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Does racial background influence outcomes following total joint arthroplasty?

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ABSTRACT

Background: The purpose of this study is to assess whether racial differences influence patient-reported outcome measures (PROMs) following primary total hip (THA) and knee (TKA) arthroplasty.
Methods: We retrospectively reviewed patients who underwent primary THA or TKA from 2016 to 2020 with available PROMs. Both THA and TKA patients were separated into three groups based on their ethnicity: Caucasian, African-American, and other races. Patient demographics, clinical data, and PROMs at various time-periods were collected and compared. Demographic differences were assessed using chi-square and ANOVA. Univariate ANCOVA was utilized to compare outcomes and PROMs while accounting for demographic differences.
Results: This study included 1999 THA patients and 1375 TKA patients. In the THA cohort, 1636 (82%) were Caucasian, 177 (9%) were African-American, and 186 (9%) were of other races. In the TKA cohort, 864 (63%) were Caucasian, 236 (17%) were African-American, and 275 (20%) were of other races. Surgical-time significantly differed between the groups that underwent THA (88.4vs.100.5vs.96.1; $p < 0.001$) with African-Americans requiring the longest operative time. Length-of-stay significantly differed in both THA (1.5vs.1.9vs.1.8; $p < 0.001$) and TKA (2.1vs.2.5vs.2.3; $p < 0.001$) cohorts, with African-Americans having the longest stay. Caucasians reported significantly higher PROM scores compared to non-Caucasians in both cohorts. All-cause emergency-department (ED) visits, 90-day postoperative events (readmissions&revisions), and discharge-disposition did not statistically differ in both cohorts.
Conclusion: Non-Caucasian patients demonstrated lower PROM scores when compared to Caucasian patients following TJA although the differences may not be clinically relevant. LOS was significantly longer for African-Americans in both THA and TKA cohorts. Further investigation identifying racial disparity interventions is warranted.
Level of evidence: Prognostic Level III

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1. Introduction

Patients with end-stage arthritis are severely limited in their choice of effective treatments for symptomatic relief.[1] Total joint arthroplasty (TJA) has proven to be the most effective treatment for patients suffering from such ailments.[2,3] Total hip arthroplasty (THA) and total knee arthroplasty (TKA) are two of the most common procedures performed in the United States and rates are steadily increasing.[4] Osteoarthritis (OA) is a non-biased entity that affects 45% of Caucasian and African-Americans alike.[5] Although TJA is an effective treatment for end-stage OA, racial disparities in access to adequate care continue to exist in the United States.[6–17] Multiple organizations including the American Academy of Orthopedic Surgeons (AAOS) have sought to study and minimize these racial disparities through an emphasis on inclusion of minority patient groups in orthopedic research and allocation of funding to investigate racial disparities in care, including specifically after TJA.[5,18,19]

Multiple reports have attempted to determine the reasons why these disparities exist between Caucasian and non-Caucasian patients.[6–17] Some studies have examined the relationship

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between the utilization of TJA by ethnic groups, while others have examined socioeconomic disparities and access to care.[11,17] It has previously been reported that minorities are less likely to perceive benefits from TJA and are more likely to encounter barriers while seeking treatment.[9,20] Additionally, minority groups have a greater likelihood of postoperative complications and need for reoperation especially for those undergoing primary TKA.[13,21,22] However, under a universally insured system, these inequalities seem to dissipate with equivalent outcomes between patients of all races.[23]

Patient reported outcome measures (PROMs) have aided orthopedic research in assessing outcomes from the patient's perspective. With the advent of more valid and reliable tests, practitioners have been able to better assess functional outcomes after TJA.[24,25] Previous studies have utilized PROMs to evaluate and report on the differences in outcomes between patients of different ethnic backgrounds[26–32] and many have suggested that African-American patients consistently report lower PROM scores than those of other races.[26,27,33] Additionally, studies have been conducted to compare the effect of Medicaid coverage as a measure of poverty to determine patient satisfaction following THA or TKA.[26,27] Though these studies found an association between poverty and poorer outcomes following TJA, they also determined that African-Americans living within equally impoverished areas as Caucasians were more likely to be dissatisfied with their outcomes.[26,27]

This study aims to assess whether race influences clinical outcomes such as surgical time, length of stay (LOS), all-cause emergency department (ED) visits, 90-day all-cause readmissions, 90-day all-cause reoperations, discharge disposition, as well as patient reported outcome measures (PROMs) following primary THA and TKA.

2. Methods

We retrospectively reviewed all patients who underwent elective primary THA or TKA between November 2016 and March 2020 who responded to at least one PROM questionnaire. This study was conducted at a single urban, academic, tertiary institution. There were a total of 6253 THA cases and 6750 TKA cases performed at our institution within the study period. Of the 6253 patients who underwent THA, 4718 (75%) were Caucasian, 750 (12%) were African-American, and 785 (13%) were of other races. Of the 6750 patients who underwent TKA, 3594 (53%) were Caucasian, 1401 (21%) were African-American, and 1755 (26%) were of other races. Both THA and TKA patients were separated into three groups based on their ethnicity: Caucasian, African-American, and all other races. Patients undergoing bilateral or revision TJA, as well as arthroplasty performed for traumatic, non-elective, or oncologic reasons were excluded from this analysis. Seventeen surgeons contributed to both THA and TKA cohorts respectively. Of the 17 surgeons who contributed cases in both cohorts, 13 completed an additional year of fellowship training in adult reconstructive surgery. The records and existing data were de-identified and a part of our institutional quality improvement program; therefore, the present study was exempt from human-subjects review by our Institutional Review Board (IRB).

2.1. Data collection

Baseline patient demographics including age, gender, body mass index (BMI), smoking status, and American Society of Anesthesiologists (ASA) classification were obtained from our electronic data warehouse (Epic Caboodle. version 15; Verona, WI) using Microsoft SQL Server Management Studio 2017 (Redmond, WA). The primary outcome measures were surgical time, length of stay (LOS), all-cause emergency department (ED) visits, 90-day all-cause readmissions, 90-day all-cause reoperations, discharge disposition, and PROM scores. The PROMs utilized included the Forgotten Joint Score-12 (FJS-12), Hip disability and Osteoarthritis Outcome Scores for Joint Replacement (HOOS, JR), and Knee Injury and Osteoarthritis Outcome Score for Joint Replacement (KOOS, JR), Veterans RAND 12 Physical and Mental components (VR-12 PCS & VR-12 MCS). LOS was evaluated in days spent in the hospital following surgery and surgical time was derived from calculating the difference between the time a patient enters the operating room and the time the patient exits.

As part of our institution's standard of care, patients were preoperatively registered for an electronic patient engagement application (EPEA; Force Therapeutics, New York, NY) by clinical care coordinators at the time of surgical scheduling. The EPEA utilizes mobile and web technology to wirelessly deliver digital PROM surveys at pre-defined time intervals. FJS-12 scores were collected at three months, one year, and two years postoperatively. HOOS, JR, KOOS, JR, VR-12 PCS, and VR-12 MCS scores were collected preoperatively, and at three months and one year postoperatively.

There were 426 THA patients who answered both three-month and one-year follow-up FJS-12 questionnaire and 90 patients who answered at both one-year and two-year follow-up. Two-hundred fifty-six TKA patients answered the FJS-12 questionnaire at three-months and one-year follow-up and 51 patients who answered at both one-year and two-year follow-up. With regards to the HOOS, JR survey, there were 1193 patients with a preoperative and one-year follow-up score. There were 588 TKA patients who answered the KOOS, JR questionnaire preoperatively and at one-year follow-up. A total of 1210 THA patients had both a preoperative and one-year VR-12 PCS and MCS scores available. Lastly, a total of 701 TKA patients had both a preoperative and one-year VR-12 PCS and MCS scores available.

2.2. Statistical analysis

Descriptive data are represented as means ± standard deviation. Statistical differences in numeric, continuous variables were detected using analysis of variance (ANOVA). Chi-squared ($\chi 2$) tests were utilized for categorical variables. Univariate analysis of covariance (ANCOVA) was used to compare all primary outcome measures being evaluated in this study including all PROMs at each of the time points between the three racial ethnic groups while accounting for the significant differences in demographic data found between both THA and TKA cohorts respectively. A p-value of less than 0.05 was considered to be statistically significant. All statistical analyses were performed using SPSS v25 (IBM Corporation, Armonk, New York).

3. Results

This study included a total of 3374 patients who underwent TJA and responded to at least one PROM questionnaire. There were 1999 patients who underwent primary THA and 1375 who underwent primary TKA. The THA cohort was comprised of 1636 (82%) Caucasians, 177 (9%) African-Americans, and 186 (9%) patients of other races. The TKA cohort was comprised of 864 (63%) Caucasians, 236 (17%) African-Americans, and 275 (20%) patients of other races. Of the total 6253 THA cases performed at our institution within the study period, 35% Caucasians, 24% African-Americans, and 24% of patients of all other races were included based on completion of PROM questionnaires. Of the total 6750 TKA cases performed at our institution within the study period, 24% Caucasians, 17% African-Americans, and 16% of patients of all other races were included based on completion of PROM questionnaires.

Patients' age statistically differed in both THA (64.55 ± 10.36 vs 59.03 ± 12.29 vs 59.02 ± 13.46; p < 0.001) and TKA (68.27 ± 8.92 vs 62.43 ± 8.99 vs 63.15 ± 9.75; p < 0.001) cohorts with Caucasians more likely to undergo surgery at a significantly older age than African-Americans and patients of all other races. Gender did not statistically differ between patients of all ethnicities in the THA cohort; however, was found to statistically differ in the TKA cohort (p < 0.001). There were significantly more male Caucasian patients that underwent TKA compared to African-Americans and patients of other races (40.5% vs 15.7% vs 28.7%; p < 0.001). BMI significantly differed between patients of all ethnicities in both the THA (28.42 ± 5.87 vs 31.08 ± 6.96 vs 28.25 ± 5.91; p < 0.001) and TKA (31.16 ± 6.59 vs 34.47 ± 6.53 vs 31.64 ± 7.20; p < 0.001) cohorts, with African-American patients having statistically higher BMI in both groups. ASA classification did not statistically differ between patients of all ethnicities in both THA (p = 0.575) and TKA (p = 0.447) cohorts. African-American patients were statistically more likely to be non-smokers at the time of their surgery in both the THA (56.2% vs 62.1% vs 55.4%; p < 0.001) and TKA (51.0% vs 66.9% vs 58.9%; p < 0.001) cohorts. The full comparison of patient demographic data is shown in Table 1.

Upon controlling for the significant differences in demographic data found between both cohorts using multilinear regression models, surgical time (minutes) significantly differed between patients in the three ethnic groups that underwent THA (88.37 ± 27.21 vs 100.56 ± 32.41 vs 96.09 ± 28.93; p < 0.001) with African-Americans requiring the longest operative time. Surgical time was not found to be statistically different between patients in the TKA cohorts (102.65 ± 23.94 vs 99.95 ± 25.42 vs 98.52 ± 24.28; p = 0.129). LOS (days) significantly differed in both THA (1.49 ± 1.19 vs 1.94 ± 1.11 vs 1.79 ± 1.37; p < 0.001) and TKA (2.10 ± 1.17 vs 2.55 ± 1.35 vs 2.27 ± 1.13; p < 0.001) cohorts, with African-Americans having the longest in-hospital stay postoperatively. We found no statistical difference between patients of racial ethnicities with regards to all-cause ED visits in both the THA (2.1% vs 1.7% vs 3.2%; p = 0.481) and TKA (2.5% vs 3.8% vs 3.6%; p = 0.455) cohorts. There was no statistical difference with respect to 90-day all-cause readmission between the three racial groups in both THA (3.2% vs 3.4% vs 2.7%; p = 0.914) and TKA (3.9% vs 0.8% vs 1.5%; p = 0.190) cohorts. Furthermore, we found no statistical difference in 90-day all-cause revisions between patients of all races in both THA (1.3% vs 2.3% vs 0.5%; p = 0.352) and TKA (0.5% vs 0.0% vs 0.0%; p = 0.323) cohorts. Although discharge disposition approached statistical significance, it did not statistically differ between the three racial groups in both the THA (p = 0.081) and TKA (p = 0.064) cohorts. These findings are summarized in Table 2.

Caucasian patients reported significantly higher FJS-12 scores at all postoperative time points compared to African-Americans and patients of all other races in the THA (3 months: 53.68 vs 41.36 vs 43.00, p = 0.002; 1 year: 68.49 vs 51.03 vs 53.32, p < 0.001; 2 years: 72.95 vs 63.75 vs 58.76, p = 0.036) and TKA (3 months: 29.17 vs 17.78 vs 21.54, p = 0.009; 1 year: 45.96 vs 31.73 vs 37.77, p = 0.002; 2 years: 55.99 vs 32.94 vs 41.50, p < 0.001) cohorts. Caucasian patients in the THA cohort reported significantly greater mean HOOS, JR scores at all time points compared to African-American patients and those of other races (Preoperative: 51.47 vs 46.69 vs 45.98, p < 0.001; 3 months: 79.12 vs 73.21 vs 73.41, p < 0.001; 1 year: 85.52 vs 79.59 vs 78.54, p < 0.001). Similar findings were observed in the TKA cohort, with Caucasians reporting significantly greater mean KOOS, JR scores in comparison to African-Americans and patients of all other races (Preoperative: 48.86 vs 41.44 vs 41.77, p < 0.001; 3 months: 63.35 vs 59.57 vs 59.00, p < 0.001; 1 year:

Table 1
Patient demographics.

THA (n = 1999)				
	Caucasian (n = 1636)	African-American (n = 177)	Other Races (n = 186)	P-Value
Age	64.55 ± 10.36	59.03 ± 12.29	59.02 ± 13.46	<0.001
Gender				0.675
Female	925 (56.5%)	103 (58.2%)	111 (59.7%)	
Male	711 (43.5%)	74 (41.8%)	75 (40.3%)	
BMI (kg/m^2)	28.42 ± 5.87	31.08 ± 6.96	28.25 ± 5.91	<0.001
ASA				0.575
1	148 (9.0%)	13 (7.3%)	22 (11.8%)	
2	1050 (64.2%)	114 (64.4%)	115 (61.8%)	
3	419 (25.6%)	50 (28.2%)	47 (25.3%)	
4	19 (1.2%)	0 (0.0%)	2 (1.1%)	
Smoking Status				<0.001
Never Smoker	920 (56.2%)	110 (62.1%)	103 (55.4%)	
Former Smoker	647 (39.5%)	47 (26.6%)	59 (31.7%)	
Current Smoker	69 (4.2%)	20 (11.3%)	24 (12.9%)	
TKA (n = 1375)				
	Caucasian (n = 864)	African-American (n = 236)	Other Races (n = 275)	P-Value
Age	68.27 ± 8.92	62.43 ± 8.99	63.15 ± 9.75	<0.001
Gender				<0.001
Female	514 (59.5%)	199 (84.3%)	196 (71.3%)	
Male	350 (40.5%)	37 (15.7%)	79 (28.7%)	
BMI (kg/m^2)	31.16 ± 6.59	34.47 ± 6.53	31.64 ± 7.20	<0.001
ASA				0.447
1	27 (3.1%)	9 (3.8%)	10 (3.6%)	
2	484 (56.0%)	128 (54.2%)	162 (58.9%)	
3	340 (39.4%)	97 (41.1%)	103 (37.5%)	
4	13 (1.5%)	2 (0.8%)	0 (0.0%)	
Smoking Status				<0.001
Never Smoker	441 (51.0%)	158 (66.9%)	162 (58.9%)	
Former Smoker	396 (45.8%)	66 (28.0%)	97 (35.3%)	
Current Smoker	27 (3.1%)	12 (5.1%)	16 (5.8%)	

*P-values are derived using one-way ANOVA for numerical values or $\chi 2$ tests for categorical values.

Table 2
Clinical outcomes.

THA				
	Caucasian	African-American	Other Races	P-Value
Surgical Time (min)	88.37 ± 27.21	100.56 ± 32.41	96.09 ± 28.93	<0.001
LOS (days)	1.49 ± 1.19	1.94 ± 1.11	1.79 ± 1.37	<0.001
All-cause ED Visits	35 (2.1%)	3 (1.7%)	6 (3.2%)	0.481
90-day all-cause Readmission	52 (3.2%)	6 (3.4%)	5 (2.7%)	0.914
90-day all-cause Revision	21 (1.3%)	4 (2.3%)	1 (0.5%)	0.352
Discharge Disposition				0.081
Home or Self-Care	1565 (96.1%)	169 (95.5%)	175 (94.6%)	
Acute Rehab Facility	14 (0.9%)	0 (0.0%)	1 (0.5%)	
Skilled Nursing Facility	50 (3.1%)	8 (4.5%)	9 (4.9%)	
TKA				
	Caucasian	African-American	Other Races	P-Value
Surgical Time (min)	102.65 ± 23.94	99.95 ± 25.42	98.52 ± 24.28	0.129
LOS (days)	2.10 ± 1.17	2.55 ± 1.35	2.27 ± 1.13	<0.001
All-cause ED Visits	22 (2.5%)	9 (3.8%)	10 (3.6%)	0.455
90-day all-cause Readmission	34 (3.9%)	2 (0.8%)	4 (1.5%)	0.190
90-day all-cause Revision	4 (0.5%)	0 (0.0%)	0 (0.0%)	0.323
Discharge Disposition				0.064
Home or Self-Care	801 (92.7%)	214 (90.7%)	256 (93.1%)	
Acute Rehab Facility	14 (1.6%)	0 (0.0%)	0 (0.0%)	
Skilled Nursing Facility	49 (5.7%)	22 (9.3%)	19 (6.9%)	

*P-values are derived using univariate ANCOVA for both numerical and categorical values while accounting for demographic differences between the groups.

72.44 vs 67.63 vs 68.19, p = 0.003). While all of these differences were statistically significant, they did not exceed the proposed minimal clinically important difference (MCID) for the HOOS, JR (7–36 point difference), and KOOS, JR (7–18 point difference).[34]

In the THA cohort, Caucasians also reported significantly greater mean VR-12 PCS scores compared to African-Americans and patients of all other races (Preoperative: 31.38 vs 29.46 vs 29.69, p = 0.010; 3 months: 43.83 vs 41.02 vs 40.13, p < 0.001; 1 year: 47.21 vs 44.98 vs 44.27; p < 0.001). However, only mean preoperative VR-12 PCS scores significantly differed between the three racial groups in the TKA cohort (Preoperative: 31.59 vs 28.92 vs 30.11, p = 0.034; 3 months: 39.04 vs 36.96 vs 37.07, p = 0.088; 1 year: 43.08 vs 40.26 vs 42.97, p = 0.136). With regards to mean VR-12 MCS scores in the THA cohort, Caucasians reported significantly greater three-month postoperative scores than African-Americans and patients of all other races; however, preoperative and one year postoperative VR-12 MCS scores did not statistically differ between the three racial groups (Preoperative: 48.74 vs 47.32 vs 46.62, p = 0.244; 3 months: 54.51 vs 52.73 vs 52.41, p = 0.044; 1 year: 54.51 vs 54.26 vs 52.57, p = 0.162). In the TKA cohort, Caucasian patients reported significantly greater mean preoperative VR-12 MCS scores compared to African-Americans and patients of all other races; however, three months and one-year postoperative scores did not statistically differ between them (Preoperative: 50.70 vs 47.96 vs 45.78, p < 0.001; 3 months: 52.14 vs 50.82 vs 50.58, p = 0.239; 1 year: 53.21 vs 54.15 vs 53.29, p = 0.618). While some of these differences were statistically significant, they did not exceed the proposed MCID of five points for the VR-12 PCS and MCS.[35] Full PROM findings for both cohorts can be seen in Table 3.

Caucasian patients who underwent THA achieved the greatest statistical mean improvement in HOOS, JR scores preoperatively to one-year postoperatively compared to African-American and patients of all other races (34.05 ± 9.10 vs 32.90 ± 10.45 vs 32.56 ± 11.12; p = 0.050). Similar findings were observed for those who underwent THA with respect to mean improvement in VR-12 PCS scores preoperatively to one-year postoperatively, as Caucasian patients achieved the largest statistical improvement (15.83 ± 5.72 vs 15.52 ± 8.11 vs 14.58 ± 5.84; p = 0.024). However, the mean improvement in VR-12 MCS scores preoperatively to one-year postoperatively did not statistically differ between patients of all races in the THA cohort although African-American patients achieved the largest improvement (5.77 ± 7.40 vs 6.94 ± 6.94 vs 5.95 ± 7.55; p = 0.133). These findings are summarized in Table 4.

Caucasian patients who underwent TKA achieved the lowest statistical mean improvement in KOOS, JR scores preoperatively to one-year postoperatively compared to African-American and patients of all other races (23.58 ± 9.21 vs 26.19 ± 9.22 vs 26.42 ± 9.82; p=<0.001). Mean improvement from preoperatively to one-year postoperatively in VR-12 PCS was found to significantly differ, as patients of all other races achieved the greatest change compared to Caucasians and African-Americans who underwent TKA (11.49 ± 6.12 vs 11.34 ± 5.58 vs 12.86 ± 5.18; pp = 0.002). A similar finding was observed with respect to VR-12 MCS score improvement from preoperatively to one-year postoperatively for patients who underwent TKA, as patients of all other races demonstrated the greatest improvement from baseline compared to their Caucasian and African-American counterparts (2.51 ± 7.07 vs 6.19 ± 7.65 vs 7.51 ± 7.49; p < 0.001). These findings are summarized in Table 4.

4. Discussion

TJA has been shown to alleviate severe symptoms of end-stage OA.[2,3,31,36] Previous reports have demonstrated improvement in pain, stiffness, and function at more than 25-year follow-up.[36,37] Overall, patients that undergo TJA have been shown to have 10-year implant survivorship rates of 95.6% for THA and 96.1% for TKA respectively.[38] African-Americans and other non-Caucasians have lower rates of undergoing primary THA and TKA than their Caucasian counterparts and have historically been shown to have poorer outcomes.[14,33] Our findings demonstrate that non-Caucasian patients achieved lower overall postoperative PROM scores when compared to Caucasian patients following TJA. However, the improvement in scores from baseline preoperative levels was equivocal across racial groups and the clinical difference in scores was negligible. LOS was significantly longer for African-Americans in both THA and TKA cohorts and surgical time was significantly longer for African-Americans in the THA cohort.

Macfarlane et al.[21] reported that although African-American

Table 3
PROMs.

THA				
	Caucasian	African-American	Other Races	P-Value
FJS-12				
3 m	53.68 ± 28.64 (n = 681)	41.36 ± 29.28 (n = 66)	43.00 ± 29.24 (n = 83)	0.002
1y	68.49 ± 27.18 (n = 752)	51.03 ± 28.38 (n = 69)	53.32 ± 34.88 (n = 75)	<0.001
2y	72.95 ± 27.83 (n = 358)	63.75 ± 30.31 (n = 47)	58.76 ± 31.35 (n = 30)	0.036
HOOS, JR				
Preop	51.47 ± 13.25 (n = 1514)	46.69 ± 13.83 (n = 155)	45.98 ± 13.80 (n = 169)	<0.001
3 m	79.12 ± 14.06 (n = 1381)	73.21 ± 14.00 (n = 146)	73.41 ± 15.22 (n = 147)	<0.001
1y	85.52 ± 15.03 (n = 1071)	79.59 ± 17.41 (n = 116)	78.54 ± 18.47 (n = 106)	<0.001
VR-12 PCS				
Preop	31.38 ± 8.39 (n = 1553)	29.46 ± 1.32 (n = 160)	29.69 ± 7.20 (n = 174)	0.010
3 m	43.83 ± 9.21 (n = 1382)	41.02 ± 8.53 (n = 146)	40.13 ± 8.76 (n = 145)	<0.001
1y	47.21 ± 9.42 (n = 1057)	44.98 ± 9.13 (n = 114)	44.27 ± 9.69 (n = 102)	<0.001
VR-12 MCS				
Preop	48.74 ± 12.27 (n = 1553)	47.32 ± 11.54 (n = 160)	46.62 ± 12.43 (n = 174)	0.244
3 m	54.51 ± 9.50 (n = 1382)	52.73 ± 10.34 (n = 146)	52.41 ± 10.39 (n = 145)	0.044
1y	54.51 ± 9.07 (n = 1057)	54.26 ± 9.71 (n = 114)	52.57 ± 11.15 (n = 102)	0.162
TKA				
	Caucasian	African-American	Other Races	P-Value
FJS-12				
3 m	29.17 ± 23.96 (n = 361)	17.78 ± 19.98 (n = 97)	21.54 ± 20.63 (n = 94)	0.009
1y	45.96 ± 27.38 (n = 374)	31.73 ± 24.48 (n = 85)	37.77 ± 25.73 (n = 89)	0.002
2y	55.99 ± 30.03 (n = 166)	32.94 ± 29.73 (n = 46)	41.50 ± 34.36 (n = 23)	<0.001
KOOS, JR				
Preop	48.86 ± 12.87 (n = 645)	41.44 ± 13.93 (n = 194)	41.77 ± 13.86 (n = 233)	<0.001
3 m	65.35 ± 12.98 (n = 683)	59.57 ± 12.82 (n = 191)	59.00 ± 12.33 (n = 181)	<0.001
1y	72.44 ± 15.32 (n = 519)	67.63 ± 15.04 (n = 133)	68.19 ± 16.32 (n = 123)	0.003
VR-12 PCS				
Preop	31.59 ± 8.28 (n = 808)	28.92 ± 7.40 (n = 199)	30.11 ± 7.47 (n = 246)	0.034
3 m	39.04 ± 9.24 (n = 681)	36.96 ± 8.19 (n = 192)	37.07 ± 8.41 (n = 178)	0.088
1y	43.08 ± 10.20 (n = 523)	40.26 ± 9.31 (n = 135)	42.97 ± 8.58 (n = 117)	0.136
VR-12 MCS				
Preop	50.70 ± 11.68 (n = 808)	47.96 ± 12.72 (n = 199)	45.78 ± 12.48 (n = 246)	<0.001
3 m	52.14 ± 10.22 (n = 681)	50.82 ± 12.01 (n = 192)	50.58 ± 11.45 (n = 178)	0.239
1y	53.21 ± 10.32 (n = 523)	54.15 ± 10.76 (n = 135)	53.29 ± 9.92 (n = 117)	0.618

*P-values are derived using univariate ANCOVA while accounting for demographic differences between the groups.

Table 4
Delta improvement in PROMs from baseline.

THA				
	Caucasian	African-American	Other Races	P-Value
HOOS, JR: Preop to 1y	34.05 ± 9.10	32.90 ± 10.45	32.56 ± 11.12	0.050
VR-12 PCS: Preop to 1y	15.83 ± 5.72	15.52 ± 8.11	14.58 ± 5.84	0.024
VR-12 MCS: Preop to 1y	5.77 ± 7.40	6.94 ± 6.94	5.95 ± 7.55	0.133
TKA				
	Caucasian	African-American	Other Races	P-Value
KOOS, JR: Preop to 1y	23.58 ± 9.21	26.19 ± 9.22	26.42 ± 9.82	<0.001
VR-12 PCS: Preop to 1y	11.49 ± 6.12	11.34 ± 5.58	12.86 ± 5.18	0.002
VR-12 MCS: Preop to 1y	2.51 ± 7.07	6.19 ± 7.65	7.51 ± 7.49	<0.001

*P-values are derived using one-way ANOVA.

patients had higher Western Ontario and Universities Osteoarthritis Index (WOMAC) pain scores and lower WOMAC functional scores at baseline when compared to their Caucasian counterparts, they were less likely to undergo TKA.[21] Furthermore, it has been reported that the non-Caucasian population has an increased risk of postoperative complications.[17] Multiple studies have attempted to address these disparities and have analyzed universally insured databases, private payer systems, and conducted a multistate analysis to observe trends in TJA by race and other socioeconomic factors.[7,9,10,17,21,23,39]

Okike et al. [23]studied the effect of race and ethnicity in patients set to undergo THA in the universally insured healthcare model of Kaiser Permanente.[23] Their study demonstrated that African-Americans and other non-Caucasians have similar or better outcomes than their Caucasian counterparts under this system. The authors acknowledge that these outcomes may be unique due to multiple factors including that Kaiser's patients are usually well insured, Kaiser itself has experienced surgeons that perform greater than 30 THAs annually, and that their system has a robust standardization of their quality of care for THA and other medical conditions.

LOS was found in our study to be greater in African-Americans and other minorities when compared to Caucasians undergoing TJA. Similarly, Stone et al.[15] reported a greater LOS for African-American patients undergoing TKA compared to patients of other racial backgrounds.[15] Furthermore, Bernstein et al.[40] showed that

TJA patients who are non-English speaking and require a translator have a significant increase in LOS when compared to primary English speakers and are more likely to be discharged somewhere other than home. Some patients who were included in our African-American population may be less likely to speak English as a first language, contributing as a potential confounder to the observed increased length of stay in this study cohort. Additionally, perhaps the increased LOS for non-Caucasians in our study can be attributed to other socioeconomic factors that extended their in-hospital stay longer than necessary when compared to Caucasians.

Surgical time was greater for non-Caucasians in the THA group, but not in TKA in the present analysis. A possible explanation for this may be due to these cases being scheduled later in the day, having more trainee participation, or simply due to these patients having a higher BMI leading to a case that is more complex. This could ultimately lead to an increased LOS as well. Surace et al.[16] studied the effect of increased surgical times in THA patients using the American College of Surgeons National Surgical Quality Improvement Project (ACS-NSQIP) database and found increased rates of readmission and other short-term complications with increased surgical times.[16] In the present study, African-Americans and other minorities underwent TJA at a significantly younger age in both THA and TKA in comparison to Caucasians. Bayliss et al.[38] reported that patients who underwent TJA at a younger age are at an increased risk for reoperations than patients who undergo TJA after the age of 70 [38].

Our analysis also found no significant difference in 90-day all-cause readmission and all-cause ED visits in both cohorts regardless of race. This contrasts previous reports which demonstrate an increased risk of readmission and ED visits for African-American patients within 90 days following surgery.[7,14] BMI significantly differed between racial groups in both THA and TKA cohorts with African-Americans having the highest BMI between all racial groups. Increased BMI has been shown to directly impact total operating room times.[41] We controlled for BMI differences between patients in all racial groups using when analyzing statistical significance in surgical time, LOS, ED visits, readmissions, revisions, discharge disposition, and all PROMs. This may account for reasons why race did not play a role in complication differences observed.

With respect to our PROM findings in our study, Caucasians consistently reported higher scores than African-Americans and other minorities in both THA and TKA cohorts. These results are consistent with recently published data. Perez et al.[28] recently studied the impact of race and gender on outcomes following TKA. They found a significantly lower preoperative Knee Injury and Osteoarthritis Outcome Score (KOOS) in African-American patients.[28] Perhaps non-Caucasian patients are waiting longer to seek treatment thus have more severe disease based on their preoperative scores being significantly lower than Caucasians. Mean improvements in PROM scores from baseline to one-year also differed between groups in our study. Caucasians in the THA cohort achieved the largest statistical change from baseline with respect to both HOOS, JR and VR-12 PCS. Non-Caucasian patients demonstrated statistically larger improvements in KOOS, JR and VR-12 MCS from baseline than Caucasians in the TKA cohort. Although these differences were found to be statistically significant, they may not be clinically relevant as the differences in HOOS, JR and KOOS, JR scores between all racial groups did not exceed the proposed MCID threshold.[34]

Interestingly, Goodman et al.[26,27] recently reviewed census track data for THA and TKA. The found that being African-American or being insured by Medicaid is associated with worse pain and function at baseline and predicts worse outcomes in pain and function at a two-year follow-up for both THA and TKA patients; however, this trend is strongly linked with poverty.[26,27] They showed that African-Americans from similarly impoverished communities as Caucasians still had worse functional outcomes despite undergoing surgery in the same hospital and receiving similar care.[26,27] Multiple studies have reported that African-American patients expect poorer outcomes when compared to Caucasians undergoing TJA.[20,28,30] Furthermore, some minorities have been reported to seek alternative methods of treatment other than TJA, such as prayer and faith healing before considering surgical options[22,42] This may lead to lower postoperative satisfaction after undergoing TJA.

Socioeconomic status has been identified as a major risk factor for poor health outcomes.[13,43–45] Previous literature suggests that patients with lower socioeconomic backgrounds experience more medical ailments than those with higher socioeconomic status, as access to healthcare is often limited in the former.[46] Recent studies have focused on the role ethnicity plays in outcomes following orthopedic procedures with African-American adults demonstrating worse functional outcomes following joint arthroplasty in comparison to Caucasian adults.[43,45,47] Ethnic disparities in outcomes following orthopedic surgery are likely multifactorial, as income, education, access to medicine, and health literacy are all likely to play a role.[46,48,49] Adequate health literacy is a necessity for optimal function following the diagnosis and treatment of physical and mental ailments.[50,51] If proper interventions are undertaken, such as providing easy to understand recovery information, patients may have a better grasp of their postoperative recovery process, which can also help taper expectations. Implementation of such strategies may have a positive effect on patient outcomes following surgical management following TJA and help decrease the gap that exists between patients of all ethnic backgrounds.

There are several limitations to this study. The retrospective nature of this study represents an area where bias may have been introduced, which we attempted to minimize by systematically controlling for demographic and other potential confounding variables. Although we examined a large number of patients, the vast majority were Caucasians. Although African-American patients included in our study self-identified as African-American there may be black patients from countries of other origin that were not accounted for in our study. Outcome differences observed in this study may be associated with broader socioeconomic parameters that we did not evaluate specifically in our study. We lacked an analysis of specific pre-existing medical comorbidities and independent risk factors that may help elucidate our findings further. All PROMs tools utilized in this study have been clinically validated; however, the MCID for the FJS-12 has yet to be determined thus making it difficult to ascertain the clinical relevance of the differences observed in the scores. Lastly, the analysis of readmissions and revisions was limited to the data pertaining to the 90-day episode of care, and therefore long-term clinical outcomes and costs were not obtained. Despite these limitations, the results presented suggest that racial disparities exist and need to be confronted face on in order to ensure equivalent outcomes for all patients seeking TJA.

5. Conclusion

Racial disparities in TJA candidates whether perceived or objective need to be addressed and minimized. While all patients achieved similar clinical benefits from undergoing TJA, African-Americans, and patients of other races generally demonstrated lower PROM scores and worse outcomes when compared to Caucasians. Results from our study could be used to educate healthcare providers on such differences between patients based on ethnic background. Further investigation is warranted to identify interventions aimed at reducing these disparities between TJA patients of all races.

Ethics, funding, and potential conflict of interest

Our Institutional Review Board (IRB) approved this study. There was no funding received. Dr. Singh, Dr. Realyvasquez, Dr. Kugelman, and Dr. Aggarwal have nothing to disclose. Dr. Long is a paid presenter/speaker for Convatec, paid consultant for Depuy, Pacira, TJO, and Think Surgical, and receives IP royalties from OrthoDevelopment outside the submitted work. Dr. Schwarzkopf is a paid consultant for Smith & Nephew, and Intellijoint. He also has stock options in Gauss Surgical outside the submitted work.

Disclosures

Dr. Singh, Dr. Realyvasquez, Dr. Kugelman, and Dr. Aggarwal have nothing to disclose. Dr. Long is a paid presenter/speaker for Convatec, paid consultant for Depuy, Pacira, TJO, and Think Surgical, and receives IP royalties from OrthoDevelopment outside the submitted work. Dr. Schwarzkopf is a paid consultant for Smith & Nephew, and Intellijoint. He also has stock options in Gauss Surgical outside the submitted work.

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