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ORIGINAL ARTICLE

# Translation, cross-cultural adaptation, reliability, and convergent and known-group validity of the Turkish full version of the Hip Disability and Osteoarthritis Outcome Score in patients with hip osteoarthritis

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***ABSTRACT***

**Objectives:** The study aimed to culturally adapt the full version of the Hip Disability and Osteoarthritis Outcome Score (HOOS) into Turkish and evaluate its reliability and validity.

**Patients and methods:** Patients with hip osteoarthritis were included in the methodological cross-cultural adaptation study between May 2022 and December 2022. We translated and adapted the HOOS into a Turkish version and validated it in a cohort of native Turkish-speaking patients with hip osteoarthritis. The HOOS includes five subscales named symptoms, pain, activities of daily living (ADL), sport and recreation (Sport/Rec), and quality of life (QoL). The psychometric properties of the Turkish HOOS were assessed. The reliability was investigated using test-retest reliability (intraclass correlation coefficient; ICC) and internal consistency methods (Cronbach's alpha). The convergent validity of the Turkish HOOS was evaluated by testing the predefined hypotheses using the correlations with the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and the European Quality of Life Scale (EQ-5D-3L), a generic QoL scale.

**Results:** A total of 202 patients (131 females, 71 males; mean age: 55.2±9.7 years; range, 50 to 70 years) were recruited for the study. Cronbach's alpha values for each subscale of the HOOS were as follows: symptoms=0.76, pain=0.94, ADL=0.96, Sport/Rec=0.87, QoL=0.78, and total score=0.98, indicating it has high internal consistency. For all subscales and total score of the HOOS, the ICC values were between 0.77 and 0.86, indicating good to excellent test-retest reliability. All correlations between each subscale and total score of the Turkish HOOS, WOMAC, and EQ-5D-3L were moderate to strong. Therefore, 23 predefined hypotheses out of 24 were confirmed with a confirmation rate of 96%, indicating the Turkish version of the HOOS had adequate convergent validity.

**Conclusion:** This study shows that the Turkish version of the HOOS has a convergent and known-group validity, internal consistency, and test-retest reliability. It can be used to assess the patient's perception of their hip and associated difficulties, as well as their symptoms and functional limitations.

***Keywords:*** Assessment, hip osteoarthritis, outcome, reliability, validity.

Hip disability and osteoarthritis are common conditions that significantly impact individuals' quality of life (QoL) and functional abilities. The effective management of hip osteoarthritis is heavily dependent on the relief of pain and increased joint mobilization. To effectively evaluate the outcomes of interventions and treatments, reliable and valid assessment tools are crucial. Therefore, healthcare professionals, hospital administrators, and researchers have a high demand for outcome measures that can accurately assess the efficacy of treatments for osteoarthritis.[1] A plethora of scales are utilized to evaluate pain and mobility in patients with hip osteoarthritis.[1,2] One such tool, the Hip Disability and Osteoarthritis Outcome Score (HOOS),[3] has gained recognition for its advantages over other scales in assessing hip-related disability and osteoarthritis outcomes. The HOOS is specifically designed to capture the multidimensional aspects of hip-related outcomes, focusing on pain, symptoms, activities of daily living (ADL), sports and recreation (Sports/Rec), and hip-related QoL. This

specificity allows for a comprehensive evaluation that addresses the unique challenges faced by individuals with hip disability and osteoarthritis. The multidimensional approach of the HOOS provides a more holistic assessment, ensuring that all relevant aspects of hip-related outcomes are considered. By encompassing different domains, the HOOS offers a comprehensive perspective on the impact of hip disability and osteoarthritis on individuals' functional abilities and overall well-being.

Furthermore, the HOOS has undergone rigorous validation processes, establishing its validity and reliability.[3] Extensive testing in diverse populations has demonstrated the ability to consistently measure what it intends to measure, ensuring reliable and consistent results.[2-11] Importantly, the HOOS demonstrates sensitivity to change, making it suitable for monitoring disease progression, evaluating treatment effectiveness, and assessing the impact of rehabilitation programs.[4] Its ability to detect changes over time enables precise tracking of improvements or deterioration in hip-related outcomes, aiding clinicians and researchers in making informed decisions.

In addition to its comprehensive nature and psychometric properties, the HOOS takes a patient-centered approach. The questionnaire items were developed with patient input, ensuring that they capture the experiences and challenges faced by individuals with hip disability and osteoarthritis. This patient-centered focus enhances the tool's relevance and applicability, allowing for a more meaningful assessment of hip-related outcomes.

Moreover, the availability of translated versions of the HOOS in different languages enhances its usability across diverse cultural and linguistic contexts.[3,5-13] Researchers and healthcare professionals can employ the tool in various populations, facilitating cross-cultural comparisons and enabling a more inclusive approach to data collection. However, only the physical function subscale, which comprises five items, has been validated in Turkish.[14]

The rationale for translating the HOOS into Turkish is multifaceted and driven by several considerations. First and foremost, translating the HOOS into Turkish enhances its accessibility and usability for researchers and healthcare professionals in Türkiye, allowing them to effectively utilize the tool and obtain reliable data specific to the Turkish population. Additionally, by culturally adapting the HOOS to the Turkish context, the translated version can better capture the experiences and challenges faced by Turkish-speaking individuals with hip disability and osteoarthritis. This cross-cultural adaptation ensures that the tool is relevant and applicable to the Turkish population, improving the accuracy of assessments and the quality of care provided. Furthermore, the translation facilitates comparative studies and international collaboration, enabling researchers in Türkiye to participate in global research efforts and fostering cross-cultural comparisons. By using a standardized tool like the HOOS, the translated version contributes to the standardization and harmonization of outcome measurement in hip disability and osteoarthritis research, allowing for meaningful comparisons between studies and enhancing the generalizability of research findings. Overall, translating the HOOS into Turkish aligns with the goal of promoting inclusivity, improving research methodologies, and providing culturally sensitive care for individuals with hip-related conditions in Türkiye. Therefore, this study aimed to present data on the cross-cultural adaptation and psychometric testing of the full version of the HOOS scale.

## PATIENTS AND METHODS

This was a methodological study including cross-cultural adaptation and psychometric analysis conducted between May and December 2022. Permission was sought from the manufacturer of the HOOS. Data were collected from the Acıbadem Adana Ortopedia Hospital. Patients who were examined and diagnosed by an orthopedic surgeon were included.

This study included patients with osteoarthritis in the hip joint. Inclusion criteria included having hip osteoarthritis diagnosed by an orthopedic surgeon according to the American College of Rheumatology's classification criteria,[17] as well as having the ability to speak and write in Turkish. Patients with hip joint endoprostheses, neurological

disease, and lower extremity surgery were excluded from the study. In a validation study, it is commonly recommended to have a sample size of "at least" five participants per item. In the case of the HOOS, which consists of 40 items, we determined the minimum required sample size to be 200 individuals.[15]

### Measures

*Hip Disability and Osteoarthritis Outcome Score*

The HOOS is a scale consisting of five subscales and 40 questions developed to evaluate patients with hip osteoarthritis. The subheadings of the scale are pain, other symptoms, function in ADL, function in sports and recreation (Sports/Rec), and hip-related QoL. The answer given for each question receives a score between 0 and 4. The total score is obtained by summing the scores for each item. A total of 100 points indicates no symptoms, and 0 points indicates that the patient has extreme symptoms.[3]

*Western Ontario and McMaster Universities Osteoarthritis Index*

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) is used to evaluate functional status and QoL in patients with osteoarthritis. The WOMAC consists of 24 questions into three subscales: pain, stiffness, and function. Higher scores indicate more severe symptoms, more disability, and poorer health. The Turkish validity and reliability of the questionnaire was conducted by Tüzün et al.[16] This questionnaire is widely used by researchers and clinicians working on osteoarthritis.

### European Quality of Life Scale

European Quality of Life Scale (EQ-5D-3L) evaluates QoL in many diseases and was developed by the EuroQoL group, a Western European QoL research society. It consists of five dimensions: movement, self-care, usual activities, pain or discomfort, and anxiety or depression. Each question is evaluated in five dimensions. Responses to each dimension are "okay," "a bit of an issue," and "overkill." In the score calculation, a value of 1 indicates excellent health, while negative values indicate being unconscious, bedridden, or other similar severe states. European Quality of Life Scale is currently available in more than 150 languages, including Turkish (https://euroqol.org/eq-5d-instruments/eq-5d-3l-about/).

### Tönnis classification system

Patients' hip osteoarthritis severity was assessed using the Tönnis classification system, which categorizes hip osteoarthritis severity into three levels: mild (Grade 1), moderate (Grade 2), and severe (Grade 3).[17] The Tönnis scores were determined by an experienced orthopedic specialist.

### Translation and cultural adaptation

In the translation and cross-cultural adaptation procedure, we followed the guidelines for the process of cross-cultural adaptation of self-report measures published by Beaton et al.[18] This rigorous procedure ensured the linguistic and cultural equivalence of the translated version.

*Stage I- Translation:* Initially, the English version of the HOOS was translated into Turkish by two individuals. One of the translators was a healthcare professional with expertise in the field and familiarity with the scale. This step aimed to capture different perspectives and ensure accuracy in the translation process.

*Stage II- Synthesis:* The translations provided by the two individuals were then synthesized and consolidated into a single form. This step involved comparing and reconciling the differences between the translations, considering the intended meaning and relevance to the Turkish-speaking population.

*Stage III- Back translation:* The resulting Turkish version of the HOOS was back translated into English by two fluent Turkish speakers who were also native English speakers. Back translation helps ensure that the essence and nuances of the original version are maintained in the translated version.

*Stage IV- Expert committee review:* An expert committee, comprising professionals with expertise in hip-related conditions, measurement development, and cross-cultural adaptation, thoroughly evaluated the differences between the original and final versions of the HOOS in Turkish. This evaluation aimed to identify any discrepancies, inconsistencies, or potential issues that could impact the validity and reliability of the translated version.

*Stage V- Pretesting:* The finalized Turkish version of the HOOS underwent pilot testing and cognitive debriefing. This involved administering the translated questionnaire to a sample of individuals with hip disability and osteoarthritis who were native Turkish speakers. The participants provided feedback on the clarity, understandability, and relevance of the items through cognitive debriefing interviews. This step helped ensure that the translated version was culturally appropriate and comprehensible to the target population. In the pilot study, 18 participants (8 males and 10 females) evaluated the Turkish HOOS and provided feedback on items that should be deleted or modified. The original author of the scale approved all corrections. At the end of this article, the latest Turkish version of the HOOS is provided. All patients were asked to refill the HOOS seven days after completing the HOOS for the first time. One-week interval was selected to refill the HOOS as it is short enough to allow for obvious clinical changes to occur and long enough to eliminate the learning effects.

**Statistical analysis**

Data analyses were conducted using the IBM SPSS version 25.0 (IBM Corp., Armonk, NY, USA) and Jamovi version 2.3 (The jamovi project, Sydney, Australia). Descriptive statistics were used for the demographic characteristics of the participants. Utilizing the Kolmogorov-Smirnov test and visually examining histograms and outliers, the distribution of the data was examined. To assess the presence of floor and ceiling effects, we calculated the proportion of participants who obtained the lowest and highest scores on the HOOS scale. Values greater than 15% showed that a floor or ceiling effect existed.[19] For all analyses, the level of statistical significance was fixed at $p<0.05$.

The internal consistency was evaluated using Cronbach's alpha coefficient, and a value of ≥0.70 was considered acceptable internal consistency.[20] For relative test-retest reliability, 95% confidence interval and intraclass correlation coefficient (ICC) values were calculated using absolute agreement and two-way mixed effects. Poor (0.50), moderate (0.50-0.75), good (0.75-0.90), and excellent (>0.90) were used to categorize the ICC values.[21] To determine the absolute test-retest reliability, we evaluated the smallest noticeable change (MDC95%) that goes beyond the level of measurement error and background noise, with a 95% level of confidence. The MDC95% was calculated using the formula: $1.96\times\sqrt{2}\times SEM$. The SEM (standard error of measurement) was estimated as the square root of the mean square error term from the repeated measures of analysis of variance.[22]

Before conducting the investigation on the convergent validity of the HOOS, some preliminary assumptions were made. It was anticipated that there would be a significant correlation, ranging from moderate to strong, between the subscales of the HOOS and the subscales of WOMAC. We hypothesized that related subscales would have a stronger correlation with each other compared to other subscales (i.e., the correlation between HOOS-Pain and WOMAC-Pain would be higher than the correlation between HOOC-Pain and WOMAC-Stiffness or WOMAC-ADL). We expected moderate to strong correlations between each subscale of the HOOC and EQ-5D-3L-Index. Similarly, we hypothesized that EQ-5D-3L-Index has the strongest correlation with HOOC-QoL among other subscales. Spearman correlation coefficients were utilized to assess the intensity of correlations. A correlation below 0.39 was deemed to be weak, while a correlation ranging from 0.40 to 0.69 was considered moderate. A correlation falling between 0.70 and 0.89 was categorized as strong, and any correlation exceeding 0.90 was labelled as very strong.[23]

To assess known-group validity, the Mann-Whitney U test was conducted to compare the median scores on the HOOS between the two Tönnis score groups (Grade 2 and 3), as we did not have any patients with Grade 1.

Confirmatory factor analysis was used to assess structural validity of the HOOS, originally proposed as a five-factor model. Model fit statistics included the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). Model fit was evaluated based on a priori values: CFI ≥0.95, TLI ≥0.95, and RMSEA ≤0.06.[24]

The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy test was utilized to

**Table 1.** Demographic and clinical characteristics of the participants (n=202)

| | n | % | Mean±SD |
|---|---|---|---|
| Age (year) | | | 55.2±9.7 |
| Sex | | | |
| Male | 71 | 35.1 | |
| Female | 131 | 64.9 | |
| Type of osteoarthritis | | | |
| Primary | 146 | 72.3 | |
| Secondary | 56 | 27.7 | |
| Tönnis grading | | | |
| Tönnis Grade 1 | 0 | 0 | |
| Tönnis Grade 2 | 19 | 9.4 | |
| Tönnis Grade 3 | 36 | 17.8 | |
| Missing data | 55 | 72.8 | |
| BMI (kg/m$^2$) | | | 27.58±5.46 |
| WOMAC-Pain | | | 12.50±4.42 |
| WOMAC-Stiffness | | | 4.49±2.30 |
| WOMAC-ADL | | | 45.04±13.52 |
| WOMAC-Total | | | 62.38±18.50 |
| EQ-5D-3L-Index | | | 0.14±0.39 |

SD: Standard deviation; BMI: Body mass index; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index; ADL: Activities of daily living; EQ-5D-3L: European Quality of Life Scale.

evaluate the adequacy of the sample size in our study. Typically, KMO values ranging from 0.8 to 1 indicate that the sample size is considered sufficient for the analysis and the sample adequately represents the underlying population.[25]

# RESULTS

## Cross-cultural adaptation

During the pilot study, a total of 18 participants (8 males and 10 females) were enlisted to assess the Turkish version of HOOS and provide their opinions on the items that required modification or removal. All participants found the HOOS to be clear and understandable, except for a few items. Some participants suggested using "friction sound, click, crackle sound" instead of "squeaking sound" in questions about symptoms and changing the expression "difficulty in taking long steps while walking" to "difficulty in taking a normal step" in Question 3. Feedback was also received regarding correcting Questions 9, 13, and 15. For example, "wearing socks" was changed to "wearing short/long socks" in Question 9, and "entering and exiting the toilet" was changed to "exiting a closet" in Question 15. Based on the feedback, patterns of questions related to function, Sports/Rec were updated to a higher level. All revisions made to the scale were authorized by the original author.

On average, the completion of the Turkish version of HOOS takes approximately 4 min. Due to the comprehensibility of the Turkish adaptation of HOOS among patients, all items were completed by the participants, leading to an absence of missing responses.

**Table 2.** Descriptive statistics, internal consistency (expressed by Cronbach's alpha), and test-retest reliability (expressed by ICC, SEM, and MDC95%) of the HOOS

| | Baseline (n=202) | | Retest (n=57) | | | ICC (n=57) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Median | IQR | Median | IQR | Cronbach's alpha (n=202) | ICC | 95% CI | SEM (n=57) | MDC95% (n=57) |
| Symptoms (5 items) | 35.0 | 25.0-55.0 | 40.0 | 35.0-50.0 | 0.76 | 0.78 | 0.63-0.88 | 5.6 | 15.6 |
| Pain (10 items) | 30.0 | 17.5-42.5 | 32.5 | 12.5-40.0 | 0.94 | 0.86 | 0.77-0.91 | 5.1 | 14.0 |
| ADL (17 items) | 29.4 | 19.1-45.6 | 33.8 | 13.2-41.2 | 0.96 | 0.85 | 0.72-0.92 | 5.4 | 15.1 |
| Sport/Rec (4 items) | 12.5 | 6.25-25.0 | 12.5 | 0-25.0 | 0.87 | 0.77 | 0.61-0.87 | 6.7 | 18.6 |
| QoL (4 items) | 12.5 | 6.3-25.0 | 12.5 | 6.3-31.3 | 0.78 | 0.82 | 0.71-0.89 | 6.1 | 16.9 |
| Total (40 items) | 25.5 | 16.2-36.3 | 25.3 | 16.1-35.1 | 0.98 | 0.84 | 0.74-0.90 | 4.1 | 11.4 |

ICC: Intraclass correlation coefficient; SEM: Standard error of measurement; MDC: Minimal detectable change; HOOS: Hip Disability and Osteoarthritis Outcome Score; IQR: Interquartile range; CI: Confidence interval; ADL: Activities of daily living; Sport/Rec: Sport and recreation; QoL: Quality of life.

**Table 3.** Spearman correlations between each subscale of HOOS, WOMAC, and EQ-5D-3L-Index

| | Symptoms | Pain | ADL | Sport/Rec | QoL | Total |
|---|---|---|---|---|---|---|
| WOMAC-Pain | | | | | | |
| Rho | -0.61 | -0.81 | -0.80 | -0.65 | -0.50 | -0.80 |
| *p* | <0.001* | <0.001* | <0.001* | <0.001* | <0.001* | <0.001* |
| WOMAC-Stiffness | | | | | | |
| Rho | -0.63 | -0.71 | -0.63 | -0.52 | -0.54 | -0.71 |
| *p* | <0.001* | <0.001* | <0.001* | <0.001* | <0.001* | <0.001* |
| WOMAC-ADL | | | | | | |
| Rho | -0.61 | -0.78 | -0.86 | -0.73 | -0.60 | -0.84 |
| *p* | <0.001* | <0.001* | <0.001* | <0.001* | <0.001* | <0.001* |
| EQ-5D-3L-Index | | | | | | |
| Rho | 0.40 | 0.55 | 0.61 | 0.59 | 0.48 | -0.60 |
| *p* | <0.001* | <0.001* | <0.001* | <0.001* | <0.001* | <0.001* |

HOOS: Hip disability and Osteoarthritis Outcome Score; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index; EQ-5D-3L: European Quality of Life Scale; ADL: Activities of daily living; Sport/Rec: Sport and recreation; QoL: Quality of life; * p<0.05.

### Participants

A total of 202 patients (131 females, 71 males; mean age: 55.2±9.7 years; range, 50 to 70 years) with osteoarthritis were recruited as participants for this study. The mean body mass index (BMI) of the participants was 27.58±5.46 kg/m$^2$. Of these patients, 146 (72.3%) had primary osteoarthritis, while 56 (27.7%) had secondary osteoarthritis. Table 1 displays information about the participants' demographic and clinical features. The KMO value was 0.908, indicating that sample size was adequate.

### Floor and ceiling effects

Floor effects (indicating the worst possible score) were found in subscales symptoms (2%), pain (3.5%), ADL (3%), Sport/Rec (24.8%), and QoL (18.3%). Ceiling effects were found in subscales pain (1%), ADL (1%), Sport/Rec (1%), QoL (1%), and total score (1%). Floor effects in subscales Sport/Rec and QoL are higher than the proposed cut-off value of 15%.

### Internal consistency and test-retest reliability

Fifty-seven patients refilled the Turkish version of the HOOS for the second time to assess the test-retest reliability. Cronbach's alpha values of each subscale and total score were above the proposed cut-off value of 0.70. Among the subscales, the total score showed a higher internal consistency. For all subscales of the Turkish HOOS, the ICC values were between 0.77 and 0.86, and for the total score, it was 0.84, indicating a good test-retest reliability. The SEM values ranged from 4.1 to 6.7. In addition, the MDC95% values ranged from 11.4 to 18.6. Table 2 presents the descriptive statistics, internal consistency, and test-retest reliability of the Turkish version of the HOOS.

### Validity

All correlations between each subscale and total score of the Turkish HOOS, WOMAC, and EQ-5D-3L-Index were moderate to strong (Table 3). Twenty-three predefined hypotheses out of 24 were confirmed with a confirmation rate of 96% (Table 4), indicating the Turkish version of the HOOS had adequate convergent validity.

The known-group validity of the HOOS subscales and total score was assessed by comparing the scores of patients with different severity levels of hip osteoarthritis. Specifically, patients with severe hip osteoarthritis

**Table 4.** Predefined hypotheses and their confirmation or rejection for testing convergent validity

| No. | Predefined hypothesis | Confirmed |
|---|---|---|
| | Moderate to strong correlation between… | |
| 1 | …HOOS-Symptoms and WOMAC-Pain | Yes |
| 2 | …HOOS-Symptoms and WOMAC-Stiffness | Yes |
| 3 | …HOOS-Symptoms and WOMAC-ADL | Yes |
| 4 | …HOOS-Symptoms and EQ-5D-3L-Index | Yes |
| 5 | …HOOS-Pain and WOMAC-Pain | Yes |
| 6 | …HOOS-Pain and WOMAC-Stiffness | Yes |
| 7 | …HOOS-Pain and WOMAC-ADL | Yes |
| 8 | …HOOS-Pain and EQ-5D-3L-Index | Yes |
| 9 | …HOOS-ADL and WOMAC-Pain | Yes |
| 10 | …HOOS-ADL and WOMAC-Stiffness | Yes |
| 11 | …HOOS-ADL and WOMAC-ADL | Yes |
| 12 | …HOOS-ADL and EQ-5D-3L-Index | Yes |
| 13 | …HOOS-Sport/Rec and WOMAC-Pain | Yes |
| 14 | …HOOS-Sport/Rec and WOMAC-Stiffness | Yes |
| 15 | …HOOS-Sport/Rec and WOMAC-ADL | Yes |
| 16 | …HOOS-Sport/Rec and EQ-5D-3L-Index | Yes |
| 17 | …HOOS-QoL and WOMAC-Pain | Yes |
| 18 | …HOOS-QoL and WOMAC-Stiffness | Yes |
| 19 | …HOOS-QoL and WOMAC-ADL | Yes |
| 20 | …HOOS-QoL and EQ-5D-3L-Index | Yes |
| 21 | Correlation between HOOS-Pain and WOMAC-Pain is stronger than those with WOMAC-Stiffness and WOMAC-ADL | Yes |
| 22 | Correlation between HOOS-Stiffness and WOMAC-Stiffness is stronger than those with WOMAC-Pain and WOMAC-ADL | Yes |
| 23 | Correlation between HOOS-ADL and WOMAC-ADL is stronger than those with WOMAC-Pain and WOMAC-Stiffness | Yes |
| 24 | EQ-5D-3L-Index has the strongest correlation with HOOS-QoL | No |
| | **Confirmation rate** | 96% |

HOOS: Hip disability and Osteoarthritis Outcome Score; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index; ADL: Activities of daily living; EQ-5D-3L: European Quality of Life Scale; QoL: Quality of life.

**Table 5.** Known-groups validity of the Turkish version of HOOS by osteoarthritis severity

| | Tönnis Grade 2 (n=19) | | Tönnis Grade 3 (n=36) | | |
|---|---|---|---|---|---|
| | Median | IQR | Median | IQR | *p* |
| Symptoms | 45 | 30-60 | 32.5 | 20-48.8 | 0.278 |
| Pain | 37.5 | 20-42.5 | 25 | 15-35 | 0.060 |
| ADL | 36.8 | 22.1-50 | 27.2 | 11.8-35.3 | 0.006* |
| Sport/Rec | 25 | 12.5- 31.3 | 6.3 | 0-25 | 0.010* |
| QoL | 12.5 | 6.3-31.3 | 12.5 | 6.3-31.3 | 0.794 |
| Total | 31.1 | 20.4-36.3 | 22.6 | 13.2-30.7 | 0.035* |

HOOS: Hip disability and Osteoarthritis Outcome Score; IQR: Interquartile range; ADL: Activities of daily living; Sport/Rec: Sport and recreation; QoL: Quality of life; * $p<0.05$.

demonstrated significantly worse scores on the ADL subscale (p=0.006), Sport/Rec subscale (p=0.010), and total score (p=0.035) of the HOOS compared to those with moderate severity. These findings suggest that the ADL and Sport/Rec subscales, as well as the total score, have adequate known-group validity, indicating their ability to discriminate between

**Table 6.** Factor loadings of the Turkish version of the HOOS according to the confirmatory factor analysis

| Factor | Item | Estimate | SE | Z | *p* |
|---|---|---|---|---|---|
| Symptoms (S) | S1. Do you feel grinding, hear clicking or any other type of noise from you hip? | 0.650 | 0.0963 | 6.75 | <0.001 |
| | S2. Difficulties spreading legs wide apart. | 0.492 | 0.0639 | 7.69 | <0.001 |
| | S3. Difficulties to stride out when walking | 0.584 | 0.0645 | 9.06 | <0.001 |
| | S4. How severe is your hip joint stiffness after first wakening in the morning? | 0.890 | 0.0611 | 14.55 | <0.001 |
| | S5. How severe is your hip stiffness after sitting, lying or resting later in the day? | 0.745 | 0.0649 | 11.48 | <0.001 |
| Pain (P) | P1. How often is your hip painful? | 0.716 | 0.0537 | 13.34 | <0.001 |
| | P2. Straightening your hip fully | 0.729 | 0.0543 | 13.41 | <0.001 |
| | P3. Bending your hip fully | 0.755 | 0.0583 | 12.96 | <0.001 |
| | P4. Walking on flat surface | 0.726 | 0.0596 | 12.17 | <0.001 |
| | P5. Going up or down stairs | 0.792 | 0.0519 | 15.25 | <0.001 |
| | P6. At night while in bed | 0.718 | 0.0700 | 10.27 | <0.001 |
| | P7. Sitting or lying | 0.821 | 0.0627 | 13.09 | <0.001 |
| | P8. Standing upright | 0.718 | 0.0587 | 12.23 | <0.001 |
| | P9. Walking on a hard surface (asphalt, concrete, etc.) | 0.770 | 0.0545 | 14.13 | <0.001 |
| | P10. Walking on an uneven surface | 0.800 | 0.0509 | 15.71 | <0.001 |
| ADL (A) | A1. Descending stairs | 0.886 | 0.0717 | 12.36 | <0.001 |
| | A2. Ascending stairs | 0.822 | 0.0556 | 14.79 | <0.001 |
| | A3. Rising from sitting | 0.811 | 0.0623 | 13.03 | <0.001 |
| | A4. Standing | 0.667 | 0.0607 | 11.00 | <0.001 |
| | A5. Bending to floor/pick up an object | 0.868 | 0.0611 | 14.21 | <0.001 |
| | A6. Walking on flat surface | 0.698 | 0.0571 | 12.22 | <0.001 |
| | A7. Getting in/out of car | 0.817 | 0.0568 | 14.39 | <0.001 |
| | A8. Going shopping | 0.844 | 0.0568 | 14.86 | <0.001 |
| | A9. Putting on socks/stockings | 0.697 | 0.0606 | 11.51 | <0.001 |
| | A10. Rising from bed | 0.890 | 0.0600 | 14.82 | <0.001 |
| | A11. Taking off socks/stockings | 0.683 | 0.0664 | 10.30 | <0.001 |
| | A12. Lying in bed (turning over, maintaining hip position) | 0.793 | 0.0598 | 13.25 | <0.001 |
| | A13. Getting in/out of bath | 0.816 | 0.0615 | 13.26 | <0.001 |
| | A14. Sitting | 0.724 | 0.0591 | 12.26 | <0.001 |
| | A15. Getting on/off toilet | 0.784 | 0.0608 | 12.90 | <0.001 |
| | A16. Heavy domestic duties (moving heavy boxes, scrubbing floors, etc.) | 0.799 | 0.0572 | 13.96 | <0.001 |
| | A17. Light domestic duties (cooking, dusting, etc.) | 0.709 | 0.0600 | 11.80 | <0.001 |
| Sport/Rec (SP) | SP1. Squatting | 0.686 | 0.0523 | 13.13 | <0.001 |
| | SP2. Running | 0.678 | 0.0507 | 13.37 | <0.001 |
| | SP3. Twisting/pivoting on your injured hip | 0.797 | 0.0559 | 14.24 | <0.001 |
| | SP4. Walking on uneven surface | 0.787 | 0.0606 | 12.99 | <0.001 |
| QoL (Q) | Q1. How often are you aware of your hip problem? | 0.610 | 0.0616 | 9.90 | <0.001 |
| | Q2. Have you modified your life style to avoid potentially damaging activities to your hip? | 0.527 | 0.0711 | 7.41 | <0.001 |
| | Q3. How much are you troubled with lack of confidence in your hip? | 0.732 | 0.0644 | 11.37 | <0.001 |
| | Q4. In general, how much difficulty do you have with your hip? | 0.879 | 0.0531 | 16.54 | <0.001 |

Model Fit Statistics: CFI=0.652, TLI=0.628, and RMSEA=0.145.
HOOS: Hip disability and Osteoarthritis Outcome Score; SE: Standard error; ADL: Activities of daily living; Sport/Rec: Sport and recreation; QoL: Quality of life; CFI: Comparative Fit Index; TLI: Tucker-Lewis Index; RMSEA: Root Mean Square Error of Approximation.

different levels of hip osteoarthritis severity. Further details can be found in Table 5.

The Turkish version of the HOOS did not meet contemporary fit recommendations based on the fit indices when evaluated using the five-factor model. The CFI had a value of 0.652, the TLI had a value of 0.628, and the RMSEA had a value of 0.145. Factor loadings of each item are presented in Table 6. These fit indices indicate that the proposed model did not adequately fit the observed data according to contemporary standards.

## DISCUSSION

This study aimed to translate and culturally adapt the HOOS into Turkish and evaluate its psychometric properties in patients with hip osteoarthritis. The findings of the study indicated that the Turkish version of the HOOS was comparable in terms of convergent and known-group validity and reliability to other translated versions.

We found that Sport/Rec and QoL subscales of the Turkish version of the HOOS has a floor effect (worst possible score). Similar results were reported by other validation studies. For example, the Polish validation study[12] of the HOOS found the floor effects for Sport/Rec (24%) and QoL (25%) subscales, French version[5] found a floor effect for the Sport/Rec (17.8%), and Persian version[13] found a floor effect again for the Sport/Rec (18%). This result was not surprising given that these two subscales were created as an expansion of the WOMAC for younger and more active individuals.[3]

Cronbach's alpha values for each subscale of the Turkish version of the HOOS were as follows: symptoms=0.76, pain=0.94, ADL=0.96, Sport/Rec=0.87, and QoL=0.78, indicating it has high internal consistency. While the lowest Cronbach's alpha value was observed in the symptoms subscale, the highest Cronbach's alpha value was seen in the ADL subscale. This result is line with previous validation studies; for example, the ADL subscales has a Cronbach's alpha of 0.94 in the French version,[5] 0.98 in the Dutch version,[8] 0.96 in the Korean,[9] German,[10] and Italian[7] versions, 0.97 in the Japanese version,[11] and 0.95 to 0.97 in the Polish version.[12] A lower value of Cronbach's alpha found in the symptoms and QoL subscales could be due to a heterogeneous construct of these subscales. On the other hand, the presence of a high Cronbach's alpha in subscales does not guarantee that they are homogenous or unidimensional. If Cronbach's alpha is very high (above 0.9), it may indicate that some items in both the 17-item ADL subscale and the 10-item Pain subscale are repetitive and assess the same question in a slightly different way. Since all previous validation studies found similar results and our aim was not to modify the HOOS, we did not attempt a reduction in these subscales to be the same as possible as the original and other validated versions.

For all subscales of the Turkish version of the HOOS, the ICC values were between 0.76 and 0.96, indicating good to excellent test-retest reliability. The previous validation studies reported similar test-retest results.[3,5,8,10,12,13] In the Turkish version of the HOOS, the SEM values ranged from 5.1 to 6.7. In addition, the MDC95% values ranged from 15.1 to 18.6. Clinicians and researchers can utilize the SEM and MDC95% values we provided as a benchmark when interpreting the HOOS scores following an intervention. It is vital to acknowledge that these values do not represent the minimal clinically important difference, but rather they indicate the level of measurement error. To sum up, these results prove that the HOOS is stable and reproducible in different languages.

The convergent validity of the Turkish HOOS was evaluated by testing the predefined hypotheses using the correlations with the WOMAC and the EQ-5D-3L, a generic QoL scale. As anticipated, we found significant associations between the different aspects of the HOOS and the corresponding sections of WOMAC, which were designed to assess similar concepts. For example, WOMAC-Pain subscale has the strongest correlation coefficient with the HOOS-Pain subscale, and similarly WOMAC-ADL subscale has the strongest correlation coefficient with the HOOS-ADL. We also found moderate correlations between the EQ-5D-3L-Index and HOOS subscales. Since the WOMAC evaluates more similar constructs as in the HOOS, it is not surprising

finding that we found weaker correlations between the HOOS and the EQ-5D-3L-Index compared to the WOMAC. On the other hand, Polish,[12] Dutch,[8] Japanese,[11] and Italian[7] versions showed strong correlation between HOOS and SF-36 (Short Form 36). Unlike other studies, we used the EQ-5D-3L instead of SF-36 since we used WOMAC, which is more related to the HOOS. To decrease the patient burden, we did not use the SF-36, which includes 36 items. Instead, we used a practical and short QoL scale. Although SF-36 and EQ-5D-3L evaluate QoL, they are different in terms of whether they are preference-based or not. Due to these reasons, we believe that the correlations were moderate in our study.

The findings of our study did not support the original five-factor structure of the HOOS scale, which is consistent with the findings of a study conducted by Miley et al.[26] involving 655 participants. These results suggest the need for item rewriting or item removal to improve the model. Additionally, it appears that the items within the constructs may not effectively measure distinct phenomena. It would be worthwhile to investigate the theoretical justifications for the observed correlated errors and determine the circumstances in which their inclusion is warranted in research. Employing exploratory procedures, such as exploratory factor analysis, could be valuable in identifying a more concise instrument from the original item pool, although it was not the focus of our study. Future research should aim to enhance the structural validity of both the original HOOS scale and its Turkish version. Based on our findings, we observed that the total score of the HOOS demonstrated better results in terms of internal consistency, test-retest reliability, and known-groups validity compared to the individual subscales. Therefore, we recommend that clinicians and researchers exercise caution when utilizing the subscales of the HOOS and instead consider using the total score as a more reliable and comprehensive measure. By using the total score, a more accurate assessment of hip disability and osteoarthritis outcomes can be obtained, providing a more comprehensive evaluation for clinical decision-making and research purposes.

The current study had some potential limitations that should be considered. One of these limitations is that all the evaluation measures used to assess the validity were based on self-reporting. While these questionnaires are commonly regarded as trustworthy and dependable methods for examining hip osteoarthritis, utilizing objective measures like an algometer, manual muscle tester, timed up and go test, sit-to-stand test, and step climbing test could have given more precise data on the validity of the Turkish version of the HOOS. Second, the cross-sectional design used in this study limited our ability to examine the changes in participants' behaviors over time and understand the longitudinal effects of the intervention. Lastly, we retrospectively attempted to obtain Tönnis scores to assess disease severity. However, since the collection of these scores was not initially planned, we encountered a significant amount of missing data. The presence of missing data could potentially introduce bias and limit the robustness of our findings related to disease severity, specifically known-groups validity.

In conclusion, the findings derived from our study demonstrate that the Turkish version of the HOOS possesses satisfactory convergent and known-group validity and reliability, congruent with the results obtained from the validation studies in other languages. The Turkish version of the HOOS is now readily accessible and can be effectively utilized for evaluating patients' subjective perception of their hip function, associated difficulties, as well as symptoms and functional limitations. Nevertheless, it is advised that clinicians and researchers proceed with caution when employing the subscales of the HOOS and instead give preference to utilizing the total score.

**Ethics Committee Approval:** The study protocol was approved by the Tarsus University Clinical Research Ethics Committee (date: 10.05.2022, no: 2022/08). The study was conducted in accordance with the principles of the Declaration of Helsinki.

**Patient Consent for Publication:** A written informed consent was obtained from each patient.

**Data Sharing Statement:** The data that support the findings of this study are available from the corresponding author upon reasonable request.

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materials: R.Ç., A.G.; Analysis and/or interpretation: A.G., R.Ç., T.K.; Literature review: A.G., K.Ç., T.K.; Writing the article: A.G., T.K.; Critical review: T.K.; Other: K.Ç.

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## KALÇA YETİYİTİMİ VE OSTEOARTRİT SONUÇ SKORU

**YÖNERGE:** Bu anket kalçanızla ilgili görüşünüzü sormaktadır. Bu bilgi, kalçanız hakkında nasıl hissettiğinizi ve günlük aktivitelerinizi ne kadar iyi yapabildiğinizi takip etmemize yardımcı olacaktır.

Her soruyu uygun bir kutucuğu işaretleyerek cevaplayın. Bir soruyu nasıl cevaplayacağınızdan emin değilseniz, lütfen verebileceğiniz en iyi cevabı verin.

### SEMPTOMLAR

Bu sorular, **geçen haftaki** kalça semptomlarınız düşünülerek cevaplanmalıdır.

**Soru 1.** Kalçanızdan sürtünme sesi, tıkırtı, çıtlama veya benzeri sesler duyuyor musunuz?

☐ Hiçbir zaman ☐ Nadiren ☐ Bazen ☐ Sıklıkla ☐ Her zaman

**Soru 2.** Bacaklarınızı yana açarken yaşadığınız zorluk

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 3.** Yürürken ***normal*** adım atmakta zorluk

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

### SERTLİK

Aşağıdaki sorular kalçanızda **geçen hafta** yaşadığınız eklem sertliği miktarıyla ilgilidir. Sertlik, kalça ekleminizi hareket ettirme kolaylığınızdaki bir kısıtlama veya yavaşlık hissidir.

**Soru 4.** Sabah uyandıktan sonra kalça eklem sertliğiniz ne kadar şiddetlidir?

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 5.** Günün ilerleyen saatlerinde, oturduktan, yattıktan veya dinlendikten sonra kalça sertliğiniz ne kadar şiddetlidir?

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

### AĞRI

**Soru 1.** Kalçanız ne sıklıkla ağrıyor?

☐ Hiçbir zaman ☐ Nadiren ☐ Bazen ☐ Sıklıkla ☐ Her zaman

Aşağıdaki aktiviteler sırasında **geçen hafta** ne kadar kalça ağrısı yaşadınız?

**Soru 2.** Kalçanızı tamamen düzeltirken

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 3.** Kalçanızı tamamen bükerken

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 4.** Düz zeminde yürürken

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 5.** Merdivenlerden çıkarken veya inerken

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 6.** Gece yataktayken

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 7.** Otururken veya yatarken

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 8.** Dik bir şekilde ayakta dururken

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 9.** Sert bir zeminde yürürken (asfalt, beton vb.)

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 10.** Düz olmayan (engebeli) bir zeminde yürürken

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Fonksiyon, günlük yaşam**

Aşağıdaki sorular fiziksel fonksiyonla ilgilidir. Fiziksel fonksiyonla, hareket etme ve kendinize bakma yeteneğinizi kastediyoruz. Aşağıdaki aktivitelerin her biri için lütfen **geçen hafta** kalçanızdan dolayı yaşadığınız zorluğun derecesini belirtiniz.

**Soru 1.** Merdivenlerden inme

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 2.** Merdivenlerden çıkma

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 3.** Oturmadan ayağa kalkma

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 4.** Oturmadan ayağa kalkma

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 5.** Yere eğilme/bir nesneyi alma

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 6.** Düz zeminde yürüme

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 7.** Arabaya binme/ arabadan inme

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 8.** Alışverişe gitme

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 9.** Kısa/uzun çorap giyme

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 10.** Yataktan kalkma

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 11.** Kısa/uzun çorap çıkarma

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 12.** Yatakta yatma (dönme, kalça pozisyonunu koruma)

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 13.** Küvete girme/küvetten çıkma

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 14.** Oturma

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 15.** Tuvalete girmek/çıkmak (klozete oturup kalkmak)

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 16.** Ağır ev işleri (ağır kutuları taşımak, zeminleri fırçalamak vb.)

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 17.** Hafif ev işleri (yemek yapma, toz alma vb.)

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Fonksiyon, spor ve eğlence aktiviteleri**

Aşağıdaki sorular, daha yüksek düzeyde aktif olduğunuzdaki fiziksel fonksiyonunuzla ilgilidir. **Son bir hafta** içinde kalçanızdan dolayı ne kadar zorluk yaşadığınız düşünülerek sorular cevaplandırılmalıdır.

**Soru 1.** Çömelme

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 2.** Koşma

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 3.** Etkilenmiş bacağınız üzerinde dönme

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Soru 4.** Düz olmayan zeminde yürüme

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

## YAŞAM KALİTESİ

**Soru 1.** Kalça probleminizin ne sıklıkla farkında olursunuz?

☐ Hiçbir zaman ☐ Ayda bir iki kere ☐ Haftada bir iki kere ☐ Günde bir iki kere ☐ Sürekli

**Soru 2.** Kalçanıza potansiyel olarak zarar verebilecek aktivitelerden kaçınmak için yaşam tarzınızı değiştirdiniz mi?

☐ Hiçbir zaman ☐ Biraz ☐ Orta derecede ☐ Ciddi derecede ☐ Tamamen

**Soru 3.** Kalçanıza olan özgüven eksikliğinden ne kadar rahatsızsınız?

☐ Hiçbir zaman ☐ Biraz ☐ Orta derecede ☐ Ciddi derecede ☐ Aşırı derecede

**Soru 4.** Genel olarak, kalçanızla ne kadar zorluk yaşıyorsunuz?

☐ Hiç ☐ Hafif ☐ Orta ☐ Şiddetli ☐ Aşırı

**Bu anketteki tüm soruları tamamladığınız için teşekkür ederiz.**