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Research Article

Cross-Cultural Adaptation and Measurement Properties of the Arabic Version of the Modified Cinccinati Knee Rating System (MCKRS)

Khaja AF[1*], Al-Samhan A[1], Hussain AA[1], Al-Awadh M[1], Mandani OW[1], Hanna SS[1]

[1]Al Razi Orthopedic Hospital, Kuwait

[*]**Corresponding Author:** Aliaa F Khaja, Al Razi Orthopedic Hospital, Kuwait; Email: aliaa.khaja@gmail.com

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Abstract

Objectives: The Modified Cincinnati Knee Rating System (mCKRS) was designed as an outcome measure to help clinicians gather information about the clinical and functional outcomes of patients after knee surgery. It applies to various knee conditions.

Design: Our goal was the translation of the mCKRS to the Arabic language followed by the investigation of its psychometric properties as well as test of its floor/ceiling effects, validity, reliability, and internal consistency.

Method: Fifty-seven patients participated in two occasions at the baseline and the follow-up after 2 weeks. We tested for internal consistency with Cronbach's α. We calculated Spearman's correlation as a means of estimating construct validity in comparison to the Arabic Knee injury and Osteoarthritis Outcome Score (KOOS). Also, the responsiveness of the mCKRS questionnaire was measured by calculating the standardized response mean (SRM).

Results: Overall, the Arabic mCKRS at the baseline had a Cronbach's α of 0.792, and 0.820 at the follow-up, which was very high and internally consistent. Intra Class correlations (ICC) indicated that the mCKRS questionnaire is reliably reproducible, while Standardized Response Mean (SRM) of the questionnaire with 1.30. This illustrates a high degree of sensitivity regarding the change. Also, we observed a strong correlation with Arabic KOOS ($r = 0.760$, $p < 0.001$), indicating that the construct validity was good. Also, all the subscales, except swelling, proved to have a high correlation with Arabic KOOS ($r > 0.70$). We did not observe any major floor and ceiling effect among all responses.

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Conclusion: From the results of the study, we can confidently say that the Arabic version of the mCKRS is reliable for diagnosis of knee injuries and produces results similar to those of the original English version.

Keywords

International Knee Documentation Committee (IKDC); Subjective Scale; Complex Knee Disorders; Modified Cincinnati Knee Rating System; Outcome Scores; Questionnaire

Introduction

Fifty percent of injuries to the knee involves the Anterior Cruciate Ligament (ACL). Statistically, this represents over 120,000 cases yearly in developed climes like the United States [1,2]. Anterior cruciate ligament injuries may result in serious consequences, such as recurrent swelling and pain, instability, meniscal injuries, and osteoarthritis [3,4].

Rehabilitation mainly involves assisting the patient to recover after surgery completely [5]. The process can be monitored through imaging tests, functional and clinical tests, and questionnaires [1]. The Modified Cincinnati Knee Rating System (mCKRS) is one of the instruments that can be used to monitor how effective the rehabilitation is after ACL Reconstruction patients [6-8]. The mCKRS assists with the evaluation of changes in clinical condition following surgery and other treatments and is very sensitive in the detection of these changes [9-11].

A study was conducted by Risberg et al., to investigate the effectiveness of the CKRS and other instruments in patients who had undergone reconstruction of the ACL [12]. The patients were also assessed at different points in time within a two-year time frame. Only the CKRS was sensitive enough to detect the clinical changes over the specified timeline [12]. This may explain why this tool is widely used in ACL injury-related studies [10,11,13-15].

CKRS can be used for the assessment of other knee defects and has equally served as a reference tool for the design and validation of other assessment instruments [16-21]. Studies conducted by Laboute et al., and Hoher et al., showed that the PPLP scoring scale was developed from the CKRS [6,22].

To the best of our knowledge, the CKRS has only been translated into the Brazilian-Portuguese language and this places a limit on its usage and comparison of results between studies [23]. For clinical research and practice, the best instruments to use are those whose validity for population interest has been proven. Thus, instruments that have been validated and adapted should be utilized. The measurement properties of these instruments bear semblance to the original [24]. The mCRKS is relevant clinically and scientifically and thus justifies the need to cross-adapt it into Arabic, allowing Arabic countries to utilize an accurate, and low-cost

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questionnaire that can assess the functionality of the knee and also observe the rehabilitation progress after injury or reconstruction of the ACL as well as other knee pathologies.

We, therefore, sought to cross-culturally adapt the CKRS into Arabic while also investigating its reliability and validity.

The Knee Injury and Osteoarthritis Outcome Score (KOOS)

There is a close relationship between KOOS and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) [25]. It is important to note that KOOS is an extension of WOMAC. The development of KOOS as well as its validation was targeted at young patients with injury or osteoarthritis of the knee [26].

It is a self-administered and self-explanatory questionnaire consisting of 42 items that cover five patient-related dimensions namely pain, ADL function, Other Disease-Specific Symptom, Sport and Recreation, and knee-related quality of life. Assignment of scores is dependent on a Likert scale system. Items have five options with scores ranging from 0 (No Problems) to 4 (Extreme Problems). Each score is a sum of the items included. The scores are then transformed to a scale of 0-100. On the scale, zero represents complex knee problems, while 100 represents no problems at all.

Methods

The translation was done according to guidelines by Guillemin, and also after obtaining permission from the copyrights holder of the original CKRS [27]. The original version was translated by two bilingual orthopaedic surgeons. An independent translation company produced two other versions. There was a similarity in all the versions produced. We did the necessary modifications to incorporate from every version and then implemented in the final version. A thorough review was conducted by an Arabic grammar checker. We received a score close to the original. We then carried out a pilot test on ten patients. The patients were selected randomly. We did this after the Arabic version had been approved by the translation committee. The patients were also interviewed by the physicians after successful completion of the questionnaire.

Over 57 knee patients took part in the study. What we considered as inclusion criteria were ability to write and read Arabic, age 21, and symptoms lasting for over 4 weeks.

We evaluated internal consistency via calculation of Cronbach's α. The internal consistency determines the extent to which various items in a particular questionnaire measure similar construct of interest [28]. As the stated in the literature, α value greater than 0.70 is acceptable, while anything above 0.95 would indicate redundancy [29].

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Also, the test-retest stability was assessed by the Intraclass Correlation Coefficient (ICC) to investigate the reproducibility of the results. If ICC was equal or greater than 0.7, the Arabic mCKRS's reliability was considered to be acceptable [30].

The construct validity indicates whether the questionnaire serves its purpose. With respect to knee conditions, do these questions measure the complaints common to knee injuries? [28].

We tested the Arabic mCKRS construct by examining its relationship with KOOS, a gold-standard questionnaire. This led us to calculate Spearman's correlation coefficient between KOOS and Arabic mCKRS. A high correlation coefficient proves the construct validity of the mCKRS. Also, we determined the accuracy of the measurement by calculating the ceiling and floor effects. The ceiling effect refers to the percentage of those with a score of 48 (high) while the floor effect refers to the percentage of patients with a very low score (0 possibly). The effects would be deemed relevant if over 15% of the respondents had ceiling or floor effect.

We performed the calculations with the 2019 version of Microsoft Excel, GraphPad Prism v.8 and IBM SPSS v. 26.

Results

57 patients were involved in the study. All the patients filled the KOOS and mCKRS questionnaires. They also accepted that we analyse their data for research purposes. Of the total participants, 64.9% were male while 35.1% were female. Average age of the participants was 33 years, with an SD of 8 years. This implies that a greater proportion of the sample was between 25 and 41 years of age. The least age was 21 years while the oldest was 48 years. According to Table 1, Standard deviations, mean, minimum, maximum, and ceiling/floor effects were calculated. mCKRS subscales appear to have a ceiling/floor effect of no more than 3%, indicating that the measurement is accurate.

	Baseline		Follow-Up		Mean Change	SRM	Floor Effect	Ceiling Effect
	Mean	SD	Mean	SD				
Pain	1.53	0.90	2.0	0.8	0.47	1.02	0%	1%
Swelling	1.95	0.96	2.0	0.5	0.05	1.33	0%	1%
Giving Way	2.32	1.20	2.5	0.9	0.18	0.78	1%	2%
Overall Activity Level	2.23	1.31	2.6	0.9	0.37	0.88	0%	0%
Walking	2.35	1.25	3.0	1.0	0.65	1.20	0%	0%
Stairs	2.05	1.22	2.5	0.6	0.45	0.93	2%	2%
Running Activity	2.44	1.23	2.5	0.9	0.06	0.40	2%	3%

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Jumping or Twisting	2.46	1.23	2.6	0.8	0.14	0.64	2%	3%
Overall Arabic mCKRS	48.8	19.1	59.5	15.3	10.7	1.3	2%	1%

Table 1: Descriptive analysis of demographic and the scores of mCKRS, including floor and ceiling effects and Standardized Response Mean (SRM).

We estimated the reliability of the questionnaire by calculating the internal consistency, which was done by using the Cronbach's alpha of 0.792 at the baseline and 0.820 at the follow-up (after 2 weeks), indicating a high degree of internal consistency. Also, the reproducibility of the questionnaire is tested by the test-retest method. For this purpose, the Intra-class Correlation Coefficient (ICC) of each construct is calculated. As shown in Table 2, all constructs have an ICC greater than 0.70.

In Table 1, the responsiveness of the mCKRS subscales is calculated and shown. The results indicate that the questionnaire as a whole has a standardized response mean of 1.30, which is high. This shows that the Arabic version of mCKRS is very sensitive to changes. mCKRS proved to be especially sensitive to changes regarding Swelling (SRM = 1.33), Pain (SRM = 1.02) and Walking (SRM = 1.20). Running activity has the lowest responsiveness in comparison to other subscales of mCKRS.

	Baseline	**Follow-Up**		**ICC**	**p**	
	Mean	**SD**	**Mean**	**SD**		
Pain	1.53	0.90	2.0	0.8	0.80	< 0.001
Swelling	1.95	0.96	2.0	0.5	0.82	< 0.001
Giving Way	2.32	1.20	2.5	0.9	0.75	0.003
Overall activity level	2.23	1.31	2.6	0.9	0.90	< 0.001
Walking	2.35	1.25	3.0	1.0	0.70	0.002
Stairs	2.05	1.22	2.5	0.6	0.82	< 0.001
Running activity	2.44	1.23	2.5	0.9	0.80	< 0.001
Jumping or Twisting	2.46	1.23	2.6	0.8	0.73	0.003
Overall Arabic mCKRS	48.8	19.1	59.5	15.3	0.72	0.005

Table 2: Mean score (Standard deviation) of constructs of mCKRS and intraclass correlations at baseline and follow-up.

To validate the Arabic mCKRS assessment, KOOS is employed as the gold standard. As seen in Table 3, Spearman's correlation is presented to measure the level of association of mCKRS

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and KOOS, as well as its construct validity. According to Table 3, we see that subscales of Arabic mCKRS have a significant statistic correlation. The correlation with pain is especially high ($r = 0.820$; $p < 0.001$), and Stairs ($r = 0.760$; $p = 0.004$). With a correlation coefficient of 0.760 ($p < 0.001$), Arabic mCKRS proved to be highly correlated with the Arabic KOOS questionnaire as a whole.

Overall Arabic KOOS		**p-value**
Pain	0.82	< 0.001
Swelling	0.64	0.020
Giving Way	0.70	0.003
Overall activity level	0.75	< 0.001
Walking	0.72	< 0.001
Stairs	0.76	0.004
Running activity	0.69	0.010
Jumping or Twisting	0.75	< 0.001
Overall Arabic mCKRS	**0.76**	**< 0.001**

Table 3: Spearman's Correlation Coefficients indicating the validity of Arabic mCKRS.

Discussion

The Arabic mCKRS has proven to be a valid instrument with good measurement properties. It can be employed in the Arabic population. Apart from ours, the only translation of the CKRS to another language has been the Brazilian-Portuguese language [23]. The results of this study may present as a basis for further translations and validations of the mCKRS. We presented more information on construct validity and internal consistency for the mCKRS.

Using an approach similar to the original CKRS, the Arabic mCKRS presented superior or similar measurement properties compared to the original CKRS. The subscales "sports function," "Symptoms rating," and "Occupational rating," were thought to be below ideal internal consistency. This may be because only three to four questions were composed, with the possibility of redundancies in each of these subscales. However, upon analyzing the internal consistency of the Arabic mCKRS, the results were considered adequate. There is the possibility that the mCKRS may have to be interpreted as a whole instead of a pool of subitems of subscales.

For the construct validity, the Arabic mCKRS proved to be strongly correlated with a coefficient of 0.760 ($p < 0.001$) with the Arabic KOOS questionnaire.

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With regards to floor and ceiling effects, no relevant effect was observed among the responses. All constructs had an interclass correlation score that was above 0.70, with similar levels of reliability when compared to the original CKRS. While we observed no floor or ceiling effects in the Arabic CKRS, the original version had a floor effect varying from 0 to 37% and a ceiling effect varying from 0 to 76% [9]. The differences in the floor and ceiling effects between the original and the translated Arabic version may be due to how the analysis was performed. The original version did analyze the floor and ceiling effects for each question of the first section. This approach to the analysis may have contributed to the increase in the number of maximum and minimum scores, thus directly influencing the floor and ceiling effect results.

In this study, we used only the Arabic mCKRS for patients with ACL injury and other knee injuries. There is a need for future studies with longer follow-ups to fully understand the properties that relate to responsiveness.

Conclusion

After the translation and validation process, the Arabic mCKRS was considered a valid instrument with reliable diagnostic tools. It is suitable for use in the Arabic population for the assessment and monitoring of recovery from knee injuries after surgery.

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