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Original Research

Racial Disparities in Outcomes of Total Joint Arthroplasty at a Single Institution: Have We Made Progress?

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ABSTRACT

Background: Health disparities disproportionately affect minority groups across the United States with respect to care access, quality, and outcomes. The aim of this study is to examine existing disparities between white and African American (AA) patients regarding postoperative outcomes following total joint arthroplasty and provide insight into disparity trends over a 9-year period.

Methods: A retrospective review of 16,779 total joint arthroplasty patients at a single institution between January 2013 and December 2021 was performed. Patients were grouped by race as AA or white. Outcomes of interest included length of stay (LOS), home discharge, 30-day emergency department return, and 30-day readmission. Univariate statistics and multivariate regressions were utilized to analyze results.

Results: Significant improvements in LOS and rates of home discharge occurred for both white and AA patients at our institution over a 9-year period, while rates of 30-day emergency department returns and readmissions demonstrated a downward but non–statistically significant trend. Despite these trends, AA patients continued to experience longer lengths of stay, less likelihood of 0- or 1-day LOS, and higher risk of nonhome discharge for most years examined. However, after controlling for demographic and comorbidity differences, the differences between groups narrowed over time resulting in no significant differences in the aforementioned 3 measures by 2021.

Conclusions: Although racial disparities in outcomes are still apparent, over time, the differences in resource utilization between AA and white patients have narrowed. Initiatives aimed at creating healthier communities with increased access to care and the ultimate goal of equitable care must continue to be pursued.

Introduction

Health disparities disproportionately affect many minority groups across the United States with respect to access to care, quality of care, utilization of care, and postoperative outcomes. In the United States, minority groups account for more than 30% of the total population, a number that is only expected to increase with time [1]. It is estimated that by the year 2050, non-Hispanic whites will no longer be the majority group in the United States [2]. Furthermore, in 2015, the Harvard Business Review estimated the US cost of race and ethnic health disparities to be roughly $245 billion dollars annually [3]. With the evolving population demographics and the costly burden of health and health care disparities, inequality within the health care system not only affects disadvantaged groups; everyone is affected by these disparities [1,2].

Osteoarthritis of the knee and hip is a common condition affecting an estimated 30.8 million adults in the United States [4]. Total joint arthroplasty (TJA) is a highly successful procedure utilized to treat these conditions in patients who have failed conservative management [4]. Most patients report high levels of satisfaction with improved pain, quality of life, and physical and mental health after the surgery [5,6]. The complication rate of patients undergoing a TJA is relatively low; however, there remain

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significant disparities between white and African American (AA) patients [7–10]. Not only are AA patients less likely to undergo a TJA, they are more likely to be younger and female who ultimately have worse outcomes postoperatively [11]. Unfortunately, it is not enough to merely recognize the existence of these disparities, but proactive measures must be taken to address health inequity head on in order to make progress for the future.

The aim of this study is to add evidence to the existing body of literature by examining the disparities that exist between white and AA patients regarding postoperative outcomes following TJAs at a single, high-volume institution. We also aim to provide insight into the trends of these disparities over a period of 9 years as well as describe various institutional initiatives that may have influenced outcomes.

Material and methods

This study was deemed exempt from institutional review board approval by the institutional clinical research committee. A retrospective chart review was performed for all patients undergoing a total knee arthroplasty (TKA) or total hip arthroplasty (THA) between January 28, 2013, and December 30, 2021. Surgeries were performed by 12 board-certified surgeons at a single institution, encompassing 1 hospital and an affiliated ambulatory surgery center. Our hospital is a regional medical center located in a suburban environment but draws patients from both urban and rural geographies. No orthopedic residency program exists at the hospital, although programs in general surgery, obstetrics and gynecology, and internal medicine are present. Data were collected using an administrative database for patient demographics and comorbidities. The American Society of Anesthesiologists (ASA) score was used to quantify preoperative health status. Comorbidity burden was calculated using the Charlson Comorbidity Index (CCI).

Perioperative protocol

All patients were cared for in a coordinated joint replacement center and received written educational materials, preoperative medical evaluations, preoperative home exercise or outpatient physical therapy, and an education class for patients and their caregivers. All patients were treated using a multimodal pain-management protocol which, depending on patient factors, included acetaminophen, oral nonsteroidal anti-inflammatory drugs, pregabalin, ketorolac, and oral opioid medications as needed.

Study population

All patients included in this study underwent a primary unilateral THA or TKA from January 2013 to December 2021. Patients undergoing a bilateral TKA or THA or revision procedures were excluded from this study. Patients that had race unknown or declined to answer were excluded, as were Asian, American Indian, or Pacific Islander due to small numbers. Patients who had expired in a hospital, had discharge disposition unknown, left against medical advice, or were transferred to another acute care hospital were also excluded. A total of 16,779 patients met the inclusion criteria.

Study outcomes

Outcomes of interest included length of stay (LOS) in days, 0- or 1-day LOS, home discharge, 30-day emergency department (ED) return, and 30-day readmission.

Statistical analysis

Patients were classified by race as AA or white, based on self-identified determination. Inferential statistics were performed to determine the impact of race on outcomes. A univariate analysis including chi-square tests and two-sided independent samples t-tests were used to determine differences in comorbidities and outcomes between groups. Two-way analyses of variance were used to assess the association between race and outcomes over time. Multivariate linear and logistic regression assessed the adjusted risk of outcomes controlling for various variables that were selected as possible confounding factors because they were significantly different at $\alpha < 0.05$ between the groups in the preliminary univariate analysis. All statistical analyses were performed using R Studio (Version 1.4.1717 2009-2021; RStudio, PBC). Statistical significance was assessed at $P < .05$.

Power analysis

An a priori power analysis was conducted to determine the sample size necessary to detect small, medium, and large effect sizes for chi-squared tests and two-sample t-tests while maintaining an alpha of 0.05 and 80% power. This study was adequately powered to detect these effect sizes for both categorical and continuous endpoints.

Results

Of the 16,779 patients, 2489 (14.8%) were AA, and 14,290 (85.2%) were white. AA TJA patients were on average 3 years younger than white TJA patients (64.55 vs 67.53 years; $P < .001$). Overall comorbidity burden was higher in AA patients as measured by the percent of patients who were ASA $\geq$3 (44.4 vs 37.7%; $P < .001$) but similar between racial groups as measured by the CCI ($P = .364$). Of the CCI comorbidities examined, AA patients demonstrated higher rates of congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), rheumatic disease, diabetes with and without chronic complications, renal disease, and acquired immune deficiency syndrome or human immunodeficiency virus (AIDS or HIV)

Table 1
Patient comorbidities by race.

Patient comorbidities	African American (n = 2489)	White (n = 14,290)	*P* value
Age	64.55 ± 9.78	67.53 ± 9.62	**<.001**
ASA 3+	1106 (44.4)	5390 (37.7)	**<.001**
MI	83 (3.3)	690 (4.8)	**.001**
CHF	187(7.5)	779 (5.4)	**<.001**
PVD	0 (0)	0 (0)	1
CVD	46 (1.8)	375 (2.6)	**.027**
Dementia	14 (0.6)	123 (0.9)	.159
COPD	510 (20.5)	2148 (15.0)	**<.001**
Rheumatic	159 (6.4)	644 (4.5)	**<.001**
PUD	5 (0.2)	36 (0.3)	.826[a]
Mild liver disease	41 (1.6)	219 (1.5)	.734
Diabetes w/o chronic complication	556 (22.3)	1908 (13.4)	**<.001**
Diabetes w/ chronic complication	148 (5.9)	441 (3.1)	**<.001**
Hemiplegia or paraplegia	3 (0.1)	12 (0.08)	.478[a]
Renal disease	269 (10.8)	1009 (7.1)	**<.001**
Malignancy	40 (1.6)	213 (1.5)	.726
Moderate liver disease	0 (0)	4 (0.03)	1[a]
Metastatic solid tumor	4 (0.2)	18 (0.1)	.557[a]
AIDS or HIV	10 (0.4)	4 (0.03)	**<.001**[a]
CCI score	3.07 ± 1.82	3.04 ± 1.60	.364

MI, myocardial infraction; PUD, peptic ulcer disease; PVD, pulmonary vascular disease.
P values < .05 are in bold. Data are expressed as n (%).
[a] Fisher's exact test.

Table 2
Population outcomes by procedure type.

Outcome measure	All patients			Total knee replacement			Total hip replacement		
	African American (n = 2489)	White (n = 14,290)	*P* value	African American (n = 1597)	White (n = 8583)	*P* value	African American (n = 892)	White (n = 5707)	*P* value
LOS (d)	1.86 ± 1.46	1.70 ± 1.49	**<.001**	1.94 ± 1.49	1.73 ± 1.42	**<.001**	1.73 ± 1.38	1.65 ± 1.59	.161
0- or 1-d LOS	1336 (53.7)	8439 (59.1)	**<.001**	805 (50.4)	4766 (55.5)	**<.001**	531 (59.5)	3673 (64.4)	**.006**
Home discharge	1959 (78.7)	12318 (86.2)	**<.001**	1220 (76.4)	7404 (86.3)	**<.001**	739 (82.8)	4914 (86.1)	**.011**
30-d ED return	151 (6.1)	649 (4.5)	**.001**	101 (6.3)	432 (5.0)	**.039**	50 (5.6)	217 (3.8)	**.014**
30-d Readmission	63 (2.5)	331 (2.3)	.561	40 (2.5)	195 (2.3)	.633	23 (2.6)	136 (2.4)	.813

P values < .05 are in bold. Data are presented as n (%) or average ± standard deviation.

(all $P < .001$). However, AA patients had lower rates of myocardial infarction (4.8 vs 3.3%; $P = .001$) and cerebrovascular disease (CVD) (1.8 vs 2.6%; $P = .027$) (Table 1).

In comparison to white patients over the entire study period, AA patients had significantly longer LOS (1.86 vs 1.70 days; $P <$ .001) and consequently had fewer patients with a LOS of 0 or 1 day (53.7 vs 59.1%; $P < .001$). Furthermore, AA patients experienced higher rates of 30-day ED returns (6.1 vs 4.5%; $P = .001$). No significant differences in rates of 30-day readmissions were observed between the racial groups (AA: 2.5% vs white: 2.3%, $P = .561$) (Table 2). When stratified by procedure, AA TKA patients were younger than white TKA patients (65.02 vs 67.81 years; $P < .001$), had a significantly longer LOS (1.94 vs 1.73 days; $P < .001$), fewer patients with an LOS of 0 or 1 day (50.4 vs 55.1%; $P < .001$), and higher rates of 30-day ED returns (6.3 vs 5.0%; $P = .001$) (Table 2). Similarly, AA THA patients were younger than white THA patients (63.71 vs 67.11 years; $P < .001$), had a significantly longer LOS (1.73 vs 1.65 days; $P < .001$), fewer patients with an LOS of 0 or 1 day (59.5 vs 64.4%; $P < .001$), and higher rates of 30-day ED return (5.6 vs 3.8%; $P = .001$) (Table 2). No significant differences in 30-day readmission rates were observed between the groups for either THA or TKA procedures.

These outcomes were then analyzed for significant differences between races over time. The LOS trended downward consistently from 2013 to 2021, but AA patients experienced a significantly longer LOS than white patients in all years besides 2013 and 2015 (Fig. 1). Subsequently, 0- or 1-day LOS trended upward from 2013 to 2021. Notably, no statistically significant differences in rates of 0- or 1-day LOS were observed after 2018 (Fig. 2). Similarly, rates of home discharge increased for both AA and white patients over the study period. While white patients experienced higher rates of home discharge from 2013 to 2018 (all $P < .05$), no statistically significant differences in home discharge rates remained after 2018 (Fig. 3). In comparison to other endpoints, a greater variability was observed in rates of both 30-day ED returns and readmissions over time, although a general downward trend was observed for both AA and white patients in both measures. No statistically significant differences in rates of either ED returns or readmissions were observed between AA and white patients, with the exception of a higher rate of ED returns in AA patients in 2021 ($P = .033$) (Figs. 4 and 5).

Multivariate linear and logistic regression examined the associations between outcomes and race by year after controlling for comorbidities that differed between groups—age, ASA, myocardial infarction, CHF, CVD, COPD, rheumatic disease, diabetes with and without chronic complication, renal disease, and AIDS or HIV. After controlling for these factors, the AA race was associated with similar lengths of stay from 2013 to 2016 and again in 2021 but with increased lengths of stay in 2017-2020 (all $P < .01$) (Table 3). When comparing odds of 0- or 1-day LOS, AA patients were significantly less likely to discharge in 0 or 1 day from 2014 to 2019 (all $P < .01$) but experienced similar rates in 2013, 2020, and 2021 (Table 4). An evaluation of home discharge demonstrated that AA patients were significantly less likely to discharge home in all years (all $P < .04$) except 2021. Finally, AA patients experienced no significant differences in the risk of ED return or readmission in all years, with the exception of increased risk of ED return in 2021 ($P = .020$) (Table 4).

Discussion

The results of the current study demonstrate that improvements in LOS and rates of home discharge occurred for both white and AA patients at our institution over a 9-year period, while rates for 30-day ED returns and readmissions demonstrated a

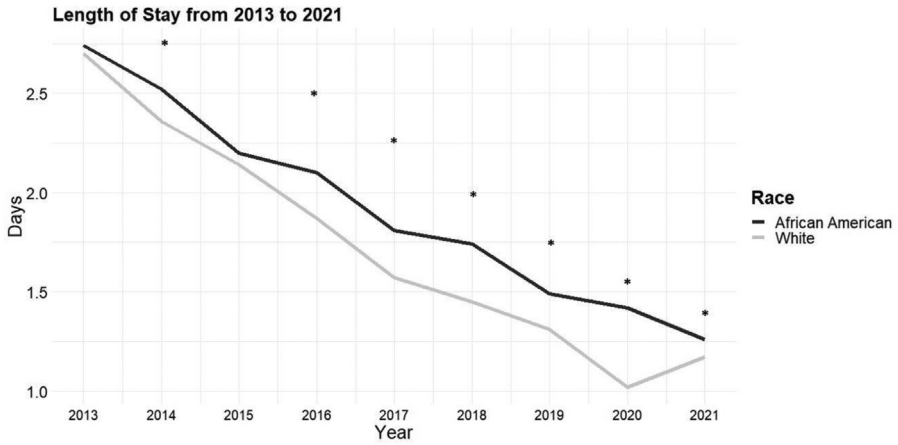

Figure 1. Length of stay days from 2013 to 2021. *$P < .05$.

downward but non−statistically significant trend. Despite these trends, AA patients continued to experience a longer LOS, less likelihood of 0- or 1-day LOS, and a higher risk of nonhome discharge for most years examined. However, the narrowing of differences between the racial groups over time and the finding that, after risk adjustment, no significant differences in these 3 measures existed by 2021 suggests progress toward reducing racial disparities is being made. In order to achieve the goal of fully eliminating disparities, it is imperative that future studies continue to evaluate their driving forces and the effects of targeted interventions in the TJA population.

The differences in demographics, comorbidities, and outcomes observed between AA and white patients undergoing a TJA in this study are in alignment with previously published results [1,11−13]. Stone et al. conducted a retrospective review of 7208 TJA patients comparing the outcomes between AA and white patients [1]. For TKAs, they demonstrated that AA patients were more likely to be female, younger, have higher body mass index (BMI), longer LOS, higher rate of readmission and discharge to skilled nursing, and lower median household income [1]. Additionally, Weiner et al. demonstrated patients of non-Hispanic black race, female gender, who are obese, have a Medicaid or an uninsured status, are older than 75 years, and have a high comorbidity burden all had a higher risk of extended LOS and nonhome discharge disposition following THAs [13]. With regard to specific comorbidities, Cusano et al. analyzed 230,712 patients undergoing TKAs and found higher rates of diabetes, hypertension, anemia, and CHF in minority patients [14]. The current study adds to this list, identifying increased rates of CVD, COPD, rheumatic disease, renal disease, and HIV/AIDS in the AA population undergoing TJAs. These data suggest that a significant opportunity for improved medical management of chronic conditions in AA patients undergoing TJAs exists. While many of the comorbidity differences represent long-term nonmodifiable disease processes, preoperative medical optimization programs are a factor that has been shown to mitigate risk in TJA patients [15−17]. Institutions aiming to reduce racial disparities should consider investing resources in such programs and ensuring appropriate access exists for patients of all races.

The results of the current study show promising trends toward the reduction of disparities in LOS and nonhome discharge. Our results also show an improvement over time with regard to LOS reducing from about 2.75 days in 2013 to about 1.25 days in 2021 for both AA and white patients. The percentage of patients with 0- or 1-day LOS has also increased from less than 10% of patients in

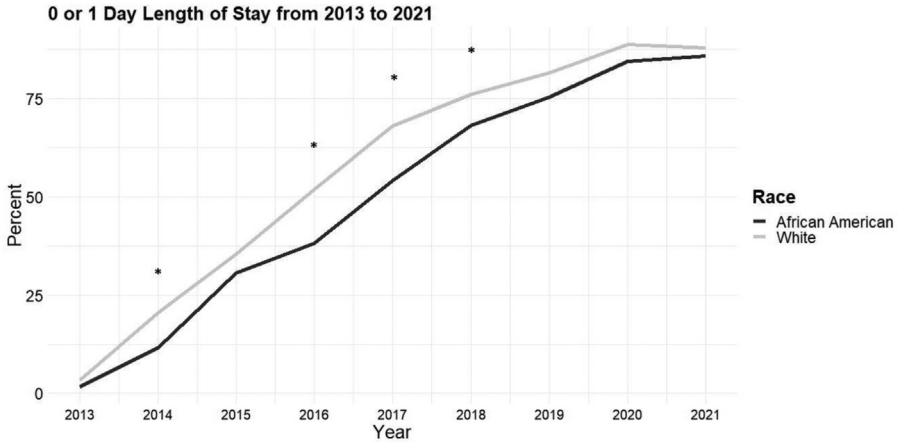

Figure 2. Zero or 1-day length of stay from 2013 to 2021. *$P < .05$.

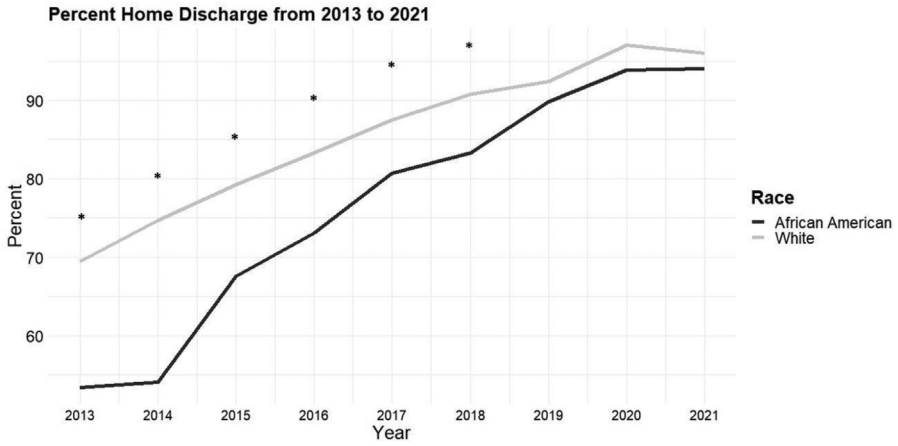

Figure 3. Home discharge from 2013 to 2021. *$P < .05$.

2013 to greater than 80% of patients in 2021. Over the study period, multiple interventions aimed at improving outcomes of all patients, and specific interventions targeting patients at increased risk of increased resource utilization have been implemented. Beginning in 2012, our institution implemented a lean process-improvement framework that included over 15 initiatives aimed at optimizing the workflows of caring for TJA patients. These included standardization and increased utilization of preoperative education courses and guidebooks, adoption of consensus clinical guidelines, refinement of the inpatient workflows and nurse navigator job duties, and the implementation of a home-based ambulatory physical therapy program. Furthermore, in 2019, an enhanced preoperative education pathway was launched which provided individualized counseling and education to minority patients and those with multiple comorbidities or socioeconomic risk factors. Evaluation of the first year of the program revealed that patients treated through an enhanced preoperative education pathway experienced similar lengths of stay, rates of home discharge, and 30-day readmissions to lower-risk patients not utilizing the pathway and that outcomes were similar between AA and non-AA patients [18]. Similar to our own results, Aseltine et al. revealed a reversal in the gap between AA and white patients regarding readmission rates regardless of patient selection or utilization of better-performing hospitals [12]. However, improvement in disparities has not been demonstrated consistently across the literature. Our institutional results are in contrast to those of a previous study that demonstrated persistent if not worsening disparities over time from 2006 to 2015 [19]. Amen et al. reported AA patients had persistent disparities in LOS and total complication rates, and moreover, they had higher rates of discharge to a facility other than home with evidence of worsening disparities [19]. Our contrasting results suggest that efforts to reduce disparities are succeeding, albeit slowly and in limited domains.

An interesting and unexpected finding of the current study was the lack of disparities in 30-day readmission rates over the entire period under examination. With the AA population demonstrating a higher prevalence of comorbidities, one would anticipate an increased risk of medical complications requiring readmission, yet this was not observed in our population. We are unable to infer the exact reason for this finding. This could potentially be due to lack of power to detect differences in the relatively infrequent occurrence of readmission, although the large sample size utilized suggests adequate power was achieved. Alternatively, it is possible that the underlying differences between populations leading to disparities

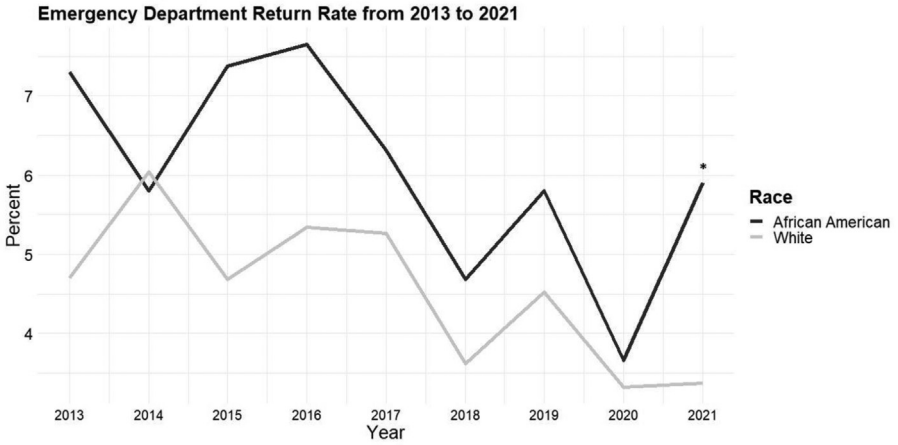

Figure 4. Thirty-day emergency department returns from 2013 to 2021. *$P < .05$.

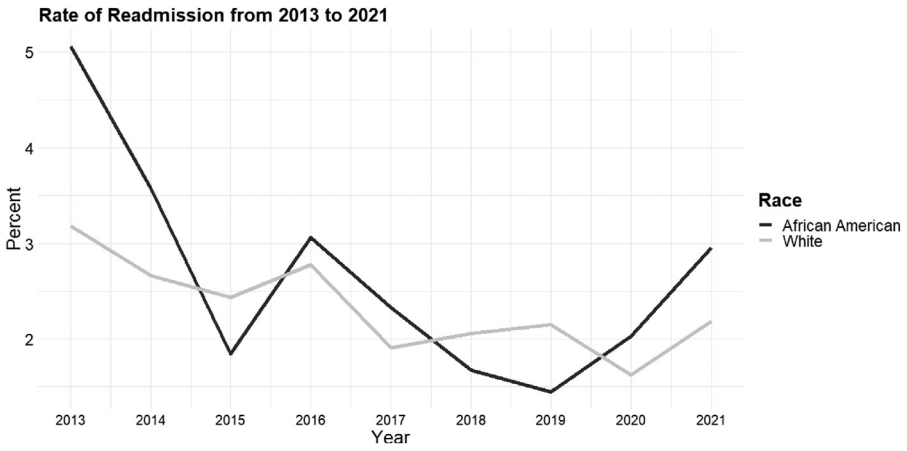

Figure 5. Thirty-day readmissions from 2013 to 2021. *$P < .05$.

in other outcome measures do not lead to true medical and surgical complications requiring admission or that the institutional protocols in place adequately mitigated the risk factors for readmission. Conversely, in a study conducted by Aseltine et al. evaluating patient disparities from 2005 to 2015, their results demonstrated the readmission rate of AA patients increased compared to that of white patients from 2005 to 2008 but then decreased relative to that of white patients from 2009 to 2015 [12]. Similarly, in a 2015 retrospective cohort study, Oronce et al. evaluated the differences in readmission rates of THA patients by race [20]. After adjustment for age, sex, hospital volume, minority-serving hospital status, and comorbidities, AAs were 38% more likely to be readmitted than white patients [20]. After further adjusting for socioeconomic status, AAs were still 30% more likely to be readmitted than white patients [20]. Given the variability in these findings, we suggest further investigation into reasons for readmissions across racial groups is required.

While the current study evaluated only disparities in outcomes, another factor that must be assessed is disparities in access to care, which also encompass disparities in utilization of orthopedic care. According to the US Census Bureau, the community our institution supports is made up of 18.3% AAs; however, only 14.8% of patients in our study were AAs, suggesting decreased utilization or access to care for this patient population [21]. To further demonstrate this disparity, in a retrospective review of Medicare claims data from 2009 to 2017, Thirukumaran et al. compared elective TJA rates among white and AA beneficiaries [22]. The authors demonstrated that AA patients were significantly less likely to undergo a TJA than their white counterparts [22]. Various reasons have been suggested in the literature for why disparities exist in access to orthopedic care. Wang et al. examined the odds of TJA eligibility based on several criteria including BMI, HgbA1c, and smoking status [23]. The authors found that while cutoffs of BMI <40, HgbA1c <8%, and nonsmoking status are important for safe and successful procedure and outcomes, these cutoffs decreased the odds of TJA eligibility for AA vs white patients, women vs men, and patients of lower vs higher socioeconomic status [23]. Furthermore, in another study, Warwick et al. demonstrated that patients with a higher comorbidity burden were 3 times more likely to have a delay in diagnosis of osteoarthritis to eventual TKA [24]. However, prior studies have demonstrated encouraging results with regard to narrowing the gap in both access to care and outcomes for TJA patients. By utilizing the National Inpatient Sample data set, Gwam et al. demonstrated an increase in TKA utilization by minority groups from 2009 to 2015 [25]. Sheth et al. evaluated trends of THA use from 2011 through 2017 and found a twofold increase in the number of AA patients undergoing THAs with significant improvements in their comorbidity profile; however, they also demonstrated no improvement in 30-day postoperative adverse events [26].

A potential causative factor of existing disparities in orthopedic care is the socioeconomic status of patients. Goodman et al. evaluated patient-reported outcomes following TKAs utilizing a hospital-based registry and found that within communities with higher poverty levels, AA patients had worse pain and function 2 years after the TKA than white patients [27]. Furthermore, in a cross-sectional study, Rahman et al. utilized the Area Deprivation Index national percentile as a measure of socioeconomic disadvantage to compare THA utilization rates among those with higher and lower disadvantages [28]. Their results demonstrated that THA rates were significantly higher in more affluent communities [28]. Holbert et al. utilized the Centers for Disease Control Social Vulnerability Index to evaluate the social vulnerability of patients undergoing a TJA with regard to home discharge and 90-day ED returns [29]. They found that patients with nonhome discharge had higher overall social vulnerability and greater vulnerability within the 4 themes evaluated by the Social Vulnerability Index including socioeconomic status, household composition and disability, minority status and language, and housing and transportation. They also demonstrated that patients returning to the ED within 90 days

Table 3
Multivariate linear regression: adjusted risk of length of stay in African American patients by year.

Year	Estimate (β)	95% Confidence interval	*P* value
2013	0.04	−0.15 to 0.23	.647
2014	0.17	−0.03 to 0.38	.096
2015	0.07	−0.11 to 0.25	.437
2016	0.04	−0.15 to 0.23	.647
2017	0.25	−0.82 to 0.13	**.007**
2018	0.23	0.07 to 0.39	**.006**
2019	0.19	0.06 to 0.33	**.006**
2020	0.38	0.23 to 0.53	**<.001**
2021	0.07	−0.16 to 0.30	.571

MI, myocardial infraction.
P values < .05 are in bold. Controlling for age, ASA, MI, CHF, CVD, COPD, rheumatic disease, diabetes with and without chronic complication, renal disease and AIDS or HIV.

Table 4
Multivariate logistic regression: adjusted risk of 0- or 1-day length of stay, home discharge, 30-day emergency department return, and 30-day readmission in African American patients by year.

Year	0- or 1-d LOS			Home discharge			30-d ED return			30-d Readmission		
	Odds ratio	95% Confidence interval	*P* value	Odds ratio	95% Confidence interval	*P* value	Odds ratio	95% Confidence interval	*P* value	Odds ratio	95% Confidence interval	*P* value
2013	0.43	0.10-1.23	.171	0.33	0.23-0.47	**<.001**	1.34	0.67-2.50	.382	1.79	0.78-3.73	.137
2014	0.46	0.29-0.71	**.001**	0.33	0.24-0.46	**<.001**	0.93	0.48-1.65	.806	1.37	0.57-2.88	.443
2015	0.71	0.52-0.96	**.028**	0.39	0.28-0.55	**<.001**	1.64	0.94-2.75	.067	0.75	0.25-1.82	.562
2016	0.51	0.39-0.67	**<.001**	0.40	0.29-0.55	**<.001**	1.36	0.83-2.14	.206	1.15	0.53-2.28	.700
2017	0.47	0.36-0.62	**<.001**	0.45	0.31-0.66	**<.001**	1.20	0.69-1.98	.499	1.19	0.47-2.63	.681
2018	0.67	0.50-0.90	**.007**	0.44	0.29-0.65	**<.001**	1.14	0.58-2.08	.680	1.33	0.52-2.98	.509
2019	0.61	0.46-0.82	**.001**	0.54	0.35-0.85	**.006**	1.25	0.73-2.06	.391	0.65	0.22-1.54	.373
2020	0.72	0.48-1.10	.117	0.48	0.25-0.99	**.038**	1.30	0.58-2.62	.492	1.29	0.41-3.40	.635
2021	0.87	0.60-1.29	.469	0.62	0.35-1.17	.124	1.96	1.08-3.40	**.020**	1.69	0.74-3.51	.185

MI, myocardial infraction.
P values < .05 are in bold. Controlling for age, ASA, MI, CHF, CVD, COPD, rheumatic disease, diabetes with and without chronic complication, renal disease and AIDS or HIV.

had lower vulnerability with socioeconomic, household composition, and disability factors [29]. These findings reiterate the fact that a multitude of factors underlie the disparities in health care. Fortunately, several of these factors are potentially modifiable such as the socioeconomic factors, housing, and transportation of patients, and therefore, there is potential to modify these factors in order to combat disparities in these areas.

In order to combat disparities and health inequity, Williams and Cooper provide a number of initiatives that could be implemented [30]. They advocate for renewing emphasis on prevention, primary care, addressing patients' social risk factors and needs, and diversifying the health care force which would act to both improve health and reduce inequalities. Williams and Cooper also suggest raising awareness of inequalities and building political will to address them [30]. Understandably, initiatives of this scope and complexity are difficult to organize and implement, and the benefits are delayed for numerous years. However, beginning with simpler methods and progressing to more complex initiatives is a reasonable strategy to approach disparities. One such method was examined in a retrospective review by Kelmer et al. who evaluated the effects of nurse navigator programs on the outcomes of TJAs [31]. They demonstrated that patients who attended nurse navigator preoperative education programs had reduced lengths of stay, decreased discharge to skilled nursing facilities, and reduced hospital charges [31]. While this study had promising results, the number of nonwhite patients that attended the education classes was significantly lower suggesting there is opportunity for outreach to encourage more minority patients to attend, which would in turn improve their health outcomes and help close the gap on disparities [31].

This study is not without limitations. First, our results are derived from data from a single institution, and therefore, they may not be applicable to the general population. This is of particular importance when considering the complex interactions between race, available health resources, and socioeconomic factors that are highly variable across geographic locations. The results are also potentially biased by the fact that race is determined by patient self-identification, and we only had sufficient number of study patients who self-identified as white or AA. Next, although a preoperative protocol exists, with 12 board-certified surgeons included in the study, we were not able to ensure that all surgeons followed the protocol exactly throughout. Lastly, health disparities are multifactorial, and while we controlled for some variables, there are other unaccounted-for variables, notably socioeconomic factors, influencing our results either directly or indirectly.

Conclusion

This study demonstrates existing disparities related to orthopedic care and the progress made at combating these disparities over the years. Although the effects on minority groups are still apparent, our study showed no significant differences after risk adjustment for lengths of stay, likelihood of 0- or 1-day LOS, and risk of nonhome discharge in 2021. These results demonstrate the progress made in decreasing the disparity gap between AA and white patients. However, there is still work to be done through initiatives aimed at creating healthier communities with more widespread access to care, with the ultimate goal of extinguishing these disparities altogether.

Conflicts of interest

Dr. King is a paid consultant for Smith & Nephew, receives research support from DePuy, and is in the editorial board of the

Journal of Arthroplasty. Dr. MacDonald a paid consultant for Smith & Nephew and receives research support from Smith & Nephew. All other authors declare no potential conflicts of interest.

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Informed patient consent

The authors confirm that written informed consent has been obtained from the involved patients or if appropriate from the parent, guardian, power of attorney of the involved patients, and they have given approval for this information to be published in this article.

References

[1] Stone AH, MacDonald JH, Joshi MS, King PJ. Differences in perioperative outcomes and complications between African American and white patients after total joint arthroplasty. J Arthroplasty 2019;34:656–62.

[2] Wheeler SM, Bryant AS. Racial and ethnic disparities in health and health care. Obstet Gynecol Clin North Am 2017;44:1–11.

[3] Ayanian JZ. The costs of racial disparities in health care. In: Boston, MA: Harvard Business Review; 2015. https://hbr.org/2015/10/the-costs-of-racial-disparities-in-health-care. [accessed 01.01.22].

[4] Abramoff B, Caldera FE. Osteoarthritis: pathology, diagnosis, and treatment options. Med Clin North Am 2020;104:293–311.

[5] Lange JK, Lee YY, Spiro SK, Haas SB. Satisfaction rates and quality of life changes following total knee arthroplasty in age-differentiated cohorts. J Arthroplasty 2018;33:1373–8.

[6] Tarakji BA, Wynkoop AT, Srivastava AK, O'Connor EG, Atkinson TS. Improvement in depression and physical health following total joint arthroplasty. J Arthroplasty 2018;33:2423–7.

[7] Bilgen MS, Yaray O, Mutlu M, Cakir AI, Bilgen OF. Short-term outcomes of outpatient surgery for total knee arthroplasty. Singapore Med J 2019;60:314–6.

[8] Chun DS, Leonard AK, Enchill Z, Suleiman LI. Racial disparities in total joint arthroplasty. Curr Rev Musculoskelet Med 2021;14:434–40.

[9] Kurtz SM, Lau E, Schmier J, Ong KL, Zhao K, Parvizi J. Infection burden for hip and knee arthroplasty in the United States. J Arthroplasty 2008;23:984–91.

[10] Usiskin I, Misra D. Racial disparities in elective total joint arthroplasty for osteoarthritis. ACR Open Rheumatol; 2022;4. p. 306.

[11] Zhang W, Lyman S, Boutin-Foster C, Parks ML, Pan TJ, Lan A, et al. Racial and ethnic disparities in utilization rate, hospital volume, and perioperative outcomes after total knee arthroplasty. J Bone Joint Surg Am 2016;98:1243–52.

[12] Aseltine Jr RH, Wang W, Benthien RA, Katz M, Wagner C, Yan J, et al. Reductions in race and ethnic disparities in hospital readmissions following total joint arthroplasty from 2005 to 2015. J Bone Joint Surg Am 2019;101:2044–50.

[13] Weiner JA, Adhia AH, Feinglass JM, Suleiman LI. Disparities in hip arthroplasty outcomes: results of a statewide hospital registry from 2016 to 2018. J Arthroplasty 2020;35:1776–83.

[14] Cusano A, Venugopal V, Gronbeck C, Harrington MA, Halawi MJ. Where do we stand today on racial and ethnic health inequities? Analysis of primary total knee arthroplasty from a 2011-2017 national database. J racial ethnic Health disparities 2021;8:1178–84.

[15] MacMahon A, Rao SS, Chaudhry YP, Hasan SA, Epstein JA, Hegde V, et al. Preoperative patient optimization in total joint arthroplasty—the paradigm shift from preoperative clearance: a narrative review. HSS J 2022;18:418–27.

[16] Feng JE, Novikov D, Anoushiravani AA, Wasterlain AS, Lofton HF, Oswald W, et al. Team Approach: perioperative optimization for total joint arthroplasty. JBJS Rev 2018;6:e4.

[17] Fournier MN, Hallock J, Mihalko WM. Preoperative optimization of total joint arthroplasty surgical risk: obesity. J Arthroplasty 2016;31:1620–4.

[18] Turcotte JJ, Brennan JC, Holbert SE, Dolle SS, King PJ. Enhanced preoperative education pathways: a step towards reducing disparities in total joint arthroplasty outcomes. J Arthroplasty 2022;37:1233–1240.e1.

[19] Amen TB, Varady NH, Rajaee S, Chen AF. Persistent racial disparities in utilization rates and perioperative metrics in total joint arthroplasty in the U.S.: a comprehensive analysis of trends from 2006 to 2015. J Bone Joint Surg Am 2020;102:811–20.

[20] Oronce CI, Shao H, Shi L. Disparities in 30-day readmissions after total hip arthroplasty. Med Care 2015;53:924–30.

[21] Bureau USC. Quick facts. In. Suitland, MD: United States Census Bureau; 2020. https://www.census.gov/quickfacts/fact/table/US/RHI225221 [accessed 01.01.22].

[22] Thirukumaran CP, Cai X, Glance LG, Kim Y, Ricciardi BF, Fiscella KA, et al. Geographic variation and disparities in total joint replacement use for Medicare beneficiaries: 2009 to 2017. J Bone Joint Surg Am 2020;102:2120–8.

[23] Wang AY, Wong MS, Humbyrd CJ. Eligibility criteria for lower extremity joint replacement may worsen racial and socioeconomic disparities. Clin Orthop Relat Res 2018;476:2301–8.

[24] Warwick H, O'Donnell J, Mather 3rd RC, Jiranek W. Disparity of health services in patients with knee osteoarthritis before total knee arthroplasty. Arthroplast Today 2020;6:81–7.

[25] Gwam C, Rosas S, Sullivan R, Luo TD, Emory CL, Plate JF. The who, what, and where of primary TKAs: an analysis of HCUP data from 2009 to 2015. J Knee Surg 2020;33:378–86.

[26] Sheth M, Chambers M, Gronbeck C, Harrington MA, Halawi MJ. Total hip arthroplasty in black/African American patients: an updated nationwide analysis. J Racial Ethn Health Disparities 2021;8:698–703.

[27] Goodman SM, Mandl LA, Parks ML, Zhang M, McHugh KR, Lee YY, et al. Disparities in TKA outcomes: Census tract data show interactions between race and poverty. Clin Orthop Relat Res 2016;474:1986–95.

[28] Rahman R, Canner JK, Haut ER, Humbyrd CJ. Is geographic socioeconomic disadvantage associated with the rate of THA in medicare-aged patients? Clin Orthop Relat Res 2021;479:575–85.

[29] Holbert SE, Cheema M, Brennan JC, MacDonald JH, King PJ, Turcotte JJ. Patients from medically underserved areas are at increased risk for nonhome discharge and emergency department return after total joint arthroplasty. J Arthroplasty 2022;37:609–15.

[30] Williams DR, Cooper LA. Reducing racial inequities in health: using what we already know to take action. Int J Environ Res Public Health 2019;16:606.

[31] Kelmer GC, Turcotte JJ, Dolle SS, Angeles JD, MacDonald JH, King PJ. Preoperative education for total joint arthroplasty: does reimbursement reduction threaten improved outcomes? J Arthroplasty 2021;36:2651–7.