Cross-cultural adaptation, reliability and validity of the Turkish version of the Hospital for Special Surgery (HSS) Knee Score

Selnur NARİN¹, Bayram ÜNVER¹, Serkan BAKIRHAN², Özgür BOZAN³, Vasfi KARATOSUN⁴

¹Department of Orthopedic Physiotherapy, School of Physical Therapy and Rehabilitation, Dokuz Eylül University, Izmir, Turkey; ²Department of Physical Therapy and Rehabilitation, School of Health, Izmir University, Izmir, Turkey; ³School of Health Sciences, Gediz University, Izmir, Turkey; ⁴Department of Orthopedics and Traumatology, Dokuz Eylül University, Faculty of Medicine, Izmir, Turkey

Objective: The purpose of this study was to adapt the English version of the Hospital for Special Surgery (HSS) knee score for use in a Turkish population and to evaluate its validity, reliability and cultural adaptation.

Methods: Standard forward-back translation of the HSS knee score was performed and the Turkish version was applied in 73 patients. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Mini-Mental State Examination and sit-to-stand test were also performed and analyzed. Internal consistency reliability was tested using Cronbach’s alpha. The intraclass correlation coefficient (ICC) was used to calculate the test-retest reliability at one-week intervals. Validity was assessed by calculating the Pearson correlation between the HSS, WOMAC and sit-to-stand test scores.

Results: The ICC ranged from 0.98 to 0.99 with high internal consistency (Cronbach’s alpha: 0.87). The WOMAC score correlated with total HSS score (r: -0.80, p<0.001) and sit-to-stand score (r: 0.12, p: 0.312).

Conclusion: The Turkish version of the HSS knee score is reliable and valid in evaluating the total knee arthroplasty in Turkish patients.

Key words: Reliability; The Hospital for Special Surgery knee score; translation; validity.

Osteoarthritis (OA) is one of the most prevalent chronic diseases worldwide and is associated with substantial impact on patients’ individual quality of life as well as on healthcare costs.¹⁻¹² Patients with OA of the hip or knee joint experience pain, stiffness and loss of joint function. Total knee arthroplasty (TKA) is the most common and successful surgical treatment in cases in which conservative treatment does not relieve pain and improve function.³⁻⁴ It is considered to be an effective intervention that improves patients’ quality of life, reduces pain and increases functional capability.⁵⁻¹⁰

For clinicians, valid measurement tools provide important information to support effective clinical interpretation. For any test or measure of health status to be considered useful, it must be reliable, valid, responsive and acceptable.¹¹
Conventional approaches to the measurement of knee function have typically involved objectively defined parameters, such as radiological findings, strength, range of motion and ligamentous laxity. Different instruments for evaluating functional capacity and disability have been developed and used for specific knee conditions. The SF-36 and The Hospital for Special Surgery (HSS) knee rating scale are instruments widely used in TKA patients.

The HSS knee rating scale is a domain-specific questionnaire developed for use as a standardized instrument capable of measuring outcomes for patients with all knee disorders (such as OA and TKA) and designed specifically to evaluate patients with TKA of the knee. The instrument can be used to evaluate a patient before knee surgery and to monitor postsurgical function. The English version of the original index has been shown to be a reliable, valid, responsive and acceptable outcome measure. The HSS knee rating scale has been addressed in a number of research studies and is widely used by physiotherapists and orthopedic surgeons in clinical settings.

Most functional status questionnaires are constructed in English. Cross-cultural adaptation of validated outcome instruments has been advocated to facilitate their use in international, multicenter clinical trials. However, direct translation of questionnaires into other languages does not guarantee their validity. For measures to be used across cultures, the items must be not only translated linguistically but also adapted culturally to maintain its cross-cultural content validity. To maintain the validity of the original instrument, while taking into consideration important cultural differences, a specific methodology has been developed for the adaptation process. Proper adaptation also serves to reduce the need for developing new instruments that have the same purpose.

The HSS knee rating scale is a commonly used in evaluating knee patients in Turkey as well as in Turks living outside of Turkey. For this reason, the purpose of this study was to cross-culturally adapt the HSS knee rating scale for Turkish patients and to determine the reliability and validity of the Turkish version of HSS knee scoring in patients with TKA.

**Patients and methods**

The translation and cross-cultural adaptation of the English version of the HSS knee rating scale into Turkish followed the recommended standard procedure. Two native Turkish speakers independently produced the forward translation of the HSS knee rating scale into the Turkish language. One (VK) was a medical doctor and the other (EBO) a university student. The translated text was then later translated back into English by a third party with fluent English.

To obtain a pre-final Turkish version of the questionnaire, an expert committee including translators, statisticians and health professionals compared the Turkish version with the original English version to detect errors of interpretation and nuances that might have been missed. The final stage of the adaptation process was to test the pre-final version. Pretesting of the pre-final Turkish version revealed no further difficulties with the questionnaire in 25 selected patients of different ages and social, ethnic, and educational backgrounds. The questionnaire was then approved by the committee and the developer of the HSS knee rating scale without any changes and was tested for validity and reliability on the study population.

The study was performed at the School of Physical Therapy and Rehabilitation and Department of Orthopedics and Traumatology in Faculty of Medicine of Dokuz Eylul University. The study included 73 patients who were independently mobile for a minimum of 6 months following TKA surgery. All operations were performed by the same surgeon (VK) using the paramedian approach. The preoperative diagnosis was OA in all patients. Only patients with primary TKA were included in this study. The Mini-Mental State Examination (MMSE) was used in determining cooperation and only patients scoring over 20 points were included. Patients with rheumatoid arthritis, septic arthritis, gout, paresis, metastatic bone disease or previous fracture of the lower limbs were excluded from the study. Our study was approved by the University Ethics Committee and all participants were informed of the trial and signed written informed consent.

The HSS knee rating scale is a disease-specific test used to evaluate knee disabilities and methods of treatment, especially TKA. The HSS knee score gives a maximum of 100 points and considers subjective functional (52%) as well as objective examination criteria (48%). The domains include pain (30 points), function (22 points), range of motion (18 points), muscular strength (10 points), deformity (10 points), and instability (10 points). Subtractions are then made for the use of walking aids, extension lag and varus valgus deformity. The resultant score is classified in the ranges of >85 as ‘excellent’, 70 to 84 as ‘good’, 60 to 69 as ‘fair’ and <60 as ‘poor’. Deductions are made as follows: up to 3 points deducted for walking aids, up to 5 points for extension lag and 1 point for every 5° of varus valgus deformity.
The MMSE was introduced by Folstein et al. in 1975. The Turkish version of the MMSE (translated by Günden et al.) was used to evaluate the cognitive state of patients. Patients with moderate to severe cognitive impairment (score <20 on the MMSE) were not included in the study.

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) is a frequently-used and recommended disease-specific questionnaire that has been found to be reliable and valid to determine self-report outcome after hip and knee replacement. The Turkish version of the WOMAC is considered a valid and reliable outcome measurement. For this reason, it was used to analyze the construct validity of the HSS. The Turkish version of the WOMAC consists of 24 questions in 3 subscales (5 pain, 2 stiffness, 17 physical function). It is available in Likert, visual analog scale and numeric rating scale formats. We used the numeric rating scale format in our study.

The ability to rise from a chair is an important activity of daily living as decreased ability can limit independence or contribute to institutionalization. The sit-to-stand test has been used as an indicator of postural control, fall risk, lower extremity strength and proprioception and as a measure of disability. The chair rise test is a more focused assessment of extensor mechanism function and is one of the activities used in functional indexes and in test batteries of physical functioning. The number of repetitions completed during a specified time interval (30 seconds) has been shown to be reliable and valid. The sit-to-stand test (30 seconds) is well suited to assess the physical function of those with lower limb arthritis, including those awaiting joint replacement surgery of the hip or knee.

Test-retest reliability measures the stability of a test over a given period of time. Intra-observer reliability was assessed through repeated assessment and additional tests were performed to assess validity. The most frequently assessed forms of reliability are test-retest reliability and internal consistency. The standard error of measurement (SEM), which represents the error between test and retest, was calculated for total scores. To determine test-retest reliability, HSS knee scoring was performed twice in one week (1 to 8 days). The intraclass correlation coefficient (ICC; range: 0.00 to 1.00) was used to determine test-retest reliability. A reliability coefficient between 0.60 and 0.80 is deemed very good and over 0.80 excellent. Internal consistency is an estimation of the strength of interrelated items in the test instrument and was assessed by calculating the Cronbach’s alpha, which ranges from 0 to 1, with higher values indicating higher internal consistency reliability.

Validity is an index of how well a test measures what is supposed to measure. To evaluate the validity of the Turkish version of the HSS knee rating scale, the WOMAC, and sit-to-stand test were used and the Pearson correlation coefficient calculated. A value between 0 and 0.25 was considered no or poor correlation, 0.26 and 0.50 moderate, 0.51 and 0.75 good and greater than 0.75 very good.

Table 1. Baseline sociodemographic and clinical characteristics of the patients.

| Patient characteristics | Number | Mean±SD | % |
|-------------------------|--------|---------|---|
| Age (years)             | 71.56±7.74 |        |   |
| Gender                  |        |         |   |
| Male                    | 8      | 11      |   |
| Female                  | 65     | 89      |   |
| Employment              |        |         |   |
| Housewife               | 55     | 75.3    |   |
| Working                 | 1      | 1.4     |   |
| Retired                 | 17     | 23.3    |   |
| Education               |        |         |   |
| Elementary school       | 42     | 57.5    |   |
| High school             | 27     | 37.0    |   |
| University              | 4      | 5.5     |   |
| Weight (kg)             | 80.32±16.60 |       |   |
| Height (cm)             | 158.91±7.55 |       |   |
| Body Mass Index         | 32.84±6.60 |       |   |
| Duration of operation (years) | 5.18±2.60 |       |   |
SPPS for Windows v.15.0 (SPSS Inc., Chicago, IL, USA) was used for all statistical analyses. Data were tested for normality using the Kolmogorov-Smirnov test. The measured variables are presented as mean±SD while the categorical variables are expressed as percentages. Validity was assessed by calculating the Pearson correlation coefficients between the HSS and other scales.

Results

All 73 patients filled in the HSS questionnaires and were investigated clinically. Participants’ sociodemographic and clinical data are presented in Table 1. Patients did not report difficulty in understanding and completing the Turkish version of the HSS questionnaire.

Intraclass correlation coefficients ranged from 0.98 to 0.99 (Table 2). The computed SEM values were low (range: 1.07 to 1.84), supporting the reliability values obtained, which reflect the individual change above the measurement error and indicate minimal clinical change. These observations also are supported by the linear regression and the scatterplot (regression coefficient: 0.99) of total scores in two consecutive measurements (Fig. 1). This indicates a strong relationship between the data collected on both occasions. There were no differences between the means of test-retest values with respect to the subscores and total scores. As for internal consistency, the Turkish version of the HSS scale had a Cronbach’s alpha of 0.87 when all items were considered.

The Turkish version of the HSS scale appeared to be valid (ICC range: 0.98 to 0.99) as assessed using the WOMAC and sit-to-stand test scores (Table 3). There was a significant negative correlation between the WOMAC score and total HSS score (r=-0.80, p<0.001) and no significant correlation between WOMAC and sit-to-stand scores (r=0.12, p=0.312). The WOMAC score had the highest correlation with the total score of the HSS scale. The sit-to-stand test had a poor correlation with the total score (r=0.12, p=0.312) (Table 3).

Discussion

The Turkish version of the HSS questionnaire was translated according to international standardized guidelines for patients who underwent TKA surgery. The agreement, reliability and validity of the Turkish version of the HSS questionnaire are acceptable in Turkish-speaking patients with TKA.

The HSS knee rating scale was developed by Insall et al. in 1976 to evaluate the pre- and postoperative assessment of four different types of knee replacement

**Table 2.** Reliability (test-retest) values of HSS questionnaire.

| HSS score    | Test*      | Retest*     | ICC†       | SEM‡       |
|--------------|------------|-------------|------------|------------|
| Pain         | 24.58 (6.35) | 24.65 (6.37) | 0.999 (0.998-0.999) | 0.74 (0.68-0.80) |
| Function     | 15.21 (4.04) | 15.24 (4.03) | 0.999 (0.998-0.999) | 0.47 (0.33-0.61) |
| ROM          | 11.28 (1.45) | 11.28 (1.47) | 0.990 (0.985-0.994) | 0.71 (0.70-1.72) |
| Muscle strength | 8.50 (1.51) | 8.50 (1.51) | 0.997 (0.996-0.998) | 0.17 (0.09-0.25) |
| Deformation  | 9.93 (0.58) | 9.93 (0.58) | 0.999 (0.999-0.999) | 0.00 (0.00-0.00)  |
| Instability  | 10.00 (0.00) | 10.00 (0.00) | 0.999 (0.999-0.999) | 0.00 (0.00-0.00)  |
| Total        | 79.27 (10.25) | 79.35 (10.25) | 0.999 (0.998-0.999) | 1.20 (1.12-1.28) |

*Data are presented as means, with standard deviations in parentheses. †Results were calculated with 95% confidence intervals in parentheses. ‡The correlation and t values cannot be computed as the standard error of the difference is 0. HSS: The Hospital for Special Surgery; ICC: Intraclass correlation coefficient; ROM: Range of motion; SEM: Standard error of measurement.

**Table 3.** Pearson correlation (r values and p values) between HSS and WOMAC, sit-to-stand scores.

| Test          | HSS (total) | Sit-to-stand | WOMAC |
|---------------|-------------|--------------|-------|
| HSS (total)   | r 1.00      | 0.12         | -0.80*|
|               | p 0.312     | <0.001       |       |
| Sit-to-stand  | r 0.12      | 1.00         | -0.02 |
|               | p 0.312     | 0.841        |       |
| WOMAC (total) | r -0.80*    | -0.02        | 1.00  |
|               | p <0.001    | 0.841        |       |

*Correlation is significant at the 0.001 level (2-tailed). Significant values for r and p are written in bold. HSS: The Hospital for Special Surgery; WOMAC: The Western Ontario and McMaster Universities Osteoarthritis Index.
prosthesis and has been shown to be reliable and valid in these patients. While different tools have been used in the evaluation of arthroplasty and knee disorders in other countries and cultural adaptations, the HSS had not previously been used in these disorders. This translation and cultural adaptation was conducted in Turkish and intended for use both in Turkey and in countries with a Turkish population. The Turkish population in European Union countries currently stands at 3 million.

In general use, the HSS knee scoring has a wide following and is deemed easy to use and quick to record. A recent study of the inter-observer reproducibility of a number of knee scoring systems found that while the HSS knee score had good overall inter-observer correlation coefficients, the reproducibility of some parts of the score was poor. The WOMAC, SF-36 and Oxford Knee Scores have undergone the most thorough assessment of reliability and validity and are therefore the most appropriate for the assessment of outcome after TKA.

The Turkish version of the HSS questionnaire was fully filled out and easily completed by all patients. The short time required to complete the questionnaire suggested that the Turkish version of the HSS questionnaire is well comprehended by native Turkish patients. In addition, the short time needed to evaluate the questionnaire by researchers confirms that the Turkish HSS questionnaire is a practical and easily assessed tool.

In many studies, a sample size of 30 subjects is not adequate for studying the reliability or validity of the instrument. When statistical estimates are derived from small samples, confidence intervals are wide and reflect a high degree of uncertainty in the precision of the reliability coefficient. Terwee et al. suggested that a sample size of at least 50 subjects should be used. Therefore, the number of patients in the current study (n=73) was considered sufficient to conduct validity and reliability analysis.

In an independent study on a different knee system, HSS scores at the 6th postoperative month were 75.6 points. Other studies reported points ranging from 85.0 to 93.0 at the one-year follow-up. Similar to the literature, at a mean time of 5.19 years after surgery, mean HSS scores were 79.35. As it is well known that maximum functional gain is achieved in the first six months following TKA surgery, patients with a minimum of six months of follow-up were included in this study.

Reliability is classically considered to comprise two domains: test-retest repeatability and internal consistency. Although ICCs have been commonly used as a measure of reliability (test-retest) in previous validations of various knee instruments, a more appropriate approach is to calculate the 95% limits of agreement for the differences between the two repeated measurements. This analysis showed acceptable agreement for the HSS scores. Additionally, the HSS scores showed acceptable internal consistency (with Cronbach alpha values clearly above 0.70). We found no differences in the means of test-retest subgroups when pain, function, ROM, muscle strength, deformation, instability and total scores were considered (Table 2). Kessler et al. reported very good internal consistency of the HSS scores, with a Cronbach’s alpha of 0.80, when compared with the Lysholm knee scale (Cronbach’s alpha, 0.89). The Cronbach’s alpha calculated in our study was 0.87, the same as that reported by Ryd and et al. We also observed a high correlation between the total scores of the two measurements. The SEM for the total score was 1.20 (range: 1.12 to 1.28). Low SEM for the HSS score indicates a high test-retest reliability and internal consistency reliability.

Table 4. Descriptive information for functional tests and MMSE.

| Test             | Score  |
|------------------|--------|
| HSS (total)      | 79.35 (10.25) |
| WOMAC (total)    | 15.27 (14.81)  |
| Sit-to-stand     | 12.23 (2.54)   |
| MMSE             | 23.15 (2.63)   |

*Data are presented as means, with standard deviations in parentheses. HSS: The Hospital for Special Surgery; MMSE: The mini-mental state examination; WOMAC: The Western Ontario and McMaster Universities Osteoarthritis Index.
for all items of the questionnaire. Criterion validity, or instrumental validity, is used to demonstrate the accuracy of the instrument by comparing it with the truth or another instrument that has been proven to be valid. The WOMAC score and sit-to-stand test were used to determine criterion validity.

WOMAC scores were highly correlated and the sit-to-stand test scores poorly correlated with the total HSS scores (Table 4). The sit-to-stand test did not have enough sensitivity and is therefore not recommended for use alone in assessing functional capacity. The Knee Outcome Survey-Activities of Daily Living Scale (KOS-ADLS) which has been adapted to Turkish could be useful for this purpose in future studies.

In conclusion, the HSS knee rating scale was successfully translated and adapted into the Turkish language. The Turkish version of the HSS scale met the criteria of reliability and validity in measuring symptoms and functional limitations in patients with knee pain.

Acknowledgment: The authors are grateful to Prof. Dr. Hülya ELLIDOKUZ for statistical suggestions and to Elif Bike ÖSÜN for her help in translation.

Conflicts of Interest: No conflicts declared.

References
1. Akodu AK, Giwa SO, Akinbo SR, Ahmed UA. Physiotherapy in the management of total knee arthroplasty: a review. Nig Q J Hosp Med 2011;21:99-105.
2. Rosemann T, Laux G, Szecsenyi J. Osteoarthritis: quality of life, comorbidities, medication and health service utilisation assessed in a large sample of primary care patients. J Orthop Surg Res 2007;2:12.
3. Bach CM, Nogler M, Steingruber IE, Ogon M, Wimmer C, Göbel G, et al. Scoring systems in total knee arthroplasty. Clin Orthop Relat Res 2002;399:184-96.
4. van den Akker-Scheek I, van Raay JJ, Reininga IH, Bulstra SK, Zijlstra W, Stevens M. Reliability and concurrent validity of the Dutch hip and knee replacement expectations surveys. BMC Musculoskelet Disord 2010;11:242.
5. American Society of Anesthesiologists (ASA) Physical Status Score [cited 2006 Feb 21]. Available at: http://www.asahq.org/physicalstatus.htm.
6. Bellamy N. WOMAC Osteoarthritis Index: A User’s Guide IX. Brisbane, Australia: The University of Queensland; 2008. p. 176.
7. Bourne RB, Chesworth BM, Davis AM, Mahomed NN, Charron KD. Patient satisfaction after total knee arthroplasty: who is satisfied and who is not? Clin Orthop Relat Res 2010;468:57-63.
8. Bourne RB, McCalden RW, MacDonald SJ, Mokete L. Guerin J. Influence of patient factors on TKA outcomes at 5 to 11 years followup. Clin Orthop Relat Res 2007;464:27-31.
9. Chesworth BM, Mahomed NN, Bourne RB, Davis AM; OJRR Study Group. Willingness to go through surgery again validated the WOMAC clinically important difference from THR/TKR surgery. J Clin Epidemiol 2008;61:907-18.
10. Escobar A, Quintana JM, Bilbao A, Aróstegui I, Lafuente I, Vidalurreta I. Responsiveness and clinically important differences for the WOMAC and SF-36 after total knee replacement. Osteoarthritis Cartilage 2007;15:273-80.
11. Kessler S, Käfer W. Comparative assessment of outcome in osteoarthritis of the knee: the utility of knee scores. Acta Chir Orthop Traumatol Cech 2007;74:332-5.
12. Higgins LD, Taylor MK, Park D, Ghodadra N, Marchant M, Pietrobon R, et al. Reliability and validity of the International Knee Documentation Committee (IKDC) Subjective Knee Form. Joint Bone Spine 2007;74:594-9.
13. Irgang JJ, Anderson AF. Development and validation of health-related quality of life measures for the knee. Clin Orthop Relat Res 2002;402:95-109.
14. Ganz SB. Rehabilitation following total knee arthroplasty. In: Sculco TP, Martucci EA, editors. Knee arthroplasty. Wien: Springer; 2002. p. 231-9.
15. Slupik A, Białożewski D. A comparative analysis of the clinical utility of the Staffelstein-score and the hospital for special surgery knee score (HSS) in monitoring physiotherapy of total knee replacement patients--preliminary study. Ortop Traumatol Rehabil 2009;11:37-45.
16. Ryd L, Karrholm J, Ahlvin P. Knee scoring systems in gonarthrosis. Evaluation of interobserver variability and the envelope of bias. Score Group. Acta Orthop Scand 1997;68:41-5.
17. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care 1992;30:473-83.
18. Terwee CB, Bot SD, de Boer MR, van der Windt DA, Knol DL, Dekker J, et al. Quality criteria were proposed for measurement properties of health status questionnaires. J Clin Epidemiol 2007;60:34-42.
19. Drake BG, Callahan CM, Dittus RS, Wright JG. Global rating systems used in assessing knee arthroplasty outcomes. J Arthroplasty 1994;9:409-17.
20. 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;25:3186-91.
21. Ware JE Jr, Keller SD, Gandek B, Brazier JE, Sullivan M. Evaluating translations of health status questionnaires. Methods from the IQOLA project. International Quality of Life Assessment. Int J Technol Assess Health Care 1995;11:525-51.
22. Ranawat CS, Shine JJ. Duo-condylar total knee arthroplasty. Clin Orthop Relat Res 1973;94:185-95. CrossRef
23. Bergsma DE, Lohmann C, Bader R, Finze S, Lukas C, Rüther W, et al. Preliminary clinical results of the MultiGen Plus Total Knee System with a ceramic femoral component-A national duo-centre study. Eur Musculoskel Rev 2009;4:82-5.
24. Davies AP. Rating systems for total knee replacement. Knee 2002;9:261-6. CrossRef
25. Insall JN, Ranawat CS, Aglietti P, Shire J. A comparison of four models of total knee-replacement prostheses. J Bone Joint Surg Am 1976;58:754-65.
26. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189-98.
27. Güngen C, Ertan T, Eker E, Yaşar R, Engin F. Reliability and validity of the standardized Mini Mental State Examination in the diagnosis of mild dementia in Turkish population. Turk Psikiyatri Derg 2002;13:273-81.
28. Leveille SG, Bean J, Bandeen-Roche K, Jones R, Hochberg M, Guralnik JM. Musculoskeletal pain and risk for falls in older disabled women living in the community. J Am Geriatr Soc 2002;50:671-8. CrossRef
29. Bellamy N, Buchanan WW, Goldsmith CH, Campbell MJ, Stirling JW, et al. Satisfactory cross cultural equivalence of the Dutch WOMAC in patients with hip osteoarthritis waiting for arthroplasty. Ann Rheum Dis 2004;63:36-42. CrossRef
30. Basaran S, Guzel R, Seydaoglu G, Guler-Uysal F. Validity, reliability, and comparison of the WOMAC osteoarthritis index and Lequesne algofunctional index in Turkish patients with hip or knee osteoarthritis. Clin Rheumatol 2010;29:749-56. CrossRef
31. Haddad FS, Garbuz DS, Chambers GK, Jagpal TJ, Masri BA, Duncan CP. The expectations of patients undergoing revision hip arthroplasty. J Arthroplasty 2001;16:87-91.
32. Gross MM, Stevenson PJ, Charette SL, Pyka G, Marcus R. Effect of muscle strength and movement speed on the biomechanics of rising from a chair in healthy elderly and young women. Gait Posture 1998;8:175-185. CrossRef
33. Unver B, Karatosun V, Bakirhan S. Ability to rise independently from a chair during 6-month follow up after unilateral and bilateral total knee replacement. J Rehabil Med 2005;37:385-7. CrossRef
34. Whitney SL, Wrisley DM, Marchetti GF, Gee MA, Redfern MS, Furman JM. Clinical measurement of sit-to-stand performance in people with balance disorders: validity of data for the Five-Times-Sit-to-Stand Test. Phys Ther 2005;85:1034-45.
35. Segura-Ortí E, Martínez-Olmos FJ. Test-retest reliability and minimal detectable change scores for sit-to-stand-to-sit tests, the six-minute walk test, the one-leg heel-rise test, and handgrip strength in people undergoing hemodialysis. Phys Ther 2011;91:1244-52. CrossRef
36. Bohannon R. Measuring muscle strength in neurological disorders. Fizyoter Rehabil 2005;16:120-33.
37. Gill S, McBurney H. Reliability of performance-based measures in people awaiting joint replacement surgery of the hip or knee. Physiother Res Int 2008;13:141-52. CrossRef
38. Lopes AD, Ciconelli RM, Carrera EF, Griffin S, Faloppa F, Dos Reis FB. Validity and reliability of the Western Ontario Rotator Cuff Index. Rheumatol Int 2006;26:1101-8. CrossRef
39. Leveille SG, Bean J, Bandeen-Roche K, Jones R, Hochberg M, et al. The reliability and validity of the Turkish version of the Western Ontario Rotator Cuff Index (WORC) for use in Brazil. Clin J Sport Med 2008;18:266-72. CrossRef
40. ShROUT PE, Fleiss JL. Intraclass correlations: uses in assessing rater reliability. Psychol Bull 1979;86:420-8. CrossRef
41. Segzin M, Incel NA, Serhan S, Camdeviren H, As I, Erdoğan C. Assessment of symptom severity and functional status in patients with carpal tunnel syndrome: reliability and functionality of the Turkish version of the Boston Questionnaire. Disabil Rehabil 2006;28:1281-5. CrossRef
42. Stratford PW, Binkley J, Solomon P, Finch E, Gill C, Moreland J. Defining the minimum level of detectable change for the Roland-Morris questionnaire. Phys Ther 1996;76:359-68.
43. Polgar S, Shane AT. Introduction to research in the health sciences. 2nd ed. London: Churchill Livingstone; 1991.
44. Carey DG, Raymond RL, Duoos BA. Intra- and interobserver reliability in selection of the heart rate deflection point during incremental exercise: comparison to a computer-generated deflection point. J Sports Sci Med 2002;1:115-21.
45. Altman DG. Practical Statistics for Medical Research. Vol. 12. CRC Press: Boca Raton, FL; 1990.
46. Polgar S, Shane AT. Introduction to research in the health sciences. 2nd ed. London: Churchill Livingstone; 1991.
47. Carey DG, Raymond RL, Duoos BA. Intra- and interobserver reliability in selection of the heart rate deflection point during incremental exercise: comparison to a computer-generated deflection point. J Sports Sci Med 2002;1:115-21.
48. Hamborg Institute of International Economics. Focus migration country profile – Turkey. No. 5, 2006. [cited 2010 Oct 5] Available at: http://www.focusmigration.de/uploads/tx_wilpubdb/CP_05_Turkey.pdf. CrossRef
49. Hawker G, Wright J, Coyte P, Paul J, Dittus R, Croxford R, et al. Health-related quality of life after knee replacement. J Bone Joint Surg Am 1998;80:163-73.
51. Bergschmidt P, Bader R, Finze S, Ansorge S, Kundt G, Mittelmeier W. Bicondylar knee arthroplasty - influence of preoperative functional restriction on early functional postoperative outcome. [Article in German] Z Orthop Unfall 2008;146:344-51. [Abstract]

52. Bin SI, Nam TS. Early results of high-flex total knee arthroplasty: comparison study at 1 year after surgery. Knee Surg Sports Traumatol Arthrosc 2007;15:350-5. CrossRef

53. Yasuda K. Long-term clinical results of cruciate-retaining total knee arthroplasty using the alumina ceramic condylar prosthesis. Scientific Exhibit No. SE035, AAOS Meeting, San Francisco; 2004.

54. Briggs KK, Kocher MS, Rodkey WG, Steadman JR. Reliability, validity, and responsiveness of the Lysholm knee score and Tegner activity scale for patients with meniscal injury of the knee. J Bone Joint Surg Am 2006;88:698-705. CrossRef

55. 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;467:2077-82. CrossRef