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The Arabic Patient-Rated Elbow Evaluation Questionnaire Has No Floor or Ceiling Effect, and The Items Load on A Three-Factor Structure Using Principal Component Analysis

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ABSTRACT

Background: The Patient-Rated Elbow Evaluation (PREE) is a commonly used self-reported outcome measure in patients with elbow dysfunctions.

Aims: The purpose of this study was to conduct an exploratory factor analysis (EFA) of the newly translated and cross-culturally adapted Patient-Rated Elbow Evaluation-Arabic version (PREE-AR). Also, to examine its floor and ceiling effects.

Patients and Methods: An EFA using the principal component analysis (PCA) method was conducted on a sample of 88 participants with elbow pain. The oblique (nonorthogonal) rotation method was used. The Eigenvalue of 1.00 was used as a cutoff point to retain a factor. A scree plot was produced to visually examine the eigenvalues. Item loading on factors with a value greater than 0.4 was considered enough to show a satisfactory inclusion in the structure. A floor or a ceiling effect was considered to be present if more than 15% of participants scored at the lowest or the highest scores respectively.

Results: The Kaiser-Meyer-Olkin (KMO) value of 0.891 with Bartlett's test of sphericity ($P<0.001$) justified the appropriateness of running the factor analysis. The analysis produced a three-factor structure which accounted for 66% of the total variance. Most of the "function" items loaded on factor number1 with less loading of the "pain" items of the three-factor structure. All participants scored outside the 15% threshold of the highest and the lowest total score of the questionnaire.

Conclusion: The newly adapted PREE-AR items are loaded on a three-factor structure and the questionnaire does not have a floor or a ceiling effect.

Keywords: factor analysis, principal component analysis, floor effect, ceiling effect

INTRODUCTION

Quantification of pain and function is increasingly important in musculoskeletal physical therapy practice. Patient-reported outcome measures provide an insight into the nature of the condition in the patient's own words which enables caregivers to accurately address the patient's needs and make the patient more actively involved in clinical decision-making [(1-5)].

Self-reported outcome measures for the elbow joint are many with the patient-rated elbow evaluation (PREE) being more specific for elbow pathologies. The PREE was developed by MacDermid [(6)] in 2001 to fill the gap in the outcome measures for elbow pain and disability and to quantify pain and function in patients with different elbow pathologies. It has 20 items; 5 items for pain and 15 for function divided into two subsections: specific and usual functional activities. The total score of the questionnaire is 200 and the higher the scores, the worse the outcome [(6)].

Since the International Classification of Functioning, Disability, and Health [(7)] (ICF) was introduced in the early 2000s, it was important to align outcome measures to the criteria outlined in the ICF classification scheme and to have a common functional language representing each disorder. It was reported that the original English version of the PREE is aligned with the framework of the ICF and with the core sets for elbow conditions [(7)].

The English PREE had excellent test-retest reliability (intraclass correlation coefficient (ICC)=0.95) and has been reported to be valid and reliable [(6)]. There is no report, however, on the internal consistency of the English PREE in patients with elbow conditions to the authors' knowledge.

Different versions of the PREE are available: German [(8)], French [(9)], Japanese [(10)], Persian [(11)], and Turkish [(2)], with some reports on its psychometric properties. Recently, the questionnaire was also cross-culturally adapted and translated into the Arabic language [(12)].

Exploratory factor analysis (EFA) is a widely used statistical method of data reduction. In questionnaire or self-reported outcome measure, it can be used to better show how multiple items of a questionnaire load or unload on a shortened version of a structure [(14)]. To the author's knowledge, factor analysis was performed only for the Japanese version of the PREE [(15)], but the type of

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that analysis was principal axis factoring, not a principal component analysis like the one performed in the current study. A Rasch analysis was also performed for the original English version of the PREE [3].

AIM OF THE STUDY

The purpose of this study is to perform an EFA to the newly cross-culturally adapted Arabic version of the patient-rated elbow evaluation (PREE-AR). The floor and ceiling effects of the PREE-AR were also examined in this study.

PATIENTS AND METHODS

A previous study by the same authors of this one performed the cross-cultural adaptation and the translation of the PREE, which can be found in appendix I. The same study also examined its psychometric properties [12]. This cross-sectional analysis was an extension of the previous study to further examine the properties of the PREE-AR. It was performed on 88 patients with different elbow pathologies after obtaining their consent to participate. The study was conducted at the Faculty of Physical Therapy, Cairo University, Egypt.

Subjects' inclusion criteria were: Arabic-speaking male and female patients with ages between 20 and 50, who have chronic, mechanical, and/or overuse elbow pain of at least three months duration. Patients were excluded otherwise. Subjects were contacted and asked to fill out the PREE-AR. They either were seen physically or were asked to fill out the questionnaire via an online link sent to their emails.

Ethical consideration:

The study has been approved by the Institutional Review Board (IRB) of the Faculty of Physical Therapy, Cairo University, Egypt, approval number: P.T.REC/012/003556. The participants signed an informed consent form before the data collection. The procedure reported in the manuscript was performed following the ethical standards of the Helsinki Declaration [13] of 1975 for studies involving human subjects.

Statistical analysis

For factor analysis, EFA using principal component analysis (PCA) was conducted using the statistical package for social sciences (SPSS) computer program version 27 software for Windows (IBM SPSS Inc., Chicago, IL, USA). The Eigenvalue of 1.00 was set as a cutoff to exclude or include factor (retained if Eigenvalue greater than 1.00). A visual interpretation of the factors was performed by using a scree plot to visually examine the eigenvalues [16]. The number of dots before which the line breaks or changes from vertical to horizontal is usually the number of the retained factors [14].

An oblique (nonorthogonal) rotation method (oblimin) was then conducted to further clarify factor rotation. This was chosen because we hypothesized that pain and function items of the questionnaire would hypothetically be correlated with one another and consequently the produced factors would be correlated with one another. Item loading on a factor with a value greater than 0.4 was considered enough to show a satisfactory inclusion in the structure [14].

For floor and ceiling effect, it was calculated as the number of patients who scored within 15% of the lowest and highest values of the total questionnaire score respectively. A floor or a ceiling effect is considered to be present if more than 15% of patients scored the lowest or the highest scores [17].

RESULTS

Subject baseline characteristics are shown in table **1**. For factor analysis, the Kaiser-Meyer-Olkin value was 0.891 with a highly significant Bartlett's test of sphericity ($P<0.001$). This justified the appropriateness of running EFA since the intercorrelation between the questionnaire items is high. The analysis produced a three-factor structure which accounted for 66% of the total variance with loading between 0.131 and 0.902. The cumulative percentage of extraction sums of squared loadings showed that the three-factor structure has the highest factor loading.

Factor **1** explained 49.5% of the variance, factor 2 explained 10% of the variance, and factor 3 explained 6.4% of the variance. All the factors explained 66% of the variance. These three factors were retained because the Eigenvalue was greater than 1.00. Items loading on the three-factor structure are presented in table **2**. The factor correlation matrix shows a low to moderate correlation between the three-factor solutions. The correlation ranged between 0.324 and 0.445 (table **3**).

Regarding floor and ceiling effects, the PREE-AR does not seem to have any of the effects since all 88 participants scored outside the 15% threshold of the highest and the lowest total score of the questionnaire.

Table (1): Baseline characteristics of participants (n=88)

Gender distribution	64% females, 36% males
Affected elbow	40% right, 27% left, 33% both
Medication received	56% none, 25% pain medications, 15% NSAIDs*, 4% other medications
Type of treatment received	97% non-surgical, 3% surgical

*__NSAIDs:__ non-steroidal anti-inflammatory drugs

Table (2): Pattern matrix. Rotation method: Oblimin with Kaiser normalization (reporting only items with high loading on each factor)

Questionnaire item	Factor 1	Factor 2	Factor 3	Communality
Item 16	0.914			0.773
Item 13	0.863			0.711
Item 14	0.845			0.749
Item 15	0.814			0.771
Item 10		0.858		0.824
Item 4		0.843		0.719
Item 1			0.765	0.587

Table (3): Factor correlation matrix

Component	Factor 1	Factor 2	Factor 3
Factor 1	-	0.413	0.445
Factor 2	0.413	-	0.324
Factor 3	0.445	0.324	-

DISCUSSION

Understanding the psychometric properties of new outcome measures is an essential component in analyzing the usefulness of their usage [14,17]. Factor analysis was performed to explore if the questionnaire items can be meaningfully clustered into smaller factors and to investigate the loading of the items on the factors

The choice of the rotation method in the PCA is to simplify and clarify the questionnaire items and to show how they load on the produced structure. The oblique (nonorthogonal) method of rotation such as "direct oblimin" and "promax" is best when the items are somehow correlated. On the other hand, an orthogonal method of rotation such as "varimax" should be used when the items do not seem to be correlated [14]. Since the items of the PREE are pain and function, the choice of a nonorthogonal (oblique) rotation method was prioritized.

Using an oblique rotation method, an author recommended that data should be examined in the structure rather than the pattern matrix since the structure matrix shows the item-factor correlation and can be easily interpreted [17].

Another author [14], recommend reporting the pattern matrix over the structure matrix since it shows the factor loading of each item with each factor structure which is considered the actual regression coefficient and indicates how much variance is explained by each item in the factor. In the current study, we reported the values of the pattern matrix as we felt it accurately defines the relationship between the item loading and the factor structure.

Most of the items loaded on the factors were related to the "function" component of the PREE-AR questionnaire. The higher loading was for the "specific activities" items of the questionnaire which loaded heavily on factor number 1. Pain items of the questionnaire partially loaded on factors 2 and 3 with lower values. This may be explained by the fact that "pain" items in the questionnaire are few; only 5 items for pain versus 15 items for the function. Although two items of the pain loaded heavily on factor number 2 with values of 0.834 and 0.726, other items showed weak loading on the factor structure.

The result of this work should be interpreted with caution since a small sample size would not efficiently produce an accurate factor analysis. The larger the sample size, the more accurate representation of the factor analysis would be. While, **Fabrigar *et al.*** [18] and **MacCallum *et al.*** [19] reported tha the sample size for factor analysis should be based on the nature of the data; the more the data have high communalities in the analysis, the smaller the sample size needed. The communalities are considered high when the value is 0.8 or greater (which rarely occurs).

In the cross-cultural adaptation of self-reported outcome measure, however, the best-reported method for sample size calculation would be the subject-to-item ratio. Some studies report that the needed sample should be 10 subjects per questionnaire item [14], other reports 20, 5, or 2 subjects per item [10,20,21]. In factor analysis studies, "the more is better" [14].

As a rule, a factor with fewer than 5 items with a score of less than 0.5 is considered a weak factor structure [14]. In the current analysis, the three produced factors have more than 5 items with a score higher than 0.5 which substantiated the model produced by the analysis. The three-factor structure is considered solid according to this interpretation although the item loaded primarily on the first factor with less loading on factors 2 and 3.

It is also important to highlight that the nature of factor analysis is exploratory and not inferential. Factor analysis is designed to explore data of a given item questionnaire. It should not be interpreted in the sense of testing hypotheses. It, therefore, should not be used to infer substantive conclusions relative to testing hypotheses. In the same sense, it is subjected to errors if the procedure is not conducted correctly if missing data is present if the sample size is extremely small, and/or if the correct extraction and/or rotation method is not used. If a decisive conclusion is an aim, then other forms of analysis such as confirmatory factor analysis (CFA) should be used. The CFA is more helpful in testing an already established instrument and provides more decisive conclusions [14].

LIMITATION OF THE STUDY

The result of this study should be interpreted with caution since a small sample size may produce a less accurate conclusion of the factor analysis.

CONCLUSION

This study extracted a three-factor structure for the Arabic version of the patient-rated elbow evaluation questionnaire. The "function" items of the questionnaire loaded heavily on factor 1 with less representation of the "pain" items of the questionnaire in the factor structure. The PREE-AR does not have a ceiling or a floor effect.

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REFERENCES

1. **Kane S, Lynch J, Taylor J (2014):** Evaluation of elbow pain in adults. Am Fam Physician, 89(8):649-57.
2. **Kanik Z, Pala O, Karabicak G *et al*. (2019):** Cross-cultural adaptation, validity, and reliability of the Turkish version of the Patient-Rated Elbow Evaluation. Clin Rheumatol., 38(11):3289-95.
3. **Vincent J, MacDermid J, King G *et al*. (2013):** Validity and sensitivity to change of patient-reported pain and disability measures for elbow pathologies. J Orthop Sports Phys Ther., 43(4):263–274
4. **Longo U, Franceschi F, Loppini M *et al*. (2008):** Rating systems for evaluation of the elbow. Br Med Bull., 87(1):131–161.
5. **Patrick D, Burke L, Powers J *et al*. (2005):** Reliability and construct validity of the SF-36 in Turkish cancer patients. Qual Life Res., 14(1):259–264.
6. **MacDermid J (2001):** Outcome evaluation in patients with elbow pathology: issues in instrument development and evaluation. J Hand Ther., 14(2):105–114.
7. **Vincent J, MacDermid J, King G *et al*. (2015):** Linking of the Patient Rated Elbow Evaluation (PREE) and the American Shoulder and Elbow Surgeons – Elbow questionnaire (pASES-e) to the International Classification of Functioning Disability and Health (ICF) and Hand Core Sets. J Hand Ther., 28(1):61-68.
8. **John M, Angst F, Pap G *et al*. (2007):** Cross cultural adaptation, reliability and validity of the patient rated elbow evaluation (PREE) for German-speaking patients. Clin Exp Rheumatol., 25(2):195.
9. **Beauchemin G, MacDermid J, Bourduas K *et al*. (2015):** Translation and validation of the PREE (Patient Rated Elbow Evaluation) to a French version. Orthop Traumatol Surg Res., 101(4):405-9.
10. **Hanyu T, Watanabe M, Masatomi T *et al*. (2013):** Reliability, validity, and responsiveness of the Japanese version of the patient-rated elbow evaluation. J Orthop Sci., 18(5):712–719.
11. **Farazdaghi M, Mansoori A, Vosoughi O *et al*. (2017):** Evaluation of the reliability and validity of the Persian version of Patient-Rated Elbow Evaluation questionnaire: Rheumatol Int., 37:743–750.
12. **Abdelmegeed M, Awad C, MacDermid J *et al.* (2022):** The patient-rated elbow evaluation was successfully translated into the Arabic language. https://doi.org/10.1016/j.jht.2022.09.006
13. **World Medical Association (2013).** World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. Jama., 310(20), 2191-2194.
14. **Costello A, Osborne J (2005):** Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. Pract Assess Res eval., 10(1):7.
15. **Hanyu T, Watanabe M, Masatomi T *et al*. (2013):** Reliability, validity, and responsiveness of the Japanese version of the patient-rated elbow evaluation. J Orthop Sci., 18(5):712–719.
16. **Domholt E (2005):** Rehabilitation Research: Principles and Applications. 3rd ed. St Louis, MO: Elsevier.
17. **Cronk B (2017):** How to use SPSS®: A step-by-step guide to analysis and interpretation. Routledge.https://books.google.com/books/about/How_to_Use_SPSS.html?id=QOw9DwA…
18. **Fabrigar L, Wegener D, MacCallum R *et al*. (1999):** Evaluating the use of exploratory factor analysis in psychological research. Psychological Methods, 4(3), 272-299.
19. **MacCallum R, Widaman K, Zhang S *et al*. (1999):** Sample size in factor analysis. Psychological Methods, 4(1), 84-99.
20. **Domazet I, Nemir J, Barl P, Đurić KS, Pašalić I, Barić H, Stančić M (2018):** Validation of the Croatian version of the Oswestry Disability Index. European Spine Journal, 27(11):2814-22.
21. **Pickering P, Osmotherly P, Attia J, McElduff P (2011):** An examination of outcome measures for pain and dysfunction in the cervical spine: a factor analysis. Spine, 36(7):581-8.

Appendix I: The Patient-Rated Elbow Evaluation-Arabic

PREE-AR (Abdelmegeed et al.)[12]

تقييم المريض لمفصل المرفق

الاسم: ---------- ---------- التاريخ : ----------

*الاسئلة أدناه ستساعدنا على فهم مقدار الصعوبة التي واجهتها في مفصل الكوع (المرفق) خلال الاسبوع الماضي. سوف تصف **متوسط** الاعراض لمفصل الكوع (المرفق) **خلال الاسبوع الماضي** على مقياس مرقم من صفر الى١٠ .*

١ -الألـــــم

قم بتقييم متوسط مقدار الألم في مفصل الكوع (المرفق) **خلال الأسبوع الماضي** بوضع دائرة على الرقم الذي يصف مقدار الألم بأفضل شكل على مقياس من صفر الى ١٠ **.الصفر** (٠) يعنى **أنك كنت لا تعاني من أي ألم** والعشرة (١٠) تعنى أنك كنت تعاني من **أسوأ ألم واجهته على الاطلاق.**

قيم ألمك	لا ألم	الاسوأ على الاطلاق
1. في أسوأ حالاته	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠	
2. عند الراحة	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠	
3. عند رفع شيء ثقيل	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠	
4. عند عمل نشاط يتطلب حركة متكررة بالمرفق	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠	
5. كم مرة غالبا يكون عندك الم	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠	
	ابدا	**دائما**

تعليقات:

٢- الإعاقات الوظيفية

أ) أنشطة محددة

قيم مدى الصعوبة التي عانيتها عند أدائك كل من العناصر المدرجة ادناه، خلال الاسبوع الماضي، بوضع دائرة حول الرقم الذي يصف بأفضل شكل مدى الصعوبة على مقياس من صفر الى ١٠. الصفر (٠) يعنى أنك لم تواجه أي صعوبة والعشرة (١٠) تعنى انه كان صعب جدا ولم تكن قادرا على ادائه على الاطلاق.

لا صعوبة **غير قادر على فعله**

6. أمشط شعري	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠
7. اكل بشوكه او ملعقة	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠
8. أسحب شيء ثقيل	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠
9. استخدم ذراعي لأنهض من الكرسي	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠
10. أحمل شيء يزن ١٠ ارطال (٤,٥ كجم) وذراعي يكون بجانبي	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠
11. ارمي شيء صغير ككره المضرب	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠
12. استخدم الهاتف	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠
13. أقفل الازرار الامامية لقميصي	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠
14. اغسل ابطي المقابل	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠
15. اربط حذائي	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠
16. أدير مقبض الباب وافتح الباب	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠

ب) أنشطة معتادة:

قيم مدى الصعوبة التي عانيتها عند أداء أنشطتك المعتادة لكل من العناصر المدرجة ادناه، على مدار الاسبوع الماضي، من خلال وضع دائرة على الرقم الذي يصف بأفضل شكل مدى الصعوبة على مقياس من صفر الى ١٠. نقصد(بالأنشطة المعتادة) تلك الانشطة التي كنت تؤديها قبل ان تبدأ لديك مشكلة بالمرفق. الصفر (٠) يعنى أنك لم تواجه أي صعوبة والعشرة (١٠) تعنى انه كان صعب جدا ولم تكن قادرا على اداء أي من أنشطتك المعتادة.

17. الأنشطة الشخصية (ارتداء الملابس، الاستحمام/الاغتسال)	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠
18. الأعمال المنزلية (التنظيف، الصيانة)	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠
19. العمل (وظيفتك او الاعمال اليومية)	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠
19. الأنشطة الترفيهية	٠ ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ١٠