Research Article

Racial and Ethnic Disparities in Hip Fracture Surgery Care in the United States From 2006 to 2015: A Nationwide Trends Study

Troy B. Amen, MD, MBA
Nathan H. Varady, MD, MBA
Evan M. Shannon, MD, MPH
Ahab Chopra, BS
Sean Rajaee, MD
Antonia F. Chen, MD, MBA

ABSTRACT

Background: Racial and ethnic disparities in the surgical treatment of hip fractures have been previously reported, demonstrating delayed time to surgery and worse perioperative outcomes for minority patients. However, data are lacking on how these disparities have trended over time and whether national efforts have succeeded in reducing them. The aim of this study was to investigate temporal trends in racial and ethnic disparities in perioperative metrics for patients undergoing hip fracture surgery in the United States from 2006 to 2015.

Methods: The National Inpatient Sample was queried for White, Black, Hispanic, and Asian patients who underwent hip fracture surgery between 2006 and 2015. Perioperative metrics, including delayed time to surgery (≥2 calendar days from admission to surgical intervention), length of stay (LOS), total inpatient complications, and mortality, were trended over time. Changes in racial and ethnic disparities were assessed using linear and logistic regression models.

Results: During the study period, there were persistent disparities in delayed time to surgery for White versus Black, Hispanic, and Asian patients (eg, White versus Black: 30.1% versus 39.7% in 2006 and 22% versus 28.8% in 2015, $P_{trend} > 0.05$ for all). Although disparities in total LOS remained consistent for White versus Black patients ($P_{trend} = 0.97$), these disparities improved for White versus Hispanic and Asian patients (eg, White versus Hispanic: 4.8 days versus 5.3 in 2006 and 4.1 days versus 4.4 in 2015, $P_{trend} < 0.05$ for both).

Discussion: Racial and ethnic disparities were persistent in time to surgery and discharge disposition for hip fracture surgery between White and minority patients from 2006 to 2015 in the United States. These disparities particularly affected Black patients. Although there were encouraging signs of improving disparities in the LOS, these

From the Department of Orthopaedic Surgery, Hospital for Special Surgery, New York City, NY (Amen, Varady); Department of Orthopaedic Surgery, Brigham and Women's Hospital, Harvard Medical School, Boston, MA (Chen); Department of Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA (Shannon); and Department of Orthopaedic Surgery (Rajaee), Cedar-Sinai Medical Center, Los Angeles, CA.

Correspondence to Dr. Amen: ament@hss.edu

None of the following authors or any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this article: Amen, Varady, Shannon, Chopra, Rajaee, and Chen.

J Am Acad Orthop Surg 2021;00:1-9

DOI: 10.5435/JAAOS-D-21-00137

findings highlight the need for renewed orthopaedic initiatives and healthcare reform policies aimed at reducing perioperative disparities in orthopaedic trauma care.

Racial and ethnic disparities within the field of orthopaedics have been extensively reported across multiple subspecialties, including orthopaedic trauma.[1,2] After sustaining a hip fracture, Black patients have been found to have higher odds of receiving nonsurgical treatment for their fractures[3] and, when treated surgically, have worse postoperative outcomes including higher rates of revision surgery, readmission, and 1-year mortality compared with White patients.[4] Multiple previous studies have also demonstrated that Black and Hispanic patients experience a markedly higher rates of delayed time to surgery (TTS) after presenting to the hospital for a hip fracture and an increased hospital length of stay (LOS) afterward, both of which further increase their risk of postoperative morbidity and mortality.[5-7]

To date, there is a paucity of data on how these racial disparities in hip fracture surgery care have evolved over time. Although there have been numerous national initiatives to combat racial disparities and increase minority access to care, including efforts by orthopaedic surgeons,[8-10] general traumotologists,[11] national policymakers,[12-15] and the private sector,[16] it remains unknown whether these initiatives have actually been effective in reducing disparities in orthopaedic trauma care. These data are critical in helping orthopaedic surgeons continue not only to understand the root causes of these disparities but to also guide future efforts to more effectively address these discrepancies in care.

The purpose of this study was to use a nationally representative sample to investigate trends in racial disparities after hip fracture surgery between White versus Black, Hispanic, and Asian patients from 2006 to 2015 in the United States. Given recent data demonstrating worsening disparities within other orthopaedic subspecialties,[17] we hypothesized that disparities between White and minority hip fracture surgery patients would persist or even worsen over time.

Methods

A retrospective cohort study was conducted using the Healthcare Cost and Utilization Project National Inpatient Sample (NIS). The NIS is the largest inpatient database in the United States containing data on over seven million inpatient hospitalizations per year and representing over 97% of the US population.[18] This database has been specifically designed for investigating trends in inpatient outcomes and healthcare delivery over time[18] and has been successfully used in numerous previous orthopaedics trends' studies.[17,19,20]

Consistent with previous methods,[6] we queried the database for patients who underwent hip fracture surgery between 2006 and 2015 using the International Classification of Diseases, Ninth Revision, Clinical Modification codes. Patient demographics were collected, including age, sex, race (White, Black, Hispanic, and Asian), median household income, insurance status (Medicare, Medicaid, private, other), 29 medical comorbidities used to calculate the Elixhauser Comorbidity Index,[21] fracture type (intracapsular, trochanteric, and subtrochanteric), and surgical procedure (total hip arthroplasty, hemiarthroplasty, open reduction and internal fixation, and closed reduction percutaneous pinning). Hospital-specific factors including hospital size (small, medium, or large) and hospital type (rural, urban nonteaching, or urban teaching) were collected. In keeping with previous methods, inpatient complications were collected and included acute renal failure, cardiac arrest, deep vein thrombosis, myocardial infarction, pulmonary embolism, pneumonia, surgical site infection, urinary tract infection, and wound dehiscence.[17] Additional perioperative outcomes obtained included the TTS, LOS, inpatient mortality, and discharge destination (home versus facility discharge [rehabilitation or nursing facility]). Similar to previous methods, TTS was calculated in calendar days by subtracting the number of days from each patient's admission to the date of their hip fracture surgery[6] and delayed TTS was defined as $\geq$2 calendar days from admission to surgical intervention.[6]

Statistical Analysis

All analyses in this study were performed while accounting for hospital strata, hospital clustering, and discharge weights.[22,23] Nationally representative estimates were created using sampling rates developed by the Agency for Healthcare Research and Quality for assessment of trends.[17,22,23] Consistent with previous methods, continuous variables were summarized as a median and interquartile range using the SURVEYMEANS procedure, and categorical variables were summarized as a number and percentage using the SUREYFREQ procedure (SAS Institute); differences in continuous and categorical

variables were assessed with t-tests and the Rao-Scott chi-squared test, respectively.[17,20,24] Differences in disparities over time were assessed using an interaction term between race and calendar year[17,25]; trends in LOS were analyzed using the SURVEYREG procedure and trends in complication rates, discharge to facility, and mortality were assessed using logistic regression using the SURVEYLOGISTIC procedure.[17]

Adjusted trends analyses were also done to control for a variety of patient and hospital-specific factors in three nested models using a (race × year) interaction to assess changes in disparities over time. Model 1 controlled for age, sex, race, year, facture type, and surgical procedure. Model 2 controlled for the previous variables as well as smoking status, medical comorbidities, and hospital characteristics. Model 3 controlled for previous variables in model 2 as well as socioeconomic status and insurance status. In these models, odds ratios (ORs) are reported for adjusted logistics regression models and adjusted mean differences are reported for linear regression models. All analyses were done in SAS v9.4 (SAS Institute), and $P < 0.05$ was considered statistically significant. This study was exempt by our institutional review board.

Results

A total of 2,055,394 hip fracture hospitalizations were included in this study. Overall, 89.3% of patients were White, 4.1% of patients were Black, 5.0% were Hispanic, and 1.5% were Asian. Demographic data for all four races are presented in Table 1.

Time to Surgery

The percent of patients who experienced a delayed TTS ≥2 days significantly declined for all races from 2006 to 2015 ($P < 0.001$ for all). However, racial disparities in the percent of patients with delayed TTS ≥2 days between White versus Black, Hispanic, and Asian patients did not show a statistically significantly decline during the study period (*Ptrend* > 0.05 for all, Figure 1). In 2006, the 30.1% of White patients experienced a delayed TTS ≥2 days, compared with 39.7%, 44.5%, and 37.2%, respectively, for Black, Hispanic, and Asian patients, whereas in 2015, 22.0% of White patients and 28.8%, 31.9%, and 25.3% days for Black, Hispanic, and Asian patients, respectively, experienced a TTS > 2 days (Figure 1). Disparities in TTS ≥1 day were also significantly higher for Black and Hispanic patients when compared with White patients and persisted over time (*Ptrend* > 0.05 for Black and Hispanic, Figure 2).

Postoperative Outcomes

Minority patients had significantly higher LOS than White patients throughout the entire study ($P < 0.001$ for all). Although disparities in total LOS persisted for White versus Black patients over time (eg, White versus Black: 4.8 days versus 5.4 in 2006 and 4.1 days versus 4.7 in 2015, $P_{trend} > 0.05$), disparities were improved for White versus Hispanic and Asian patients (eg, White versus Hispanic: 4.8 days versus 5.3 in 2006 and 4.1 days versus 4.4 in 2015, $P_{trend} < 0.001$ for both).

Minority patients also had significantly lower rates of facility discharges when compared with White patients ($P < 0.001$ for all). Disparities in facility discharges after hip fracture surgery persisted for all minority races during the entire study period. For example, in 2006, 84.9% of White patients were discharged to facilities, compared with 77.9%, 76.1%, and 77.2%, respectively, for Black, Hispanic, and Asian patients, whereas in 2015, 83.2% of White patients were discharged to facilities, compared with 75.9%, 74.4%, and 72.9%, respectively (Table 2).

Hispanic patients, interestingly, had lower total complication rates when compared with White patients ($P < 0.001$). However, no other differences in total complications were found for White versus Black, Hispanic, and Asian patients ($P > 0.05$ for all). Inpatient mortality was not statistically significant between White and minority races and was downward trending for both races (Table 2).

Adjusted Outcomes

The unadjusted results were largely corroborated by all three adjusted models for White versus Black patients (Table 3). For example, after controlling for age, sex, smoking status, medical comorbidities, hospital characteristics, socioeconomic status, insurance type, fracture type, and surgical procedure (model 3), Black race remained associated with higher rates of delayed TTS > 2 days (OR = 1.43, 95% confidence interval [CI] = 1.36 to 1.51, $P < 0.001$) and increased LOS (adjusted mean difference = 0.88 days, 95% CI = 0.77 to 0.99 days, $P < 0.001$) with no improvements in these disparities over time ($P_{trend} > 0.05$ for all models). Interestingly, however, after adjusting, Black race was actually found to be associated with higher rates of facility discharges (OR = 1.08, 95% CI = 1.02 to 1.14, $P = 0.008$) when compared with White patients. Similar trends to the unadjusted results were found for Hispanic and Asian patients in most of the adjusted models (Table 3).

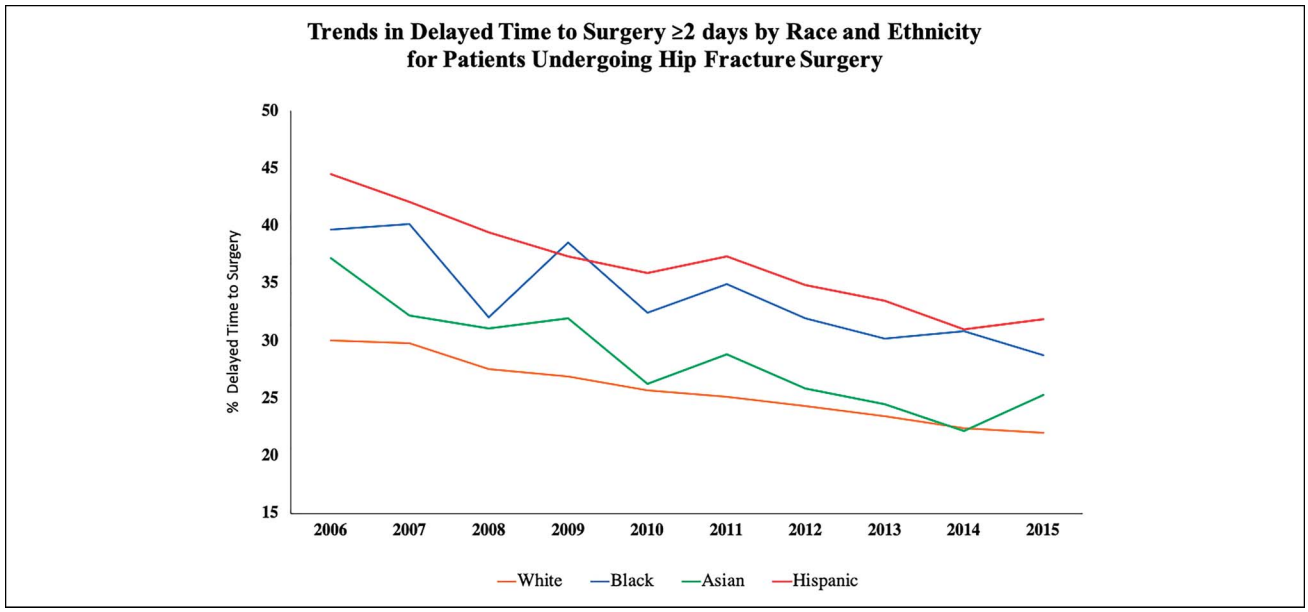
Table 1. **Patient Demographics and Hospital Characteristics for Patients Undergoing Hip Fracture Surgery by Race and Ethnicity**

	White	Black	Hispanic	Asian	*P*
N (%)	1,835,320 (89.3%)	84,732 (4.1%)	103,231 (5%)	32,112 (1.6%)	
Median (IQR) age (yr)	81.7 (73.3-87.3)	76.7 (63.1-85.4)	80.2 (70.6-86.3)	81.1 (72.2-86.8)	<0.001
Age (no. [%])					<0.001
<65 yr	214,795 (11.7%)	22,301 (26.3%)	17,197 (16.7%)	4,181 (13%)	
65-79 yr	511,540 (27.9%)	24,839 (29.3%)	31,282 (30.3%)	9,637 (30%)	
≥80 yr	1,108,911 (60.4%)	37,592 (44.4%)	54,752 (53%)	18,294 (57%)	
Sex (no. [%])					<0.001
Male	536,022 (29.2%)	34,147 (40.3%)	34,491 (33.4%)	9,031 (28.1%)	
Female	1,299,220 (70.8%)	50,585 (59.7%)	68,740 (66.6%)	23,077 (71.9%)	
Median (IQR) Elixhauser Comorbidity Index	2.3 (1.2-3.6)	2.5 (1.3-3.8)	2.3 (1.2-3.7)	2.1 (1-3.4)	<0.001
Median (IQR) length of stay (d)	4.4 (3.3-6.1)	5 (3.6-7.5)	4.7 (3.4-6.8)	4.6 (3.3-6.7)	<0.001
Income					<0.001
First quartile	431,696 (24%)	43,832 (53%)	39,376 (39.3%)	4,373 (14%)	
Second quartile	489,875 (27.2%)	17,111 (20.7%)	22,404 (22.4%)	5,808 (18.6%)	
Third quartile	447,794 (24.8%)	12,296 (14.9%)	23,202 (23.2%)	7,913 (25.3%)	
Fourth quartile	432,863 (24%)	9,415 (11.4%)	15,222 (15.2%)	13,160 (42.1%)	
Insurance status					<0.001
Medicare	1,552,368 (84.7%)	61,535 (72.9%)	75,830 (73.5%)	23,455 (73.1%)	
Medicaid	34,924 (1.9%)	7,368 (8.7%)	9,420 (9.1%)	2,931 (9.1%)	
Private	183,491 (10%)	9,577 (11.3%)	10,534 (10.2%)	4,105 (12.8%)	
Self-pay	23,459 (1.3%)	3,252 (3.9%)	4,036 (3.9%)	943 (2.9%)	
Other	38,521 (2.1%)	2,723 (3.2%)	3,320 (3.2%)	669 (2.1%)	
Hospital location type (no. [%])					<0.001
Rural	255,840 (14%)	6,051 (7.2%)	6,853 (6.7%)	1,463 (4.6%)	
Urban, nonteaching	825,200 (45.1%)	27,287 (32.4%)	48,226 (46.8%)	13,910 (43.6%)	
Urban, teaching	746,734 (40.9%)	50,811 (60.4%)	47,905 (46.5%)	16,551 (51.8%)	
Hospital size (no. [%])					0.003
Small	256,350 (14%)	8,496 (10.1%)	12,694 (12.3%)	4,983 (15.6%)	
Medium	512,873 (28.1%)	22,903 (27.2%)	28,654 (27.8%)	8,663 (27.1%)	
Large	1,058,551 (57.9%)	52,750 (62.7%)	61,637 (59.9%)	18,277 (57.3%)	

Discussion

Although racial and ethnic disparities within orthopaedic trauma have been reported,[1,2] data are lacking on how these disparities may have evolved over time in response to numerous national healthcare initiatives aimed at eliminating them. In this study, we found persisting and improving disparities in hip fracture surgery care between White and minority patients from 2006 to 2015 in the United States. Specifically, we found that disparities in delayed TTS and facility discharges persisted over time for Black, Hispanic, and Asian patients when compared with White patients. Encouragingly, there was evidence of narrowing racial disparities in LOS for Hispanic and Asian patients when compared with White patients. Overall, however, these nuanced

Figure 1

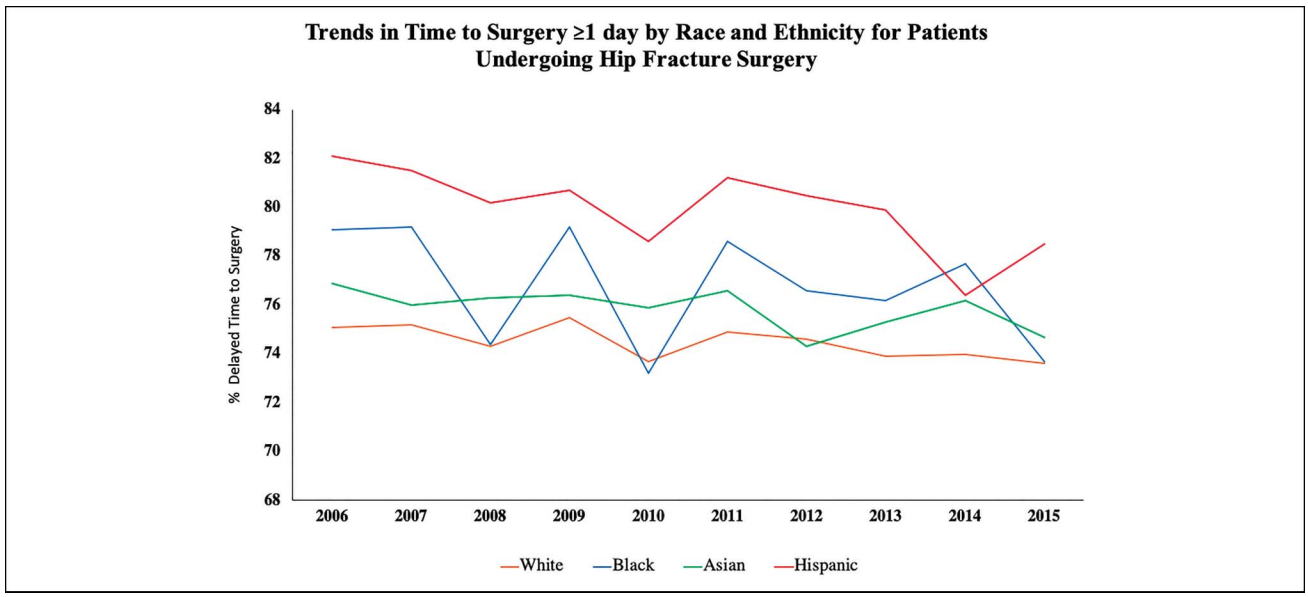


Line diagram showing nationwide trends in delayed time to surgery for patients undergoing hip fracture surgery by race and ethnicity.

results continue to suggest the need for renewed orthopaedic initiatives and policy reforms to continue reducing racial inequalities in orthopaedic trauma care.

To our knowledge, this is the first study to provide data on national trends in racial and ethnic disparities in orthopaedic hip fracture surgery care. Previous research within this field has focused primarily on using aggregate data to assess for disparities, without examining how these disparities have changed over time.[4-6,26] One of the most striking disparities highlighted by previous studies is the markedly higher rates of delayed TTS experienced by Black and Hispanic patients after hip fracture presentation.[5,6] Unfortunately, we found that disparities in delayed TTS ≥2 days persisted over time for Black, Hispanic, and Asians patients when compared with White patients. These findings are especially concerning,

Figure 2



Line diagram showing nationwide trends in time to surgery ≥1 day for patients undergoing hip fracture surgery by race and ethnicity.

Table 2. **Nationwide Trends in Time to Surgery and Perioperative Metrics for Patients Undergoing Hip Fracture Surgery by Race and Ethnicity**

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	P_{trend}[a]
White											
Median (IQR) length of stay (d)	4.8 (3.5-6.7)	4.7 (3.5-6.6)	4.6 (3.4-6.4)	4.5 (3.3-6.2)	4.5 (3.3-6.2)	4.3 (3.3-6)	4.3 (3.2-5.9)	4.2 (3.2-5.8)	4.1 (3.1-5.8)	4.1 (3-5.7)	—
Any complication (no. [%])	41,414 (26%)	42,508 (27%)	51,646 (28.6%)	54,642 (29.7%)	57,997 (30.3%)	64,040 (31.7%)	59,310 (30.6%)	60,840 (30.5%)	62,885 (30.7%)	48,480 (30%)	—
Facility discharge (no. [%])	135,250 (84.9%)	133,005 (84.4%)	153,284 (84.8%)	155,893 (84.9%)	162,335 (84.8%)	171,015 (84.9%)	163,895 (84.6%)	167,685 (84.1%)	171,700 (83.8%)	134,395 (83.2%)	—
Mortality (no. [%])	3,572 (2.2%)	3,259 (2.1%)	3,908 (2.2%)	3,692 (2%)	3,777 (2%)	3,993 (2%)	3,485 (1.8%)	3,275 (1.6%)	3,670 (1.8%)	2,800 (1.7%)	—
Black											
Median (IQR) length of stay (d)	5.4 (3.8-8.1)	5.4 (3.8-7.9)	5.1 (3.6-7.1)	5.2 (3.7-7.7)	5.1 (3.6-7.7)	5.1 (3.7-7.6)	4.9 (3.4-7.3)	4.7 (3.4-6.9)	4.9 (3.4-7.1)	4.7 (3.3-7.2)	0.97
Any complication (no. [%])	1803 (27.8%)	2070 (28.6%)	2,239 (29%)	2,462 (31.5%)	3,173 (32%)	2,777 (29.6%)	3,080 (32.7%)	2,975 (31.8%)	3,120 (32.9%)	2,525 (31.9%)	0.80
Facility discharge (no. [%])	5,061 (77.9%)	5,575 (77%)	6,085 (78.8%)	6,067 (77.7%)	7,614 (76.9%)	7,390 (78.8%)	7,435 (79%)	7,280 (77.8%)	7,225 (76.4%)	6,005 (75.9%)	0.68
Mortality (no. [%])	177 (2.7%)	88 (1.2%)	108 (1.4%)	166 (2.1%)	138 (1.4%)	115 (1.2%)	160 (1.7%)	85 (0.9%)	160 (1.7%)	120 (1.5%)	NA
Hispanic											
Median (IQR) length of stay (d)	5.3 (3.8-7.8)	5.2 (3.7-7.5)	5 (3.5-7.4)	4.8 (3.4-6.8)	4.9 (3.5-6.9)	4.6 (3.4-6.6)	4.6 (3.3-6.4)	4.4 (3.2-6.3)	4.4 (3.2-6.3)	4.4 (3.2-6.4)	0.005
Any complication (no. [%])	2,130 (22.2%)	2,233 (27.4%)	2,524 (28.6%)	3,075 (28.1%)	2,863 (27.7%)	3,576 (28.7%)	3,155 (30.7%)	3,130 (28.8%)	3,450 (29.2%)	3,090 (30.9%)	0.20
Facility discharge (no. [%])	7,273 (76.1%)	6,061 (74.6%)	6,794 (77%)	8,432 (77.1%)	7,833 (75.8%)	9,496 (76.6%)	8,135 (79.2%)	8,325 (76.9%)	9,235 (78.3%)	7,430 (74.4%)	0.19
Mortality (no. [%])	201 (2.1%)	81 (1%)	173 (2%)	205 (1.9%)	164 (1.6%)	204 (1.6%)	155 (1.5%)	135 (1.2%)	140 (1.2%)	110 (1.1%)	NA
Asian TKA											
Median (IQR) length of stay (d)	5.6 (3.8-8.2)	5 (3.6-7.3)	5.1 (3.6-7)	4.7 (3.4-6.7)	4.6 (3.4-6.6)	4.3 (3.2-6.1)	4.6 (3.2-6.7)	4.2 (3.2-5.7)	4.2 (3.1-6.3)	4.2 (3.1-6.1)	0.05
Any complication (no. [%])	805 (29%)	765 (25.2%)	948 (28.6%)	925 (26%)	1,014 (29.9%)	889 (28.5%)	825 (27.3%)	730 (25%)	935 (27.8%)	980 (27.1%)	0.02
Facility discharge (no. [%])	2,144 (77.2%)	2,225 (73.3%)	2,582 (77.9%)	2,804 (78.9%)	2,650 (78.3%)	2,429 (77.9%)	2,375 (78.5%)	2,195 (75%)	2,510 (74.7%)	2,630 (72.9%)	0.73
Mortality (no. [%])	79 (2.8%)	45 (1.5%)	59 (1.8%)	54 (1.5%)	30 (0.9%)	57 (1.8%)	30 (1%)	40 (1.4%)	40 (1.2%)	30 (0.8%)	NA

[a]Refers to the *P*-value for the change in disparities between White and Black, Hispanic, and Asian patients over time. NA indicates that race was not statistically associated with this outcome and that a P_{trend} could not be meaningfully reported.

Table 3. Adjusted Nationwide Trends in Time to Surgery and Perioperative Metrics for Patients Undergoing Hip Fracture Surgery by Race and Ethnicity

	Black			Hispanic			Asian		
	OR[a] (95% CI)	*P*	P_{trend}	OR[a] (95% CI)	*P*	P_{trend}	OR[a] (95% CI)	*P*	P_{trend}
Model 1									
Time to surgery ≥2 d	1.56 (1.49-1.63)	<0.001	0.72	1.75 (1.63-1.89)	<0.001	0.22	1.18 (1.09-1.27)	0.001	0.16
Discharge to facility	1.14 (1.08-1.20)	<0.001	0.42	0.70 (0.66-0.75)	<0.001	0.65	0.58 (0.53-0.64)	<0.001	0.78
Length of stay[a]	1.18 (1.06-1.31)	<0.001	0.92	0.66 (0.50-0.81)	<0.001	0.005	0.58 (0.38-0.78)	<0.001	0.06
Mortality	0.95 (0.84-1.07)	0.39	0.81	0.85 (0.75-0.96)	0.008	0.18	0.78 (0.63-0.96)	0.018	0.08
Model 2									
Time to surgery ≥2 d	1.48 (1.40-1.55)	<0.001	0.73	1.74 (1.61-1.88)	<0.001	0.31	1.19 (1.09-1.29)	0.004	0.29
Discharge to facility	1.07 (1.01-1.13)	0.025	0.36	0.68 (0.63-0.73)	<0.001	0.12	0.59 (0.53-0.65)	<0.001	0.46
Length of stay[a]	0.99 (0.87-1.10)	<0.001	0.55	0.68 (0.56-0.80)	<0.001	<0.001	0.67 (0.56-0.78)	<0.001	0.004
Mortality	0.89 (0.78-1.01)	0.07	0.46	0.89 (0.78-1.01)	0.066	0.41	0.87 (0.70-1.09)	0.22	0.41
Model 3									
Time to surgery ≥2 d	1.43 (1.36-1.51)	<0.001	0.48	1.70 (1.57-1.84)	<0.001	0.32	1.15 (1.06-1.25)	0.024	0.45
Discharge to facility	1.08 (1.02-1.14)	0.008	0.48	0.75 (0.70-0.81)	<0.001	0.21	0.65 (0.59-0.73)	<0.001	0.24
Length of stay[a]	0.88 (0.77-0.99)	<0.001	0.29	0.56 (0.45-0.67)	<0.001	<0.001	0.53 (0.43-0.62)	<0.001	0.010
Mortality	0.85 (0.74-0.97)	0.016	0.39	0.87 (0.76-0.99)	0.032	0.46	0.86 (0.68-1.07)	0.18	0.71

CI = confidence interval, OR = odds ratio

[a]Except for LOS, which is given as the adjusted mean difference.

All models controlled for race and year, and the following characteristics. Model 1: age, sex, fracture location, and surgical procedure. Model 2: model 1, smoking status, medical comorbidities, and hospital characteristics. Model 3: model 2, socioeconomic status and insurance status. Each model was then run with the addition of the race × year interaction to determine the change in disparity (P_{trend}). White is reference category for all models.

given well established associations between delayed TTS greater than 48 hours and higher rates of postoperative morbidity and mortality.[27] These findings may also have notable financial implications for hospitals treating minority populations because delayed surgical intervention has been shown to increase overall healthcare costs associated with hip fracture surgery care.[28]

Another notable finding of this study was the existence of disparities in LOS between White and minority patients. Previous studies using state-specific and single institution data have reported conflicting results on this topic.[5,7] Our findings support those by Coffield et al,[7] which found markedly longer LOS for Black patients after hip fracture treatment. Not only did we expand these results in a much larger nationally representative sample, but we importantly demonstrated notable improvements in these disparities over time for Hispanic and Asian patients. These findings are promising, given that shorter LOS for hip fracture surgery care has been associated with markedly lower odds of 30-day mortality[29] and lower overall hospital costs in other orthopaedic procedures.[19]

The improvements in racial disparities found in this study are encouraging and contrast previous trends studies that demonstrate persisting or worsening racial disparities in other orthopaedic subspecialties.[17,25,30] The improvements found in this study may be partly due

to numerous national efforts within the last two decades, aimed at specifically advancing care for minority patients within the United States.[15,31-33] Legislative enactments including the Affordable Care Act and the expansion of Medicaid have also increased access to emergency care for many minority groups[14,34,35] while also possibly increasing quality of care for these patients through pay-for-performance and public quality reporting programs.[4] In parallel, orthopaedic-specific initiatives by the American Academy of Orthopaedic Surgeons[9] and others[8-10,13] have sought to eliminate disparities in orthopaedic care through research initiatives, such as the "Musculoskeletal Healthcare Disparities Symposium" and priority action plans aimed at raising awareness, while also attempting to increase diversity within the orthopaedics workforce. Although these efforts are commendable and improvements have been observed, the narrowing of these disparities has not necessarily resulted in their elimination, and several other disparities have continued to persist without notable improvement.

Disparities in discharge destinations for White versus minority patients were also found to persist throughout the entire study period. These findings, which build on previous studies demonstrating higher rates of home discharge for Black and Hispanic patients after hip fracture surgery,[36] are concerning, given that inpatient rehabilitation after hip fracture surgery markedly aids in restoring mobility for patients[37] and is associated with lower 6-month mortality.[38] Moving forward, it may be beneficial to develop standardized rehabilitation protocols to reduce these disparities and improve postoperative functional outcomes for minority patients.[38,39]

The causes of the disparities in this study are likely due to a host of complex socioeconomic, cultural, political, and patient-specific factors, as well as unintended bias in physician decision-making. Interestingly, a recent study by Okike et al[26] demonstrated that universal insurance coverage and standardized protocols used by integrated healthcare systems may be able to markedly reduce, if not eliminate, racial disparities after hip fracture surgery. Similar studies have shown that racial disparities in total joint arthroplasty care can be reduced in universally insured populations[40] and through state-specific legislation reinforcing culturally appropriate medical care.[41] In fact, there was no difference in inpatient mortality between minority patients and White patients in our unadjusted results. Similarly, total inpatient complication rates were similar between Black, Asian, and White patients and actually lower for Hispanic patients when compared with White patients. Moreover, in our adjusted results, after controlling for various factors including smoking status, comorbidities, and hospital characteristics, some racial disparities were attenuated. These findings, as well as those from previous studies, continue to provide evidence that eliminating disparities in orthopaedic care is possible and that these disparities stem from not only sociodemographic and baseline health-related factors but also differences in access to care including patient insurance status and the hospitals in which patients are treated.

Although this study has several strengths, including its use of a large nationally representative sample, it also has several limitations. First, like most large databases, data regarding each patient encounter were derived primarily from billing data, which may be subject to miscoding. Second, the NIS database only contains data on the index admission, and longer term outcomes after discharge, including pain and function, are not captured. Data on inpatient mortality may be interpreted with caution because the number of inpatient deaths was very low and longer term mortality rates were unavailable. Finally, although total complications were ascertained from NIS diagnosis codes as consistent with countless previous NIS studies, it is possible that these codes may be limited in their ability to distinguish postoperative complications from previous comorbid conditions.

In conclusion, there were signs of persisting racial and ethnic disparities in hip fracture surgery care from 2006 to 2015 in the United States, specifically with respect to TTS and discharge disposition. Encouragingly, there were improving trends in the LOS for Hispanic and Asian patients, which may highlight some success after recent orthopaedic initiatives and healthcare policy reforms. Although these improvements should be commended, racial disparities within hip fracture surgery care continue to exist and renewed efforts are still needed to continue eliminating unequal care on a national level.

References

References printed in **bold type** are those published within the past 5 years.

1. Pandya NK, Wustrack R, Metz L, Ward D: Current concepts in orthopaedic care disparities. *J Am Acad Orthop Surg* 2018;26: 823-832.

2. Schoenfeld AJ, Tipirneni R, Nelson JH, Carpenter JE, Iwashyna TJ: The influence of race and ethnicity on complications and mortality after orthopedic surgery: A systematic review of the literature. *Med Care* 2014; 52:842-851.

3. Neuman MD, Fleisher LA, Even-Shoshan O, Mi L, Silber JH: Nonoperative care for hip fracture in the elderly: The influence of race, income, and comorbidities. *Med Care* 2010;48:314-320.

4. Dy CJ, Lane JM, Pan TJ, Parks ML, Lyman S: Racial and socioeconomic disparities in hip fracture care. *J Bone Joint Surg Am* 2016;98:858-865.

5. Ali I, Vattigunta S, Jang JM, et al: Racial disparities are present in the timing of radiographic assessment and surgical treatment of hip fractures. *Clin Orthop Relat Res* 2020;478:455-461.

6. Ryan DJ, Yoshihara H, Yoneoka D, Egol KA, Zuckerman JD: Delay in hip fracture surgery: An analysis of patient-specific and hospital-specific risk factors. *J Orthop Trauma* 2015;29:343-348.

7. Coffield E, Thirunavukkarasu S, Ho E, Munnangi S, Angus LDG: Disparities in length of stay for hip fracture treatment between patients treated in safety-net and non-safety-net hospitals. *BMC Health Serv Res* 2020;20:100.

8. Dykes DC, White AA: Getting to equal: Strategies to understand and eliminate general and orthopaedic healthcare disparities. *Clin Orthop Relat Res* 2009;467:2598-2605.

9. O'Connor MI, Lavernia CJ, Nelson CL: AAOS/ORS/ABJS musculoskeletal healthcare disparities research Symposium: Editorial comment: A call to arms: Eliminating musculoskeletal healthcare disparities. *Clin Orthop Relat Res* 2011;469:1805-1808.

10. *Movement is Life: A Catalyst for Change: Addressing Musculoskeletal Health Disparities*, 2010. https://www.movementislifecaucus.com/.

11. Hosking JE, Ameratunga SN, Bramley DM, Crengle SM: Reducing ethnic disparities in the quality of trauma care: An important research gap. *Ann Surg* 2011;253:233-237.

12. King RK, Green AR, Tan-Mcgrory A, Donahue EJ, Kimbrough-Sugick J, Betancourt JR: A plan for action: Key perspectives from the racial/ethnic disparities strategy forum. *Milbank Q* 2008;86:241-272.

13. Eichner J, Vladeck BC: Medicare as a catalyst for reducing health disparities, *Health Aff* 2020;24:365-375.

14. Scott JW, Neiman PU, Najjar PA, et al: Potential impact of affordable care act-related insurance expansion on trauma care reimbursement. *J Trauma Acute Care Surg* 2017;82:887-895.

15. US Department of Health and Human Services: *Health People 2020*. Washington, DC, 2010. https://www.healthypeople.gov/2020/About-Healthy-People.

16. Hassett P: Taking on racial and ethnic disparities in health care: The experience at Aetna. *Health Aff* 2005;24:417-420.

17. 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. *J Bone Joint Surg* 2020;102:811-820.

18. Agency for Healthcare Research and Quality: *Healthcare Cost and Utilization Project-HCUP a Federal-State-Industry Partnership, Vol 4287*, 2016. https://www.ahrq.gov/data/hcup/index.html.

19. Molloy IB, Martin BI, Moschetti WE, Jevsevar DS: Effects of the length of stay on the cost of total knee and total hip arthroplasty from 2002 to 2013. *J Bone Joint Surg Am* 2017;99:402-407.

20. Ju DG, Rajaee SS, Mirocha J, Lin CA, Moon CN: Nationwide analysis of femoral neck fractures in elderly patients a receding tide. *J Bone Joint Surg Am* 2017;99:1932-1940.

21. Elixhauser A, Steiner C, Harris DR, Coffey RM: Comorbidity measures for use with administrative data. *Med Care* 1998;36:8-27.

22. Agency for Healthcare and Research Quality: Producing National HCUP Estimates - Accessible Version. https://www.hcup-us.ahrq.gov/tech_assist/nationalestimates/508_course/508course_2018.jsp. Accessed July 20, 2020.

23. U.S. Agency for Healthcare Research and Quality: *HCUP Methods Series: Using the HCUP National Inpatient Sample to Estimate Trends (Revised 12/15/15) Report # 2006-05*, https://www.hcup-us.ahrq.gov/reports/methods/2006_05_NISTrendsReport_1988-2004.pdf. Accessed July 20, 2020.

24. Rajaee SS, Campbell JC, Mirocha J, Paiement GD: Increasing burden of total hip arthroplasty revisions in patients between 45 and 64 years of age. *J Bone Joint Surg Am* 2018;100:449-458.

25. 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;73:2107-2115.

26. Okike K, Chan PH, Prentice HA, Paxton EW, Navarro RA: Association between race and ethnicity and hip fracture outcomes in a universally insured population. *J Bone Joint Surg Am* 2018;100:1126-1131.

27. Moja L, Piatti A, Pecoraro V, et al: Timing matters in hip fracture surgery: Patients operated within 48 hours have better outcomes. A meta-analysis and meta-regression of over 190,000 patients. *PLoS One* 2012;7:e46175.

28. Pincus D, Wasserstein D, Ravi B, et al: Medical costs of delayed hip fracture surgery. *J Bone Joint Surg Am* 2018;100:1387-1396.

29. Nikkel LE, Kates SL, Schreck M, Maceroli M, Mahmood B, Elfar JC: Length of hospital stay after hip fracture and risk of early mortality after discharge in New York state: Retrospective cohort study. *BMJ* 2015;351:h6246.

30. Singh JA, Ramachandran R: Persisting racial disparities in total shoulder arthroplasty utilization and outcomes. *J Racial Ethnic Health Disparities* 2016;3:259-266.

31. Institute of Medicine (US) Committee on Understanding and Eliminating Racial and Ethnic Disparities in Health Care; Smedley BD, Stith AY, Nelson AR, eds: *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*. Washington, DC: National Academies Press, 2003. doi: 10.17226/12875.

32. Koh HK, Graham G, Glied SA: Reducing racial and ethnic disparities: The action plan from the department of health and human services. *Health Aff* 2011;30:1822-1829.

33. Services, C for M& M: *Guide to Reducing Disparities in Readmissions Guide to Reducing Disparities in Readmissions*. Accessed July 20, 2020.

34. Chen J, Vargas-Bustamante A, Mortensen K, Ortega AN: Racial and ethnic disparities in health care access and utilization under the affordable care Act. *Med Care* 2016;54:140-146.

35. Zerhouni YA, Scott JW, Ta C, et al.: Impact of the affordable care Act on trauma and emergency general surgery: An Eastern Association for the Surgery of Trauma systematic review and meta-analysis. *J Trauma Acute Care Surg* 2019;87:491-501.

36. Freburger JK, Holmes GM, Ku LJE: Postacute rehabilitation care for hip fracture: Who gets the most care?. *J Am Geriatr Soc* 2012;60:1929-1935.

37. Auais MA, Eilayyan O, Mayo NE: Extended exercise rehabilitation after hip fracture improves patients' physical function: A systematic review and meta-analysis. *Phys Ther* 2012;92:1437-1451.

38. Tedesco D, Gibertoni D, Rucci P, et al: Impact of rehabilitation on mortality and readmissions after surgery for hip fracture. *BMC Health Serv Res* 2018;18:701.

39. Penrod JD, Litke A, Hawkes WG, et al: *The Association of Race, Gender, and Comorbidity With Mortality and Function After Hip Fracture*, 2008. Accessed July 20, 2020.

40. Okike K, Chan PH, Prentice HA, Navarro RA, Hinman AD, Paxton EW: Association of race and ethnicity with total hip arthroplasty outcomes in a universally insured population. *J Bone Joint Surg Am* 2019;101:1160-1167.

41. Aseltine RH, Wang W, Benthien RA, 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;101:2044-2050.