

# Arabic Translation of the Knee Outcome Survey–Sports Activities Scale With Cross-cultural Adaptation and Validation

Hamza M. Alrabai,<sup>\*†</sup> MD, Abdulrahman D. Algarni,<sup>†</sup> MD, Abdulrahman Ahmed Alshehri,<sup>‡</sup> MD, Adel Faiz Alshihri,<sup>‡</sup> MD, Ammar Saleh Almansour,<sup>‡</sup> MD, Rawaf Khalid Alrawaf,<sup>‡</sup> MD, and Abdulaziz S. Al-Ahaideb,<sup>†</sup> MD

*Investigation performed at King Khalid University Hospital, King Saud University, Riyadh, Saudi Arabia*

**Background:** There are few sports-specific knee functional scales in the Arabic language. The Knee Outcome Survey–Sports Activities Scale (KOS-SAS) is a validated sports-specific patient-reported outcome measure that assesses knee function in an athletic population.

**Purpose:** To provide a validated Arabic version of the KOS-SAS (KOS-SAS-Ar) while achieving cross-cultural adaptation for use in an Arabic-speaking population with sports-related knee disorders.

**Study Design:** Cohort study (diagnosis); Level of evidence, 2.

**Methods:** There were 2 independent translators who conducted a forward translation of the KOS-SAS, followed by a backward translation by different translators. Subsequently, researchers and expert invitees judged the conceptual content and cultural adaptations of the final translation. A total of 276 patients completed the KOS-SAS-Ar as well as the International Knee Documentation Committee (IKDC) subjective assessment of knee function and a visual analog scale (VAS) for pain. Statistical analysis was performed for test-retest reliability, convergent validity, construct validity, and factor analysis.

**Results:** The test-retest reliability of the KOS-SAS-Ar was high ( $r = 0.9$ ). The items of the KOS-SAS-Ar had statistically significant internal consistency, with a Cronbach alpha of .924 ( $P < .0001$ ). The KOS-SAS-Ar Symptoms subscore correlated with the VAS pain score ( $P < .0001$ ), and the KOS-SAS-Ar Functional Limitations subscore correlated with the IKDC subjective score ( $P < .0001$ ). The construct validity of the KOS-SAS-Ar was satisfactory (Kaiser-Meyer-Olkin value = 0.868; Bartlett test:  $P < .0001$ ). Factor analysis showed a statistical correlation among the 11 items of the KOS-SAS-Ar.

**Conclusion:** The KOS-SAS-Ar demonstrated favorable reliability and validity, and it appears to be a suitable tool for Arabic-speaking patients with sports-related knee conditions.

**Keywords:** athletic knee; functional score; knee performance; knee score; sports activity

Physical fitness is crucial for a healthy life.<sup>6</sup> Nowadays, more people tend to practice sports frequently.<sup>8</sup> The knee joint is highly susceptible to sports-related injuries, more so than other joints.<sup>11,20</sup> Knee disorders can affect overall performance in sports.<sup>18,19</sup> Clinically, a valid assessment scale that directly measures how patients perceive their own knee function may be useful in tracing progression rather than relying on physiological or laboratory examinations.<sup>5</sup> Various validated patient-reported outcome measures (PROMs) of knee function are available<sup>4,17</sup>; however, general knee function scoring systems may not adequately address sports knee disorders.<sup>8</sup>

The Knee Outcome Survey<sup>13</sup> (KOS) consists of 2 distinct sections: the Activities of Daily Living Scale (KOS-ADLS), which mainly measures regular knee functional levels in daily routines, and the Sports Activities Scale (KOS-SAS), which evaluates higher knee function in sports in the physically active population.<sup>4</sup> Both scales have been proven to be valid and reliable.<sup>4</sup> The KOS-ADLS has been translated and validated into numerous languages, including German,<sup>3</sup> Portuguese,<sup>9</sup> Turkish,<sup>7</sup> Greek,<sup>14</sup> French,<sup>21</sup> and Arabic.<sup>1</sup> Thus far, the KOS-SAS has been only translated into Portuguese.<sup>8</sup>

As it is desirable that PROMs are available in the mother tongue of the patients for optimal results, we aimed to provide a validated Arabic version of the KOS-SAS (KOS-SAS-Ar) and achieve cross-cultural adaptation. The KOS-SAS-Ar is expected to offer an athletic knee assessment tool

The Orthopaedic Journal of Sports Medicine, 11(6), 23259671231175895

DOI: 10.1177/23259671231175895

© The Author(s) 2023

This open-access article is published and distributed under the Creative Commons Attribution - NonCommercial - No Derivatives License (<https://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits the noncommercial use, distribution, and reproduction of the article in any medium, provided the original author and source are credited. You may not alter, transform, or build upon this article without the permission of the Author(s). For article reuse guidelines, please visit SAGE's website at <http://www.sagepub.com/journals-permissions>.

for the Arabic-speaking population across 22 countries globally but mainly in the Middle East and North Africa.

## METHODS

This study was conducted between June 2019 and January 2020. The study protocol was approved by our institutional review board, and all included patients provided written informed consent.

### KOS-SAS Instrument

The KOS-SAS comprises 11 items that are subcategorized into 2 sections: the Symptoms subscale (7 items) and the Functional Limitations with Sports Activities (Functional Limitations) subscale (4 items) (Appendix Figure A1). The first 7 items evaluate knee symptoms in terms of severity, calibrated over 6 levels: “never have” (5 points), “have but does not affect sports activity” (4 points), “affects sports activity slightly” (3 points), “affects sports activity moderately” (2 points), “affects sports activity severely” (1 point), and “prevents me from all sports activity” (0 points). Items 8 to 11 assess the ability to perform specific knee athletic movements on a similar 6-level scale: “not difficult at all” (5 points), “minimally difficult” (4 points), “somewhat difficult” (3 points), “fairly difficult” (2 points), “very difficult” (1 point), and “unable to do” (0 points).<sup>4</sup> The final score is calculated by dividing the raw total score by 55 and multiplying the quotient by 100. The highest score (100) indicates normal knee function, while the lowest score (0) indicates the loss of knee function.

The KOS-SAS has 9 additional items that are not included in numerical scoring. These add-on items represent a complementary subjective assessment section for rating knee function during sports and the level and frequency of sports activities at different stages: before the injury, before treatment, and at the time of the survey response.

### Translation and Cross-cultural Adaptation

We obtained written permission to translate the original English KOS-SAS from the primary author.<sup>13</sup> Conceptual rather than literal translations were implemented throughout the translation process. The KOS-SAS-Ar was developed in Modern Standard Arabic (MSA). The translation process was performed in accordance with the guidelines for cross-cultural adaptation of self-reported measures.<sup>2</sup> First, 2 bilingual clinicians independently translated the original English version into Arabic. The translated version was then blindly converted back to English by 2 qualified

translators from the College of Languages and Translation, King Saud University. Finally, we evaluated the quality of the final translation by comparing each Arabic-translated KOS-SAS item with its original English counterpart. The finalized KOS-SAS-Ar is available in Appendix Figure A2.

### Patients and Study Design

The questionnaire was distributed to 276 patients with knee disorders. The participants were verbally invited and recruited from an orthopaedic clinic. The sampling method used was simple random sampling. After the exclusion of patients who did not fit inclusion criteria, participants were selected from a scheduled patient list of the outpatient orthopaedic sports clinic based on random numbers. The inclusion criteria were native Arabic speakers, patients with a history of sports injuries, and adults aged  $\geq 18$  years. The exclusion criteria were non-Arabic speakers, patients with degenerative abnormalities, patients with multiple joint injuries, and children.

The demographic data of the participants were collected, including their sex, age, height, weight, level of education, and duration of the knee condition. In addition to the KOS-SAS-Ar, the participants completed a visual analog scale (VAS) for pain<sup>15</sup> and the International Knee Documentation Committee (IKDC) subjective assessment of knee function.<sup>10,12</sup> Help was available for the patients who required assistance in completing the questionnaire.

### Validation and Reliability

Test-retest reliability refers to the degree of consistency of the test results over time. A reliable test should provide consistent measurements each time that the test is performed. In our study, we ensured test-retest reliability by administering the KOS-SAS-Ar to 20 patients from the study sample twice within a week. All participants of the retest stated that their knee conditions remained the same since the primary test. The standard error of measurement (SEM) indicates how far the measurements of a certain test are, relative to the true measurement. As the SEM increases, the test reliability decreases and vice versa. The smallest detectable change (SDC) refers to the minimum amount of change that is required to result in a real difference in the outcomes. Any change less than the SDC value can be attributed to a random error.

Internal consistency reflects the degree of homogeneity among items of an instrument that share a common target measurement. We measured internal consistency using the Cronbach alpha. The Cronbach alpha is an index of internal consistency used to measure how 2 groups of items are

\*Address correspondence to Hamza M. Alrabai, MD, Department of Orthopedics, College of Medicine, King Saud University, PO Box 7805, Riyadh 11472, Saudi Arabia (email: halrabai@ksu.edu.sa) (Twitter: @AlrabaiHM).

<sup>†</sup>Department of Orthopedics, College of Medicine, King Saud University, Riyadh, Saudi Arabia.

<sup>‡</sup>College of Medicine, King Saud University, Riyadh, Saudi Arabia.

Final revision submitted February 18, 2023; accepted March 2, 2023.

The authors declared that there are no conflicts of interest in the authorship and publication of this contribution. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.

Ethical approval for this study was obtained from King Saud University (No. 13/3811/IRB).

TABLE 1  
Participants' Responses on KOS-SAS-Ar Subjective Assessment Section<sup>a</sup>

Subjective Rating	Normal	Nearly Normal	Abnormal	Severely Abnormal
Overall knee function during sports activities	109 (39.5)	112 (40.6)	41 (14.9)	14 (5.1)
Current level of sports activity as a result of knee problem	98 (35.5)	114 (41.3)	49 (17.8)	15 (5.4)
Highest Level of Sports Activity	Strenuous Sports <sup>b</sup>	Moderate Sports <sup>c</sup>	Light Sports <sup>d</sup>	Impossible
Before injury	189 (68.5)	52 (18.8)	35 (12.7)	0 (0.0)
Before treatment	78 (28.3)	58 (21.0)	67 (24.3)	73 (26.4)
Currently	106 (38.4)	68 (24.6)	71 (25.7)	31 (11.2)
Frequency of sports participation	≥4 Times/wk	1-3 Times/wk	1-3 Times/mo	<1 Time/mo
Before injury	101 (36.6)	108 (39.1)	45 (16.3)	22 (8.0)
Before treatment	42 (15.2)	50 (18.1)	80 (29.0)	104 (37.7)
Currently	57 (20.7)	56 (20.3)	90 (32.6)	73 (26.4)
Current level of knee function during sports activities, <sup>e</sup> %	66.8 ± 27.0			

<sup>a</sup>Data are reported as mean ± SD or n (%). KOS-SAS-Ar, Arabic version of the Knee Outcome Survey–Sports Activities Scale.

<sup>b</sup>Examples: football, soccer, basketball.

<sup>c</sup>Examples: tennis, skiing.

<sup>d</sup>Examples: cycling, swimming, golf.

<sup>e</sup>0% = unable to perform sports activities, 100% = preinjury level.

related as a unit. The Cronbach alpha is expressed on a scale from 0 to 1, with higher values representing higher degrees of internal consistency.

Convergent validity describes how close 2 constructs are in terms of measuring relatively similar entities. For this purpose, we examined the participants' scores on the VAS and KOS-SAS-Ar Symptoms subscale for convergent validity in reference to symptoms. Similarly, the participants' scores on the IKDC subjective form and KOS-SAS-Ar Functional Limitations subscale were tested for convergent validity concerning function. Construct validity shows the extent to which a construct is valid for testing the target concept. The construct validity of the KOS-SAS-Ar was tested using confirmatory factor analysis.

### Statistical Analysis

The data were analyzed using SPSS (Version 24.0; IBM). Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to define quantitative and categorical variables. The SEM was calculated from the standard deviation of a set of scores and the reliability coefficient using the formula  $SEM = S/\sqrt{1-r}$ , where  $S$  is the standard deviation and  $r$  is the reliability coefficient of the measurement. The SDC was calculated based on the SEM and a given degree of confidence, for instance, 95% ( $SDC = SEM \times 1.96/\sqrt{2}$ ). The intraclass correlation for internal consistency of the KOS-SAS-Ar was evaluated using the Cronbach alpha in which values were interpreted as excellent ( $\geq 0.9$ ), good ( $< 0.9$  to  $\geq 0.8$ ), acceptable ( $< 0.8$  to  $\geq 0.7$ ), questionable ( $< 0.7$  to  $\geq 0.6$ ), poor ( $< 0.6$  to  $\geq 0.5$ ), or unacceptable ( $< 0.5$ ). Convergent validity was assessed using Pearson correlation analysis between the KOS-SAS-Ar Symptoms subscale items and VAS scores as well as between the KOS-SAS-Ar Functional Limitations subscale items and IKDC subjective scores.

Simple regression analysis was used to observe the linear relationship between the KOS-SAS-Ar subscores for symptoms and sports activities. The construct validity of the KOS-SAS-Ar was determined by performing confirmatory factor analysis. A correlation matrix, the Kaiser-Meyer-Olkin (KMO) test of sampling adequacy, and the Bartlett test of sphericity were used to obtain 11-item factorability. In factor analysis, the principal component method was used, and the proportion of variance was estimated through initial eigenvalues expressed by each of the factors. Varimax rotation was used to obtain rotated factors. A  $P$  value  $\leq .05$  was used to indicate statistical significance.

### RESULTS

Among the 276 participants who completed the KOS-SAS-Ar, 164 (59.4%) were male and 112 (40.6%) were female. The mean age of these participants was  $28.03 \pm 8.70$  years. The mean height and weight of the participants were  $169.76 \pm 5.46$  cm and  $80.62 \pm 9.74$  kg, respectively. Additionally, 68% of the participants were college graduates, and the remaining participants held either postgraduate degrees (7%) or undergraduate-level degrees (25%). The mean duration of the knee condition among the patients was  $6.53 \pm 3.44$  months. Various knee disorders were observed among the participants, including knee sprain ( $n = 176$  [63.8%]), anterior cruciate ligament injury ( $n = 59$  [21.4%]), patellofemoral maltracking ( $n = 14$  [5.1%]), meniscal injury ( $n = 12$  [4.3%]), medial collateral ligament injury ( $n = 8$  [2.9%]), lateral collateral ligament injury ( $n = 5$  [1.8%]), and multiligamentous injury ( $n = 2$  [0.7%]). The mean VAS pain score was  $6.76 \pm 2.60$ , and the mean IKDC subjective score was 87.30.

As demonstrated in Table 1, the patients' responses to the KOS-SAS-Ar subjective assessment section items

TABLE 2  
Internal Consistency of All Items and Subscales of KOS-SAS-Ar<sup>a</sup>

	Mean if Item Deleted	Variance if Item Deleted	Corrected Item - Total Correlation	Squared Multiple Correlation	Cronbach $\alpha$ if Item Deleted
Symptoms subscale					
Item 1	5.9710	39.286	0.649	0.544	.850
Item 2	6.5580	40.248	0.669	0.635	.847
Item 3	6.8949	43.120	0.593	0.566	.857
Item 4	6.7428	40.570	0.631	0.506	.852
Item 5	6.8188	38.360	0.689	0.663	.844
Item 6	7.1014	41.473	0.608	0.599	.855
Item 7	6.4565	38.787	0.673	0.504	.846
Cronbach $\alpha$	—	—	—	—	.869
Functional Limitations subscale					
Item 8	4.9891	23.080	0.777	0.671	.953
Item 9	4.4964	19.356	0.915	0.842	.909
Item 10	4.7174	19.243	0.907	0.835	.912
Item 11	4.5036	18.782	0.877	0.835	.923
Cronbach $\alpha$	—	—	—	—	.943
Cronbach $\alpha$ of all items	—	—	—	—	.924

<sup>a</sup>Dashes indicate not applicable. KOS-SAS-Ar, Arabic version of the Knee Outcome Survey–Sports Activities Scale.

regarding sports-related activities revealed that they estimated the current function of their knees as  $66.8\% \pm 27.0\%$ . The overall level of knee function in sports was judged to be “nearly normal” by 40.6% ( $n = 112$ ) of the participants, and 41.3% ( $n = 114$ ) of the participants chose “nearly normal” to describe their current level of knee function in sports. Regarding the highest level of sports activity, 68.5% ( $n = 189$ ) showed an ability to participate in strenuous sports before the injury. That rate decreased before receiving treatment to 28.3% ( $n = 78$ ). At the time of the questionnaire, 38.4% ( $n = 106$ ) of the participants stated an ability to partake in strenuous sports. Regarding the frequency of sports participation before the injury, 39.1% ( $n = 108$ ) of the patients reported a mean of 1 to 3 times weekly. The sports frequency dropped before treatment to less than once per month among 37.7% ( $n = 104$ ) of the participants. The mean frequency of sports participation during the survey was 1 to 3 times monthly, as stated by 32.6% ( $n = 90$ ) of the respondents.

The final KOS-SAS-Ar showed a high level of test-retest reliability (Pearson  $r = 0.9$ ). The data showed a normal distribution. As shown in Table 2, high internal consistency was demonstrated for the items of the KOS-SAS-Ar Symptoms subscale (Cronbach  $\alpha = .869$ ;  $P < .0001$ ) and the KOS-SAS-Ar Functional Limitations subscale (Cronbach  $\alpha = .943$ ;  $P < .0001$ ). Furthermore, the overall internal consistency of the KOS-SAS-Ar was high (Cronbach  $\alpha = .924$ ;  $P < .0001$ ). The SEM and SDC of the KOS-SAS-Ar were 3.369 and 9.338, respectively.

Regression analysis indicated a moderate linear relationship between the scores on the KOS-SAS-Ar Symptoms subscale and VAS pain scores ( $R^2 = 0.341$ ;  $P < .0001$ ) (Table 3). A change of 48.85% in the VAS score was elucidated using the KOS-SAS-Ar Symptoms subscore. Moreover, a moderate linear relationship was demonstrated between the scores on the KOS-SAS-Ar Functional Limitations

TABLE 3  
Relationship of KOS-SAS-Ar Symptoms Subscore With VAS Pain Score<sup>a</sup>

Symptoms Subscale	$R^2$	$P$
Item 1: Pain	0.326	<.0001
Item 2: Grinding/grating	0.383	<.0001
Item 3: Stiffness	0.325	<.0001
Item 4: Swelling	0.317	<.0001
Item 5: Slipping/partial giving way	0.288	<.0001
Item 6: Buckling/full giving way	0.294	<.0001
Item 7: Weakness	0.338	<.0001
Total	0.341	<.0001

<sup>a</sup>KOS-SAS-Ar, Arabic version of the Knee Outcome Survey–Sports Activities Scale; VAS, visual analog scale.

TABLE 4  
Relationship of KOS-SAS-Ar Functional Limitations Subscore With IKDC Subjective Score<sup>a</sup>

Functional Limitations Subscale	$R^2$	$P$
Item 8: Run straight ahead	0.443	<.0001
Item 9: Jump and land on the involved leg	0.422	<.0001
Item 10: Stop and start quickly	0.472	<.0001
Item 11: Cut and pivot on the involved leg	0.454	<.0001
Total	0.489	<.0001

<sup>a</sup>IKDC, International Knee Documentation Committee; KOS-SAS-Ar, Arabic version of the Knee Outcome Survey–Sports Activities Scale.

subscale and IKDC subjective scores ( $R^2 = 0.489$ ;  $P < .0001$ ) (Table 4).

Construct validity was verified using factor analysis. The correlation among the 11 items of the KOS-SAS-Ar

TABLE 5  
Communalities of 11 Items and Rotated Component Matrix of KOS-SAS-Ar<sup>a</sup>

	Communalities		Factors	
	Initial	Extractions	Sports	Symptoms
Symptoms subscale				
Item 1	0.1	0.691	0.364	0.748
Item 2	0.1	0.673	0.248	0.782
Item 3	0.1	0.621	0.131	0.777
Item 4	0.1	0.530	0.489	0.540
Item 5	0.1	0.641	0.333	0.728
Item 6	0.1	0.623	0.191	0.766
Item 7	0.1	0.629	0.461	0.645
Functional Limitations subscale				
Item 8	0.1	0.733	0.831	0.208
Item 9	0.1	0.900	0.935	0.162
Item 10	0.1	0.873	0.907	0.224
Item 11	0.1	0.830	0.877	0.245

<sup>a</sup>KOS-SAS-Ar, Arabic version of the Knee Outcome Survey-Sports Activities Scale.

displayed statistical significance. There was no multicollinearity, as the determinant of the correlation matrix was 0.0001. The KMO value was 0.868, greater than the accepted level of >0.5, allowing us to proceed with factor analysis. The result of the Bartlett test of sphericity was also significant ( $P < .0001$ ), indicating that the correlation matrix was not an identity matrix. Analysis of communalities showed that the variance among variables was accounted for by the extracted factors (Table 5).

There were 2 factors identified: sports and symptoms. Analysis of the 2-factor extraction along with their eigenvalues, percentage of variance attributable to each factor, and cumulative variance of the factors showed that sports accounted for 56.94% of the variance, while symptoms accounted for 13.46% of the variance, with a cumulative variance of 70.40%. From the scree plot, the curve began to flatten after factor number 2; thus, only 2 factors were retained (Figure 1). Table 5 also illustrates the loading of the 11 items on the 2 factors extracted. The higher the absolute value of the loading, the greater the factor contributing to the variable. The loading indicated that 2 factors independently contributed to each of the items without any overlap.

## DISCUSSION

The KOS-SAS-Ar showed favorable results in terms of internal consistency (Cronbach  $\alpha = .924$ ) and construct validity (KMO value = 0.868; Bartlett test:  $P < .0001$ ). As Arabic is a widely spoken language among more than 400 million people,<sup>22</sup> the KOS-SAS-Ar will be useful for Arabic-speaking athletes with knee complaints. Furthermore, utilizing the MSA style for the Arabic KOS-SAS renders it to be readily understood and answered appropriately by patients. Currently, MSA is the dominant form of

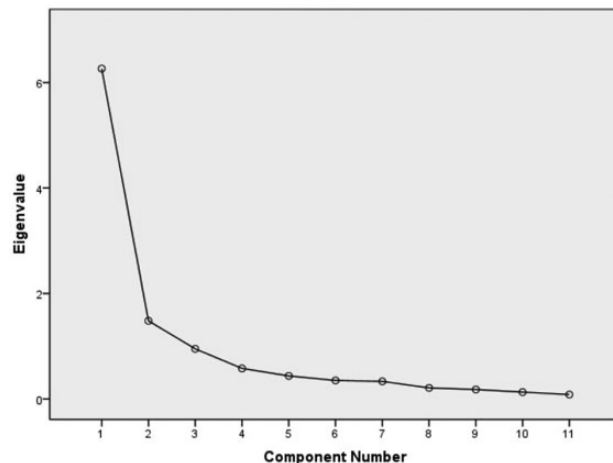


Figure 1. Screen plot of eigenvalues toward the extraction of the number of factors.

spoken and written Arabic in classrooms, media, and publications.<sup>16</sup>

To the best of our knowledge, apart from the Portuguese version,<sup>8</sup> no other non-English version of the KOS-SAS exists. In the current study, the KOS-SAS-Ar was completed by 276 patients with multiple sports-related knee abnormalities, and excellent test-retest reliability ( $r = 0.9$ ) was demonstrated over a 1-week interval. Similarly, the Portuguese KOS-SAS showed high intraobserver reliability (correlation coefficient = 0.9778;  $P < .001$ ).<sup>8</sup> The low SEM of the KOS-SAS-Ar (3.369) reflects its high reliability, and the SDC of 9.338 indicates that, for a given patient, any change in the KOS-SAS-Ar score >9.338 can be considered a true change rather than resulting from a random variation. Regarding the KOS-SAS, the SEM and SDC have not been determined yet in the previous literature. For the sake of comparison, the KOS-ADLS can be taken as a reasonably similar knee functional scale. The present study findings were comparable with the published SEM and SDC values for the English,<sup>13</sup> German,<sup>3</sup> and Turkish<sup>7</sup> versions of the KOS-ADLS. Moreover, the items of the KOS-SAS-Ar appeared to be coherently related, with a high degree of internal consistency (Cronbach  $\alpha = .924$ ).

The validity of each KOS-SAS-Ar item was assessed by quantifying the correlation between relatively related items obtained from similar measures. A significant correlation was observed between the KOS-SAS-Ar Symptoms subscore and the VAS pain score. A similar correlation was observed between the Portuguese version of the KOS-SAS and the VAS.<sup>8</sup> It was not possible to further test the convergent validity of the KOS-SAS-Ar Symptoms subscale with any other instrument besides the VAS because of a lack of Arabic-validated knee symptom scales at the time of this study. A statistically significant correlation was also found between the KOS-SAS-Ar Functional Limitations subscore and the IKDC subjective score. Likewise, the Portuguese KOS-SAS correlated well with the functional capacity section of the 36-item Short Form Health Survey.<sup>8</sup>

Both KOS-SAS-Ar subscales appeared to be linearly related in regression analysis. Similarly, regression analysis demonstrated a significant linear relationship between the IKDC subjective score and the VAS pain score. The construct validity of the KOS-SAS-Ar was favorable. Factor analysis showed a statistical correlation among the 11 items of the KOS-SAS-Ar.

### Limitations

The main limitation of this study was the relative lack of validated sports-focused knee functional scoring systems in the Arabic language. There is a remarkable scarcity of validated Arabic PROMs, indicating an existing gap in the literature. The availability of corresponding Arabic knee function scales for athletes can provide more rational comparisons. However, certain elements of the KOS-SAS-Ar have been matched with corresponding elements from similar scales for the sake of correlation and validation processes. It could be a limitation that convergent validity for the symptoms-related items of the KOS-SAS-Ar was tested using the VAS only. A further potential limitation of this study was the difficulty of including many participants from various geographic locations where certain Arabic dialects are predominantly spoken. However, the widespread use of MSA makes it the best available medium for communication among Arabic speakers.

### CONCLUSION

The KOS-SAS-Ar demonstrated favorable reliability and validity, and it appears to be a suitable tool for Arabic-speaking patients with sports-related knee conditions.

### REFERENCES

- Algarni AD, Alrabai HM, Al-Ahaideb A, Kachanathu SJ, AlShammari SA. Arabic translation, cultural adaptation, and validation study of Knee Outcome Survey: Activities of Daily Living Scale (KOS-ADLS). *Rheumatol Int*. 2017;37(9):1585-1589.
- Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine (Phila Pa 1976)*. 2000;25(24):3186-3191.
- Bizzini M, Gorelick M. Development of a German version of the Knee Outcome Survey for daily activities. *Arch Orthop Trauma Surg*. 2007;127(9):781-789.
- Borsa P, Lephart S, Irrgang J. Sport-specificity of knee scoring systems to assess disability in former cruciate ligament-deficient athletes. *J Sports Rehab*. 1998;7(1):44-60.
- Bryant D, Schünemann H, Brozek J, Jaeschke R, Guyatt G. Patient reported outcomes: general principles of development and interpretability. *Pol Arch Med Wewn*. 2007;117(4):5-11.
- Bueno AM, Pilgaard M, Hulme A, et al. Injury prevalence across sports: a descriptive analysis on a representative sample of the Danish population. *Inj Epidemiol*. 2018;5(1):6.
- Evcik D, Ay S, Ege A, Turel A, Kavuncu V. Adaptation and validation of Turkish version of the Knee Outcome Survey-Activities for Daily Living Scale. *Clin Orthop Relat Res*. 2009;467(8):2077-2082.
- Gonçalves CCK, Peccin MS, Almeida GJM, Cohen M. Translation, validation and cultural adaptation of the "Sports Activities Scale." *Acta Ortop Bras*. 2007;15(5):246-250.
- Gonçalves RS, Cabri J, Pinheiro JP. Cross-cultural adaptation and validation of the Portuguese version of the Knee Outcome Survey-Activities of Daily Living Scale (KOS-ADLS). *Clin Rheumatol*. 2008;27(11):1445-1449.
- Hefti F, Müller W, Jakob RP, Stäubli HU. Evaluation of knee ligament injuries with the IKDC form. *Knee Surg Sports Traumatol Arthrosc*. 1993;1(3-4):226-234.
- Hinz M, Kleim BD, Berthold DP, et al. Injury patterns, risk factors, and return to sport in Brazilian jiu jitsu: a cross-sectional survey of 1140 athletes. *Orthop J Sports Med*. 2021;9(12):23259671211062568.
- Irrgang JJ, Ho H, Harner CD, Fu FH. Use of the International Knee Documentation Committee guidelines to assess outcome following anterior cruciate ligament reconstruction. *Knee Surg Sports Traumatol Arthrosc*. 1998;6(2):107-114.
- Irrgang JJ, Snyder-Mackler L, Wainner RS, Fu FH, Harner CD. Development of a patient-reported measure of function of the knee. *J Bone Joint Surg Am*. 1998;80(8):1132-1145.
- Kapreli E, Panelli G, Strimpakos N, Billis E, Zacharopoulos A, Athanasopoulos S. Cross-cultural adaptation of the Greek version of the Knee Outcome Survey-Activities of Daily Living Scale (KOS-ADLS). *Knee*. 2011;18(6):424-427.
- Langley GB, Sheppeard H. The visual analogue scale: its use in pain measurement. *Rheumatol Int*. 1985;5(4):145-148.
- Mahmoud A. A linguistic perspective of the effect of English on MSA: manifestations and ramifications. *J King Saud Univ Language Transl*. 2013;25(1):35-43.
- Marx RG, Jones EC, Allen AA, et al. Reliability, validity, and responsiveness of four knee outcome scales for athletic patients. *J Bone Joint Surg Am*. 2001;83(10):1459-1469.
- McGuine TA, Winterstein AP, Carr K, Hetzel S. Changes in health-related quality of life and knee function after knee injury in young female athletes. *Orthop J Sports Med*. 2014;2(4):2325967114530988.
- Naimark MB, Kegel G, O'Donnell T, Lavigne S, Heveran C, Crawford DC. Knee function assessment in patients with meniscus injury: a preliminary study of reproducibility, response to treatment, and correlation with patient-reported questionnaire outcomes. *Orthop J Sports Med*. 2014;2(9):2325967114550987.
- Nunes G, de Castro LV, Wageck B, Kume V, Chiesa GS, de Noronha M. Translation into Portuguese of questionnaires to assess knee injuries. *Acta Ortop Bras*. 2013;21(5):288-294.
- Roy JS, Esculier JF, Maltais DB. Translation, cross-cultural adaptation and validation of the French version of the Knee Outcome Survey-Activities of Daily Living Scale. *Clin Rehabil*. 2014;28:614-623.
- United Nations Arabic. Home page. Accessed February 4, 2022. <https://www.un.org/ar>

### Knee Outcome Survey: Sports Activities Scale

**Symptoms**

Symptom	Never have [5]	Have, but does not affect sports activity [4]	Affects sports activity slightly [3]	Affects sports activity moderately [2]	Affects sports activity severely [1]	Prevents me from all sports activity [0]
Pain [SAS 1]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Grinding or grating [SAS 2]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stiffness [SAS 3]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Swelling [SAS 4]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Slipping or partial giving way of knee [SAS 5]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Buckling or full giving way of knee [SAS 6]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Weakness [SAS 7]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Functional Limitations with Sports Activities**

Sports activity	Not difficult at all [5]	Minimally difficult [4]	Somewhat difficult [3]	Fairly difficult [2]	Very difficult [1]	Unable to do [0]
Run straight ahead? [SAS 8]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jump and land on your involved leg? [SAS 9]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stop and start quickly? [SAS 10]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cut and pivot on your involved leg? [SAS 11]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How would you rate the current function of your knee during sports activities on a scale from 0 to 100 with 100 being your level of knee function prior to your injury and 0 being the inability to perform any sports activities?	<input style="width: 30px; height: 20px;" type="text"/> %
	Normal                  Nearly normal                  Abnormal                  Severely abnormal
How would you rate the overall function of your knee during sports activities?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
As a result of your knee problem, how would you rate your current level of activity during sports?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Describe your highest level of sports activity at each of the following points in time.	Strenuous sports*                  Moderate sports**                  Light sports***                  No sports activities possible
Prior to your knee injury	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Prior to treatment of your knee injury	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Currently	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Describe the frequency that you participated in sports activity at each of the following points in time.	4 to 7 times per week                  1 to 3 times per week                  1 to 3 times per month                  Less than 1 time per month
Prior to your knee injury	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Prior to treatment of your knee injury	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Currently	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

\*Strenuous sports (ex. football, soccer, basketball)

\*\*Moderate sports (ex. tennis, skiing)

\*\*\*Light sports (ex. cycling, swimming, golf)

**Appendix Figure A1.** English version of the Knee Outcome Survey–Sports Activities Scale.

## دراسة استقصائية لوظيفة الركبة: مقياس الأنشطة الرياضية

## مقياس الأعراض

المستوى الرياضي						الأعراض
الأعراض تمنعني من أداء جميع الأنشطة الرياضية [0]	الأعراض تؤثر بشدة على نشاطي الرياضي [1]	الأعراض تؤثر بشكل متوسط على نشاطي الرياضي [2]	الأعراض تؤثر قليلاً على نشاطي الرياضي [3]	لدي أعراض ولكنها لا تؤثر على نشاطي الرياضي [4]	ليس لدي أعراض [5]	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	الألم [SAS 1]
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	خشونة وعدم سلاسة الحركة [SAS 2]
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	التيبس [SAS 3]
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	التورم [SAS 4]
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	التعثر أو الانفلات الجزئي للركبة [SAS 5]
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	الزوغان أو الانفلات الكامل للركبة [SAS 6]
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	الضعف [SAS 7]

## مقياس الرياضة

الرياضة	غير صعب [5]	صعب قليلاً [4]	صعب بعض الشيء [3]	صعب بشكل ملحوظ [2]	صعب جداً [1]	غير قادر على القيام بالنشاط [0]
أركض بشكل مستقيم [SAS 8]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
أقفز وأهبط على الرجل المصابة [SAS 9]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
أتوقف وأستأنف بسرعة [SAS 10]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
أتوقف وأستدير على الرجل المصابة [SAS 11]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

% <input type="checkbox"/>				كيف تقيم وظيفة ركبتك في الوقت الحالي عند أدائك للأنشطة الرياضية على المقياس المتدرج من صفر إلى مئة باعتبار أن مئة تمثل المستوى الوظيفي لركبتك قبل الإصابة وصفر يمثل العجز عن القيام بأي من الأنشطة الرياضية؟
طبيعي	شبه طبيعي	غير طبيعي	غير طبيعي جداً	كيف تقيم وظيفة ركبتك بشكل عام عند القيام بالأنشطة الرياضية؟
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	نتيجة لإصابتك في الركبة، كيف تقيم مستواك الحالي في أدائك للأنشطة الرياضية؟
الرياضات الشاقة*	الرياضات المتوسطة**	الرياضات الخفيفة***	الرياضة غير ممكنة	صف أعلى مستوى لك في كل من الأنشطة الرياضية التالية
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	قبل الإصابة
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	قبل المعالجة
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	في الوقت الحالي
٤ إلى ٧ مرات أسبوعياً	مرة إلى ٣ مرات أسبوعياً	مرة إلى ٣ مرات شهرياً	أقل من مرة في الشهر	حدد معدل مشاركتك في الأنشطة الرياضية التالية
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	قبل الإصابة
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	قبل المعالجة
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	في الوقت الحالي

\* الرياضات الشاقة مثل كرة القدم وكرة السلة

\*\* الرياضات المتوسطة مثل كرة المضرب والتزلج

\*\*\* الرياضات الخفيفة مثل ركوب الدراجات والسباحة

Appendix Figure A2. Arabic version of the Knee Outcome Survey-Sports Activities Scale (SAS).