Racial Disparities in the Utilization of Shoulder Arthroplasty in the United States

Trends from 2011 to 2017

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Background: As the incidence of shoulder arthroplasty rises at exponential rates, race is an important consideration, as racial disparities have been reported in lower-extremity arthroplasty in the United States. Our study sought to examine these disparities.

Methods: Using the National Inpatient Sample (NIS) database, all anatomic total shoulder arthroplasty (aTSA) and reverse total shoulder arthroplasty (RSA) procedures from 2011 to 2017 were analyzed. The patients were divided into the Black, Hispanic, and White groups.

Results: Overall, 91.4% of the patients undergoing any shoulder arthroplasty procedure were White, 4.75% were Black, and 3.85% were Hispanic. Age and sex-standardized RSA utilization rates (per 100,000) in White patients increased by 139% from 6.94 in 2011 to 16.60 in 2017. The disparity for Black patients, compared with White patients, was 118% in 2011 and 124% in 2017; the disparity for Hispanic patients was 112% in 2011 and 103% in 2017. Similar disparities in aTSA utilization rates were seen; when compared with White patients, there was a 150% disparity in 2011 and a 197% disparity in 2017 for Black patients, and a 169% disparity in 2011 and a 262% disparity in 2017 for Hispanic patients. Finally, Blacks had a higher rate of non-home discharge, longer length of stay, and higher overall costs, while Hispanics had a longer length of stay and higher cost than Whites.

Conclusions: Despite many efforts to reduce racial disparities in health-care utilization, the chasm in shoulder arthroplasty in the United States appears to be large and widening further. The exponential increase in utilization of shoulder arthroplasty has not been shared equally among races, and the disparities are larger than those reported in lower-extremity arthroplasty.

The incidence of shoulder arthroplasty has risen dramatically in recent years, in large part due to technological advancements in both reverse and anatomic shoulder arthroplasty implants and expanded indications for the use of the reverse shoulder prosthesis[1,2]. From 2011 to 2025, the incidence of reverse total shoulder arthroplasty (RSA) in the United States is projected to have risen 191%, and this increase in incidence is projected to continue[3-8]. Given this rapid expansion of utilization of anatomic total shoulder arthroplasty (aTSA) and RSA procedures, there are many important questions surrounding the demographic, social, and economic factors associated with this rise.

Racial disparities have been increasingly reported in the orthopaedic literature[9-11]. Persistent and even increasing racial disparities have recently been reported in total hip and knee arthroplasty (THA and TKA) in the United States. For example, utilization rates were reported to be lower in the Black population compared with other races, and perioperative outcomes were worse[9].

As with TKA and THA, prior literature dealing with shoulder arthroplasty has also demonstrated disparities in TSA utilization, with Black populations having a lower utilization rate[12-14]. Additionally, other authors have found increased rates of some complications and operative time[15,16]. However, due to ICD-9 (International Classification of Diseases, Ninth Revision) coding limitations, many of the previous studies have failed to describe racial disparities specific to RSA and aTSA. In addition, previous studies were performed before large-scale initiatives led by both the orthopaedic community and government agencies to combat health-care disparities[17-19]. Other studies have also failed to describe utilization trends in the Hispanic population[17-19], who make up 18.5% of the total U.S. population[20].

Hence, we performed a study to examine racial disparities in the utilization of aTSA and of RSA from 2011 to 2017 in the United States, and to compare those disparities with those that exist in THA and TKA. We also aimed to examine perioperative health-care utilization, including discharge destination, length of stay (LOS), and cost, by race. We hypothesized that Black and Hispanic racial/ethnic groups would have a lower utilization rate of TSA, compared with the non-Hispanic White population, and that the disparity would have persisted in recent years.

Materials and Methods

As a review of publicly available, de-identified data from the National Inpatient Sample (NIS), this study was deemed exempt from review by our institutional review board. The NIS, maintained by the Healthcare Cost and Utilization Project (HCUP) of the Agency for Healthcare Research and Quality, was used in conjunction with population estimates from the U.S. Census Bureau to estimate the annual incidence and procedural trends of shoulder arthroplasty from 2011 to 2017. The NIS allows for national stratification of data collected from 20% of the nation's hospitals ranging over 48 states and the District of Colombia. These estimates were then categorized by race. Using discharge weights and survey design variables, the NIS can be used to create a nationally representative sample of all discharges in the United States and assess trends over time[21].

ICD-9 and ICD-10 procedure codes were utilized to query the NIS for all primary RSA and aTSA procedures; 2017 was the most recent year for which data were available from the NIS at the time of analysis. In addition, THA and TKA procedures were queried in order to make comparisons with shoulder arthroplasty. Data were queried beginning in 2011, as the ICD-9 procedure code for RSA was not unique prior to October 1, 2010. Additionally, ICD-10 procedure codes were utilized to query for all arthroplasty procedures occurring after October 1, 2015, when the transition from ICD-9 to ICD-10 took place. Using ICD-9 and ICD-10 diagnosis codes, all patients undergoing surgery for a proximal humeral fracture were excluded from analysis to ensure an elective surgery cohort. In the comparison with THA and TKA, patients with a fracture who were undergoing THA or TKA were also excluded.

The NIS categorizes race as White, Black, Hispanic, Asian or Pacific Islander, Native American, and other. For the purposes of this study, patients categorized as other were excluded from analysis, as we could not define the subgroup population and derive incidences. The NIS is compiled from the individual state inpatient databases and combines 2 data elements from these data sources to arrive at the value for race present in the NIS. These 2 self-identified data elements are (1) race and (2) Hispanic ethnicity. When setting the value for race in the NIS, the state inpatient database value for Hispanic ethnicity takes precedence over the value for race. Hence, any person in the NIS coded as White is non-Hispanic White, and any person coded as Black is non-Hispanic Black. Therefore, when deriving population estimates from the U.S. Census Bureau to calculate population-adjusted incidence, the non-Hispanic population was used for each race group (White, Black, Asian or Pacific Islander, Native American), while the total Hispanic population was used for setting the reference population for Hispanics. Given the low number of Asian, Pacific Islander, and Native American populations, we focused this study on the White, Black, and Hispanic groups.

Demographic and hospital information was collected for all patients. This included age, sex, insurance type, Elixhauser comorbidities[22], patient smoking status, income quartile of the patient's home ZIP code, region of the hospital, teaching status of the hospital, and hospital control. Elixhauser comorbidities were tabulated and categorized as 0, 1, 2, 3, or ≥4 comorbidities. Insurance payer type was categorized as private, Medicaid, Medicare, or other/uninsured. We also collected markers of health-care utilization available in the NIS, including LOS, discharge destination, and cost. LOS was dichotomized as extended (a hospital stay of >2 days) or not extended. Cost was derived from total hospital charges using cost-to-charge ratios provided by the HCUP. Cost was adjusted for inflation to 2017 U.S. dollars with the United States Consumer Price Index[23]. Cost was also dichotomized, with increased cost defined as over $20,000 (a value slightly higher than the median).

All statistical analysis was performed using SAS version 9.4 (SAS Institute). Coding for race was missing for 9.16% of the unweighted sample in 2011 and 5.18% of the sample in 2017. For this reason, and as recommended by the HCUP and as done in previous analyses[24], missing race/ethnicity was imputed using a multinomial logistic model using age, sex, insurance status, comorbid conditions, hospital region, hospital control, and hospital teaching status to predict the missing value for race. The complex survey design of the NIS was accounted for when performing all analyses with use of the SURVEYMEANS, SURVEYFREQ, SURVEYREG, and SURVEYLOGISTIC procedures in SAS. Baseline characteristics, comorbidities, and complications were compared using chi-square tests and independent-sample t tests. Logistic regression was utilized to control for patient demographics and comorbid conditions in order to assess the independent association of race with health-care utilization outcomes. Changes in magnitude of disparities over time were assessed by using an interaction term between race and calendar year, as done in previous analyses[9,12,25]. This assessed whether the disparities increased or decreased over the time period studied. The percentage difference in utilization rates in a certain year between a certain racial category and White patients was defined as the disparity percentage. All incidence rates were defined per 100,000 population for each racial category (White, Black, Hispanic). P = 0.05 was considered significant.

Source of Funding

Results

Cohort Demographics

A total of 472,956 elective shoulder arthroplasties took place over the 7-year period from 2011 to 2017 in White, Black, and Hispanic patients. Overall, 91.40% of the total sample was White, 4.75% was Black, and 3.85% was Hispanic. Black patients were found more likely to be younger (median age, 66 years; interquartile range, 59 to 73 years) and female

(Table I). Additionally, almost half (44.77%) of all Black patients but only a fifth (20.47%) of the White patients had home ZIP codes in the lowest income quartile (p < 0.001). Comorbidity information can be found in Table I.

Utilization Rates of RSA
Age and sex-standardized utilization rates (per 100,000 population) of RSA in White patients increased 139%, from 6.94 (95% confidence interval [CI]: 5.56 to 8.33) in 2011 to 16.60 (CI: 14.94 to 18.27)

in 2017. In comparison, Black patients had a 133% increase, from 3.18 (95% CI: 1.32 to 5.16) in 2011 to 7.41 (CI: 4.88 to 10.01) in 2017. Likewise, Hispanic patients saw a 150% increase, from 3.27 (CI: 1.34 to 5.29) in 2011 to 8.17 (CI: 5.36 to 11.02) in 2017. Comparisons of changes in disparity can be found in Table II and Figure 1.

Utilization Rates of aTSA
Age and sex-standardized utilization rates of aTSA in White patients increased 28%, from 10.27 (CI: 8.54 to 12.01) in 2011

TABLE I Univariate Analysis of Treating Hospital and Patient Characteristics*				
Characteristic	White	Black	Hispanic	P Value
Total (no. [%])	432,273	22,487	18,197	-
Age (yr)	70 (64-76)	66 (59-73)	70 (62-76)	<0.001
Sex				<0.001
Male	198,644 (45.95)	7,045 (31.33)	7,672 (42.16)	
Female	233,629 (54.05)	15,442 (68.67)	10,525 (57.84)	
Payer				<0.001
Private	303,657 (70.25)	14,142 (62.89)	11,985 (65.86)	
Medicaid	9,494 (2.20)	1,776 (7.90)	1,039 (5.71)	
Medicare	101,204 (23.41)	5,027 (22.36)	3,829 (21.04)	
Other/uninsured	17,918 (4.14)	1,542 (6.86)	1,343 (7.38)	
ZIP code income quartile				<0.001
1st	88,494 (20.47)	10,067 (44.77)	5,494 (30.19)	
2nd	118,932 (27.51)	5,012 (22.29)	4,751 (26.11)	
3rd	122,033 (28.23)	4,400 (19.57)	4,501 (24.74)	
4th	102,814 (23.78)	3,008 (13.38)	3,450 (18.96)	
Hospital region				<0.001
Northeast	63,580 (14.71)	2,856 (12.70)	1,833 (10.07)	
Midwest	126,681 (29.31)	5,538 (24.63)	2,570 (14.12)	
South	154,717 (35.79)	11,780 (52.38)	6,809 (37.42)	
West	87,295 (20.19)	2,314 (10.29)	6,986 (38.39)	
Positive smoking status	76,067 (17.60)	4,703 (20.91)	2,414 (13.27)	
Hospital control				<0.001
Government	41,238 (9.54)	2,794 (12.43)	1,463 (8.04)	
Private, non-profit	326,408 (75.51)	16,718 (74.35)	12,439 (68.36)	
Private, for profit	64,627 (14.95)	2,974 (13.23)	4,295 (23.60)	
Hospital teaching status				<0.001
Rural	39,956 (9.24)	1,075 (4.78)	900 (4.95)	
Urban teaching	145,605 (33.68)	6,329 (28.15)	5,465 (30.04)	
Urban non-teaching	246,712 (57.07)	15,082 (67.07)	11,831 (65.02)	
Elixhauser comorbidities				<0.001
0	63,212 (14.62)	1,936 (8.61)	2,513 (13.81)	
1	114,383 (26.46)	4,609 (20.50)	4,351 (23.91)	
2	110,489 (25.56)	6,208 (27.61)	4,910 (26.98)	
3	73,215 (16.94)	4,531 (20.15)	3,355 (18.44)	
≥4	70,974 (16.42)	5,202 (23.14)	3,067 (16.86)	

*The values for age are given as the median, with the interquartile range in parentheses. All other values are given as the number of patients, with the percentage among that race in parentheses.

	White			Black				Hispanic			
Year	Volume	Crude Incidence*	Standardized Incidence*	Volume	Crude Incidence*	Standardized Incidence*	Disparity	Volume	Crude Incidence*	Standardized Incidence*	Disparity
2011	17,184 (14,862-19,506)	8.7 (7.53-9.88)	6.94 (5.56-8.33)	953 (696-1,211)	2.48 (1.81-3.16)	3.18 (1.32-5.16)	118%	762 (557-968)	1.51 (1.1-1.92)	3.27 (1.34-5.29)	112%
2012	19,305 (18,022-20,588)	9.77 (9.12-10.42)	7.61 (6.55-8.7)	980 (811-1,149)	2.53 (2.09-2.96)	3.23 (1.49-5.06)	136%	850 (696-1,004)	1.65 (1.35-1.95)	3.45 (1.55-5.38)	121%
2013	24,280 (22,694-25,866)	12.28 (11.48-13.08)	9.34 (8.12-10.58)	1,195 (1,029-1,361)	3.05 (2.63-3.48)	3.75 (1.91-5.69)	149%	1,175 (979-1,371)	2.24 (1.87-2.61)	4.63 (2.42-6.89)	102%
2014	29,760 (27,974-31,546)	15.05 (14.14-15.95)	11.25 (9.88-12.63)	1,550 (1,333-1,767)	3.93 (3.38-4.47)	4.71 (2.53-6.95)	139%	1,455 (1,208-1,702)	2.72 (2.26-3.18)	5.25 (2.81-7.73)	114%
2015	36,285 (34,212-38,358)	18.34 (17.29-19.39)	13.39 (11.89-14.91)	2,105 (1,860-2,350)	5.28 (4.67-5.9)	6.1 (3.69-8.57)	120%	1,775 (1,474-2,076)	3.25 (2.7-3.8)	6.07 (3.5-8.66)	121%
2016	40,595 (38,355-42,835)	20.52 (19.39-21.65)	14.64 (13.07-16.22)	2,225 (1,969-2,481)	5.53 (4.89-6.17)	6.2 (3.9-8.52)	136%	1,935 (1,625-2,245)	3.47 (2.92-4.03)	6.31 (3.85-8.8)	132%
2017	47,285 (44,807-49,763)	23.91 (22.66-25.16)	16.6 (14.94-18.27)	2,795 (2,501-3,089)	6.89 (6.16-7.61)	7.41 (4.88-10.01)	124%	2675 (2,279-30,71)	4.71 (4.01-5.41)	8.17 (5.36-11.02)	103%
Change†			139.3%			133.5%				149.9%	

*Estimated incidence, with the 95% confidence interval in parentheses, per 100,000 in the subpopulation †Calculated with incidence estimates adjusted in the subgroup population.

to 13.15 (CI: 11.61 to 14.71) in 2017. In Black patients, standardized utilization rates increased only 8% (Fig. 2, Table III). Standardized utilization rates for Hispanic patients were stable through the study period, showing only minimal changes (Fig. 2, Table III). Compared with White patients, these utilization rates represented a 150% disparity in 2011 and a 197% disparity in 2017 for Black patients, and a 169% disparity in 2011 and a 262% disparity in 2017 for Hispanic patients (Fig. 2, Table III).
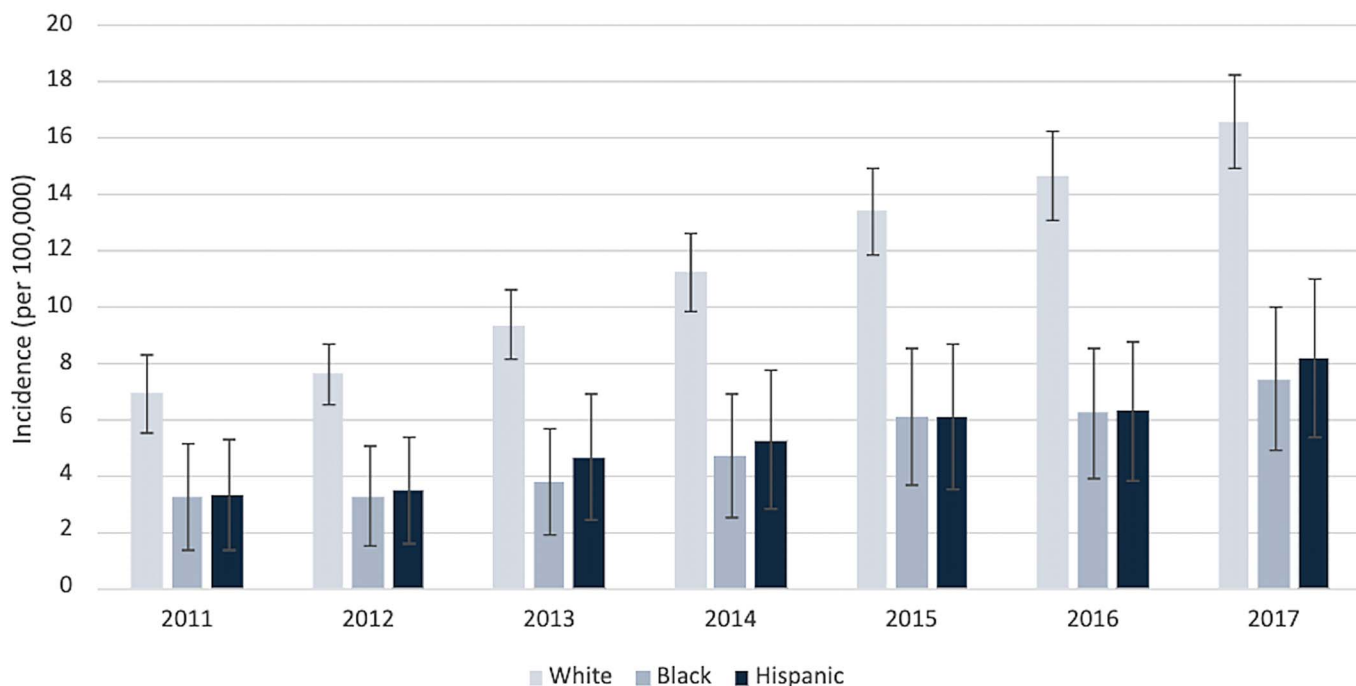

Fig. 1
Age and sex-standardized incidence of elective reverse total shoulder arthroplasty (RSA) by race.

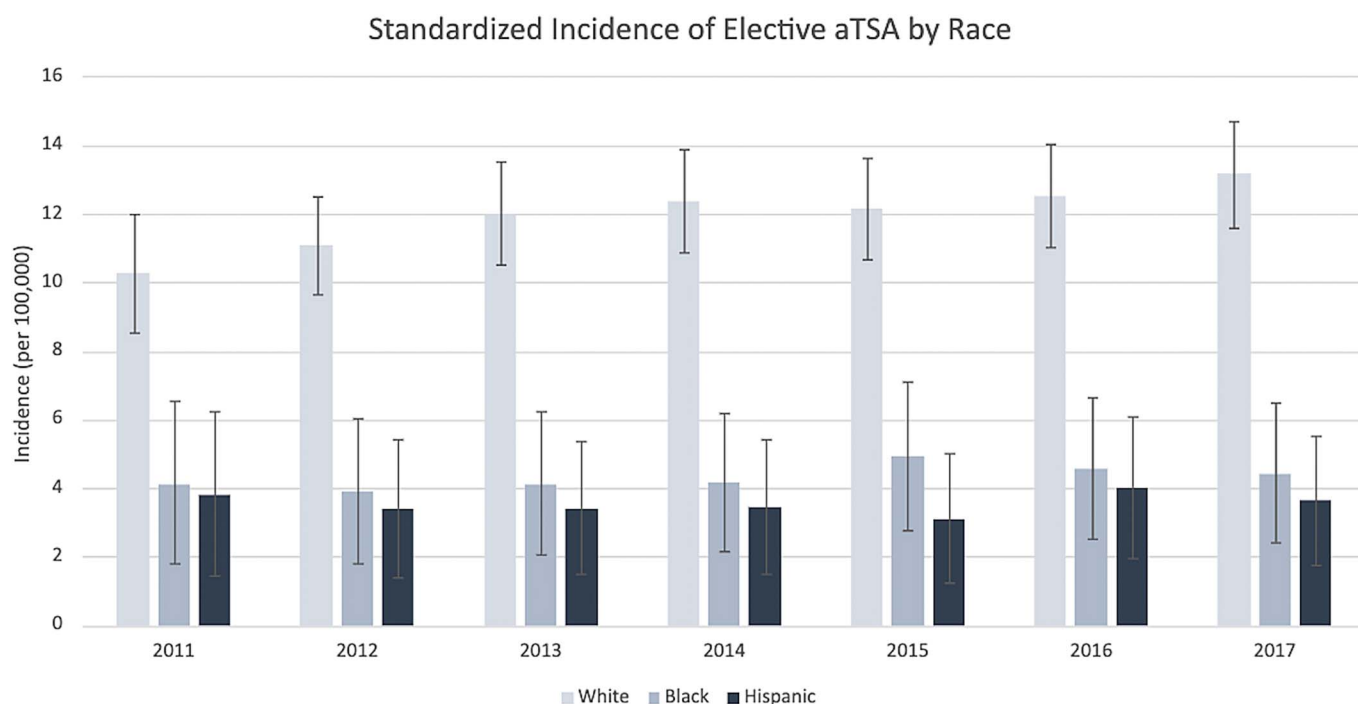## Standardized Incidence of Elective aTSA by Race

Fig. 2
Age and sex-standardized incidence of elective anatomical total shoulder arthroplasty (aTSA) by race.

Comparison with THA and TKA

Disparities were also observed for THA and TKA over the same time period, but were smaller in magnitude than those found in shoulder arthroplasty except in the instance of THA and shoulder arthroplasty among Hispanic patients. Incidence rate comparisons for TKA, THA, and TSA are shown in Table IV and Figures 3, 4, and 5. For Black patients, the disparities in TKA utilization compared with White patients were 36% in 2011 and 44% in 2017. Likewise, for Hispanic patients, disparities were 46% in 2011 and 70% in 2017. Similar disparities were seen for the THA population (Table IV). For shoulder arthroplasty (RSA plus aTSA), disparities of 151% and 152% existed in 2017 for Black and Hispanic patients, respectively (Table IV).

	White			Black				Hispanic			
Year	Volume	Crude Incidence*	Standardized Incidence*	Volume	Crude Incidence*	Standardized Incidence*	Disparity	Volume	Crude Incidence*	Standardized Incidence*	Disparity
2011	25,029 (22,277-27,781)	12.67 (11.28-14.07)	10.27 (8.54-12.01)	1,313 (1,007-1,620)	3.42 (2.62-4.22)	4.12 (1.81-6.54)	150%	974 (709-1239)	1.93 (1.41-2.46)	3.81 (1.45-6.22)	169%
2012	27,640 (26,054-29,225)	13.99 (13.18-14.79)	11.08 (9.66-12.5)	1,275 (1,068-1,482)	3.29 (2.76-3.82)	3.9 (1.83-6.04)	184%	915 (739-1,091)	1.78 (1.44-2.12)	3.4 (1.41-5.45)	226%
2013	30,660 (28,857-32,463)	15.51 (14.6-16.42)	12.01 (10.51-13.53)	1,390 (1,204-1,576)	3.55 (3.08-4.03)	4.11 (2.09-6.24)	192%	985 (808-1,162)	1.88 (1.54-2.22)	3.41 (1.5-5.37)	252%
2014	32,175 (30,426-33,924)	16.27 (15.38-17.15)	12.35 (10.86-13.86)	1,465 (1,270-1,660)	3.71 (3.22-4.2)	4.14 (2.16-6.21)	199%	1,035 (828-1,242)	1.93 (1.55-2.32)	3.43 (1.49-5.43)	260%
2015	32,145 (30,451-33,838)	16.25 (15.39-17.1)	12.15 (10.66-13.64)	1,805 (1,582-2,028)	4.53 (3.97-5.09)	4.91 (2.76-7.13)	147%	995 (771-1,219)	1.82 (1.41-2.23)	3.1 (1.27-5.03)	292%
2016	33,750 (31,917-35,583)	17.06 (16.13-17.99)	12.52 (11.03-14.03)	1,710 (1,500-1,920)	4.25 (3.73-4.77)	4.55 (2.51-6.65)	175%	1,385 (1,138-1,632)	2.48 (2.04-2.93)	4.01 (1.97-6.1)	212%
2017	36,180 (34,225-38,135)	18.3 (17.31-19.28)	13.15 (11.61-14.71)	1,725 (1,514-1,936)	4.25 (3.73-4.77)	4.43 (2.42-6.52)	197%	1,280 (1,047-1,513)	2.25 (1.84-2.66)	3.63 (1.76-5.55)	262%
Change†			28.00%			7.60%				−4.80%	

TABLE III Procedural Volume and Incidence of Elective Anatomic Total Shoulder Arthroplasty by Race

*Estimated incidence, with the 95% confidence interval in parentheses, per 100,000 in the subpopulation †Calculated with incidence estimates adjusted in the subgroup population.

TABLE IV Age and Sex-Standardized Rates of Total Joint Arthroplasty*								
	All Shoulder Arthroplasty			Total Knee Arthroplasty			Total Hip Arthroplasty		
Year	White	Black	Hispanic	White	Black	Hispanic	White	Black	Hispanic
2011	17.21 (14.56-19.87)	7.3 (4.03-10.66)	7.07 (3.71-10.45)	211.54 (193.3-229.8)	155.28 (131.27-179.36)	145.33 (114.01-176.72)	100.92 (90.81-111.04)	67.32 (53.83-80.82)	39.69 (27.68-51.72)
2012	18.7 (16.73-20.68)	7.14 (4.23-10.11)	6.85 (3.92-9.8)	212.2 (201.3-223.1)	146.42 (130.4-162.53)	118.76 (101.81-135.77)	108.31 (101-115.62)	69.66 (58.87-80.49)	35.13 (26.69-43.59)
2013	21.36 (19.21-23.51)	7.87 (4.98-10.86)	8.04 (4.91-11.22)	217.78 (206.63-228.95)	146.84 (131.09-162.63)	126.85 (109.32-144.42)	114.38 (106.64-122.12)	73.26 (62.36-84.18)	38.32 (29.31-47.34)
2014	23.6 (21.37-25.86)	8.85 (5.72-12.05)	8.68 (5.33-12.06)	218.86 (207.75-229.98)	148.45 (132.89-164.03)	130.7 (113.24-148.2)	121.62 (113.78-129.47)	77.47 (66.35-88.61)	39.44 (30.82-48.05)
2015	25.54 (23.2-27.89)	11.01 (7.62-14.46)	9.17 (5.74-12.66)	220.95 (209.99-231.9)	160.42 (144.36-176.53)	125.32 (108.5-142.19)	128.57 (120.49-136.65)	86.66 (74.98-98.35)	39.49 (30.62-48.37)
2016	27.16 (24.75-29.59)	10.75 (7.49-14.06)	10.32 (6.87-13.79)	228.7 (217.46-239.95)	157.51 (141.47-173.64)	129.58 (112.3-146.9)	139.16 (130.54-147.79)	87.86 (75.9-99.83)	42.23 (33.48-50.99)
2017	29.75 (27.21-32.31)	11.84 (8.4-15.36)	11.8 (8.15-15.49)	227.52 (216.21-238.84)	158.33 (141.92-174.8)	133.76 (117.15-150.43)	140.23 (131.52-148.94)	89.43 (77.54-101.35)	45.88 (37.13-54.65)
Disparity in 2017	-	151.00%	152.00%	-	44.00%	70.10%	-	56.80%	205.60%

*Estimated incidence, with the 95% confidence interval in parentheses, per 100,000 in the subpopulation.

Perioperative Health-Care Utilization and Costs

Rates of perioperative health-care utilization, including non-home discharge destination, cost, and LOS, were investigated across race categories (Table V). On multivariate analysis, 1.32 (CI: 1.20 to 1.46, p < 0.001) times greater odds of a non-home discharge destination were observed in Black patients compared with White patients. Likewise, increased odds of extended LOS were present for both Black (odds ratio [OR] = 1.39, CI: 1.28 to 1.50, p < 0.001) and Hispanic patients (OR = 1.18, CI: 1.07 to 1.30, p < 0.001) on multivariate analysis. Increased costs were also present on multivariate analysis for both Black (OR = 1.29, CI: 1.18 to 1.39) and Hispanic (OR = 1.13, CI: 1.01 to 1.28)

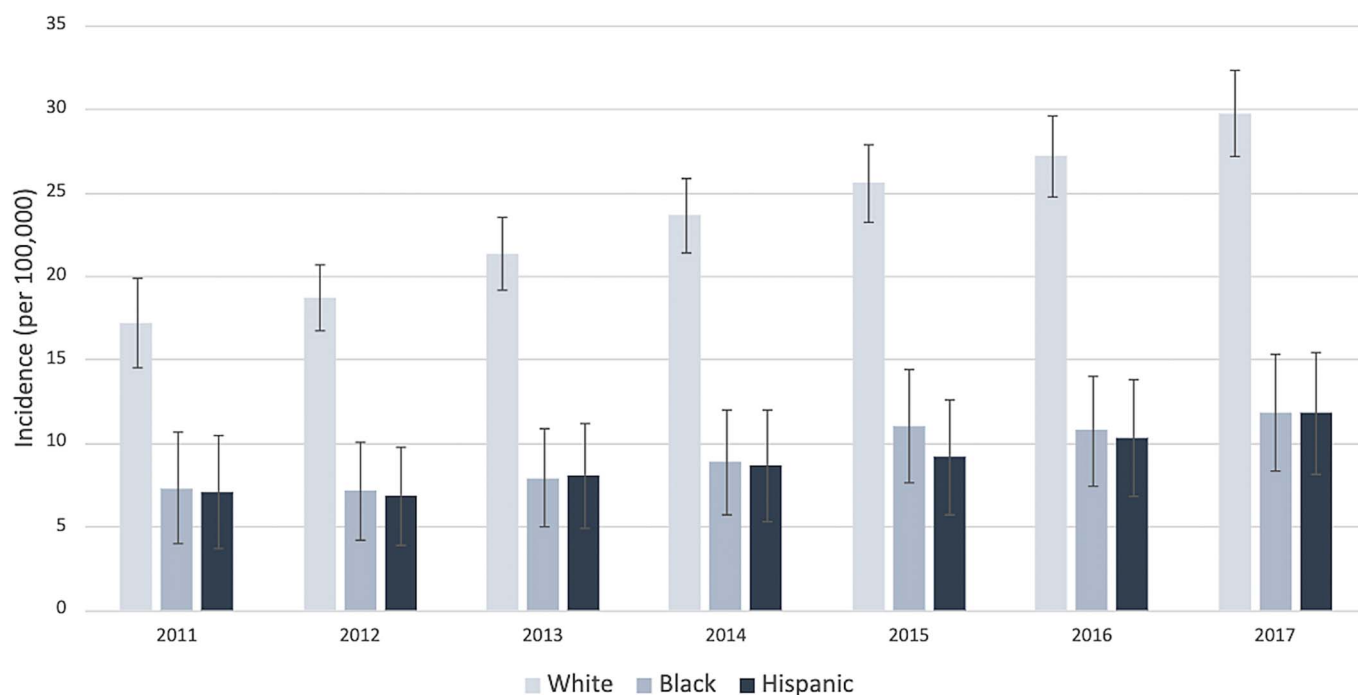## Age and Sex Standardized Rates of Shoulder Arthroplasty by Race

Fig. 3
Age and sex-standardized rates of total shoulder arthroplasty by race.

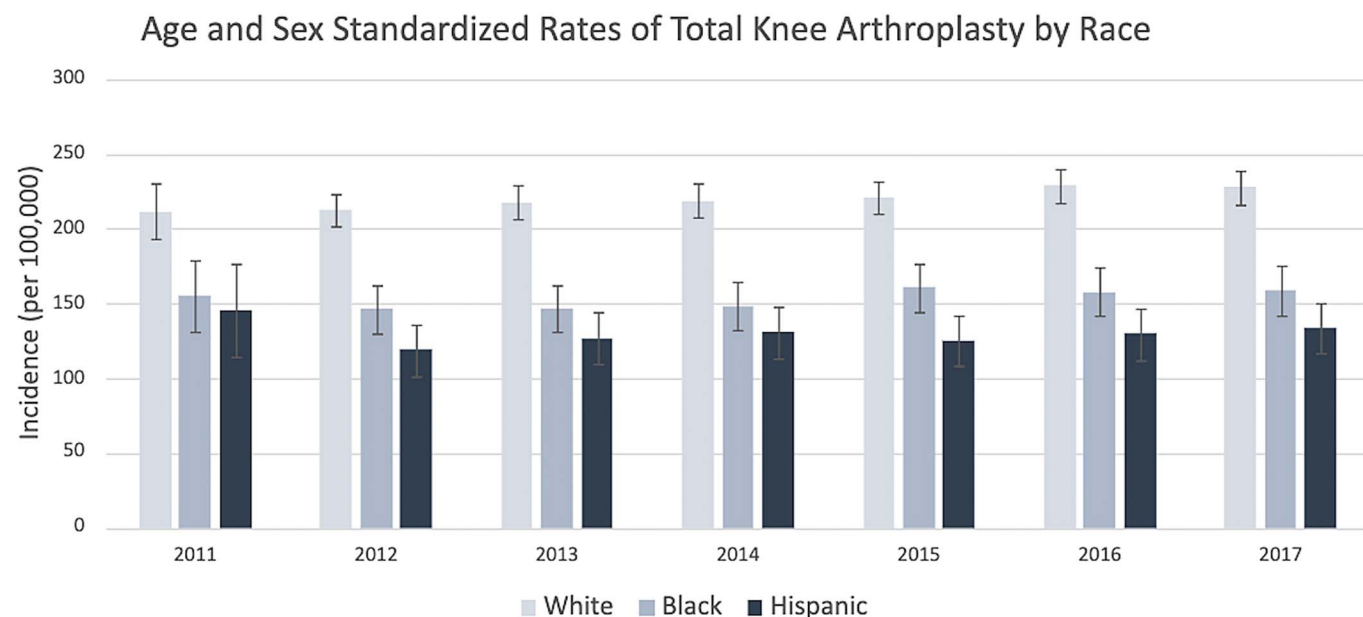## Age and Sex Standardized Rates of Total Knee Arthroplasty by Race

Fig. 4
Age and sex-standardized rates of total knee arthroplasty by race.

patients compared with White patients (Table VI). There was no change in these disparities over time (Table VI).

Discussion

The results of this study indicate that racial disparities are prominent for both RSA and aTSA. This finding coexists with findings that minority representation in orthopaedic residency programs has been decreasing in recent years[26] and that current Black and Hispanic representation among academic physicians in shoulder and elbow surgery is nearly nonexistent[27]. We found a >100% difference in utilization rates between White Americans and other racial groups for both aTSA and RSA.
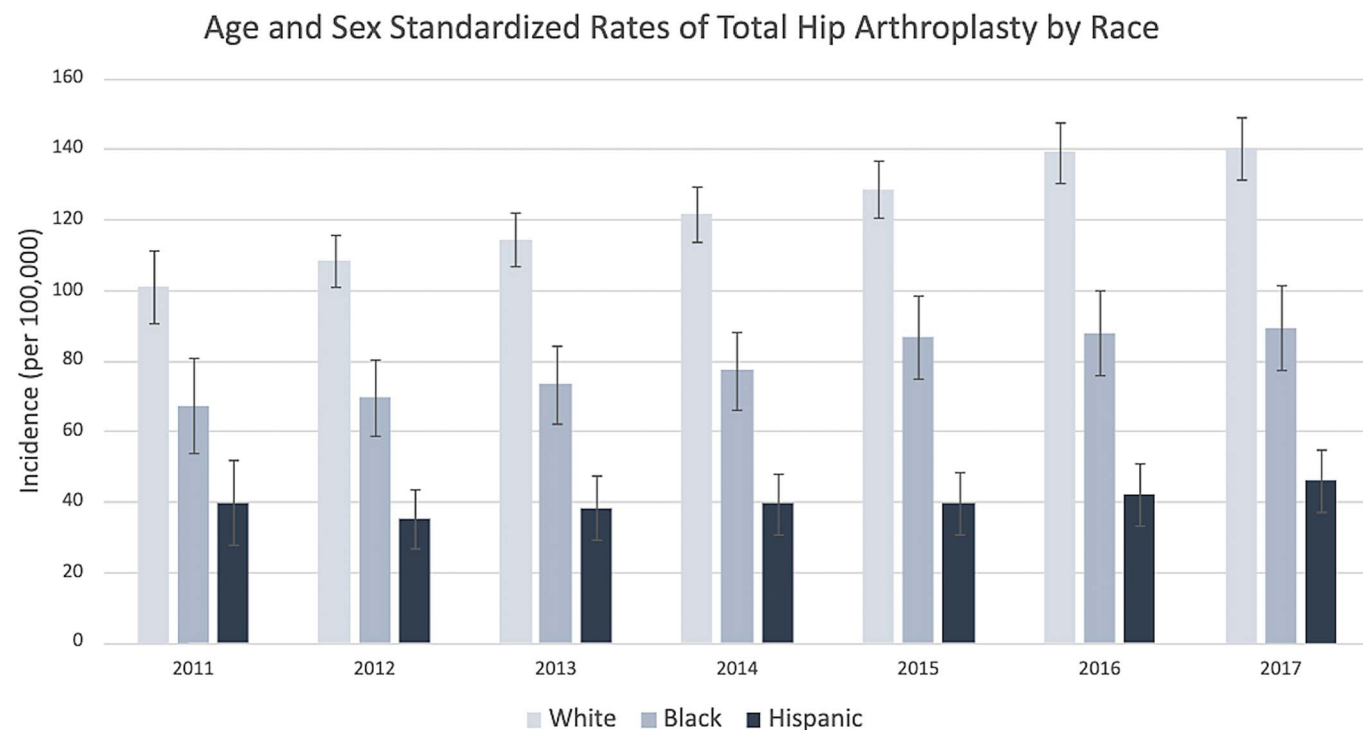
Age and Sex Standardized Rates of Total Hip Arthroplasty by Race

Fig. 5
Age and sex-standardized rates of total hip arthroplasty by race.

TABLE V Univariate Analysis of Perioperative Health-Care Utilization*				
Characteristic	White	Black	Hispanic	P Value
Total no. of patients	432,273	22,487	18,197	-
Cost of >$20,000	135,600 (31.92)	7,403 (33.88)	6,499 (36.65)	<0.001
Non-home discharge	49,267 (11.40)	3,234 (14.38)	1,956 (10.75)	<0.001
Extended LOS of >2 days	86,593 (20.03)	6,343 (28.21)	4,219 (23.19)	<0.001

*The values are given as the number of patients, with or without the percentage in parentheses. LOS = length of stay.

These data, in conjunction with recent reports regarding THA and TKA[19], indicate that governmental and organizational efforts to combat these inequalities have yet to be successful.

Our findings mirror those reported for THA and TKA, in which prior authors have found increasing or persistent disparities for Black patients compared with the White population. Additionally, Black patients have been shown to have higher rates of perioperative health-care utilization[19]. The reason for the observed disparities is unclear, and the mechanism is likely both complex and multifactorial. Racial disparities in general have been posited to include lack of access to adequate health insurance coverage[28], socioeconomic inequalities[29], and geographic and cultural differences between providers and patients[30]. For example, studies have indicated that physicians are less receptive to pain experienced by Black compared with White patients, and suggest less treatment for pain[31,32]. Despite this, even after accounting for implicit cultural bias or socioeconomic differences, race and ethnicity have remained significant predictors of the quality of health care that patients receive[18,33]. Of note, in a study in a managed health-care system with uniformly equal access to care, reoperation and complication rates were similar between Black, White, and Hispanic patients, although Black and Hispanic patients still had higher rates of 90-day emergency department visits[34]. Thus, some of these disparities in outcomes could be associated with insurance status, as has been previously demonstrated in shoulder arthroplasty[35,36].

The differences in utilization rates found in this study persisted despite the prevalence of arthritis being equivalent between Whites and Blacks, and despite the fact that Blacks have higher arthritis-attributable limitations[37]. In contrast, arthritis prevalence among Hispanics is lower[37], which may partially explain a disparity found in the current study between Hispanics and non-Hispanic White patients. However, it is of note that, to our knowledge, no study has compared the prevalence of glenohumeral arthritis by race. Furthermore, the disparities between White and non-White patients may, in part, be explained by racial differences in willingness to undergo surgical intervention for arthritis. For instance, a prior study found that Black patients were less willing to undergo TKA than White patients (62% versus 80%, respectively)[38]. Furthermore, non-White race has been shown to influence initial management of atraumatic rotator cuff tears, with Black and Hispanic patients being less likely to receive or be offered initial surgical care and more likely to undergo watchful waiting[39]. It is unclear if this discrepancy is due to patient preference or provider recommendation, but a similar relationship may be causing the disparities seen in the shoulder arthroplasty population[39]. Furthermore, this may be economically driven, as patients from lower socioeconomic backgrounds may not be able to afford to undergo surgery, particularly in a non-weight-bearing joint like the shoulder.

Our hope is that these data will enhance efforts by orthopaedic regulatory bodies to ameliorate these disparities, especially given the rapidly expanding incidence of shoulder arthroplasty and projections of continued growth[40]. Recent studies have highlighted that Black and Hispanic patients in a universally insured population have not only similar utilization rates but similar revision risks following surgery, underlining that the elimination of postoperative disparities may also be

TABLE VI Multivariate Analysis of Perioperative Health-Care Utilization*								
	Non-Home Discharge			Extended LOS of >2 Days			Cost of >$20,000		
	OR (95% CI)	P Value	P Value for Trend	OR (95% CI)	P Value	P Value for Trend	OR (95% CI)	P Value	P Value for Trend
White	Ref.	-	-	Ref.	-	-	Ref.	-	-
Black	1.32 (1.20-1.46)	<0.001	0.989	1.39 (1.28-1.50)	<0.001	0.828	1.29 (1.18-1.39)	<0.001	0.484
Hispanic	0.92 (0.81-1.04)	0.199	0.582	1.18 (1.07-1.30)	<0.001	0.177	1.13 (1.01-1.28)	0.029	0.595

*Controlled for hospital characteristics, patient comorbidities, and shoulder arthroplasty type. OR = odds ratio, CI = confidence interval, and LOS = length of stay.

possible when patients have uniform access to care[15]. Similar findings were seen in our study, where rates of non-home discharge, extended LOS, and cost exceeding the median were higher in Black and Hispanic patients compared with White patients.

Addressing the disparities observed in this study will take time and likely a multifaceted approach. Possible contributing solutions include increasing Black and Hispanic representation in shoulder and elbow surgery, which may increase physician cultural competency and satisfaction and improve patient access to care, ultimately translating to improved outcomes and treatment rates of these underrepresented populations[41,42]. In addition, there are psychological and cultural factors that likely lead to the underutilization, as we see from the racial differences observed in patient willingness to undergo TKA reported by Suarez-Almazor et al.[43]. Furthermore, diversity among orthopaedic training remains dismal. Adelani et al. reported that the number of orthopaedic surgery residency programs with 0 underrepresented minorities (URMs) has grown from 2002 to 2019, and the overall number of URM residents has decreased[26]. Ramirez and Franklin reported that the representation of URMs, specifically Hispanics and Blacks, in both orthopaedic residency and AAOS (American Academy of Orthopaedic Surgeons) membership is not at all proportional to their representation in the U.S. Census population[44]. Some evidence supports that intervention may be successful in addressing the disparities noted in the current study. In Connecticut, for instance, recent declines in readmission have been much more pronounced among Black patients compared with White patients after cultural competency policy initiatives were introduced in 2009 to raise awareness of the need for culturally appropriate care among physicians[45].

There are multiple limitations that should be considered when interpreting the results of this investigation, most of which are inherent to the deficiencies of a large administrative database. The accuracy of our findings is reliant on the accuracy of various codes entered into the database. In addition, there are limitations in the ability of this stratified sample to represent the entire landscape of shoulder arthroplasty across the country, as there may be bias in hospital sampling. It is also important to note that, although studies have found the prevalence of arthritis to be greater in African Americans, they have not specifically shown that glenohumeral arthritis follows this trend. The use of a reimbursement-based database is a limitation, as patients or procedures would be overlooked if the codes are incorrect or omitted, or if their treatment is not reimbursable. Furthermore, we were unable to analyze smaller subpopulations in which a stratified sample of discharge records may not accurately represent the true procedural volume, and for this reason we did not provide modeling for American Indians and Asians/Pacific Islanders. Additionally, NIS estimates of shoulder arthroplasty may underestimate the true volume; there has been a rise in ambulatory procedures as physician and hospital competency with the procedure grows, and racial disparities may or may not also be present in the ambulatory surgery setting. Finally, it is important to note that our database was limited to racial self-identification, which often does not provide accurate data on multiracial patients because they are forced to self-identify as monoracial.

In conclusion, despite action plans to reduce racial disparities in total joint arthroplasty, our data show that the chasm for TSA in the United States continues to widen. The exponential increase in utilization of shoulder arthroplasty has not been shared equally among races, and disparities are larger than those present for TKA and THA. Funding for research and education should be focused on determining why these disparities exist. Possible solutions include increasing URM representation in shoulder and elbow surgery, which has been limited to date, as that may help to improve patient access to and comfort with their care. Also, it is important to note that psychological factors such as groupthink or patient perceptions and cultural attitudes play a role. In addition, disparities in socioeconomic status, insurance status, and general health exist, and these only add further complexity to this issue. ■

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