RESEARCH ARTICLE

Shoulder Arthroplasty Utilization Based on Race - Are Black Patients Underrepresented?

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Abstract

Background: This study aimed to analyze national and institutional trends in shoulder arthroplasty utilization based on patient race.

Methods: The Nationwide Inpatient Sample (NIS) was employed to determine racial trends in shoulder arthroplasty utilization at a national level. An institutional database was then utilized to retrospectively identify all patients, undergoing shoulder arthroplasty within 2011-2013. Descriptive statistics were used to compare self-identified black and non-black subpopulations.

Results: The NIS identified 256,832 primary shoulder arthroplasties within 2005-2011. Black patients constituted 3.92% (n=10,074) of cases. Utilization increased from 3.36% in 2005 to 4.49% in 2011. Locally, a total number of 1,174 primary shoulder arthroplasties were performed, the recipients of 5.96% (n=70) of which were black. Females accounted for 48/70 (68.6%) of black patients. Black patients had a higher body mass index (33.6 vs. 30.1, *P<0.0001*) and were younger (62.6 vs. 67.2 years, *P<0.0001*), compared to the non-black patients. Regarding insurance type, 1,074 patients (i.e., 65 black and 1,009 non-black) had comprehensive insurance data. Chi-square analysis of five major insurance categories, including private, Medicare, Medicaid, workers' compensation, and personal injury, indicated no difference in insurance patterns (χ^2=3.658, *P=0.454*).

Conclusion: The findings revealed significant racial disparity in shoulder arthroplasty utilization both at national and institutional levels. This disparity exists despite the similar rates of osteoarthritis in both white and black patients. Black patients in our institution had similar clinical, demographic, and socioeconomic characteristics as in our non-black patients. The obtained results highlighted the need for the expansion of black patients' access to care services related to major joint reconstruction.

Level of evidence: III

Keywords: Nationwide inpatient sample, Public policy, Race utilization, Total shoulder arthroplasty

Introduction

Total joint replacement has been a highly reliable treatment for osteoarthritis (OA), fractures, and arthropathy over decades. Many studies have examined racial and ethnical disparities regarding the utilization of joint replacement surgery for hip and knee OA (1–12). However, the impact of race on shoulder arthroplasty utilization has not been a well-studied subject. Previous analyses only examined shoulder arthroplasty utilization at a national level. The results of the mentioned studies showed a similar pattern of

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under-utilization in black patients (13-15).

Based on multiple studies, black patients in the United States have equal frequency and severity of hip and knee OA, compared to white patients. However, there is a disparity in the utilization of major joint reconstruction between the two races (16-19). Moreover, black patients are clinically more likely to show symptoms evident of hip and knee OA (20, 21). The previous epidemiological studies on the incidence of OA strictly focused on hip and knee OA; nonetheless, there is no reason to expect different trends in shoulder OA epidemiology.

The present study aimed to further explore racial disparity in shoulder arthroplasty utilization. To this end, a comparison was made between self-identified black and non-black patients regarding the rate of shoulder arthroplasty utilization both at national and institutional levels. This study also involved the analysis of possible confounding demographic, clinical, and socioeconomic variables that may explain racial differences in shoulder arthroplasty utilization.

Materials and Methods

This is a retrospective study examining racial disparity in shoulder arthroplasty utilization at national and institutional levels. The first component of this study was a national analysis of the racial demographics of shoulder arthroplasty utilization, using the Nationwide Inpatient Sample (NIS). The NIS is a valid survey of 7-8 million patient records, which is collected annually from approximately 1,000 hospitals. This survey represents an estimated 20% of all hospital discharges in the US (22). The Healthcare Cost and Utilization Project (HCUP) specifically designed NIS to help to the development of healthcare policy. The HCUP provides statistical trend files to appropriately adjust for yearly variation in sampling methods (23, 24).

The data for this study was collected during 2005-2011, using the International Classification of Diseases, 9th revision (ICD-9) codes 81.80, 81.81, and 81.88 signifying primary total shoulder arthroplasty, hemiarthroplasty, and reverse total shoulder arthroplasty, respectively. Other codes, such as 81.97 (revision of joint replacement of upper extremity), were not included in the study as they were not procedurally specific to shoulder arthroplasty. Then, the evaluation of racial trends in shoulder arthroplasty utilization at a national level was accomplished using descriptive statistics.

After obtaining the approval of the Institutional Review Board, we examined our electronic database of shoulder arthroplasty to identify all patients who underwent shoulder arthroplasty from 9/27/2010 to 12/31/2013 at our two high-volume, urban tertiary referral centers. This database was formulated by searching the electronic records of our institution, using ICD-9 codes 79.31 (open reduction of humerus fracture), 80.01 (arthrotomy for the removal of a prosthesis without replacement), 81.80 (total shoulder arthroplasty), 81.81 (shoulder hemiarthroplasty), 81.82 (repair of recurrent shoulder dislocation), 81.83 (other repair of shoulder;

e.g., arthroplasty), 81.88 (reverse total shoulder arthroplasty), and 81.97 (revision joint replacement of upper extremity).

Since these codes are not always specific, the identified individual operative reports were reviewed to identify all patients who truly underwent total shoulder arthroplasty. Then, the population was divided into two subpopulations of self-identified and nonself-identified black patients. Clinical and demographic data of this population were also analyzed to determine if there were any clinical variables that would help explain any racial differences in arthroplasty utilization.

The data that were examined included gender, primary versus revision surgery, diagnosis leading to arthroplasty, body mass index (BMI), and medical comorbidities as measured by age-adjusted Charlson Comorbidity Index (CCI) (modified to be used with the ICD-9) (25, 26). Descriptive statistics were utilized to determine any differences in the black and non-black patient populations. Then, social variables were examined to assess any potential barriers to care. Chi-square analysis was performed on such data as insurance types (including private, Medicare, Medicaid, workers' compensation, and private injury), state place residence (New Jersey, Pennsylvania , and Delaware [our three in-network states or out of network]), Hospital Service Area [HSR; aggregate of zip codes by the Dartmouth Atlas]), marital status (single, married, divorced, widowed), and possession of an email address (as an indicator of internet access which may have some implications on accessing healthcare information) (27). However, income level was not recorded for our patients; therefore, it was not possible to analyze this variable.

Finally, the data on race and shoulder arthroplasty were compared to data on race provided by the US Census Bureau for individuals over the age of 65 years (28). The collected data from the US Census included national trends that were examined in the context of the NIS data and local trends that were examined in the context of the patient catchment area of our institution. All statistical analyses were performed in Excel software (version 2013; Microsoft; Redmond, WA).

Results

Analysis of the NIS revealed the implementation of a total of 256,832 primary shoulder arthroplasty procedures within 2005-2011. Anatomic shoulder arthroplasty, hemiarthroplasties, and reverse shoulder arthroplasties accounted for 139,975, 94,553, and 22,304 cases, respectively. Out of the 256,832 arthroplasty patients, 10,074 (3.92%) cases were self-identified blacks. Moreover, 5,370 (3.84%), 3,648 (3.86%), and 1,056 (4.73%) subjects were identified as blacks with anatomic shoulder arthroplasty, hemiarthroplasty, and reverse shoulder arthroplasty, respectively. This overall arthroplasty utilization (3.92%) was significantly lower than the rate obtained for the US population aged over 65 years (8.8%) that were self-identified blacks (28). Considering this racial disparity in shoulder arthroplasty utilization at the national level, we explored

our institutional experience.

Review of our institution electronic database led to the identification of all shoulder arthroplasty cases (n=1,174) performed from 9/27/2011 to 12/31/2013. During that time, only (5.96%) 70 patients were self-identified blacks. There was a similar distribution of primary and revision surgery, with 61 (87.1%) primary surgeries and 9 (12.8%) revisions performed in black patients, compared to (87.6%) 967 primaries and (12.4%)137 revisions in non-black patients. The OA (44.3%), cuff tear arthroplasty (21.4%), and rheumatic disease (12.9%) were the three most frequent diagnostic indices in black patients.

Regarding the non-black patients, the diagnostic indices for OA, cuff tear arthropathy, and post-traumatic arthritis were obtained as 48.2%, 27.6%, and 6.0%, respectively. The average BMI and CCI for black patients were 33.6±7.58 and 3.63±1.60, respectively, compared to 30.1±6.64 and 3.87±1.60 in non-black patients. A comparison was made between the two populations with regard to clinical and demographic variables [Table 1]. Our black patients were younger ($P<0.0001$) and mostly female ($P=0.009$). They had higher BMI ($P<0.0001$) and mostly had rheumatoid arthritis as primary diagnosis ($\chi^2=18.359$, $P=0.001$ for all index diagnoses).

After analyzing the clinical variables, the Chi-square analysis was performed on a number of subtypes of categorical variables. Regarding the insurance type, there was no significant difference in the distribution of private, Medicare, Medicaid, Worker's Compensation, or personal injury coverage between black and non-black patients ($\chi^2=3.658$, $P=0.454$) [Figure 1]. Notably, no treated patient was uninsured. In terms of marital status, there was no significant difference between the black and non-black patients considering the distribution of married, single, divorced, or widowed status ($\chi^2=1.809$, $P=0.613$) [Figure 2]. Analysis of residential location revealed no significant difference between the black and non-black patients regarding the distribution of place of residence ($\chi^2=2.429$, $P=0.488$) [Figure 3]. Investigation of HSR (collections of zip codes into similarly sized referral areas by the Dartmouth Atlas) showed similar homogeneity of referral areas between black and non-black patients ($\chi^2=70.818$, $P=0.615$) [Figure 4] (27). Finally, the analysis of the possession of an email address (an indicator of internet access with potential access to online healthcare information) showed that both populations had a similar rate of email access ($\chi^2=0.653$, $P=0.419$) [Figure 5].

Our institutional data found similar trends of underrepresentation of shoulder arthroplasty of self-identified black patients as the value shown by the NIS. The NIS data demonstrated that despite accounting for 8.8% of the population over the age of 65, self-identified black patients only accounted for 3.92% of the shoulder arthroplasty population. Based on our institutional data, despite accounting for 20.2% of our institution main catchment area, the Delaware Valley, self-identified black patients only accounted for 5.96%

Table 1. Black and non-black patients with shoulder arthroplasty			
	Black (n=70)	**Non-Black (n=1,104)**	*P values*
Age (years)	62.6 (34.9-86.6)	67.2 (22.3-94.1)	*P<0.0001*
Male	22 (31.4%)	525 (47.6%)	*P=0.009*
BMI	33.6 (18.0-62.8)	30.1 (16.0-65.4)	*P<0.0001*
CCI	3.63 (0-8)	3.86 (0-14)	*P=0.227*
LOS (days)	2.5 (1-8)	2.4 (0-39)	*P=0.320*
Diagnosis			*p=0.001*
OA	31 (47.1%)	532 (48.2%)	
CTA	15 (21.4%)	305 (27.6%)	
RA	9 (12.9%)	50 (4.5%)	
PTA	1 (1.4%)	66 (6.0%)	
Failed 1^0	9 (12.9%)	137 (12.4%)	
Procedure			*P=0.801*
Anatomic	43 (61.4%)	625 (56.6%)	
Hemi	6 (8.6%)	96 (8.7%)	
Reverse	19 (27.1%)	359 (32.5%)	
Other	2 (2.9%)	24 (2.2%)	

BMI: body mass index, CCI: Charlson Comorbidity Index, LOS: length of stay, OA: osteoarthritis, CTA: cuff tear arthropathy, RA: rheumatoid arthritis, PTA: post-traumatic arthritis
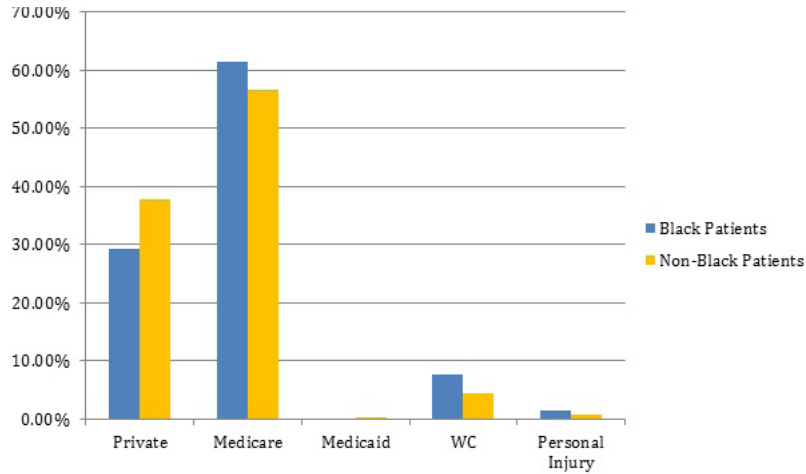
Figure 1. Comparison of insurance types between self-identified black and non-black patients.

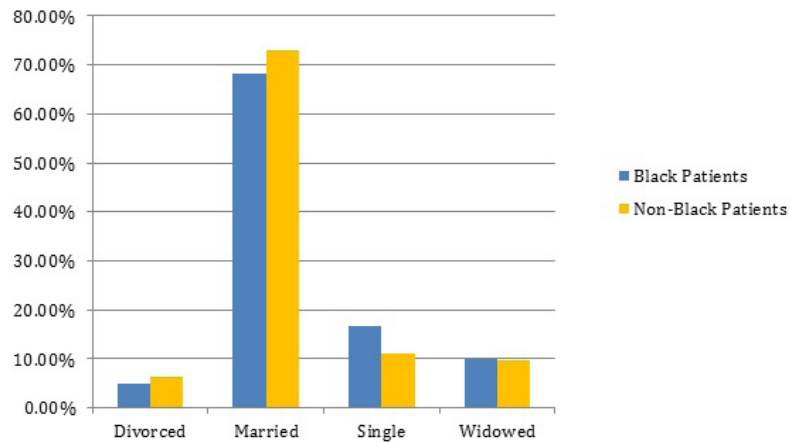

identified black patients and non-black patients

Figure 2. Comparison of marital status between self-identified black and non-black patients.
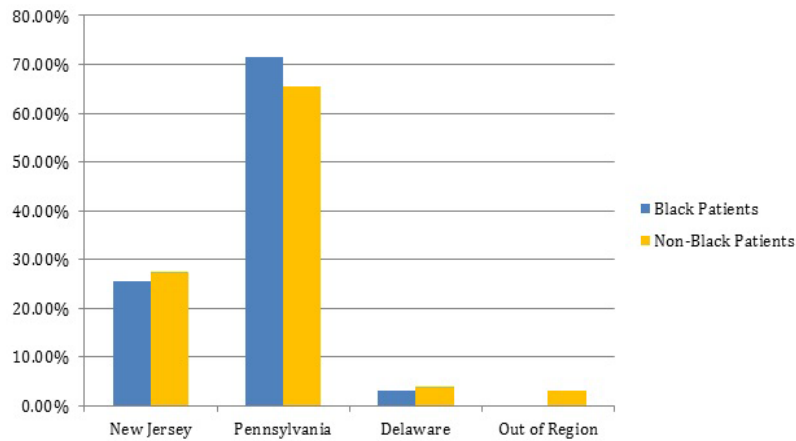

Figure 3. Comparison of the place of residence between self-identified black and non-black patients.
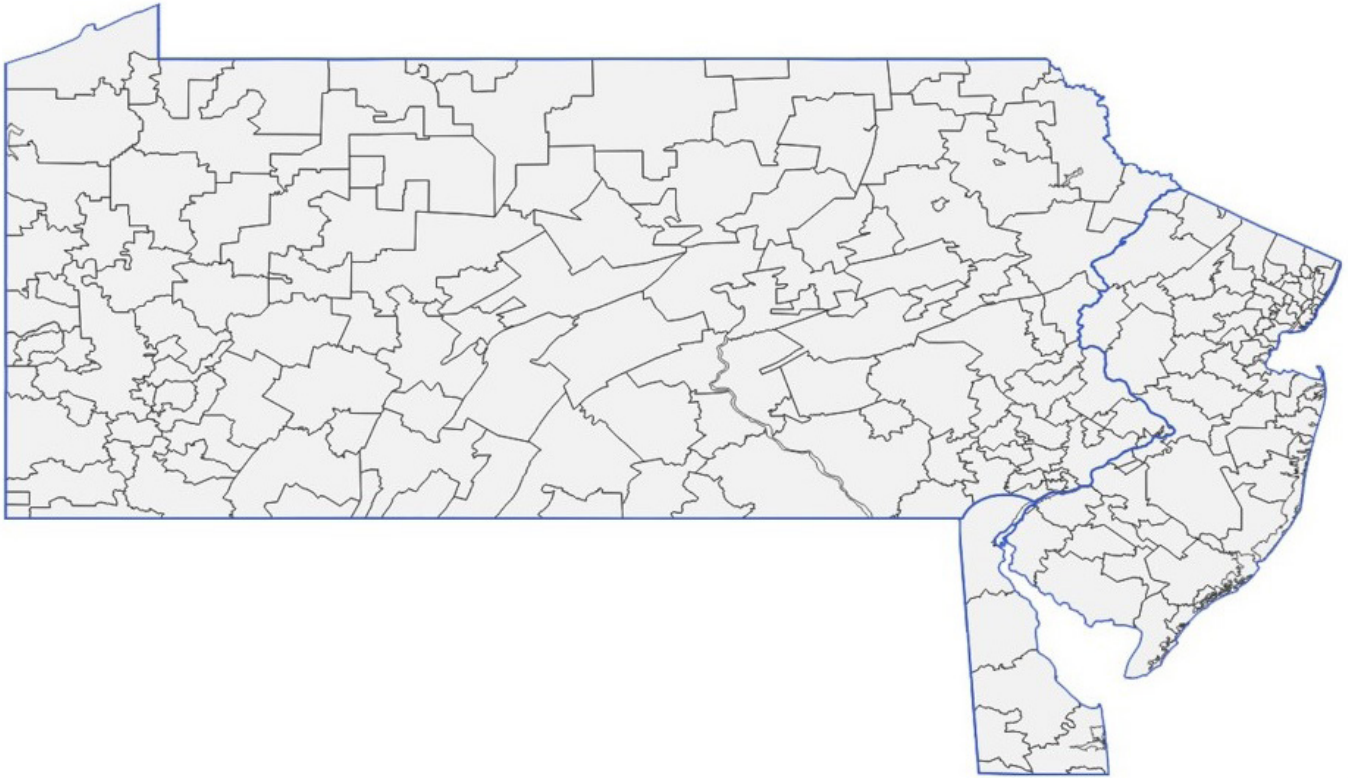
Figure 4. Map of all Hospital Service Areas in three main states from which our patients were referred (patients living outside our three main referral states were excluded).
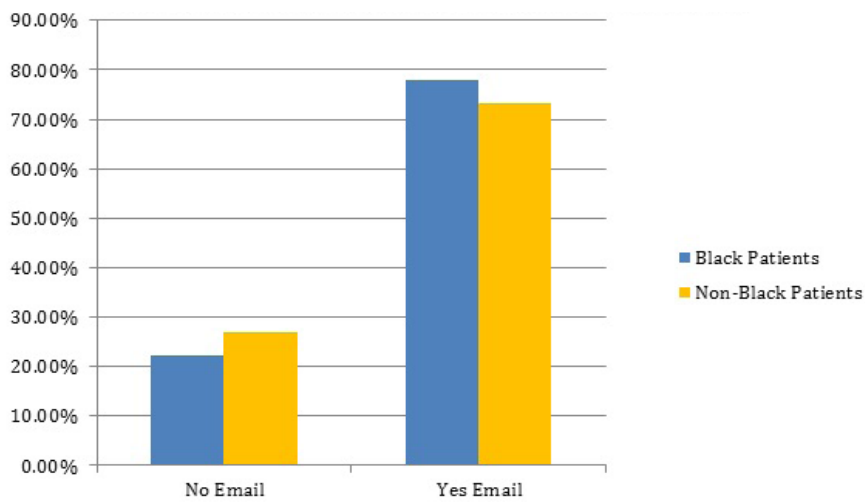

Figure 5. Comparison of email access between self-identified black and non-black patients.

of our shoulder arthroplasty population. Data from our large-volume, urban institution found a similar degree of under-utilization of shoulder arthroplasty to the value obtained at a national level [Figure 6] (29).

Discussion

The results revealed a significant racial disparity in shoulder arthroplasty utilization both at the national and institutional levels. Nationally, within 2005-
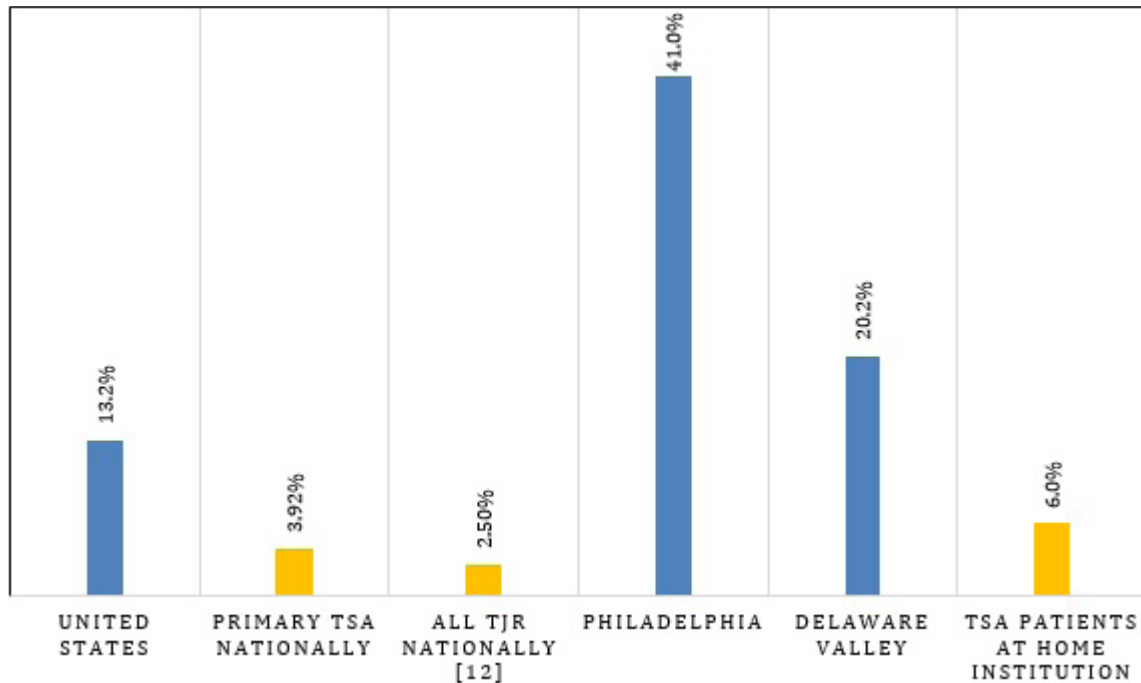
Figure 6. Percentage of self-identified black people in the population.

2011, the shoulder arthroplasty utilization rate in non-black patients was greater than that in black patients. This nationally lower shoulder arthroplasty utilization in black patients is similar to the findings of the related literature (13, 14). Although there was an increase in the utilization of shoulder arthroplasty in blacks during 2005-2011 (3.36-4.49%), the usage still falls below those expected when compared to the demographics of the US population over the age of 65 years (28).

The shoulder arthroplasty data from our own institutional experience are in line with the utilization rates seen nationally for self-identified black patients. Among these black patients managed with shoulder replacements, females accounted for the majority of the operations. Additionally, black patients had greater BMI, were younger, and had a higher proportion of rheumatoid arthritis, compared to the non-black patients. This disparity exists in the setting of black population that had a similar rate of OA to that of white patients. This further highlights the need for the expansion of black patients' access to care services related to major joint reconstruction.

The self-identified black and non-black populations were highly comparable in terms of socioeconomic variables, such as insurance type, marital status, place and HSR of residence, and access to email (as an indicator of access to healthcare, home support system, poverty level of patient's place of residence, and online access to healthcare information). However, the low number of performed shoulder arthroplasty may be due to that a higher percentage of self-identified black people may do not have the mentioned resources.

National insurance data collected by Kaiser within the time of this study revealed lower rates of insurance coverage in the self-identified black population in comparison to the non-blacks (30). This is especially salient in this study as none of the treated patients were uninsured. Analysis of national marital rates by the Bureau of Labor and Statistics at the time of this study indicated that lower marital rates in the self-identified black population were related to the non-black population (31).

Regarding internet utilization, the Pew Research Center found self-identified black citizens to be less likely to utilize the internet than the non-black population (32). With regard to the similarities between the self-identified black and non-black patients in terms of socioeconomic variables, it is possible that we are utilizing shoulder arthroplasty in a population that has a certain baseline socioeconomic level and missing the disproportionate number of self-identified black citizens who do not have access to these healthcare resources. This highlights a need for increasing efforts to improve healthcare access in under-served patient populations and may enhance the rate of glenohumeral arthritis management in the self-identified black population.

In addition to these socioeconomic variables, there may be other noninvestigated variables in this analysis that affect racial trends. Analysis of the perception of joint replacement and patient reported expectations after surgery may also explain racial differences in arthroplasty utilization (7, 33-40). Black patients

may be less likely to consider knee and/or hip replacements as an effective OA treatment and were more likely to turn to complementary medicine or self-care, compared to Caucasians (37). Furthermore, black patients are less likely to be familiar with the procedure and associate joint replacement with a worse outcome (38).

Since surgeons tend to focus on building a rapport, discuss non-scientific matters, and spend less time explaining the biomedical concepts of the procedure to black patients, compared to white patients, black patients may be less familiar with the available management options for OA (36). In 2012, Mota et al. reported that black patients had lower expectations regarding efficacy and were less familiar with the operation than Caucasians. They also found that black patients were less likely to personally know someone who has undergone the procedure (39). As expected, studies have shown that the lack of familiarity, increased fear, and willingness to undergo joint replacement surgery among African American patients correlate with lower patient expectations regarding the procedure (7, 35). These racial differences in expectations and familiarity with arthroplasty options for OA may explain the racial differences in arthroplasty utilization despite the similar rates of OA and an increased perception of pain in black patients.

The retrospective nature of the national and institutional collected data was the main limitation of the present study. While it is necessary to examine the current utilization practices of shoulder arthroplasty, the reason for the existence of the racial disparity cannot be inferred. Additionally, while we attempted to analyze healthcare access through insurance type, place of residence, marital status, and access to email/ Internet, unavailable variables (e.g., income, type of residence, and education level) may be the actual drivers of this disparity. Further prospective studies on shoulder arthroplasty utilization based on race may be helpful in determining the responsible causes.

The findings of the present study indicated a lower rate of shoulder arthroplasty utilization in black patients, compared to that in the non-blacks. This disparity was found to be present at a national (using the NIS data) and institutional levels (based on our two high-volumes, urban hospitals). The results demonstrated that all treated patients (i.e., both blacks and non-blacks) had a similar distribution of social traits. This highlights a potential lack of underlying healthcare resources that must be addressed in the black population in order to increase access to advanced treatment options like shoulder arthroplasty.

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