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Total Hip Arthroplasty in Black/African American Patients: an Updated Nationwide Analysis

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Abstract

Background The purpose of this was to investigate recent trends in procedure utilization, comorbidity profiles, hospital length of stay (LOS), 30-day outcomes, and risk factors for adverse events (AEs) among Black patients undergoing total hip arthroplasty (THA).

Methods Using the American College of Surgeons National Surgery Quality Improvement Program, we retrospectively reviewed all Black patients who underwent elective, primary THA between 2011 and 2017. Mixed effects logistic regression analyses were performed to determine the trends in the study outcomes across each individual year. Multivariate logistic regression analyses were performed to identify independent risk factors for AEs.

Results A total of 11,574 Black patients were analyzed. Over the study period, there was an increase by 109% in THA procedures performed in this racial group. During the same time, there were reductions in the prevalence of anemia, dyspnea, tobacco smoking, and osteonecrosis ($p < 0.001$). The rates of 30-day surgical complications, readmissions, reoperations, and mortality remained unchanged. Only the rate of medical complications demonstrated improvement, driven by a decrease in the incidence of postoperative myocardial infarction ($p < 0.001$). There was also a significant reduction in LOS > 2 days (68 to 37%, $p < 0.001$). Independent risk factors for AEs were body mass index > 35, American Society of Anesthesiologists score > 2, dependent functional status, diabetes, bleeding disorders, chronic kidney disease, and osteonecrosis as the surgical indication.

Conclusion Between 2011 and 2017, there were improving trends in procedure utilization, comorbidity profiles, and LOS among Black patients undergoing primary THA, but the overall rates of 30-day outcomes remained unchanged. We identified a number of risk factors that may help guide preoperative optimization and patient counseling to mitigate postoperative AEs.

Keywords Black/African American · Total hip arthroplasty · Adverse events · Risk factors · Time trends

Introduction

The National Institute of Arthritis and Musculoskeletal Diseases has designated racial disparities in orthopaedic surgery as a major priority for investigation and action [1]. Racial disparities are well established in total joint arthroplasty (TJA), particularly in the Black/African American community [2, 3]. Black patients have been shown to have lower procedure utilization rates, higher complication rates [4], lower functional outcomes, increased revision rates [5–7], and lower patient satisfaction [8]. These findings coupled with a rapidly growing demand in TJA [9, 10] beg the need for greater understanding of population-specific risk factors and trends in health outcomes to reduce racial disparities in TJA care.

Over the past decade, there have been several initiatives aimed at improving access to care and health outcomes among minority individuals. One notable example is the Affordable Care Act (ACA) of 2010 that expanded healthcare coverage to uninsured Americans in low- and middle-income households. The ACA also included provisions to improve the collection of race/ethnicity in healthcare databases and increased funding for various community-based initiatives to address racial/ethnic disparities. Emerging reports following the ACA have shown significant reductions in the number of uninsured minorities [11, 12]. For example, in the initial few months following the first ACA open enrollment period in 2014, the percentage of uninsured non-Hispanic Blacks declined from 25.5% in 2013 to 17.2% [12]. Along the same time, TJA practice has experienced tremendous advancements including less-invasive surgical approaches, improved perioperative

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recovery protocols, and adoption of bundled payment models that are intended to promote high-quality outcomes and lower costs. The impact of the aforementioned initiatives and advancements in TJA care on minority patients remain unclear. Furthermore, as value-based care takes hold, there is a growing emphasis to create risk stratification protocols that optimize surgical outcomes. Given the intricacies and complexities inherent to each racial group, population-specific risk stratification would allow more specific preoperative optimization to mitigate potential adverse events following surgery.

The objective of this study was to examine annual trends in procedure utilization, comorbidity profiles, hospital length of stay (LOS), 30-day outcomes, and risk factors for adverse events among Black patients undergoing primary total hip arthroplasty (THA) in a current time period reflecting greater access to care along with greater scrutiny on the value of care provided. The information obtained in this study will help us gauge how THA care in the Black community has evolved in light of the numerous recent legislative and surgical changes. In addition, population-specific risk stratification may allow more precise preoperative optimization in this racial group.

Methods

Institutional review board approval was not required. The American College of Surgeons National Surgery Quality Improvement Program (ACS-NSQIP) database was queried for all patients who self-identified as non-Hispanic Black/African American and underwent primary, elective THA between 2011 and 2017. The procedures were confirmed to be elective by cross-referencing associated ICD-9 and ICD-10 codes. The ACS-NSQIP is a national chart-based database with over 600 participating hospitals. It captures all the surgical cases for hospitals with lower volumes and uses a systemic sampling for those with larger volumes [13]. The database includes encounter data spanning hospital admission up to 30 days postoperatively.

Variables collected in the ACS-NSQIP include age, sex, body mass index (BMI), current smoking, chronic steroid use, American Society of Anesthesiologists (ASA) physical classification, functional status (independent vs. partially/completely dependent), living environment (admitted directly from home vs. facility), and select comorbidities: diabetes, hypertension, chronic obstructive pulmonary disease (COPD), heart failure, anemia, metastatic cancer, coagulopathy, dyspnea, ascites, and chronic kidney disease (CKD). Other variables include surgical diagnosis, operative time, and laterality (unilateral vs. bilateral).

The primary outcomes of the study were the annual trends in THA utilization, comorbidity profiles, LOS, and 30-day adverse events (AEs) during the study period. AEs included medical complications, surgical complications, readmissions, reoperations, and mortality. A secondary outcome of the study was identifying the risk factors associated with the development of AEs.

Values for continuous variables were presented as mean and standard deviation, and nominal variables as frequency and percentage. For temporal changes, the overall p values were determined from a univariate mixed effects logistic regression, which included an ordinal time variable for admission year. For simplicity, data was presented in time period cohorts; however, all analyses were performed across each individual year. For identification of risk factors for AEs, univariate analyses were first conducted to explore the association of each collected variable with development of any postoperative AE. For nominal variables, overall p values were determined using chi-squared tests. For continuous variables, overall p values were obtained from Welch's t test. Multivariate logistic regression analyses were then utilized to yield odds ratios for developing any postoperative AE. Statistical significance was defined as $p < 0.05$. Data was analyzed using Stata 16.0 (State Statistical Software: Release 16. College Station, TX: StateCorp LLC).

Results

A total of 11,574 Black patients were included in the analysis accounting for 7.4% of all THAs performed during the study period compared with 74.5% in non-Hispanic Whites. Between 2011 and 2017, there was a 109% increase in the number of THAs performed among Black patients. There were also reductions in the rates of tobacco smoking (1.4%, $p = 0.024$), anemia (6.6%, $p < 0.0001$), dyspnea (1.0%, $p < 0.0001$), and osteonecrosis (3.32%, $p < 0.0001$). Table 1 summarizes the trends in demographics, comorbidity, and perioperative characteristics for the study cohort.

Postoperatively, the frequency of inpatient stays > 2 days decreased from 68.4 to 36.8% ($p < 0.0001$). There were 647 patients (5.6%) who developed 30-day AEs. Except for a reduction in medical complications (largely myocardial infarction, $p = 0.014$), there were no differences in rates of readmissions, reoperations, surgical complications (including DVT/PE), or mortality over the study period. Table 2 summarizes the trends in 30-day postoperative outcomes.

After controlling for all baseline and perioperative differences, independent risk factors for 30-day AEs were BMI > 35 (OR 1.28; 95% CI, 1.07–1.54; $p = 0.007$), ASA classification > 2 (OR 1.65; 95% CI 1.31–1.93; $p < 0.0001$), dependent functional status (OR 1.65; 95% CI, 1.12–2.43; $p = 0.011$), bleeding disorders (OR 1.62; 95% CI 1.05–2.50; $p = 0.031$), CKD (OR 2.10; 95% CI, 1.59–2.76; $p < 0.0001$), and osteonecrosis (OR 1.52; 95% CI, 1.19–1.95; $p = 0.001$). Figure 1 summarizes the results of the multivariate logistic regression analyses.

Table 1 Trends in baseline and perioperative characteristics of the study cohort

Variable	2011–2013	2014–2015	2016–2017	*p* value
N = 11,574	2512	3814	5248	–
Demographic characteristics				
Age (years)	60.0 ± 12.2	59.2 ± 11.8	60.3 ± 11.4	*< 0.0001*
Sex				0.099
Female	1349 (53.7%)	1960 (51.4%)	2804 (53.4%)	
Male	1163 (46.3%)	1854 (48.6%)	2444 (46.6%)	
Body mass index (kg/m^2)	31.6 ± 6.9	31.8 ± 7.0	31.8 ± 6.6	0.332
Current smoker	608 (24.2%)	992 (26.0%)	1194 (22.8%)	*0.024*
Chronic steroid use	126 (5.0%)	179 (4.7%)	268 (5.1%)	0.094
ASA classification	2.5 ± 0.6	2.5 ± 0.6	2.5 ± 0.6	*0.033*
Functional status				*0.011*
Independent	2422 (97.3%)	3693 (97.2%)	5122 (97.8%)	
Partially or completely dependent	67 (2.7%)	108 (2.8%)	118 (2.3%)	
Preoperative living environment				0.525
Admitted directly from home	2494 (99.4%)	3797 (99.6%)	5219 (99.6%)	
Admitted from a facility	14 (0.6%)	15 (0.4%)	22 (0.4%)	
Comorbidity characteristics				
Diabetes	459 (18.3%)	659 (17.3%)	1005 (19.2%)	0.369
Hypertension	1721 (68.5%)	2654 (69.6%)	3665 (69.8%)	0.413
Chronic obstructive pulmonary Disease	91 (3.6%)	159 (4.2%)	230 (4.4%)	0.619
Chronic heart failure	16 (0.6%)	12 (0.3%)	22 (0.4%)	0.133
Anemia	970 (39.7%)	1189 (32.5%)	1684 (33.1%)	*< 0.0001*
Metastatic cancer	8 (0.3%)	5 (0.1%)	10 (0.2%)	0.708
Bleeding disorder	63 (2.5%)	76 (2.0%)	91 (1.7%)	0.093
Dyspnea	161 (6.4%)	185 (4.9%)	281 (5.4%)	*< 0.0001*
Ascites	0 (0.0%)	0 (0.0%)	0 (0.0%)	–
Chronic kidney disease	137 (5.7%)	182 (5.1%)	258 (5.2%)	0.847
Perioperative characteristics				
Diagnosis				*< 0.0001*
Primary osteoarthritis	2163 (86.1%)	3350 (87.8%)	4655 (88.7%)	
Inflammatory arthritis	17 (0.7%)	13 (0.3%)	18 (0.3%)	
Posttraumatic arthritis	14 (0.6%)	15 (0.4%)	53 (1.0%)	
Childhood dysplasia	5 (0.2%)	8 (0.2%)	37 (0.7%)	
Osteonecrosis	313 (12.5%)	428 (11.2%)	485 (9.2%)	
Bilateral procedure	12 (0.5%)	28 (0.7%)	47 (0.9%)	0.095
Procedure length (min) > 100	1122 (44.7%)	1718 (45.1%)	2306 (44.0%)	0.478

Values are presented as mean and standard deviation (continuous variables) or as frequency and percentage (nominal variables). For nominal variables, overall *p* values are obtained from a chi-squared test. For continuous variables, overall *p* values are obtained from an overall *F* test of one-way analysis of variance (ANOVA). For simplicity, data is presented in time period cohorts; however, all analyses were performed across each individual year. Significant values in italics and defined $p < 0.05$

Discussion

To our knowledge, this is the first study to examine the time trends in health profiles and outcomes pertaining to primary THA among Black patients. Specifically, the study explored the annual trends in procedure utilization, comorbidity profiles, LOS, and 30-day outcomes between 2011 and 2017. Over the study period, there was a twofold increase in the number of Black patients undergoing THA although remained disproportionally low compared with their White counterparts. This was accompanied by reductions in the rates of anemia, dyspnea, tobacco smoking, and osteonecrosis. Despite such favorable trends in comorbidity profiles, the overall rates of 30-day postoperative adverse events (AEs) remained unchanged. Only the rate of medical complications showed

Table 2 Trends in length of stay and 30-day outcomes of the study cohort

Variable	2011–2013	2014–2015	2016–2017	*p* value
Any postoperative event	136 (5.4%)	227 (6.0%)	284 (5.4%)	0.413
Mortality	3 (0.1%)	8 (0.2%)	11 (0.2%)	0.801
Readmission	75 (3.7%)	155 (4.2%)	199 (3.8%)	0.582
Reoperation	54 (2.2%)	86 (2.3%)	98 (1.9%)	0.061
Inpatient stay (> 2 days)	1717 (68.4%)	2034 (53.3%)	1931 (36.8%)	*< 0.0001*
Any complication	76 (3.0%)	114 (3.0%)	134 (2.6%)	*0.050*
Any surgical complication	57 (2.3%)	76 (2.0%)	92 (1.8%)	0.067
Wound infection	28 (1.1%)	41 (1.1%)	42 (0.8%)	0.158
Reintubation	8 (0.3%)	9 (0.2%)	14 (0.3%)	0.640
Ventilator > 48 h	1 (0.0%)	1 (0.0%)	5 (0.1%)	0.612
Pulmonary embolism	8 (0.3%)	18 (0.5%)	18 (0.3%)	0.608
Deep vein thrombosis	16 (0.6%)	14 (0.4%)	22 (0.4%)	0.119
Any medical complication	37 (1.5%)	51 (1.3%)	58 (1.1%)	*0.028*
Sepsis or septic shock	13 (0.5%)	16 (0.4%)	24 (0.5%)	0.783
Cardiac arrest	3 (0.1%)	6 (0.2%)	3 (0.1%)	0.221
Myocardial infarction	8 (0.3%)	4 (0.1%)	7 (0.1%)	*0.014*
Stroke	3 (0.1%)	4 (0.1%)	9 (0.2%)	0.973
Acute renal insufficiency	7 (0.3%)	9 (0.2%)	12 (0.2%)	0.537
Pneumonia	10 (0.4%)	16 (0.4%)	18 (0.3%)	0.344
Urinary tract infection	3 (0.1%)	4 (0.1%)	9 (0.2%)	0.973

Values are presented as frequency and percentage (nominal variables). Overall *p* values are determined from a univariate mixed effects logistic regression, which included an ordinal time variable for admission year. For simplicity, data is presented in time period cohorts; however, all analyses were performed across each individual year. Significant values in italics and defined as $p < 0.05$

improvement, which was primarily driven decreased incidence of myocardial infarction. The percentage of Black patients requiring prolonged hospitalization decreased by nearly one-half. Independent risk factors for AEs were

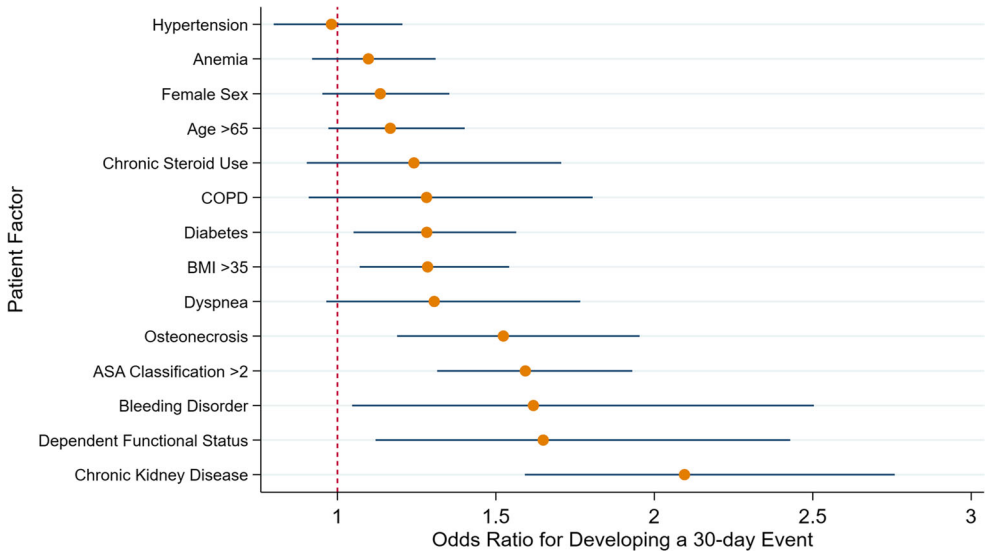

Fig. 1 Multivariate logistic regression analysis for development of a 30-day postoperative event. A multivariate logistic regression was utilized to yield odds ratios for development of a postsurgical event, defined as any combination of a medical complication, surgical complication, mortality, readmission, or reoperation. Patient factors previously demonstrating ($p < 0.05$) or approaching significance ($p < 0.10$) between the patient groups (Table 1) were controlled for in the regression analysis. Continuous variables (age, BMI, ASA score) were converted to nominal variables according to Youden's index so as to maximize the discriminative capacity of the cutoff value. COPD, chronic obstructive pulmonary disease; BMI, body mass index; ASA, American Society of Anesthesiologists physical classification system

BMI > 35, ASA classification > 2, dependent functional status, diabetes, bleeding disorders, CKD, and osteonecrosis as the THA indication.

The observed trend toward shorter LOS from 2011 to 2017 mirrors trends in the general population as fast-track and outpatient THAs have become more prevalent. Prior studies on short stay TJA have demonstrated significant cost savings without compromising safety. However, patients with certain major medical comorbidities may not be appropriate for these accelerated protocols. The historically higher comorbidity burden in Black patients may pose a barrier to the adoption of short stay TJA in this racial group. Moreover, we are unable to comment on discharge disposition due to limitations in our data, and it is possible that some of this trend could be explained by earlier discharge to post-acute facilities. Nevertheless, the observed trends for improved comorbidity profiles and lack of increased postoperative AEs associated with the simultaneous decline in LOS over the study period are encouraging.

Our study suggests flattening in the rates of worsening arthroplasty outcomes among Black patients in recent years compared with older reports. In an 18-year analysis of Medicare beneficiaries undergoing THA, Singh et al. [4] showed an increased rate of hospital readmission in Black patients between 1991 and 2008 compared with Whites. However, consistent with our findings, a more recent retrospective analysis of a state arthroplasty registry by Aseltine et al. [14] showed narrowing disparities in 30-day readmission rates in Black patients from 2005 to 2015. It is likely that the receding tide in postsurgical adverse events is influenced by improvements in comorbidity profiles and/or optimization prior to surgery given our observation of the decreasing rates of tobacco smoking, anemia, dyspnea, and osteonecrosis at the time of surgery. Those factors have been shown to impact THA outcomes. For example, Kapadia et al. [15] demonstrated in a retrospective matched cohort study that tobacco smoking was associated with higher complication and revision rates following THA. The disconnect between improving comorbidity profiles and frank improvements in readmissions, reoperations, and mortality is somewhat surprising. Unfortunately, root cause analysis was not possible due to limitations of the ACS-NSQIP database.

While the number of THAs performed in Black patients has doubled over the recent years, Blacks made up only 7.4% of all THAs performed captured in the NSQIP database during the study period with the vast majority of procedures performed in White patients. This utilization rate appears to be disproportionate to 2018 United States Census showing that 12.7% of the population identified as non-Hispanic Black [16] and that the prevalence of both radiographic and symptomatic osteoarthritis among Black individuals were similar to Whites [17]. Clearly, despite encouraging trends in procedure utilization in the Black community, efforts are still needed to improve access to THA.

While numerous studies have demonstrated racial disparities in TJA, few have proposed interventions to bridge this gap. This likely reflects the complex and multifactorial nature of racial disparities. Based on our analysis of Black patients who experienced postoperative adverse events, one potential target for intervention is the early identification and mitigation of high-risk patients through preoperative counseling, medical optimization, referral to specialized surgery centers, and/or close postoperative follow-up. This is especially important in patients with osteonecrosis, ASA classification > 2, chronic kidney disease, and bleeding disorders, and those who are functionally debilitated at baseline as identified in the present study. The latter patient factor deserves a closer look as it is likely related to the tendency among minority patients to seek treatment at more advanced stages of arthritis [6]. Within the Black community, patients are more likely to be underinsured, have insurance plans that require referral from their primary care physicians, or be part of underdeveloped referral networks [18, 19]. This means more time is spent in the referral process, further delaying presentation to specialized arthritis care while pain and disability worsen [20]. To add to this challenge, caring for minority patients has traditionally been complicated by physician distrust, higher perception of increased postoperative pain [21, 22], and racial differences in physician pain management practices [23] leading to fewer patients seeking surgery. Our data lends support to promote efforts toward expedient reconstructive treatment when nonoperative management has failed and before functional capacity has severely deteriorated.

There are multiple limitations to this study. First, the ACS-NSQIP database collects from a disproportionately high number of academic hospitals. Academic centers are more likely to take on complex and high-risk cases compared with community hospitals, and hence, this could have potentially skewed the rates of adverse events. Second, the ACS-NSQIP database does not contain a comprehensive list of patient characteristics and is subject to abstraction errors. For example, socioeconomic factors known to affect health outcomes were not available. Third, we lack pain and functional outcome scores that reflect on the quality of care perceived by patients. Fourth, the surgical cases captured by the ACS-NSQIP database represent only a small sample of all THAs performed in the USA. While the database is often used to measure and improve the quality of surgical care, it is often criticized as lacking data from non-academic hospitals and surgical centers where the larger percentage of THAs are performed. However, the knowledge derived from this study should still be applicable regardless of the hospital type and is consistent with previous reports.

In conclusion, we observed favorable trends in procedure utilization, comorbidity profiles, and LOS among Black patients undergoing primary THA between 2011 and 2017. However, the rates of 30-day adverse health outcomes remained steady during the same period, suggesting flattening

in the previously reported worsening outcomes. Still, more work remains to be done as the overall rates of procedure utilization, LOS, and outcomes remain lower compared with Whites. Patients with BMI > 35, ASA classification > 2, dependent functional status, diabetes, bleeding disorders, CKD, and preoperative diagnosis of osteonecrosis appear to be higher risk for developing AEs. Future research should look at the multi-faceted aspects including socioeconomic determinants that impact Black patients undergoing THA with a focus on providing the necessary resources to improve procedure utilization and outcomes.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval This article does not contain any studies with human participants performed by any of the authors. Furthermore, the study was IRB-exempt.

Informed Consent Not applicable

References

1. Pérez-Stable E. At NIH, Minority health is everyone's concern, every day. National Institute of Arthritis and Musculoskeletal and Skin Diseases Available at: https://www.niams.nih.gov/about/about-the-director/letter/nih-minority-health-everyones-concern-every-day. Last accessed April 21, 2020.
2. Rowley DL, Jenkins BC, Frazier E. Utilization of joint arthroplasty: racial and ethnic disparities in the Veterans Affairs Health Care System. J Am Acad Orthop Surg. 2007;15(Suppl 1):S43–8.
3. 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(15):1243–52.
4. Singh JA, Lu X, Rosenthal GE, Ibrahim S, Cram P. Racial disparities in knee and hip total joint arthroplasty: an 18-year analysis of national Medicare data. Ann Rheum Dis. 2014;73(12):2107–15.
5. 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(9):1986–95.
6. Goodman SM, Mehta B, Zhang M, Szymonifka J, Nguyen JT, Lee L, et al. Disparities in total hip arthroplasty outcomes: census tract data show interactions between race and community deprivation. J Am Acad Orthop Surg. 2018;26(21):e457–64.
7. Lavernia CJ, Villa JM. Does race affect outcomes in total joint arthroplasty? Clin Orthop Relat Res. 2015;473(11):3535–41.
8. Allen Butler R, Rosenzweig S, Myers L, Barrack RL. The Frank Stinchfield Award: the impact of socioeconomic factors on outcome after THA: a prospective, randomized study. Clin Orthop Relat Res. 2011;469(2):339–47.
9. Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. J Bone Joint Surg Am. 2007;89(4):780–5.
10. Kurtz SM, Ong KL, Lau E, Bozic KJ. Impact of the economic downturn on total joint replacement demand in the United States: updated projections to 2021. J Bone Joint Surg Am. 2014;96(8):624–30.
11. Buchmueller TC, Levinson ZM, Levy HG, Wolfe BL. Effect of the Affordable Care Act on racial and ethnic disparities in health insurance coverage. Am J Public Health. 2016;106(8):1416–21.
12. McMorrow S, Long SK, Kenney GM, Anderson N. Uninsurance disparities have narrowed for Black and Hispanic adults under the Affordable Care Act. Health Aff (Millwood). 2015;34(10):1774–8.
13. The American College of Surgeons National Surgical Quality Improvement Program. Frequently asked questions. Available at: https://www.facs.org/quality-programs/acs-nsqip/faq. Last accessed on July 14, 2020.
14. Aseltine RH Jr, 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(22):2044–50.
15. Kapadia BH, Issa K, Pivec R, Bonutti PM, Mont MA. Tobacco use may be associated with increased revision and complication rates following total hip arthroplasty. J Arthroplast. 2014;29(4):777–80.
16. United States Census Bureau. *Race: American Community Survey*. Available at: https://data.census.gov/cedsci/all?q=Race%20and%20Ethnicity&tid=ACSDT1Y2018.B02001&vintage=2018&hidePreview=false. Last accessed on Mary 7, 2020.
17. Foley B, Cleveland RJ, Renner JB, Jordan JM, Nelson AE. Racial differences in associations between baseline patterns of radiographic osteoarthritis and multiple definitions of progression of hip osteoarthritis: the Johnston County Osteoarthritis Project. Arthritis Res Ther. 2015;17:366.
18. Ghomrawi HMK, Funk RJ, Parks ML, Owen-Smith J, Hollingsworth JM. Physician referral patterns and racial disparities in total hip replacement: a network analysis approach. PLoS One. 2018;13(2):e0193014.
19. Halbert CH, Armstrong K, Gandy OH Jr, Shaker L. Racial differences in trust in health care providers. Arch Intern Med. 2006;166(8):896–901.
20. Santaguida PL, Hawker GA, Hudak PL, et al. Patient characteristics affecting the prognosis of total hip and knee joint arthroplasty: a systematic review. Can J Surg. 2008;51(6):428–36.
21. Allen KD, Golightly YM, Callahan LF, Helmick CG, Ibrahim SA, Kwoh CK, et al. Race and sex differences in willingness to undergo total joint replacement: the Johnston County Osteoarthritis Project. Arthritis Care Res (Hoboken). 2014;66(8):1193–202.
22. Katz JN. Persistence of racial and ethnic differences in utilization and adverse outcomes of total joint replacement. J Bone Joint Surg Am. 2016;98(15):1241–2.
23. Tamayo-Sarver JH, Hinze SW, Cydulka RK, Baker DW. Racial and ethnic disparities in emergency department analgesic prescription. Am J Public Health. 2003;93(12):2067–73.