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Variation in patient requirement for post-discharge physical therapy following total hip and knee arthroplasty

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ABSTRACT

Objectives: To determine the proportion of patients that partake in post-discharge physiotherapy following hip and knee arthroplasty, assess the influence on post-operative outcomes, and model which patient would benefit from post-operative physio therapy from pre-operative data.

Design: Prospective cohort study

Setting: Single NHS orthopaedic teaching hospital

Participants: 1395 THAs and 1374 TKAs over a 2.5 year period.

Outcome measures: Access of post-discharge physiotherapy was reported at 6-months post-op. The Oxford Hip or Knee Score and EQ5D questionnaire and post-operative satisfaction metric.

Results: 662 (48.2%) TKA and 493 (35.3%) THA patients accessed post-discharge physiotherapy. THAs accessing physiotherapy were younger (64.9 vs 69.1y, p<0.001) and more likely to be female (p<0.001). PROs (p<0.001) and satisfaction (p=0.001) were superior in THAs not accessing physiotherapy. TKAs accessing physiotherapy were younger (68.2 vs 71.0y, p<0.001) and more likely to live in a less deprived area (p=0.028). PROs (p<0.001) and satisfaction (p<0.001) were superior in TKA patients not accessing physiotherapy. Regression models using PRO and demographic data predicted post-discharge therapy access with an accuracy of only 17% greater than chance in THAs and 7% in TKAs.

Conclusions: Only a third of THA and half of TKA patients accessed post-discharge physiotherapy. The patients that did not access physiotherapy reported superior outcome scores and satisfaction, suggesting variation in need for post-arthroplasty physiotherapy, however it was not possible to reliably predict which patients would seek access to additional therapy from pre-operative symptom data.

Keywords: Total knee Arthroplasty, Total Hip Arthroplasty, Physiotherapy, Treatment satisfaction

ARTICLE SUMMARY

STRENGTHS AND LIMITATIONS

- This is a relatively large patient cohort of 2769 total hip and knee replacements performed over a 2 year period at a single orthopaedic unit evaluating a consistent specific delivery model of post-discharge rehabilitation provision.
- A particular strength of this study design is the depth of linked demographic and outcomes data available with which to construct the predictive models.
- Data relating to access of post-surgical physiotherapy was reported by the patient at 6 months post-operation.
- We are not able to determine the referral route by which the patient accessed post-discharge therapy, nor what specific therapy was received.

INTRODUCTION

Lower limb osteoarthritis is an extremely common and disabling condition, which may ultimately require surgical intervention. In excess of 90,000 total hip and 90,000 total knee arthroplasties are performed each year in the UK alone [1]. Projections suggest continued increases of surgical volume year on year [2, 3]. Though joint replacement is effective at reducing pain and improving physical function in patients with end stage osteoarthritis, a sub-group of patients continue to report dissatisfaction with their post-operative outcome [4, 5] highlighted by protracted physical impairment [6] and activity limitations [7-10].

Physical therapy is thought to be an important component in achieving optimal results following lower limb arthroplasty [11]. Immediately post-surgery, throughout the inpatient stay, physiotherapy is aimed at encouraging mobilisation and facilitating a safe discharge. Though subsequent post- discharge physiotherapy is often promoted there is considerable national and international variation in actual therapy provision. Specific rehabilitation protocols are strongly entrenched at individual units however the wider efficacy of post-operative physiotherapeutic intervention is poorly established [12-18]. This uncertainty as to effectiveness makes it difficult for commissioning organisations, healthcare providers, and patients to make decisions as to the role of post-discharge physiotherapy following total joint arthroplasty.

The purpose of this study was to assess what proportion of patients access post-discharge physiotherapy following total hip and knee arthroplasty, whether therapy impacts upon post-operative patient reported outcomes and whether it is possible to predict which patients go on to seek additional post-discharge physiotherapy.

METHODS

Study design and participants

This was a prospective observational cohort study. Data collection was through questionnaires administered pre-operatively at hospital clinic appointment and then via postal review at 6 post-operatively. Ethical approval was obtained from the institutional review board (11/AL/0079).

Patients undergoing unilateral total hip or knee arthroplasty (THA or TKA) at a single NHS teaching hospital were prospectively assessed over a 32 month period between January 2013 and September 2015.

The study centre is the only hospital receiving adult referrals for a predominantly urban regional population of approximately 850 000 people. Surgery was carried out by multiple consultant orthopaedic surgeons and their supervised trainees. Routine local protocols are followed for all aspects of inpatient post-operative care. Immediate post-operative therapy is also protocol driven focussing on knee range of movement, muscle re-education and mobilising with appropriate walking aids.

Post-discharge practice at the study centre is to provide outpatient physiotherapy as required. As such, patients are referred to out-patient physiotherapy based on clinically assessed need at time of discharge or at 6 week post-operative clinical review, with additional referral routes available to the patient through general practice services and a national patient self-referral telephone triage system.

Outcome measures

Demographic data was obtained for patient health status and socioeconomic denominators. Physical outcomes were assessed with the Oxford Hip or Knee Score and EQ5D questionnaire.

The Oxford Hip and Knee Scores (OHS and OKS) each consist of 12 questions assessing the patient's pain and function [19, 20]. Each item is answered on a 5-point response scale ranging from 0 to 4, generating a summed total score ranging from 0 to 48, where 0 indicates the worst possible outcome and 48 good joint function.

The EQ-5D is a standardised instrument with five items for use as a measure of self-reported general health [21]. Applicable to a wide range of health conditions and treatments, it provides a simple descriptive profile and a single index value for health status.

Patient satisfaction was assessed using a 5 point Likert response format at 6 months post-surgery. Self-report of physiotherapy attendance was recorded a 6 month assessment. Data was collected independently from the clinical teams.

Statistical analysis

Demographic indicators are given as frequencies or means with standard deviations as a measure of dispersal. Differences between patients who accessed physiotherapy after total joint surgery and those who did not were investigated with t-tests, chi-square tests and Mann-Whitney-U tests as appropriate. Effect sizes for differences in metric variables are given as Cohen's d.

To identify predictors of physiotherapy access we used a binary logistic regression model with physiotherapy access as dependent variable and patient characteristics and preoperative OKS/OHS and EQ-5D as predictors. The predictors were included using a forward selection stepwise model building technique (likelihood ratio) with an entry criterion of alpha=0.05. Model fit is described with percentage of correct classifications and predictors are given as odds ratios with corresponding 95% confidence intervals. Using this methodology the chance level of correct classifications is 50% and the model-based classification is compared against this value. Analyses were performed with BMI SPSS version 21.0.

RESULTS

Data from 1395 THA patients (58.1% female, mean age 67.6 ± 11.8 years) and 1374 TKA patients (56.6% female, mean age 69.7 ± 9.3 years) was available for analysis. Of this total surgical cohort, 662 (48.2%) knee arthroplasty and 493 (35.3%) hip arthroplasty patients accessed post-operative out-patient physiotherapy.

Total Hip Arthroplasty

THA patients accessing physiotherapy were younger (64.9 vs 69.1 years, $p<0.001$) and more likely to be female ($p<0.001$), however there were no differences in BMI ($p=0.788$) or social deprivation index ($p=0.438$) between the groups (Table 1).

Patient outcomes scores at 6 months were superior in the 64.7% of THA patients that did not access post-operative physiotherapy in terms of absolute OHS (35.8 vs 39.4 points, p<0.001). Baseline scores were subtly, but statistically, worse in the group that accessed post-operative therapy (20.1 points vs 21.4 points, p=0.008), however the patients that did not access physiotherapy made a larger gain in pain and function scores (pre-to post-op change in OHS 15.6 points vs 18.0 points, p<0.001, Cohen's d=0.23) (Table 1 and Figure 1).

EQ5D scores pre and post-surgery were lower in patients referring for physiotherapy both pre-surgery (0.35 vs 0.41, p=0.004,) and post-surgery (0.70 vs 0.80, p<0.001). Cohen's d for pre-postoperative improvement was 0.12 with mean changes in EQ5D score of 0.35 in those that accessed physiotherapy compared to 0.39 in those that did not (p=0.023) (Table 1 and Figure 2).

The patients that did not access post-operative physiotherapy were more satisfied at 6 months (p<0.001, Z=-6.43), with approximately twice the number of patients dissatisfied and very dissatisfied in the group that accessed physiotherapy (Table 1).

Total Knee Arthroplasty

TKA patients accessing physiotherapy were modestly but significantly younger (68.2 vs 71.0 years, p<0.001). There was no difference in gender (p=0.099). Those that accessed physiotherapy were more likely to live in a less deprived area (p=0.028); there was no difference in BMI between groups (p=0.198) (Table 2).

Patient outcomes were superior in the 51.8% of TKA patients that did not access post-operative physiotherapy in terms of absolute OKS (35.9 vs 32.3 points, p<0.001). There was no difference in pre-operative score between groups (20.9 points respectively, p = 0.965), reflected in a lesser change in OKS for the group that accessed physiotherapy post-operatively (11.4 points vs 15.0 points, p<0.001, Cohen's d=0.39) (Table 2 and Figure 3).

There were also differences in improvement measured with the EQ-5D (Table 2). Patients accessing physiotherapy improved 0.25 points, compared to 0.35 points in those who did not (p<0.001, Cohen's d=0.32, Figure 4). Again there was no difference in pre-operative scores between groups (0.43 vs 0.41, p = 0.183), while postoperative scores differed significantly (0.68 vs 0.77, p<0.001).

The patients that did not access post-operative physiotherapy were more satisfied (p<0.001, Z=-8.22), with approximately twice the number of patients dissatisfied and very dissatisfied in the group that accessed physiotherapy (Table 2).

Multivariate analysis

Binary logistic regression modelling was undertaken to determine if post-operative access to physiotherapy could be predicted by pre-operative patient variables. A regression model with three predictors (age, sex and pre-operative EQ-5D score) was able to correctly classify 66.9% of THA patients with regard to post-operative physiotherapy access (Table 3). This percentage of correct classifications was significantly (p<0.001) different from chance level (50% correct classifications). In TKA patients the regression model comprised only two significant predictors (age and sex) and provided a percentage of correct classifications of 57.4%, again significantly better than chance (p<0.001).

DISCUSSION

Only a third of patients that underwent total hip arthroplasty and half of those who underwent total knee arthroplasty accessed post-discharge outpatient physiotherapy to assist with their recovery. The patients that did not access post-discharge physiotherapy do not seem to have been adversely affected by this decision as this group reported superior outcome scores. Functional outcome and satisfaction scores at 6 months in patients that did not access additional physiotherapy compare well to national outcome figures for both hip and knee arthroplasty [22], suggesting that post-discharge outpatient therapy is not necessarily required in all cases. Indeed it would appear that referral for post-discharge therapy may be a marker of patients at risk of poor outcomes.

There is no consensus as to how best to rehabilitate patients following lower limb joint arthroplasty. Systematic reviews of post-operative rehabilitation interventions suggest that no one approach is beneficial in improving outcomes [8, 16-18] and a recent Cochrane review stressed the general low quality of the evidence base [23].

In this study, routine post-discharge out-patient physiotherapy was not provided following total hip and knee replacement. Instead the local standard of care was for patients to undertake prescribed home exercises, with all patients able to access additional out-patient physiotherapy services should they require or wish to. Under this system, patients are referred to physiotherapy based on clinical need. This 'need' for therapy was determined by clinical staff at time of discharge (either doctor or physiotherapist), or at 6 week out-patient review (consultant team or allied health professional arthroplasty practitioner), or at any point through the patient's GP service. Separately the patient could refer themselves via a self-referral telephone triage system or access private therapy out with the NHS.

We cannot, evaluate the effectiveness of post-discharge physiotherapy with this data. Those who accessed additional therapy in this cohort reported lower scores, suggesting greater physical dysfunction in the early post-operative phase. It may be that the additional therapy improved the patient outcomes compared to having had no such intervention. Patients and clinicians expect a rehabilitation component to be provided as part of the care pathway for joint arthroplasty. Though there is a role for physiotherapy, it may be that differing levels of therapy provision should be targeted to those that require additional input as opposed to blanket provision for all in the early post-operative phase. Self-directed home exercises were sufficient for the majority of patients in this study. From a health economic and service delivery perspective this is clearly attractive, however relies on accurately targeting therapy provision to those that require the additional input.

We were able to construct statistically significant regression models using pre-operative data to correctly classify the patients that accessed post-operative therapy, however these models were poor in terms of accuracy. The hip replacement model was only 17% greater than chance at identifying the patients that accessed physiotherapy. The THA patients who accessed physiotherapy post-op reported lower general health scores (EQ5D) but broadly equivalent joint specific health scores (OHS). This drove the regression model and perhaps suggests frailty may be related to the requirement for additional therapy, however it must be noted that these patients were on average 5 years younger than the larger group that did not attend additional physiotherapy. Interestingly pre-operative pain levels, BMI and deprivation status did not influence the models.

Notably more knee arthroplasty patients required or wished to access additional physiotherapy than hip arthroplasty, which is perhaps consistent with the reports of greater treatment success and

patient outcomes following hip arthroplasty [5, 24]. Despite applying a range of pre-operative demographic and symptom state indicators, we were only able to model the additional use of post-discharge physiotherapy to an accuracy of 7% greater than chance. Interestingly in the TKA cohort, the model relied solely on small associations with age and sex. In this model, pre-operative pain / function / health scores, social deprivation and BMI did not help determine which patient would go on to require additional therapy.

Though various factors have been associated with poor clinical outcomes following TKA, currently, we cannot reliably predict pre-operatively who will struggle to recover post-operatively. Larger and more comprehensive predictor studies (for example incorporating psychological variables) are required to determine which patient factors lead to poorer post-operative outcomes and to see if particular patient groups benefit from post-discharge physiotherapy. Further insight may be provided by the multicentre TRIO study which is currently evaluating this [25].

Strengths and Limitations

Strengths of this study are the relatively large consecutive patient cohort of approximately 1400 THA and 1400 TKA operations performed over a 2.5 year period at a single orthopaedic unit, and the depth of linked demographic and outcomes data available. Our data is in line with UK national figures for patient demographics and pre and post-operative outcome scores. Limitations are that the access to physiotherapy was documented and reported by the patient at 6 months and we are not able to determine the route by which the patient accessed post-discharge therapy, nor what specific therapy was received. The relatively short post-operative 6 month timeframe results that we cannot comment on longitudinal changes in outcomes, nor whether those patients that access physiotherapy 'caught-up' with those that did not in terms of clinical outcome scores at subsequent later time points.

CONCLUSION

In a large single centre study, only a third of hip arthroplasty and half of knee arthroplasty patients accessed post-discharge physiotherapy. Those who did not access additional therapy reported greater post-operative outcome scores and satisfaction, suggesting variation in requirement for post-arthroplasty physiotherapy. We were unable to predict pre-operatively (with demographics and symptom report) which patients would subsequently access additional input. Future work should explore additional factors with a view to targeting additional treatment to improve outcomes.

CONTRIBUTORS

DFH, conceived the study, interpreted the results, drafted and revised the manuscript. FCL performed the statistical analysis, drafted the results and contributed to manuscript revisions. DJM obtained the data, collated the data and contributed to manuscript drafting and revision. GMF contributed to results interpretation, manuscript drafting and revision. DJB contributed to results interpretation, manuscript drafting and revision. HRS contributed to results interpretation, manuscript drafting and revision. JTP contributed to the study design, results interpretation, manuscript drafting and revision. CRH contributed to the study design, results interpretation, manuscript drafting and revision.

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CONFLICT OF INTEREST STATEMENT

DFH, DJB, GMF and HRS, are grant holders on the Arthritis Research UK funded TRIO study. Though there is no financial or direct academic conflict, this work can be considered as relevant background for the (currently) ongoing TRIO study.

ETHICAL APPROVAL

Ethical approval was obtained from the Scotland A Research Ethics Committee (11/AL/0079).

DATA SHARING STATEMENT

The raw data cannot be made publically available to protect patient confidentiality, however restricted data may be made available if deemed reasonable by the data custodian. Such requests should be made to CRH via the corresponding author.

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TABLES

Table 1 Descriptive and outcome data for THA by post-operative physiotherapy access

Referred for physiotherapy	Yes	No	Effect size		p
Sex					
female N (%)	324 (65.7)	486 (53.9)		X^2 = 18.352	p<0.001‡
male N (%)	169 (34.3)	416 (46.1)			
Side					
left, N (%)	212 (43.5)	422 (47.6)		X^2 = 2.123	p=0.157‡
right N (%)	275 (56.5)	464 (52.4)			
SIMD					
1st quintile N (%)	37 (7.5)	76 (8.4)		Z = -0.78	p=0.438*
2nd quintile N (%)	78 (15.8)	160 (17.7)			
3rd quintile N (%)	85 (17.2)	166 (18.4)			
4th quintile N (%)	129 (26.2)	193 (21.4)			
5th quintile N (%)	164 (33.3)	307 (34.0)			
Age Mean (SD)	64.9 (13.2)	69.1 (10.6)	0.35±	T = -6.08	p<0.001†
BMI Mean (SD)	28.3 (6.9)	28.2 (5.0)	0.02±	T = 0.27	p=0.788†
OKS					
Pre-op	20.1 (8.6)	21.4 (8.6)	1.31±	T = -2.67	p=0.008†
Post-op	35.8 (9.8)	39.4 (8.6)	0.39±	T = -6.96	p<0.001†
Improvement	15.6 (10.6)	18.0 (9.9)	0.23±	T = -4.06	p<0.001†
EQ5D					
Pre-op	0.35 (0.3)	0.41 (0.3)	0.20±	T = -2.92	p=0.004†
Post-op	0.70 (0.3)	0.80 (0.2)	0.39±	T = -6.52	p<0.001†
Improvement	0.35 (0.4)	0.39 (0.3)	0.12±	T = -2.28	p=0.023†
Satisfaction					
Very satisfied	280 (57.4)	648 (73.3)		Z = -6.43	p<0.001*
Satisfied	122 (25.0)	165 (18.7)			
Neither satisfied nor dissat	44 (9.0)	43 (4.9)			
Dissatisfied	27 (5.5)	13 (1.5)			
Very dissatisfied	15 (3.1)	15 (1.7)			

Mann-Whitney-U*, t-test†, Chi-square‡, Cohen's d±

Table 2 Descriptive and outcomes data for TKA by postoperative physiotherapy access

Referred for physiotherapy	Yes	No	Effect size		P
Sex					
female N (%)	390 (58.9)	388 (54.5)		X^2 = 2.726	p=0.099‡
male N (%)	272 (41.1)	324 (45.5)			
Side					
left N (%)	321 (49.5)	337 (47.7)		X^2 = 0.404	p=0.525‡
right N (%)	328 (50.5)	369 (52.3)			
SIMD					
1st quintile N (%)	63 (9.5)	66 (9.3)		Z = -2.19	p=0.028*
2nd quintile N (%)	104 (15.7)	162 (22.8)			
3rd quintile N (%)	122 (18.4)	136 (19.1)			
4th quintile N (%)	164 (24.8)	138 (19.4)			
5th quintile N (%)	209 (31.6)	210 (29.5)			
Age Mean (SD)	68.2 (9.7)	71.0 (8.6)	0.30±	T = -5.73	p<0.001†
BMI Mean (SD)	31.1 (6.0)	30.6 (5.9)	0.01±	T = 1.29	p=0.198†
OKS					
Pre-op	20.9 (7.8)	20.9 (7.9)	<0.01±	T = -0.04	p=0.965†
Post-op	32.3 (9.8)	35.9 (9.1)	0.38±	T = -6.99	p<0.001†
Improvement	11.4 (9.4)	15.0 (8.9)	0.39±	T = -7.16	p<0.001†
EQ5D					
Pre-op	0.43 (0.3)	0.41 (0.3)	0.07±	T = 1.33	p=0.183†
Post-op	0.68 (0.3)	0.77 (0.2)	0.35±	T = -6.34	p<0.001†
Improvement	0.25 (0.3)	0.35 (0.3)	0.32±	T = -6.15	p<0.001†
Satisfaction, N (%)					
Very satisfied	271 (41.6)	427 (61.3)		Z = -8.22	p<0.001*
Satisfied	214 (32.8)	198 (28.4)			
Neither satisfied nor dissat	98 (15.0)	43 (6.2)			
Dissatisfied	51 (7.8)	20 (2.9)			
Very dissatisfied	18 (2.8)	9 (1.3)			

Mann-Whitney-U*, t-test†, Chi-square‡, Cohen's d±

Table 3 Predictive accuracy of demographic and preoperative outcome-parameters for patients referring for physiotherapy

	THA				TKA			
	OR	95% confidence interval	p	Correct classifications	OR	95% confidence interval	p	Correct classifications
Age	1.03	1.02-1.04	<0.001	66.9 %	1.04	1.02-1.05	<0.001	57.4 %
Sex	1.60	1.27-2.03	<0.001		1.26	1.01-1.58	0.038	
EQ-5D	1.54	1.08-1.20	0.018		-	-	-	-

FIGURES

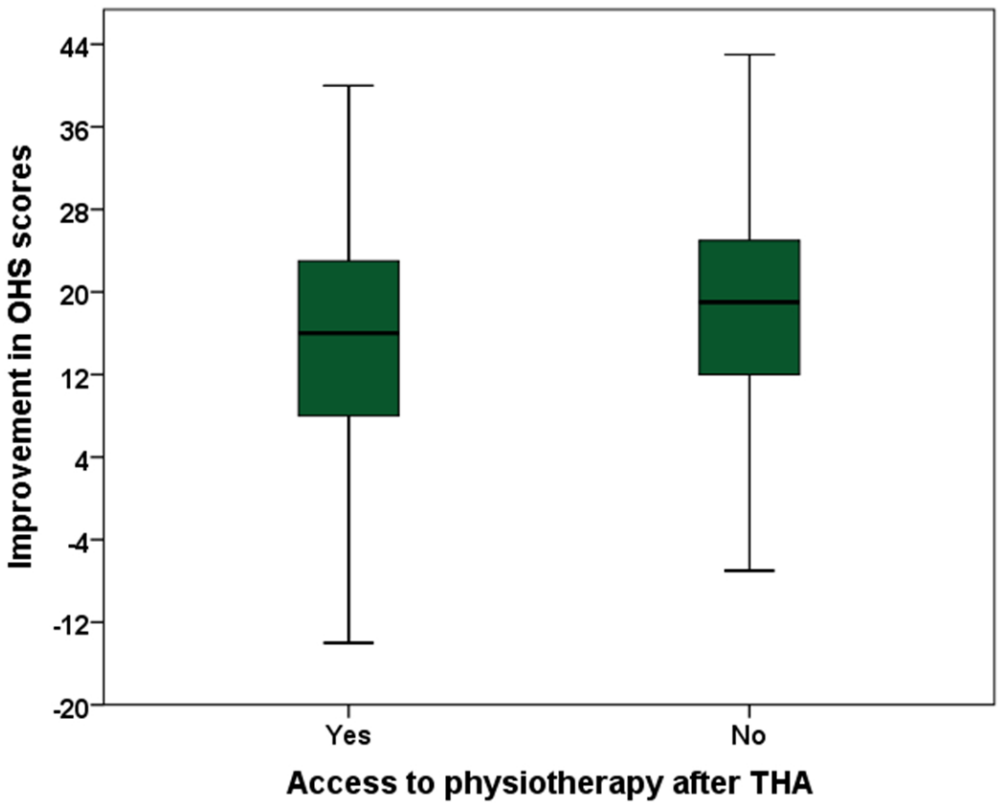

Figure 1 - Change in Oxford Hip Scores by post-operative physiotherapy access in THA patients

276x223mm (96 x 96 DPI)

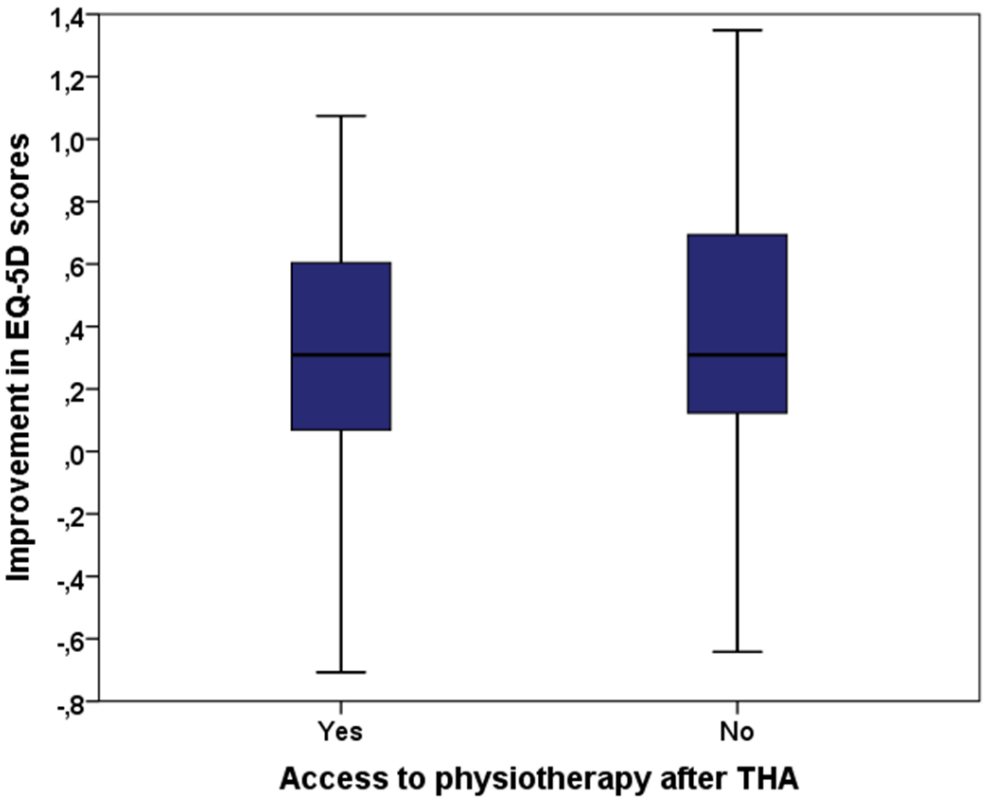

Figure 2 - Change in EQ5D scores by post-operative physiotherapy access in THA patients

279x223mm (96 x 96 DPI)

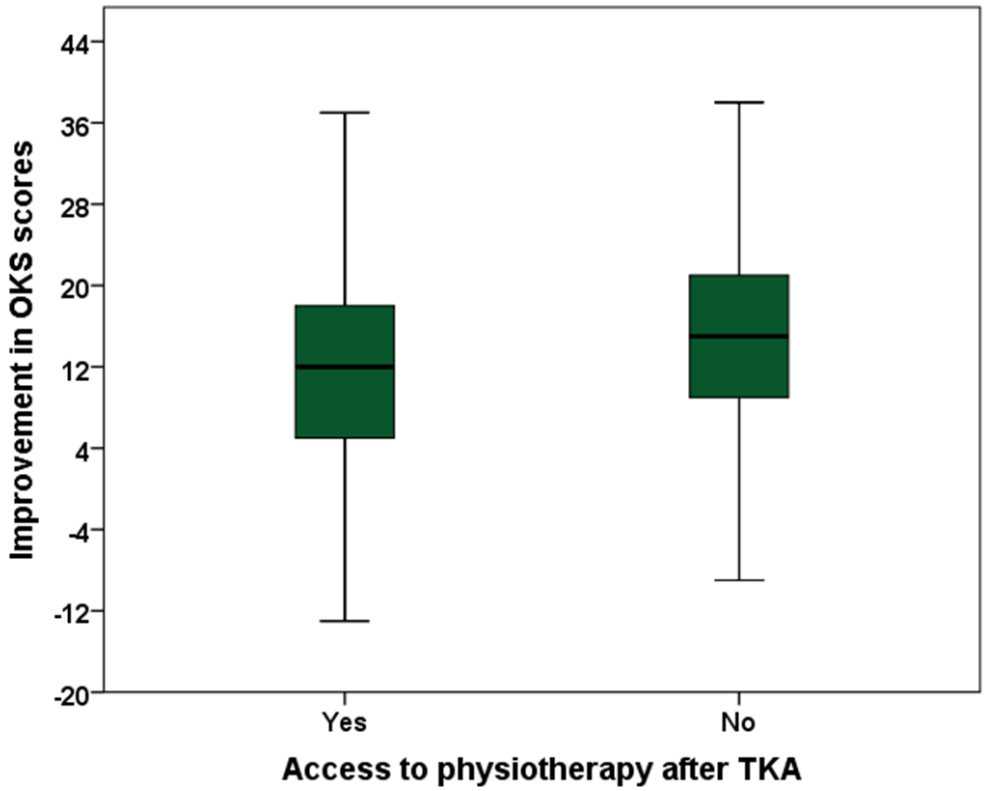

Figure 3 - Change in Oxford Knee Scores by post-operative physiotherapy access in TKA patients

274x220mm (96 x 96 DPI)

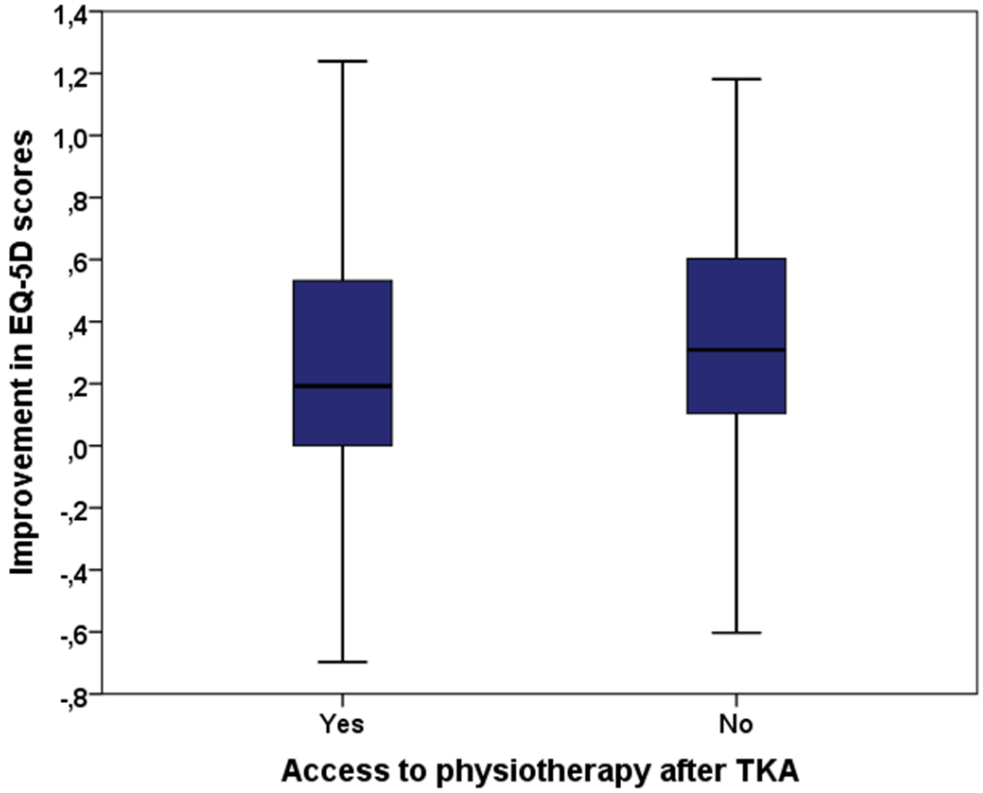

Figure 4 - Change in EQ5D scores by post-operative physiotherapy access in TKA patients

279x223mm (96 x 96 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Exploring variation in patient access of post-discharge physiotherapy following total hip and knee arthroplasty under a choice based system in the UK: an observational cohort study.

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Keywords:	Total knee Arthroplasty, Total Hip Arthroplasty, Physiotherapy

Exploring variation in patient access of post-discharge physiotherapy following total hip and knee arthroplasty under a choice based system in the UK: an observational cohort study.

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ABSTRACT

Objectives: To assess a targeted 'therapy as required' model of post-discharge outpatient physiotherapy provision. Specifically we investigated what proportion of patients accessed post-discharge physiotherapy following THA and TKA, whether accessing therapy was associated with post-arthroplasty patient reported outcomes and whether it was possible to predict which patients' would access post-discharge physiotherapy from pre-operative data.

Design: Prospective cohort study

Setting: Single National Health Service orthopaedic teaching hospital

Participants: 1395 patients undergoing THA and 1374 patients undergoing TKA.

Outcome measures: Self-reported access of post-discharge physiotherapy, the Oxford Hip or Knee Score and EQ5D questionnaire and post-operative satisfaction metric.

Results: 662 (48.2%) TKA and 493 (35.3%) THA patients accessed additional post-discharge physiotherapy. Patient reported outcomes ($p<0.001$) and satisfaction ($p=0.001$) were higher in both THA and TKA patients that did not access the post-discharge physiotherapy. Regression models using pre-operative symptom burden and demographic data predicted post-discharge therapy access with an accuracy of only 17% greater than chance in THA and 7% in TKA.

Conclusions: In a choice based service model of targeted rehabilitation 'as required' following hip and knee arthroplasty only a third of THA and half of TKA patients accessed post-discharge outpatient therapy. The patients that did not access additional outpatient physiotherapy reported higher outcome scores and satisfaction, suggesting variation in the need for post-arthroplasty physiotherapy, and that targeting of rehabilitation may be a cost-effective model, however it was not possible to reliably predict which patients would access post-discharge physiotherapy pre-operatively.

Keywords: Total knee Arthroplasty, Total Hip Arthroplasty, Physiotherapy

ARTICLE SUMMARY

STRENGTHS AND LIMITATIONS

- This is a relatively large patient cohort of 2769 total hip and knee replacements performed over a 2 year period at a single orthopaedic unit evaluating a consistent and specific delivery model of post-discharge rehabilitation provision.
- A particular strength of this study design is the depth of linked demographic and outcomes data available with which to construct the predictive models.
- Data relating to access of post-surgical physiotherapy was reported by the patient at 6 months post-operation.
- We are not able to determine the referral route by which the patient accessed post-discharge therapy, nor what specific therapy was received.

INTRODUCTION

Lower limb osteoarthritis is an extremely common and disabling condition, which may ultimately require surgical intervention. In excess of 90,000 total hip and 90,000 total knee arthroplasties (THA and TKA) are performed each year in the UK alone[1]. Projections suggest continued increases of surgical volume year on year[2 3]. Though joint replacement is effective at reducing pain and improving physical function in patients with end stage osteoarthritis, a sub-group of patients continue to report dissatisfaction with their post-operative outcome[4 5] highlighted by protracted physical impairment [6] and activity limitations[7-10].

Physiotherapy is thought to be an important component in achieving optimal results following THA or TKA[11]. Immediately post-surgery, throughout the inpatient stay, physiotherapy is aimed at encouraging mobilisation and facilitating a safe discharge. Though subsequent post- discharge physiotherapy is often promoted there is considerable national and international variation in actual therapy provision. Specific rehabilitation protocols are strongly entrenched at individual physiotherapy departments however the wider efficacy of post-operative physiotherapeutic intervention is poorly established[12-18]. This uncertainty as to effectiveness of physiotherapy interventions makes it difficult for commissioning organisations, healthcare providers, and patients to make decisions as to the role of post-discharge physiotherapy following total joint arthroplasty, and in determining the correct level and mechanism of funding for such services. As a result there is substantial variety in the delivery and content of post-operative physiotherapy following joint arthroplasty across the UK.

The purpose of this study was to assess a targeted 'therapy as required' model of post-discharge physiotherapy provision. Under this service model, routine post-discharge out-patient physiotherapy is not provided following THA and TKA. Instead the local standard of care is for patients to undertake prescribed home exercises, with all patients able to access additional out-patient physiotherapy services should they require or wish to do so. Specifically, we investigated what proportion of patients accessed post-discharge physiotherapy following THA and TKA, whether accessing therapy was associated with post-arthroplasty patient reported outcomes and whether it was possible to predict which patients would access post-discharge physiotherapy from pre-operative data.

METHODS

Study design and participants

This was a prospective observational cohort study. All patients undergoing primary hip and knee arthroplasty were invited to participate in the study that ran alongside the department's routine outcomes data collection project. Data collection was through questionnaires administered pre-operatively at hospital clinic appointment (2 weeks prior to surgery) and then via postal review at 6 months post-operatively. Patients were sent forms on the 6 month anniversary of the surgical episode, with a further follow-up sent 2 weeks later if no response was received.

Ethical approval was obtained from the Scotland A Research Ethics Committee (11/AL/0079). Informed consent was obtained. Patients undergoing primary unilateral THA or TKA at a single National Health Service teaching hospital were prospectively assessed over a 32 month period between January 2013 and September 2015.

The study centre is the only hospital receiving adult referrals for a predominantly urban regional population of approximately 850 000 people. Surgery was carried out by 12 consultant orthopaedic surgeons and their supervised trainees. Local protocols were followed for all aspects of pre-operative, inpatient, and post-operative care.

Pre-operatively a booklet is provided to patients with information about the procedure (THA or TKA) which includes detail on rehabilitation, advising as to activity and highlighting exercises to perform. Immediate post-operative therapy (inpatient stay) is protocol driven focussing on knee range of movement, muscle re-education and mobilising with appropriate walking aids to facilitate a safe discharge. Post-discharge practice at the study centre is to promote continued performance of the exercises learned and only to provide outpatient physiotherapy as required. As such, patients are referred to out-patient physiotherapy based on clinically assessed need at time of discharge or at 6 week post-operative clinical review, with additional referral routes available to the patient through general practice services and a national patient self-referral telephone triage system.

Demographic data was obtained for the patient's age, sex, BMI, socioeconomic denominators using the Scottish Index of Multiple Deprivation (SIMD). The SIMD is a national statistic based on postcode. It combines data on 38 indicators across 7 domains, namely: income, employment, health, education, skills and training, housing, geographic access and crime. We applied the 2012 SIMD dataset. Physical outcomes were assessed with the Oxford Hip or Knee Score (OHS and OKS) and EuroQol- 5 Dimension (EQ-5D-3L) questionnaire. Both questionnaires have been thoroughly validated and are the national statistics of choice in the UK for measuring arthroplasty outcomes.

Outcome measures

The Oxford Hip and Knee Scores each consist of 12 questions assessing the patient's pain and function[19 20]. Each item is answered on a 5-point response scale ranging from 0 to 4, generating a summed total score ranging from 0 to 48, where 0 indicates the worst possible outcome and 48 good joint function.

The EQ-5D is a standardised instrument with five items covering mobility, self-care, usual activities, pain and discomfort as well as anxiety and depression[21]. As a measure of self-reported general health, it is applicable to a wide range of health conditions and treatments and provides a simple descriptive profile and a single index value for health status. Lower scores represent a worse health sate.

Patient satisfaction was assessed using a 5 point Likert response format at 6 months post-surgery. Patients were asked to rate their overall satisfaction with their operated hip or knee (response options: very satisfied, satisfied, unsure, dissatisfied or very dissatisfied). Self-report of physiotherapy attendance was recorded at 6 month assessment.

Patient and Public Involvement

There was no specific patient involvement in the design or conduct of the study methodology, however the study question as to the role of physiotherapy in the post-operative period following joint arthroplasty was highlighted as a priority area for research by a patient feedback project at the study centre.

Statistical analysis

Analyses were performed with SPSS V21.0[22]. Demographic indicators are presented as frequencies or means with standard deviations as a measure of dispersal. Differences between patients who accessed physiotherapy after total joint arthroplasty and those who did not were investigated with t-tests, chi-square tests and Mann-Whitney-U tests as appropriate. Effect sizes for differences in metric variables are given as Cohen's d.

To identify predictors of physiotherapy access we used a binary logistic regression model with physiotherapy access as dependent variable and patient characteristics and preoperative OKS/OHS and EQ-5D as predictors. The predictors were included using a forward selection stepwise model building technique (likelihood ratio) with an entry criterion of alpha=0.05. Model fit is described with percentage of correct classifications and predictors are given as odds ratios with corresponding 95% confidence intervals. Using this methodology, the chance level of correct classifications is 50% and the model-based classification is compared against this value.

RESULTS

1534 patients underwent primary THA and 1503 primary TKA in the study time window. 97% of cases were coded as being performed for a diagnosis of osteoarthritis. Survey data was available for 1395 (90.9%) THA patients and for 1374 (91.4%) TKA patients. All data was included in the analysis. THA patients had a mean age of 67.6 ± 11.8 years, 58.1% were female, TKA patients had a mean age 69.7 ± 9.3 years, 56.6% were female. Of this total surgical cohort, 493 (35.3%) THA and 662 (48.2%) TKA patients accessed post-operative out-patient physiotherapy.

Total Hip Arthroplasty

THA patients accessing physiotherapy were younger (64.9 vs 69.1 years, p<0.001) and more likely to be female (p<0.001), however there were no differences in BMI (p=0.788) or social deprivation index (p=0.438) between the groups (Table 1).

Patients that did not access post-operative physiotherapy had statistically higher scores (39.4±8.6) on the OHS than patients who accessed post-operative physiotherapy (35.8±9.8) at 6 months follow-up (p<0.001).At baseline, patients that accessed post-operative physiotherapy had statistically lower scores (20.1±8.6) than patients who accessed post-operative physiotherapy (21.4±8.6) on the OHS (p=0.008).However patients that did not access physiotherapy made a larger gain in pain and function scores measures with the OHS: improvement from baseline to 6 months follow-up was 15.6±10.6 points without post-surgery physiotherapy access and 18.0±9.9 points for such that did access physiotherapy, p<0.001, Cohen's d=0.23) (Table 1 and Figure 1).

EQ5D scores pre and post-surgery were lower in patients referring for physiotherapy both pre-surgery (0.35 vs 0.41, p=0.004,) and post-surgery (0.70 vs 0.80, p<0.001). Cohen's d for pre-postoperative improvement was 0.12 with mean changes in EQ5D score of 0.35 in those that accessed physiotherapy compared to 0.39 in those that did not (p=0.023) (Table 1 and Figure 2).

The patients that did not access post-operative physiotherapy were more satisfied at 6 months (p<0.001, Z=-6.43), with approximately twice the number of patients dissatisfied and very dissatisfied in the group that accessed physiotherapy (Table 1).

Total Knee Arthroplasty

TKA patients accessing physiotherapy were modestly but significantly younger (68.2 vs 71.0 years, p<0.001). There was no difference in gender (p=0.099). Those that accessed physiotherapy were more likely to live in a less deprived area (p=0.028); there was no difference in BMI between groups (p=0.198) (Table 2).

Patient outcomes were better in the 51.8% of TKA patients that did not access post-operative physiotherapy in terms of absolute OKS (35.9 vs 32.3 points, p<0.001). There was no difference in pre-operative score between groups (20.9 points respectively, p = 0.965), reflected in a lesser change in OKS for the group that accessed physiotherapy post-operatively (11.4 points vs 15.0 points, p<0.001, Cohen's d=0.39) (Table 2 and Figure 3).

There were also differences in improvement measured with the EQ-5D (Table 2). Patients accessing physiotherapy improved 0.25 points, compared to 0.35 points in those who did not (p<0.001, Cohen's d=0.32, Figure 4). Again there was no difference in pre-operative scores between groups (0.43 vs 0.41, p = 0.183), while postoperative scores differed significantly (0.68 vs 0.77, p<0.001).

The patients that did not access post-operative physiotherapy were more satisfied (p<0.001, Z=-8.22), with approximately twice the number of patients dissatisfied and very dissatisfied in the group that accessed physiotherapy (Table 2).

Multivariate analysis

Binary logistic regression modelling was undertaken to determine if post-operative access to physiotherapy could be predicted by pre-operative patient variables. A regression model with three predictors (age, sex and pre-operative EQ-5D score) was able to correctly classify 66.9% of THA patients with regard to post-operative physiotherapy access (Table 3). This percentage of correct classifications was significantly (p<0.001) different from chance level (50% correct classifications). In TKA patients the regression model comprised only two significant predictors (age and sex) and provided a percentage of correct classifications of 57.4%, again significantly better than chance (p<0.001).

DISCUSSION

There is no consensus as to how best to rehabilitate patients following THA or TKA. Systematic reviews of post-operative rehabilitation interventions suggest that no one approach is beneficial in improving outcomes[8 16 18] and a recent Cochrane review stressed the general low quality of the evidence base[23]. In this study we review an 'access physiotherapy as needed' model of post-discharge service delivery. Routine post-discharge out-patient physiotherapy was not provided following THA and TKA. Instead the local standard of care was for patients to undertake prescribed home exercises, with all patients able to access additional out-patient physiotherapy services should they require or wish to do so. Under this system, patients can be referred to physiotherapy based on clinical need as determined by clinical staff at time of discharge (either doctor or physiotherapist), or at 6 week out-patient review (consultant team or allied health professional arthroplasty practitioner), or at any point through the patient's GP service. Separately the patient could refer

themselves via a self-referral telephone triage system or access private therapy out with the National Health Service.

Under this system, only a third of patients that underwent THA and half of those who underwent TKA accessed post-discharge outpatient physiotherapy to assist with their recovery. The patients that did not access post-discharge physiotherapy do not seem to have been adversely affected by this decision as this group reported better outcome scores. A difference in pre-to post-operative change in Oxford Score of approximately 3 points was observed between the THA patients, and approximately 4 points in the TKA patients that accessed physiotherapy compared to those that did not. The minimal clinically important difference in Oxford Scores has been estimated at 5 points[24], in THA and 4 points in TKA suggesting the statistical differences reported in the THA patients are unlikely to reflect a clinically meaningful difference, but that the TKA data may represent variation in clinical outcomes between groups.

The Oxford Scores, EQ—5D scores and satisfaction scores at 6 months reported by the patients that *did not* access additional post-discharge physiotherapy compare well to national outcome figures for both THA and TKA patients[25]. This suggests that post-discharge outpatient physiotherapy is not necessarily required in all cases, and that (broadly) patients and clinicians are able to make a judgement as to whether they should attend such therapy. Indeed it would appear that referral for post-discharge therapy may be a marker of patients at risk of poor outcomes.

This is an observational cohort study and we do not attempt to evaluate the effectiveness of undertaking post-discharge physiotherapy with this data. Those who accessed additional therapy in this cohort reported lower scores, suggesting greater physical dysfunction in the early post-operative phase. It may be that the additional therapy improved the patient outcomes compared to having had no such intervention. Patients and clinicians expect a rehabilitation component to be provided as part of the care pathway for joint arthroplasty. Though there is a role for physiotherapy around total joint arthroplasty, it may be that post-discharge physiotherapy should be targeted to those that require additional input as opposed to blanket provision for all in the early post-operative phase. In this setting, self-directed home exercises appear to have been sufficient for the majority of patients to achieve a good outcome post-arthroplasty. From a health economic and service delivery perspective this is clearly attractive, however relies on accurately targeting physiotherapy to those that require the additional input.

We were able to construct statistically significant regression models using pre-operative data to correctly classify the patients that accessed post-operative therapy, however these models were poor in terms of accuracy. The hip replacement model was only 17% greater than chance at identifying the patients that accessed physiotherapy. The THA patients who accessed physiotherapy post-op reported lower general health scores (EQ5D) but broadly equivalent joint specific health scores (OHS). The EQ5D data essentially drove the regression model and perhaps suggests poorer health status or frailty may be related to the requirement for additional therapy; however it must be noted that these patients were on average 5 years younger than those that did not attend additional physiotherapy, suggesting health and not age is the pertinent factor here. Interestingly pre-operative pain levels, BMI and deprivation status did not influence the models.

Notably more TKA patients required or wished to access additional physiotherapy than THA, which is perhaps consistent with the reports of greater treatment success and patient outcomes following hip arthroplasty[5 26]. Despite applying a range of pre-operative demographic and symptom state

indicators, we were only able to model the additional use of post-discharge physiotherapy to an accuracy of 7% greater than chance. Interestingly in the TKA cohort, the model relied solely on small associations with age and sex. In this model, pre-operative pain / function / health scores, social deprivation and BMI did not help determine which patient would go on to require additional therapy.

Though various factors have been associated with poor clinical outcomes following TKA, currently, we cannot reliably predict pre-operatively who will struggle to recover post-operatively. Larger and more comprehensive predictor studies (for example incorporating psychological variables) are required to determine which patient factors lead to poorer post-operative outcomes and to see if particular patient groups benefit from post-discharge physiotherapy. Further insight may be provided by the multicentre TRIO and COASt studies that are currently evaluating this in the UK[26, 27]. Alternatively, it may be that it is the patient's response to surgery as opposed to pre-operative characteristics is that determine the need for post-operative rehabilitation and that there is no reliable way to predict this pre-operatively.

Strengths and Limitations

A strength of this study is the relatively large patient cohort of 2769 arthroplasties and the depth of linked demographic and outcome data. Additionally, that our data is in line with UK national figures for patient demographics and pre and post-operative outcome scores lends wider credibility. Limitations are that the access of physiotherapy was documented and reported by the patient at 6 months post-arthroplasty and we are not able to determine the route by which the patient accessed this post-discharge therapy, nor what specific therapy was received. The relatively short post-operative 6 month timeframe results that we cannot comment on longitudinal changes in outcomes, nor whether those patients that access physiotherapy 'caught-up' with those that did not in terms of clinical outcome scores at subsequent later time points. The study was not designed to evaluate the effectiveness of the physiotherapy received, however future studies may be able to targeted therapy to patients deemed 'at need of intervention', and randomise to differing levels or modes of intervention.

CONCLUSION

In a choice based service model of targeted physiotherapy 'as required' following hip and knee arthroplasty only a third of THA and half of TKA patients accessed post-discharge physiotherapy. Those who did not access additional therapy reported greater post-operative outcome scores and satisfaction, suggesting a variation in requirement for post-arthroplasty physiotherapy. We were unable to predict pre-operatively (with demographic and symptom data) which patients would subsequently access additional input.

CONTRIBUTORS

DFH, conceived the study, interpreted the results, drafted and revised the manuscript. FCL performed the statistical analysis, drafted the results and contributed to manuscript revisions. DJM obtained the data, collated the data and contributed to manuscript drafting and revision. GMF contributed to results interpretation, manuscript drafting and revision. DJB contributed to results

interpretation, manuscript drafting and revision. HRS contributed to results interpretation, manuscript drafting and revision. JTP contributed to the study design, results interpretation, manuscript drafting and revision. CRH contributed to the study design, results interpretation, manuscript drafting and revision.

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CONFLICT OF INTEREST STATEMENT

DFH, DJB, GMF and HRS, are grant holders on the Arthritis Research UK funded TRIO study. Though there is no financial or direct academic conflict, this work can be considered as relevant background for the (currently) ongoing TRIO study.

ETHICAL APPROVAL

Ethical approval was obtained from the Scotland A Research Ethics Committee (11/AL/0079).

DATA SHARING STATEMENT

The raw data cannot be made publicly available to protect patient confidentiality, however restricted data may be made available if deemed reasonable by the data custodian. Such requests should be made to CRH via the corresponding author.

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TABLES

Table 1 Descriptive and outcome data for THA by post-operative physiotherapy access

Referred for physiotherapy	Yes	No	Effect size		p
Sex					
female N (%)	324 (65.7)	486 (53.9)		X^2 = 18.352	p<0.001‡
male N (%)	169 (34.3)	416 (46.1)			
Side					
left, N (%)	212 (43.5)	422 (47.6)		X^2 = 2.123	p=0.157‡
right N (%)	275 (56.5)	464 (52.4)			
SIMD					
1st quintile N (%)	37 (7.5)	76 (8.4)		Z = -0.78	p=0.438*
2nd quintile N (%)	78 (15.8)	160 (17.7)			
3rd quintile N (%)	85 (17.2)	166 (18.4)			
4th quintile N (%)	129 (26.2)	193 (21.4)			
5th quintile N (%)	164 (33.3)	307 (34.0)			
Age Mean (SD)	64.9 (13.2)	69.1 (10.6)	0.35±	T = -6.08	p<0.001†
BMI Mean (SD)	28.3 (6.9)	28.2 (5.0)	0.02±	T = 0.27	p=0.788†
OKS					
Pre-op	20.1 (8.6)	21.4 (8.6)	1.31±	T = -2.67	p=0.008†
Post-op	35.8 (9.8)	39.4 (8.6)	0.39±	T = -6.96	p<0.001†
Improvement	15.6 (10.6)	18.0 (9.9)	0.23±	T = -4.06	p<0.001†
EQ-5D					
Pre-op	0.35 (0.3)	0.41 (0.3)	0.20±	T = -2.92	p=0.004†
Post-op	0.70 (0.3)	0.80 (0.2)	0.39±	T = -6.52	p<0.001†
Improvement	0.35 (0.4)	0.39 (0.3)	0.12±	T = -2.28	p=0.023†
Satisfaction					
Very satisfied	280 (57.4)	648 (73.3)		Z = -6.43	p<0.001*
Satisfied	122 (25.0)	165 (18.7)			
Neither satisfied nor	44 (9.0)	43 (4.9)			
dissatisfied	27 (5.5)	13 (1.5)			
Dissatisfied	15 (3.1)	15 (1.7)			
Very dissatisfied					

Mann-Whitney-U*, t-test†, Chi-square‡, Cohen's d±

Scottish Index of Multiple Deprivation (SIMD); Body Mass Index (BMI); Oxford Knee Score (OKS); EuroQol 5-Dimension (EQ-5D)

Table 2 Descriptive and outcomes data for TKA by postoperative physiotherapy access

Referred for physiotherapy	Yes	No	Effect size		P
Sex					
female N (%)	390 (58.9)	388 (54.5)		X^2 = 2.726	p=0.099‡
male N (%)	272 (41.1)	324 (45.5)			
Side					
left N (%)	321 (49.5)	337 (47.7)		X^2 = 0.404	p=0.525‡
right N (%)	328 (50.5)	369 (52.3)			
SIMD					
1st quintile N (%)	63 (9.5)	66 (9.3)		Z = -2.19	p=0.028*
2nd quintile N (%)	104 (15.7)	162 (22.8)			
3rd quintile N (%)	122 (18.4)	136 (19.1)			
4th quintile N (%)	164 (24.8)	138 (19.4)			
5th quintile N (%)	209 (31.6)	210 (29.5)			
Age Mean (SD)	68.2 (9.7)	71.0 (8.6)	0.30±	T = -5.73	p<0.001†
BMI Mean (SD)	31.1 (6.0)	30.6 (5.9)	0.01±	T = 1.29	p=0.198†
OKS					
Pre-op	20.9 (7.8)	20.9 (7.9)	<0.01±	T = -0.04	p=0.965†
Post-op	32.3 (9.8)	35.9 (9.1)	0.38±	T = -6.99	p<0.001†
Improvement	11.4 (9.4)	15.0 (8.9)	0.39±	T = -7.16	p<0.001†
EQ-5D					
Pre-op	0.43 (0.3)	0.41 (0.3)	0.07±	T = 1.33	p=0.183†
Post-op	0.68 (0.3)	0.77 (0.2)	0.35±	T = -6.34	p<0.001†
Improvement	0.25 (0.3)	0.35 (0.3)	0.32±	T = -6.15	p<0.001†
Satisfaction, N (%)					
Very satisfied	271 (41.6)	427 (61.3)		Z = -8.22	p<0.001*
Satisfied	214 (32.8)	198 (28.4)			
Neither satisfied nor dissat	98 (15.0)	43 (6.2)			
Dissatisfied	51 (7.8)	20 (2.9)			
Very dissatisfied	18 (2.8)	9 (1.3)			

Mann-Whitney-U*, t-test†, Chi-square‡, Cohen's d±

Scottish Index of Multiple Deprivation (SIMD); Body Mass Index (BMI); Oxford Hip Score (OKS); EuroQol 5-Dimension (EQ-5D)

Table 3 Predictive accuracy of demographic and preoperative outcome-parameters for patients referring for physiotherapy

	THA				TKA			
	OR	95% confidence interval	p	Correct classifications	OR	95% confidence interval	p	Correct classifications
Age	1.03	1.02-1.04	<0.001	66.9 %	1.04	1.02-1.05	<0.001	57.4 %
Sex	1.60	1.27-2.03	<0.001		1.26	1.01-1.58	0.038	
EQ-5D	1.54	1.08-1.20	0.018		-	-	-	-

FIGURES

Figure 1 - Change in Oxford Hip Scores by post-operative physiotherapy access in THA patients

Figure 2 - Change in EQ5D scores by post-operative physiotherapy access in THA patients

Figure 3 - Change in Oxford Knee Scores by post-operative physiotherapy access in TKA patients

Figure 4 - Change in EQ5D scores by post-operative physiotherapy access in TKA patients

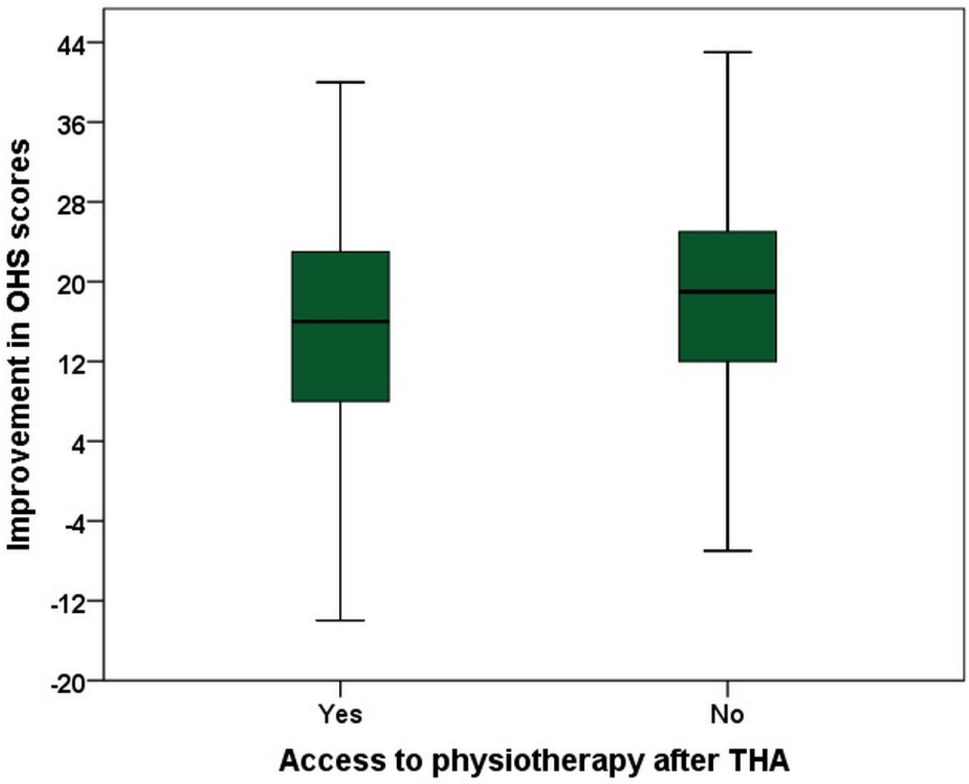

Figure 1 - Change in Oxford Hip Scores by post-operative physiotherapy access in THA patients

112x90mm (300 x 300 DPI)

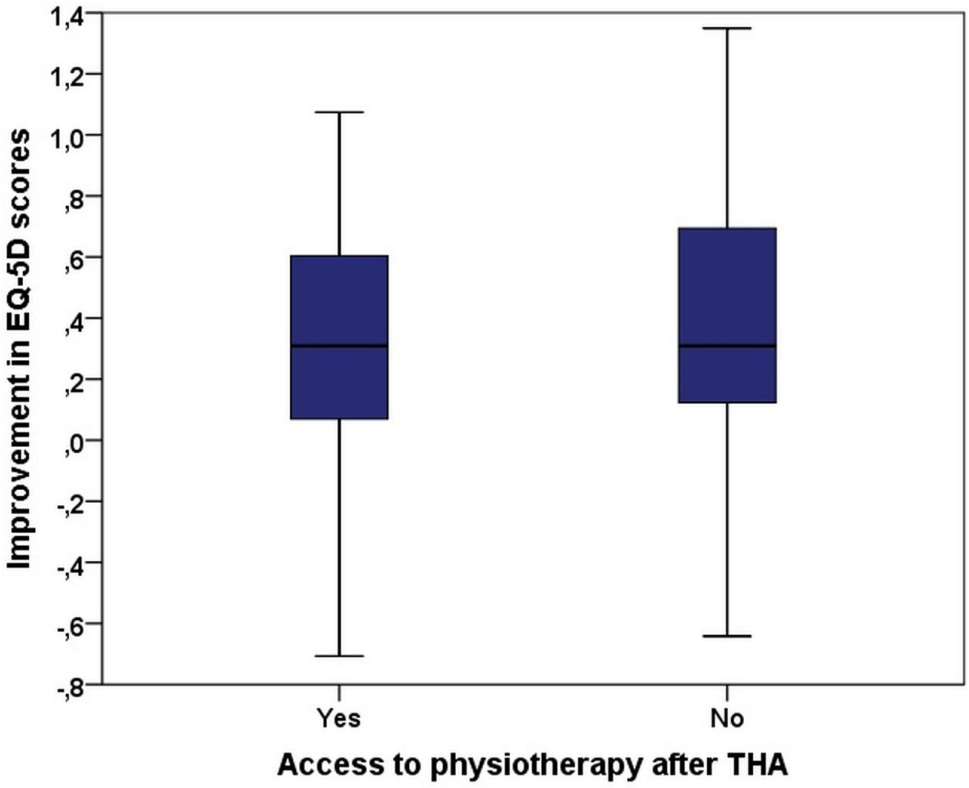

Figure 2 - Change in EQ5D scores by post-operative physiotherapy access in THA patients

112x90mm (300 x 300 DPI)

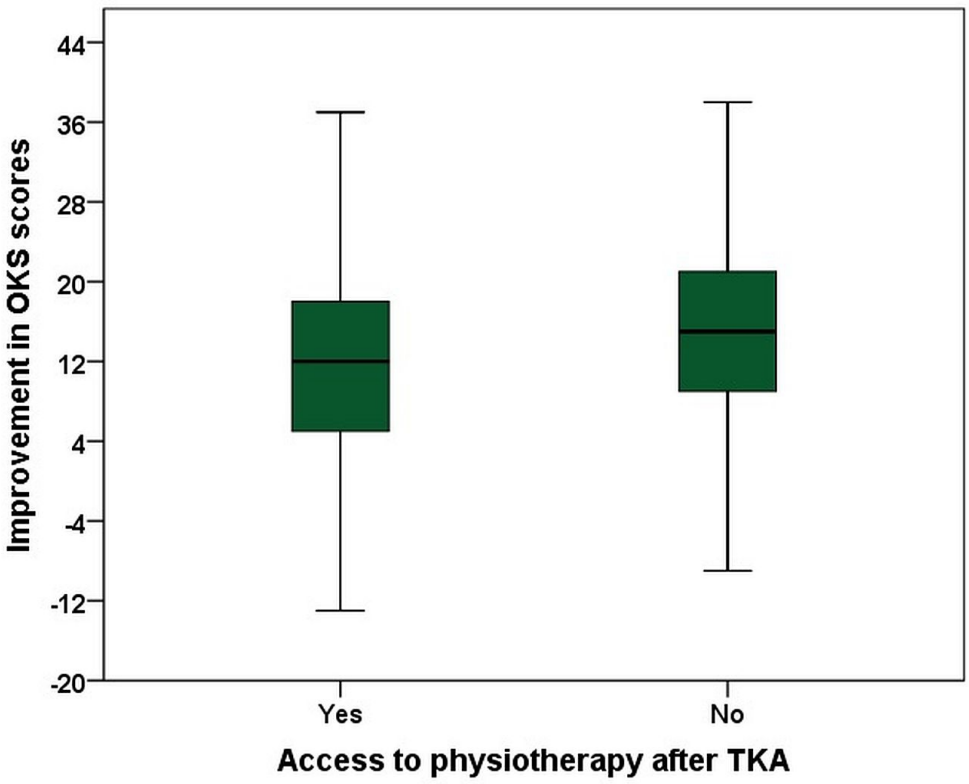

Figure 3 - Change in Oxford Knee Scores by post-operative physiotherapy access in TKA patients

112x90mm (300 x 300 DPI)

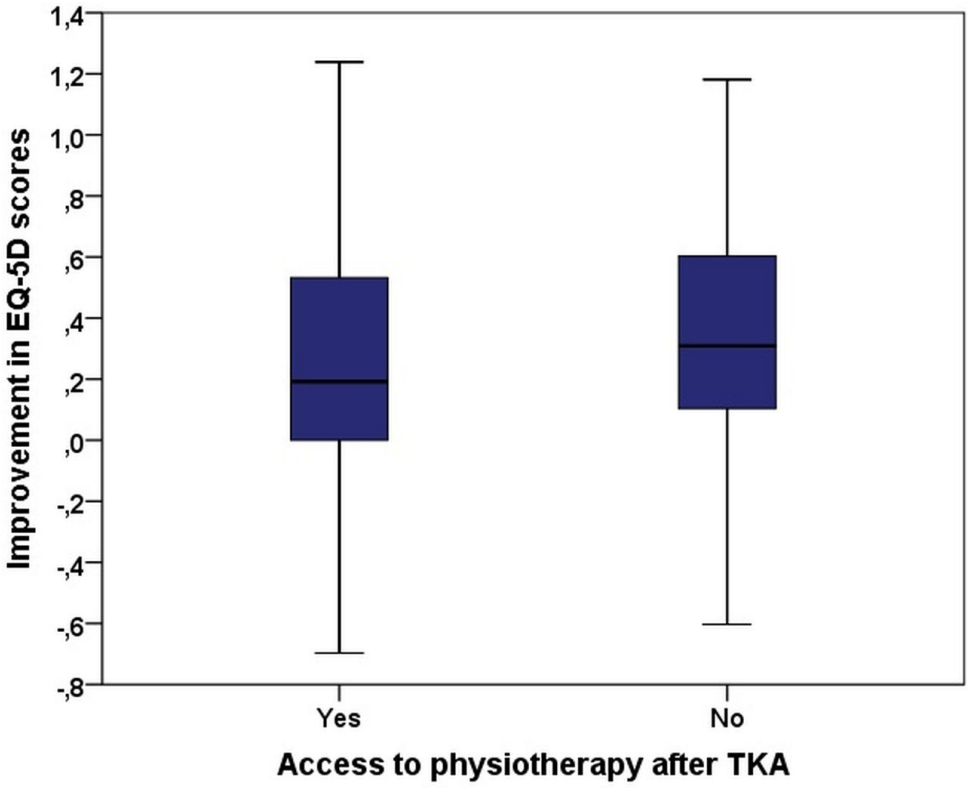

Figure 4 - Change in EQ5D scores by post-operative physiotherapy access in TKA patients

112x90mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4,5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	4,5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4,5
Bias	9	Describe any efforts to address potential sources of bias	4,5
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5,6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5,6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	4
		(*d*) If applicable, explain how loss to follow-up was addressed	4
		(*e*) Describe any sensitivity analyses	6
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6,7
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	6,7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6,7
		(*b*) Report category boundaries when continuous variables were categorized	6,7
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	8,9
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8,9
Generalisability	21	Discuss the generalisability (external validity) of the study results	8,9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	10

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Exploring variation in patient access of post-discharge physiotherapy following total hip and knee arthroplasty under a choice based system in the UK: an observational cohort study.

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Keywords:	Total knee Arthroplasty, Total Hip Arthroplasty, Physiotherapy, Outcomes

Exploring variation in patient access of post-discharge physiotherapy following total hip and knee arthroplasty under a choice based system in the UK: an observational cohort study.

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ABSTRACT

Objectives: To assess a targeted 'therapy as required' model of post-discharge outpatient physiotherapy provision. Specifically, we investigated what proportion of patients accessed post-discharge physiotherapy following THA and TKA, whether accessing therapy was associated with post-arthroplasty patient reported outcomes and whether it was possible to predict which patients would access post-discharge physiotherapy from pre-operative data.

Design: Prospective cohort study

Setting: Single National Health Service orthopaedic teaching hospital

Participants: 1395 patients undergoing THA and 1374 patients undergoing TKA.

Outcome measures: Self-reported access of post-discharge physiotherapy, the Oxford Hip or Knee Score and EQ-5D questionnaire and post-operative surgical episode satisfaction metric.

Results: 662 (48.2%) patients with TKA and 493 (35.3%) patients with THA accessed additional post-discharge physiotherapy. Patient reported outcomes ($p<0.001$) and surgical episode satisfaction ($p=0.001$) scores were higher in both THA and TKA patients who did not participate in post-discharge physiotherapy. Regression models using pre-operative symptom and demographic data predicted post-discharge therapy access with an accuracy of only 17% greater than chance in patients with THA and 7% greater than chance in patients with TKA.

Conclusions: In a choice based service model of targeted 'therapy as required' following hip and knee arthroplasty only a third of THA and half of TKA patients accessed post-discharge outpatient physiotherapy. Patients who reported greater post-operative outcome scores and surgical episode satisfaction did not access post-discharge physiotherapy, suggesting variation in the need for post-arthroplasty rehabilitation. As such, targeting rehabilitation may be a cost-effective model, however it was not possible to reliably predict which patients would access post-discharge physiotherapy from pre-operative data.

Keywords: Total Knee Arthroplasty, Total Hip Arthroplasty, Physiotherapy, Outcomes

ARTICLE SUMMARY

STRENGTHS AND LIMITATIONS

- This is a relatively large patient cohort of 2769 total hip and knee replacements performed over a 2 year period at a single orthopaedic unit evaluating a consistent and specific delivery model of post-discharge rehabilitation provision.
- A particular strength of this study design is the depth of linked demographic and outcomes data available with which to construct the predictive models.
- Data relating to access of post-surgical physiotherapy was reported by the patient at 6 months post-operation via a survey tool and is open to potential responder biases, however the large sample size somewhat mitigates this issue.
- We are not able to determine the referral route by which the patient accessed post-discharge therapy, nor the specific content of the physiotherapy received.

INTRODUCTION

Lower limb osteoarthritis is an extremely common and disabling condition, which may ultimately require surgical intervention. In excess of 90,000 total hip and 90,000 total knee arthroplasties (THA and TKA) are performed each year in the UK alone[1]. Projections suggest continued increases of surgical volume year on year[2 3]. Though joint replacement is effective at reducing pain and improving physical function in patients with end stage osteoarthritis, a sub-group of patients continue to report dissatisfaction with their post-operative outcome[4 5] highlighted by protracted physical impairment[6] and activity limitations[7-10].

Physiotherapy is thought to be an important component in achieving optimal results following THA or TKA[11]. Immediately post-surgery and throughout the inpatient stay, physiotherapy is aimed at encouraging mobilisation and facilitating a safe discharge. Though subsequent further post-discharge physiotherapy is often promoted there is considerable national and international variation in actual therapy provision. Specific rehabilitation protocols are strongly entrenched at individual physiotherapy departments however the wider efficacy of post-operative physiotherapeutic intervention is poorly established[12-18]. This uncertainty as to effectiveness of physiotherapy interventions makes it difficult for commissioning organisations, healthcare providers, and patients to make decisions as to the role of post-discharge physiotherapy following total joint arthroplasty, and in determining the correct level and mechanism of funding for such services. As a result there is substantial variety in the delivery and content of post-operative physiotherapy following joint arthroplasty across the UK.

The purpose of this study was to explore variation in patient access of post-discharge physiotherapy following THA and TKA under a choice based system in the UK. Under this 'therapy as required' service model, post-discharge out-patient physiotherapy is not routinely provided following THA and TKA. Instead, the local standard of care is for patients to undertake prescribed home exercises, with all patients able to access additional out-patient physiotherapy should they require or wish to do so. Specifically, we investigated what proportion of patients accessed additional post-discharge physiotherapy following THA and TKA, whether accessing therapy was associated with post-arthroplasty patient reported outcomes and whether it was possible to predict which patients would access post-discharge physiotherapy from pre-operative data.

METHODS

Study design and participants

This was a prospective observational cohort study. All patients undergoing primary THA and TKA were invited to participate in the study that ran alongside the department's routine outcomes data collection project. Data collection was through questionnaires administered pre-operatively at hospital clinic appointment (2 weeks prior to surgery) and then via postal review at 6 months post-operatively. Patients were sent forms on the 6 month anniversary of the surgical episode, with a further follow-up sent 2 weeks later if no response was received.

Ethical approval was obtained from the Scotland A Research Ethics Committee (11/AL/0079). Informed consent was obtained. Patients undergoing primary unilateral THA or TKA at a single National Health Service teaching hospital were prospectively assessed over a 32 month period between January 2013 and September 2015.

The study centre is the only hospital receiving adult referrals for a predominantly urban regional population of approximately 850 000 people. Surgery was carried out by 12 consultant orthopaedic surgeons and their supervised trainees. Local protocols were followed for all aspects of pre-operative, inpatient, and post-operative care.

Pre-operatively a booklet was provided to patients with information about the procedure (THA or TKA) which included detail on rehabilitation, advising as to activity and highlighting exercises to perform. Immediate post-operative therapy (inpatient stay) was protocol driven focussing on knee range of movement, muscle re-education and mobilising with appropriate walking aids to facilitate a safe discharge. Post-discharge practice at the study centre is to promote continued performance of the exercises learned and only to provide outpatient physiotherapy as required. As such, patients were referred to out-patient physiotherapy based on clinically assessed need at time of discharge or at 6 week post-operative clinical review, with additional referral routes available to the patient through general practice services and a national patient self-referral telephone triage system.

Demographic data was obtained for the patient's age, sex, BMI and socioeconomic denominators using the Scottish Index of Multiple Deprivation (SIMD). The SIMD is a national statistic based on postcode. It combines data on 38 indicators across 7 domains, namely: income, employment, health, education, skills and training, housing, geographic access and crime. We applied the 2012 SIMD national dataset, and report quintiles (from least deprived to most deprived; the 5th quintile representing the most deprived patients). We employed the 'datazone' approach where quintile cut-points are identified based on the potential scores in the national SIMD dataset as opposed to reporting quintile distributions calculated from the population in question. Physical outcomes were assessed with the Oxford Hip or Knee Score (OHS and OKS) and EuroQol- 5 Dimension (EQ-5D) questionnaire. Both questionnaires have been thoroughly validated and are the national statistics of choice in the UK for measuring arthroplasty outcomes.

Outcome measures

The Oxford Hip and Knee Scores each consist of 12 questions assessing the patient's pain and function[19 20]. Each item is answered on a 5-point response scale with scores ranging from 0 to 4, generating a summed total score from 0 to 48, where 0 indicates the worst possible outcome and 48 the best possible score. The minimally important clinical difference (MCID) of the scores is generally accepted as 5 points in THA, and 4 points in TKA.

The EQ-5D is a standardised instrument with five items covering mobility, self-care, usual activities, pain and discomfort as well as anxiety and depression[21]. As a measure of self-reported general health, it is applicable to a wide range of health conditions and treatments and provides a simple descriptive profile and a single index value for health status. Lower scores represent a worse health state. We applied the most commonly used EQ-5D-3L version, with 3 possible responses to the 5 questions, and a summary index calculated by applying preference weights for the UK general population[22]. The summary score is anchored at 0 signifying 'death' and 1 'perfect health', however with score weighting negative value are possible and are interpreted as health states worse than death.

Patient surgical episode satisfaction was assessed using a 5 point Likert response format at 6 months post-surgery. Patients were asked to rate their overall satisfaction with their operated hip or knee

(response options: very satisfied, satisfied, unsure, dissatisfied, or very dissatisfied). Self-report of physiotherapy attendance was recorded at 6 month assessment.

Patient and Public Involvement

There was no specific patient involvement in the design or conduct of the study methodology, however the study question as to the role of physiotherapy in the post-operative period following joint arthroplasty was highlighted as a priority area for research by a patient feedback project at the study centre.

Statistical analysis

Analyses were performed with SPSS V21.[23]. Demographic indicators are presented as frequencies or means with standard deviations as a measure of dispersal. Differences between patients who accessed physiotherapy after total joint arthroplasty and those who did not were investigated with t-tests, chi-square tests, and Mann-Whitney-U tests as appropriate. Effect sizes for differences in continuous variables are given as Cohen's d.

To identify predictors of physiotherapy access we used a binary logistic regression model with physiotherapy access as dependent variable and patient characteristics and preoperative OKS/OHS and EQ-5D as predictors. The predictors were included using a forward selection stepwise model building technique (likelihood ratio) with an entry criterion of alpha=0.05. Model fit is described with percentage of correct classifications and predictors are given as odds ratios with corresponding 95% confidence intervals. Using this methodology, the chance level of correct classifications is 50% and the model-based classification is compared against this value.

RESULTS

1534 patients underwent primary THA and 1503 primary TKA in the study time window. 97% of cases were coded as being performed for a diagnosis of osteoarthritis (the remaining patients being rheumatoid or psoriatic arthritis). Survey data was available for 1395 (90.9%) THA patients and for 1374 (91.4%) TKA patients. All data was included in the analysis. THA patients had a mean age of 67.6 ± 11.8 years, 58.1% were female, TKA patients had a mean age 69.7 ± 9.3 years, 56.6% were female. Of this total surgical cohort, 493 (35.3%) THA and 662 (48.2%) TKA patients accessed post-operative out-patient physiotherapy.

Total Hip Arthroplasty

Patients with TKA accessing post-discharge physiotherapy were younger (64.9 vs 69.1 years, p<0.001) and more likely to be female (p<0.001), however there were no differences in BMI (p=0.788) or social deprivation index (p=0.438) between the groups (Table 1).

Patients that did not access post-discharge physiotherapy reported statistically higher scores (39.4±8.6) on the OHS than patients who accessed post-discharge physiotherapy (35.8±9.8) at 6 months follow-up (p<0.001). At baseline, patients who accessed post-discharge physiotherapy had statistically lower scores (20.1±8.6) than patients who did not access post-discharge physiotherapy

(21.4±8.6, p=0.008). However, patients who did not access post-discharge physiotherapy made a larger gain, OHS improvement from baseline to 6 months follow-up was 15.6±10.6 points in those who accessed post-discharge physiotherapy and 18.0±9.9 points for those who did not (p<0.001, Cohen's d=0.23) (Table 1 and Figure 1). These statistical differences observed in OHS between groups does not however reflect clinically meaningful variations in patient outcomes based on the MCID of the score.

EQ-5D scores were lower in patients accessing post-discharge physiotherapy both pre-surgery (0.35 vs 0.41, p=0.004,) and post-surgery (0.70 vs 0.80, p<0.001). Cohen's d for pre-postoperative improvement was 0.12 with mean changes in EQ-5D score of 0.35 in those that accessed physiotherapy compared to 0.39 in those that did not (p=0.023) (Table 1 and Figure 2).

The patients who did not access post-operative physiotherapy reported greater surgical episode satisfaction at 6 months (p<0.001, Z=-6.43), with twice the number of patients reporting either dissatisfied or very dissatisfied observed in the group that accessed physiotherapy (Table 1).

Total Knee Arthroplasty

Patients with TKA accessing post-discharge physiotherapy were modestly but significantly younger (68.2 vs 71.0 years, p<0.001). There was no difference in sex (p=0.099). Patients who accessed physiotherapy were more likely to live in a less deprived area (p=0.028); there was no difference in BMI between groups (p=0.198) (Table 2).

Patient outcomes were better in the 51.8% of TKA patients that did not access post-discharge physiotherapy in terms of absolute OKS (35.9 vs 32.3 points, p<0.001). There was no difference in pre-operative score between groups (20.9 points in each group, p=0.965), reflected in a lesser change in OKS for the patients who accessed post-discharge physiotherapy (11.4 points vs 15.0 points, p<0.001, Cohen's d=0.39) (Table 2 and Figure 3). These between group differences may reflect clinically important variations in patient outcomes based on the MCID of the OKS.

There were also differences in improvement measured with the EQ-5D (Table 2). Patients accessing post-discharge physiotherapy improved by 0.25 points, compared to 0.35 points in those who did not (p<0.001, Cohen's d=0.32, Figure 4). Again there was no difference in pre-operative scores between groups (0.43 vs 0.41, p = 0.183), while post-operative scores differed significantly (0.68 vs 0.77, p<0.001).

The patients who did not access post-operative physiotherapy reported greater surgical episode satisfaction (p<0.001, Z=-8.22), with twice the number of dissatisfied and very dissatisfied patients in the group that accessed post-discharge physiotherapy (Table 2).

Multivariate analysis

A regression model with three predictors (age, sex and pre-operative EQ-5D score) was able to correctly classify 66.9% of patients with THA in regard to post-operative physiotherapy access (Table 3). This percentage of correct classifications was significantly (p<0.001) different from chance level (50% correct classifications). In patients with TKA the regression model comprised only two significant predictors (age and sex) and provided a percentage of correct classifications of 57.4%, again significantly better than chance (p<0.001).

DISCUSSION

There is no consensus as to how best to rehabilitate patients following THA or TKA. Systematic reviews of post-operative rehabilitation interventions suggest that no one approach is beneficial in improving outcomes[8 16 18] and a recent Cochrane review stressed the general low quality of the evidence base[24]. In this study we review an 'therapy as required' model of service delivery, where routine post-discharge out-patient physiotherapy was not provided following THA and TKA. Instead the local standard of care was for patients to undertake prescribed home exercises, with all patients able to access additional out-patient physiotherapy should they require or wish to do so. Under this system, patients could be referred to physiotherapy by clinical staff at time of discharge (inpatient medical or therapy teams), or at 6 week post-surgical out-patient review (surgical team or specialist physiotherapist / nurse practitioner), or at any point through the patient's General Practitioner service. Separately the patient could refer themselves via a national self-referral telephone triage system or self-fund physiotherapy from a private provider, distinct to provision via the National Health Service.

Under this 'therapy as required' system, only a third of patients who underwent THA and half of those who underwent TKA accessed post-discharge outpatient physiotherapy to assist with their recovery. The patients that did not access post-discharge physiotherapy do not seem to have been adversely affected by this decision as this group reported generally better outcome and surgical episode satisfaction scores. A difference in pre-to post-operative change in Oxford Score of approximately 3 points was observed between the THA patients, and approximately 4 points in the TKA patients that accessed physiotherapy compared to those that did not. The minimal clinically important difference in Oxford Scores has been estimated at 5 points, in THA and 4 points in TKA[25] suggesting the statistical differences reported in the THA patients are unlikely to reflect a clinically meaningful difference, but that the TKA data may represent variation in clinical outcomes between groups.

The Oxford Scores, EQ-5D scores and satisfaction scores at 6 months reported by the patients that *did not* access additional post-discharge physiotherapy compare well to national outcome figures for both THA and TKA patients[26]. This suggests that post-discharge outpatient physiotherapy is not necessarily required in all cases, and that (broadly) patients and clinicians are able to make a judgement as to whether they should attend such therapy.

This is an observational cohort study and we do not attempt to evaluate the effectiveness of post-discharge physiotherapy with this data. Those who accessed additional therapy in this cohort reported lower scores, suggesting greater pain and physical dysfunction in the early post-operative phase. It may be that the additional therapy improved the patient outcomes compared to having had no such intervention. Patients and clinicians expect a rehabilitation component to be provided as part of the care pathway for joint arthroplasty. Though there is a role for physiotherapy around total joint arthroplasty, it may be that post-discharge physiotherapy should be targeted to those that require additional rehabilitation to optimise outcomes as opposed to blanket provision for all in the early post-operative phase. In this setting, self-directed home exercises appear to have been sufficient for the majority of patients to achieve a good outcome post-arthroplasty. This finding could be explored for cost-effectiveness from the health economic and service delivery perspective, however relies on accurately targeting physiotherapy to those that require the additional input.

We were able to construct statistically significant regression models using pre-operative data to correctly classify the patients that accessed post-operative therapy, however these models were poor in terms of accuracy. The model describing access of post-discharge physiotherapy following THA was only 17% greater than chance at identifying which patients accessed physiotherapy. The patients who accessed post-discharge physiotherapy reported lower general health scores (EQ-5D) but broadly equivalent joint specific pain and function scores (OHS). The EQ-5D data essentially drove the regression model and perhaps suggests poorer health status may be related to the requirement for additional therapy; however, it must be noted that these patients were on average 5 years younger than those that did not attend additional physiotherapy, suggesting health and not age is the pertinent factor here. Interestingly pre-operative pain and functional ability (Oxford Score), BMI and deprivation status did not influence the models.

Notably more TKA patients required or wished to access additional physiotherapy than THA, which is perhaps consistent with the reports of greater treatment success and patient outcomes following hip arthroplasty[5 26]. Despite applying a range of pre-operative demographic and symptom state indicators, we were only able to model the additional use of post-discharge physiotherapy to an accuracy of 7% greater than chance. Interestingly in the TKA cohort, the model relied solely on small associations with age and sex. In this model, pre-operative pain / function / health scores, social deprivation and BMI did not help determine which patients would go on to require additional therapy.

Though various factors have been associated with poor clinical outcomes following TKA, currently, we cannot reliably predict pre-operatively who will struggle to recover post-operatively. Larger and more comprehensive predictor studies (for example incorporating psychological variables) are required to determine which patient factors lead to poorer post-operative outcomes and to see if particular patient groups benefit from post-discharge physiotherapy. Further insight may be provided by the multicentre TRIO and COASt studies that are currently evaluating this in the UK[27, 28]. Alternatively, it may be that it is the patient's response to surgery as opposed to pre-operative characteristics that determine the need for post-operative rehabilitation and that there is no reliable way to predict this pre-operatively.

Strengths and Limitations

A strength of this study is the relatively large patient cohort of 2769 arthroplasties and the depth of linked demographic and outcome data. Additionally, that our data is in line with UK national figures for patient demographics and pre and post-operative outcome scores lends wider credibility. Limitations are that the access of post-discharge physiotherapy was documented and reported by the patient at 6 months post-arthroplasty, which open potential responder biases. Further, we are not able to determine the route by which the patient accessed this post-discharge therapy, nor the content of the specific physiotherapy received. The relatively short post-operative 6 month timeframe results that we cannot comment on longitudinal changes in outcomes, nor whether those patients that access physiotherapy 'caught-up' with those that did not in terms of clinical outcome scores at subsequent later time points. The study was not designed to evaluate the effectiveness of the physiotherapy received, however future studies may be able to target therapy to patients deemed 'at need of intervention', and randomise to differing levels or modes of intervention.

CONCLUSION

In a choice based service model of targeted 'therapy as required' following hip and knee arthroplasty only a third of THA and half of TKA patients accessed post-discharge physiotherapy. Patients who reported greater post-operative outcome scores and surgical episode satisfaction did not access additional therapy, suggesting a variation in requirement for post-arthroplasty physiotherapy. We were unable to predict pre-operatively (with demographic and symptom data) which patients would subsequently access additional input.

CONTRIBUTORS

DFH conceived the study, interpreted the results, drafted and revised the manuscript. FCL performed the statistical analysis, drafted the results and contributed to manuscript revisions. DJM collated the data and contributed to manuscript drafting and revision. GMF contributed to results interpretation, manuscript drafting and revision. DJB contributed to results interpretation, manuscript drafting and revision. HRS contributed to results interpretation, manuscript drafting and revision. JTP contributed to the study design, results interpretation, manuscript drafting and revision. CRH contributed to the study design, results interpretation, manuscript drafting and revision.

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CONFLICT OF INTEREST STATEMENT

DFH, DJB, GMF and HRS, are grant holders on the Arthritis Research UK funded TRIO study. Though there is no financial or direct academic conflict, this work can be considered as relevant background for the (currently) ongoing TRIO study.

ETHICAL APPROVAL

Ethical approval was obtained from the Scotland A Research Ethics Committee (11/AL/0079).

DATA SHARING STATEMENT

The raw data cannot be made publicly available to protect patient confidentiality; however restricted data may be made available if deemed reasonable by the data custodian. Such requests should be made to CRH via the corresponding author.

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TABLES

Table 1 Demographic and outcome data for patients with THA by post-discharge physiotherapy access

Referred for physiotherapy	Yes	No	Effect size	statistic	significance
Sex N (%)					
female	324 (65.7)	486 (53.9)		X^2 = 18.352	p<0.001‡
male	169 (34.3)	416 (46.1)			
Side N (%)					
left	212 (43.5)	422 (47.6)		X^2 = 2.123	p=0.157‡
right	275 (56.5)	464 (52.4)			
SIMD					
1st quintile N (%)	37 (7.5)	76 (8.4)		Z = -0.78	p=0.438*
2nd quintile N (%)	78 (15.8)	160 (17.7)			
3rd quintile N (%)	85 (17.2)	166 (18.4)			
4th quintile N (%)	129 (26.2)	193 (21.4)			
5th quintile N (%)	164 (33.3)	307 (34.0)			
Age Mean (SD)	64.9 (13.2)	69.1 (10.6)	0.35±	T = -6.08	p<0.001†
BMI Mean (SD)	28.3 (6.9)	28.2 (5.0)	0.02±	T = 0.27	p=0.788†
OHS					
Pre-op	20.1 (8.6)	21.4 (8.6)	1.31±	T = -2.67	p=0.008†
Post-op	35.8 (9.8)	39.4 (8.6)	0.39±	T = -6.96	p<0.001†
Change	15.6 (10.6)	18.0 (9.9)	0.23±	T = -4.06	p<0.001†
EQ-5D					
Pre-op	0.35 (0.3)	0.41 (0.3)	0.20±	T = -2.92	p=0.004†
Post-op	0.70 (0.3)	0.80 (0.2)	0.39±	T = -6.52	p<0.001†
Change	0.35 (0.4)	0.39 (0.3)	0.12±	T = -2.28	p=0.023†
Satisfaction					
Very satisfied	280 (57.4)	648 (73.3)		Z = -6.43	p<0.001*
Satisfied	122 (25.0)	165 (18.7)			
Neither satisfied / dissatisfied	44 (9.0)	43 (4.9)			
Dissatisfied	27 (5.5)	13 (1.5)			
Very dissatisfied	15 (3.1)	15 (1.7)			

Mann-Whitney-U*, t-test†, Chi-square‡, Cohen's d±

Scottish Index of Multiple Deprivation (SIMD); Body Mass Index (BMI); Oxford Hip Score (OKS); EuroQol 5-Dimension (EQ-5D)

Table 2 Demographic and outcomes data for patients with TKA by post-discharge physiotherapy access

Referred for physiotherapy	Yes	No	Effect size	statistic	significance
Sex N (%)					
female	390 (58.9)	388 (54.5)		X^2 = 2.726	p=0.099‡
male	272 (41.1)	324 (45.5)			
Side N (%)					
left	321 (49.5)	337 (47.7)		X^2 = 0.404	p=0.525‡
right	328 (50.5)	369 (52.3)			
SIMD					
1st quintile N (%)	63 (9.5)	66 (9.3)		Z = -2.19	p=0.028*
2nd quintile N (%)	104 (15.7)	162 (22.8)			
3rd quintile N (%)	122 (18.4)	136 (19.1)			
4th quintile N (%)	164 (24.8)	138 (19.4)			
5th quintile N (%)	209 (31.6)	210 (29.5)			
Age Mean (SD)	68.2 (9.7)	71.0 (8.6)	0.30±	T = -5.73	p<0.001†
BMI Mean (SD)	31.1 (6.0)	30.6 (5.9)	0.01±	T = 1.29	p=0.198†
OKS					
Pre-op	20.9 (7.8)	20.9 (7.9)	<0.01±	T = -0.04	p=0.965†
Post-op	32.3 (9.8)	35.9 (9.1)	0.38±	T = -6.99	p<0.001†
Improvement	11.4 (9.4)	15.0 (8.9)	0.39±	T = -7.16	p<0.001†
EQ-5D					
Pre-op	0.43 (0.3)	0.41 (0.3)	0.07±	T = 1.33	p=0.183†
Post-op	0.68 (0.3)	0.77 (0.2)	0.35±	T = -6.34	p<0.001†
Improvement	0.25 (0.3)	0.35 (0.3)	0.32±	T = -6.15	p<0.001†
Satisfaction, N (%)					
Very satisfied	271 (41.6)	427 (61.3)		Z = -8.22	p<0.001*
Satisfied	214 (32.8)	198 (28.4)			
Neither satisfied / dissatisfied	98 (15.0)	43 (6.2)			
Dissatisfied	51 (7.8)	20 (2.9)			
Very dissatisfied	18 (2.8)	9 (1.3)			

Mann-Whitney-U*, t-test†, Chi-square‡, Cohen's d±

Scottish Index of Multiple Deprivation (SIMD); Body Mass Index (BMI); Oxford Knee Score (OKS); EuroQol 5-Dimension (EQ-5D)

Table 3 Predictive accuracy of model parameters for patients accessing post-discharge physiotherapy

	THA				TKA			
	OR	95% confidence interval	p	Correct classifications	OR	95% confidence interval	p	Correct classifications
Age	1.03	1.02-1.04	<0.001	66.9 %	1.04	1.02-1.05	<0.001	57.4 %
Sex	1.60	1.27-2.03	<0.001		1.26	1.01-1.58	0.038	
EQ-5D	1.54	1.08-1.20	0.018		-	-	-	-

FIGURES

Figure 1 - Change in Oxford Hip Scores by THA post-discharge physiotherapy access

Figure 2 - Change in EQ-5D scores by THA post-discharge physiotherapy access

Figure 3 - Change in Oxford Knee Scores by TKA post-discharge physiotherapy access

Figure 4 - Change in EQ-5D scores by TKA post-discharge physiotherapy access

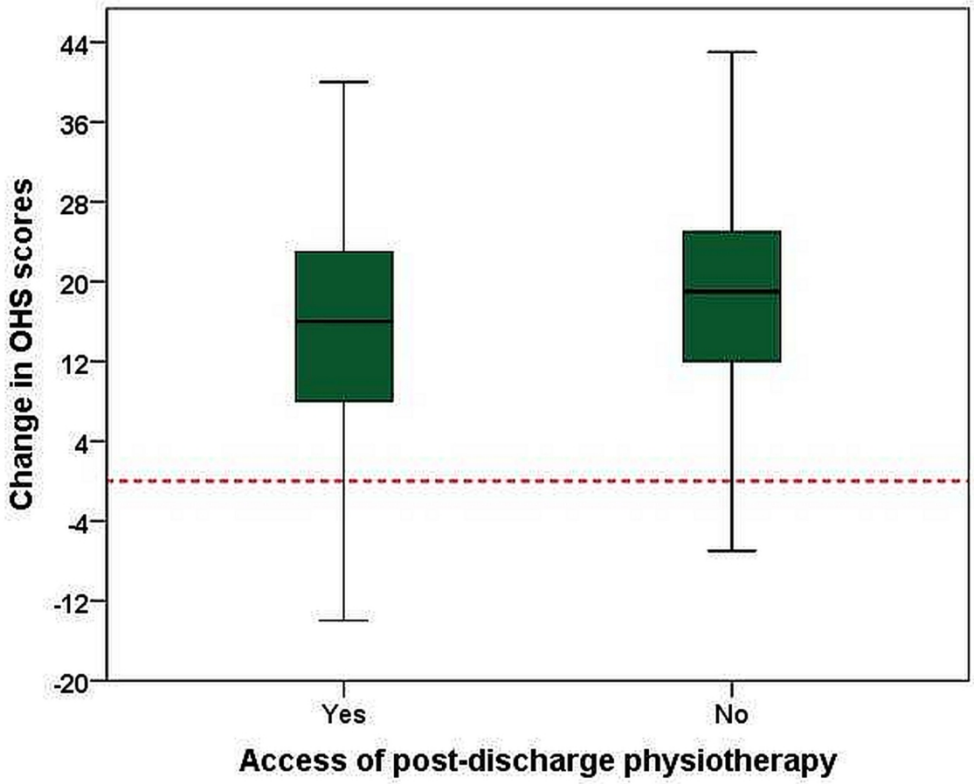

Figure 1 - Change in Oxford Hip Scores by THA post-discharge physiotherapy access

221x174mm (300 x 300 DPI)

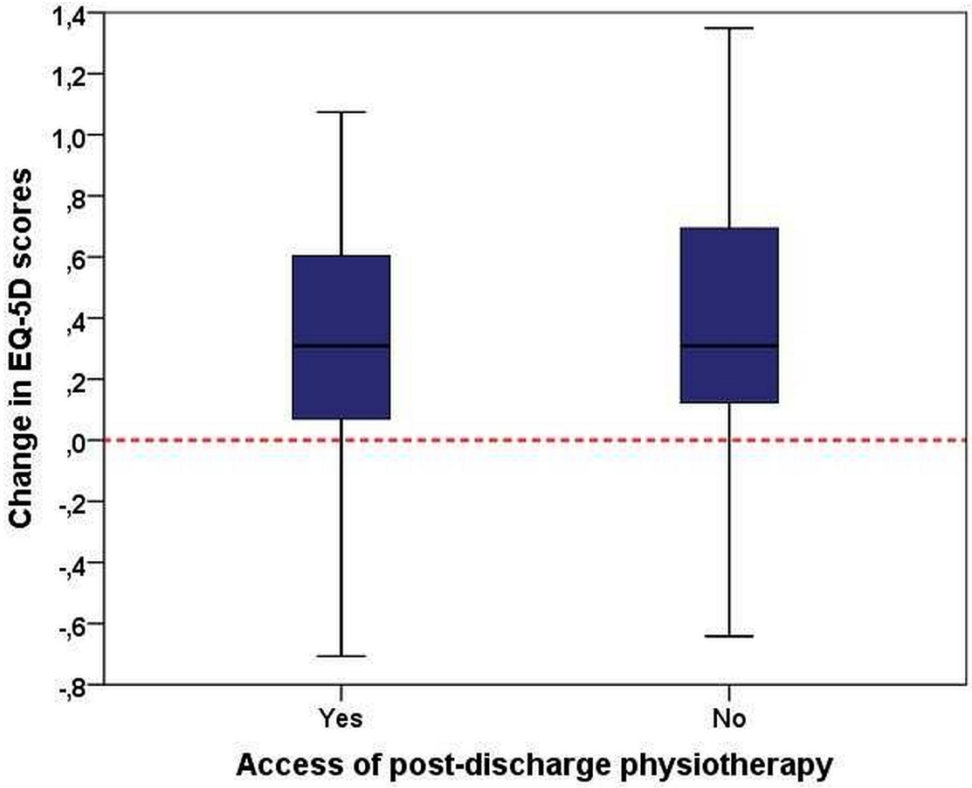

Figure 2 - Change in EQ-5D scores by THA post-discharge physiotherapy access

221x177mm (300 x 300 DPI)

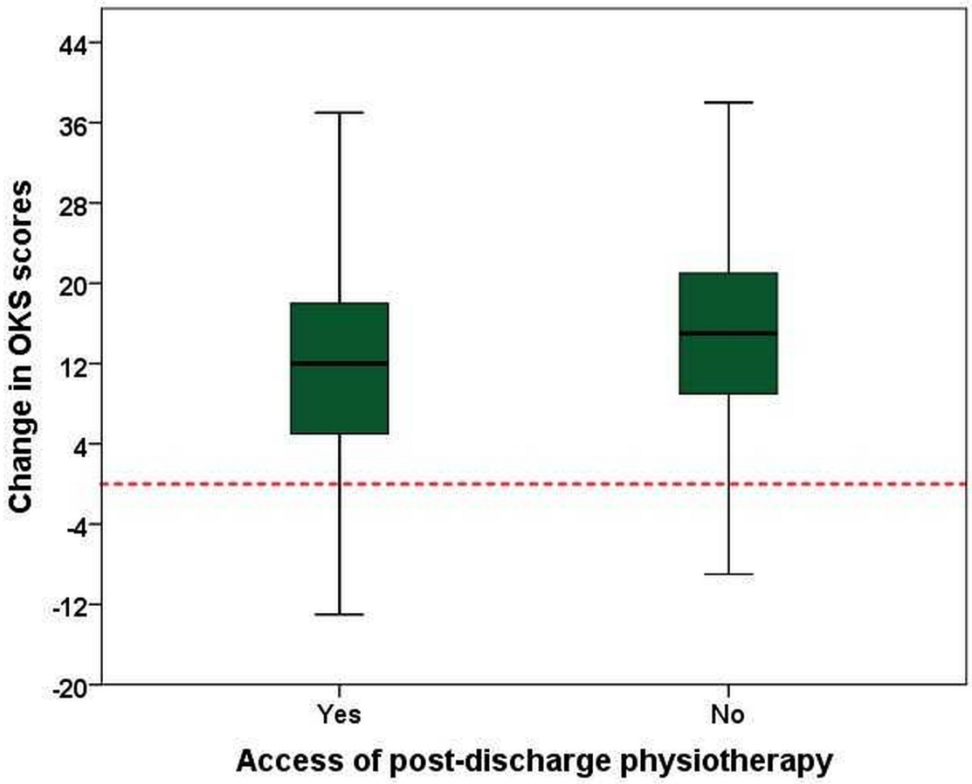

Figure 3 - Change in Oxford Knee Scores by TKA post-discharge physiotherapy access

221x177mm (300 x 300 DPI)

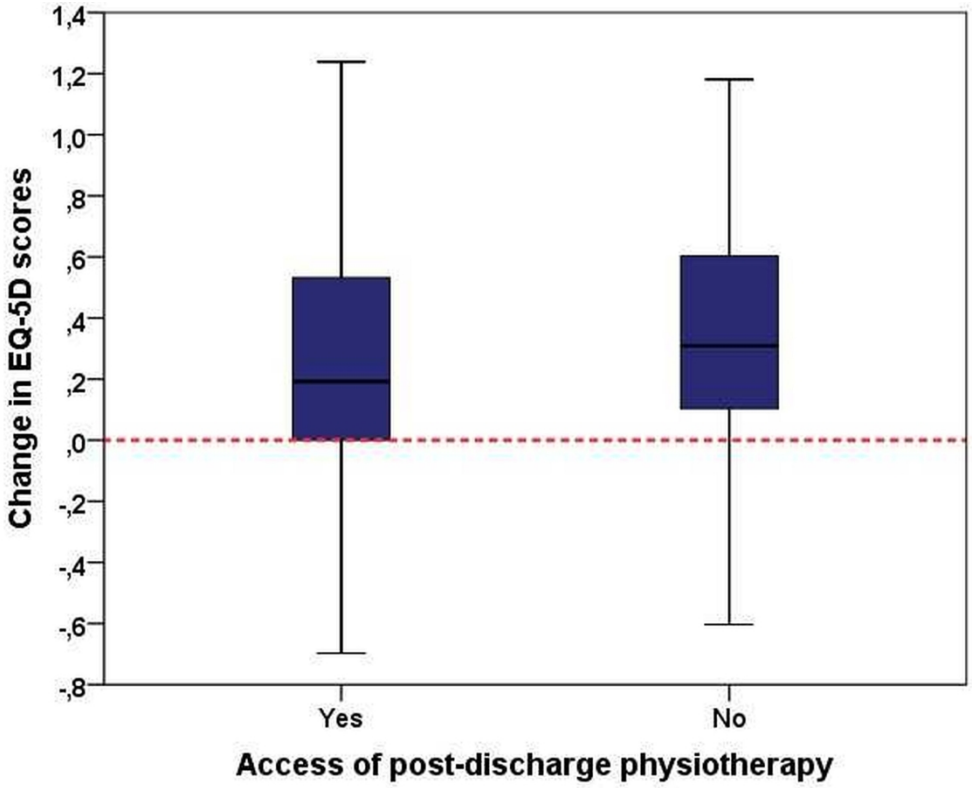

Figure 4 - Change in EQ-5D scores by TKA post-discharge physiotherapy access

221x177mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4,5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	4,5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4,5
Bias	9	Describe any efforts to address potential sources of bias	4,5
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5,6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5,6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	4
		(*d*) If applicable, explain how loss to follow-up was addressed	4
		(*e*) Describe any sensitivity analyses	6
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6,7
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	6,7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6,7
		(*b*) Report category boundaries when continuous variables were categorized	6,7
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	8,9
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8,9
Generalisability	21	Discuss the generalisability (external validity) of the study results	8,9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	10

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Exploring variation in patient access of post-discharge physiotherapy following total hip and knee arthroplasty under a choice based system in the UK: an observational cohort study.

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Keywords:	Total knee Arthroplasty, Total Hip Arthroplasty, Physiotherapy, Outcomes

Exploring variation in patient access of post-discharge physiotherapy following total hip and knee arthroplasty under a choice based system in the UK: an observational cohort study.

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ABSTRACT

Objectives: To assess a targeted 'therapy as required' model of post-discharge outpatient physiotherapy provision. Specifically, we investigated what proportion of patients accessed post-discharge physiotherapy following total hip arthroplasty (THA) and total knee arthroplasty (TKA), whether accessing therapy was associated with post-arthroplasty patient reported outcomes and whether it was possible to predict which patients would access post-discharge physiotherapy from pre-operative data.

Design: Prospective, observational, longitudinal cohort study

Setting: Single National Health Service orthopaedic teaching hospital in the United Kingdom

Participants: 1395 patients undergoing total hip arthroplasty and 1374 patients undergoing total knee arthroplasty.

Primary and Secondary Outcome measures: Self-reported access of post-discharge physiotherapy, the Oxford Hip or Knee Score, EuroQol 5-dimension questionnaire and post-operative surgical episode satisfaction metric.

Results: 662 (48.2%) patients with TKA and 493 (35.3%) patients with THA accessed additional post-discharge physiotherapy. Patient reported outcomes ($p<0.001$) and surgical episode satisfaction ($p=0.001$) in both hip and knee arthroplasty were higher in patients that did not participate in post-discharge physiotherapy. Regression models using pre-operative symptom burden and demographic data predicted post-discharge therapy access with an accuracy of only 17% greater than chance in patients with THA and 7% greater than chance in patients with TKA.

Conclusions: In a choice-based service model of targeted rehabilitation 'as required' following hip and knee arthroplasty only a third of hip arthroplasty and half of knee arthroplasty patients accessed post-discharge outpatient therapy. Patients who reported greater post-operative outcome scores and surgical episode satisfaction did not access post-discharge physiotherapy, suggesting variation in the need for post-arthroplasty outpatient physiotherapy. As such, targeting of rehabilitation may be a cost-effective model, however it was not possible to reliably predict which patients would access post-discharge physiotherapy from pre-operative data.

Keywords: Total knee Arthroplasty, Total Hip Arthroplasty, Physiotherapy

ARTICLE SUMMARY

STRENGTHS AND LIMITATIONS

- This is a relatively large patient cohort of 2769 total hip and knee replacements performed over a 2 year period at a single orthopaedic unit evaluating a consistent and specific delivery model of post-discharge rehabilitation provision.
- A particular strength of this study design is the depth of linked demographic and outcomes data available with which to construct the predictive models.
- Data relating to access of post-surgical physiotherapy was reported by the patient at 6 months post-operation via a survey tool, and is open to responder biases, however the large sample size somewhat mitigates this issue.
- We are not able to determine the referral route by which the patient accessed post-discharge therapy, nor the specific content of the physiotherapy received.

INTRODUCTION

Lower limb osteoarthritis is an extremely common and disabling condition, which may ultimately require surgical intervention. In excess of 90,000 total hip and 90,000 total knee arthroplasties (THA and TKA) are performed each year in the UK alone[1]. Projections suggest continued increases of surgical volume year on year[2 3]. Though joint replacement is effective at reducing pain and improving physical function in patients with end stage osteoarthritis, a sub-group of patients continue to report dissatisfaction with their post-operative outcome[4 5] highlighted by protracted physical impairment [6] and activity limitations[7-10].

Physiotherapy is thought to be an important component in achieving optimal results following THA or TKA[11]. Immediately post-surgery, throughout the inpatient stay, physiotherapy is aimed at encouraging mobilisation and facilitating a safe discharge. Though subsequent post- discharge physiotherapy is often promoted there is considerable national and international variation in actual therapy provision. Specific rehabilitation protocols are strongly entrenched at individual physiotherapy departments however the wider efficacy of post-operative physiotherapeutic intervention is poorly established[12-18]. This uncertainty as to effectiveness of physiotherapy interventions makes it difficult for commissioning organisations, healthcare providers, and patients to make decisions as to the role of post-discharge physiotherapy following total joint arthroplasty, and in determining the correct level and mechanism of funding for such services. As a result there is substantial variety in the delivery and content of post-operative physiotherapy following joint arthroplasty across the UK.

The purpose of this study was to explore variation in patient access of post-discharge physiotherapy following THA and TKA under a choice based system in the UK. Under this service model, routine post-discharge out-patient physiotherapy is not provided following THA and TKA. Instead the local standard of care is for patients to undertake prescribed home exercises, with all patients able to access additional out-patient physiotherapy services should they require or wish to do so. Specifically, we investigated what proportion of patients accessed post-discharge physiotherapy following THA and TKA, whether accessing therapy was associated with post-arthroplasty patient reported outcomes and whether it was possible to predict which patients would access post-discharge physiotherapy from pre-operative data.

METHODS

Study design and participants

This was a prospective observational cohort study. All patients undergoing primary THA and TKA were invited to participate in the study that ran alongside the department's routine outcomes data collection project. Data collection was through questionnaires administered pre-operatively at hospital clinic appointment (2 weeks prior to surgery) and then via postal review at 6 months post-operatively. Patients were sent forms on the 6 month anniversary of the surgical episode, with a further follow-up sent 2 weeks later if no response was received.

Ethical approval was obtained from the Scotland A Research Ethics Committee (11/AL/0079). All study participants provided informed consent prior to inclusion in the cohort. Patients undergoing primary unilateral THA or TKA at a single National Health Service teaching hospital were prospectively assessed over a 32 month period between January 2013 and September 2015.

The study centre is the only hospital receiving adult referrals for a predominantly urban regional population of approximately 850 000 people. Surgery was carried out by 12 consultant orthopaedic surgeons and their supervised trainees. Local protocols were followed for all aspects of pre-operative, inpatient, and post-operative care.

Pre-operatively a booklet was provided to patients with information about the procedure (THA or TKA) which included detail on rehabilitation, advising as to activity and highlighting exercises to perform. Immediate post-operative therapy (inpatient stay) was protocol driven focussing on knee range of movement, muscle re-education and mobilising with appropriate walking aids to facilitate a safe discharge. Post-discharge practice at the study centre is to promote continued performance of the exercises learned and only to provide outpatient physiotherapy as required. As such, patients were referred to out-patient physiotherapy based on clinically assessed need at time of discharge or at 6 week post-operative clinical review, with additional referral routes available to the patient through general practice services and a national patient self-referral telephone triage system.

Demographic data was obtained for the patient's age, sex, BMI and socioeconomic denominators using the Scottish Index of Multiple Deprivation (SIMD). The SIMD is a national statistic based on postcode. It combines data on 38 indicators across 7 domains, namely: income, employment, health, education, skills and training, housing, geographic access and crime. We applied the 2012 SIMD national dataset, and report quintiles (from least deprived to most deprived; the 5th quintile representing the most deprived patients). We employed the 'datazone' approach where quintile cut-points are identified based on the potential scores in the national SIMD dataset as opposed to reporting quintile distributions calculated from the population in question Physical outcomes were assessed with the Oxford Hip or Knee Score (OHS and OKS) and EuroQol- 5 Dimension (EQ-5D) questionnaire. Both questionnaires have been thoroughly validated and are the national statistics of choice in the UK for measuring arthroplasty outcomes.

Outcome measures

The Oxford Hip and Knee Scores each consist of 12 questions assessing the patient's pain and function[19 20]. Each item is answered on a 5-point response scale ranging from 0 to 4, generating a summed total score ranging from 0 to 48, where 0 indicates the worst possible outcome and 48 good joint function.

The EQ-5D is a standardised instrument with five items covering mobility, self-care, usual activities, pain and discomfort as well as anxiety and depression[21]. As a measure of self-reported general health, it is applicable to a wide range of health conditions and treatments and provides a simple descriptive profile and a single index value for health status. Lower scores represent a worse health state. We applied the most commonly used EQ-5D-3L version, where there are 3 possible responses to the 5 questions.

Patient surgical episode satisfaction was assessed using a 5 point Likert response format at 6 months post-surgery. Patients were asked to rate their overall satisfaction with their operated hip or knee (response options: very satisfied, satisfied, unsure, dissatisfied, or very dissatisfied). Self-report of physiotherapy attendance was recorded at 6 month assessment.

Patient and Public Involvement

There was no specific patient involvement in the design or conduct of the study methodology, however the study question as to the role of physiotherapy in the post-operative period following joint arthroplasty was highlighted as a priority area for research by a patient feedback project at the study centre.

Statistical analysis

Analyses were performed with SPSS V21.0[22]. Demographic indicators are presented as frequencies or means with standard deviations as a measure of dispersal. Differences between patients who accessed physiotherapy after total joint arthroplasty and those who did not were investigated with t-tests, chi-square tests, and Mann-Whitney-U tests as appropriate. Effect sizes for differences in continuous variables are given as Cohen's d.

To identify predictors of physiotherapy access we used a binary logistic regression model with physiotherapy access as dependent variable and patient characteristics and preoperative OKS/OHS and EQ-5D as predictors. The predictors were included using a forward selection stepwise model building technique (likelihood ratio) with an entry criterion of alpha=0.05. Model fit is described with percentage of correct classifications and predictors are given as odds ratios with corresponding 95% confidence intervals. Using this methodology, the chance level of correct classifications is 50% and the model-based classification is compared against this value.

RESULTS

1534 patients underwent primary THA and 1503 primary TKA in the study time window. 97% of cases were coded as being performed for a diagnosis of osteoarthritis (the remaining patients being coded as rheumatoid or psoriatic arthritis). Survey data was available for 1395 (90.9%) patients that underwent THA and for 1374 (91.4%) patients that underwent TKA. All data was included in the analysis. Patients with THA had a mean age of 67.6 ± 11.8 years, 58.1% were female, patients with TKA had a mean age 69.7 ± 9.3 years, 56.6% were female. Of this total surgical cohort, 493 (35.3%) THA and 662 (48.2%) TKA patients accessed post-operative out-patient physiotherapy.

Total Hip Arthroplasty

Patients with TKA accessing post-discharge physiotherapy were younger (64.9 vs 69.1 years, $p<0.001$) and more likely to be female ($p<0.001$), however there were no differences in BMI ($p=0.788$) or social deprivation index ($p=0.438$) between the groups (Table 1).

Patients that did not access post-discharge physiotherapy had statistically higher scores (39.4±8.6) on the OHS than patients who accessed post-discharge physiotherapy (35.8±9.8) at 6 months follow-up ($p<0.001$). At baseline, patients that accessed post-discharge physiotherapy had statistically lower scores (20.1±8.6) than patients who accessed post-discharge physiotherapy (21.4±8.6) on the OHS ($p=0.008$). However patients who accessed physiotherapy made a larger gain in pain and function scores with the OHS: improvement from baseline to 6 months follow-up was 15.6±10.6 points without post-discharge physiotherapy access and 18.0±9.9 points for such that did access physiotherapy ($p<0.001$, Cohen's $d=0.23$) (Table 1 and Figure 1).

EQ-5D scores were lower in patients accessing post-discharge physiotherapy both pre-surgery (0.35 vs 0.41, p=0.004,) and post-surgery (0.70 vs 0.80, p<0.001). Cohen's d for pre-postoperative improvement was 0.12 with mean changes in EQ-5D score of 0.35 in those that accessed physiotherapy compared to 0.39 in those that did not (p=0.023) (Table 1 and Figure 2).

The patients who did not access post-operative physiotherapy reported greater surgical episode satisfaction at 6 months (p<0.001, Z=-6.43), twice the number of patients reporting either dissatisfied or very dissatisfied were observed in the group that accessed physiotherapy (Table 1).

Total Knee Arthroplasty

Patients with TKA accessing post-discharge physiotherapy were modestly but significantly younger (68.2 vs 71.0 years, p<0.001). There was no difference in sex (p=0.099). Patients who accessed physiotherapy were more likely to live in a less deprived area (p=0.028); there was no difference in BMI between groups (p=0.198) (Table 2).

Patient outcomes were superior in the 51.8% of TKA patients that did not access post-discharge physiotherapy in terms of absolute OKS (35.9 vs 32.3 points, p<0.001). There was no difference in pre-operative score between groups (20.9 points in each group p=0.965), reflected in a lesser change in OKS for the patients who accessed post-discharge physiotherapy (11.4 points vs 15.0 points, p<0.001, Cohen's d=0.39) (Table 2 and Figure 3).

There were also differences in improvement measured with the EQ-5D (Table 2). Patients accessing post-discharge physiotherapy improved 0.25 points, compared to 0.35 points in those who did not (p<0.001, Cohen's d=0.32, Figure 4). Again there was no difference in pre-operative scores between groups (0.43 vs 0.41, p = 0.183), while post-operative scores differed significantly (0.68 vs 0.77, p<0.001).

The patients who did not access post-operative physiotherapy reported greater surgical episode satisfaction (p<0.001, Z=-8.22), with twice the number of patients dissatisfied and very dissatisfied in the group that accessed post-discharge physiotherapy (Table 2).

Multivariate analysis

Binary logistic regression modelling was undertaken to determine if post-operative access to physiotherapy could be predicted by pre-operative patient variables. A regression model with three predictors (age, sex and pre-operative EQ-5D score) was able to correctly classify 66.9% of patients with THA in regard to post-operative physiotherapy access (Table 3). This percentage of correct classifications was significantly (p<0.001) different from chance level (50% correct classifications). In patients with TKA the regression model comprised only two significant predictors (age and sex) and provided a percentage of correct classifications of 57.4%, again significantly better than chance (p<0.001).

DISCUSSION

There is no consensus as to how best to rehabilitate patients following THA or TKA. Systematic reviews of post-operative rehabilitation interventions suggest that no one approach is beneficial in improving outcomes[8 16 18] and a recent Cochrane review stressed the general low quality of the

evidence base[23]. In this study we review an 'access physiotherapy as needed' model of post-discharge service delivery. Routine post-discharge out-patient physiotherapy was not provided following THA and TKA. Instead the local standard of care was for patients to undertake prescribed home exercises, with all patients able to access additional out-patient physiotherapy services should they require or wish to do so. Under this system, patients can be referred to physiotherapy based on clinical need as determined by clinical staff at time of discharge (either inpatient medical or therapy teams), or at 6 week out-patient review (medical, nursing or therapy team performing these out-patient post-surgery reviews), or at any point through the patient's General Practitioner service. Separately the patient could refer themselves via a self-referral telephone triage system or access private physiotherapy self-funded and distinct to physiotherapy provision via the National Health Service.

Under this system, only a third of patients that underwent THA and half of those who underwent TKA accessed post-discharge outpatient physiotherapy to assist with their recovery. The patients that did not access post-discharge physiotherapy do not seem to have been adversely affected by this decision as this group reported better outcome scores. A difference in pre-to post-operative change in Oxford Score of approximately 3 points was observed between the THA patients, and approximately 4 points in the TKA patients that accessed physiotherapy compared to those that did not. The minimal clinically important difference in Oxford Scores has been estimated at 5 points[24], in THA and 4 points in TKA suggesting the statistical differences reported in the THA patients are unlikely to reflect a clinically meaningful difference, but that the TKA data may represent variation in clinical outcomes between groups.

The Oxford Scores, EQ-5D scores and satisfaction scores at 6 months reported by the patients that *did not* access additional post-discharge physiotherapy compare well to national outcome figures for both THA and TKA patients[25]. This suggests that post-discharge outpatient physiotherapy is not necessarily required in all cases, and that (broadly) patients and clinicians are able to make a judgement as to whether they should attend such therapy.

This is an observational cohort study and we do not attempt to evaluate the effectiveness of undertaking post-discharge physiotherapy with this data. Those who accessed additional therapy in this cohort reported lower scores, suggesting greater physical dysfunction in the early post-operative phase. It may be that the additional therapy improved the patient outcomes compared to having had no such intervention. Patients and clinicians expect a rehabilitation component to be provided as part of the care pathway for joint arthroplasty. Though there is a role for physiotherapy around total joint arthroplasty, it may be that post-discharge physiotherapy should be targeted to those that require additional rehabilitation to optimise outcomes as opposed to blanket provision for all in the early post-operative phase. In this setting, self-directed home exercises appear to have been sufficient for the majority of patients to achieve a good outcome post-arthroplasty. This finding could be explored for cost-effectiveness from the health economic and service delivery perspective, however relies on accurately targeting physiotherapy to those that require the additional input.

We were able to construct statistically significant regression models using pre-operative data to correctly classify the patients that accessed post-operative therapy, however these models were poor in terms of accuracy. The model describing access of post-discharge physiotherapy following THA was only 17% greater than chance at identifying the patients that accessed physiotherapy. The patients that underwent THA who accessed physiotherapy post-discharge reported lower general health scores (EQ-5D) but broadly equivalent joint specific pain and function (OHS). The EQ-5D data essentially drove the regression model and perhaps suggests poorer health status may be related to the requirement for additional therapy; however it must be noted that these patients were on

average 5 years younger than those that did not attend additional physiotherapy, suggesting health and not age is the pertinent factor here. Interestingly pre-operative pain and functional ability (Oxford Score), BMI and deprivation status did not influence the models.

Notably more TKA patients required or wished to access additional physiotherapy than THA, which is perhaps consistent with the reports of greater treatment success and patient outcomes following hip arthroplasty[5 26]. Despite applying a range of pre-operative demographic and symptom state indicators, we were only able to model the additional use of post-discharge physiotherapy to an accuracy of 7% greater than chance. Interestingly in the TKA cohort, the model relied solely on small associations with age and sex. In this model, pre-operative pain / function / health scores, social deprivation and BMI did not help determine which patient would go on to require additional therapy.

Though various factors have been associated with poor clinical outcomes following TKA, currently, we cannot reliably predict pre-operatively who will struggle to recover post-operatively. Larger and more comprehensive predictor studies (for example incorporating psychological variables) are required to determine which patient factors lead to poorer post-operative outcomes and to see if particular patient groups benefit from post-discharge physiotherapy. Further insight may be provided by the multicentre TRIO and COASt studies that are currently evaluating this in the UK[26, 27]. Alternatively, it may be that it is the patient's response to surgery as opposed to pre-operative characteristics that determine the need for post-operative rehabilitation and that there is no reliable way to predict this pre-operatively.

Strengths and Limitations

A strength of this study is the relatively large patient cohort of 2769 arthroplasties and the depth of linked demographic and outcome data. Additionally, that our data is in line with UK national figures for patient demographics and pre and post-operative outcome scores lends wider credibility. Limitations are that the access of post-discharge physiotherapy was documented and reported by the patient at 6 months post-arthroplasty, which open potential responder biases. Further, we are not able to determine the route by which the patient accessed this post-discharge therapy, nor the content of the specific physiotherapy received. The relatively short post-operative 6 month timeframe results that we cannot comment on longitudinal changes in outcomes, nor whether those patients that access physiotherapy 'caught-up' with those that did not in terms of clinical outcome scores at subsequent later time points. The study was not designed to evaluate the effectiveness of the physiotherapy received, however future studies may be able to target therapy to patients deemed 'at need of intervention', and randomise to differing levels or modes of intervention.

CONCLUSION

In a choice based service model of targeted physiotherapy 'as required' following hip and knee arthroplasty only a third of THA and half of TKA patients accessed post-discharge physiotherapy. Patients who reported greater post-operative outcome scores and surgical episode satisfaction did not access additional therapy, suggesting a variation in requirement for post-arthroplasty physiotherapy. We were unable to predict pre-operatively (with demographic and symptom data) which patients would subsequently access additional input.

CONTRIBUTORS

DFH, conceived the study, interpreted the results, drafted and revised the manuscript. FCL performed the statistical analysis, drafted the results and contributed to manuscript revisions. DJM obtained the data, collated the data and contributed to manuscript drafting and revision. GMF contributed to results interpretation, manuscript drafting and revision. DJB contributed to results interpretation, manuscript drafting and revision. HRS contributed to results interpretation, manuscript drafting and revision. JTP contributed to the study design, results interpretation, manuscript drafting and revision. CRH contributed to the study design, results interpretation, manuscript drafting and revision.

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CONFLICT OF INTEREST STATEMENT

DFH, DJB, GMF and HRS, are grant holders on the Arthritis Research UK funded TRIO study. Though there is no financial or direct academic conflict, this work can be considered as relevant background for the (currently) ongoing TRIO study.

ETHICAL APPROVAL

Ethical approval was obtained from the Scotland A Research Ethics Committee (11/AL/0079).

DATA SHARING STATEMENT

The raw data cannot be made publicly available to protect patient confidentiality, however restricted data may be made available if deemed reasonable by the data custodian. Such requests should be made to CRH via the corresponding author.

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TABLES

Table 1 Demographic and outcome data for patients with THA by post-discharge physiotherapy access

Referred for physiotherapy	Yes	No	Effect size	statistic	significance
Sex N (%)					
female	324 (65.7)	486 (53.9)		X^2 = 18.352	p<0.001‡
male	169 (34.3)	416 (46.1)			
Side N (%)					
left	212 (43.5)	422 (47.6)		X^2 = 2.123	p=0.157‡
right	275 (56.5)	464 (52.4)			
SIMD					
1st quintile N (%)	37 (7.5)	76 (8.4)		Z = -0.78	p=0.438*
2nd quintile N (%)	78 (15.8)	160 (17.7)			
3rd quintile N (%)	85 (17.2)	166 (18.4)			
4th quintile N (%)	129 (26.2)	193 (21.4)			
5th quintile N (%)	164 (33.3)	307 (34.0)			
Age Mean (SD)	64.9 (13.2)	69.1 (10.6)	0.35±	T = -6.08	p<0.001†
BMI Mean (SD)	28.3 (6.9)	28.2 (5.0)	0.02±	T = 0.27	p=0.788†
OHS					
Pre-op	20.1 (8.6)	21.4 (8.6)	1.31±	T = -2.67	p=0.008†
Post-op	35.8 (9.8)	39.4 (8.6)	0.39±	T = -6.96	p<0.001†
Change	15.6 (10.6)	18.0 (9.9)	0.23±	T = -4.06	p<0.001†
EQ-5D					
Pre-op	0.35 (0.3)	0.41 (0.3)	0.20±	T = -2.92	p=0.004†
Post-op	0.70 (0.3)	0.80 (0.2)	0.39±	T = -6.52	p<0.001†
Change	0.35 (0.4)	0.39 (0.3)	0.12±	T = -2.28	p=0.023†
Satisfaction					
Very satisfied	280 (57.4)	648 (73.3)		Z = -6.43	p<0.001*
Satisfied	122 (25.0)	165 (18.7)			
Neither satisfied nor	44 (9.0)	43 (4.9)			
dissatisfied	27 (5.5)	13 (1.5)			
Dissatisfied	15 (3.1)	15 (1.7)			
Very dissatisfied					

Mann-Whitney-U*, t-test†, Chi-square‡, Cohen's d±

Scottish Index of Multiple Deprivation (SIMD); Body Mass Index (BMI); Oxford Hip Score (OKS); EuroQol 5-Dimension (EQ-5D)

Table 2 Demographic and outcomes data for patients with TKA by post-discharge physiotherapy access

Referred for physiotherapy	Yes	No	Effect size	statistic	significance
Sex N (%)					
female	390 (58.9)	388 (54.5)		X^2 = 2.726	p=0.099‡
male	272 (41.1)	324 (45.5)			
Side N (%)					
left	321 (49.5)	337 (47.7)		X^2 = 0.404	p=0.525‡
right	328 (50.5)	369 (52.3)			
SIMD					
1st quintile N (%)	63 (9.5)	66 (9.3)		Z = -2.19	p=0.028*
2nd quintile N (%)	104 (15.7)	162 (22.8)			
3rd quintile N (%)	122 (18.4)	136 (19.1)			
4th quintile N (%)	164 (24.8)	138 (19.4)			
5th quintile N (%)	209 (31.6)	210 (29.5)			
Age Mean (SD)	68.2 (9.7)	71.0 (8.6)	0.30±	T = -5.73	p<0.001†
BMI Mean (SD)	31.1 (6.0)	30.6 (5.9)	0.01±	T = 1.29	p=0.198†
OKS					
Pre-op	20.9 (7.8)	20.9 (7.9)	<0.01±	T = -0.04	p=0.965†
Post-op	32.3 (9.8)	35.9 (9.1)	0.38±	T = -6.99	p<0.001†
Improvement	11.4 (9.4)	15.0 (8.9)	0.39±	T = -7.16	p<0.001†
EQ-5D					
Pre-op	0.43 (0.3)	0.41 (0.3)	0.07±	T = 1.33	p=0.183†
Post-op	0.68 (0.3)	0.77 (0.2)	0.35±	T = -6.34	p<0.001†
Improvement	0.25 (0.3)	0.35 (0.3)	0.32±	T = -6.15	p<0.001†
Satisfaction, N (%)					
Very satisfied	271 (41.6)	427 (61.3)		Z = -8.22	p<0.001*
Satisfied	214 (32.8)	198 (28.4)			
Neither satisfied nor dissat	98 (15.0)	43 (6.2)			
Dissatisfied	51 (7.8)	20 (2.9)			
Very dissatisfied	18 (2.8)	9 (1.3)			

Mann-Whitney-U*, t-test†, Chi-square‡, Cohen's d±

Scottish Index of Multiple Deprivation (SIMD); Body Mass Index (BMI); Oxford Knee Score (OKS); EuroQol 5-Dimension (EQ-5D)

Table 3 Predictive accuracy of demographic and preoperative outcome-parameters for patients accessing post-discharge physiotherapy

	THA				TKA			
	OR	95% confidence interval	p	Correct classifications	OR	95% confidence interval	p	Correct classifications
Age	1.03	1.02-1.04	<0.001	66.9 %	1.04	1.02-1.05	<0.001	57.4 %
Sex	1.60	1.27-2.03	<0.001		1.26	1.01-1.58	0.038	
EQ-5D	1.54	1.08-1.20	0.018		-	-	-	-

FIGURES

Figure 1 - Change in Oxford Hip Scores by post-operative physiotherapy access in THA patients

Figure 2 - Change in EQ-5D scores by post-operative physiotherapy access in THA patients

Figure 3 - Change in Oxford Knee Scores by post-operative physiotherapy access in TKA patients

Figure 4 - Change in EQ-5D scores by post-operative physiotherapy access in TKA patients

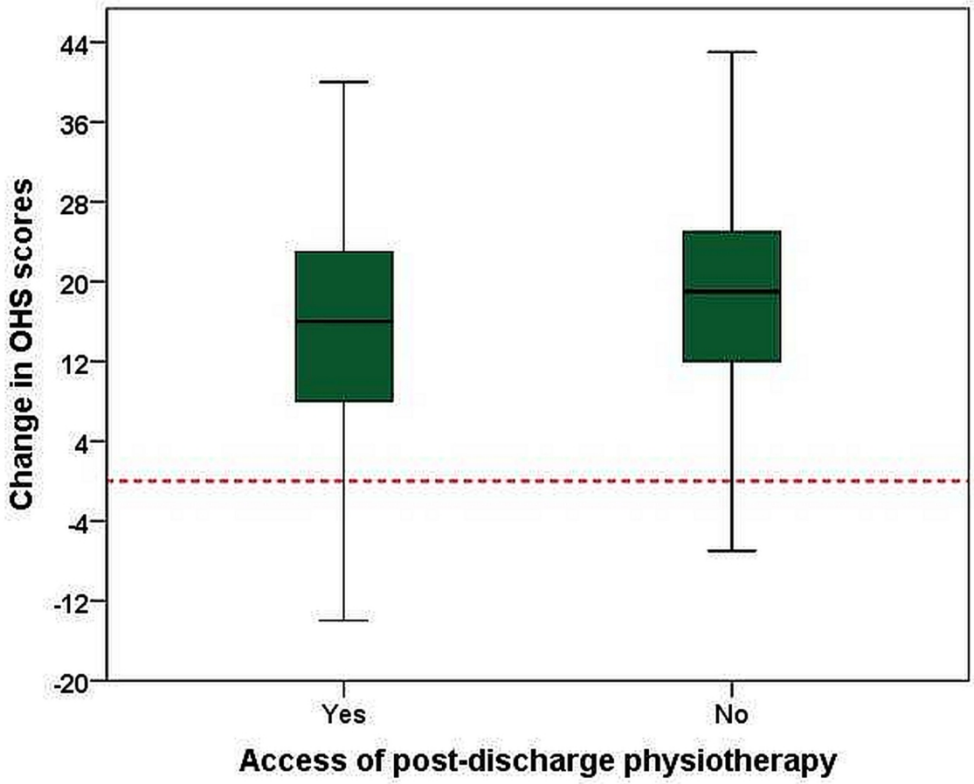

Figure 1 - Change in Oxford Hip Scores by THA post-discharge physiotherapy access

221x174mm (300 x 300 DPI)

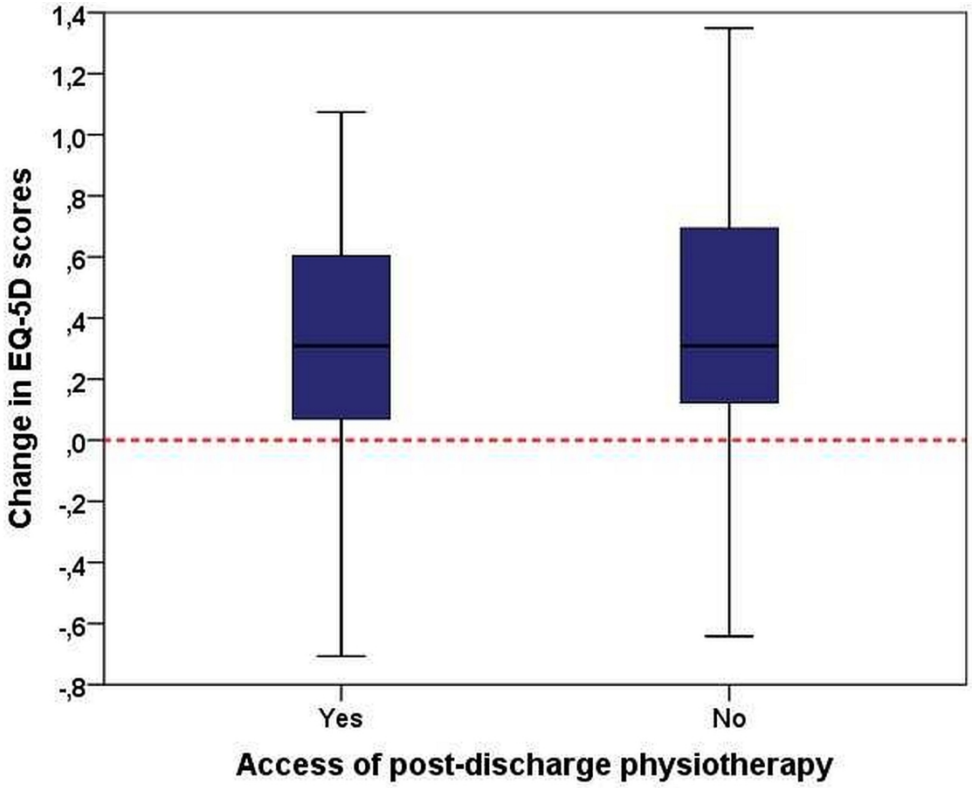

Figure 2 - Change in EQ-5D scores by THA post-discharge physiotherapy access

221x177mm (300 x 300 DPI)

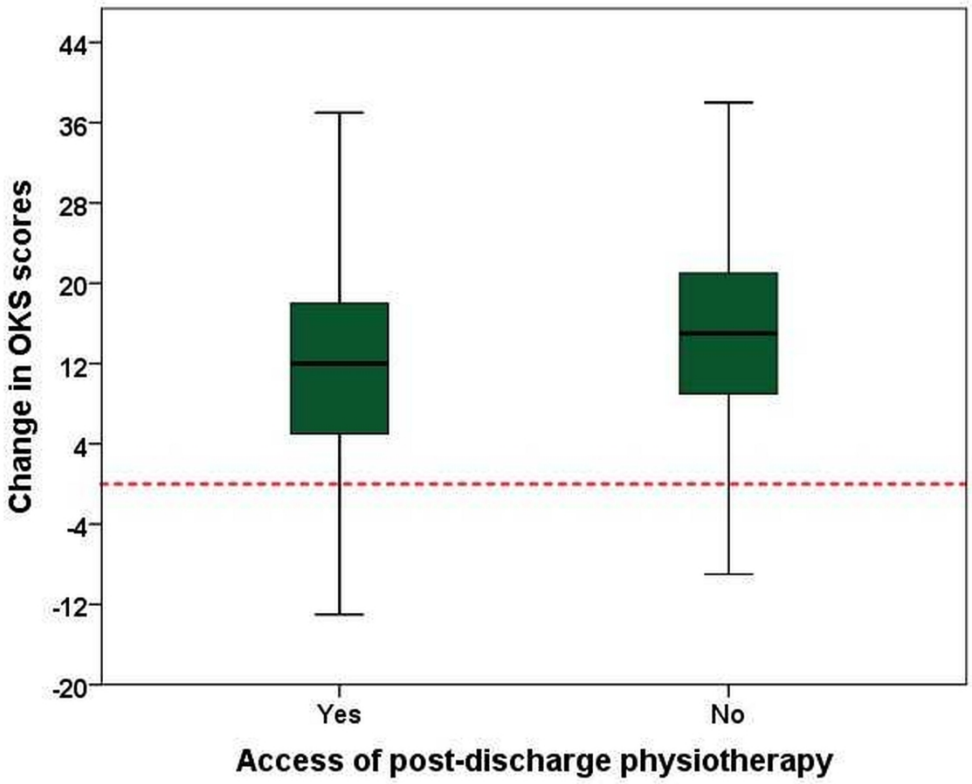

Figure 3 - Change in Oxford Knee Scores by TKA post-discharge physiotherapy access

221x177mm (300 x 300 DPI)

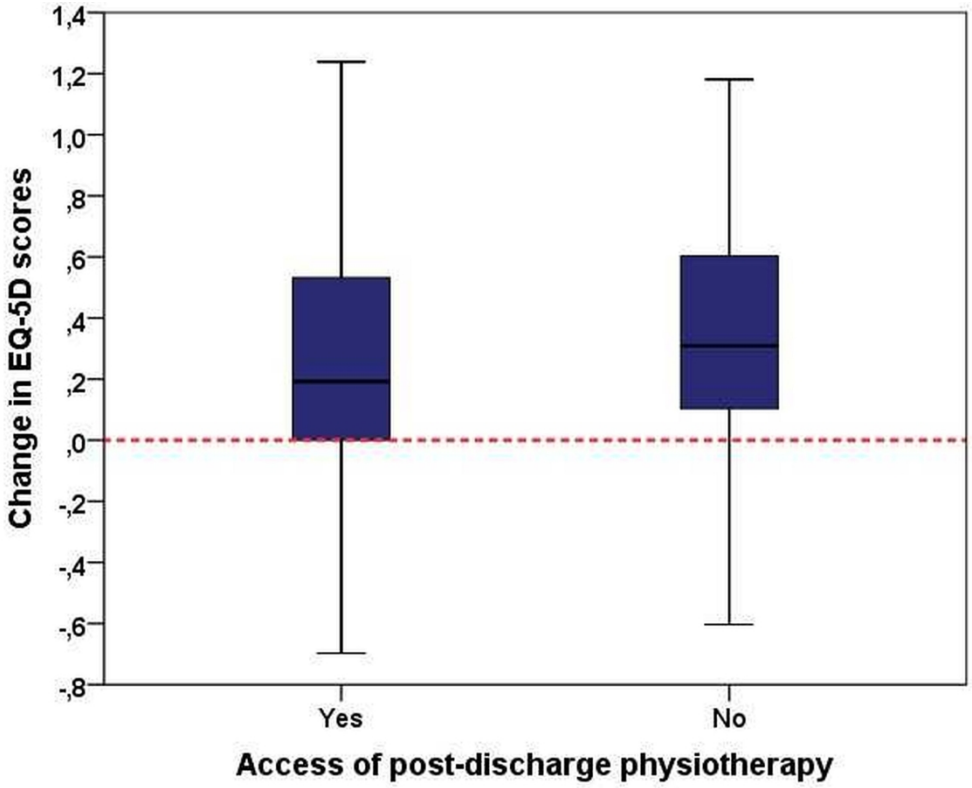

Figure 4 - Change in EQ-5D scores by TKA post-discharge physiotherapy access

221x177mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4,5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	4,5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4,5
Bias	9	Describe any efforts to address potential sources of bias	4,5
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5,6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5,6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	4
		(*d*) If applicable, explain how loss to follow-up was addressed	4
		(*e*) Describe any sensitivity analyses	6
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6,7
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	6,7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6,7
		(*b*) Report category boundaries when continuous variables were categorized	6,7
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	8,9
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8,9
Generalisability	21	Discuss the generalisability (external validity) of the study results	8,9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	10

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.