Psychometrical properties of the Turkish translation of the New Knee Society Scoring System

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Objective: To translate the New Knee Society Scoring System (KSS) into Turkish and to evaluate the psychometric properties of the translated questionnaire.

Methods: This study was conducted on 66 knees of 43 pre-op patients who were scheduled for total knee arthroplasty (TKA) and 50 knees of 26 knee arthroplasty patients at least 6 months postoperatively. KSS was translated and culturally adapted according to the guidelines of Guillemin and Beaton. Demographic and clinical characteristics of the patients were recorded. Patients completed WOMAC, KOOS and SF-36 surveys along with the Turkish version of the new KSS. After the initial evaluation, patients were asked to re-fill the new KSS 1 week later. Internal consistency and reliability were tested using Cronbach’s alpha coefficient and intraclass correlation coefficient (ICC). Validity was assessed by calculating the Spearman’s correlation coefficient between the new KSS and WOMAC, KOOS and SF-36 scores.

Results: The mean ages of the pre and post-operative groups were 67.16 ± 7.85 years and 71.65 ± 6.95 years respectively. The Cronbach’s alpha coefficients of the new KSS calculated for symptoms (0.814), patient satisfaction (0.947), patient expectations (pre-op = 1.000, post-op = 0.997) and functional activities (0.864) were high. The ICC scores ranged between 0.790 and 0.951. The pain subscore of the new KSS and the pain subscores of the WOMAC (r = −0.720; p < 0.01), KOOS (r = 0.550; p < 0.01) and SF-36 (r = −0.434; p < 0.01) were highly correlated. Emotional role functioning (RH), mental health (MH) and social role functioning (SF) subscores of SF-36 showed no correlation with the all subscores of the new KSS. No floor or ceiling effects in the new KSS scores were detected.

Conclusion: It is concluded that the new KSS is a valid and reliable questionnaire which can be used in evaluating the pre and post-operative Turkish speaking TKA patients.

Level of evidence: Level III Diagnostic Study.

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Introduction

Osteoarthritis (OA) is the most common chronic and degenerative joint disease.1,2 It usually occurs in weight-bearing joints, also most commonly seen in the knee joint.3,4 In the final stage of knee OA when conservative treatment is insufficient, a surgical treatment “total knee arthroplasty (TKA)” is applied to patients to reduce pain, improve mobility skills and quality of life.5,6 It has been reported that the utilization of TKA is rising. In a study conducted in the United States, approximately 15% of patients have symptomatic knee OA.7 Ceyhan and colleagues reported that a total of 283,400 primary and 9900 revision total knee arthroplasty were performed between 2010 and 2014 in Turkey.8

Orthopedic assessment measures generally focus on objective parameters such as radiographic analysis or clinical tests. In recent years, another dimension has been added to clinical outcome evaluations after the validity of patient-centered questionnaires.9 It is suggested that TKA should not only be assessed by clinical tools, but also satisfaction and expectations of the patient in relation to their daily living activities should also be assessed.10 Before and after the TKA, patients are evaluated both with patient-oriented and performance-based assessment tools.11 In 1989, Knee Society...
developed the Knee Society Scoring System which is a simple and objective scoring system. This questionnaire has become one of the most commonly used tool in the world for evaluating the functional status of TKA patients.\textsuperscript{12,13} Nevertheless, with the developing medical facilities and the rising expectations of the patient population, problems arise with regard to validity, reliability and consistency, depending on the initial questionnaire only evaluating objective parameters.\textsuperscript{13} Therefore, the scientific committee of the Knee Society has developed a new scoring system that includes patient’s satisfaction, expectation, recreational and sports activities, in addition to objective parameters of the previous survey. Thus, the new tool provides more comprehensive assessment for both pre-operative and post-operative TKA patients.\textsuperscript{14}

The new KSS is a comprehensive and widely used questionnaire. Six version studies were conducted for the questionnaire with validity and reliability: French,\textsuperscript{15} Dutch,\textsuperscript{16} Japanese,\textsuperscript{17} Chinese,\textsuperscript{18} Korean\textsuperscript{19} and Brazilian Portuguese.\textsuperscript{20} Considering the prevalence of OA\textsuperscript{21} in Turkey, the Turkish version of the questionnaire and the analysis of the psychometric properties are necessary. The aim of the study was to translate and culturally adapt the Knee Society's New Knee Scoring System into Turkish language and to evaluate the psychometric properties of the translated questionnaire.

**Materials and methods**

**Translation and adaptation process**

Methods and recommendations of Guillemin et al and Beaton et al were used for the translation and cross-cultural adaptation of the Turkish version of the new KSS.\textsuperscript{22,23} The English version of the questionnaire was translated into Turkish independently by the translation committee members consisted of four physiotherapist academicians. The translated versions were edited by the 4-person translation committee taking into account the Turkish socio-cultural and linguistic characteristics and the Turkish draft version revised. Only the discretionary activities section of functional activities domain of the questionnaire was adapted to Turkish culture. In this section, instead of “ballet” activity, the option of “folk dances” seemed appropriate. The adapted Turkish draft version was back-translated into English by a native English translator who was blind to the original questionnaire. After this process, the questionnaire was re-evaluated by the same 4-person translation committee. Last version was created after some adjustments by analyzing the compatibility with the original version (Appendix 1).

**Study design**

Our study was carried out on an 18-months period from January 2015 to June 2016 prospectively. The study was conducted in the Orthopedics and Traumatology Clinic of Mugla Sıtkı Koçman University Training and Research Hospital with patients in the at least 6 postoperative months. The inclusion criteria of the study were; Turkish literate persons, primary TKA indication with diagnosis of primary OA, have spent at least 6 months after surgery for post-op group of cases. The exclusion criteria of the study were; having TKA surgery due to trauma, patients with poor cognitive function or poor reading skills, patients with neurological disorders that can affect mobility, having postoperative complications (infection, deep vein thrombosis, etc.) and having undergone revision surgery, and patients who refuse to sign the consent form. The sample size is determined by the general principles and recommendation of Altman used in comparison studies which requires at least 50 data usage.\textsuperscript{24} A total of 81 patients were included in the study at first. However, 12 patients were excluded from the study because they did not participate in the second evaluation after one week. As a result, the study was conducted with 116 knees (58 right, 58 left) of 69 patients. The survey was conducted in accordance with the Helsinki declaration, taking the patient’s consent and within ethical principles. Permission has been obtained from concession holder, The Knee Society, for the translation of the new KSS. The study protocol was approved by the ethics committee of Muğla Sıtkı Koçman University.

Socio-demographical characteristics of the patients were recorded. All participants completed the Turkish versions of WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index), KOOS (The Knee Injury and Osteoarthritis Outcome Score) and SF-36 (Short Form-36), as well as the new KSS for initial assessment. One week after the first evaluation patients were asked to refil the new KSS for the reproducibility analyses.

The new KSS is a both physician and patient reported measure developed to evaluate TKA patients’ satisfaction, expectation, physical activities and the clinical and functional status in the pre-op and post-op periods. It consists of four sub-scales: symptoms (0–25 points), satisfaction score (0–40 points), expectation score (0–15 points), and functional activity score (0–110 points). Functional activity score was divided into three sub-categories: walking and standing, standard activities, and advanced activities and discretionary activities. Higher score indicates worse function.\textsuperscript{13,14,25} The Turkish version of the WOMAC\textsuperscript{26} and KOOS\textsuperscript{27} and questionnaires were chosen because they are generally used to assess OA patients. Besides being valid, reliable and highly accurate index that clinically determines the change in health status of patients who have knee and hip OA and who are treated for disease, their internal consistency and test-retest reliability for patients with knee disorders have proven. To assess validity, we also used the Turkish version of the SF-36 which is considered as a reference score for assessing OA patients.\textsuperscript{28}

**Statistical analysis**

For all the statistical analyses, SPSS for Windows v20.0 (SPSS Inc, Chicago, IL) computer program was used. Quantitative variables were presented as mean ± standard deviation (X ± SD) and qualitative variables were presented as percent (%). Confidence interval of 95% was accepted. Minimum and maximum scores of individual items and total value of the subscores were examined for possible floor or ceiling effect. If more than 15% of the participants achieved a minimum or maximum score, the presence of floor or ceiling effect could be mentioned.

**Analysis of the psychometric properties**

**Reliability**

Internal consistency was measured using the Cronbach’s alpha coefficient. The Cronbach’s alpha co-efficient was calculated for the 4 subscore of the questionnaire (symptoms, patient satisfactions, patient expectations, functional activities) separately. Intra class correlation coefficient (ICC) was used to assess test-retest reliability. Two-way random-effect model single-measure reliability analysis was used. The ICC was calculated for each item and subscores.

**Validity**

Construct validity of the scale was assessed by calculating the Spearman’s correlation coefficient between the subscores of the new KSS and the subscores of WOMAC, KOOS and SF-36. For the analysis of convergent validity, the Spearman’s correlation coefficient (r) between the subscores of the new KSS and similar
subscores of WOMAC, KOOS and SF-36 was used. The discriminant validity was assessed using the Spearman correlation coefficient between the subscores of the new KSS and emotional role strength (RH), mental health (MH) and social functioning (SF) subscores of the SF-36. A high correlation coefficient for the convergent, and a low correlation coefficient for the discriminant validity were expected.

Results

The study was carried out with 69 cases (68.85 ± 7.78 years) who met the inclusion criteria and agreed to participate in the study. In the pre-op group a total of 43 patients (37 women (86%) and 6 men (14%)) with a mean age 67.16 ± 7.84 years, and in the post-op group a total of 26 patients (21 (80.8) women and 5 (19.2%) men) with a mean age 71.65 ± 6.95 years were assessed. One knee joint was preoperative and the other knee joint was postoperative for 11 patients. These patients were evaluated by including them into both preoperative and postoperative groups. A total of 116 knees (66 preoperative knees, and 50 postoperative knees) were evaluated. The socio-demographic, physical and clinical characteristics of the patients are given in Table 1. The absolute values of the WOMAC, KOOS and SF36 scales are given in Table 2.

Floor effect was observed only for Advanced Activities subscore (%15,9). No ceiling effect was observed for the individual items and for the total value of the new KSS subscores.

Reliability

The Cronbach’s alpha coefficient was calculated for the subscores of the questionnaire; symptoms (3 questions), satisfaction (5 questions), expectations (3 questions) and functional activities (17 questions). The Cronbach’s alpha coefficient for the 4 subscores of the new KSS was high (Cronbach α > 0.80). Test-retest evaluation of the new KSS was performed by calculating the ICC coefficient of each subscore of the scale. The ICC scores ranged from 0.790 to 0.951 and were excellent in the majority of the reliability items. The scale was suitable for reproducibility (Table 3).

Validity

Correlation coefficients between the subscores of the scales are given in Table 4. The symptoms subscore was correlated with all subscores of WOMAC and KOOS (p < 0.05). Besides, it was correlated with role limitations due to physical function and pain subscores of SF-36.

Satisfaction subscore was similarly correlated with all subscores of WOMAC. It was not correlated with pain, stiffness and daily life subscores of KOOS. Alike to symptoms subscore, satisfaction subscore was correlated with pain subscore of SF-36. The expectations score was found to be correlated with KOOS pain subscore, SF-36 general health and social function subscores for the postoperative group. Functional activities subscore was correlated with WOMAC pain, KOOS daily life, quality of life subscores and SF-36 pain subscore.

Discussion

In the present study, the Turkish version of the new KSS was proved to be valid and reliable for the assessment of Turkish speaking patients with preoperative and postoperative TKA. The translation and adaptation of the new KSS into Turkish is important in terms of enabling the native Turkish speakers who live in other European Union countries with a population of around three million, besides the people living in Turkey.25 We believe that translating and adapting such a questionnaire is important for demonstrating functional status of Turkish speaking TKA patients, specifically.

In the pilot study for Turkish version, all parts of the questionnaire were found to be intelligible. Only the “ballet” activity in the discretionary activities section of the functional activities subscore was adapted to Turkish culture and the “folk dances” option was deemed appropriate. Pilot studies have not been conducted in French and Japanese versions.15,17 It is emphasized that some corrections are required for the study of the French version.15 It is stated that similar arrangements have been made in the study of the Japanese version. In Japanese study, cultural adaptation has also been emphasized by adding “hiking” and “ground golf” activities, which are known to be widespread in Japan and shown in previous studies in popularity, to the discretionary activities section of the functional activities.17

In our study, no major floor or ceiling effects were observed for the minimum and maximum scores for individual items and for the total value of the new KSS subscores. Similarly, in Dutch, Chinese and Japanese version of the questionnaire, it was reported that there was no floor or ceiling effects.30,31 In Korean and Brazilian Portuguese versions floor or ceiling effect were not considered.19,20

Symptoms, patient satisfaction, patient expectations and functional activities subscores were found to be higher in the Cronbach α values. Similarly, in the French version of the questionnaire, the Cronbach’s alpha coefficient was calculated for four subscores, and all of them were found to be reliable, although the symptoms section had the lowest correlation coefficient.19 In the Japanese version of the study, the lowest Cronbach’s alpha score were reported for symptoms subscore and also all subscores of the questionnaire were reliable.12 All subscores were found reliable in the Dutch, Chinese and Korean versions of the questionnaire as well.16,18,19

The ICC scores of our study were between 0.790 and 0.951 for the four subscores of the questionnaire. Reliability was excellent in most of the version studies of the new KSS. It was seen that the scale was adequate in terms of reproducibility. In the French version, the ICC values were found to be between 0.84 and 0.97, while between 0.73 and 0.92 in the Dutch version, between 0.65 and 0.88 in the Japanese version and between 0.69 and 0.86 in the Korean version.15,16,17,18 In the Chinese version, ICC value was calculated only for the total score and this score was reported as 0.92.18 In the Dutch and French versions, researchers calculated Cronbach’s alpha coefficient and ICC for total score.15,16 Since in the user manual scores were calculated only for subscores for the new KSS, we didn’t calculate the total score, hence made no statistical analyzes including total score.

In accordance with our hypothesis, high correlation was observed between the new KSS symptom subscore and pain

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Table 1
The socio-demographic physical and clinical characteristics of the patients.

| Characteristic                      | Total (n = 69)     |
|-------------------------------------|-------------------|
| Age (years, mean±SD)                | 68.85 ± 7.78      |
| Height (m, mean±SD)                 | 1.60 ± 0.05       |
| Weight (kg, mean±SD)                | 81.62 ± 14.23     |
| BMI (kg/m², mean±SD)                | 31.73 ± 5.38      |
| Symptom duration (years)            | 6.25 ± 4.16       |
| Education                           |                   |
| Literate (n, %)                     | 15 (52.7)         |
| Primary school (n, %)               | 50 (72.5)         |
| High school (n, %)                  | 4 (25.8)          |
| Residence                           |                   |
| Urban (n, %)                        | 33 (54.7)         |
| Rural (n, %)                        | 36 (55.2)         |

SD: standard deviation, n: number of patients.
The subscores of KOOS, WOMAC, and SF-36. The pain subscores of WOMAC and SF-36 and functional activities subscore of the new KSS were correlated in concordance with our hypothesis. SF-36’s RH subscore was not correlated with symptoms, satisfaction, expectations and functional activities subscores. MH and SF subscores similarly had low correlation coefficients with the symptom subscore of the new KSS.

Correlation with the KOOS, AMIQUAL and SF-12 questionnaires were used to analyze construct validity in the French version. In French version, the symptoms section was correlated with the subscores of pain and functional activities parameters in a similar manner with our study. Expectations subscore was correlated with only pain score; besides, satisfaction subscore was correlated with pain, symptoms and functional activities subscores of the

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**Table 2**

Average values (standard deviation, min-max) for WOMAC, KOOS and SF36 questionnaires.

|                  | Mean ± SD     | Range     |
|------------------|---------------|-----------|
| WOMAC            |               |           |
| Pain             | 8.00 ± 3.98   | (0–15)    |
| Stiffness        | 2.13 ± 1.69   | (0–6)     |
| Physical Functions | 35.85 ± 11.51 | (7–68)    |
| KOOS             |               |           |
| Symptoms         | 62.13 ± 12.65 | (25–100)  |
| Pain             | 47.00 ± 17.32 | (19.44–100) |
| Daily life       | 38.41 ± 15.43 | (0–95.59) |
| Sports/Leisure   | 19.31 ± 13.78 | (0–50)    |
| Quality of life  | 19.61 ± 12.76 | (0–43.75) |
| SF-36            |               |           |
| Physical function (PF) | 12.09 ± 20.37 | (0–50)    |
| Role limitations due to physical health (RP) | 33.17 ± 44.79 | (0–100)     |
| Bodily pain (BP) | 37.03 ± 3.05  | (0–100)   |
| General health (GH) | 42.79 ± 10.69 | (20–82)    |
| Energy/Vitality (VT) | 50.0 ± 5.36  | (35–70)   |
| Social function (SF) | 50.50 ± 2.31  | (25–100)  |
| Role limitations due to emotional problems (RH) | 72.114 ± 3.66 | (0–100)    |
| Emotional well-being (MH) | 51.97 ± 6.89 | (0–64)     |

SD: standard deviation, n: number of patients.

**Table 3**

Test-retest reliability and internal consistency for the sub-scores of DC-YDPS.

|                  | n  | Test Mean ± SD | Retest Mean ± SD | ICC (95% CI) | α   |
|------------------|----|----------------|------------------|-------------|-----|
| Symptoms         | 116| 14.76 ± 6.30   | 14.84 ± 6.00     | 0.95 (0.93–0.97) | 0.81 |
| Satisfaction     | 116| 17.91 ± 8.97   | 18.01 ± 8.51     | 0.90 (0.85–0.93) | 0.95 |
| Expectations (pre-op group) | 66 | 9.40 ± 2.62    | 9.81 ± 2.71      | 0.79 (0.66–0.87) | 1.00 |
| Expectations (post-op group) | 50 | 9.62 ± 2.61    | 9.64 ± 2.71      | 0.85 (0.74–0.92) | 1.00 |
| Functional activities | 116| 44.53 ± 17.80  | 44.22 ± 18.89    | 0.95 (0.93–0.97) | 0.86 |

n: number of patients, ICC: Intra-class correlation coefficient, CI: Confidence interval, α: Cronbach’s alpha.

**Table 4**

Correlation between WOMAC, KOOS, SF-36 with DC-YDPS.

|                  | Symptoms | Satisfaction | Expectations (Pre-op) | Expectations (Post-op) | FA |
|------------------|----------|--------------|-----------------------|------------------------|----|
| WOMAC            | n = 116  | n = 116      | n = 66                | n = 50                 | n = 116 |
| Pain             | −0.720** | −0.597**     | −0.046                | −0.047                 | −0.368** |
| Stiffness        | −0.472** | −0.264**     | 0.075                 | −0.095                 | −0.140 |
| Physical function| −0.558** | −0.335**     | 0.123                 | −0.149                 | −0.167 |
| KOOS             | n = 116  | n = 116      | n = 66                | n = 50                 | n = 116 |
| Symptoms         | 0.426**  | 0.297**      | 0.028                 | 0.009                  | 0.110 |
| Pain             | 0.550**  | 0.481**      | −0.011                | 0.289*                 | 0.029 |
| Daily life       | 0.421**  | 0.322**      | 0.074                 | 0.053                  | 0.268** |
| Sports/Leisure   | 0.250**  | 0.130        | 0.121                 | 0.024                  | 0.091 |
| Quality of life  | 0.220*   | 0.176        | 0.085                 | 0.019                  | 0.244* |
| SF-36            | n = 116  | n = 116      | n = 66                | n = 50                 | n = 116 |
| Physical function| −0.065   | −0.030       | 0.452**               | 0.134                  | −0.071 |
| Role physical    | 0.254**  | 0.161        | −0.112                | 0.122                  | 0.174 |
| Bodily pain      | 0.434**  | 0.285**      | 0.176                 | 0.227                  | 0.305** |
| General health   | 0.017    | −0.014       | −0.162                | 0.390**                | 0.076 |
| Vitality         | −0.117   | −0.141       | 0.241                 | −0.052                 | −0.136 |
| Social function  | −0.008   | 0.073        | 0.338**               | 0.289*                 | 0.189 |
| Role emotional   | −0.002   | −0.013       | 0.196                 | −0.052                 | 0.027 |
| Mental health    | 0.119    | 0.069        | −0.205                | −0.218                 | 0.150 |

*: p < 0.05, **: p < 0.01, FA: Functional activities.
questionnaires. The subscores of the functional activities section were similarly correlated with the pain, symptoms, and physical activity subscores. In the Japanese version, all four scores were associated with the Oxford Knee Score. In the Korean version all subscores were correlated with the Korean version of the WOMAC. The findings obtained from our study are in conformity with the literature examples given above confirms the construct validity of our study.

There are some limitations of this study. First four different questionnaires including the new KSS were administered at the same evaluation session in both pre and postoperative cases might cause responder burden which could have influence on patients’ responses. Second majority of the study sample consisted of older female patients from the rural areas. There may be difference in pain thresholds, activity levels, and satisfaction degrees between genders. Further studies might be needed to evaluate the psychometric properties of Turkish new KSS in male patients. Not conducting a blinded design was the third limitation of the study. Due to the clinical circumstances such a study design could not be established.

Conclusions
It was concluded that the Turkish version of the new KSS is a valid and reliable questionnaire and can be used in all native Turkish speaking TKA patients both pre and postoperatively. Although it was not evaluated in the study it was observed that multi-part structure and larger number of questions in the questionnaire may cause some difficulty to patient’s questionnaire perception. To eliminate this possible disadvantage of the questionnaire and to prevent the unacceptance of the patients we advise to prepare a quiet environment for the patients to fill in the questionnaire.

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Appendix A. Supplementary data
Supplementary data to this article can be found online at https://doi.org/10.1016/j.aott.2019.03.003.

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