(1), 15. https://doi.org/10.1186/s12955-016-0417-7

Shim, H. S., Choi, J. S., & Kim, S. W. (2018). A role for postoperative negative pressure wound therapy in multitissue hand injuries. *BioMed Research International, 2018*, 3629643. https://doi.org/10.1155/2018/3629643

Spearman, C. (1961). "General Intelligence" objectively determined and measured. *The American Journal of Psychology*, *15*(2), 201-292. https://doi.org/10.2307/1412107

Stratford, P. W. (2001). Development and initial validation of the *Upper Extremity Functional Index*. *Physiotheraphy Canada, 52*, 259-267.

Tavakol, M., & Dennick, R. (2011, Jun 27). Making sense of Cronbach's alpha. *International Journal of Medical Education,*

2, 53-55. https://doi.org/10.5116/ijme.4dfb.8dfd

Weldring, T., & Smith, S. M. (2013). Article commentary: Patient-reported outcomes (pros) and patient-reported outcome measures (PROMs). *Health Services Insights, 6*, HSI. S11093.

Wells, G. A., Russell, A. S., Haraoui, B., Bissonnette, R., & Ware, C. F. (2011). Validity of quality of life measurement tools--from generic to disease-specific. *The Journal of Rheumatology Supplement, 88*, 2-6. https://doi.org/10.3899/jrheum.110906