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Original Article

Development of the Persian Version of Knee Outcome Survey Activities for Daily Living Scale

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What's Known

- Patient-reported outcome measures allow therapists to evaluate the effects of management from patients' vantage point.
- Knee outcome survey (KOS) is a widely used scale to measure the consequences of knee osteoarthritis. It is designed to evaluate the functional status following a knee injury.

What's New

- The Persian version of the knee outcome survey activities of daily living (KOS-ADL) scale is a valid and reliable measure to assess the functional limitation experienced by patients with different severity of knee osteoarthritis.

Abstract

Background: The knee outcome survey-activities of daily living (KOS-ADL) scale is a self-reported measure to determine knee function and symptoms in individuals suffering from a variety of knee disorders. The present study aimed to assess the validity, reliability, and cross-cultural adaptation of the Persian version of the KOS-ADL scale.

Methods: In this cross-sectional and psychometric study, 130 patients (14 men and 116 women) with different grades of knee osteoarthritis were recruited. The construct validity of the scale was examined through the correlation between the domains of KOS-ADL and the subclasses of the knee injury and osteoarthritis outcome score (KOOS). To assess the test-retest reliability, 40 of the participants were requested to fill in the questionnaire again with an 8-day interval. The internal consistency of the questionnaire and its subclasses was evaluated with Cronbach's alpha coefficient. To evaluate construct validity, concurrent construct validity was examined with a correlation matrix using Pearson's correlation coefficients between the KOS-ADL domains and KOOS total score and subclasses. The test-retest reliability was analyzed using the intra-class correlation coefficient (ICC). The Kappa coefficient was used to determine the intra-rater agreement.

Results: The Persian version of the KOS-ADL scale had good reliability (ICC=0.79) and internal consistency (α=0.92). There was a good correlation between the KOS-ADL total score and KOOS subclasses ($r \geq 0.71$, $P \leq 0.001$).

Conclusion: The Persian version of the KOS-ADL scale is a valid and reliable instrument to evaluate the symptoms and functional status of people suffering from knee osteoarthritis.

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Introduction

Osteoarthritis (OA) is a type of joint disease characterized by pain and stiffness. It can cause physical disability and eventually become a socio-economic burden on the societies.[1-4] OA is the most common chronic and progressive disease in the United States.[1, 2] Considering the important role of the knee in the lower extremity, knee OA can adversely affect individual's functional independence.[2, 5] Due to the rapidly increasing prevalence of OA, there is a need for an accurate assessment tool of patients' health requirements.[2, 3] There are several approaches to assess

people with OA, among which patient-reported outcome measures (PROMs) are the preferred methods.[6-8] The knee outcome survey (KOS) is a widely used scale to measure the consequences of knee OA.[9-14] The scale is designed to evaluate the functional status of patients following a knee injury.[12] It includes two separate domains, namely symptoms and activities of daily living (ADL) disturbance related to knee for measurement of symptoms and functional restriction in the activities of daily living (ADL) as well as sport activities.[9, 13, 15] The main advantage of this scale is that it differentiates between ADL and sports activity. It can also be used to assess different knee problems such as ligamentous and meniscus injuries, OA, and patellofemoral pain syndrome.[10, 13, 16]

The KOS scale was originally developed in the English language,[12] then, it has been translated into several other languages such as German,[15] Turkish,[11] Portuguese,[16] and Greek.[13] Considering cultural, lingual, and geographical variations,[17] the validity and reliability of any questionnaire could be negatively affected by the translation process.[18] Hence, the objective of the present study was to assess the validity and reliability, and cross-cultural adaptation of the Persian version of the knee outcome survey-activities of daily living (KOS-ADL) scale.

Patients and Methods

The present cross-sectional and psychometric study was conducted from summer 2015 to fall 2016 at the Musculoskeletal Research Center, Isfahan University of Medical Sciences, Isfahan, Iran. The study was approved by the Ethics Committee of Isfahan University of Medical Sciences (code: IR.MUI.REC.1394.394596). Permission from Professor J.J. Irrgang (the developer of KOS) was obtained to translate the questionnaire into the Persian language. A team of experts together with Professor J.J. Irrgang jointly supervised the process and were consulted for planning and data analysis of the study.

The convenient sampling method was used to recruit the participants among patients from various public and private health care centers in Isfahan, Iran. The target population was the patients with varying severity of knee OA, stratified in accordance with the criteria proposed by the American College of Rheumatology (ACR)[19] and based on the Kellgren-Lawrence (K–L) grading scale and the Osteoarthritis Research Society International (OARSI) grading system.[20] Knee radiographs were performed by standing on both legs.[3, 21] Radiographs taken within two months prior to the study were also accepted to avoid unnecessary exposure of the participants to X-rays. The inclusion criteria were the ability to walk without assistive devices, a pain level of at least 30% on the visual analog scale (VAS),[16, 22] and proficiency in the Persian language. The exclusion criteria were undergoing physical therapy or other palliative or medical management program that may affect the pain level and ADL within 30 days prior to the study,[23] positive history of other osteo-arthropathies,[23] suffering from heart disease or neurological problems,[24] or any other disabling factor that reduces functional independence and the level of activity,[20, 25] fracture of the lower extremities within six months prior to the study,[22] steroid injection in any lower extremity joints within six months prior to the study, lower extremity malalignment,[23] severe non-osteoarthritic knee effusion or arthroplasty,[11, 22, 23] and other joints pathologies including ligament, menisci, or patellofemoral problems.[12, 14] A physical therapist, who was blind to the study design, approved the participation of the volunteers by verifying the inclusion and exclusion criteria through a comprehensive physical examination and review of their medical history. Written informed consent was obtained from all the participants.

Instruments

Knee Injury and Osteoarthritis Outcome Score (KOOS)

Considering wrong ordering of the answer options in the LK 1.0 version of Persian KOOS, LK 2.0 was used in the present study.[26] This questionnaire was used to validate the KOS-ADL scale. It assesses the outcomes of five subclasses, namely pain (7 items), symptoms (9 items), ADL (17 items), sport and recreation function (5 items), and knee-related quality of life (4 items). Each item is scored on a Likert scale from 0 (no problems) to 4 (extreme problem). For each subclass, the score is normalized to a 0-100 scale where higher scores indicate better functional status.[27] The Persian version of the questionnaire was developed by Salavati and others.[24]

Knee Outcome Survey Activities of Daily Living (KOS-ADL) Scale

This self-administered scale consists of two domains, namely symptoms (six factors) and ADL disturbance related to knee (eight factors). Note that three additional factors (15 to 17) are not used for calculating the total score of the KOS-ADL scale. The response to the symptoms questions is scored from 0 (the symptom prevents me from all daily activities) to 5 (I do not have the symptom). The response to questions

in the ADL disturbance related to knee is scored from 0 (I am unable to do the activity) to 5 (activity is not difficult). The total score is calculated by summing the scores of all 14 factors.[12]

Tegner Scale of Physical Activity

Tegner is a scale of sports activities. The responses are scaled from level 0 (sick leave or disability pension due to knee problems) to level 10 (competitive sports such as football, soccer, rugby).[28] Negahban and others have cross-culturally adapted the Persian version of the scale.[29]

Translation of KOS-ADL Scale

Translation and cultural adaptation of the scale were in accordance with the protocol recommended by the Manufacturers Alliance for Productivity and Innovation (MAPI).[30] The process included translation into Persian and back translation followed by face validity and reliability assessments. The instrument was translated into the Persian language by two independent native Persian-speaking health professionals with proficient English language skills. The translators were blind to the study design and to the other one's translation. The translated documents were then consolidated by a knee specialist who was blind to the original questionnaire. This preliminary version of the document was reviewed in an expert consensus that included the principal researcher, translators, and three knee specialists. To ensure conceptual equivalence, the final Persian version of the document was independently back-translated into the English language by two separate new translators, who were blind to the original English version of the questionnaire. They were Persian speaking medical specialists who were living in an English speaking country and were blind to each other's translation. Their work was consolidated into one document by a third translator who was blind to the study design and the original version of the questionnaire. This version was subsequently sent to the developer of KOS for confirmation.

Initial face validity assessment indicated that eight factors of the second domain of the scale, i.e., ADL disturbance related to knee were unclear to 56.7% of the sample population. Following internal meetings and consultation with the developer of KOS, it was decided to complement those factors requiring further clarification (items 7-14) with simple icons. The subsequent face validity assessment showed that all factors and the associated answers were clear to the sample population.

Data Collection

The participants were selected in accordance with the inclusion and exclusion criteria and studied X-rays, and subsequently, demographic and clinical data were collected through interviews and medical history taking. In line with a previous study,[13] the KOS-ADL questionnaire was initially presented to 30 of the volunteers. In case of any ambiguities, the research team clarified each item of the questionnaire while noting the shortcomings of the translated version. Potential modifications were implemented after consultation with the developer of KOS to conclude the face validity phase. In the validity phase, the modified version of the translated KOS-ADL questionnaire and the Persian version of KOOS were presented to 130 patients. The group was requested to fill in the questionnaire independently, without any guidance from the research team. In the reliability phase, the test-retest method was used. From the recruited patients, 40 patients were requested to fill in the questionnaires again with an 8-day interval.[12, 24, 26]

Statistical Methods

Data were analyzed with SPSS software (version 18.0) using a two-tailed test. P values<0.05 were considered statistically significant. Content validity was determined using the participants' ranking of their knee performance and by the consensus of an expert team (Delphi techniques).[31] The internal consistency of the questionnaire and its domains was evaluated with Cronbach's alpha, and values ≥0.70 were considered acceptable.[11, 13, 32] To evaluate construct validity, concurrent construct validity was examined with a correlation matrix using the Pearson's correlations coefficient between the domains of KOS-ADL and subclasses of KOOS.[11] Correlation coefficients >0.50 were classified as strong, 0.35-0.50 as moderate, and <0.35 as weak.[25] The reliability (test-retest) was examined using the intraclass correlation coefficient (ICC),[10, 11, 13, 15, 16] where values ≥0.7 were considered acceptable.[15, 33] Descriptive statistics were presented as mean±standard deviation (SD) or frequency and percentages. The Kappa coefficient was used to determine the intra-rater agreement, where a coefficient ≤1 indicated a perfect agreement.[34] Floor and ceiling effects were calculated based on the scores obtained by the participants for each KOS-ADL item. Since in KOS-ADL, the option that shows better knee condition gets higher score in Likert scale, the percentage of selecting the lowest (score 0) and the highest (score 5) indicated the ceiling and floor effects, respectively. If more than 15%

of participants scored an item "zero" or "five", then ceiling or floor effects (respectively) was present.[35] The component matrix was extracted using factor analysis. The rotated component matrix was calculated using varimax with Kaiser normalization.

Results

From a total of 130 subjects (14 man and 116 woman) who were included in the study, 40 subjects were engaged for test-retest reliability. There were no missing data for any of the items of the KOS-ADL, KOOS, and Tegner scales. However, some demographic data from 31 participants were not available. There was no significant difference between the demographic characteristics of the participants in the validity (n=130) and reliability (n=40) phases (table 1).

Validity

The content validity of the Persian version of the KOS-ADL scale was confirmed by the subjects and the expert consensus. As a measure of concurrent construct validity, the coefficients of correlation between the KOS-ADL domains and KOOS subclasses are presented in table 2.

The results showed a strong and statistically significant correlation between the total score of KOS-ADL and the subclasses of KOOS (correlation coefficient ≥0.71, P≤0.001). Similarly, the correlation between the domains of KOS-ADL (symptoms and function) and the subclasses of KOOS was strong (correlation coefficient ≥0.56, P≤0.001). The Spearman's correlation coefficients for each item of the KOS-ADL scale concerning the subclasses of KOOS are listed in table 3.

The item by item correlation between KOS-ADL and KOOS revealed an acceptable modest correlation between the two scales (supplement 1). The floor and ceiling effects were investigated for the individual KOS-ADL items (table 4).

Reliability

All the 40 participants taking part in the test-retest reliability assessment completed the test and returned the questionnaires (missing data=0) with an acceptable ICC value (0.79). As presented in table 5, Cronbach's alpha

Table 1: Demographic characteristics of the participants

Variables	Parameters	Validity phase	Reliability phase	P value
Anthropometric Data (mean±SD)	Age (years)	56.65±9.94	57.80±9.28	0.61
	Weight (kg)	74.04±10.75	71.15±10.05	0.81
	Height (cm)	160.86±8.23	159.27±8.71	0.61
	BMI (kg/m^2)	28.70±3.87	28.07±3.48	0.12
Sex (n, %)	Man	14 (10.80)	3 (7.50)	0.73
	Woman	116 (89.20)	37 (92.50)	
OA severity (n, %)	1	19 (14.60)	4 (10.00)	0.05
	2	69 (53.10)	24 (60.00)	
	3	37 (28.50)	11 (27.50)	
	4	5 (3.80)	1 (2.50)	
Tegner score (n, %)	0	20 (15.40)	3 (7.50)	0.22
	1	27 (20.80)	6 (15.00)	
	2	58 (44.60)	24 (60.00)	
	3	19 (14.60)	3 (7.50)	
	4	2 (1.50)	1 (2.50)	
	5	4 (3.10)	3 (7.50)	
Educational level (n, %)	Under diploma	51 (39.20)	16 (40.00)	0.27
	Diploma	25 (19.20)	10 (25.00)	
	Post diploma	22 (16.90)	14 (35.00)	
	Not available	32 (24.60)	0 (0.00)	
Symmetrical involvement (n, %)	Asymmetrical	46 (35.40)	7 (17.50)	0.02
	Symmetrical	53 (40.80)	33 (82.50)	
	Not available	31 (23.80)	0 (0.00)	
Present symptoms (n, %)	Pain	82 (63.10)	29 (72.50)	0.54
	Morning stiffness	61 (46.90)	13 (32.50)	0.05
	Inability to move	54 (41.50)	15 (37.50)	0.39
	Disturbance in ADL	46 (35.40)	15 (37.50)	0.71
	Inability to go up/down stairs	84 (64.60)	29 (72.50)	0.28
	Not available	31 (23.80)	4 (10.00)	0.75

BMI: Body Mass Index, OA: Osteoarthritis

Table 2: Correlation between the Persian version of Knee Outcome Survey Activities of Daily Living domains and the subclasses of the Knee Injury and Osteoarthritis Outcome

KOS-ADL domains	KOOS subclasses				
	Symptoms	Pain	Activities of daily living	Sport and entertainment	Quality of life
Total score	0.78* (P≤0.001)	0.77* (P≤0.001)	0.76* (P≤0.001)	0.71* (P≤0.001)	0.73* (P≤0.001)
Symptoms	0.80* (P≤0.001)	0.74* (P≤0.001)	0.69* (P≤0.001)	0.56* (P≤0.001)	0.62* (P≤0.001)
Function	0.63* (P≤0.001)	0.67* (P≤0.001)	0.69* (P≤0.001)	0.70* (P≤0.001)	0.69* (P≤0.001)

*Pearson's correlation coefficient. Correlation was significant at the 0.01 level (2-tailed). KOS-ADL: Knee Outcome Survey Activities of Daily Living

Table 3: Spearman's correlation coefficient between Knee Outcome Survey Activities of Daily Living domains and the scores of the Knee Injury and Osteoarthritis Outcome Score subclasses

KOS-ADL factors		KOOS subclasses				
		Symptoms	Pain	Activities of daily living	Sport and entertainment	Quality of life
ADL1	Pain	0.59*	0.66*	0.61*	0.60*	0.47*
ADL2	Stiffness	0.65*	0.59*	0.56*	0.53*	0.51*
ADL3	Swelling	0.61*	0.45*	0.45*	0.36*	0.37*
ADL4	Giving way, buckling, or shifting of the knee	0.53*	0.52*	0.45*	0.32*	0.40*
ADL5	Weakness	0.55*	0.49*	0.42*	0.37*	0.38*
ADL6	Limping	0.67*	0.66*	0.59*	0.49*	0.57*
ADL7	Walk	0.54*	0.58*	0.48*	0.55*	0.52*
ADL8	Go up stairs	0.49*	0.51*	0.47*	0.46*	0.36*
ADL9	Go down stairs	0.41*	0.48*	0.51*	0.46*	0.36*
ADL10	Stand	0.47*	0.51*	0.52*	0.43*	0.45*
ADL11	Kneel on the front of your knee	0.48*	0.49*	0.54*	0.59*	0.58*
ADL12	Squat	0.60*	0.56*	0.59*	0.56*	0.62*
ADL13	Sit with your knee bent	0.53*	0.51*	0.57*	0.54*	0.57*
ADL14	Rise from a chair	0.54*	0.56*	0.59*	0.53*	0.52*

P≤0.001, *Correlation is significant at the 0.01 level (2-tailed). KOS-ADL: Knee Outcome Survey Activities of Daily Living, ADL: Activities of Daily Living

Table 4: Floor and ceiling effects for knee outcome survey activities of daily living factors

KOS-ADL factors		Floor effect (%)	Ceiling effect (%)
ADL1	Pain	5.4	3.8
ADL2	Stiffness	15.4*	3.1
ADL3	Swelling	34.6*	3.8
ADL4	Giving way, buckling, or shifting of the knee	27.7*	3.1
ADL5	Weakness	19.2*	3.8
ADL6	Limping	33.8*	4.6
ADL7	Walk	16.9*	0.8
ADL8	Go up stairs	3.8	3.8
ADL9	Go down stairs	8.5	3.8
ADL10	Stand	17.7*	0.8
ADL11	Kneel on the front of your knee	5.4	31.5*
ADL12	Squat	3.8	44.6*
ADL13	Sit with your knee bent	3.1	45.4*
ADL14	Rise from a chair	23.1*	8.5

KOS-ADL: Knee Outcome Survey Activities of Daily Living, ADL: Activities of Daily Living; *Floor/ceiling effect is present, ≥15% of participants selected extreme choice

Table 5: Reliability of knee outcome survey activities of daily living

ICC score (95% CI)	Cronbach's alpha	Corrected item-total correlation	Minimal detectable change	Minimal important change	P value
0.89 (0.84-0.92)	0.92	0.65	4.93	1.78	≤0.001

Table 6: The pairwise comparison between the responses of the participants to the factors of both domains of the knee outcome survey activities of daily living

KOS-ADL factors		P value*
ADL1	Pain	0.26
ADL2	Stiffness	0.97
ADL3	Swelling	0.10
ADL4	Giving way, buckling, or shifting of the knee	0.46
ADL5	Weakness	0.93
ADL6	Limping	0.21
ADL7	Walk	0.41
ADL8	Go up stairs	0.62
ADL9	Go down stairs	0.06
ADL10	Stand	0.31
ADL11	Kneel on the front of your knee	0.85
ADL12	Squat	0.15
ADL13	Sit with your knee bent	0.05
ADL14	Rise from a chair	0.73

P>0.05, *The mean difference and weighted Kappa, KOS-ADL: Knee Outcome Survey Activities of Daily Living, ADL: Activities of Daily Living

Table 7: Component and rotated component matrices

KOS-ADL factors		Rotated component matrix	
		1	2
ADL1	Pain	0.40	0.68
ADL2	Stiffness	0.31	0.71
ADL3	Swelling	0.09	0.78
ADL4	Giving way, buckling, or shifting of the knee	0.19	0.73
ADL5	Weakness	0.24	0.71
ADL6	Limping	0.45	0.60
ADL7	Walk	0.70	0.39
ADL8	Go up stairs	0.76	0.33
ADL9	Go down stairs	0.71	0.30
ADL10	Stand	0.68	0.31
ADL11	Kneel on the front of your knee	0.86	0.12
ADL12	Squat	0.82	0.23
ADL13	Sit with your knee bent	0.84	0.17
ADL14	Rise from a chair	0.66	0.36

The two components extracted using principal component analysis. KOS-ADL: Knee Outcome Survey Activities of Daily Living, ADL: Activities of Daily Living

coefficient (0.92), corrected item-total correlation (0.50-0.74), and ICC (0.89) were acceptable. Since the Cronbach's alpha value was high enough (α≥0.80), item deleted Cronbach's Alpha was not needed to be calculated. Minimal detectable changes and minimal important change for KOS-ADL are listed in table 5.

The mean difference and weighted Kappa for KOS-ADL were -2.04 and 0.13, respectively. As shown in table 6, the response of the participants to all questions was the same in the first and the last administration of the questionnaires for both dimensions of the KOS-ADL scale (P>0.05), which confirms the ICC results.

For the additional three items (15, 16, and 17) that were not included in calculating the KOS-ADL score, there was no significant difference between the response of the participants (P=0.07, 0.29, 1.00, respectively). These items assessed the individual's perception of the knee performance during ADL.

Confirmatory factor analysis was used to certify the validity of the Persian version of the KOS-ADL scale. The Kaiser-Meyer-Olkin (KMO) index was 0.91, and Bartlett's test of sphericity was statistically significant (P≤0.001), supporting a significant correlation between the factors. Based on the principal component analysis, the extracted communality was 0.56-0.76%.

Of the first KOS-ADL domain, the first-factor "pain" represented 51.44% of the variance. This factor together with the joint stiffness (ADL2), with 10.98% of factor variances, represented 62.42% of the variance. It indicated that the first two items of the KOS-ADL were the key factors in describing knee OA symptoms (table 7).

The rotated component matrix was calculated using varimax with Kaiser Normalization. As

shown in table 7, the first domain of KOS-ADL (symptoms) had the highest correlation with the second domain (ADL disturbance related to knee). While the second domain was well-correlated with the first domain.

Discussion

OA adversely affects the functional performance and daily activities of the clients.[33, 36] KOS-ADL is a valid and reliable scale for analyzing both functional impairments and the effect of the therapeutic strategies in people suffering from various knee pathologies.[12] In the present study, we developed the Persian version of the KOS-ADL scale and assessed its cross-cultural adaptation. Our results showed that the Persian version of the KOS-ADL scale is a valid instrument with good reliability and internal consistency for application in clinical settings and research studies.

During the initial face validity phase, face-to-face interviews with 30 participants indicated that some factors in the second domain ADL disturbance related to knee were ambiguous. After consultation with the developer, it was decided to simplify these items with icons. The subsequent face validity assessment showed that all items and the associated answers were well understood by the participants.

In the absence of any gold standard to measure the functional performance in knee OA,[37, 38] we could not determine the criterion validity of the Persian version of KOS-ADL. However, we opted for a comparative tool i.e. KOOS, which is cost-free, readily available, and contains an appropriate number of questions. As an abridged version of the Western Ontario and McMaster Universities Osteoarthritis (WOMAC), KOOS takes less than 5 minutes to be completed, making it the most suitable tool to test a large sample size as in our study, which saves a considerable amount of time.[27]

The Persian version of KOS-ADL had a good construct validity (0.71-0.78) when correlated with KOOS subclasses.[39] In addition, there was an acceptable correlation between the scores of KOS-ADL domains (symptoms and function) and KOOS subclasses. The homogenous sample size (i.e. as a result of strict inclusion/exclusion criteria and the use of knee specific outcome measure) was the main reason for the acceptable correlation coefficient between the two tools. Previous studies have used tools such as the visual analog scale (VAS), global rating scale (GRS), Short-Form Health Survey (SF-36), Lysholm knee score, global rating of function, and some other functional tests to determine the construct validity of various language versions of KOS-ADL.[11, 13, 15, 16] However, none of these instruments had been specifically developed to measure knee OA.

In the present study, the highest correlation coefficients were attained between the KOS-ADL total score and the symptoms and ADL subclasses of KOOS, confirming the main concept of KOS-ADL. The Cronbach's alpha for the Persian version of KOS-ADL was exactly the same as the original version,[24] indicating its accuracy in determining individual's issues with knee OA. Furthermore, the addition of simple icons to ambiguous questions positively contributed to the high Cronbach's alpha ($\alpha \geq 0.80$) of the Persian version of KOS-ADL compared with other versions.[40]

The ICC value of the Persian version of KOS-ADL was 0.79 (0.60-0.89), which was lower than the corresponding value of the original version (0.97),[11, 12] German and Portuguese versions,[15, 16] Turkish version (0.99), and Greek version (0.96). This could be due to two main reasons. First, the education level of the participants was not reported in other language versions, which may, to some extent, affect the ICC value. Second, the test-retest interval in the other language versions was shorter than that in our study, which may affect their result by the possibility of recall bias. Note that the developers of KOS-ADL[12] implemented the test-retest assessment just before and after a single treatment session.

The Minimal detectable changes value in our study was 4.9 compared with the Turkish (2.59) and German (6.4) versions of KOS-ADL. Note that this value was not reported for the other versions. Our results showed that the floor and ceiling effects were 0% and 0.8%, respectively, indicating that the samples were homogenous in symptoms and functional limitations. Our results were comparable to the original KOS-ADL[12] and the Portuguese version.[16] The reported floor and ceiling effects in the Greek version were 0% and 11.7%, respectively.[13]

It should be noted that the ADL scale is not meant to be scored as two subscales (symptoms and functional limitations). The same as the original version by Irrgang and colleagues,[12] our study approved that a single factor was sufficient to explain the variability in the total score. This was confirmed by the large ratio of the 1st to 2nd eigenvalue (~7.5 to ~1.5 based on the screen plot) and by the factor loadings >0.50 in the unrotated model. Irrgang and colleagues had very similar findings in their previous study on the English version of the ADL scale and interpreted this to indicate that the items were "unidimensional enough" to justify combining

the item responses into a single score, which has advantages for interpretation of the score of the ADL scale. Therefore, the preferred scoring method is to combine all items into a single total score as opposed to two subscale scores.

There are some limitations to the present study worth noting. We did not differentiate the effect of involvement of either knee in asymmetric cases. Besides, the number of patients in the different grades of knee OA severity were not equal, which may deviate the ICC score toward that of moderately affected subjects (K-L grade 2 and 3). Cultural adaptation of KOS-Sport, determining the responsiveness and predictive value of KOS-ADL, and factor analysis of the KOS-ADL factors are recommended for future studies. The current study confirmed the application of the Persian version of KOS-ADL in people suffering from different knee OA severities. Validation of the Persian version of KOS-ADL in other knee pathologies is strongly recommended.

Conclusion

The Persian version of the KOS-ADL scale is a valid and reliable instrument to evaluate the knee functional status of the Iranians with different grades of knee OA.

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