Patients Reported Outcomes Measures (PROMs) Trajectories After Elective Hip Arthroplasty: A Latent Class Growth Analysis

Davide Golinelli (✉ davide.golinelli@unibo.it)

Alma Mater Studiorum - University of Bologna

Alberto Grassi

IRCCS Istituto Ortopedico Rizzoli

Dario Tedesco

Health and Welfare, Emilia-Romagna Region

Francesco Sanmarchi

Alma Mater Studiorum - University of Bologna

Simona Rosa

Alma Mater Studiorum – University of Bologna

Paola Rucci

Alma Mater Studiorum - University of Bologna

Marilina Amabile

IRCCS Istituto Ortopedico Rizzoli

Monica Cosentino

IRCCS Istituto Ortopedico Rizzoli

Barbara Bordini

IRCCS Istituto Ortopedico Rizzoli

Maria Pia Fantini

Alma Mater Studiorum - University of Bologna

Stefano Zaffagnini

IRCCS Istituto Ortopedico Rizzoli

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Abstract

Background. Patient-Reported Outcome Measures (PROMs) are an extensively used tool to assess and improve the quality of healthcare services. PROMs are affected by individual characteristics in patients undergoing hip arthroplasty (HA). The aim of this study is to identify distinct groups of patients with unique score-trajectories using the Latent Class Growth Analysis (LCGA) technique and to determine patients' features associated with these groups.

Methods. We conducted a prospective, cohort study analyzing PROMs questionnaires (Euro Quality 5 Dimensions 3L, EQ-5D-3L, Euro-Quality-Visual-Analytic-Score, EQ-VAS, Hip disability and Osteoarthritis Outcome Score, HOOS-PS) administered to patients undergoing elective HA at successive time points. For each score, LCGA was carried out to identify subgroups of patients assessed pre-operatively, and at 6 and 12 months after HA. Multinomial logistic regression was used to identify the demographic and clinical characteristics associated with the latent trajectories.

Results. We identified three distinct trajectories for each PROM score. These trajectories indicated high response heterogeneity to the HA among the patients (n=991): one trajectory showing an improvement at 6 months followed by a plateau, a second trajectory showing a lower starting level followed by a consistent improvement, and a third trajectory showing a modest improvement at 6 months followed by a modest decline at 12 months. Patient's gender, ASA score ≥ 3 , obesity and the main diagnosis were significantly associated with different PROMs trajectories.

Conclusions. These findings underline the importance of patient-centered care, supporting the usefulness of integrating PROMs data alongside routinely collected healthcare records for guiding clinical care and maximizing patient outcomes.

Trial registration number: Protocol version (1.0) and trial registration data are available on the platform www.clinicaltrial.gov with the identifier NCT03790267, posted on December 31, 2018.

Key Points

1. Patient-Reported Outcome Measures (PROMs) are an extensively used tool to assess and improve the quality of healthcare services.
2. Latent class growth analysis technique allows the user to classify distinct subgroups of patients that follow a similar pattern of change over time. Through this analysis, we identified three distinct trajectories for each PROM score: one trajectory showing an improvement at 6 months followed by a plateau, a second trajectory showing a lower starting level followed by a consistent improvement, and a third trajectory showing a modest improvement at 6 months followed by a modest decline at 12 months.
3. Patient-reported outcomes can inform care decisions and help healthcare professionals choose the right treatment option when various types of interventions are available and when patients'

characteristics may influence the outcome's trends after surgery.

1. Introduction

The number of hip arthroplasties (HA) is rising worldwide, due to the higher longevity of the population and the higher incidence of osteoarthritis [1-5], representing a challenge for healthcare providers, given its consequences on the patient functional outcomes, quality of life (QoL), and related costs. As populations age, chronic conditions and disability affect more people and this reflects on health systems' sustainability and overall performance [5, 7].

Although health systems usually monitor healthcare performance and quality indicators, less information is available on how patients experience the process of care and on to what extent it adds value to their lives. Patient perspective on health outcomes is essential to support continuous quality improvement of health services and the importance of patient-reported outcomes measures (PROMs) to evaluate outcomes after surgery is gaining recognition, as they are increasingly integrated into clinical practice [8].

With a mandate from the Organization for Economic Cooperation and Development (OECD) Health Ministers, the OECD launched in 2017 the initiative of Patient-Reported Indicators Surveys (PaRIS), with the goal of building patient-centered health systems [8]. The PaRIS survey of patients with chronic conditions is aimed to fill this critical information gap, focusing on how patients report about their own health, quality of life, or functional status associated with the healthcare or treatment they have received [9]. The PaRIS Initiative particularly focuses on the systematic collection of PROMs indicators (Euro Quality 5 Dimensions 3L, EQ-5D-3L, Euro Quality Visual Analytic Score, EQ-VAS, and Hip disability and Osteoarthritis Outcome Score, HOOS-PS) in patients undergoing elective hip and knee arthroplasty [8,9].

The IRCCS Rizzoli Orthopedic Institute (IOR), a third-level single-specialty orthopedic hospital based in Bologna, Italy, which is also a member of the International Society of Orthopaedic Centers (ISOC), was selected as one of the pilot centers to launch the PaRIS initiative in Italy, with the aim to accelerate the adoption and reporting of validated, standardized, internationally comparable patient-reported indicators. About 60% of patients admitted to IOR for joint replacement surgery come from other Italian regions.

Patients undergoing HA usually experience a significant improvement in PROMs within the first year after surgery and tend to plateau in the following years. Although scientific evidence supports this trend [10-12], many authors have identified subgroups of patients with different recovery trajectories and a diverse range of outcomes, some reporting delayed functional gains, or even a short- and medium-term worsening. Several patient characteristics may play a role in determining different PROMs trajectories. It is therefore critical to describe and define specific subgroups of patients, especially for elective surgery, where a profiled, risk-based management and personalization of care can make the difference to reach better outcomes.

The aim of this study is to identify distinct groups of patients with unique score-trajectories for three PROMs indicators (EQ-5D-3L EQ-VAS, and HOOS-PS) in patients undergoing elective HA, and to determine

patients' features associated with these groups.

2. Material And Methods

2.1.Study design and data collection

The PaRIS-IOR is a prospective, single site, cohort study that started on January 1, 2019, and consists of the administration of PROMs questionnaires investigating quality of life (EQ-5D-3L, and EQ-VAS [10,13]) and joint-specific functional outcomes (HOOS-PS [14]), to patients on the list for elective HA. PROMs baseline questionnaires were administered to patients awaiting surgery by specifically trained researchers within 30 days before surgery. The follow-up questionnaires were mailed 6 and 12 months after surgery.

IOR was selected as a pilot center for the Initiative (PaRIS-IOR study) also because it hosts the Registry of Orthopedic Prosthetic Implants (RIPO). PROMs data were linked with those routinely collected by the RIPO [15] and other regional administrative data (i.e., hospital discharge records), in order to track patients' medical history and to define patients' health profile.

Patients undergoing elective HA between January 1st and December 31st, 2019, constituted the baseline population, and were used to investigate the trajectories and characteristics of PROMs at 6 and 12 months after surgery. Data included patients' demographics, pathology leading to joint replacement, type of surgical procedures, and the characteristics of the implant. Specifically, we collected and analyzed: (i) the patients' characteristics and profile, including age and sex distribution, Body Mass Index, BMI, Elixhauser Comorbidity Index, ECI [16], American Society of Anesthesiologists (ASA) score, Modified-Chronic Disease Score for clinical severity, M-CDS [17]; (ii) the PROMs questionnaire total scores: EQ-5D-3L score (general range from less than 0, where 0 is a health state equivalent to death and negative values are valued as worse than death to 1, perfect health), EQ-VAS, HOOS-PS score (range 0-100, where 0 is worst and 100 is best) for HA patients.

Inclusion criteria were males and females aged 18-95 years undergoing elective primary hip arthroplasty; exclusion criteria were: severe cognitive impairment; arthroplasty for musculoskeletal cancer; patient not eligible for surgical procedures; hip arthroplasty in the 12 months prior to enrollment. The detailed study protocol, inclusion and exclusion criteria and other information are described in a previous publication [18]. This study follows the STROBE reporting guidelines for observational studies [19, 20].

2.2.Statistical analysis

Baseline demographic and clinical characteristics were summarized using mean and standard deviation, median and interquartile range, or absolute and percentage frequencies, as appropriate.

To determine whether patients completing the study questionnaires at 6 and 12 months were representative of the baseline sample, patients lost to follow-up and completers were compared at 12 months on age, gender, BMI, ASA score, region of residence, and primary diagnosis. Information about

variable's distributions and missing data mechanism can be found in the supplementary material. Values were compared using a t-test or Chi-square test. Significance level was set to 0.05.

2.2.1.Latent class trajectory analysis

Latent class growth analysis (LCGA) was carried out to identify subgroups of patients for three outcomes (EQ-VAS, EQ-5D-3L, HOOS-PS) assessed pre-operatively and at 6 and 12 months of each according to their trajectories of functioning and quality of life (described using utility values) pre-surgery and up to 12 months following total hip replacement without consideration of covariates. The metric of time used for the LCGA was determined by the study design.

LCGA is a special type of Growth Mixture Modeling, whereby the variance and covariance estimates for the growth factors within each class are assumed to be fixed to zero [22]. By this assumption, all individual growth trajectories within a class are homogeneous. This technique allows the user to classify distinct subgroups that follow a similar pattern of change over time hence it is appropriate for analyzing longitudinal data [22]. LCGA can accommodate missing data without excluding from the analysis patients that do not report questionnaires at 6 and/or 12 months, thus allowing the user to define trajectories for the full set of patients [23].

Bayesian information criterion (BIC) and entropy were used to identify the best models. This index has no predefined cut-offs and can only be interpreted when comparing different models. A lower BIC indicates a better model fit. There is no BIC threshold to identify the best model, therefore the lower the BIC, the better the model.

Patients were cross-classified according to the trajectory group for two PROMs indicators: HOOS-PS and EQ-VAS. The former was chosen to account for patients' reported functionality and mobility, while the latter for patients' overall reported quality of life. This choice was made to investigate the distribution of patients reported QoL and functionality scores within the study population.

2.2.2.Multinomial logistic regression

Multinomial logistic regression with a stepwise selection of variables was used to identify the demographic and clinical characteristics associated with the latent trajectories. Specifically, we included the following demographic and clinical variables that are routinely recorded in the administrative databases or in the registry: age, sex, BMI (normal weight/underweight, overweight, and obese), diagnosis (primary coxarthrosis vs other diagnosis), ASA score (1, 2, 3 or more), surgical approach (anterior, lateral, posterior-lateral) and head diameters <32 mm, ≥32 mm).

The trajectory showing the better outcomes over time was selected as the reference category and was compared with the other two classes.

All statistical analyses were performed using SPSS, version 25.0 and R, version 4.1.0.

2.3.Protocol registration: Protocol version (1.0) and trial registration data are available on the platform www.clinicaltrial.gov with the identifier NCT03790267, posted on December 31, 2018.

3. Results

3.1.Study population

During the study period 1562 patients underwent HA at the IOR. Of those, the study population (Table 1, Figure 1) consisted of 991 HA patients, after 571 cases were excluded due to one of the following reasons: not eligible based on inclusion and exclusion criteria (n = 239), not consenting to participate in the study (n = 238), missing baseline PROMs (n = 1), and bilateral surgery where the most recent surgery was already included (n = 93).

Table 1 shows the baseline patient characteristics. Mean age was 60.4 years (SD = 13.9) and 48.7% were female. Overall, the mean preoperative PROMs were: 0.5 (SD = 0.2) for EQ-5D-3L score, 52.2 (SD = 18.4) for EQ-VAS, and 54.0 (SD = 17.0) for HOOS-PS. Of those included, complete PROMs data at 12 months were available for 612 patients (61.7%). The mean postoperative PROMs at 12 months were 0.8 (SD = 0.2) for EQ-5D-3L score, 79.3 (SD = 16.9) for EQ-VAS, and 84.9 (SD = 15.4) for HOOS-PS.

Patients assessed at 12 months overall overlapped those included at baseline (Table S1, Supplemental material), except for an older age (mean age among completers and lost at follow up was 62.3 [SD = 13.0] vs. 57.4 [SD = 14.7], respectively, $p < 0.001$) region of residence (51.6% vs 37.7% resident in Emilia-Romagna, $p < 0.001$) and primary diagnosis (73.5% vs 64.9% of primary coxarthrosis, $p = 0.004$).

3.2.Model selection and characterization of trajectories

The model with three classes was chosen over the 4-class groups (Tables S2-4, Supplemental material) to achieve a balance between model parsimony and an adequate identification of PROMs patterns for each PROMs indicator (Fig. 2). The 3-class model produced three distinct PROMs trajectories and met all diagnostic tests criteria. The probability of membership for each allocated class ranged between 0.78 and 0.85 (detailed results can be found in Tables S5-7, Supplemental material).

EQ-5D-3L trajectories. First trajectory included 582 (59%) patients starting with higher pre-surgery EQ-5D-3L score, improving at 6 months, and maintaining a stable score at 12 months (class high-high, HH). Second trajectory included 379 (38%) patients starting with low EQ-5D-3L scores, strongly improving at 6 months, and continuing to improve at 12 months, although with a slower pace (class low-high, LH). Third trajectory included a small group of 30 (3%) individuals, starting with an intermediate score, that remained stable at 6 months and then slightly declined at 12 months (class intermediate-low, IL).

EQ-VAS trajectories. First trajectory included 799 (81%) patients starting with higher pre-surgery EQ-VAS, improving at 6 months, and maintaining a stable score at 12 months (class HH). Second trajectory included 145 (15%) patients starting with low EQ-VAS scores, strongly improving at 6 months, and continuing to improve at 12 months, although with a slower pace (class LH). Third trajectory included a

small group of 47 (5%) individuals, starting with an intermediate EQ-VAS score, that remained stable at 6 months and then slightly declined at 12 months (class IL).

HOOS-PS trajectories. First trajectory included 765 (77%) patients starting with higher pre-surgery HOOS-PS, improving at 6 months, and maintaining a stable score at 12 months (class HH). Second trajectory included 170 (17%) patients starting with low HOOS-PS scores, strongly improving at 6 months, and continuing to improve at 12 months, although with a slower pace (class LH). Third trajectory included a small group of 56 (6%) individuals, starting with an intermediate HOOS-PS score, that remained stable at 6 months and then slightly declined at 12 months (class IL).

Patients were cross-classified according to the trajectory group for HOOS-PS and EQ-VAS to determine whether the results were consistent across PROMs indicators (Table S8, Supplemental material). Six-hundred-ninety-eight patients (54%) fell in the HH trajectory across the two PROMs indicators, 77 (13%) patients benefited from the intervention and fell in the LH trajectory and 22 patients fell in the worst trajectory group for both indicators (IL).

3.3. Socio-demographic and clinical predictors of trajectory group membership

EQ-5D-3L trajectories (Table 2). Patients assigned to the IL trajectory were more likely to be obese (OR 5.1 [95%CI 1.4-18.3], $p=0.013$) than those in HH trajectory. Patients in the LH trajectory group were more likely to be female (OR 2.7 [95%CI 1.9-3.7], $p<0.001$), to be obese (OR 2.0 [95%CI 1.3-3.1], $p=0.002$), to have an ASA score equal to 2 or ≥ 3 (OR 4.4 [95%CI 2.4-7.9], $p<0.001$, and OR 1.9 [95%CI 1.3-2.9], $p=0.003$, respectively), and to be younger than those in HH trajectory (OR 1.0 [95%CI 1.0-1.0], $p<0.001$).

EQ-VAS trajectories (Table 3). Patients assigned to the IL trajectory were more likely to have an ASA score equal to 3 (OR 4.9 [95%CI 1.7-14.1], $p=0.003$) than those in HH trajectory. Patients in the LH trajectory group were more likely to be female (OR 2.0 [95%CI 1.3-3.1], $p=0.003$), to have a diagnosis other than coxarthrosis (OR 2.3 [95%CI 1.5-3.6], $p<0.001$), and to be in ASA 3 (OR 4.0 [95%CI 2.0-7.9], $p<0.001$), than those in HH trajectory.

HOOS-PS trajectories (Table 4). Patients assigned to the IL trajectory were more likely to be obese (OR 2.9 [95%CI 1.1-7.2], $p=0.025$) and have an ASA score equal to 3 (OR 3.6 [95%CI 1.4-9.1], $p=0.006$) than those in HH trajectory. Lastly, patients in the LH trajectory group were more likely to be female (OR 3.4 [95%CI 2.1-5.6], $p<0.001$), to be obese (OR 3.1 [95%CI 1.6-5.7], $p<0.001$), to have a diagnosis other than coxarthrosis (OR 2.2 [95%CI 1.4-3.5], $p=0.001$), and have an ASA score equal to 3 (OR 3.0 [95%CI 1.5-6.2], $p=0.002$), than those in HH trajectory.

4. Discussion

This study explored quality of life and functioning among patients who underwent HA, found three distinguished outcome trajectories using three widely used PROMs tools (EQ-5D-3L, EQ-VAS, HOOS-PS), and identified which patient characteristics were associated with high-performance and low-performance

outcome trajectories. The three identified trajectories were consistent among the three PROMs tools, with one trajectory (HH) accounting for most patients in each scale, showing an increasing trend in quality of life and functioning at 6 months after surgery, followed by a plateau at 12 months. The second trajectory (LH) showed a lower starting level followed by a consistent improvement at 6 and 12 months. The third trajectory showed a modest improvement at 6 months followed by a modest decline at 12 months. Our findings also showed that being a woman, obese and with a high ASA score (≥ 3) was associated with worse outcome trajectory in terms of quality of life and functioning after HA.

This study has an important strength in the collection of PROMs at a mid-term time-point (post-surgical 6 months), differently from most studies which adopt longer-term time-points (12 or 24 months) [5, 7, 8, 12, 25-27]. This allowed us to define the medium-term effects of the surgical intervention [5, 24-26]. Overall, baseline characteristics and PROMs' score of the study population, both pre and post operatively, are in line with previous studies [26-28], although compared on slightly different time points.

Using latent class growth analysis, we identified three distinct PROMs trajectories indicating the presence of significant heterogeneity in reported health among HA patients. This analysis allowed us to demonstrate heterogeneity within the cohort, providing insights on the medium-term PROMs and the potential value of surgical intervention across different patient groups. The trajectories of PROMs scores indicate that most patients showed a considerable improvement within 6 months, followed by a slightly less prominent one at 12 months. This kind of trajectory is frequently reported for patients undergoing hip surgery [8]. However, unlike much of the available literature [5, 7, 8, 12], this study underlines the importance of analyzing 6-months PROMs trends to identify the early effects of HA surgery on patients' QoL and hip-specific functioning. Specifically, we found that the highest proportion of patients was admitted to surgery with high PROMs scores, slightly improved at 6 months after surgery and preserved adequate levels of functioning and quality of life at 12 months. A second subgroup of patients started from low PROMs scores, but strongly improved at 6 months and then preserved high levels of functionality and quality of life at 12 months. Plenty of literature supports this finding [5, 7, 8, 12, 25-27], as it is common for HA patients to improve functioning and quality of life after surgery and then to show a plateau. However, our main finding is that a small number of patients (3.7%), admitted to HA surgery with intermediate PROMs scores, did not show any significant improvement at 6 months, and even worsened at 12 months.

The multinomial logistic regression revealed the patients' baseline demographic and clinical characteristics associated with the latent trajectories. Obesity and an ASA score ≥ 3 were associated with a higher likelihood of being in the worst trajectory (IL) for all the QoL and functioning indicators. Plenty of literature confirms that obesity is a strong predictor for either the development of diseases that inevitably require HA (e.g. osteoarthritis) and poor outcomes after the intervention in terms of overall health status and joint's functionality.

The analysis showed that an ASA score ≥ 3 is related to worse QoL and functioning after surgery. This finding confirms the body of evidence on the importance of the ASA score for stratifying patients at

different risk of worse outcomes patterns after surgery [29-31]. The use of the ASA score is indeed widespread among healthcare professionals to assess patients' eligibility for surgery [29-31]. Our study suggests that this score, combined with other indicators, could be implemented to predict a patient's functional prognosis as well as the expected QoL improvement after the intervention, thus allowing patients and surgeons to make the most sensible/appropriate choice, relying on a commonly used tool.

Notably, being female is linked to a higher probability of improvement for each of the considered scores. Patients belonging to these categories are the ones characterized by the lower pre-surgery scores and the largest improvement 6 months after the intervention, that is patients who benefit the most from the arthroplasty. A strong body of literature [32-37] suggests that females have a higher pain tolerance threshold compared to males. This could lead to delayed arthroplasty given that one of the main parameters considered for HA surgery is pain. Reasons for this may be traced back to biological and/or psychological factors. Scientific literature in this area clearly suggests that men and women differ in their responses to pain, with increased pain sensitivity and risk for clinical pain commonly being observed among women [32]. Large-scale epidemiological studies have consistently revealed a higher female prevalence of several painful diseases [33-35]. Differences observed for self-reported pain may be also a function of women over-reporting their pain relative to men (or men under-reporting). Some authors suggest that the difference is more than a physiological difference, and worst PROMs among women correlates with greater severity and longer duration of the underlying condition [36, 37]. Furthermore, delayed care-seeking behavior could be one of the reasons for the differences found in this study. It is possible that for cultural, working-related, or organizational reasons, females undergo HA at later stage of disability respect to males. On the other hand, patients in this trajectory highly benefited from HA, showing the largest improvement 6 months after HA. A possible explanation for this can be found in the fact that females are usually considered better responders compared to males [38].

Our work emphasizes one of the main benefits of PROMs' collection. In the context of personalized healthcare, the ability to link patient characteristics to the respective projected outcomes, allows to improve patient outcomes by inquiring their subjective perception of the health status. Differently from previous research [8, 12], this study also captures the 6 months PROMs after surgery, hence the medium-term effects of HA on PROMs. This is important for identifying early effects of HA and their determinants. Although many studies focused on identifying potential risk factors and integrating these to improve medical decision making, associating short- and medium-term PROMs to patient demographic and clinical characteristics can improve the delivery of personalized services and to optimize surgery outcomes.

4.1.Limits of the study

This study has some limitations. First, the baseline population refers to a single third level mono-specialty hospital. This may lead to describing PROMs in a highly selected population. The results of similar studies conducted in hospitals of different levels, and therefore with different populations in terms of

patients' case-mix, may give different results. In the future, comparisons between patients recruited from different healthcare facilities are needed.

5. Conclusions

Knowledge derived from patient-reported data can be leveraged to develop decision aids and update clinical practice guidelines. Data generated by patients can also contribute to assessing the quality of healthcare pathways especially when combined with other demographic and clinical data derived from routinely collected administrative databases.

The PaRIS-IOR study represents the first large systematic collection of PROMs in patients undergoing arthroplasty in Italy and has important implications in targeting the factors affecting patient-reported outcomes after joint arthroplasty. This study shows the high response heterogeneity to the surgical procedure of HA patients. Among several demographic and clinical characteristics, patient's gender, ASA score ≥ 3 , obesity and the main diagnosis are significantly associated with different PROMs trajectories 6 and 12 months after HA. These findings underline the importance of patient-centered care, supporting the usefulness of integrating PROMs data alongside routinely collected healthcare records for guiding clinical care and maximizing patient outcomes.

Measuring patient-reported metrics helps to target the health care provided on the individual needs. Patient-reported outcomes can inform care decisions and help healthcare professionals choose the right treatment option when various types of interventions are available and when patients' characteristics may influence the outcome's trends after surgery.

List Of Abbreviations

HF: hip fracture

PROMs: Patient Reported Outcome Measures

IOR: Rizzoli Orthopedic Institute

EQ-5D-3L: Euro Quality 5 Dimensions 3L

EQ-VAS: Euro Quality Visual Analytic Score,

HOOS-PS: Hip disability and Osteoarthritis Outcome Score

ASA score: American Society of Anesthesiologists score

PaRIS: Patient-Reported Indicators Surveys

OECD: Organization for Economic Cooperation and Development

ECl: Elixhauser Comorbidity Index

Declarations

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Conflicts of interest/Competing interests

The authors declare that they have no specific competing interests.

Ethics approval

This study has been approved by the Emilia Romagna AVEC research ethics committee board with identifier code: PG0013646 approved on 11-29-2018. The study is also available on the platform www.clinicalTrials.gov, with the identifier: NCT03790267.

Consent to participate

All participants to the PaRIS-IOR study are asked to sign two informed consents prior to being included in the study, one for privacy and one for participation.

Consent for publication

Consent to publish from the participant to report patient data have been obtained.

Availability of data and material

The data used in the study are controlled by Rizzoli Orthopedic Institute and cannot be shared publicly. However, aggregated, and anonymized data are available upon specific request to the corresponding authors. Interested researchers can replicate our study findings by contacting the authors or the Rizzoli Orthopedic Institute.

Code availability

Not applicable

Authors' Contribution

DG contributed to design, data interpretation, and drafted the manuscript; AG contributed to study design, data interpretation, and drafted the manuscript; DT and FS contributed to design and data acquisition, and drafted the manuscript; SR and FS contributed to data analysis contributed to design and data interpretation; PR contributed to data analysis and interpretation and reviewed the manuscript; MA contributed to data acquisition and reviewed the manuscript; MC contributed to data acquisition and analysis; BB contributed to data interpretation and reviewed the manuscript; MPF contributed to conception and data interpretation, and critically revised the manuscript; SZ contributed to design, data interpretation, and critically revised the manuscript.

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Tables

Table 1. Descriptive characteristics of the study population at baseline (n=991).

	<i>n</i>	%	Mean	SD
Mean Age, y	991		60.4	13.9
Sex,				
Female	483	48.7		
Male	508	51.3		
BMI, <i>n</i> (%)				
normal weight/underweight	340	35.6		
overweight	402	42.1		
obese	213	22.3		
Diagnosis				
Primary coxarthrosis	696	70.2		
Other	295	29.8		
ASA score				
1	235	25.5		
2	526	57.1		
3	160	17.4		
Incision				
Anterior	294	29.9		
Lateral	623	63.4		
Posterior-lateral	66	6.7		
Head diameter				
<32 mm	435	43.9		
≥32 mm	556	56.1		
Length of stay, d	991		6.8	2.6
Residents in RER	459	46.3		
M-CDS*				
0-1	124	27.0		
2-4	189	41.2		
5-6	68	14.8		

7-9	37	8.1	
≥10	41	8.9	
PROMs baseline score			
EQ-5D-3L	991	0.5	0.2
EQ-VAS	991	52.2	18.4
HOOS-PS	991	54.0	17.0
PROMs 12-month score			
EQ-5D-3L	612	0.8	0.2
EQ-VAS	612	79.3	16.9
HOOS-PS	612	84.9	15.4

Note: * M-CDS=Modified-Chronic Disease Score. Available only for patients residing in RER, Emilia Romagna region (N = 459)

Table 2. Results of the multinomial logistic regression for EQ-5D-3L.

EQ-5D-3L ^a		OR	LB	UB	p-value
IL vs HH	Female	1.002	.420	2.394	.996
	Male	.	.	.	.
	BMI = Obese	5.086	1.412	18.322	.013
	BMI = Overweight	2.797	.829	9.429	.097
	BMI = Normal weight/underweight	.	.	.	.
	ASA ≥ 3	3.866	.887	16.838	.072
	ASA 2	.903	.255	3.193	.874
	ASA 1	.	.	.	.
	Age	1.004	.964	1.045	.863
LH vs HH	Female	2.687	1.931	3.739	.000
	Male	.	.	.	.
	BMI = Obese	1.979	1.284	3.050	.002
	BMI = Overweight	1.325	.914	1.922	.138
	BMI = Normal weight/underweight	.	.	.	.
	ASA ≥ 3	4.392	2.433	7.927	.000
	ASA 2	1.924	1.257	2.944	.003
	ASA 1	.	.	.	.
	Age	.974	.961	.988	.000

a. The reference category is: High-High (HH)

Table 3. Results of the multinomial logistic regression for EQ-VAS.

EQ-VAS ^a		OR	LB	UB	p-value
IL vs HH	Female	1.619	.795	3.297	.185
	Male	.	.	.	.
	Other diagnosis	1.187	.541	2.602	.669
	Primary coxarthrosis	.	.	.	.
	ASA ≥ 3	4.929	1.724	14.090	.003
	ASA 2	1.438	.529	3.908	.476
	ASA 1	.	.	.	.
LH vs HH	Female	1.976	1.255	3.111	.003
	Male	.	.	.	.
	Other diagnosis	2.309	1.465	3.641	.000
	Primary coxarthrosis	.	.	.	.
	ASA ≥ 3	3.966	1.994	7.888	.000
	ASA 2	1.770	.976	3.212	.060
	ASA 1	.	.	.	.

a. The reference category is: High-High (HH)Low-low (LL)

Table 4. Results of the multinomial logistic regression for HOOS-PS.

HOOS-PS ^a		OR	LB	UB	p-value
IL vs HH	Female	1.467	.753	2.857	.260
	Male	.	.	.	.
	BMI = Obese	2.862	1.142	7.175	.025
	BMI = Overweight	1.795	.778	4.146	.170
	BMI = Normal weight/underweight	.	.	.	.
	Other diagnosis	1.843	.925	3.673	.082
	Primary coxarthrosis	.	.	.	.
	ASA ≥3	3.619	1.434	9.132	.006
	ASA 2	.910	.373	2.220	.837
	ASA 1	.	.	.	.
LH vs HH	Female	3.431	2.102	5.599	.000
	Male	.	.	.	.
	BMI = Obese	3.061	1.644	5.699	.000
	BMI = Overweight	1.746	.993	3.072	.053
	BMI = Normal weight/underweight	.	.	.	.
	Other diagnosis	2.202	1.371	3.537	.001
	Primary coxarthrosis	.	.	.	.
	ASA ≥3	3.046	1.491	6.222	.002
	ASA 2	1.359	.734	2.517	.329
	ASA 1	.	.	.	.

a. The reference category is: High-High (HH)

Figures

Figure 1

Flow chart of the study population

Figure 2

Results from Latent Class Growth Analysis for EQ-VAS, EQ-5D-3L, HOOS-PS scores.

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