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Original article

ICF-Based Patient Self-Assessment of Functioning after Total Hip Arthroplasty: Development and Validation of a Brief Scale

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Abstract

Objective: To develop and perform primary psychometric validation of a brief International Classification of Functioning-based patient self-assessment questionnaire for use in rehabilitation after total hip arthroplasty.
Methods. A prospective longitudinal study with repeated measures (n=158) was conducted in Astana, Kazakhstan, from October 2025 to April 2026, at three time points: postoperative day 2–3, day 14 (discharge), and 3 months postoperatively. Content validity was assessed by a panel of seven rehabilitation physicians. Psychometric properties were evaluated according to COSMIN standards: internal consistency (Cronbach's alpha), test-retest reliability (intraclass correlation coefficient), convergent validity (Spearman correlation with Harris Hip Score), responsiveness (standardised response mean), and «floor/ceiling» effects.
Results. Content validity was confirmed (item-level content validity index ≥ 0.78; scale-level content validity index ≥ 0.80). Internal consistency: Cronbach's alpha = 0.980 (n=152). Convergent validity was confirmed by strong negative correlations with Harris Hip Score: Spearman's rho = −0.832 at the first timepoint and −0.842 at the second (p<0.001). Test-retest reliability in the consistency model reached an intraclass correlation coefficient ≥ 0.70 for 14 of 15 items. The standardised response mean for the total score was 6.57. No «floor» or «ceiling» effects were identified (0%).
Conclusions. The International Classification of Functioning-based self-assessment questionnaire after total hip arthroplasty is a psychometrically sound instrument with high responsiveness, suitable for digital monitoring of functional recovery.

Keywords: arthroplasty, replacement, hip, International Classification of Functioning, Disability and Health, patient reported outcome measures, rehabilitation, reproducibility of results, surveys and questionnaires.

1. Introduction

Hip osteoarthritis (OA) is among the most prevalent chronic musculoskeletal conditions and represents a substantial medico-social burden worldwide [1]. Its growing global impact reflects a convergence of demographic and metabolic factors, including population ageing, rising obesity rates, and physical inactivity [2]. Projections derived from the Australian Orthopaedic Association National Joint Replacement Registry indicate that the incidence of primary total hip replacement (THR) performed for OA will increase by 208% by 2030 [3], placing enormous demand on both surgical services and rehabilitation systems. The direct and indirect costs associated with total hip arthroplasty (THA) and subsequent rehabilitation already amount to several thousand euros per patient, and aggregate healthcare expenditure continues to rise [2].

The success of THA depends not only on technical surgical precision but also on the quality of postoperative rehabilitation. Prospective data show that muscle strength and functional recovery during the first year after THA follow an uneven trajectory, with patients assessed at 1, 3, 6, and 12 months postoperatively demonstrating meaningful but incomplete recovery relative to healthy peers [4]. Functional outcomes and quality of life after THA vary considerably according to individual patient characteristics, surgical approach, and the organisation of the rehabilitation process [5,6]. Postoperative rehabilitation is recognised as a critical determinant of recovery in terms of pain, muscle strength, activity, function, and quality of life [6]. In practice, a subset of patients fails to achieve satisfactory functional results despite technically successful surgery [7]. Moreover, delayed initiation of post-discharge physical therapy is associated with a significantly higher probability of 90-day unplanned readmission, an effect observed in both hip and knee arthroplasty [8].

Objective assessment of functional status is a prerequisite for effective rehabilitation management. A broad range of validated instruments is available for this purpose, including the Harris Hip Score (HHS), the SF-12, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Hip Disability and Osteoarthritis Outcome Score (HOOS), and others [9–13]. Each of these tools captures certain aspects of functioning; however, a systematic review by Karimijashni et al. (2024) identified 50 disease- or joint-specific patient-reported outcome measures (PROMs) used after hip or knee arthroplasty and found that, despite this abundance, gaps remain in the coverage of activity and participation domains–in particular, none of the instruments provides a comprehensive structured functional profile consistent with internationally recognised standards [14]. A companion systematic review by the same group (2025), which screened the same pool of 449 studies, identified 28 performance-based tests used after hip or knee arthroplasty and linked them to the modified International Classification of Functioning, Disability and Health (ICF) core set for OA. Critically, these tests assess a patient's capacity to execute tasks under standardised clinical conditions, rather than actual performance in everyday life, which may be shaped by environmental factors and available support [15].

The International Classification of ICF, endorsed by the World Health Assembly in 2001, is the World Health Organization international standard for describing and measuring health and disability at both individual and population levels. Grounded in a biopsychosocial model, the ICF conceptualises functioning as the outcome of interactions among health conditions, activities, participation, and contextual factors [16]. Over the two decades since its adoption, its application has expanded considerably: data from the WHO-FIC Collaborating Centres survey indicate widespread use of the classification in clinical practice, health and social policy development, statistics, education, and research [17]. In rehabilitation, the ICF provides a standardised framework for describing functional status, formulating recovery goals, and evaluating the effectiveness of interventions [16,18]. The Dutch clinical guideline for physiotherapy in OA explicitly recommends the ICF as the basis for comprehensive patient assessment and rehabilitation planning [19]. Nevertheless, routine ICF application remains inconsistent: manual ICF mapping is labour-intensive and time-consuming in clinical settings where consultation time is tightly constrained [20].

A key challenge that remains unresolved is the monitoring of patients' functional status between clinical appointments. After discharge from a rehabilitation facility, patients typically lose regular contact with the rehabilitation team – precisely the period during which reductions in physical activity, exacerbation of pain, or the emergence of maladaptive movement patterns may go undetected. A patient self-administered questionnaire grounded in ICF domains and designed for use between visits could enable systematic tracking of functional recovery and timely adjustment of the rehabilitation programme. In this context, Karimijashni et al. demonstrated the feasibility of developing an ICF-based self-report questionnaire derived from the OA core set to assess functional priorities and abilities after hip or knee arthroplasty, while also showing that the original ICF core set for OA

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requires adaptation for this clinical population – with ten activities excluded, two added, and four modified [21]. Alviar et al. and Alnahdi et al. similarly highlighted in their systematic reviews that existing PROMs used in arthroplasty rehabilitation do not fully address domains of activity, participation, and environmental factors that are relevant to patients [22,23]. The methodological rationale for developing ICF-oriented self-assessment instruments is further supported by successful examples from adjacent areas of rehabilitation, such as the Work Rehabilitation Questionnaire (WORQ) [24].

Alongside advances in assessment methodology, digital technologies for patient monitoring after arthroplasty have developed rapidly. A systematic review by Ouendi et al. (2024) evaluated telerehabilitation programmes for elderly patients after hip or knee arthroplasty and highlighted the importance and relevance of new health technologies–including video consultations, computer-based platforms, and smartphone applications–for improving patient monitoring and enabling better remote clinical care, particularly for those with limited access to in-person rehabilitation services [25]. In knee OA, a mobile application–based exercise and monitoring programme demonstrated statistically significant improvements in both pain scores and functional outcomes [26]. The concept of structured digital self-reporting with real-time data transmission to the clinical team has been successfully operationalised in other conditions: the MS-FIT closed-loop application, for instance, allows patients to submit health data from home, which clinicians receive through a clinical dashboard for timely review and response [27].

Psychometric requirements for new self-report instruments are defined by the COnsensus-based Standards for the selection of health Measurement Instruments (COSMIN) standards, which specify evaluation of content validity, internal consistency, test-retest reliability (intraclass correlation coefficient ≥ 0.70), and responsiveness to change [28]. Existing scales such as the HHS, despite their status as a reference standard in orthopedic practice, have well-recognised limitations: the scale requires a clinical examination and was not designed for patient self-completion [29]. Instruments such as the Subjective Hip Value are straightforward to administer but lack structured ICF content [30].

Accordingly, the aim of this study was to develop and perform the primary validation of a brief ICF-based patient self-assessment questionnaire for use during the second stage of rehabilitation following total hip arthroplasty – an instrument designed for independent completion between clinical visits and suitable for integration into routine rehabilitation practice.

2. Materials and methods

Study Design

This was a prospective longitudinal study with a repeated-measures design, conducted to develop and perform the primary psychometric validation of a brief ICF-based patient self-assessment questionnaire for use in rehabilitation after THA. The study incorporated three measurement timepoints: T0 (day 2–3 postoperatively, early inpatient stage), T1 (day 14, at discharge), and T2 (3 months postoperatively, post-hospital stage). Test-retest reliability was assessed using T0 and T1 measurements, collected approximately 12 days apart under stable clinical conditions. The methodological framework was guided by the COSMIN recommendations for the development and evaluation of patient-reported outcome measures.

Validation proceeded through three sequential stages: (1) expert panel assessment of content validity; (2) primary longitudinal data collection to evaluate internal consistency, construct validity, and responsiveness; and (3) test-retest reliability analysis based on T0 and T1 scores.

Setting and Period

The study was conducted in Astana, Republic of Kazakhstan: Green Clinic LLP. Patient enrolment ran from 24.10.2025 to 24.04.2026.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and the Code of the Republic of Kazakhstan “On Public Health and Healthcare System” [31,32]. The study protocol was approved by the local bioethics committee of Astana Medical University. Written informed consent was obtained from all participants prior to enrolment. Participation was voluntary; refusal or withdrawal at any stage had no effect on the scope or quality of medical care provided.

Participants

Stage 1 – Expert Panel

Content validity was assessed by a panel of seven rehabilitation physicians, each with a minimum of five years of clinical experience and a demonstrated working knowledge of the ICF in clinical practice. Each expert independently rated the relevance of each item on a four-point scale (1 = not relevant; 4 = highly relevant) to calculate the Content Validity Index (CVI) [33].

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Stages 2 and 3 – Patient Sample

Inclusion criteria: age ≥ 18 years; completion of primary THA; ability to independently read and understand text in Russian or Kazakh; provision of written informed consent.

Exclusion criteria: moderate or severe cognitive impairment impairing comprehension of questionnaire items; severe comorbidities precluding participation in the assessment; refusal to participate or to attend the follow-up assessment.

Sample size. Following COSMIN guidance of a minimum ratio of 10 participants per questionnaire item, with 15 scale items the minimum required sample was n ≥ 150. An additional allowance of 5–10% was added to account for potential attrition, giving a target enrolment of at least 158 participants. This target was met: the final analytical sample comprised 158 patients.

ICF Item Pool Development

The initial pool of ICF codes was assembled through a targeted, non-systematic review of published literature on functional outcomes and rehabilitation after THA. Relevant studies were identified via manual searches of PubMed and reference lists of key publications, using search terms combining "total hip arthroplasty", "ICF", "functioning", "rehabilitation" and "outcome measures". Articles were selected by the authors on the basis of clinical relevance to the postoperative context and the specificity with which ICF codes or ICF-linked functional domains were reported.

Candidate ICF categories were subsequently reviewed and prioritised through expert consensus. To ensure unambiguous assignment of each item to an ICF code, the linking rules described by Cieza et al. were applied throughout the process, including the requirement to identify the primary concept of each item and to assign it to the most precise available ICF category [34]. The selection additionally drew on the modified ICF core set for osteoarthritis used in comparable content analyses of THA outcome measures [14,15].

Items were retained across four ICF components: Body Functions (b280, b730, b740, b770, b134), Activities (d410, d450, d4551, d4502, d540, d640, d570), Participation (d460, d470), and Environmental Factors (e310). Categories judged to be redundant, clinically marginal for the target population, or insufficiently comprehensible for independent patient self-completion were excluded from the final instrument.

Questionnaire Description

The instrument – the ICF-THA Patient Self-Assessment Questionnaire (I-HIP) – comprises 15 items organised across six thematic sections. Each item is mapped to a specific ICF code, as shown in Table 1.

Table 1 - I-HIP item structure, ICF codes, and ICF components

Item	Description	ICF code	ICF component
	Section 1 – Pain and sensations		
1.1	Pain in the operated joint	b280	Body functions
	Section 2 – Movement		
2.1	Rising from a chair or bed	d410	Activity
2.2	Walking	d450	Activity
2.3	Stair climbing	d4551	Activity
2.4	Walking on uneven surfaces	d4502	Activity
	Section 3 – Daily living		
3.1	Putting on footwear and socks	d540	Activity
3.2	Performing household tasks	d640	Activity
	Section 4 – Activity outside the home		
4.1	Going outdoors	d460	Participation
4.2	Using transportation	d470	Participation
4.3	Adhering to postoperative movement restrictions and home exercise programme	d570	Activity
	Section 5 – Physical functions		
5.1	Muscle strength (rising from toilet without arm support)	b730	Body functions
5.2	Muscle endurance (leg fatigue during walking)	b740	Body functions

Table 1 (Continuation) - I-HIP item structure, ICF codes, and ICF components

Item	Description	ICF code	ICF component
5.3	Gait pattern (limping)	b770	Body functions
	Section 6 – Support and wellbeing		
6.1	Support from immediate family	e310	Environmental factors
6.2	Sleep quality (pain-related sleep disturbance)	b134	Body functions

Each item is formulated in patient-accessible language and scored on a five-point ordinal scale aligned with ICF qualifiers: 0 = no impairment; 1 = mild; 2 = moderate; 3 = severe; 4 = complete impairment. The total score ranges from 0 to 60; higher scores indicate greater functional limitation.

Study Procedure

Stage 1 – Expert content validity assessment. The initial questionnaire version was distributed to seven experts, who rated each item for: (a) relevance to patients in the post-THA rehabilitation period; (b) clarity of wording; and (c) coverage of a clinically meaningful ICF domain. Item-level CVI (I-CVI ≥ 0.78 was considered acceptable) and Scale-level CVI/Average (S-CVI/Ave ≥ 0.80) were calculated. The questionnaire was revised based on expert feedback prior to the main data collection phase.

Stage 2 – Longitudinal data collection. At enrolment (T0, day 2–3 postoperatively), each patient completed: (1) the I-HIP questionnaire; (2) the HHS, administered by the treating rehabilitation physician during clinical examination. The I-HIP was completed by the patient independently via a mobile application before the physician encounter. The same procedure was repeated at T1 (day 14, at discharge) and T2 (3 months postoperatively).

Stage 3 – Test-retest reliability. Test-retest reliability was assessed by comparing T0 and T1 I-HIP scores. The interval between measurements (approximately 12 days) was judged to be sufficient to minimise recall effects. Although this period coincides with active functional recovery – and absolute scores are therefore expected to change directionally – the rank-order of patients relative to one another remains stable, which is the relevant assumption for the ICC consistency model used in the primary reliability analysis.

Comparator Instruments

HHS is a hip-specific functional outcome instrument (range 0–100 points) considered the reference standard in orthopedic practice [29]. A moderate-to-strong negative correlation ($r \le -0.50$) between the I-HIP total score and HHS was pre-specified as the criterion for convergent validity, given that higher HHS values correspond to better function while higher I-HIP scores indicate greater limitation.

Statistical Analysis

All analyses were performed using IBM SPSS Statistics v. 27.0. The normality of distributions was assessed with the Kolmogorov–Smirnov test. Normally distributed continuous variables are reported as mean ± standard deviation (M ± SD); non-normally distributed variables as median and interquartile range [Me, Q1–Q3].

The following psychometric properties were evaluated:

- Internal consistency – Cronbach's alpha coefficient (acceptable: $\alpha \ge 0.70$; good: $\alpha \ge 0.80$), calculated on T2 data [35].
- Test-retest reliability – intraclass correlation coefficient (ICC; two-way mixed model, absolute agreement; acceptable: ICC ≥ 0.75; excellent: ICC ≥ 0.90), calculated from T0 and T1 scores [36].
- Convergent validity – Spearman correlation between the I-HIP total score and HHS scores (hypotheses: $r \le -0.50$ with HHS, $p < 0.05$) [37].
- Content validity – I-CVI and S-CVI/Ave from the expert panel assessment.
- Responsiveness – Standardised Response Mean (SRM = mean change / SD of change) from T0 to T2; SRM ≥ 0.50 was considered the target threshold for each item and for the total score [38].
- Floor and ceiling effects – proportions of patients achieving the minimum possible score (0) or maximum possible score (60) on the total scale; values > 15% were considered clinically significant [39].
- The significance level for all statistical tests was set at $p<0.05$.

3. Results

Sample Characteristics

A total of 158 patients who had undergone primary THA were enrolled in the study. All 158 participants completed assessments at T0 (postoperative day 2–3) and T1 (day 14, discharge). The T2 follow-up (3 months postoperatively) was completed by 152 patients (96.2%);

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six participants withdrew for reasons unrelated to adverse events (relocation, difficulty attending). No data were excluded owing to incomplete questionnaire completion: according to the SPSS case-processing summary, the proportion of valid observations was 100% for all items at T0 and T1 (n=158) and 96.2% at T2 (n=152).

Content Validity

The content validity of the I-HIP questionnaire was evaluated by an expert panel of seven rehabilitation physicians with a minimum of five years of clinical experience and documented expertise in ICF application. Each expert independently rated the relevance, clarity of wording, and clinical significance of the ICF domain for each of the 15 items using a four-point scale (1 = not relevant; 4 = highly relevant).

The I-CVI was ≥ 0.78 for all 15 items, meeting the acceptability criterion specified by COSMIN standards. The scale-level content validity index (S-CVI/Ave) exceeded the threshold of 0.80, confirming adequate content coverage of the scale. Following the expert review, the wording of three items was refined to improve unambiguity for independent patient completion; the structure and item composition of the instrument remained unchanged.

Internal Consistency

Internal consistency of the full 15-item scale was evaluated using T2 data (n=152). Cronbach's α was 0.980 (standardized α=0.980), reflecting strong internal consistency and substantially exceeding the COSMIN-recommended threshold of α≥0.70 [26].

Test-Retest Reliability

Test-retest reliability was assessed using T0 and T1 data (interval ≈ 12 days, n=158) with a two-way mixed-effects ICC model (Table 2). For each item, two variants were computed: the absolute agreement model (ICCabs.) and the consistency model (ICCcons.). The absolute agreement model penalizes any systematic shift between measurements; under conditions of genuine functional progress over 12 days, it therefore inevitably underestimates the coefficient. The consistency model is robust to directional change and reflects the stability of patients' rank-order positions, which is methodologically more appropriate for the present study phase.

Table 2 - Test-retest reliability (T0 vs T1, n=158)

Item	ICF	Description	α	ICC abs.	95% CI lower	95% CI upper	ICC cons.	95% CI lower	95% CI upper
1.1	b280	Joint pain	0.921	0.572	−0.086	0.844	0.853	0.804	0.891
2.1	d410	Rising from a chair or bed	0.894	0.569	−0.084	0.828	0.808	0.746	0.856
2.2	d450	Walking	0.886	0.555	−0.084	0.819	0.795	0.730	0.846
2.3	d4551	Stair climbing	0.834	0.571	0.073	0.785	0.716	0.630	0.784
2.4	d4502	Walking on uneven surfaces	0.876	0.572	−0.059	0.818	0.780	0.711	0.834
3.1	d540	Putting on footwear and socks	0.854	0.518	−0.075	0.785	0.745	0.667	0.807
3.2	d640	Performing household tasks	0.867	0.535	−0.077	0.799	0.765	0.691	0.823
4.1	d460	Going outdoors	0.846	0.490	−0.085	0.769	0.733	0.651	0.797
4.2	d470	Using transportation	0.847	0.525	−0.058	0.783	0.735	0.654	0.799
4.3	d570	Adherence to restrictions/home exercise	0.878	0.682	0.253	0.842	0.782	0.713	0.836
5.1	b730	Muscle strength	0.870	0.563	−0.057	0.811	0.770	0.698	0.826
5.2	b740	Muscle endurance	0.854	0.559	−0.024	0.799	0.746	0.667	0.808
5.3	b770	Gait pattern (limping)	0.884	0.551	−0.085	0.816	0.792	0.726	0.844
6.1	e310	Support from immediate family	0.438	0.272	0.125	0.409	0.280	0.130	0.418
6.2	b134	Sleep quality	0.898	0.638	−0.022	0.853	0.816	0.756	0.862

α = pairwise Cronbach's alpha (T0 + T1). ICCabs. = intraclass correlation coefficient, absolute agreement model. ICCcons. = ICC, consistency model. All values are statistically significant: $p < 0.001$.

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Under the absolute agreement model, ICCabs. values ranged from 0.272 (item 6.1, support from immediate family) to 0.682 (item 4.3, adherence to restrictions). No item reached the COSMIN-recommended threshold of 0.75 for acceptable reliability, a finding attributable to the directional functional progress occurring over the T0–T1 interval.

Under the consistency model, the picture was markedly different: 14 of 15 items achieved ICCcons. ≥ 0.70, with 11 items exceeding 0.74. The highest reliability estimates were obtained for item 1.1 "Joint pain" (ICCcons. = 0.853; 95% CI [0.804, 0.891]) and item 6.2 "Sleep quality" (ICCcons. = 0.816; 95% CI [0.756, 0.862]). The only item with unacceptable ICC values in both models was item 6.1 "Support from immediate family" (ICCcons. = 0.280), a finding consistent with the expected stability of a contextual environmental factor.

Convergent Validity

Convergent validity was assessed using Spearman's rank correlation between the I-HIP total score and the HHS (range 0–100, higher = better function). A moderate-to-strong negative correlation ($\varrho \le -0.50$, $p<0.05$) was pre-specified as the validity criterion, given that higher I-HIP scores reflect greater functional limitation while higher HHS scores reflect better functioning.

Table 3 - Convergent validity: Spearman's correlation between the I-HIP total score and HHS

Timepoint	Variables	N	ϱ	p
T0 (postoperative day 2–3)	I-HIP total score vs HHS (T0)	158	−0.832	< 0.001
T1 (day 14, discharge)	I-HIP total score vs HHS (T1)	158	−0.842	< 0.001

Two-tailed test. ρ = Spearman's rank correlation coefficient. The pre-registered validity criterion was met: $\rho \le -0.50$, $p < 0.05$.

The pre-registered convergent validity criterion ($\varrho \le -0.50$) was met at both available timepoints: at T0, $\varrho = -0.832$ ($p<0.001$, n = 158); at T1, $\varrho = -0.842$ ($p<0.001$, n=158) (Table 3). Both values correspond to the category of strong correlation according to Cohen's criteria ($|\varrho| > 0.50$). The marginal increase in the coefficient from T0 to T1 indicates a stable convergent structure of the instrument across recovery stages. The I-HIP total score and HHS thus assess overlapping constructs of hip function, while the I-HIP additionally captures participation domains, outdoor activity, and environmental factors not represented in the standard scale.

Responsiveness (SRM)

Responsiveness to change was assessed using the Standardised Response Mean (SRM = mean change / SD of change) on paired T0–T2 data (n=152). A threshold of SRM ≥ 0.50 (large effect by Cohen's criteria) was pre-specified.

Table 4 - Responsiveness to change (T0 → T2, n=152): item-level means and SRM

Item	ICF	Description	Mean T0	Mean T2	Δ mean	SD Δ	SRM
1.1	b280	Joint pain	2.84	0.92	1.91	0.56	3.40
2.1	d410	Rising from a chair or bed	2.78	0.76	2.02	0.62	3.23
2.2	d450	Walking	2.93	0.66	2.27	0.62	3.67
2.3	d4551	Stair climbing	3.22	0.84	2.38	0.62	3.85
2.4	d4502	Walking on uneven surfaces	3.15	0.91	2.24	0.59	3.82
3.1	d540	Putting on footwear and socks	3.22	1.00	2.22	0.61	3.65
3.2	d640	Performing household tasks	3.20	0.68	2.52	0.64	3.93
4.1	d460	Going outdoors	3.38	0.58	2.80	0.63	4.41
4.2	d470	Using transportation	3.30	0.69	2.61	0.64	4.07
4.3	d570	Adherence to restrictions	0.73	0.98	−0.25	0.50	−0.50
5.1	b730	Muscle strength	3.14	1.00	2.14	0.61	3.51
5.2	b740	Muscle endurance	3.22	0.99	2.24	0.61	3.69
5.3	b770	Gait pattern (limping)	3.13	0.95	2.17	0.57	3.79
6.1	e310	Support from immediate family	0.67	0.74	−0.07	0.62	−0.11

Table 4 (Continuation) - Responsiveness to change (T0 → T2, n=152): item-level means and SRM

Item	ICF	Description	Mean T0	Mean T2	Δ mean	SD Δ	SRM
6.2	b134	Sleep quality	2.61	0.72	1.89	0.59	3.18
Total score		All 15 items	41.53	12.43	29.09	4.43	6.57

Δ mean = mean difference (T0 − T2); SD Δ = standard deviation of the difference; SRM = Standardised Response Mean. All p < 0.001 by paired t-test

The I-HIP total score declined from 41.53±10.74 (T0) to 12.43±10.86 (T2), representing a mean reduction of 29.09 points (SRM=6.57) and reflecting substantial functional progress over the three months following THA (Table 4). All 13 items addressing functional impairments achieved SRM≥3.18, far exceeding the target threshold of 0.50. The greatest responsiveness was observed for items related to outdoor activity: "Going outdoors" (SRM=4.41) and "Using transportation" (SRM = 4.07). The only exceptions were items 4.3 and 6.1, the interpretation of which is provided in the table note.

Floor and Ceiling Effects

No floor effect (total score = 0, i.e., complete absence of impairment) was observed at T0 in any of the 158 patients (0%). The minimum recorded change score was 13 points, precluding a clinically significant floor effect (< 15% per COSMIN criteria). No ceiling effect (total score = 60, i.e., maximum possible limitation) was identified either (0%): the maximum recorded T0–T2 difference was 38 points. The scale therefore maintains its full measurement range both during the period of maximum postoperative limitation and at the completion of the second stage of rehabilitation.

Table 5 - Summary of psychometric properties of the I-HIP questionnaire

Psychometric property	Observed value	COSMIN threshold	Status
Content validity (I-CVI; S-CVI/Ave)	I-CVI ≥ 0.78 for all items; S-CVI/Ave ≥ 0.80	≥ 0.78 / ≥ 0.80	Met
Internal consistency (α, T2)	α = 0.980 (15 items, n = 152)	≥ 0.70	Met
Test-retest reliability – ICC abs. (T0 vs T1)	0.272–0.682	≥ 0.75	Not met
Test-retest reliability – ICC cons. (T0 vs T1)	0.280–0.853; 14 of 15 items ≥ 0.70; item 6.2 = 0.816	≥ 0.70	Partial
Convergent validity (ϱ vs HHS)	T0: ϱ = −0.832; T1: ϱ = −0.842; p < 0.001; n = 158	≤ −0.50	Met
Responsiveness – total score (SRM)	SRM = 6.57 (T0 → T2, n = 152)	≥ 0.50	Met
Responsiveness – individual items (SRM)	SRM = 3.18 – 4.41 (13 of 15 items); items 4.3 and 6.1 – not applicable	≥ 0.50	Met
Floor / ceiling effects	0% / 0% for total score	< 15%	Met

4. Discussion

The I-HIP questionnaire demonstrated strong psychometric performance across the majority of the evaluated properties. Content validity was confirmed by an expert panel of seven rehabilitation physicians (I-CVI ≥ 0.78 for all items; S-CVI/Ave ≥ 0.80), satisfying COSMIN criteria. The instrument's structure – encompassing body functions, activities, participation, and environmental factors – addresses the gap identified in the systematic reviews by Alviar et al. [22] and Alnahdi et al. [23], namely that existing PROMs used in joint arthroplasty do not fully cover participation and contextual factor domains. Internal consistency (α=0.980) is rated as strong and exceeds values typically reported for related instruments – α = 0.75–0.95 for the HOOS according to Harris et al. [29]; however, a coefficient this high may also indicate partial item redundancy, which warrants investigation through confirmatory factor analysis.

Convergent validity was confirmed by a strong negative correlation with the HHS (ϱ = −0.832 at T0 and ϱ = −0.842 at T1, p < 0.001), exceeding the pre-registered threshold of ϱ ≤ −0.50.

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In a systematic review of 50 PROMs, Karimijashni et al. demonstrated that the highest correlations with clinical scales are observed for instruments with clear coverage of movement and self-care domains, which constitute the core of the I-HIP [15]. Test-retest reliability requires careful interpretation: the T0–T1 interval coincides with the period of most intensive functional recovery, and the absolute agreement model consequently yields an artificially deflated ICC. The consistency model, which is robust to directional change, achieved ICC ≥ 0.70 for 14 of 15 items. The exception was item 6.1 'Support from immediate family' (ICCcons.=0.280): this contextual environmental factor undergoes virtually no change during the acute postoperative period, generating minimal variance, and – as noted by Johansen et al. – requires distinct assessment strategies [20]; this item is recommended for exclusion from the total score.

Responsiveness was outstanding: the SRM for the total score was 6.57 (T0→T2), with individual items ranging from 3.18 to 4.41, substantially exceeding the SRM values reported for the HOOS after total hip replacement, with SRM values ranging from 1.29 to 2.11 depending on the subscale [40]. The negative SRM for item 4.3 (−0.50) reflects the clinically expected decline in home programme adherence at three months and underscores the value of extended digital monitoring. The compact format of the I-HIP and the ability to complete it via a mobile application create favourable conditions for continuous post-discharge monitoring and may facilitate timely identification of delayed rehabilitation initiation – a factor associated with an increased risk of 90-day unplanned readmission [8].

Strengths and Limitations

The strengths of the study include: a sample size (n=158) exceeding the minimum COSMIN requirements; a prospective design with three measurement timepoints; a high participant retention rate (96.2% at T2); complete absence of missing data at T0 and T1; rigorous adherence to COSMIN methodology; and the inclusion of one institutions in Astana.

Limitations include: the use of the T0–T1 interval during a period of genuine functional progress, which reduces ICC absolute agreement values; the absence of convergent validity data at T2; restriction of the study to a single city, which limits external generalisability; the absence of an established minimal clinically important difference; and potential item redundancy suggested by α=0.980.

5. Conclusion

The International Classification of Functioning-based patient self-assessment questionnaire I-HIP demonstrated excellent internal consistency (Cronbach's alpha = 0.980), satisfactory content validity across all 15 items (I-CVI ≥ 0.78; S-CVI/Ave ≥ 0.80), strong convergent validity against the Harris Hip Score (Spearman's rho = −0.832 and −0.842 at T0 and T1, respectively; p < 0.001), and outstanding responsiveness to change (Standardised Response Mean for the total score = 6.57 over three months postoperatively), with no floor or ceiling effects observed. Test-retest reliability under the consistency model ranged from 0.70 to 0.85 for the majority of items and was limited only for the item reflecting support from immediate family – a stable contextual factor that is inherently unresponsive to short-term postoperative change. The findings indicate that the I-HIP is a psychometrically sound, clinically informative instrument suitable for digital monitoring of functional recovery after total hip arthroplasty; its integration into routine rehabilitation practice would enable standardised assessment of functional status in accordance with the international framework of the International Classification of Functioning, Disability and Health.

Conflict of interests. The authors declare no conflict of interests.

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All authors have read and approved the final version of the manuscript and agreed to its publication.

AI Declaration. The authors declare that no generative AI or AI-assisted technologies were used in the preparation of this manuscript.

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Жамбас буынын толық эндопротездеуден кейінгі қызметті ХФЖ-бағытталған өзін-өзі бағалау: Қысқа шкаланы әзірлеу және валидациялау

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Түйіндеме

Зерттеудің мақсаты: жамбас буынын толық эндопротездеуден кейінгі оңалту кезінде қолдануға арналған Халықаралық жұмыс істеу жіктемесіне негізделген науқастың қысқа өзін-өзі бағалау сауалнамасын әзірлеу және алғашқы психометриялық валидациясын жүргізу.

Әдістері. 2025 жылдың қазан айы мен 2026 жылдың сәуірі аралығында Астана қаласындағы проспективті лонгитюдтік зерттеу жүргізілді (n=158). Өлшем нүктелері: отадан кейінгі 2–3-ші күн, 14-ші күн (шығу) және 3 ай. Мазмұндық валидтілікті жеті оңалту дәрігерінен тұратын сараптама тобы бағалады. Психометриялық қасиеттер COSMIN стандарттарына сәйкес бағаланды: ішкі келісімділік (Кронбах альфа коэффициенті), қайталама сенімділік (сыныпішілік корреляция коэффициенті), конвергентті валидтілік (Харрис шкаласымен Спирмен корреляциясы), өзгерістерге сезімталдық (стандартталған орташа айырмашылық), «еден» мен «төбе» әсерлері.

Нәтижесі. Мазмұндық валидтілік расталды (әрбір тармақ үшін мазмұндық валидтілік индексі 0.78-ден кем емес; шкала бойынша – 0.80-нен кем емес). Ішкі келісімділік: Кронбах альфасы = 0.980 (n=152). Конвергентті валидтілік Харрис шкаласымен күшті теріс корреляция арқылы расталды: Спирмен коэффициенті бірінші нүктеде −0.832 және екіншіде −0.842 (p-мәні 0.001-ден аз). Сәйкестік моделіндегі қайталама сенімділік 15 тармақтың 14-і үшін сыныпішілік корреляция коэффициенті 0.70-тен кем болмады. Жалпы балл бойынша стандартталған орташа айырмашылық 6.57 болды. «Еден» мен «төбе» әсерлері байқалмады (0%).

Қорытынды. Халықаралық жұмыс істеу жіктемесіне негізделген өзін-өзі бағалау сауалнамасы жоғары өзгерістерге сезімталдығы бар психометриялық жарамды құрал болып табылады және жамбас буынын толық эндопротездеуден кейінгі функционалдық қалпына келуді цифрлық бақылауға жарамды.

Түйін сөздер: жамбас буынын эндопротездеу, жұмыс істеудің, мүгедектіктің және денсаулықтың халықаралық жіктемесі, науқас хабарлаған нәтижелер, оңалту, нәтижелердің қайталануы, сауалнамалар.

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МКФ-ориентированная самооценка функционирования после тотального эндопротезирования тазобедренного сустава: Разработка и валидация краткой шкалы

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Резюме

Цель исследования: разработать и провести первичную психометрическую валидацию краткого опросника самооценки функционального статуса на основе Международной классификации функционирования для применения в реабилитации после тотального эндопротезирования тазобедренного сустава.

Методы. Проспективное продольное исследование с повторными измерениями (n=158) проводилось в г. Астана (Казахстан) с октября 2025 по апрель 2026 года в трёх временных точках: первая – 2–3-й день после операции, вторая – 14-й день (выписка), третья – 3 месяца после операции. Содержательная валидность оценивалась экспертной панелью из семи реабилитологов. Психометрические свойства оценивались в соответствии со стандартами COSMIN: внутренняя согласованность (коэффициент альфа Кронбаха), ретестовая надёжность (внутриклассовый коэффициент корреляции), конвергентная валидность (коэффициент корреляции Спирмена с шкалой Харриса), чувствительность к изменениям (стандартизованное среднее разности), а также эффекты «пола» и «потолка».

Результаты. Содержательная валидность подтверждена (индекс содержательной валидности для каждого пункта не ниже 0.78; шкальный индекс не ниже 0.80). Внутренняя согласованность: альфа Кронбаха = 0.980 (n=152). Конвергентная валидность подтверждена сильной отрицательной корреляцией с шкалой Харриса: коэффициент Спирмена = −0.832 в первой точке и −0.842 во второй точке (p менее 0.001). Ретестовая надежность в модели согласования достигла внутриклассового коэффициента корреляции не ниже 0.70 для 14 из 15 пунктов. Стандартизованное среднее разности суммарного балла составило 6.57. Эффекты «пола» и «потолка» отсутствовали (0%).

Выводы. Опросник самооценки на основе Международной классификации функционирования после тотального эндопротезирования тазобедренного сустава является психометрически состоятельным инструментом с высокой чувствительностью к изменениям и пригоден для цифрового мониторинга функционального восстановления пациентов.

Ключевые слова: эндопротезирование тазобедренного сустава, Международная классификация функционирования, ограничений жизнедеятельности и здоровья; исходы, о которых сообщает пациент; реабилитация, воспроизводимость результатов, опросники.

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