BJO

■ ARTHROPLASTY

Loss to patient-reported outcome measure follow-up after hip arthroplasty and knee arthroplasty

PATIENT SATISFACTION, ASSOCIATIONS WITH NON-RESPONSE, AND MAXIMIZING RETURNS

L. A. Ross,
S. C. O'Rourke,
G. Toland,
D. J. MacDonald,
N. D. Clement,
C. E. H. Scott

From Edinburgh Orthopaedics, Royal Infirmary of Edinburgh, UK

Aims

The aim of this study was to determine satisfaction rates after hip and knee arthroplasty in patients who did not respond to postoperative patient-reported outcome measures (PROMs), characteristics of non-responders, and contact preferences to maximize response rates.

Methods

A prospective cohort study of patients planned to undergo hip arthroplasty (n = 713) and knee arthroplasty (n = 737) at a UK university teaching hospital who had completed preoperative PROMs questionnaires, including the EuroQol five-dimension health-related quality of life score, and Oxford Hip Score (OHS) and Oxford Knee Score (OKS). Follow-up questionnaires were sent by post at one year, including satisfaction scoring. Attempts were made to contact patients who did not initially respond. Univariate, logistic regression, and receiver operator curve analysis was performed.

Results

At one year, 667 hip patients (93.5%) and 685 knee patients (92.9%) had undergone surgery and were alive. No response was received from 151/667 hip patients (22.6%), 83 (55.0%) of whom were ultimately contacted); or from 108/685 knee patients (15.8%), 91 (84.3%) of whom were ultimately contacted. There was no difference in satisfaction after arthroplasty between initial non-responders and responders for hips (74/81 satisfied vs 476/516 satisfied; p = 0.847) or knees (81/93 satisfied vs 470/561 satisfied; p = 0.480). Initial non-response and persistent non-response was associated with younger age, higher BMIs, and worse preoperative PROMs for both hip and knee patients (p < 0.050). Being in employment was associated with persistent non-response for hip patients (p = 0.047). Multivariate analysis demonstrated that younger age (p < 0.038), higher BMI (p = 0.018), and poorer preoperative OHS (p = 0.031) were independently associated with persistent non-response to hip PROMs. No independent associations were identified for knees. Using a threshold of > 66.4 years predicted a preference for contact by post (area under the curve 0.723 (95% confidence interval (CI) 0.647 to 0.799; p < 0.001, though this CI crosses the 0.7 limit considered reliable).

Conclusion

The majority of initial non-responders were ultimately contactable with effort. Satisfaction rates were not inferior in patients who did not initially respond to PROMs.
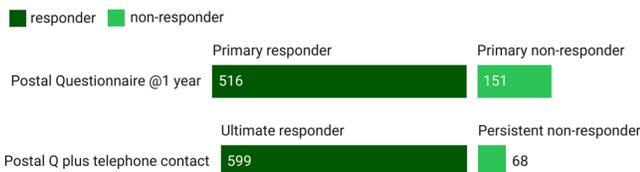
Cite this article: *Bone Jt Open* 2022;3-4:275–283.

Introduction

Patient-reported outcome measures (PROMs) are important in evaluating the "success" of hip and knee arthroplasty, and are essential quantitative measures for investigating new procedures and techniques. PROMs capture the patient's own evaluation of the outcome of their surgery in a single quantifiable score.

Hips

■ responder   ■ non-responder

	Primary responder	Primary non-responder
Postal Questionnaire @1 year	516	151

	Ultimate responder	Persistent non-responder
Postal Q plus telephone contact	599	68

Knees

■ responder   ■ non-responder

	Primary responder	Primary non-responder
Postal Questionnaire @1 year	577	108

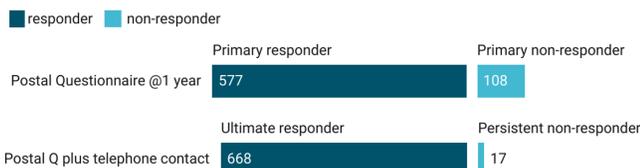|	Ultimate responder	Persistent non-responder
Postal Q plus telephone contact	668	17

Fig. 1

Definitions and proportions of responders for hip and knee cohorts.

PROMs are important as patient and surgeon perceptions of "success" following hip and knee arthroplasty are not necessarily aligned.[1] Assuming a PROM has been well constructed, validated PROMs provide an 'objective' evaluation that quantifies the pain, function, or disease severity as perceived by the patient.[2] Loss to follow-up or non-response to PROMs after hip and knee arthroplasty affects this ability.

It is recommended that the characteristics of non-responders should be reported by individual studies and registries;[3] however, a systematic review of knee specific PROMs identified that evaluation of the completion rate of many of the PROMS surveyed was not possible due to inconsistent reporting in the literature.[4] The non-response rate that will invalidate the results of a study is unclear,[5] but a response rate of > 60% has been defined as acceptable by the International Society of Arthroplasty Registries (ISAR) PROMs Working Group.[3–6] The effect of non-response on data interpretation remains unclear. Understanding the reasons for non-response is essential to both accurately interpret the data we do have and maximize response rates for the future.

The primary aim of this study was to determine satisfaction rates following arthroplasty in patients who completed preoperative PROMs but who had failed to complete one year PROMs questionnaires. Secondary aims included identifying characteristics of non-responders, determining what contact rates could be achieved, and exploring contact preferences to maximize response rates in the future.

Methods

During 2018, preoperative PROMs questionnaires were completed by 709 consecutive patients planned to undergo hip arthroplasty surgery (total hip arthroplasty (THA) and revision THA (rTHA)), and 737 planned to undergo knee arthroplasty (KA) surgery and revision total knee arthroplasty (rTKA)). Questionnaires including

a detailed comorbidity questionnaire, employment questions, general health (EuroQol five dimension (EQ-5D)), and joint-specific (Oxford Hip Score (OHS) or Oxford Knee Score (OKS)) PROMs. Specifically, the questionnaire asked about the Charlson index comorbidities: myocardial infarction, congestive heart failure, peripheral arterial disease (PAD), stroke with hemiplegia, dementia, chronic obstructive pulmonary disease (COPD), connective tissue disorder, diabetes, kidney disease and liver disease, back pain, and pain in other joints. Employment status was recorded from the options: working full-time, working part-time, retired, on sick-leave, or unemployed. A free text box was available to record other options and specific occupation was also recorded. Preoperative questionnaires were collected at a pre-assessment clinic a few weeks prior to surgery, when additional demographical data, including age, sex, and BMI, were recorded by the research team. Social deprivation was determined using the Scottish Index of Multiple Deprivation (SIMD).[7] This assigns a deprivation quintile (1= most deprived, 5= east deprived) according to postcode based upon indicators of deprivation such as employment, income, crime, housing, health, education and access to services. Height and weight were measured by nurses in the preassessment clinic to calculate BMI.

Surgery was performed or supervised by 16 surgeons at a large orthopaedic teaching hospital. Patients followed standardized postoperative rehabilitation following THA/rTHA and similarly following KA/rTKA according to a uniform departmental rehabilitation care plan. All patients were reviewed clinically at six to eight weeks after surgery with additional clinical follow-up at the discretion of the treating clinician.

At one-year postoperatively, questionnaires were posted out to patients and included EQ-5D, OHS/OKS, and a measure of patient satisfaction ("How satisfied are you with your operated knee/hip") using a five-point Likert scale with the options 'very satisfied', 'satisfied', 'uncertain', 'dissatisfied', and 'very dissatisfied'. Patient experience was measured using a visual analogue scale of 0 to 100 ("Out of 100 how would you rate your hospital experience with 0 being the 'worst' and 100 the 'best' possible"). These were completed independently of routine care. A prepaid addressed envelope was included for questionnaire return. The EQ-5D score provides a validated and standardized measure of five health domains (mobility, self-care, ability to perform usual activities, pain/discomfort, and anxiety/depression), each rated 1 to 3 (no problems, moderate difficulties, severe difficulties, respectively), in addition to two visual analogue scales of health and pain (scale 0 to 100). The OHS and OKS are validated hip- and knee-specific outcome measures, respectively, where 12 questions (five possible answers) give scores from 0 to 48 (higher scores = better function). Satisfaction scores were dichotomized to satisfied
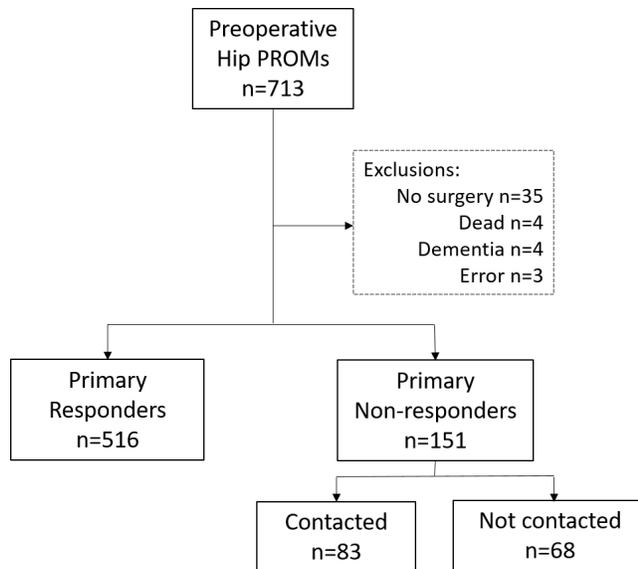
```
┌─────────────────┐
│  Preoperative   │
│   Hip PROMs     │
│     n=713       │
└─────────────────┘
         │
         │        ┌─────────────────────────┐
         │        │ Exclusions:             │
         ├───────▶│   No surgery n=35       │
         │        │   Dead n=4              │
         │        │   Dementia n=4          │
         │        │   Error n=3             │
         │        └─────────────────────────┘
         │
    ┌────┴─────────────────┐
    ▼                      ▼
┌──────────┐      ┌──────────────────┐
│ Primary  │      │    Primary       │
│Responders│      │ Non-responders   │
│  n=516   │      │     n=151        │
└──────────┘      └──────────────────┘
                      │        │
                      ▼        ▼
              ┌──────────┐  ┌──────────────┐
              │Contacted │  │Not contacted │
              │  n=83    │  │   n=68       │
              └──────────┘  └──────────────┘
```

Fig. 2

Flowchart for hip patients.

('very satisfied' and 'satisfied') or dissatisfied ('uncertain', 'dissatisfied', and 'very dissatisfied') for analysis.

Patients who did not respond to the one-year questionnaire were identified in October 2020, and attempts made to contact them by telephone. Electronic patient records were examined to obtain contact details and details of any clinical follow-up that had been performed. Both landline and mobile phones numbers were used. Messages were not left on answering machines for reasons of patient confidentiality. If a relative answered the phone, they were asked when it would be convenient for researchers to phone back. Emergency contacts or next of kin were not contacted. Where contact was not possible, general practitioners (GPs) were contacted to confirm contact details, and further attempts were made to contact the patient at home. In total, ≥ two attempts were made to contact each patient using their most recent contact details (≥ one time during working hours and ≥ one time in the evening). Text messages were not sent as this was not possible via the hospital system. Patient email addresses are not included as part of the electronic patient record and so emails were not sent. When contactable, patients were asked whether they received the postal questionnaire; whether they had completed and returned it; reasons for non-completion/non-return; whether they were satisfied with their arthroplasty from the options 'satisfied', 'uncertain' or 'dissatisfied'; whether they had undergone any further surgery to the joint; and whether they would rather receive patient questionnaires in another format, for example electronically.

Statistical analysis. Data were analyzed using SPSS version 25.0 (IBM, USA). Univariate analysis was performed using parametric (paired and unpaired t-test) and nonparametric (Mann-Whitney U test, Wilcoxon's signed rank test) tests, as appropriate, to assess differences in continuous variables between groups (responders and non-responders; ultimate responders and persistent non-responders). Nominal categorical variables were analyzed using chi-squared test or Fisher's exact test. Variables found to be associated with persistent non-response at the 10% level or less were entered stepwise into a multivariate binary logistic regression analysis, using an enter methodology, to identify independent associations with loss to follow-up.

Receiver operating characteristic (ROC) curve analysis was used to identify the threshold age that identified response to PROMs by post and preference for mode of PROMs completion. The area under the ROC curve ranges from 0.5, indicating a "chance" discrimination, 0.7 to 0.8 is considered acceptable, 0.8 to 0.9 is considered excellent, and more than 0.9 is considered outstanding discrimination and 1.0 indicates perfect accuracy.[8] The threshold value is the point of maximal sensitivity and specificity in predicting PROMs response or PROMs preference. A p-value < 0.05 was considered statistically significant.

Results

Hips. There were 516 patients who responded to hip questionnaires one year following surgery (452 THAs; 64 rTHAs), and 197 (27.6%) did not respond. Of these, 151 (21.2% of the cohort; 76.6% of all missing responses) were true non-responders who had undergone hip arthroplasty surgery and were alive and capable of completing PROMs, but for whom postoperative scores were not received (Figures 1 and 2). Patient characteristics of responders and non-responders are given in Table I. Despite best efforts, 68 hip patients remained uncontactable (35.2% of those initially uncontactable and 9.6% of the entire hip cohort). Current GPs were successfully contacted for 46 of these 68 uncontactable patients, but the study team could not obtain a valid phone number for 22 cases and 36 did not answer.

Contact was made with 83/151 patients (55.0%) who had initially not responded to postal questionnaires. Reasons for initial non-response are provided in Table II. Four non-responders had developed dementia postoperatively and had been unable to complete PROMs, and a further three had other health reasons preventing completion, such as prolonged hospital admissions. Initial non-responders were significantly younger than responders with significantly (p ≤ 0.050) worse preoperative PROMs (OHS, VAS-pain scores, EQ-5D, and EQ-visual analogue scale (VAS) scores; Table II). There were no significant differences in comorbidities between responders and initial-non-responders for any of the Charlson comorbidities examined (p > 0.050, chi-squared test). Similarly, persistent non-responders were significantly younger

Table I. Univariate analysis comparing responders, non-responders, and persistent non-responders (lost to follow-up) to postal questionnaire following hip arthroplasty.

Hips	Responder (n = 516)	Initial non-responder (n = 151)	p-value	Ultimate responder (n = 599)	Persistent non-responder (n = 68)	p-value
Mean age, yrs (SD)	68.2 (11.8)	60.3 (15.1)	< 0.001*	66.9 (13.0)	58.3 (12.2)	< 0.001*
Mean BMI, kg/m^2 (SD)	28.1 (5.3)	29.0 (6.2)	0.077*	28.1 (5.3)	31.0 (7.1)	0.004*
Male sex, n (%)	212 (41)	54 (36)	0.209‡	240 (40)	26 (38)	0.847‡
Primary, n (%)	452 (88)	136 (90)	0.324‡	527 (88)	61 (90)	0.470‡
Revision, n (%)	64 (12)	15 (10)		72 (12)	7 (10)	
Preoperative PROMs						
Median EQ-5D (IQR)	0.516 (0.06-0.69)	0.088 (-0.02-0.62)	< 0.001†	0.264 (0.03-0.73)	0.159 (-0.02-0.62)	0.007†
Median EQ-VAS-Health (IQR)	70 (50-80)	62 (49-79)	0.002†	60 (50-94)	70 (40-79)	0.050†
Mean VAS-Pain (SD)	49.1 (23.9)	53.4 (25.4)	0.042*	50.0 (24.4)	52.9 (23.7)	0.379*
Mean OHS (SD)	21.1 (9.6)	16.8 (8.5)	< 0.001*	20.4 (9.6)	15.9 (7.9)	< 0.001*
Median Patient experience (IQR)	90 (80-98)	90 (76-98)	0.051†	90 (70-96)	89 (69-98)	0.098†
Employment status, n (%)	n = 343	n = 140		n = 428	n = 55	
Working full-time	92 (27)	42 (30)	0.140‡	111 (26)	23 (42)	0.047‡
Working part-time	26 (8)	10 (7)		33 (8)	3 (5)	
Retired	111 (32)	42 (30)		142 (33)	11 (20)	
Sick leave	95 (28)	30 (21)		114 (27)	11 (20)	
Unemployed	19 (3)	15 (11)		27 (6)	7 (13)	
School/student	0 (0)	1 (1)		1 (1)	0 (0)	

*Unpaired *t*-test.
†Mann-Whitney U test.
‡Chi-squared test.
EQ-5D, EuroQol five-dimension; IQR, interquartile range; OHS, Oxford Hip Score; OHS, Oxford Hip Score; PROMs, patient-reported outcome measures; SD, standard deviation; VAS, visual analogue scale.

Table II. Patient-provided reason for non-response to initial postal questionnaire.

Reason	Hips (n = 151), n (%)	Knees (n = 108), n (%)
Uncontactable	68 (45)	17 (16)
Contacted	83 (55)	91 (84)
Did send back	0 (0)	17 (16)
Did not receive/does not remember receiving	64 (42)	61 (56)
Forgot to complete	14 (9)	4 (4)
Unable to read/write	1 (1)	3 (3)
Unable to complete for health/caring reasons	2 (1)	5 (5)
Dissatisfied and so did not want to complete	2 (1)	0 (0)
Satisfied and so did not want to complete	0 (0)	1 (1)

than ultimate responders, with higher BMIs and worse preoperative OHS, EQ-5D scores, and general health scores (p < 0.050; Table II). Employment status at the time of hip arthroplasty was not associated with primary response, but was significantly associated with ultimate response (p = 0.047, chi-squared test; Table III). Among primary non-responders whose unemployment status was known, our ability to contact patients was significantly associated with working status: 17/46 workers contactable versus 53/76 non-workers contactable (p = 0.001, chi-squared test). Multivariate analysis demonstrated that younger age (p = 0.038), higher BMI (p = 0.018), and poorer preoperative OHS (p = 0.031) were

independently associated with persistent non-response to hip PROMs (Table IV).

Of primary non-responders who were contacted, 74/81 (91.4%) were satisfied with the outcome of their hip arthroplasty compared to 476/516 (92.2%) of initial responders (p = 0.847, chi-squared test; Figure 3).

Knees. There were 577 patients (540 KAs; 37 rTKAs) who responded to knee questionnaires one year following surgery, and 160/737 (21.7%) did not respond. This was a significantly better response rate than that of patients following THA (p < 0.001, chi-squared test). Of these, 108 (14.6% of the cohort; 67.5% of all missing responses) were true non-responders who had undergone knee arthroplasty surgery and were alive capable of completing PROMs, but for whom postoperative scores were not received (Figure 1 and Figure 4). Patient characteristics of responders and non-responders are given in Table III. Despite best efforts, 17 knee patients were uncontactable (10.4% of those initially non-responsive; 2.3% of the entire knee cohort). Current GPs were successfully contacted for uncontactable patients, but the study team could not obtain a valid phone number for one case and 16 did not answer.

Contact was made with 91/108 patients (84.3%) who had initially not responded to postal questionnaire but who had undergone KA. Reasons for initial non-response are provided in Table IV. Three non-responders

Table III. Univariate analysis comparing responders, non-responders, and persistent non-responders (lost to follow-up) to postal questionnaire following knee arthroplasty.

Knees	Responder (n = 577)	Initial non-responder (n = 108)	p-value	Ultimate responder (n = 670)	Persistent non-responder (n = 17)	p-value
Age, yrs (SD)	69.9 (9.4)	65.7 (10.0)	< 0.001†	69.3 (9.6)	68.0 (8.6)	0.542†
BMI, kg/m² (SD)	30.3 (5.5)	31.9 (6.7)	0.024†	30.5 (5.7)	32.1 (6.9)	0.231†
Male sex, n (%)	263 (46)	35 (32)	0.011§	294 (44)	4 (24)	0.059‡
Primary, n (%)	540 (94)	103 (95)	0.478§	628 (94)	17 (100)	0.623§
Revision, n (%)	37 (6)	5 (5)		42 (6)	0 (0)	
Preoperative PROMs						
Median EQ-5D (IQR)	0.59 (0.10 to 0.69)	0.16 (0.06 to 0.62)	0.003¶	0.52 (0.09 to 0.69)	0.16 (0.00 to 0.69)	0.403¶
Mean VAS-Pain (SD)	52.6 (20.8)	51.7 (22.3)	0.674†	52.3 (21.0)	57.0 (22.8)	0.333†
Median VAS-Health (IQR)	71 (52 to 81)	66 (50 to 80)	0.025¶	70 (50 to 80)	70 (50 to 72)	0.115¶
Mean OKS (SD)	20.7 (7.7)	17.8 (8.1)	0.001†	20.3 (7.9)	18.9 (8.3)	0.479†
Median patient experience (IQR)	90 (80 to 98)	90 (76 to 97)	0.627¶	90 (80 to 98)	88 (80 to 97)	0.677¶
Employment status, n (%)	n = 451	n = 107		n = 542	n = 16	
Working full-time	80 (18)	20 (19)	0.101§	97 (18)	3 (19)	0.758§
Working part-ime	20 (4)	10 (9)		33 (6)	2 (12)	
Retired	209 (46)	51 (48)		254 (47)	6 (38)	
Sick leave	126 (28)	20 (19)		142 (26)	4 (25)	
Unemployed	11 (2)	6 (6)		16 (3)	1 (6)	

†Unpaired *t*-test.
‡Fisher's exact test.
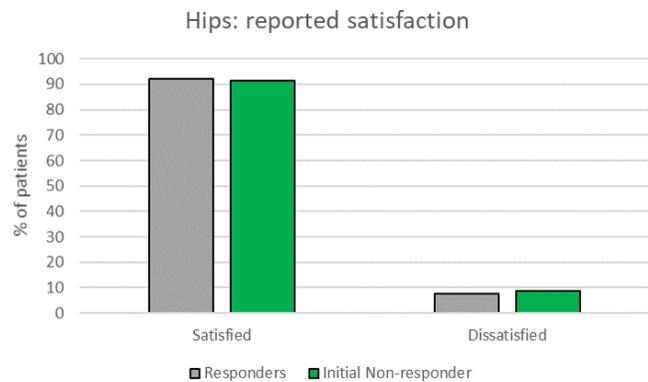§Chi-squared test.
¶Mann-Whitney U test.
EQ-5D, EuroQol five-dimension; IQR, interquartile range; OKS, Oxford Knee Score; PROMs, patient-reported outcome measures; SD, standard deviation; VAS, visual analogue scale.

Table IV. Multivariate analysis of associations with persistent non-response to PROMs after hip arthroplasty.

Predictors in the model	B	OR (95% CI)	p-value
Hips R² = 0.101			
Age, yrs	0.026	1.03 (1.00 to 1.05)	0.038
BMI, kg/m²	-0.059	0.94 (0.90 to 0.99)	0.018
VAS-Health score	0.001	1.00 (0.99 to 1.02)	0.914
OHS	0.056	1.06 (1.00 to 1.11)	0.031
EQ-5D	-0.279	0.76 (0.20 to 2.86)	0.681
Employed full- or part-time	-0.419	0.66 (0.33 to 1.30)	0.226

CI, confidence interval; EQ-5D, EuroQol five-dimension; OHS, Oxford Hip Score; PROMs, patient-reported outcome measures; VAS, visual analogue scale.

Fig. 3

Satisfaction rates following hip arthroplasty (primary and revision) for primary responders and primary non-responders who were contactable.

had developed dementia postoperatively and had been unable to complete PROMs and a further five had other health reasons preventing completion, such as prolonged hospital admissions. Initial non-responders were significantly younger than responders with significantly worse preoperative OKS (p < 0.001) and EQ-5D scores (p < 0.001; Table III). There were no significant differences in comorbidities between responders and initial-non-responders for any of the Charlson comorbidities examined or for SIMD quintiles (p > 0.050, chi-squared test) or for the total number of comorbidities (median two comorbidities in both groups; p = 0.318, Mann-Whitney U test). Employment status at the time of knee arthroplasty did not significantly affect primary or ultimate response (Table III). Among primary non-responders, employment status did not affect ultimate contactability significantly: 42/45 workers contactable vs 51/63 non-workers contactable (p = 0.057, Fisher's exact test). There was no significant differences in the variables examined between ultimate responders and persistent non-responders (Table III).

There was no difference in the reported satisfaction at 1 year among responders (470/561; 83.8%) and that reported by primary non-responders who were successfully contacted (81/93; 87.1%) (p = 0.480, chi-squared; Figure 5).
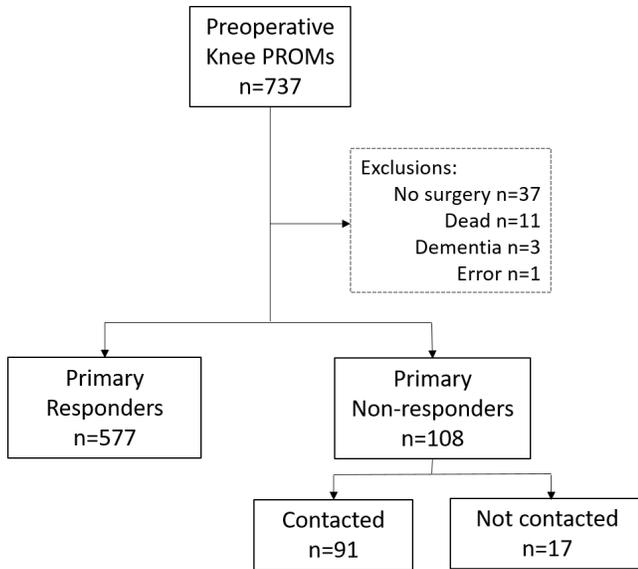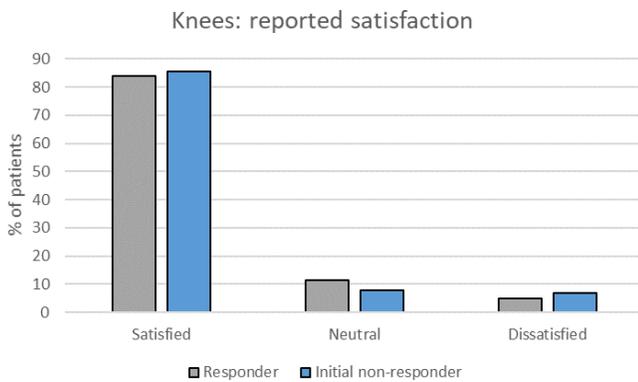
Fig. 4

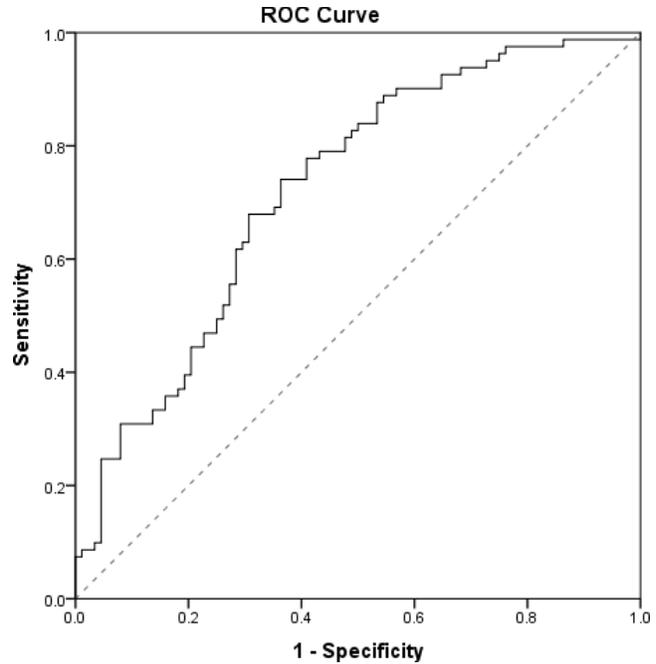Flowchart for knee patients.

Fig. 6

Receiver operating characteristic curve of contact preferences of hip and knee arthroplasty patients for patient-reported outcome measures by age (area under the curve 0.723 (95% confidence interval 0.647 to 0.799; p < 0.001). A threshold of > 66.4 years predicted a preference for contact by post with 65.4% sensitivity and 68.1% specificity.

Fig. 5

Satisfaction rates following knee arthroplasty (primary and revision) for primary responders and primary non-responders who were contactable.

Preferences for contact. Combining both hip and knee patients (n = 1,352), ROC analysis using age to predict PROMs response gave an area under the curve (AUC) of 0.650 (95% CI 0.613 to 0.688; p < 0.001). At less than 70%, age may not therefore be a reliable predictor of response, reflected by a sensitivity of 61% and a specificity of 61% for a defined threshold of 67 years predicting response to postal PROMs. However, using this threshold, patients aged < 67 years were less likely to respond to postal PROMs with odds ratio (OR) 0.63 (0.558 to 0.711) compared to older patients.

Among primary non-responders there was no significant difference between hip and knee patients in terms of a contact preference for post: 33/81 primary hip non-responders, and 44/88 primary knee non-responders (p = 0.227, chi-squared test). Patient sex similarly did not affect contact preferences for post (p = 0.174, chi-squared test). Patients who preferred to be contacted by post, as

opposed to online or by telephone, were significantly older than those who would prefer online or telephone contact (mean difference 8.7 years (95% CI 5.2 to 12.1; p < 0.001, unpaired t-test)).

ROC analysis demonstrated an AUC of 0.723 (95% CI 0.647 to 0.799; p < 0.001) for predicting contact preferences by age: using a cut point of > 66.4 years predicted a preference for contact by post with 65.4% sensitivity and 68.1% specificity (Figure 6).

Discussion

When administering postoperative PROMs by post to hip and knee arthroplasty patients, the current study found an initial 72% response rate for hip patients and 78% response rate for knee patients. Excluding patients who had not undergone their intended surgery gave a one year PROMs follow-up rate of 78% for hips and 85% for knees. Telephoning patients who had not responded primarily to postal PROMs questionnaires reduced the rate of true loss to PROMs follow-up from 14.6% to 2.3% among knee patients and from 21.2% to 9.6% among hip patients. Primary non-responders were younger with worse preoperative joint specific and general health scores. Age was significantly associated with both primary and persistent non-responders among hip patients. Within this patient group, many were still working, and

this appeared to affect the ability to contact them by telephone. Age was also a factor in primary non-response among knee patients, who were, on average, five years older than hip non-responders and were found to be more contactable. An age threshold of < 67 years was predictive of a desire to receive PROMs by other means (typically digitally by email or phone). When primary non-responders were contacted, rates of satisfaction with their arthroplasty were no different than satisfaction rates among primary responders.

Many successful PROMs databases have high data capture rates and can be considered representative of the population that they sample. In a database with a high data capture rate, the current study demonstrated that primary non-responders were younger, had higher mean preoperative BMI, and reported worse preoperative joint specific and general health scores. Failure to respond to preoperative arthroplasty PROMs has previously been associated with younger age from the Californian Joint Arthroplasty Registry.[9] Non-response to postoperative PROMS was associated with patients discharged to a location other than their home, those who experienced a complication, and those who had failed to complete the PROMs at the previous timepoint.[9] Absolute response rates in their study were, however, very low, with only 30% of patients completing preoperative PROMs and 18% completing PROMs at one year. Where data capture rates are low, it is more important that non-responders be examined as the sample collected is less likely to be representative. With such poor response rates, these associations may not apply to other populations with better data capture. In a study of > 4,000 patient episodes of hand surgery, Stirling et al[10] again identified younger age as being significantly associated with non-response to postoperative PROMS. They also identified worse preoperative PROMs, deprivation, unemployment, and higher comorbidities as risk factors for non-response, but did not attempt to contact the patients to measure outcome.

It is important that we understand the implications and rates of missing data, as well as identifying targets to improve data collection. The response rates reported in registry-based studies are often poor and are typically lower than the 60% recommended by ISAR.[3] Response rates vary by registry and by the condition reported. Analysis of a national hip fracture database demonstrated missing data in up to 78% of cases for individual variables.[11] A review of arthroscopic registries demonstrated a mean PROMs response rate of 56% at 0.5 years and 44% to 59% at one year.[12] Considering arthroplasty specifically, Lindgren et al[13] reported a 51% (47,201/92,602) postoperative PROMs response rate from the Swedish Hip Arthroplasty Register. Reports from the national PROMs programme in England and Wales demonstrate that 72% of hips (209,761/289,808) and 71% of knees (222,933/312,479) who completed preoperative PROMs

also completed postoperative PROMs.[14] However, as the original denominator (the total number of patients undergoing arthroplasty) is not reported, the ultimate response rate as a percentage of the total number of patients undergoing hip or knee arthroplasty remains unclear.

An assumption made when PROMs were first introduced was that non-responders are dissatisfied.[15] It is generally accepted that hip arthroplasty patients are overall more satisfied following THA (91% to 93%)[16,17] than knee arthroplasty patients undergoing TKA (81% to 88%).[18;19] The current study demonstrates that of primary non-responders to hip PROMS who were subsequently contacted 74/81 (91.4%) were satisfied with the outcome of their arthroplasty compared to 476/516 (92.2%) of initial responders. For knees, 81/93 (87.1%) of initial non-responders who were contacted were satisfied with their KA, compared to 470/561 (83.8%) of initial responders.

Patient preferences for electronic or pen-and-paper PROMs was examined by Keurentjes et al[20] in a cohort of 565 THA patients and 387 TKA patients reporting that the majority (82% of THA patients and 87% of knees) preferred pen-and-paper questionnaires. Similar to the current study, younger age was associated with a preference for electronic questionnaires in addition to higher completed level of schooling. However, preferences were determined at one year follow-up only and thus results were biased to responders. Non-responders were not reported.

In contrast to paper PROMs, electronic PROMs often offer automatic reminders to non-responders and require responses to all items before continuing to the next item thus potentially reducing missing or incomplete data.[21] Though in general patients are becoming more familiar with digital platforms, digital methods are not universally accessible or acceptable to all patients, a fact echoed by the current study, in which older patients preferred paper PROMS. The ISAR PROMs working group currently recommend that, where possible, both paper- and electronic-based methods be available as not all patients want to be contacted in the same way for PROMs completion. The current study demonstrated a threshold of < 67 years of age was found to be predictive of both primary non-response to postal questionnaire and a desire to receive PROMs by other means (typically, digitally by email or phone).

A higher likelihood of responding to automated electronic PROMs follow-up after hip and knee surgery has been associated with better mental health and higher levels of education.[22] However, failure to respond to automated electronic PROMs was again associated with younger age following knee surgery.[22] Though younger patients may prefer to receive PROMs by electronic means, they do not necessarily complete them.

Almost half of patients who did not initially respond (125/259; 48%) stated that they had not received the questionnaire, and a further 17 stated that they had sent it back, but it had not been received. These logistical issues could potentially be reduced with electronic administration. Telephone follow-up of non-responders has been demonstrated to boost PROMs completion rates, in addition to other incentives, such as monetary compensation, shorter and personalized questionnaires, and the use of recorded delivery mail or prepaid envelopes.[23] Tariq et al[24] reported that following knee surgery, a personalized surgeon letter sent to non-responders to PROMs was an efficient and relatively cost-effective method to increase PROMs follow-up rate. In the current study, telephone follow-up of primary non-responders reduced non-response by more than half for hips and by more than 80% for knees. However, our ability to successfully contact patients by phone was associated with employment status and age: younger patients who were working were more difficult to contact than older patients who were not working. Knee arthroplasty primary non-responders were, on average, five years older than hip non-responders and were overall more contactable than hips.

Limitations of this study include that it is single-centre. However, the study centre is typical of arthroplasty centres throughout the UK in terms of operative numbers and follow-up. All PROMs were administered by postal questionnaire, whereas many centres may now use electronic platforms. Not all patients answered the employment section of the questionnaire. The costs of contacting patients by post, and the additional cost of chasing non-responders, was not calculated. Both primary and revision surgeries were included. When contactable, patient feedback was obtained by a telephone call from medical practitioners affiliated with the operating centre, and this may have influenced patients who may not have felt able to disclose their true feelings. Other limitations include a persistent loss to follow-up rate, variation in the number of attempts to contact each patient or their GP, and potential uncertainty regarding whether postal questionnaires were successfully delivered, received, or returned, as this delivery process was not recorded or monitored.

In conclusion, loss to one-year PROMs follow-up after THA and KA was associated with younger age and worse preoperative joint specific and general health PROMs. Younger age may introduce unique barriers to responding to PROMs questionnaires, such as a predilection for electronic feedback and greater employment commitments. Offering the option of electronic reporting of PROMs may increase response rates, especially among younger patients. The current study demonstrated that the majority of initial non-responders were contactable when efforts were made by telephone, and in doing so found that there was no significant difference in patient satisfaction after hip and knee arthroplasty between responders and initial non-responders: non-response did not indicate poor outcome.

Take home message
- Initial non-response rates to postal questionnaires were improved considerably when attempts were made to contact patients by phone.
- When contactable, rates of satisfaction after hip or knee arthroplasty did not differ between those who had initially replied to patient-reported outcome measures (PROMs) questionnaires and those who failed to respond.
- Non-responders were younger with worse preoperative PROMs compared to responders for both hip and knee patients. Employment also played a role in bioth response and contactability for hip patients.
- Patients aged 67 years and older demonstrated a preference for PROMs by postal questionnaire whereas younger patients would prefer to complete PROMs electronically. Offering a choice may improve response rates and thus representation.

Twitter
Follow L. A. Ross @Laurenaliceross
Follow C. E. H. Scott @EdinburghKnee
Follow Edinburgh Orthopaedics @EdinOrthopaedic

References
1. **Harris IA**, **Harris AM**, **Naylor JM**, **Adie S**, **Mittal R**, **Dao AT**. Discordance between patient and surgeon satisfaction after total joint arthroplasty. *J Arthroplasty*. 2013;28(5):722–727.
2. **Hamilton DF**, **Giesinger JM**, **Giesinger K**. It is merely subjective opinion that patient-reported outcome measures are not objective tools. *Bone Joint Res*. 2017;6(12):665–666.
3. **Rolfson O**, **Bohm E**, **Franklin P**, **et al**. Patient-reported outcome measures in arthroplasty registries report of the Patient-Reported Outcome Measures Working Group of the International Society of Arthroplasty Registries Part II. Recommendations for selection, administration, and analysis. *Acta Orthop*. 2016;87 Suppl 1(Suppl 1):9–23.
4. **Ramkumar PN**, **Harris JD**, **Noble PC**. Patient-reported outcome measures after total knee arthroplasty: a systematic review. *Bone Joint Res*. 2015;4(7):120–127.
5. **Chung KC**. Survey response rate, a guide for readers and authors. *J Hand Surg Am*. 2014;39(3):421–422.
6. **Bohm ER**, **Kirby S**, **Trepman E**, **et al**. Collection and reporting of patient-reported outcome measures in arthroplasty registries: multinational survey and recommendations. *Clin Orthop Relat Res*. 2021;479(10):2151–2166.
7. **No authors listed**. Scottish Index of Multiple Deprivation 2020. https://www.gov.scot/collections/scottish-index-of-multiple-deprivation-2020/ (date last accessed 23 March 2022).
8. **Mandrekar JN**. Receiver operating characteristic curve in diagnostic test assessment. *J Thorac Oncol*. 2010;5(9):1315–1316.
9. **Patel J**, **Lee JH**, **Li Z**, **SooHoo NF**, **Bozic K**, **Huddleston JI**. Predictors of low patient-reported outcomes response rates in the California Joint Replacement Registry. *J Arthroplasty*. 2015;30(12):2071–2075.
10. **Stirling PHC**, **Jenkins PJ**, **Ng N**, **Clement ND**, **Duckworth AD**, **McEachan JE**. Nonresponder bias in hand surgery: analysis of 1945 cases lost to follow-up over a 6-year period. *J Hand Surg Eur Vol*. 2022;47(2):197–205.
11. **Basques BA**, **McLynn RP**, **Lukasiewicz AM**, **Samuel AM**, **Bohl DD**, **Grauer JN**. Missing data may lead to changes in hip fracture database studies. *Bone Joint J*. 2018;100-B(2):226–232.
12. **Ueland TE**, **Carreira DS**, **Martin RRL**. Substantial loss to follow-up and missing data in national arthroscopy registries: a systematic review. *Arthroscopy*. 2021;37(2):761–770.
13. **Lindgren JV**, **Wretenberg P**, **Kärrholm J**, **Garellick G**, **Rolfson O**. Patient-reported outcome is influenced by surgical approach in total hip replacement. *Bone Joint J*. 2014;96-B(5):590–596.
14. **Price AJ**, **Kang S**, **Cook JA**, **et al**. The use of patient-reported outcome measures to guide referral for hip and knee arthroplasty. *Bone Joint J*. 2020;102-B(7):941–949.
15. **Murray DW**, **Britton AR**, **Bulstrode CJ**. Loss to follow-up matters. *J Bone Joint Surg Br*. 1997;79-B(2):254–257.

16. **Scott CEH**, **Bugler KE**, **Clement ND**, **MacDonald D**, **Howie CR**, **Biant LC**. Patient expectations of arthroplasty of the hip and knee. *J Bone Joint Surg Br.* 2012;94-B(7):974–981.

17. **Anakwe RE**, **Jenkins PJ**, **Moran M**. Predicting dissatisfaction after total hip arthroplasty: a study of 850 patients. *J Arthroplasty.* 2011;26(2):209–213.

18. **Scott CEH**, **Howie CR**, **MacDonald D**, **Biant LC**. Predicting dissatisfaction following total knee replacement: a prospective study of 1217 patients. *J Bone Joint Surg Br.* 2010;92-B(9):1253–1258.

19. **Scott CEH**, **Holland G**, **Krahelski O**, **Murray IR**, **Keating JF**, **Keenan OJF**. Patterns of cartilage loss and anterior cruciate ligament status in end-stage osteoarthritis of the knee. *Bone Joint J.* 2020;102-B(6):716–726.

20. **Keurentjes JC**, **Fiocco M**, **So-Osman C**, **et al**. Hip and knee replacement patients prefer pen-and-paper questionnaires: Implications for future patient-reported outcome measure studies. *Bone Joint Res.* 2013;2(11):238–244.

21. **Rolfson O**, **Bohm E**, **Franklin P**, **et al**. Patient-reported outcome measures in arthroplasty registries. *Acta Orthop.* 2016;87(sup1):9–23.

22. **OME Cleveland Clinic Orthopaedics**. Value in research: achieving validated outcome measurements while mitigating follow-up cost. *J Bone Joint Surg Am.* 2020;102-A(5):419–427.

23. **Edwards P**, **Roberts I**, **Clarke M**, **et al**. Increasing response rates to postal questionnaires: systematic review. *BMJ.* 2002;324(7347):1183.

24. **Tariq MB**, **Jones MH**, **Strnad G**, **Sosic E**, **Health C**, **Spindler KP**. A last-ditch effort and personalized surgeon letter improves PROMs follow-up rate in sports medicine patients: a crossover randomized controlled trial. *J Knee Surg.* 2021;34(2):130–136.

Author information:
- L. A. Ross, MRCSEd, Specialty Registrar
- S. C. O'Rourke, MRCSEd, Major Trauma Fellow
- G. Toland, MRCSEd, Specialty Registrar
- N. D. Clement, MD, PhD, FRCSEd(Tr&Orth), Consultant Orthopaedic Surgeon Edinburgh Orthopaedics, Royal Infirmary of Edinburgh, Edinburgh, UK.
- D. J. MacDonald, BA (Hons), MCQI CQP, Clinical Research Manager, Department of Orthopaedics, University of Edinburgh, Edinburgh, UK.
- C. E. H. Scott, MD, MSc, BSc, FRCSEd(Tr&Orth), MFSTEd, Consultant Orthopaedic Surgeon, NRS Clinician, Edinburgh Orthopaedics, Royal Infirmary of Edinburgh, Edinburgh, UK; Department of Orthopaedics, University of Edinburgh, Edinburgh, UK.