

Original Research Article

Construct validity of the Moroccan KOOS via SF-36 correlations in patients with knee disorders

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ABSTRACT

Background: The knee injury and osteoarthritis outcome score (KOOS) is a widely used patient-reported measure of knee pain, symptoms, function, and quality of life (QoL). This study aimed to evaluate the construct validity of the Moroccan KOOS by examining its convergent and divergent validity with SF-36 dimensions.

Methods: A cross-sectional study was conducted including patients with knee disorders in Morocco. Participants completed the Moroccan version of the KOOS and the SF-36 health-related QoL questionnaire. Construct validity was evaluated by examining correlations between the five KOOS subscales (Pain, Symptoms, Activities of Daily Living (ADL), Sport/Rec, and QoL) and the eight SF-36 dimensions.

Results: Strong positive correlations were observed between KOOS subscales and SF-36 Physical Functioning (D1) and Role Physical (D2), particularly for Pain, ADL, Sport/Rec, and QoL ($r=0.405 - 0.769$, $p<0.01$), supporting convergent validity. Significant positive correlations were found between KOOS subscales and SF-36 Bodily Pain (D3) ($r=0.283$ to 0.698 , $p<0.01$). Positive correlations were also observed with Vitality (D5) and Role Emotional (D7), whereas weak or non-significant correlations with General Health (D4) and Social Functioning (D6) supported divergent validity. Additionally, negative correlations with Mental Health (D8) were observed for most KOOS subscales, further confirming construct distinctiveness.

Conclusions: The Moroccan version of the KOOS demonstrated very good construct validity, consistent with findings from other cross-cultural validations, confirming its relevance and robustness in the Moroccan population with knee disorders.

Keywords: Knee pain, Construct validity, SF-36, KOOS Questionnaire

INTRODUCTION

The knee injury and osteoarthritis outcome score (KOOS) is a widely used patient-reported outcome measure designed to assess knee-related pain, symptoms, functional limitations, and knee-specific quality of life (QoL). Originally developed for patients with joint injuries and

knee osteoarthritis, KOOS comprises five subscales: pain, symptoms, activities of daily living (ADL), sports and recreation (Sport/Rec), and knee-related QoL.¹ The KOOS has been shown to be a valid, reliable, and responsive instrument for assessing outcomes in patients with various knee conditions, including after surgical interventions

such as total knee arthroplasty and anterior cruciate ligament reconstruction.²

The SF-36 Health Survey (SF-36) is a generic instrument measuring health-related QoL across eight dimensions: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health.³ The instrument provides insights into broad health constructs and has been extensively validated for use in diverse populations and disease contexts, making it a standard tool for health status assessment and comparisons across studies and interventions.⁴

Comparing KOOS subscale scores with corresponding SF-36 dimensions allow evaluating the construct validity (both convergent and divergent) of KOOS in a given population. Indeed, validation studies across different languages and settings have demonstrated moderate to strong correlations between KOOS subscales and relevant SF-36 domains (e.g., KOOS Pain with SF-36 Bodily Pain, KOOS ADL with SF-36 Physical Functioning), supporting KOOS's construct validity.⁵

Moreover, Age is a key factor influencing the presentation and progression of knee disorders and related patient-reported outcomes. Population-based reference data show that KOOS subscale scores tend to decrease with increasing age, indicating worse knee-related symptoms and functional status among older adults, and highlighting the need to consider age when interpreting knee outcome measures. Similarly, age- and sex-specific differences in KOOS scores have been documented, with older age groups and female participants often reporting lower knee function and QoL compared with younger or male counterparts.⁶

Thus, the primary aim of this study was to assess the construct validity of the KOOS by evaluating the correlations between each of its five subscales and the corresponding SF-36 dimensions. We hypothesized a priori that the KOOS Pain subscale would demonstrate the strongest correlation with the SF-36 Bodily Pain domain, whereas the ADL and Sport/Rec subscales would correlate most strongly with Physical Functioning. We also expected the KOOS QoL subscale to show strong correlations with the physical health domains of the SF-36, particularly Physical Functioning and Bodily Pain. In contrast, weaker correlations were anticipated with the mental and social health domains of the SF-36 (Vitality, Social Functioning, Role Emotional, and Mental Health), supporting divergent validity. The secondary objective was to explore the associations between age and each KOOS subscale, including analyses stratified by sex.

METHODS

Study design and setting

A cross-sectional study was conducted among Moroccan adults presenting with knee pain. Participants were

recruited from a tertiary-care university hospital rheumatology department. Data were collected between June 2019 and September 2020 using standardized questionnaires administered anonymously.

Study population

Eligible participants were adults aged ≥ 18 years who reported knee pain and were able to complete the questionnaires independently. Patients with cognitive impairment or major comorbid conditions that could independently affect health-related QoL and interfere with questionnaire completion were excluded. These included central nervous system disorders (e.g., stroke, spinal cord injury or Parkinson's disease), acute medical conditions, and other severe disabling illnesses unrelated to the knee. The baseline clinical characteristics of the participants are presented in Table 1.

Consent to participate

Written informed consent was obtained from all participants. Data confidentiality and anonymity were strictly maintained.

Sample size calculation

The required sample size for detecting a correlation between KOOS subscales and SF-36 dimensions was calculated using the formula based on Fisher's z transformation:

$$n = ((Z_{1-\alpha/2} + Z_{1-\beta}) / (0.5 \times \ln((1+r)/(1-r))))^2 + 3$$

where r is the expected correlation coefficient, $Z_{1-\alpha/2}$ corresponds to a two-sided significance level of 0.05 (1.96), and $Z_{1-\beta}$ corresponds to a statistical power of 80% (0.84).

Assuming a moderate expected correlation of $r=0.30$, the minimum required sample size was approximately 84 participants. A total of 98 subjects were included in the present study, exceeding the calculated requirement and ensuring adequate statistical power for the planned correlation analyses. This approach is consistent with standard statistical methods for determining sample size in correlation studies based on Fisher's z transformation.⁷

Data collection and variables

Sociodemographic and clinical data were collected using a structured questionnaire and included age, sex, educational level, and relevant clinical characteristics.

QoL measurement

KOOS

The KOOS was used to assess QoL. The KOOS is a validated self-administered instrument consisting of 42

items divided into five subscales: Pain, Symptoms, Activities of Daily Living (ADL), Sports, Function and Recreational activities and Knee-related QoL. Each subscale is scored from 0 to 100, with higher scores indicating better knee-related health status.² We used the validated version of this questionnaire, which has been adapted and validated for the Moroccan context.⁸

Short form-36 health survey (SF-36)

Generic health-related QoL was assessed using the Arabic version of the SF-36, a validated instrument that has been psychometrically validated in a Moroccan population. The SF-36 includes eight domains: Physical Functioning, Role Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role Emotional, and Mental Health. Each domain is scored on a 0–100 scale, with higher scores indicating better perceived health status.^{9,10}

Statistical analysis

Descriptive statistics were used to summarize participant characteristics and questionnaire scores. Continuous variables were expressed as means and standard deviations (SD) and qualitative variables were presented by percentages. The normality of continuous variables was assessed using the Kolmogorov–Smirnov test. Depending on the distribution of the data, construct validity was evaluated by calculating either Pearson's or Spearman's correlation coefficients between the KOOS and SF-36 subscales. Statistical significance was set at $p \leq 0.05$. Data were entered into Microsoft Excel, and statistical analyses were carried out using SPSS software, version 26.

RESULTS

A total of 98 adults with knee pain were included in the study, comprising 52 men (53.1%) and 46 women (46.1%), with a mean age of 53.33 ± 16 years (Table 1).

Table 1: Baseline clinical characteristics of the participants (n=98).

Variables	N (%)
Age (years); mean (SD) (n=98)	53.3 (16)
Gender (n=98)	
Male	52 (53.1%)
Female	46 (46.9%)
Type of knee condition (n=83)	
Knee osteoarthritis	5 (6%)
Others	78 (94%)

Table 2: Means±standards deviation (SD) of the five KOOS subscales and the eight SF-36 subscales.

Subscales	Mean±SD
KOOS subscales	
Pain	51.58±20.87
Symptoms	59.14±16
ADL	54.84±20.9
Sports /Rec	30.0±25.32
QoL	43.04±28.25
SF-36 subscales	
Physical Functioning (D1)	42.35±29.6
Role Physical (D2)	20.66±36
Bodily Pain (D3)	51±21.82
General Health (D4)	52.1±9.55
Vitality (D5)	44.65±11.51
Social Functioning (D6)	50.76±10.12
Role Emotional (D7)	49.65±47.2
Mental Health (D8)	47±16.03

KOOS and SF-36 descriptive statistics

The mean scores and standard deviations of the five KOOS subscales and the eight SF-36 dimensions are presented in Table 2. Among the KOOS subscales, the highest mean score was observed for Symptoms, with a mean of 59.14

(16), reflecting relatively better status in this domain, whereas the lowest KOOS subscale score was observed for Sport/Rec, with a mean of 30 (25.32), reflecting limitations in high-demand physical activities. For the SF-36, the highest score was observed in the General Health dimension, with a mean of 52.10 (9.55), and the lowest in Role Physical, with a mean of 20.66 (36), indicating

relatively preserved general health but marked limitations in physical role functioning.

Internal coherence of KOOS

Correlations between KOOS subscales are shown in Table 3, indicating moderate to strong positive associations across domains (ranging from $r=0.105$ to $r=0.818$). These results suggest good internal coherence of the KOOS subscales in this population.

Construct validity: KOOS vs SF-36

No significant correlations were observed between any KOOS subscale and D4 (General Health) or D6 (Social Functioning), supporting divergent validity, as these dimensions are conceptually less directly related to knee-specific outcomes (Table 4).

Table 3: Correlations between KOOS subscales (internal correlations).

KOOS subscales	Pain	Symptoms	ADL	Sports	QoL
Pain	1	0.118	0.818**	0.545**	0.573**
Symptoms	0.118	1	0.105	0.183	0.296*
ADL	0.818**	0.105	1	0.708**	0.553**
Sports/Rec	0.545**	0.183	0.708**	1	0.517**
QoL	0.573**	0.296*	0.553**	0.517**	1

* $p<0.05$; ** $p<0.001$

Table 4: Correlation matrix between KOOS and SF-36 subscales.

Subscales	SF-36 D1	SF-36 D2	SF-36 D3	SF-36 D4	SF-36 D5	SF-36 D6	SF-36 D7	SF-36 D8
Pain	0.651**	0.444**	0.635**	0.154	0.270*	-0.001	0.416**	-0.235*
Symptoms	0.135	0.194	0.283*	0.043	0.254*	-0.032	0.228*	-0.217*
ADL	0.674**	0.486**	0.587**	0.164	0.244*	-0.034	0.389**	-0.369**
Sports/Rec	0.562**	0.403**	0.501**	0.096	0.209*	-0.084	0.254*	-0.369**
QoL	0.769**	0.621**	0.698**	0.120	0.309*	-0.081	0.550**	0.349**

* $p<0.05$; ** $p<0.001$

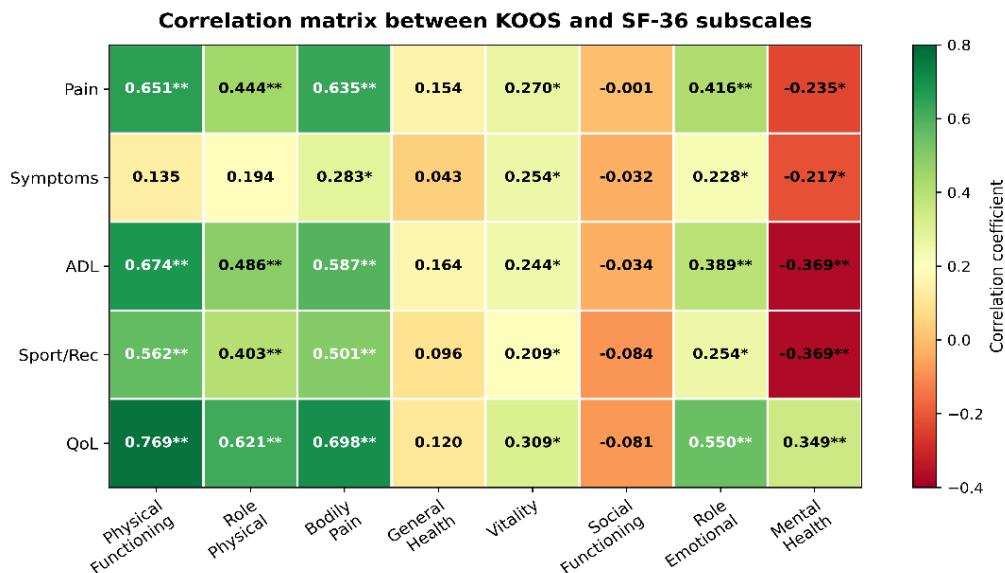


Figure 1: Heatmap of correlations between KOOS subscales and SF-36 domains.

This heatmap shows correlations between the five KOOS subscales and eight SF-36 dimensions. Green indicates positive correlations. Red indicates negative correlations. Values appear in each cell, with stronger relationships represented by more intense colours.

In contrast, D1 (Physical Functioning) and D2 (Role Physical) showed significant positive correlations with KOOS Pain, Sport/Rec, ADL, and QoL subscales (all

$p<0.001$), supporting convergent validity, consistent with the expectation that better physical functioning relates to better knee-specific outcomes.

For D3 (Bodily Pain), significant positive correlations were observed with KOOS Pain, Symptoms, ADL, Sport/Rec, and QoL subscales (all $p < 0.001$) (Table 4).

D5 (Vitality) displayed weak but significant positive correlations with all KOOS subscales, indicating limited overlap between the constructs assessed by the two instruments while suggesting that higher energy levels are associated with better knee-related outcomes (Table 4).

D7 (Role Emotional) showed significant positive correlations with all KOOS subscales, indicating a modest association between emotional role functioning and knee-specific health status. Regarding the Mental Health domain (D8), small but significant negative correlations were observed with the KOOS Pain, Symptoms, ADL, and Sport/Rec subscales, whereas the KOOS QoL subscale showed a significant positive correlation ($r = 0.349$, $p < 0.01$). These findings suggest that psychological well-being is associated with knee-specific outcomes, although the relationships are generally weaker and less consistent

than those observed for the physical health domains (Table 4).

The correlations between the KOOS subscales and the SF-36 dimensions are visually summarized in Figure 1 using a heatmap representation. This figure illustrates the direction and strength of the associations, with color gradients indicating the magnitude of correlation coefficients and numerical values displayed within each cell.

Associations between KOOS and age

In the overall sample, age showed weak but significant negative correlations with the KOOS Pain ($r = -0.234$, $p < 0.05$) and Sport/Recreation ($r = -0.209$, $p < 0.05$) subscales, indicating that increasing age was associated with poorer pain-related and sport/Rec outcomes. No significant correlations were observed between age and the Symptoms, ADL, or QoL subscales (Table 5).

Table 5: Correlation between KOOS sub-scores and age.

KOOS sub-scores	Age		
	r coefficient		
	Men	Women	Total
Pain	-0.352*	-0.118	-0.234*
Symptoms	0.116	-0.038	0.014
ADL	-0.222	-0.072	-0.149
Sports/Rec	-0.177	-0.171	-0.209*
QoL	-0.249	-0.084	-0.182

* $p < 0.05$.

In the sex-stratified analyses, a significant negative correlation between age and the Pain subscale was observed among men ($r = -0.352$, $p < 0.05$), whereas no significant associations were found among women for any KOOS subscale.

DISCUSSION

In this study, the KOOS demonstrated good construct validity in a Moroccan adult population with knee pain, as evidenced by expected patterns of correlations with the SF-36 dimensions. Convergent validity was supported by significant positive correlations between KOOS subscales and related SF-36 domains, such as Physical Functioning (D1) and Role Physical (D2), particularly with the KOOS Sport/Rec and ADL subscales, reflecting the expected relationship between knee-specific outcomes and general physical health. These findings are consistent with previous studies showing that KOOS subscales correlate strongly with physically relevant SF-36 dimensions.^{1,11}

Similarly, the weak or non-significant correlations observed between the KOOS subscales and the SF-36 General Health (D4) and Social Functioning (D6) domains support divergent validity, indicating limited overlap between these constructs. In contrast, the weak but

significant correlations with Vitality (D5) and the moderate correlations with Role Emotional (D7) suggest that energy levels and emotional role functioning are related, albeit to a lesser extent than the physical health domains. These findings are consistent with previous cross-cultural validation studies of the KOOS.¹²⁻¹⁴

As hypothesized, the KOOS Pain, ADL, Sport/Rec, and QoL subscales demonstrated significant positive correlations with the SF-36 Bodily Pain domain (D3). The strongest correlations were observed for the Pain, ADL, and QoL subscales, reflecting the conceptual overlap between pain severity and knee-related function. These findings support the convergent validity of the KOOS, as better pain-related health status measured by the SF-36 was associated with better knee-specific outcomes.^{15,16}

Finally, negative correlations between KOOS subscales and the SF-36 Mental Health dimension (D8) further support divergent validity, indicating that knee-specific symptoms and functional limitations are conceptually distinct from general psychological well-being.¹⁷

The correlations observed with the SF-36 Mental Health domain (D8) indicate that psychological well-being is associated with knee-specific symptoms and function,

although the relationships were generally weaker and less consistent than those observed for the physical health domains. This finding suggests that, while mental health contributes to patients' perceptions of knee-related health, it represents a related but distinct construct rather than evidence of divergent validity.¹⁶

Our findings also indicate that age is negatively correlated with four KOOS subscales pain, ADL, Sport/Rec, and QoL suggesting that older participants experience greater knee pain, reduced functional ability, and lower knee-related QoL. This observation aligns with existing literature reporting age-related declines in physical function and increased symptom burden among individuals with knee osteoarthritis and other knee disorders.^{6,18}

Age-related functional decline is likely multifactorial, reflecting degenerative joint changes, sarcopenia, and reduced physical activity levels, which together contribute to worsening knee symptoms and limitations.¹⁹ These findings highlight the importance of considering age when interpreting KOOS scores and underscore the instrument's sensitivity to clinically relevant differences in knee function across the adult lifespan.

This study provides further evidence that the KOOS is a reliable and valid tool for evaluating knee-related outcomes in Moroccan adults, capturing both physical and QoL dimensions while demonstrating appropriate convergent and divergent validity. The observed age-related patterns reinforce the clinical relevance of the KOOS, suggesting that it can sensitively detect functional differences across age groups. However, the cross-sectional design limits causal interpretations, and the sample was drawn from a single clinical center, which may affect generalizability. Future studies should evaluate KOOS psychometrics in larger and more diverse Moroccan populations.

CONCLUSION

This study provides evidence that the Moroccan version of the Knee Injury and Osteoarthritis Outcome Score (KOOS) demonstrates very good construct validity in patients with knee disorders. The observed pattern of correlations with the SF-36 dimensions supports both convergent and divergent validity, in line with the theoretical framework of the instrument. These findings are consistent with results reported in previous cross-cultural validation studies conducted in diverse populations, reinforcing the robustness and cross-cultural applicability of the KOOS.

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Ethical approval: This study was approved by the Hospital-University Ethics Committee of Fez, Morocco (reference number 07/19) and was conducted in accordance with the principles of the Declaration of Helsinki

REFERENCES

1. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynnon BD. Knee injury and osteoarthritis outcome score (KOOS)—development of a self-administered outcome measure. *J Orthop Sports Phys Ther.* 1998;28(2):88–96.
2. Roos EM, Toksvig-Larsen S. Knee injury and osteoarthritis outcome score (KOOS)—validation and comparison to the WOMAC in total knee replacement. *Health Qual Life Outcomes.* 2003;1:17.
3. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care.* 1992;30(6):473–83.
4. Filnmus. SF-36 – Short Form Health Survey. Marseille (FR): Filnmus. Available from: <https://www.filmus.fr/la-documentation/professionnels-de-la-sante/documentation-medicale/outils-devaluation/sf-36> Accessed on 10 July 2026.
5. Multanen J, Honkanen M, Häkkinen A, Kiviranta I. Construct validity and reliability of the Finnish version of the Knee Injury and Osteoarthritis Outcome Score. *BMC Musculoskelet Disord.* 2018 May 22;19:155.
6. Paradowski PT, Bergman S, Sundén-Lundius A, Lohmander LS, Roos EM. Knee complaints vary with age and gender in the adult population. Population-based reference data for the Knee Injury and Osteoarthritis Outcome Score (KOOS). *BMC Musculoskelet Disord.* 2006;7:38.
7. Bonett DG, Wright TA. Sample size requirements for estimating Pearson, Kendall and Spearman correlations. *Psychometrika.* 2000;65(1):23–8.
8. Mahfoudi H, Filankembo A, Qarmiche N, Otmani N, Chrifi Alaoui A, Harzy T, et al. P014 – Échelle marocaine KOOS adulte : traduction, adaptation culturelle et validation [abstract]. *Rev Epidemiol Sante Publique.* 2023;71(Suppl 2):101655.
9. El Emrani L, Senhaji M, Bendriss A. Measuring health-related quality of life in the population of Tetouan, Morocco, by the SF-36: normative data and the influence of gender and age. *East Mediterr Health J.* 2016;22(2):133–41.
10. Khoudri I, Ali Zeggwagh A, Abidi K, Madani N, Abouqal R. Measurement properties of the short form-36 and health-related quality of life after

- intensive care in Morocco. *Acta Anaesthesiol Scand.* 2007;51:189–97.
11. Roos EM, Lohmander LS. The Knee Injury and Osteoarthritis Outcome Score (KOOS): from joint injury to osteoarthritis. *Health Qual Life Outcomes.* 2003;1:64.
 12. Phatama KY, Aziz A, Bimadi MH, Oktafandi IGNAA, Cendikiawan F, Mustamsir E. Knee Injury and Osteoarthritis Outcome Score: validity and reliability of an Indonesian version. *Ochsner J.* 2021;21(1):63–7.
 13. Cheung RTH, Ngai SPC, Ho KKW. Chinese adaptation and validation of the Knee Injury and Osteoarthritis Outcome Score (KOOS) in patients with knee osteoarthritis. *Rheumatol Int.* 2016;36:1449–54.
 14. Lizaaur-Utrilla A, Miralles-Muñoz FA, González-Parreño S, López-Prats FA. Validation of the Spanish version of the Knee Injury and Osteoarthritis Outcome Score (KOOS) for elderly patients with total knee replacement. *J Orthop Res.* 2019;37(10):2157–62.
 15. Ware JE, Kosinski M, Gandek B. SF-36 Health Survey: manual and interpretation guide. Lincoln (RI): QualityMetric Incorporated; 2000.
 16. Collins NJ, Misra D, Felson DT, Crossley KM, Roos EM. Measures of knee function: International Knee Documentation Committee (IKDC) Subjective Knee Evaluation Form, Knee Injury and Osteoarthritis Outcome Score (KOOS), KOOS-PS, KOS-ADL, Lysholm, Oxford Knee Score, WOMAC, Activity Rating Scale, and Tegner Activity Score. *Arthritis Care Res (Hoboken).* 2011;63(Suppl 11):S208–28.
 17. Gonçalves RS, Cabri J, Pinheiro JP, Ferreira PL, Gil J. Reliability, validity and responsiveness of the Portuguese version of the Knee injury and Osteoarthritis Outcome Score – Physical Function Short-form (KOOS-PS). *Osteoarthritis Cartilage.* 2010;18(3):372–6.
 18. Alshahrani AS, Aljaffar AB, Albin Ahmed BJ, Altabash MW, Dajani ZA, Alamer AH, et al. Correlation between Kellgren-Lawrence classification of osteoarthritis and Knee Injury and Osteoarthritis Outcome Score. *World J Orthop.* 2025;16:11.
 19. Stefanacci RG. Modifications physiques liées à l'âge. In: Manuel MSD, version pour professionnels de la santé. Rahway (NJ): Merck & Co. Available from: <https://www.msdmanuals.com/fr/professional/gériatrie/prise-en-charge-du-patient-gériatrique/modifications-physiques-liées-à-l-âge> Karl Accessed on 10 July 2026.

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