The Dutch Version of the Oxford Knee Score – Activity and Participation Questionnaire: A Validation Study

Malou te Molder (✉ M.temolder@maartenskliniek.nl)

Sint Maartenskliniek

Johanna Vriezekolk

Sint Maartenskliniek

Menno Bénard

Sint Maartenskliniek

Petra Heesterbeek

Sint Maartenskliniek

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Abstract

Background: Patients undergoing total knee arthroplasty (TKA) tend to be younger and tend to receive TKA at an earlier stage compared to 20 years ago. The Oxford Knee Score – Activity and Participation (OKS-APQ) questionnaire evaluates higher levels of activity and participation, reflecting activity patterns of younger or more active people. The purpose of this study was to translate a Dutch-language version of the OKS-APQ questionnaire, and to validate it in pre- and postoperative TKA patients.

Methods: We evaluated the Dutch translation of the OKS-APQ for reliability and validity. Internal consistency, test-retest reliability, factor analysis, construct validity and floor and ceiling effects were evaluated using quality criteria. The OKS-APQ, the Oxford Knee Score (OKS), the Short Form-36 (SF-36), a Visual Analogue Scale (VAS) for pain and the Forgotten Joint Score (FJS) were assessed in 131 patients, and the OKS-APQ was administered twice in 50 patients after an interval of minimal 2 weeks.

Results: Internal consistency (Cronbach α 's from 0.81 to 0.95) and test-retest reliability (Intraclass Correlation Coefficients (ICCs) from 0.63 – 0.88) were satisfactory to good. The standard Error of Measurements (SEMs) ranged from 8.5 – 12.2 and the Smallest Detectable Changes in individuals (SDC_{ind}) ranged from 23.5 – 34.0 (on a scale from 0 to 100). Confirmatory factor analyses (CFA) indices indicated a satisfactory fit of a 1-factor model (Comparative Fit Index (CFI): 0.97, Tucker-Lewis Index (TLI): 0.96, Root Mean Square Error of Approximation (RMSEA): 0.1, Standardized Root Mean Square Residual (SRMSR): 0.03). Construct validity was supported as >75% of the hypotheses were confirmed and floor effects were observed in preoperative patients.

Conclusions: The Dutch translation of the OKS-APQ showed good reliability and validity in the Dutch population, and can be used alongside the OKS in clinical research and clinical practice to discriminate among levels of activity and participation in postoperative patients.

Background

The Oxford knee score (OKS) questionnaire is a validated patient-reported outcome measure (PROM), developed for patients undergoing Total Knee Arthroplasty (TKA)(1). The OKS was developed in 1998 to reflect patients' perception of knee pain and functional impairment(1). Nowadays, patients undergoing TKA tend to be younger and receive TKA at an earlier stage compared to 20 years ago(2, 3). Younger patients with an active lifestyle, have higher expectations of the outcome after the procedure(2, 4). Patients want to stay active and engaged in their social and recreational activities up to and after retiring(2). Regaining a higher level of participation in social and recreational activities becomes more important for patients after TKA(2). This implies that besides pain and disability, participation has become an important outcome domain. For that reason, the original OKS was extended with an additional one-dimensional subscale, the Oxford Knee Score – Activity and Participation Questionnaire (OKS-APQ), to better monitor changes in activity and participation levels after TKA(4).

The OKS-APQ evaluates activity and participation levels (e.g. sports, dancing, and participation in activities with friends and family) that fit activity patterns of younger or more active patients(4). Besides the original

English version of the OKS-APQ and a Chinese version(5), the questionnaire has not been translated and validated in other languages including Dutch. The original OKS-APQ has shown to be a valuable complement to the OKS, particularly where further detail regarding the levels of activity and participation are required(4).

In order to use the OKS-APQ questionnaire in the Netherlands, a process of translation and validation is required. The present study aimed to translate the OKS-APQ into the Dutch language and to assess the unidimensionality of the scale, the test-retest reliability, internal consistency, construct validity and floor and ceiling effects, in knee osteoarthritis patients who underwent TKA(6).

Methods

We performed a translation of the OKS-APQ into Dutch and prospectively evaluated the measurement properties of the Dutch version. Measurement properties were evaluated using COSMIN quality criteria(6).

Procedure of translation

The OKS-APQ questionnaire was translated from English to Dutch according to the advised forward-backward translation multi step approach for translation as described by Beaton et al(7,8). During the last step, the definitive version was tested in a subset of 5 preoperative and 5 postoperative TKA patients. These patients completed the questionnaire at home and were asked to make notes if they thought a question was difficult to understand. No issues regarding the items of the OKS-APQ questionnaire were reported by the patients.

Patients

As a rule of thumb, at least 100 patients were required to perform methodological testing(9), and we aimed to include preoperative and postoperative patients. The preoperative study sample was recruited from the waiting list for TKA and the postoperative patients were selected from the outpatient registry. There were no age restrictions. All patients underwent TKA at the department of orthopaedics at the Sint Maartenskliniek in Nijmegen between 2015 and 2018. Patients unable to speak and understand Dutch written language were excluded. The study was assessed by the local review committee, but not by the Medical Ethics Committee because this study was not subject to the Dutch medical research involving human subject act. All patients gave their written informed consent to participate in the study.

Questionnaires

In addition to completing the OKS-APQ, patients completed additional condition-specific questionnaires which are commonly used in pre- and postoperative TKA patients between January 2017 and December 2019. All preoperative patients completed the following four questionnaires: the OKS-APQ, the Oxford Knee Score (OKS)(10), the Short Form-36 (SF-36)(11), and a Visual Analogue Scale for pain(12). Postoperative patients also completed an additional fifth questionnaire, the Forgotten Joint Score (FJS)(13). All patients

were asked to complete the questionnaires for a second time, after a minimum of two weeks, which was considered appropriate for the test-retest reliability(6).

Evaluation of measurement properties

Oxford Knee Score - Activity and Participation (OKS-APQ)

The OKS-APQ eight-item questionnaire was developed to measure higher levels of activity and participation and is recommended to be used to complement the OKS as an additional scale(4). Items are scored on a five-point Likert scale, ranging from 0 “strongly agree” to 4 “strongly disagree”. Total summary score ranges from 0 to 32, and scores are converted to a 0 to 100 measure(4). A lower total sum score represents lower levels of activity and participation(4).

Oxford Knee Score (OKS)

The OKS 12-item questionnaire has been developed for patients undergoing TKA to evaluate the patients’ perception of pain and functional impairment in the knee(10). The questionnaire consists of 12 questions and it is possible to derive separate OKS pain and function subscales(10). Responses are scored on a 5-point Likert scale, ranging from 0 “significant disability” to 4 “no problem”, in which the final score is an aggregate, sum score for pain and function(14). The total scores ranges from 0 to 48; a lower OKS sum score represents poor function and more pain. The OKS has good measurement properties(10), however ceiling effects were demonstrated in postoperative patients(15,16).

MOS Short Form 36 (SF-36)

The SF-36 is a 36-item questionnaire assessing health-related Quality of Life (QoL). It consists of eight dimensions that are aggregated to two summary scores: Physical Component Score (PCS) and Mental Component Score (MCS) (both 0-100)(11). The SF-36 is widely used and has shown to be reliable and valid in the Dutch general population(11,17,18). A lower score represents a lower level of QoL (10).

Visual analogue scale for pain (VAS pain)

The VAS for pain is a single item scale assessing the intensity of pain in the knee during the past 2 to 3 days. The 100-mm VAS is simple to use, and has already been applied in different populations and settings(12). The score varies from 0 (no pain), to 100 (worst pain). It has shown to be valid and reliable(12).

Forgotten Joint Score (FJS-12)

The 12-item Forgotten Joint Score (FJS-12) questionnaire evaluates the patients’ ‘joint awareness’ during activities of daily living (i.e. stair climbing, walking and gardening). The responses were scored on a five-

point Likert scale, ranging from 0 “never” to 4 “mostly”. Item scores were summed and converted to a 0 to 100 scale, a low total sum score reflects that the patient is not able to forget the affected/replaced joint during activities of daily living(13).

Methodological testing & statistical analysis

Kolmogorov Smirnov test was used to test the normality of the OKS-APQ items, OKS-APQ total score and other PROM total scores. Descriptive statistics were used to summarize the data; mean and standard deviation (SD) or median (25th – 75th percentile) for continuous variables and counts and percentages for categorical variables, and to investigate the frequencies of missing data. All statistical analyses were performed in STATA version 13.0 (StataCorp, College Station, Texas). A P-value < 0.05 was considered statistically significant for all analyses.

Reliability

Reliability is the degree to which the Dutch OKS-APQ is free from measurement error. To evaluate reliability, internal consistency, test-retest reliability, the measurement error and the smallest detectable change were calculated.

Internal consistency

Internal consistency is a measure to evaluate to what extent the eight items of the Dutch OKS-APQ refer to the same underlying construct(9). Internal consistency of the Dutch version of the OKS-APQ was determined by calculating the Cronbach’s alpha(9). A Cronbach’s alpha between 0.7 and 0.9 for the eight items of the OKS-APQ indicates good internal consistency(9). The Cronbach’s alpha was measured on the pooled sample and the separate pre- and postoperative samples.

Test-retest reliability

Test-retest reliability involves the degree to which the results of the Dutch OKS-APQ are consistent across repeated measurements(9). To evaluate the reliability of the Dutch OKS-APQ, we calculated intraclass correlation coefficients (ICCs) with a 95% confidence interval (95% CI). In addition, we provided the different variance components to show the systematic differences between the two timepoints in preoperative and postoperative patients. More specific, we used the ICC two-way random effects model type agreement to measure the reliability(9). An ICC equal to and larger than 0.7 is generally accepted as good(9). ICCs were calculated for the pooled sample and the separate pre- and postoperative samples.

Measurement error & Smallest detectable change

The measurement error is the systematic and random error of a participant's score that is not attributed to true changes in the construct to be measured(6). The standard error of measurement (SEM) was calculated using the square root of the error variance(9,19).

The smallest detectable change (SDC) reflects the smallest individual change in score that can be interpreted as a real change in one individual (SDC_{ind}). This was calculated by the $SEM * 1.96 * \sqrt{2}(9,19)$. The SDC_{ind} can be divided by $\sqrt{n}$ (n = sample size) to calculate the SDC in a group of patients (SDC_{group})(9,19). SEM and SDC were calculated for the pooled sample and the separate pre- and postoperative samples.

Validity

Validity is the degree to which the Dutch OKS-APQ measures the construct(s) it purports to measure. To evaluate validity, structural validity, construct validity and content validity were measured.

Structural validity

Confirmatory factor analyses (CFA) was used to validate the 1-factor structure of the original English version of the OKS-APQ(4). We examined the comparative fit index (CFI), the Tucker-Lewis Index (TLI), the root mean square error of approximation (RMSEA) and the standardized root mean squared residual (SRMR) to assess goodness of fit of this model. The following indices of fit were considered satisfactory: CFI: > 0.95; RMSEA (0 to 1): < 0.05 representing close fit, <0.08 good fit, <0.1 satisfactory fit and SRMR: < 0.05(20). CFA was assessed using the pooled sample (pre- and postoperative patients).

Construct validity

Validity is the degree to which the OKS-APQ measures the construct it supposes to measure. Since there is no gold standard in the measurement of PROMs, validity was measured as construct validity(9). Construct validity refers to the extent to which the OKS-APQ was related to other measures based on theoretically derived, predefined hypotheses. Construct validity was supported when at least 75% of the results are in accordance with the predefined hypotheses (Table 1)(9). Construct validity was expressed by assessing Pearson correlation coefficients or the nonparametric Spearman's correlation coefficients(9). The strength of the correlations was interpreted as "weak" ($r = 0.10 - 0.30$), "moderate" ($r = 0.31 - 0.50$) or "strong" ($r = 0.51 - 1.00$)(21). Predefined hypotheses were formulated for the pooled and separate pre- and postoperative samples.

Content validity

A quality criterion for content validity is the absence of floor and ceiling effects. Presence of floor and ceiling effects on the OKS-APQ may influence the test-retest reliability, and construct validity of the questionnaire(9). Patients with the lowest or highest possible score cannot be distinguished from each other, thus reliability is

reduced(9). Floor and ceiling effects, in pre- and postoperative samples separately, were determined by calculating the number of individuals that obtained the lowest (0) or highest (100) scores possible and were considered present if more than 15% of the patients achieved the highest or lowest total summary score(9). In addition, floor and ceiling effects on item-level was determined.

Table 1
Predefined hypotheses for evaluating the construct validity of the Dutch OKS-APQ

Hypothesis
A. Strong positive correlation ($r > 0.50$):
1. A strong positive correlation between OKS-APQ and OKS (pooled, pre- and postoperative patients);
2. A strong positive correlation between OKS-APQ and FJS (in postoperative patients);
3. A strong positive correlation between OKS-APQ and PCS (SF-36) (pooled, pre- and postoperative patients);
B. Moderate to strong negative correlation ($r > 0.31$):
4. A moderate to strong negative correlation between OKS-APQ and VAS pain (pooled, pre- and postoperative patients);
C. Weak to moderate positive correlation ($r \ 0.10 - 0.50$):
5. A weak to moderate positive correlation between OKS-APQ and MCS (SF-36) (pooled, pre- and postoperative patients);
Abbreviations: OKS-APQ, Oxford knee score – Activity & Participation Questionnaire; FJS, Forgotten joint score; OKS, Oxford knee score; SF-36, 36-Item Short Form Health Survey Questionnaire; VAS for pain, Visual Analogue Scale; PCS, Physical Component Score; MCS, Mental Component Score.

Results

Demographic data

A total of 131 patients were included, with mean age 66.3 (9.4) years, of which 72 were preoperative patients with OA prior to TKA, and 59 were postoperative patients ≥ 6 months after TKA (Table 2). Both the pooled data and the separated pre- and postoperative samples were not normally distributed ($p < 0.05$). The missing values per item and for the total scores ranged from: 0 to 5.34% missing values, with the latter only for VAS pain. All missing items on the OKS-APQ (Table 3), OKS and SF-36 were imputed as recommended with patient-specific mean values of completed items. Because 10% missing data for a variable is considered acceptable(22), we performed the analyses without further evaluation or adjustment of the other variables.

Internal consistency

The item-total correlations were calculated for each item (Table 3). Internal consistency was appropriate; Cronbach alpha values exceeded 0.70 for the pooled and separate samples of pre- and postoperative patients (Table 4).

Test-retest reliability

Fifty patients (12 preoperative and 38 postoperative patients) completed the questionnaires for a second time, after a minimum of two weeks. The median scores (25th – 75th percentile) for the test and retest of the OKS-APQ, the ICCs and variance components are presented in Table 4. The OKS-APQ showed good test-retest reliability in the pooled and postoperative samples with ICCs > 0.85. The largest systematic differences between the “true” scores of the patients were found in postoperative patients (Table 4).

Measurement error & Smallest detectable change

SEM, SDC_{ind} and SDC_{group} in the pooled pre- and postoperative patients are presented in Table 4.

Structural validity

The fit of a 1-factor model in the CFA resulted in a CFI of 0.97, a TLI of 0.96, a RMSEA of 0.10 and a SRMR of 0.03. CFA fit indices indicated a satisfactory fit of a 1-factor model.

Construct validity

The assessment of construct validity showed a strong positive correlation with the OKS in both pre- and postoperative patients and a strong positive correlation with the FJS-12 and PCS of the SF-36 in postoperative patients (Table 5). The OKS-APQ showed a moderate to strong negative correlation with the VAS pain and a weak to moderate positive correlation with the MCS of the SF-36 in both pre- and postoperative patients.

Content validity

In the preoperative patient sample a floor effect was observed for the summary score of the OKS-APQ. Twenty one patients (29.2%) scored the lowest level of activity and participation. No ceiling effect was observed for the summary score. In the postoperative patient sample, no floor and ceiling effects were observed for the summary score. Floor and ceiling effects for the items of the OKS-APQ in the pre- and postoperative sample are presented in Table 3.

Table 2
Patient Characteristics

Sociodemographic	Pooled sample (n = 131)	Preoperative sample (n = 72)	Postoperative sample (n = 59)
Age; mean (SD),(yr)	66.3 (9.4)	66.2 (9.3)	66.4 (9.6)
Self-report measures; median (25th – 75th percentile)			
OKS - Activity & Participation (OKS-APQ) (scale 0-100)	21.9 (6.3– 56.3)	10.9 (0–23.4)	62.5 (25–84.4)
Oxford Knee Score (OKS) (scale 0–48)	29 (20–39)	22 (15–29)	39 (30–44)
VAS Pain (scale 0-100)	30 (10.5–63.5)	59 (31–74)	11 (4–28)
Quality of life			
Physical component (SF-36-PCS) (scale 0-100)	34.1 (27.8– 40.8)	30.6 (25.8–34.8)	39.8 (33.6–46.8)
Mental component (SF-36-MCS) (scale 0-100)	52.8 (42.5– 57.2)	50.6 (41.7–56.4)	53.7 (48.0–57.3)
Forgotten Joint Score (FJS) (scale 0-100)	NA	NA	37.5 (14.6–60.4)
SD indicates standard deviation; OKS APQ Oxford Knee Score - Activity and Participation Questionnaire; OKS Oxford Knee Score; VAS Visual Analogue Scale; SF-36, 36-item Short Form Health Survey Questionnaire; SF-36-MCS, Mental Component Score; SF-36-PCS, Physical Component Score; FJS Forgotten Joint Score.			

Table 3
Characteristics of the Dutch OKS-APQ

Items	Item-Total Correlation (pooled sample)	Missing, n (%) (pooled sample)	Floor, n (%) (preoperative sample)	Ceiling, n (%) (preoperative sample)	Floor, n (%) (postoperative sample)	Ceiling, n (%) (postoperative sample)
It is a problem for me to do activities (e.g. sports, dancing, walking) to the level I want, because of my knee	0.84	0 (0.0%)	64 (89%)	1 (1.4%)	19 (32.2%)	7 (11.9%)
It is a problem for me to carry heavy things (e.g. items at work, shopping or a child), because of my knee	0.83	0 (0.0%)	41 (56.9%)	1 (1.4%)	12 (20.3%)	15 (25.4%)
I need to modify my work or everyday activities, because of my knee	0.92	4 (3.1%)	42 (60%)	3 (4.3%)	11 (19.3%)	18 (31.6%)

Items	Item-Total Correlation (pooled sample)	Missing, n (%) (pooled sample)	Floor, n (%) (preoperative sample)	Ceiling, n (%) (preoperative sample)	Floor, n (%) (postoperative sample)	Ceiling, n (%) (postoperative sample)
I need to plan carefully before going out for the day because of my knee (e.g. taking painkillers, using a knee brace or checking that there will be places to sit down)	0.89	0 (0.0%)	44 (61.1%)	2 (2.8%)	9 (15.3%)	27 (45.8%)
It is a problem for me to fully take part in activities with friends and family, because of my knee	0.85	0 (0.0%)	34 (47.2%)	1 (1.4%)	11 (18.6%)	18 (30.5%)
It is a problem for me to walk at the pace I would like, because of my knee	0.88	0 (0.0%)	62 (86.1%)	10 (13.9%)	16 (27.1%)	12 (20.3%)
It is a problem for me to twist or turn, as my knee may give way or be painful	0.87	0 (0.0%)	46 (63.9%)	3 (4.2%)	10 (17%)	23 (39%)

Items	Item-Total Correlation (pooled sample)	Missing, n (%) (pooled sample)	Floor, n (%) (preoperative sample)	Ceiling, n (%) (preoperative sample)	Floor, n (%) (postoperative sample)	Ceiling, n (%) (postoperative sample)
It is a problem for me that I need to take longer to do everyday activities, because of my knee	0.88	1 (0.8%)	29 (40.9%)	8 (11.3%)	7 (12.1%)	18 (31%)

Table 4
Reliability of the Dutch OKS-APQ

Study sample		Pooled sample (n = 131)	Preoperative sample (n = 72)	Postoperative sample (n = 59)
Cronbach α		0.95	0.81	0.95
Test-retest sample		Pooled sample (n = 50)	Preoperative sample (n = 12)	Postoperative sample (n = 38)
OKS-APQ test median (25th – 75th percentile)		43.8 (17.97–81.25)	9.38 (0.00–29.69)	67.19 (27.34–82.03)
OKS-APQ retest median (25th – 75th percentile)		39.06 (15.63–72.66)	15.63 (0.78–28.13)	62.50 (21.88–78.13)
ICC (95% CI)		0.88 (0.80–0.93)	0.63 (0.10–0.88)	0.85 (0.72–0.92)
Variance components	σ^2_p	946.61	125.62	820.31
	σ^2_o	0.06	0.00	2.08
	$\sigma^2_{\text{residual}}$	130.90	72.02	147.49
SEM		11.44	8.49	12.23
SDC _{ind}		31.59	23.53	34.00
SDC _{group}		4.47	6.79	5.52
<p>ICC Intraclass correlation coefficient; SEM standard error of measurement; SDC_{ind} smallest detectable change in one individual; SDC_{group} smallest detectable change in a group.</p> <p>σ^2_p: The variance of the patients (i.e. the systematic differences between the ‘true’ scores of the patients; σ^2_o: variance due to systematic differences between observers/timepoints; $\sigma^2_{\text{residual}}$: Residual variance (i.e. random error variance).</p>				

Table 5
Construct validity of the Dutch OKS-APQ

Predefined Hypothesis	Spearman correlation*		
	Pooled sample	Preoperative sample	Postoperative sample
1. A strong positive correlation between OKS-APQ and OKS;	0.83	0.63	0.80
2. A strong positive correlation between OKS-APQ and FJS;	NA	NA	0.74
3. A strong positive correlation between OKS-APQ and PCS (SF-36);	0.65	0.40	0.59
4. A moderate to strong negative correlation between OKS-APQ and VAS pain;	-0.68	-0.43	-0.63
5. A weak to moderate positive correlation between OKS-APQ and MCS (SF-36);	0.47	0.50	0.40
<p>*All correlations $P < 0.001$.</p> <p>Abbreviations: OKS-APQ, Oxford knee score – Activity & Participation Questionnaire; OKS, Oxford knee score; FJS, Forgotten joint score; SF-36, 36-Item Short Form Health Survey Questionnaire; VAS for pain, Visual Analogue Scale; PCS, Physical Component Score; MCS, Mental Component Score.</p>			

Discussion

The primary objective of this study was to evaluate the measurement properties of the Dutch translation of the OKS-APQ (in the Dutch population). We examined and confirmed the validity and reliability of the Dutch OKS-APQ in a sample of pre-operative and postoperative patients with TKA. No floor and ceiling effects are observed in postoperative patients. However, floor effects were observed in preoperative patients indicating that the Dutch OKS-APQ is not able to discriminate among the lowest levels of activity and participation in the preoperative situation solely based on the OKS-APQ.

The OKS-APQ was developed and published in 2014 by Dawson et al.(4) to supplement the OKS score, in order to assess higher levels of activity and participation. The development of the OKS-APQ was patient-oriented as 8 interviews with patients were conducted and the final 8 items were selected and validated by standard methods(4). Our Dutch population was on average 5 years older compared to the English population in the study by Dawson et al(4). However, the results of measurement properties in the present study are comparable to those of the original English version(4) and the Chinese version(5). With a good internal consistency (Cronbach's alpha: 0.85 and 0.90 respectively), test-retest reliability (ICC of 0.79 (or 0.92 when one outlier was excluded) and 0.96 respectively) and supported construct validity ($r > 0.5$ with the OKS, American Knee Society Scores (AKSS) and SF-36 PCS)(4). The unidimensional scale was explored and confirmed (excellent fit: CFI: 1 and RMSEA of 0.0) in the original study(4) and confirmed in the present study. The pattern of floor and ceiling effects in the present study were comparable to the original study however,

no floor or ceiling effects were observed in the Chinese version which was validated in a preoperative sample(5).

For clinical practice, this study shows that the Dutch OKS-APQ is able to discriminate among postoperative patients whereas the OKS score previously demonstrated ceiling effects in postoperative patients(15, 16). The developers of the OKS-APQ recommended to use the OKS-APQ to complement the OKS as an additional scale(4). Therefore, the use of the OKS-APQ alongside the OKS is best used only in postoperative patients and not in preoperative patients because the OKS-APQ showed limited discriminatory power in the preoperative situation. In addition, the OKS-APQ may provide support for transferring patients to transmural care (e.g. physiotherapy or social work) when patients are still not satisfied with the prosthesis because of problems in social participation and recreational activities including sports. This may be subject for future investigations.

Limitations

We chose to investigate preoperative patients and postoperative patients 6 months after TKA. No participant took part in both samplings, and therefore, we were not able to investigate the responsiveness of the Dutch OKS-APQ. Dawson et al. found highly statistically significant improvements in scores at 6 months postoperative and an effect size (ES) of 4.16 for the OKS-APQ(4) indicating the responsiveness of the OKS-APQ. Further longitudinal research is needed to confirm the responsiveness of the OKS-APQ in Dutch TKA patients. Nor were we able to investigate the interpretability of the OKS-APQ. Without being able to calculate the MIC, it is difficult to interpret the SEM and SDC because we cannot check whether the SEM and SDC are smaller than the MIC(6). Furthermore, although the rule of thumb of at least 100 patients was met, the sample size was rather small, especially for the subsample analyses of pre- and postoperative patients. Finally, our findings were based on a sample of patients who were or will be treated in a specialized hospital, this should be taken into account when generalizing to other samples or settings.

Conclusion

The Dutch version of the OKS-APQ yielded satisfactory to good test-retest reliability, internal consistency, structural, construct and content validity. The unidimensionality of the OKS-APQ was confirmed. Floor effects were observed in preoperative patients indicating that the OKS-APQ was not able to discriminate among the lowest levels of activity and participation in the preoperative situation solely based on the OKS-APQ. The OKS-APQ questionnaire can be used in clinical research and clinical practice to discriminate among levels of activity and participation in the postoperative situation.

List Of Abbreviations

OA: Osteoarthritis; TKA: Total Knee Arthroplasty; PROMs: Patient-Reported Outcome Measures; QoL: Quality of Life; VAS: Visual Analogue Scale; OKS: Oxford Knee Score; OKS-APQ: Oxford Knee Score – Activity & Participation Questionnaire; FJS: Forgotten Joint Score; SF-36: 36-item Short Form Health Survey Questionnaire; MCS: Mental Component Score; PCS: Physical Component Score; AKSS: American Knee

Society Score; EQ-5D: EuroQol 5D; CFA: Confirmatory Factor Analyses; ICC: Intraclass Correlation Coefficient; SEM: Standard Error of Measurement; SDC: Smallest Detectable Change; MIC: Minimal Important Change; ES: Effect Sizes

Declarations

Ethics approval and consent to participate

The study was assessed by the local review committee however not by the Medical Ethics Committee because this study was not subject to the Dutch medical research involving human subject act. The study was conducted and reported according to the COSMIN guidelines. Written consent was obtained from each participant.

Consent for publication

Not applicable.

Availability of data and material

The datasets used during the current study are available from the corresponding author on reasonable request.

Competing interests

There are no competing interests. The institution of the authors reports received grants from Smith & Nephew, Stryker and Zimmer Biomet, however all outside the submitted work.

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Authors' contributions

The authors declare the following contributions to the preparation of the manuscript: Study conception and design (MB, PH); data collection (MB, MtM), data analysis and table 1,2,3,4,5 (MtM, JV) and interpretation of data (MtM, JV); drafting of the manuscript (MtM); critical revision of the manuscript for important intellectual content (all authors); final approval of the manuscript (all authors). All authors take responsibility for the integrity of the work and agreed to submit the article for publication.

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