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### Citation for published version:

Robinson, P, Khan, S, MacDonald, D, Murray, I, Macpherson, G & Clement, N 2022, 'Golfers have a greater improvement in their hip specific function compared to non-golfers after total hip arthroplasty but less than three-quarters returned to golf', *Bone & Joint Open*, vol. 3, no. 2, pp. 145–151. <https://doi.org/10.1302/2633-1462.32.BJO-2022-0002.R1>

### Digital Object Identifier (DOI):

[10.1302/2633-1462.32.BJO-2022-0002.R1](https://doi.org/10.1302/2633-1462.32.BJO-2022-0002.R1)

### Link:

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### Document Version:

Publisher's PDF, also known as Version of record

### Published In:

Bone & Joint Open

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## ■ HIP

# Golfers have a greater improvement in their hip specific function compared to non-golfers after total hip arthroplasty, but less than three-quarters returned to golf

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## Aims

Golf is a popular pursuit among those requiring total hip arthroplasty (THA). The aim of this study was to determine if participating in golf is associated with greater functional outcomes, satisfaction, or improvement in quality of life (QoL) compared to non-golfers.

## Methods

All patients undergoing primary THA over a one-year period at a single institution were included with one-year postoperative outcomes. Patients were retrospectively followed up to assess if they had been golfers at the time of their surgery. Multivariate linear regression analysis was performed to assess the independent association of preoperative golfing status on outcomes.

## Results

The study cohort consisted of a total of 308 patients undergoing THA, of whom 44 were golfers (14%). This included 120 male patients (39%) and 188 female patients (61%), with an overall mean age of 67.8 years (SD 11.6). Golfers had a greater mean postoperative Oxford Hip Score (OHS) (3.7 (95% confidence interval (CI) 1.9 to 5.5);  $p < 0.001$ ) and EuroQoL visual analogue scale (5.5 (95% CI 0.1 to 11.9);  $p = 0.039$ ). However, there were no differences in EuroQoL five-dimension score ( $p = 0.124$ ), pain visual analogue scale ( $p = 0.505$ ), or Forgotten Joint Score ( $p = 0.215$ ). When adjusting for confounders, golfers had a greater improvement in their Oxford Hip Score (2.7 (95% CI 0.2 to 5.3);  $p < 0.001$ ) compared to non-golfers. Of the 44 patients who reported being golfers at the time of their surgery, 32 (72.7%) returned to golf and 84.4% of those were satisfied with their involvement in golf following surgery. Those who returned to golf were more likely to be male ( $p = 0.039$ ) and had higher (better) preoperative health-related QoL ( $p = 0.040$ ) and hip-related functional scores ( $p = 0.026$ ).

## Conclusion

Golfers had a greater improvement in their hip-specific function compared to non-golfers after THA. However, less than three-quarters of patients return to golf, with male patients and those who had greater preoperative QoL or hip-related function being more likely to return to play.

**Cite this article:** *Bone Jt Open* 2022;3-2:145–151.

**Keywords:** Golf, Hip, Arthroplasty, Outcomes, Recovery

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doi: 10.1302/2633-1462.32.BJO-  
2022-0002.R1

*Bone Jt Open* 2022;3-2:145–151.

## Introduction

Total hip arthroplasty (THA) is an effective treatment for hip arthritis that can return patients to a pain-free and functional state.<sup>1–3</sup> There are over 175,000 hip and knee

arthroplasties performed in England, Wales, and Scotland each year,<sup>4,5</sup> while 1.88 million hip and knee arthroplasties performed are in the USA,<sup>6</sup> and the volume is predicted to continue to grow.<sup>7,8</sup> When patients are

**Table 1.** Preoperative demographics and functional outcomes between both golfers and non-golfers.

Demographic	Study cohort (n = 514)	Golfer		Difference/OR (95% CI)	p-value
		No (n = 264)	Yes (n = 44)		
<b>Sex (%)</b>					
Male	120 (39)	82	38		
Female	188 (61)	182	6	OR 0.1 (0.03 to 0.2)	< 0.001*
<b>Side (%)</b>					
Left	182 (59.1)	159	23		
Right	126 (40.9)	105	21	OR 1.4 (0.7 to 2.6)	0.320*
Mean age, yrs (SD)	67.8 (11.6)	68.2 (11.2)	65.3 (11.1)	Diff -3 (-6.7 to 0.7)	0.116†
Mean BMI kg/m <sup>2</sup> (SD)	28 (5.3)	28 (5.5)	27.5 (4.1)	Diff -0.6 (-2.3 to 1.1)	0.510†
<b>Comorbidities, n</b>					
IHD	30	26	4	OR 0.9 (0.3 to 2.8)	0.568‡
COPD	28	27	1	OR 0.2 (0.03 to 1.4)	0.066‡
Vascular disease	30	29	1	OR 0.2 (0.03 to 1.4)	0.096‡
Diabetes	41	37	4	OR 0.6 (0.2 to 1.8)	0.477‡
Gastric ulcer	24	22	2	OR 0.5 (0.1 to 2.3)	0.549‡
Kidney disease	25	23	2	OR 0.5 (0.1 to 2.2)	0.551‡
Liver disease	24	22	4	OR 1.1 (0.4 to 3.4)	0.775‡
Cerebrovascular disease	22	21	1	OR 0.3 (0.04 to 2.1)	0.337‡
Mean preoperative EQ-5D VAS (SD)	70.6 (20.7)	69.9 (21.1)	74.8 (18.5)	Diff 4.8 (-1.8 to 11.4)	0.153†
Mean preoperative EQSD Index (SD)	0.407 (0.311)	0.396 (0.309)	0.477 (0.315)	Diff 0.1 (-0.2 to 0.2)	0.109†
Mean preoperative pain VAS (SD)	52.2 (21.9)	52.1 (21.9)	52.4 (21.9)	Diff 0.4 (-6.7 to 7.4)	0.923†
Mean preoperative OHS (SD)	20.6 (8.2)	20.0 (8.0)	23.9 (8.4)	Diff 3.8 (1.3 to 6.4)	0.004†

\*Chi-squared test.

†Independent-samples *t*-test.

‡Fisher's exact test.

CI, confidence interval; COPD, chronic obstructive pulmonary disease; EQ-5D, EuroQol five-dimension questionnaire; IHD, ischaemic heart disease; OHS, Oxford Hip Score; OR, odds ratio; SD, standard deviation; VAS, visual analogue scale.

physically active prior to their THA, they are more likely to return to being “back to normal” compared to inactive patients.<sup>9</sup> It has been reported that up to 20% of patients who undergo lower limb arthroplasties are golfers.<sup>10</sup> Therefore, the impact of arthritis on golfers' quality of life (QoL) can be significant if it prevents them from participating in their favoured recreational activities.<sup>11</sup> A previous study has shown that restrictions to golf during the COVID-19 pandemic had a negative effect on well-being and life satisfaction, and that the reopening of golf courses improved a sense of belonging and enjoyment.<sup>12</sup> Similar impacts may occur when golfers who suffer from arthritis are unable to play the game and can no longer enjoy the social and health benefits of playing.

Playing golf can contribute to meeting the World Health Organization (WHO) recommendations for physical activity.<sup>13</sup> A previous study reported that golfers live, on average, five years longer than a matched non-golfing cohort.<sup>14</sup> However, it is unclear whether being a golfer has any influence on the functional outcomes following THA compared to non-golfers. It is possible that their expectations may be different, and this has previously been shown to influence outcome.<sup>15,16</sup> In addition, there is a paucity of knowledge regarding golfers' motivation to return to golf following THA, and whether there are factors that influence the rate of return to golf.

The primary aim of this study was to assess if golfers had greater improvement in their hip-specific outcomes compared to non-golfers one year following surgery. The secondary aims were to assess preoperative differences in demographics, symptoms, and function; postoperative differences in health-related quality of life (HRQoL); the rates of return to golf following surgery and factors that influence this; and the influence of golf on motivation and recovery following THA.

## Methods

Patients were identified from a prospectively compiled arthroplasty database. One year (2016) of patients undergoing primary THA for osteoarthritis (OA) were included (n = 439). All patients received the Exeter polished taper V40 cemented femur (Stryker, USA) and either a Trident acetabulum (Stryker) or cemented Contemporary cup (Stryker). Inclusion criteria were: primary THA, unilateral surgery, preoperative diagnosis of OA, and preoperative and one-year postoperative outcome measures. Exclusion criteria included those not consenting to follow-up, or revision surgery. Demographic and comorbidity data were collected preoperatively. Patients were retrospectively followed up to assess if they had been golfers at the time of their surgery. They were also asked questions

**Table II.** Comparison of postoperative variables between golfers and non-golfers.

Outcome variables	Golfer		Difference (95% CI)	p-value*
	No (n = 264)	Yes (n = 44)		
EQ VAS	77.1 (20.6)	82.6 (15.2)	5.5 (0.1 to 11.9)	0.039
EQ-5D Index	0.793 (0.225)	0.85 (0.229)	0.1 (-0.02 to 0.10)	0.124
Pain VAS	75.3 (29.4)	78.5 (31.1)	3.2 (-6.3 to 12.7)	0.505
OHS	39.5 (7.7)	43.1 (5.2)	3.7 (1.9 to 5.5)	< 0.001
FJS	56.4 (30.1)	62.1 (27.3)	5.7 (-3.4 to 14.7)	0.215

\*Independent-samples *t*-test.

CI, confidence interval; EQ-5D, EuroQol five-dimension questionnaire; FJS, Forgotten Joint Score; OHS, Oxford Hip Score; VAS, visual analogue scale.

regarding their involvement and expectations regarding golf postoperatively.

**Outcomes measurements.** The primary outcome measure was the Oxford Hip Score (OHS),<sup>17,18</sup> which was recorded preoperatively and at one year postoperatively. The OHS comprises 12 questions assessed on a Likert scale with values from 0 to 4. A summative score is then calculated where 48 is the best possible score (least symptomatic) and 0 is the worst possible score (most symptomatic). The minimal clinically important difference (MCID) for the OHS is five points, and is thought to represent a clinical difference between two groups of patients.<sup>19</sup>

The Forgotten Joint Score (FJS) consists of 12 questions and evaluates the awareness of the affected joint during an array of activities of daily living. Each question is scored on a Likert scale ranging from 0 to 4. The total sum of the scores is converted into a scale ranging from 0 to 100, where higher scores reflect less joint awareness.

The EuroQoL (EQ) general health questionnaire evaluates five domains (5D: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) and was recorded preoperatively and at one year postoperatively.<sup>20</sup> The three-level (3L) version of the EQ questionnaire was used, with the responses to the five domains being recorded at three levels of severity (no problems, some problems, or unable/extreme problems). This index is on a scale of -0.594 to 1, where 1 represents perfect health, and 0 represents death. Negative values represent a state perceived as worse than death.<sup>11</sup> The second page of the EQ questionnaire consists of a standard vertical 20 cm visual analogue scale (EQ-VAS) which is transformed to a scale of 0 (poor health) to 100 (best health) with current HRQoL.

A VAS was also used to assess subjective pain using a 15 cm horizontal scale from 0 to 100, where 100 is no pain and 0 is pain as bad as it could be.

Patient satisfaction was assessed by asking the question, "How satisfied are you with your operated hip?". The response was recorded using a five-point Likert scale: very satisfied, satisfied, neither satisfied nor dissatisfied (simplified to neutral for the rest of the article), dissatisfied, and very dissatisfied. Satisfaction was dichotomized into 'satisfied' and 'dissatisfied'. Satisfied was considered 'satisfied' and 'very satisfied', and dissatisfied was

considered 'neutral', 'dissatisfied', and 'very dissatisfied'. Five further questions were posed specifically to those who reported being a golfer at the time of the surgery.

**Golf-related outcomes.** All patients were contacted and asked whether they were a golfer prior to their THA. A golfer was defined as someone who considered golf as a hobby prior to surgery and played on a golf course. Golfers were asked if they returned to golf postoperatively and if they were still playing currently. They were also asked if returning to golf was a motivator for undergoing THA, if they believed golf was beneficial to their recovery, and if it improved their overall wellbeing. Of those patients who returned to golf, they were asked to define how satisfied they were with their involvement in the game of golf since THA on a five-point Likert scale: very satisfied, satisfied, neutral, dissatisfied, and very dissatisfied.

**Patients.** The study cohort consisted of a total of 308 patients undergoing THA with complete pre- and postoperative data that met the inclusion criteria. This included 120 male patients (39%) and 188 female patients (61%), with an overall mean age of 67.8 years (standard deviation (SD) 11.6) and a mean BMI of 28 kg/m<sup>2</sup> (SD 5.3). All golfers were right-handed. A total of 182 THAs were performed on the left side (59%) and 126 on the right side (41%). Preoperative demographic comparisons between the golfer cohort (n = 264) and the non-golfer cohort (n = 44) can be seen in Table I.

**Statistical analysis.** SPSS v. 17.0 (SPSS, USA) was used for all data analysis. Data were assessed for normality and parametric tests conducted where appropriate. Scalar variables were assessed using either an independent-samples *t*-test, or one-way analysis of variance (ANOVA). A chi-squared test was used to assess sex, comorbidity, and satisfaction differences between groups. Fisher's exact test was used for groups of less than five. Significance was set as a p-value of < 0.05. Multivariate linear regression analysis was performed to assess for golfing status as a preoperative independent variable when adjusted for preoperative confounders. Binary logistic regression was also performed to assess if golfing status predicted postoperative satisfaction when adjusting for confounders.

A post-hoc power calculation was performed using the MCID for the OHS (primary outcome measure) of 5,

**Table III.** Multivariate linear regression analysis of golfing status as an independent predictor for change in scores when adjusting for confounders.

Variable	B (95% CI)	p-value
<b>EQ-5D Index (r<sup>2</sup> = 0.1)</b>		
Non-golfer	Reference	
Golfer	0.04 (-0.03 to 0.1)	0.289
<b>EQ VAS (r<sup>2</sup> = 0.04)</b>		
Non-golfer	Reference	
Golfer	4.6 (-2.3 to 11.5)	0.162
<b>Pain VAS (r<sup>2</sup> = 0.01)</b>		
Non-golfer	Reference	
Golfer	3.2 (-7.2 to 13.7)	0.549
<b>OHS (r<sup>2</sup> = 0.1)</b>		
Non-golfer	Reference	
Golfer	2.7 (0.2 to 5.3)	0.037
<b>FJS (r<sup>2</sup> = 0.03)</b>		
Non-golfer	Reference	
Golfer	1 (-9.3 to 11.3)	0.849

CI, confidence interval; EQ-5D, EuroQol five-dimension questionnaire; OHS, Oxford Hip Score; VAS, visual analogue scale.

a SD of nine points (effect size 0.556), with an  $\alpha$  of 0.05 and two tailed analysis, and with 44 in the golfing group and 264 in the non-golfing group the study achieved 93% power.

## Results

**Functional and health-related outcomes.** There was no difference in preoperative health-related measures between golfers and non-golfers ( $p = 0.109$ , independent-samples  $t$ -test) (Table I). However, golfers had significantly higher preoperative hip specific function measured by the OHS (20.0 (SD 8.0) vs 23.9 (SD 8.4);  $p = 0.004$ , independent-samples  $t$ -test) (Table I), which remained so postoperatively (39.5 (SD 7.7) vs 43.1 (SD 5.2);  $p < 0.001$ , independent-samples  $t$ -test) (Table II). Golfers had greater perceived postoperative health status measured by the EQ VAS ( $p = 0.039$ , independent-samples  $t$ -test); however, there was no difference in EQ-5D index ( $p = 0.124$ , independent-samples  $t$ -test) or pain VAS ( $p = 0.505$ , independent-samples  $t$ -test). Golfers were not more aware of their joint compared to non-golfers according to the FJS ( $p = 0.215$ , independent-samples  $t$ -test) (Table II). When adjusting for confounders, golfers had a significantly greater improvement in their OHS of 2.7 points ( $p = 0.037$ ) when compared to non-golfers, however there were no other significant differences in the change in outcome measures between the groups (Table III).

At one-year follow-up, there were 39 golfers (88.6%) who were satisfied and five (11.4%) who were dissatisfied, compared to 238 non-golfers (90.2%) who were satisfied and 26 (9.8%) who were dissatisfied ( $p = 0.757$ , Fisher's exact test; Table IV). Following binary regression analysis adjusting for preoperative variables, there was

**Table IV.** Comparison of postoperative satisfaction at one year between golfers and non-golfers.

Satisfaction	Golfer		OR (95% CI)	p-value*
	No	Yes		
Satisfied	238	39		
Dissatisfied	39	5	1.4 (0.6 to 3)	0.757

\*Fisher's exact test.

CI, confidence interval; OR, odds ratio.

**Table V.** Reasons for golfers not returning to play following total hip arthroplasty.

Reason for not returning	Patients, n
Lost the habit of playing	2
Time restraints	2
Pain in hip	1
Poor mobility	1
<b>Other medical reasons</b>	
Back pain	2
Other operations	2
Hand osteoarthritis	1
Forearm injury	1

no difference in satisfaction between golfers and non-golfers ( $p = 0.934$ ).

**Returning to golf following THA.** Of the 44 patients who reported being golfers at the time of their surgery, 32 returned to golf (72.7%). Of those, 26 (81%) were still playing five years postoperatively. Of those who were no longer playing, one patient associated this with problems related to their THA (Table V). In total, 19 patients (43.2%) reported golf as being an important reason for undergoing surgery, 20 patients (45.4%) reported that they felt golf helped with their rehabilitation, and 26 (59%) felt returning to golf improved their overall wellbeing. Of those who returned to golf, 27 patients (84.4%) were deemed to be satisfied overall with their involvement in golf following surgery. There were no differences in postoperative outcome measures in golfers when comparing left- and right-sided surgery. More males returned to golf compared to females ( $p = 0.039$ , Fisher's exact test); however, there were no other differences in demographics between patients who returned to golf and those who did not (Table VI). Patients who returned to golf had a greater preoperative HRQoL ( $p = 0.040$ , independent-samples  $t$ -test) and hip-related functional scores ( $p = 0.026$ , independent-samples  $t$ -test). There were no differences in postoperative outcome measures (Table VI).

## Discussion

The most important finding of this study was that golfers had greater pre- and postoperative hip-specific function, and when adjusting for confounding, significantly greater improvement in the hip-specific function compared to non-golfers following THA. The rate of returning to golf following surgery was only 72.7% (n

**Table VI.** Comparison of demographic and functional outcomes of golfers who returned and those who did not.

Variable	Return to golf		Difference/OR (95% CI)	p-value
	No (n = 12)	Yes (n = 32)		
<b>Sex, n (%)</b>				
Male	8	30		
Female	4	2	OR 0.1 (0.02 to 0.9)	0.039*
<b>Side, n (%)</b>				
Left	8	15		
Right	4	17	OR 2.3 (0.6 to 9.1)	0.318*
Mean age, yrs (SD)	69.5 (12)	63.4 (10.5)	Diff -5.8 (-13.3 to 1.6)	0.122†
Mean BMI, kg/m <sup>2</sup> (SD)	28.5 (5.6)	27.1 (3.5)	Diff -1.5 (-4.3 to 1.4)	0.301†
<b>Comorbidities, n</b>				
IHD	1	3	OR 1.1 (0.1 to 12.1)	0.915*
COPD	0	1	OR 1 (1 to 1.1)	0.536*
Vascular disease	0	1	OR 1 (1 to 1.1)	0.536*
Diabetes	1	3	OR 1.1 (0.1 to 12.1)	0.915*
Gastric ulcer	0	2	OR 1.1 (1 to 1.2)	0.375*
Kidney disease	0	2	OR 1.1 (1 to 1.2)	0.375*
Liver disease	1	3	OR 1.1 (0.1 to 12.1)	0.915*
Cerebrovascular disease	0	3	OR 1.1 (1 to 1.2)	0.272*
<b>Preoperative</b>				
Mean EQ-5D VAS (SD)	64.1 (23.8)	78.7 (14.7)	Diff 14.6 (-1.1 to 30.3)	0.018†
Mean EQ-5D Index (SD)	0.291 (0.361)	0.547 (0.27)	Diff 0.3 (0.01 to 0.5)	0.040†
Mean pain VAS (SD)	47.8 (20.8)	54.2 (22.4)	Diff 6.4 (-8.7 to 21.2)	0.399†
Mean OHS (SD)	19.3 (7.1)	25.6 (8.3)	Diff 6.2 (1 to 11.4)	0.026†
<b>Postoperative</b>				
Mean EQ-5D VAS (SD)	81.8 (24)	83 (10.7)	Diff 1.2 (-9.2 to 11.7)	0.819†
Mean EQ-5D Index (SD)	0.837 (0.251)	0.855 (0.04)	Diff 0.02 (-0.1 to 0.2)	0.814†
Mean pain VAS (SD)	80.9 (30.7)	77.7 (31.8)	Diff -3.3 (-24.7 to 18.2)	0.761†
Mean OHS (SD)	42.7 (6.6)	43.3 (4.6)	Diff 0.7 (-2.9 to 4.2)	0.716†
Mean FJS (SD)	63.6 (26)	61.5 (28.2)	Diff -2.1 (-20.9 to 16.8)	0.826†
<b>Satisfaction, n</b>				
Satisfied	10	28		
Dissatisfied	2	4	OR 1.4 (0.2 to 8.9)	0.720*

\*Fisher's exact test.

†Independent-samples *t*-test.

CI, confidence interval; COPD, chronic obstructive pulmonary disease; EQ-5D, EuroQol five-dimension questionnaire; FJS, Forgotten Joint Score; IHD, ischaemic heart disease; OHS, Oxford Hip Score; OR, odds ratio; SD, standard deviation; VAS, visual analogue scale.

= 32) at one year postoperatively, and a self-reported satisfactory involvement in the game was achieved by 84.4% (n = 27).

Golf is known to be an activity which can provide moderate physical activity, given its requirement to walk significant distances during a round.<sup>21-23</sup> This exercise may contribute to the superior preoperative functional scores observed in golfers. The same may be true for the greater postoperative function and golf's ability to aid with recovery. In addition, it would also be consistent with preoperative function being a significant predictor of postoperative outcomes following joint arthroplasty.<sup>24</sup> Golfers in our study had pre- and postoperative OHSs four points greater than non-golfers, which is more than the suggested lower threshold for the minimal clinically important difference of three points.<sup>17</sup> Golfers also reported perceived greater health status, according to the EQ-VAS, postoperatively compared to

non-golfers. Returning to golf may contribute to the perception that patients are back to a healthier state with improved wellbeing.<sup>12</sup>

Although golfers reported greater functional outcomes postoperatively, there was no difference in joint awareness measured by the FJS. Golf is a physically demanding sport for an elderly population, requiring both strength and balance to swing the golf club,<sup>25</sup> and endurance to walk the golf course.<sup>22</sup> Despite these demands, golfers reported an equivalent level of joint awareness in their joint compared to a general population. However, the activity levels of the comparative cohort have not been explored in this study.

The overall prevalence of golfers was 14%, which increased to 32% for male patients. The demographics of this study are unique to the UK; however, they are similar to a European study which reported a prevalence of 20% in a cohort undergoing lower limb arthroplasty.<sup>10</sup>



More than 70% of the golfers returned to golf following surgery. Previous rates of returning to golf after THA have been higher in the literature, ranging from 87% to 95%.<sup>26,27</sup> Despite a high percentage of golfers reporting golf as a primary motivator for undergoing surgery, satisfaction rates were not different between the golf and non-golf cohorts. The motivation for returning to golf after hip arthroplasty has not previously been explored. In the present study, golfers reported that getting back to playing sport contributed to their reason for undergoing joint arthroplasty in 43.2% of cases (n = 19). Awareness of this by the operating clinician may be an important part of preoperative counselling.

The physical and mental health benefits of golf were reported by our cohort of golfers, with 45.4% (n = 20) believing golf contributed to their rehabilitation and nearly 59% of golfers (n = 26) believing that returning to the game improved their overall wellbeing. Preoperative factors may be able to predict the ability to return to golf. Those who returned had higher HRQoL scores and hip-related functional scores compared to those who did not. Although the study was not powered to detect these differences, it may suggest that preoperative rehabilitation and health improvements could be beneficial to golfers who are keen to return to their sport. Further prospective research is needed to assess predictors of returning to golf.

This study must be interpreted considering its limitations. The overall response rate was 70%, which may expose the results to selection bias. The golfing cohort consisted predominantly of males. However, this is reflective of the overall golfing demographic and previous studies have shown no influence on sex following THA.<sup>28,29</sup> Furthermore, adjustment was made for sex during the regression analysis which did not change the significance of the findings. The severity or pattern of OA within the hip prior to surgery was not assessed, nor were symptomatic degenerative joint diseases elsewhere in the body. In addition, activity levels in the non-golfing cohort were not explored, however, the study did not aim to explore this, instead simply assessing the outcomes of golfers following THA compared to all other THA patients, and therefore allowing for generic, pragmatic guidance for clinicians at the time of preoperative counselling and postoperative review.

In conclusion, golfers have a greater improvement in their hip-specific function (OHS) compared to non-golfers after THA. However, less than three-quarters of patients will return to golf, with male sex and those who have greater preoperative QoL or hip-related function more likely to return.



### Take home message

- Golfers have a greater improvement in their hip-specific function compared to non-golfers after total hip arthroplasty (THA).

- Male sex and preoperative quality of life and hip function can predict those who will return to golf following THA.

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**Funding statement:**

- The authors received no financial or material support for the research, authorship, and/or publication of this article.

**ICMJE COI statement:**

- I. R. Murray reports consulting fees from Stryker, unrelated to this study. G. J. Macpherson reports consulting fees, payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events, and support for attending meetings and/or travel from Stryker, all unrelated to this study.

**Acknowledgements:**

- We would like to thank all the patients who have taken part in this project.

**Ethical review statement:**

- Ethical approval was obtained from the regional ethics committee (Research Ethics Committee, South East Scotland Research Ethics Service, Scotland [16/SS/0026]) for analysis and publication of the presented data. The data collection was carried out in accordance with the GMC guidelines for good clinical practice and the Declaration of Helsinki.

**Open access funding**

- The authors confirm the open access funding for this study was provided by the Department of Trauma and Orthopaedic Surgery, University of Edinburgh.

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