■ ARTHROPLASTY

The number of patients "worse than death" while waiting for a hip or knee arthroplasty has nearly doubled during the COVID-19 pandemic

A UK NATIONWIDE SURVEY

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Aims

The aim of this study was to assess the quality of life of patients on the waiting list for a total hip (THA) or knee arthroplasty (KA) during the COVID-19 pandemic. Secondary aims were to assess whether length of time on the waiting list influenced quality of life and rate of deferral of surgery.

Methods

During the study period (August and September 2020) 843 patients (THA n = 394, KA n = 449) from ten centres in the UK reported their EuroQol five dimension (EQ-5D) scores and completed a waiting list questionnaire (2020 group). Patient demographic details, procedure, and date when listed were recorded. Patients scoring less than zero for their EQ-5D score were defined to be in a health state "worse than death" (WTD). Data from a retrospective cohort (January 2014 to September 2017) were used as the control group.

Results

The 2020 group had a significantly worse EQ-5D score compared to the control group for both THA ($p < 0.001$) and KA ($p < 0.001$). Over one-third (35.0%, n = 138/394) of patients waiting for a THA and nearly a quarter (22.3%, n = 100/449) for KA were in a health state WTD, which was significantly greater than the control group (odds ratio 2.30 (95% confidence interval (CI) 1.83 to 2.93) and 2.08 (95% CI 1.61 to 2.70), respectively; $p < 0.001$). Over 80% (n = 680/843) of the 2020 group felt that their quality of life had deteriorated while waiting. Each additional month spent on the waiting list was independently associated with a decrease in quality of life (EQ-5D: -0.0135, $p = 0.004$). There were 117 (13.9%) patients who wished to defer their surgery and the main reason for this was health concerns for themselves and or their family (99.1%, n = 116/117).

Conclusion

Over one-third of patients waiting for THA and nearly one-quarter waiting for a KA were in a state WTD, which was approaching double that observed prior to the pandemic. Increasing length of time on the waiting list was associated with decreasing quality of life.

Level of evidence: Level III retrospective case control study

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Introduction

The COVID-19 pandemic has had a significant impact on elective arthroplasty in the UK, with the cessation of nonurgent cases in mid to late March 2020.[1-3] When the incidence of new COVID-19 cases decreases across the UK the recommencement of planned orthopaedic elective services will need to be prioritized alongside other cancer and surgical services as resources may not be available for a full return to normal practice. When normal capacity is resumed there will be increased numbers of patients waiting much longer for hip and knee arthroplasty. There may also be some patients on

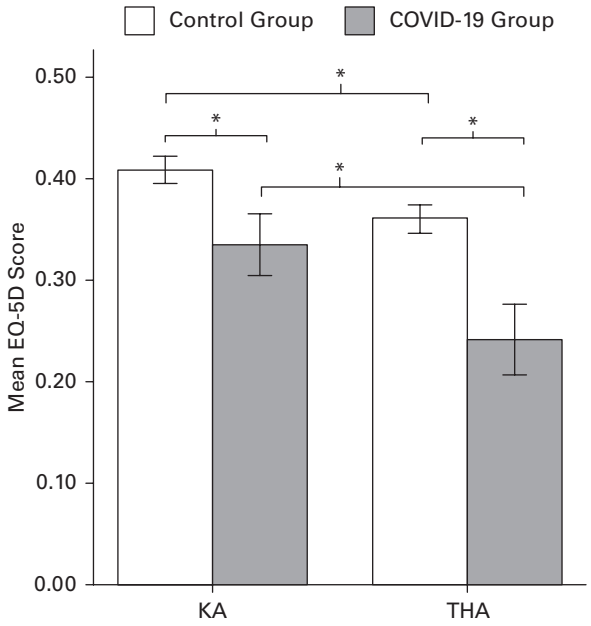

Fig. 1

Bar chart of EuroQol five-dimension (EQ-5D) scores for the control (pre-COVID-19) and COVID-19 (2020) groups for patients waiting for a total hip (THA) or knee (KA) arthroplasty. The error bars represent 95% confidence intervals. *p < 0.001, independent-samples *t*-test.

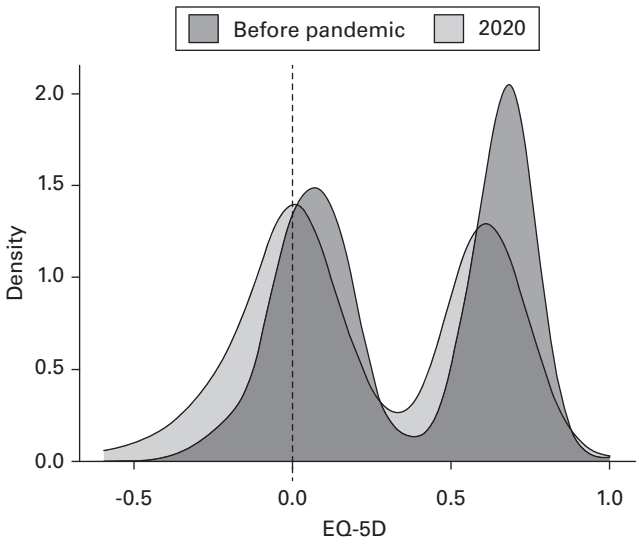

Fig. 2

Density plot for the distribution of EuroQol five-dimension (EQ-5D) scores for patients awaiting a total hip arthroplasty before the pandemic and for the 2020 cohort.

the waiting list who may prefer to defer surgery due to the mortality risk associated with COVID-19 in the postoperative period, despite this being relatively low even at the height of first wave of the pandemic.[4]

Scott et al[5] have previously shown the quality of life of patients waiting for hip and knee arthroplasty to be "worse than death" (WTD) for 19% and 12%, respectively, when defined as an EuroQoL (EQ) index of less than zero. However in their study, patients were prioritized according to their symptoms and surgery for those with the worst quality of life was expedited. During the COVID-19 pandemic and cessation of elective services, prioritizing those with the worst quality of life may have not been possible. Recommencement of services may lead to prioritization of patients who have the lowest surgical risk, which may further delay surgery in those with worst quality of life due to their associated comorbidity.[1] Currently there are no available data in relation to the quality of life of patients on NHS waiting lists for primary hip and knee arthroplasty. It is unknown whether patients would want to undergo surgery due to the associated risk of COVID-19.[4]

The primary aim of this study was to assess the quality of life of patients on the waiting lists for a hip or knee arthroplasty during the COVID-19 pandemic. The secondary aims were to assess: whether length of time on the waiting list influenced quality of life; patient opinions and options for future surgery; if patients wanted to proceed with surgery or delay intervention in view of the risks associated with COVID-19; the reason(s) for delaying surgery if this is their decision; and whether these metrics differed between patients listed for hip or knee arthroplasty.

Methods

A multicentre cross-sectional study was conducted across ten orthopaedic departments (Aberdeen, Bristol, Edinburgh, Fife, Glasgow, Leicester, Newcastle, Oswestry, University College London, and Wrightington) in the UK of patients on the NHS waiting lists for either a total hip (THA) or total (TKA) or partial knee arthroplasty (PKA) during the months of August and September 2020. This survey was registered and approved at each of the participating sites as an audit project or a quality improvement project. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for reporting observational studies were followed.[6]

Patients meeting the inclusion and exclusion criteria were selected from waiting lists at the ten study centres. When the survey began, six centres were participating with the aim to obtain data on 100 patients (50 THA and 50 KA) to meet the power calculation. However, four additional centres requested permission to participate during the study period and therefore 843 patients were included across ten sites. Patient demographic data (age and sex), proposed procedure (THA, TKA, or PKA), and date when listed were recorded. Patients were contacted by telephone and asked to complete an interviewer-administrated verbal EQ-5D questionnaire[7] and in addition were asked questions relating to their quality of life, opinions about undergoing surgery in view of the COVID-19 pandemic and whether they wanted to defer their surgery and the reasons for this. The study protocol, hard copy patient questionnaire (should the researcher have required this while undertaking the telephone interview), and the data collection tool were sent to each site prior to the commencement of the study (Supplementary Material). The inclusion criteria were patients placed on the non-urgent elective orthopaedic waiting list for a primary THA or P/TKA prior to and including March 2020 who were able to complete

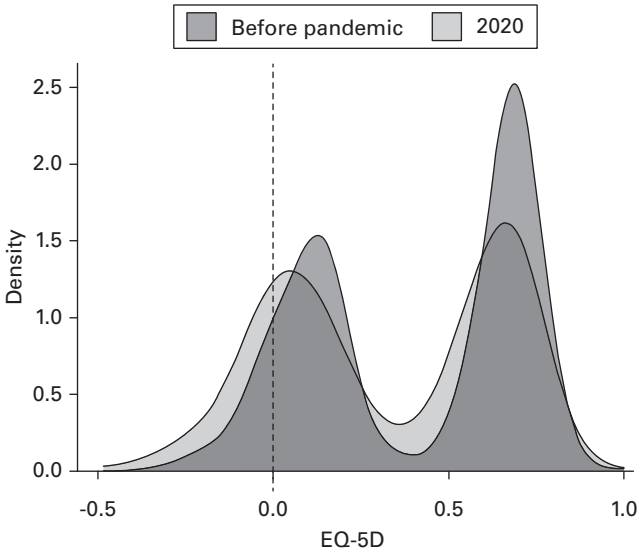

Fig. 3

Density plot for the distribution of EuroQol five-dimension (EQ-5D) scores for patients awaiting a knee arthroplasty before the pandemic and for the 2020 cohort.

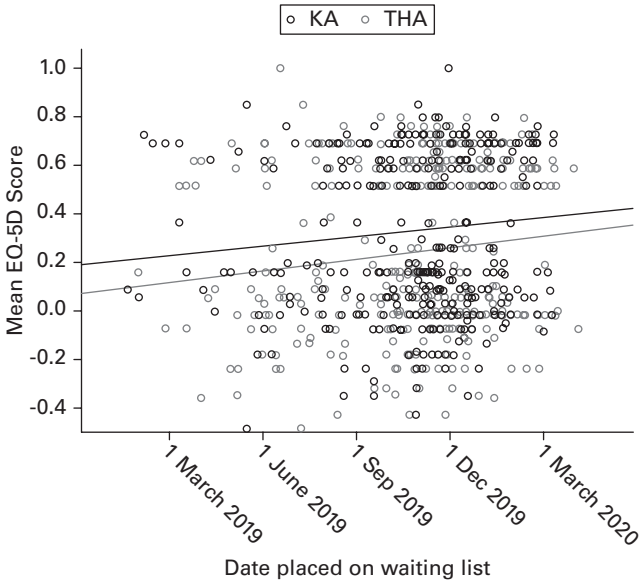

Fig. 4

Scatter plot and line of best fit for correlation between the time patients were listed for their total hip (THA) (grey, r = 0.12) or knee (KA) (black, r = 0.10) arthroplasty and mean EuroQol five-dimension (EQ-5D) score in August/September 2020.

a telephone interview. Patients listed for revision surgery or urgent arthroplasty were excluded. The chosen interviewer at each site was left to the centre's discretion and availability of staff.

The EQ general health questionnaire evaluates five domains: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression.[7] The three-level (3L) version of the EQ-5D questionnaire was used, with responses to the five domains recorded at three levels of severity (no/slight problems; moderate/severe; or unable/extreme problems). Permission was obtained from the EuroQol Research Foundation to use the UK interviewer-administered version of the EQ-5D-3L version. This index is on a scale of -0.594 to 1, where 1 represents perfect health and 0 represents death.[8] Patients scoring less than zero for the EQ-5D score were defined to be in a state WTD.[5] The minimal clinically important difference (MCID) in the EQ-5D score after THA is 0.08, therefore a difference in the score of 0.08 or more was defined as clinically important.[9] The EQ visual analogue scale (VAS) was also completed, again using the UK interviewer-administered version, that assesses how good or bad the patient's health is on that day and ranges from 100 (best health) to 0 (worst health).

Data from the previously published study by Scott et al[5] were used for the unmatched control groups and were thought to represent baseline data over a period (from January 2014 to September 2017) that was not affected by the COVID-19 pandemic. Sex, age, EQ-5D, and EQ-VAS data were available for 2,073 patients waiting for a THA and 2,168 patients waiting for a TKA.

Statistical analysis. Statistical analysis was performed using SPSS v. 17 (IBM, Armonk, New York, USA). Parametric tests were used to assess continuous variables for significant differences between groups using an independent-samples *t*-test (age, EQ-5D, and EQ-VAS scores). Dichotomous variables were assessed using a chi-squared test or Fisher's exact test (if less than five in one cell) for the between group comparisons (sex, joint, WTD). Pearson's *r* was used to assess the relationship between scalar variables (length of time on waiting list and EQ-5D). Multivariate linear analysis was used to assess the independent association of factors influencing the EQ-5D score after adjusting for confounding variables. A p-value < 0.05 was defined as statistically significant.

A power calculation was performed using the MCID of 0.08 points in the EQ-5D score,[9] a SD of 0.32 points[5] (effect size 0.25), an α of 0.025 (Bonferonni correction for multiple testing: total hip and knee arthroplasty groups), two tailed independent-samples *t*-test and a power of 95% determined a minimum of 277 patients would be required in each of the groups (THA and knee arthroplasty) from 2020 to compare with the 2,000 patients in the control groups (allocation ratio 1:7) i.e. 277 vs 1,935 for both THA and knee arthroplasty groups.

Results

During the study period, 843 patients reported their EQ-5D and EQ-VAS scores and completed the COVID-19 questionnaire. There were 344 male (40.8%) and 499 female patients (59.2%) with a mean age of 69.1 years (26 to 98). There were 394 waiting for a THA and 449 waiting for a TKA (n = 418) or a PKA (n = 31). For analytical purposes, TKA and PKA were grouped together as a knee arthroplasty (KA) group.

Quality of life of patients currently on the waiting list. There were no significant differences in age or sex between the 2020 group and the control groups (Table I). The 2020 groups had significantly (p < 0.001, independent-samples *t*-test) worse EQ-5D and EQ-VAS scores compared with the control groups, for both patients awaiting THA and KA (Table I and Figure 1).

Table I. Demographic data, EuroQol five-dimension, EuroQol visual analogue scale, and worse than death status for total hip and knee arthroplasty according group.

Variable	Control	2020	Difference/OR (95% CI)	p-value
THA	**(n = 2,073)**	**(n = 394)**		
Mean age, yrs (SD)	67.4 (11.6)	68.0 (12.3)	0.7 (-0.6 to 1.9)	0.304*
Sex, n (%)				
Female	1,253 (60.4)	240 (60.9)	Reference	
Male	820 (39.6)	154 (39.1)	0.98 (0.79 to 1.22)	0.861†
Mean EQ-5D (SD)	0.360 (0.325)	0.241 (0.351)	0.119 (0.083 to 0.154)	< 0.001*
Mean EQ-VAS (SD)	67.4 (22.2)	54.0 (23.3)	13.3 (10.8 to 15.9)	< 0.001*
WTD, n (%)				
No	1,682 (81.1)	256 (65.0)	Reference	
Yes	391 (18.9)	138 (35.0)	2.30 (1.83 to 2.93)	< 0.001†
KA	**(n = 2,168)**	**(n = 449)**		
Mean age, yrs (SD)	69.4 (9.6)	70.0 (9.4)	0.7 (-0.3 to 1.7)	0.159*
Sex, n (%)				
Female	1243 (57.3)	259 (57.7)	Reference	
Male	925 (42.7)	190 (42.3)	0.99 (0.80 to 1.21)	0.891†
Mean EQ-5D (SD)	0.408 (0.311)	0.335 (0.327)	0.074 (0.042 to 0.105)	< 0.001*
Mean EQ-VAS (SD)	69.8 (20.6)	58.3 (21.9)	11.4 (9.2 to 13.7)	< 0.001*
WTD, n (%)				
No	1,906 (87.9)	349 (77.7)	Reference	
Yes	262 (12.1)	100 (22.3)	2.08 (1.61 to 2.70)	< 0.001†

*Independent-samples *t*-test.
†Chi-squared test.
CI, confidence interval; EQ-5D, EuroQol five-dimension score; EQ-VAS, EuroQol visual analogue scale; KA, knee arthroplasty; OR, odds ratio; THA, total hip arthroplasty; WTD, worse than death.

Table II. Linear regression analysis was used to identify whether age, sex, joint, and time spent on waiting list were independently associated with change in the preoperative EuroQol five-dimension score for the 2020 group.

Predictors in model	Beta (95% CI)*	p-value†
Age (per year)	0.003 (0.001 to 0.005)	0.005
Sex		
Female	Reference	
Male	0.057 (0.011 to 0.103)	0.016
Joint		
KA	Reference	
THA	-0.082 (-0.128 to -0.037)	< 0.001
Time on waiting list (per month)	-0.0135 (-0.004 to -0.023)	0.004
Centre		
Control‡	Reference	
Rest	0.07 (-0.008 to 0.148)	0.090

*Change in EuroQol five-dimension score.
†Linear regression analysis.
‡Centre providing the control group (2014 to 2017) data.
CI, confidence interval; KA, knee arthroplasty; THA, total hip arthroplasty.

Over one-third (35.0%; n = 138/394) of patients waiting for a THA and nearly a quarter (22.3%; n = 100/449) of patients waiting for a KA were in a state WTD, which was approaching twice that observed in the control groups for both THA ($p < 0.001$, chi-squared test) and KA ($p < 0.001$, chi-squared test) (Table I). There was no significant difference ($p = 0.505$, Fisher's exact test) between TKA and PKA for the number of the patients WTD (n = 95 (22.7%) vs n = 5 (16.1%), respectively). The worse health-related quality of life in the 2020 groups relative to the control groups is illustrated by a shift to the left in the density plots of the EQ-5D scores (Figures 2 and 3).

The influence of length of waiting time on quality of life. Patients were listed for their THA or KA between January 2019 to March 2020. There was a significant correlation between date of listing for THA (Pearson's $r = 0.12$; $p = 0.015$) or KA (Pearson's $r = 0.10$; $p = 0.043$) and EQ-5D scores, with longer waiting time being associated with a worse EQ-5D score (Figure 4). Regression analysis demonstrated that for each additional month spent on the waiting list was associated with a significant decrease in the EQ-5D score (Table II), and for each additional six months on the waiting list patients may experience a clinically significant deterioration in their health-related quality of life ($^{\text{MCID in EQ-5D } 0.08}/_{\text{change per month } 0.013} = 6$ months). Regression analysis also demonstrated younger age, female sex, and THA to be associated with a worse preoperative EQ-5D score (Table II).

Patients' opinion and options for future surgery. In the 2020 group over 80% of patients (680/843) felt that their quality of life had deteriorated while waiting for their arthroplasty. This was significantly greater in those awaiting THA compared with those waiting for a KA ($p < 0.001$, chi-squared test) (Table III). The majority (86.1%, n = 726/843) of patients were willing to undergo their surgery during the COVID-19 pandemic, with those waiting for a THA were more likely to want to go forward with their surgery (Table III). Approximately half of the patients (52.3%, n = 441/843) wished to have a face-to-face consultation, in preference to a telephone or video consultation, should they go forward with surgery and more than two-thirds (67.6%, n = 570/843) felt a discussion regarding the risks of surgery could be left until immediately before surgery (Table III). Approximately half of the patients were happy to have their

Table III. Responses to the questions asked to the 2020 cohort (n = 843) regarding their effect of waiting for surgery and opinions about future surgery according to whether they were waiting for a total hip or knee arthroplasty.

Question	All (n, %)	THA (n, %)	KA (n, %)	OR (95% CI)	p-value*
Do you feel that your quality of life has deteriorated while waiting for your surgery?					< 0.001
Yes	680 (80.7)	338 (85.8)	342 (76.2)	1.89 (1.32 to 2.70)	
No	163 (19.3)	56 (14.2)	107 (23.8)	Reference	
Would you be willing to undergo your proposed surgery in view of the COVID-19 pandemic?					0.020
Yes	726 (86.1)	351 (89.1)	375 (83.5)	1.61 (1.08 to 2.41)	
No	117 (13.9)	43 (10.9)	74 (16.5)	Reference	
If you decide to go ahead with surgery, which sort of consultation would you prefer?					
Face-to-face	441 (52.3)	199 (50.5)	242 (53.9)	Reference	
Telephone	350 (41.5)	172 (43.7)	178 (39.6)	0.91 (0.78 to 1.07)	0.259
Video	43 (5.1)	21 (5.3)	22 (4.9)	0.87 (0.49 to 1.54)	0.639
Missing	9 (1.1)	2 (0.5)	7 (1.6)		
Do you think a full discussion on risk could be left until immediately before surgery?					0.999
Yes	570 (67.6)	268 (68)	302 (67.3)	0.99 (0.74 to 1.33)	
No	263 (31.2)	124 (31.5)	139 (31.0)	Reference	
Missing	10 (1.2)	2 (0.5)	8 (1.8)		
All waiting times being equal, would you be happy for a different surgeon to carry out your surgery?					0.238
Yes	495 (58.7)	241 (61.2)	254 (56.6)	1.18 (0.90 to 1.56)	
No	339 (40.2)	151 (38.3)	188 (41.9)	Reference	
Missing	9 (1.1)	2 (0.5)	7 (1.6)		
All waiting times being equal, would you be happy to have your operation in a different hospital?					0.094
Yes	419 (49.7)	209 (53)	210 (46.8)	1.26 (0.96 to 1.66)	
No	415 (49.2)	183 (46.4)	232 (51.7)	Reference	
Missing	9 (1.1)	2 (0.5)	7 (1.6)		

*Chi-squared test.
CI, confidence interval; KA, knee arthroplasty; OR, odds ratio; THA, total hip arthroplasty.

surgery under a different surgeon (58.7%, n = 495/843) or hospital (49.7%, n = 419/843) provided waiting times were equal (Table III).

Proceed or delay surgery in view of the current COVID-19 risks. There were 117 patients (13.9%) who wished to defer surgery due to the risks associated with COVID-19 when assessed during August and September 2020. Patients on the waiting list for THA who wanted to defer their surgery (n = 43) had a clinically and statistically significantly greater (better) EQ-5D score but this was not observed in the group awaiting a KA (Table IV). Of the 117 wishing to defer their surgery, 28 (23.9%) had a WTD EQ-5D score, which was not significantly different to those wishing to proceed (n = 210, 28.9%; p = 0.265, chi-squared test). All except one patient of these 28 stated their reason for deferral was "fear of having surgery in hospital will increase your chance of catching COVID-19".

Reasons for delaying surgery. The main reason declared by the 117 patients wishing to defer their surgery was health concerns for themselves and/or their family (Table V). Two thirds of patients felt that they had not had the opportunity to discuss their concerns with a health professional (Table V). The main reasons for deferral were worries of acquiring COVID-19 in hospital (78.6%; n = 92/117) and the risk of dying should they become infected (69.2%) (Table V). Whereas, the 14 day pre-surgery isolation period (16.2%), concerns regarding the hospitals ability to care for them (27.4%), and limited visiting of family and friends while in hospital (20.5%) were not predominant reasons to defer for most patients (Table V). There were no differences in the reasons for deferral of surgery between THA and KA (Table V).

Differences between patients waiting for hip and knee arthroplasty. Patients waiting for a THA had significantly worse EQ-5D (p < 0.001, independent-samples *t*-test) and EQ-VAS (p = 0.010, independent-samples *t*-test) scores compared with those waiting for a KA in the 2020 cohort (Table VI and Figure 1), and were more likely to be in a state WTD. When adjusting for confounding, patients waiting for a THA had a clinically and statistically significantly worse EQ-5D score (Table II).

Discussion

This study has shown that patients waiting for THA and KA during the COVID-19 pandemic had a significantly worse quality of life than expected relative to previous years. Over one-third of patients waiting for a THA and nearly one-quarter of patients waiting for a KA were in a health state WTD, which was approaching double that observed prior to the pandemic. There was a direct correlation between increasing length of time of the waiting list and a worsening quality of life: for each additional six months of waiting there was a clinically significant deterioration in health-related quality of

Table IV. Demographic data, EuroQol five-dimension, EuroQol visual analogue scale, and worse than death status according to whether the patient wanted to proceed or defer their total hip or knee arthroplasty.

Variable	Proceed	Defer	Difference/OR (95% CI)	p-value
THA	**(n = 351)**	**(n = 43)**		
Mean age, yrs (SD)	67.7 (12.4)	71.2 (10.6)	3.6 (-0.3 to 7.5)	0.072*
Sex, n (%)				
Female	217 (61.8)	23 (53.5)	Reference	
Male	134 (38.2)	20 (46.5)	1.41 (0.75 to 2.66)	0.290†
Mean EQ-5D (SD)	0.224 (0.345)	0.385 (0.362)	0.162 (0.051 to 0.272)	0.004*
Mean EQ-VAS (SD)	53.0 (23.4)	62.4 (21.0)	9.4 (1.5 to 17.3)	0.020*
WTD, n (%)				
No	224 (63.8)	32 (74.4)	Reference	
Yes	127 (36.2)	11 (25.6)	0.61 (0.30 to 1.24)	0.169†
KA	**(n = 375)**	**(n = 74)**		
Mean age, yrs (SD)	69.9 (9.1)	71.0 (10.4)	1.2 (-1.1 to 3.5)	0.318†
Sex, n (%)				
Female	209 (55.7)	50 (67.6)	Reference	
Male	166 (44.3)	24 (32.4)	0.60 (0.36 to 1.02)	0.060†
Mean EQ-5D (SD)	0.328 (0.322)	0.370 (0.351)	0.042 (-0.040 to 0.123)	0.316*
Mean EQ-VAS (SD)	57.7 (22.1)	61.5 (20.9)	3.8 (-1.9 to 9.5)	0.193*
WTD, n (%)				
No	292 (77.9)	57 (77.0)	Reference	
Yes	83 (22.1)	17 (23.0)	1.05 (0.58 to 1.90)	0.874†

*Independent-samples *t*-test.
†Chi-squared test.
CI, confidence interval; EQ-5D, EuroQol five-dimension score; EQ-VAS, EuroQol visual analogue scale; KA, knee arthroplasty; OR, odds ratio; THA, total hip arthroplasty; WTD, worse than death.

life. This was supported subjectively by the patient's opinion, with over 80% stating that their quality of life had deteriorated while waiting for their arthroplasty. The majority of patients (86.1%) were theoretically willing to undergo their surgery despite the potential risks associated with COVID-19; however, half wished to have a face-to-face consultation should they go forward with surgery. Half the patients were happy to have their arthroplasty under a different surgeon or hospital. Those wishing to defer surgery had concerns for themselves and or their family and were more likely to be waiting for a KA.

The EQ-5D score has been proven to be a reliable and responsive measure of health-related quality of life and is validated for use in a number of populations and conditions including degenerative joint disease.[10,11] A total of 243 health states (indices) are possible and differ by country according to population preferences. This UK-based study uses the UK value set in which 84/243 (35%) of the possible health states are negative and can be defined as WTD.[12] This WTD definition is researcher-generated and reflects the construction of the EQ-5D score.[10] These negative or WTD states have been defined as such by 3,395 individuals from the UK grading each state using the time trade-off method: the less time in the health state that could be endured, the lower the score.[12] These negative (WTD) scores are therefore a hypothetical value judgement made by the UK general public based on their beliefs of health-related quality of life. The ability to score negative health states enables a broader description of severe disability and severely poor health, and lessens the floor effect of this score. However, despite having a WTD score 28 patients did not want to go forward with surgery due to fears of contracting COVID-19 in hospital, which may not fully support their WTD status or may reflect patient choice to delay surgery until they perceive it is safer to proceed. The control cohort of patients used in the current study demonstrated that using this definition, in normal circumstances, 19% of patients waiting for THA and 12% of patients awaiting TKA were in a health state WTD.[5] Under normal circumstances, these patients who are the worst affected by degenerative joint disease would be prioritized and thus tend to wait less time for their surgery.[5] It has therefore not been previously possible to investigate the effect of delayed and prolonged waiting times on health-related quality of life.

At the start of the COVID-19 pandemic all non-urgent operating within the NHS was suspended. Trauma and orthopaedics were reduced to just 3.3% of normal operating volumes in England, the lowest percentage of any surgical speciality.[3] Since restarting after the first wave, rates of orthopaedic admissions for surgery peaked at 63% of normal in England[3] and in Scotland arthroplasty surgery was being performed at a rate of 40% of normal.[2] This reduction of 60% in operating capacity far exceeds the 14% of patients who would have potentially chosen to defer their surgery currently because of the pandemic. As the pandemic has continued, the number of patients who wish to defer surgery is reducing.[4,13] This may reflect a reduction in the fear of COVID-19 as vaccines are developed, but similarly could reflect a deterioration in health-related quality of life altering the balance of perceived risk.[4]

COVID-19-free pathways have enabled some elective orthopaedic operating during the pandemic and have been shown to be effective and safe in terms of both viral transmission and

Table V. Responses to the questions asked to the patients from the 2020 cohort that wished to defer their surgery (n = 117) in relation to the reasons behind their decision.

Question	All (n, %)	THA (n, %)	KA (n, %)	OR (95% CI)	p-value
Was this because of health concerns for:					
Yourself	46 (39.3)	18 (41.9)	28 (37.8)	Reference	
Family	12 (10.3)	3 (7.0)	9 (12.2)	0.52 (0.12 to 2.18)	0.506*
Both	58 (49.6)	22 (51.2)	36 (48.6)	0.95 (0.43 to 2.11)	0.888†
Neither	1 (0.9)	0 (0)	1 (1.4)	N/A	0.999†
Have you had the opportunity to discuss your concerns around surgery with a health professional?					
Yes	39 (33.3)	13 (30.2)	26 (35.1)	Reference	
No	78 (66.7)	30 (69.8)	48 (64.9)	1.25 (0.56 to 2.80)	0.290†
Are you worried that having surgery in hospital will increase your chance of catching COVID-19?					
Yes	92 (78.6)	35 (81.4)	57 (77)	Reference	
No	25 (21.4)	8 (18.6)	17 (23)	0.77 (0.30 to 1.96)	0.578†
Are you concerned that if you catch COVD-19 your chance of survival is less because of the proposed surgery?					
Yes	81 (69.2)	33 (76.7)	48 (64.9)	Reference	
No	36 (30.8)	10 (23.3)	26 (35.1)	0.56 (0.24 to 1.31)	0.180†
Did you decline surgery because you were unable to self-isolate for 14 days?					
Yes	19 (16.2)	8 (18.6)	11 (14.9)	Reference	
No	98 (83.8)	35 (81.4)	63 (85.1)	0.76 (0.28 to 2.08)	0.597†
Did you decline surgery because of concerns over the hospital's ability to care for you during your admission because of the COVID-19 pandemic?					
Yes	32 (27.4)	12 (27.9)	20 (27)	Reference	
No	85 (72.6)	31 (72.1)	54 (73)	0.96 (0.41 to 2.22)	0.920†
Did you decline surgery because of the lack of visiting rights in hospital for your friends and family?					
Yes	24 (20.5)	11 (25.6)	13 (17.6)	Reference	
No	93 (79.5)	32 (74.4)	61 (82.4)	0.62 (0.25 to 1.54)	0.301†

*Fisher's exact test.
†Chi-squared test.
CI, confidence interval; N/A, not applicable; OR, odds ratio.

Table VI. Demographic data, EuroQol five-dimension, EuroQol visual analogue scale worse than death status and patient's choice to defer their surgery according to whether they were waiting for a total hip or knee arthroplasty.

Variable	THA (n = 394)	KA (n = 449)	Difference/OR (95% CI)	p-value
Mean age, yrs (SD)	68.0 (12.3)	70.0 (9.4)	2.0 (0.5 to 3.5)	0.008*
Sex, n (%)				
Female	240 (60.9)	259 (57.7)	Reference	
Male	154 (39.1)	190 (42.3)	0.88 (0.66 to 1.15)	0.341†
Mean EQ-5D (SD)	0.241 (0.351)	0.335 (0.327)	0.093 (0.048 to 0.139)	< 0.001*
Mean EQ-VAS (SD)	54.0 (23.3)	58.3 (21.9)	4.2 (1.0 to 7.6)	0.010*
WTD, n (%)				
No	256 (65.0)	349 (77.7)	Reference	
Yes	138 (35.0)	100 (22.3)	1.88 (1.39 to 2.55)	< 0.001†

*Independent samples *t*-test.
†Chi-squared test.
CI, confidence interval; EQ-5D, EuroQol five-dimension; EQ-VAS, EuroQol visual analogue scale; KA, knee arthroplasty; OR, odds ratio; THA, total hip arthroplasty; WTD, worse than death.

morbidity and mortality.[13,14] Developing COVID-19 during the perioperative period is associated with excess mortality;[15,16] however, the postoperative mortality risk due to COVID-19 following hip and knee arthroplasty at the peak of the first wave of the pandemic has been estimated at 1/1,000.[15] As a speciality, the current rate of surgery in orthopaedics is lower than in all other surgical specialties except oral surgery.[17] In England the number of patients waiting for surgery is higher for orthopaedics than for any other surgical speciality.[3] Using data from the Scottish Arthroplasty Project, Yapp et al[2] have reported that had arthroplasty operating been restarted at a rate of 120% of pre-COVID activity in October 2020 it would take 24 to 27 months to clear the backlog. This is also supported by waiting list data from England that estimated with 30% increased activity it would take 20 months if there was no hidden burden of unreferred patients, and 48 months if there was a hidden burden, to return to pre-COVID-19 waiting list numbers.[1] However, it may not be possible to work at 120% or 130% within the NHS for

the foreseeable future. Presently additional capacity from the private sector may not be available in the future due to pressures on their own waiting lists. Non-urgent elective operating has again been postponed due to the second wave of the pandemic and therefore this waiting backlog is currently increasing.

The current study has demonstrated not only that a third of THA patients and nearly one-quarter of KA patients are now living in a health state WTD, but also that longer time on the waiting list was associated with a significantly worse health-related quality of life. As of December 2020, approximately 40,000 patients in England and Scotland had been waiting over one year for orthopaedic surgery.[3,18] Based on previous levels of arthroplasty, approximately one-third of these patients are likely to be waiting for hip or knee arthroplasty.[18] This translates to more than 13,000 patients waiting over one year after listing for hip or knee arthroplasty. While patients wait longer their pain is managed in primary care where medical practitioners may come under increasing pressure to prescribe opiate medication, against current recommendations for osteoarthritis management.[19] The current study has found that clinically significant deteriorations exceeding the EQ-5D MCID occur with each additional six-month wait for hip or knee arthroplasty. Similar to Morris et al,[20] more than 80% of patients subjectively reported their health-related quality of life had deteriorated while on the waiting list during the pandemic. EQ-5D scores in patients with degenerative joint disease of the hip and knee are known to be independently associated with joint-specific patient-reported outcome measures (PROMs) and thus pain and function from the involved joint.[5] It has also previously been demonstrated that patients with worse preoperative EQ-5D scores ultimately achieve worse Oxford Hip and Knee Scores and worse rates of patient satisfaction following hip and knee arthroplasty[5] and are less likely to return to work.[21] Delaying these patients on indefinite waiting lists and deprioritizing the recommencement of "elective" orthopaedic operating is not benign: it will have real and lasting effects on these patients who may achieve poorer outcomes as a result.

This study has limitations. Comorbidities and joint-specific PROMs were not included. This was for ease of applying the questionnaire over the telephone. The relationship between comorbidities, joint-specific PROMs, and EQ-5D indices have been investigated and delineated previously in a large cohort.[5] Resource allocation within a healthcare setting like the NHS is based on quality adjusted life years that are derived from health utility scores such as the EQ-5D score, not on joint-specific function. Therefore, the EQ scores were collected in isolation. Patients were selected at random from the waiting lists to avoid selection bias but were not consecutive and non-responders may have influenced the interpretation of results. The multicentre nature of the study however enhances its generalizability and external validity. The comparative control cohort from 2014 to 2017 was from a single centre, including over 4,000 arthroplasty patients with nearly identical preoperative EQ-5D scores to that observed in the National Joint Registry, and is therefore likely to be representative of patients awaiting hip and knee arthroplasty across the UK.[22,23] Furthermore, the single centre providing the control group data was not significantly different from the other centres providing data for the 2020 group (Table II). However, those in the 2020 group were interviewed during a global pandemic and while during August and September 2020 in the UK there were only limited social restrictions in place, this was a different landscape to that of the control data collection period of 2014 to 2017. Therefore, it is not possible to be certain whether a societal state of pessimism due to the COVID-19 pandemic influenced the patients' perceptions when they responded to the questionnaire or if a real physical deterioration had occurred. However, without sampling people not on the waiting list to assess the influence of COVID-19 restrictions on the population, this persists as a limitation.

In conclusion, over a third of patients waiting for a THA and nearly one-quarter of patients waiting for knee arthroplasty were in a health state WTD, almost double that observed previously. Subjectively over 80% of patients reported a decline in their health-related quality of life while on the waiting list. Objectively health-related quality of life scores correlated and declined significantly with time on the waiting list and therefore those in a state WTD will likely grow as the wait time increases. In a societal context this is highly relevant, especially when considering the health service rationing and prioritization that will be required not only during the recommencement of routine operating but over future years as the NHS recovers from the impact of COVID-19.

Take home message

- One-third of patients waiting for total hip arthroplasty and nearly one-quarter waiting for a knee arthroplasty procedure were in a state "worse than death".
- Every increasing six-month period a patient waited for surgery was associated with a clinically significant deterioration in the quality of their life.

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