

Racial and Socioeconomic Disparities in Hip Fracture Care

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Background: Despite declines in both the incidence of and mortality following hip fracture, there are racial and socioeconomic disparities in treatment access and outcomes. We evaluated the presence and implications of disparities in delivery of care, hypothesizing that race and community socioeconomic characteristics would influence quality of care for patients with a hip fracture.

Methods: We collected data from the New York State Department of Health Statewide Planning and Research Cooperative System (SPARCS), which prospectively captures information on all discharges from nonfederal acute-care hospitals in New York State. Records for 197,290 New York State residents who underwent surgery for a hip fracture between 1998 and 2010 in New York State were identified from SPARCS using International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes. Multivariable regression models were used to evaluate the association of patient characteristics, social deprivation, and hospital/surgeon volume with time from admission to surgery, in-hospital complications, readmission, and 1-year mortality.

Results: After adjusting for patient and surgery characteristics, hospital/surgeon volume, social deprivation, and other variables, black patients were at greater risk for delayed surgery (odds ratio [OR] = 1.49; 95% confidence interval [CI] = 1.42, 1.57), a reoperation (hazard ratio [HR] = 1.21; CI = 1.11, 1.32), readmission (OR = 1.17; CI = 1.11, 1.22), and 1-year mortality (HR = 1.13; CI = 1.07, 1.21) than white patients. Subgroup analyses showed a greater risk for delayed surgery for black and Asian patients compared with white patients, regardless of social deprivation. Additionally, there was a greater risk for readmission for black patients compared with white patients, regardless of social deprivation. Compared with Medicare patients, Medicaid patients were at increased risk for delayed surgery (OR = 1.17; CI = 1.10, 1.24) whereas privately insured patients were at decreased risk for delayed surgery (OR = 0.77; CI = 0.74, 0.81), readmission (OR = 0.77; CI = 0.74, 0.81), complications (OR = 0.80; CI = 0.77, 0.84), and 1-year mortality (HR = 0.80; CI = 0.75, 0.85).

Conclusions: There are race and insurance-based disparities in delivery of care for patients with hip fracture, some of which persist after adjusting for social deprivation. In addition to investigation into reasons contributing to disparities, targeted interventions should be developed to mitigate effects of disparities on patients at greatest risk.

Level of Evidence: Prognostic Level III. See Instructions for Authors for a complete description of levels of evidence.

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The annual costs associated with caring for patients with hip fractures in the United States are projected to rise to USD 25 billion by 2025¹. Given this substantial cost burden and the devastating effects of the injury, improvements in the quality and value of hip fracture care are attractive to both policymakers and health-care providers. Despite national

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TABLE 1 Patient and Hospital Characteristics (N = 197,290)

Characteristics	No. (%)
Patient Characteristics	
Age group	
<65 yr	21,967 (11.1%)
65-75 yr	29,683 (15.1%)
76-85 yr	75,453 (38.2%)
>85 yr	70,187 (35.6%)
Sex	
Male	52,916 (26.8%)
Female	144,374 (73.2%)
Race	
White	166,782 (84.5%)
Black	9,457 (4.8%)
Asian	3,252 (1.7%)
Other	9,610 (4.9%)
Missing	8,189 (4.2%)
Osteoporosis diagnosis present on admission	32,178 (16.3%)
Deyo comorbidity index	
0	102,119 (51.8%)
1	54,185 (27.5%)
2	21,488 (10.9%)
3	8,039 (4.1%)
≥4	11,459 (5.8%)
Insurance type	
Medicare	163,643 (83.0%)
Medicaid	7,673 (3.9%)
Private	17,423 (8.8%)
Workers' Compensation	1,854 (0.9%)
No-fault	3,275 (1.7%)
Other or uninsured	3,422 (1.7%)
Type of hip fracture treatment	
Total hip arthroplasty	5,963 (3.0%)
Hip hemiarthroplasty	56,865 (28.8%)
Other (including open reduction and internal fixation)	134,462 (68.2%)
Characteristics of treating hospital	
No. of beds	
<200	40,382 (20.5%)
200-299	41,519 (21.0%)
300-399	30,316 (15.4%)
400-499	27,940 (14.2%)
≥500	57,133 (29.0%)
Location of hospital	
Urban	171,467 (86.9%)
Rural	25,823 (13.1%)
Teaching status	
Teaching	70,853 (35.9%)
Not teaching	127,067 (64.4%)

trends indicating declines in both the incidence of and associated mortality following hip fracture^{2,3}, a growing body of evidence suggests that there are racial and socioeconomic disparities in treatment and outcomes of this condition⁴⁻⁶. As our health-care system strives toward the consistent provision of high-quality, high-value care, these disparities must be better understood.

Studies from outside of the United States have demonstrated the influence of patient and community characteristics on the treatment and outcomes of hip fractures^{7,8}. However, these relationships have not been yet clearly defined for patients in the United States⁹. The unique considerations of American health care, such as the presence of a large government-based insurer in a multipayer fee-for-service environment, justify further investigation. Previous studies of potential racial and socioeconomic disparities in hip fracture outcomes in the United States have been largely limited to Medicare beneficiaries, with mortality as the lone outcome¹⁰⁻¹². Evaluation with metrics regarding multiple payers and additional outcomes is necessary to more fully characterize the extent of disparities in the care of patients with hip fractures.

In the current investigation, we used statewide administrative data from 1998 to 2010 to determine the presence and implications of disparities in delivery of care to patients with hip fractures. We hypothesized that race and community socioeconomic characteristics would influence the quality of care for patients with hip fractures, as measured by the timing of surgery, reoperations within 1 year, 90-day readmissions, 90-day complications, and 1-year in-hospital mortality.

Materials and Methods

Study Population and Data Sources

The New York State Department of Health Statewide Planning and Research Cooperative System (SPARCS) prospectively captures information on all discharges from nonfederal acute-care hospitals in New York State. Records for 197,290 New York State residents who underwent surgery for a hip fracture between 1998 and 2010 in New York State were identified from SPARCS using International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes (see Appendix). To identify subsequent events, we searched records for 1 year following discharge. This data set has been used for prior investigations of orthopaedic health services, and the comprehensiveness of its procedure codes has been validated for total knee arthroplasty¹³.

Definitions of Predictors

Patient age, sex, race, comorbidities, presence of an osteoporosis diagnosis (based on ICD-9 diagnosis code) on admission, type of surgery (total hip arthroplasty, hip hemiarthroplasty, or internal fixation), and insurance status were considered potential patient-level predictors of outcomes after hip fracture treatment. Race was defined as white, black, Asian/Pacific Islander, or other. A comorbidity index was calculated using the Deyo modification of the Charlson Comorbidity Index^{14,15}, which includes dementia as a component. Insurance status was defined as private, Medicare, Medicaid, Workers' Compensation, no-fault, or other/uninsured. On the basis of the same ICD-9-CM codes used for identification of the study cohort (see Appendix), hospital volume of hip fracture surgery was calculated for the 4 quarters before the quarter of the index surgery for each patient. The same process was used to determine the surgeon's annual volume of hip fracture surgery.

To estimate the socioeconomic status of the patient's surrounding community, we included the Area Deprivation Index¹⁶. This index is a validated geographic neighborhood-based measure of socioeconomic deprivation based on United States Census data. The number of hospitals within the patient's

TABLE II Subgroup Analysis of Racial Differences Stratified by Area Deprivation Index

Area Deprivation Index Percentile†	OR* (95% CI)			HR* (95% CI)	
	Time from Admission to Surgery >2 Days	90-Day Readmission	90-Day Complications	Reoperation Within 1 Yr (Excluding Implant Removal)	1-Yr In-Hospital Mortality
0-25th					
Black vs. white	1.44 (1.37, 1.52)‡	1.14 (1.07, 1.20)‡	1.00 (0.94, 1.05)	1.19 (1.08, 1.32)‡	1.13 (1.05, 1.22)‡
Asian vs. white	1.14 (1.05, 1.24)§	0.85 (0.78, 0.93)‡	0.92 (0.84, 1.00)#	0.69 (0.57, 0.84)‡	0.86 (0.76, 0.98)#
Other vs. white	1.18 (1.12, 1.25)‡	0.95 (0.90, 1.00)#	1.00 (0.95, 1.06)	0.84 (0.75, 0.94)§	0.99 (0.92, 1.07)
Missing vs. white	0.91 (0.84, 0.97)§	0.80 (0.75, 0.85)‡	0.78 (0.73, 0.84)‡	0.93 (0.82, 1.06)	0.92 (0.84, 1.01)
25th-75th					
Black vs. white	2.06 (1.82, 2.32)‡	1.32 (1.17, 1.48)‡	1.26 (1.12, 1.42)‡	1.26 (1.02, 1.56)#	1.19 (1.01, 1.41)#
Asian vs. white	1.55 (1.02, 2.35)#	0.99 (0.67, 1.46)	1.12 (0.76, 1.65)	1.39 (0.72, 2.68)	1.05 (0.58, 1.90)
Other vs. white	1.96 (1.72, 2.23)‡	0.97 (0.86, 1.10)	1.08 (0.95, 1.23)	1.01 (0.79, 1.30)	0.94 (0.77, 1.14)
Missing vs. white	1.31 (1.16, 1.48)‡	0.82 (0.74, 0.91)‡	0.59 (0.53, 0.66)‡	0.82 (0.65, 1.03)	0.93 (0.80, 1.09)
75th-100th					
Black vs. white	1.44 (1.18, 1.76)‡	1.26 (1.06, 1.49)§	0.95 (0.79, 1.14)	1.14 (0.82, 1.58)	0.99 (0.76, 1.30)
Asian vs. white	2.12 (1.22, 3.68)§	0.59 (0.31, 1.12)	0.72 (0.39, 1.33)	0.31 (0.04, 2.17)	0.35 (0.09, 1.40)
Other vs. white	1.27 (0.87, 1.85)	0.98 (0.71, 1.35)	0.77 (0.54, 1.11)	0.62 (0.28, 1.39)	1.32 (0.84, 2.09)
Missing vs. white	1.17 (0.80, 1.72)	0.68 (0.49, 0.94)#	0.49 (0.34, 0.70)‡	0.74 (0.35, 1.57)	1.22 (0.80, 1.88)

*OR and HR were adjusted for age, sex, type of surgery, osteoporosis diagnosis present on admission, Deyo comorbidity index, insurance type, and community characteristics including number of hospitals in the hospital service area, number of beds at treating hospital, urban or rural type of treating hospital, teaching status of treating hospital, annual hospital volume of hip fracture surgery in preceding 12 months, and annual volume of hip fracture surgery of individual surgeons. †A higher Area Deprivation Index quartile indicates more deprivation. ‡P < 0.001. §P < 0.01. #P < 0.05.

hospital service area (as defined by the Dartmouth Atlas of Health Care¹⁷) was derived from annual American Hospital Association survey data. The hospital was determined to be in either a rural or an urban community using the Rural-Urban Commuting Area Codes¹⁸. Selected characteristics of the hospital (number of beds and teaching status) where the patient was treated were also recorded for the purpose of inclusion in the multivariable regression model.

End Points of Analysis

The timing of surgery was designated as either within or after 2 calendar days from the date of admission. The type and timing of subsequent procedures, complications within 90 days, readmission within 90 days, and in-hospital mortality within 1 year of discharge were recorded. Deaths that occurred outside of a hospital within New York State (such as at home or out of state) were not captured in this analysis. A subsequent procedure for removal of implants alone (without any additional procedures) was excluded as a reoperation because of its potentially elective nature. The following complications were recorded: acute myocardial infarction, congestive heart failure, cerebrovascular ischemia/stroke, pulmonary embolism/deep venous thrombosis, intracranial injury, burns, retained foreign object, air embolism, blood incompatibility, major bleeding, sepsis/septicemia/shock, pressure ulcer, catheter-associated urinary tract infection, vascular catheter-associated infection, ileus, pneumonia, surgical site infection (including both periprosthetic and wound infections), hip dislocation, hip fracture, and mechanical complications (ICD-9-CM codes shown in the Appendix).

Statistical Analyses

Multivariable logistic regression models were used to evaluate the association of patient and community characteristics with time to surgery, readmission, complications, reoperations, and mortality while adjusting for surgery type, osteoporosis diagnosis on admission, number of hospitals within the patient's

surrounding community, number of beds in the treating hospital, type of hospital (urban or rural), teaching status of hospital, and Area Deprivation Index¹⁶. All models included both hospital and surgeon volume, categorized by quartile and with the highest-volume quartile used as the reference group. Cox proportional hazards models with similar covariable adjustments were used for reoperations and 1-year mortality. For the reoperation model, any patients who died during the index hospital admission or within 1 year after the index surgery were censored. All eligible variables were included in the models. All analyses were performed using the SAS System for Windows 9.3 (SAS Institute).

Subgroup Analyses

To further examine the influence of socioeconomic characteristics on our outcomes of interest, we performed a series of subgroup analyses. On the basis of the Area Deprivation Index of their community, patients were stratified into the lowest Area Deprivation Index quartile (least deprived), the middle 2 quartiles, and the highest quartile (most deprived). Within these groups, the likelihood of experiencing a delay of >2 days before undergoing surgery, readmission within 90 days, complications, reoperations, and mortality were compared among racial groups (white, black, Asian, and other, with white as the reference group). For example, the risk of readmission was compared between black and white patients within the highest Area Deprivation Index quartile (most deprived). These multivariable regression analyses were adjusted for the same covariables included in the main analysis.

Results

There were 197,290 patients included in the study. The mean age (and standard deviation) was 79.1 ± 14.5 years (interquartile range, 75 to 88 years). The majority (73.2%) of the patients were female. The most common race was white (84.5%),

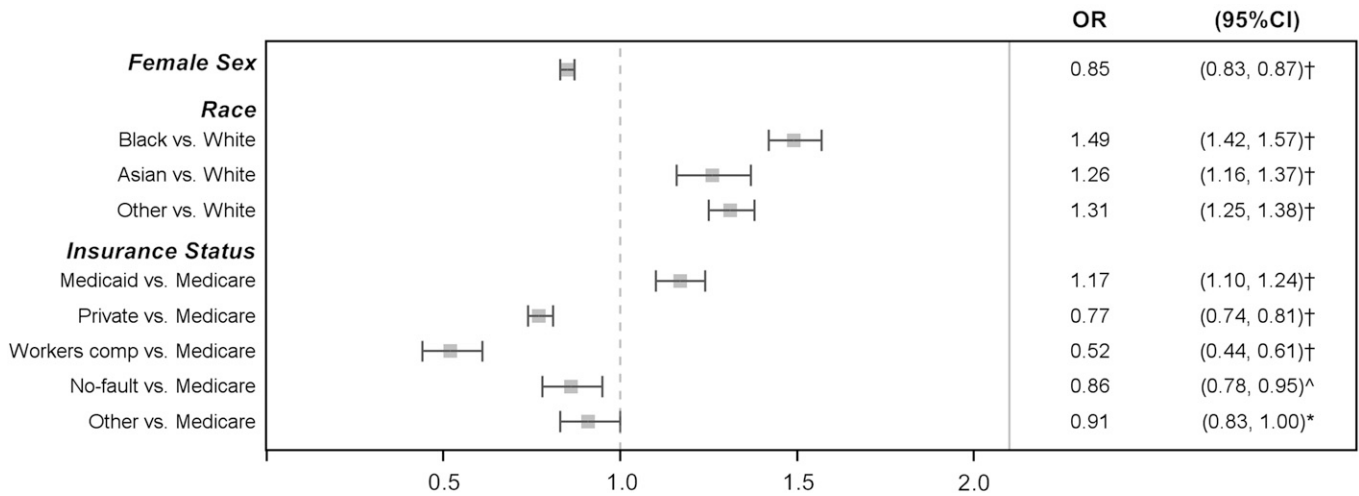


Fig. 1 Patient characteristics associated with delayed hip fracture surgery (multivariable logistic regression model adjusted for characteristics shown and age, Deyo Comorbidity Index, type of surgery, osteoporosis diagnosis present on admission, number of hospitals in hospital service area, number of beds at treating hospital, urban or rural type of treating hospital, teaching status of treating hospital, hospital volume of hip fracture cases, surgeon volume of hip fracture cases, and Area Deprivation Index). *P < 0.05; ^p < 0.01; †p < 0.001.

followed by other (4.9%), black (4.8%), and Asian (1.7%). The most common insurance type was Medicare (83.0%), followed by private (8.8%) and Medicaid (3.9%) (Table I).

The majority of patients (79.8%) underwent surgery within 2 calendar days after admission. The 90-day readmission rate was 27.7%. The most frequent complication within 90 days after discharge was catheter-associated urinary tract infection (9.8% of all patients), followed by congestive heart failure (7.5% of all patients) and pneumonia (7.1% of all patients); overall, 26.6% of the patients experienced at least 1 complication. The rate of reoperations within 1 year of discharge was 5.3%, with the most common procedure being irrigation and debridement (4.6% of all

patients and 36.1% of the reoperations). In-hospital mortality within 1 year was 7.1%. This outcome includes deaths that occurred during the initial hospital admission and those that occurred during a subsequent hospitalization (in New York State) within 1 year after discharge (see Appendix).

The multivariable logistic regression and Cox proportional hazards models indicated that men and patients with higher Deyo comorbidity scores were at greater risk for delayed surgery (Fig. 1), readmissions (Fig. 2), reoperations (Fig. 3), complications, and 1-year in-hospital mortality (Fig. 4). Older patients were at increased risk for delayed surgery (Fig. 1), readmissions (Fig. 2), complications, and 1-year in-hospital

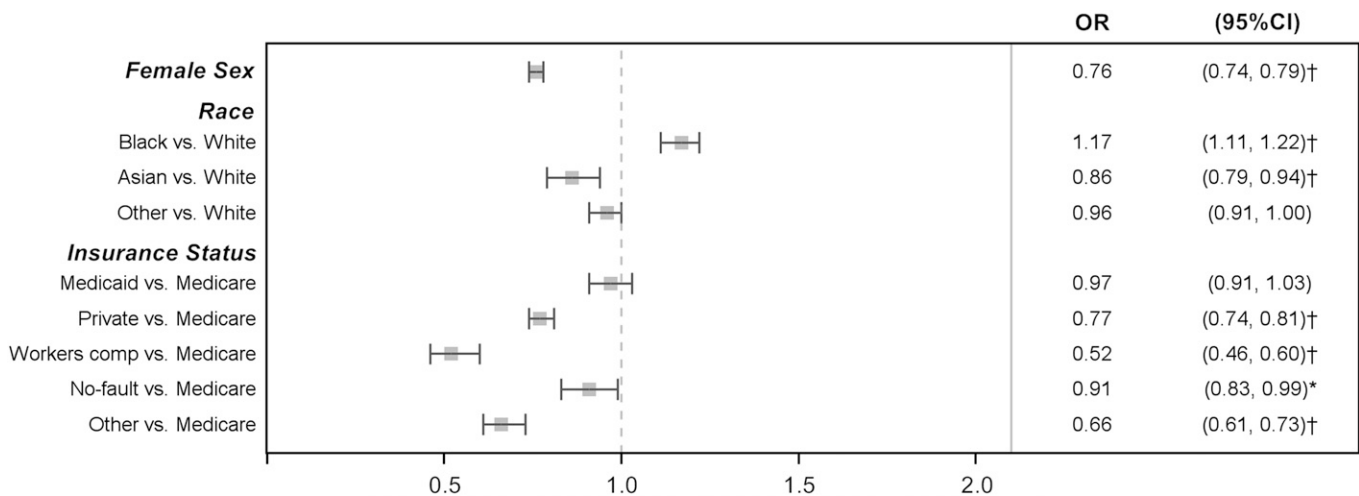


Fig. 2 Patient characteristics associated with readmission within 90 days after hip fracture surgery (multivariable logistic regression model adjusted for characteristics shown and age, Deyo Comorbidity Index, type of surgery, osteoporosis diagnosis present on admission, number of hospitals in hospital service area, number of beds at treating hospital, urban or rural type of treating hospital, teaching status of treating hospital, hospital volume of hip fracture cases, surgeon volume of hip fracture cases, and Area Deprivation Index). *P < 0.05; ^p < 0.01; †p < 0.001.

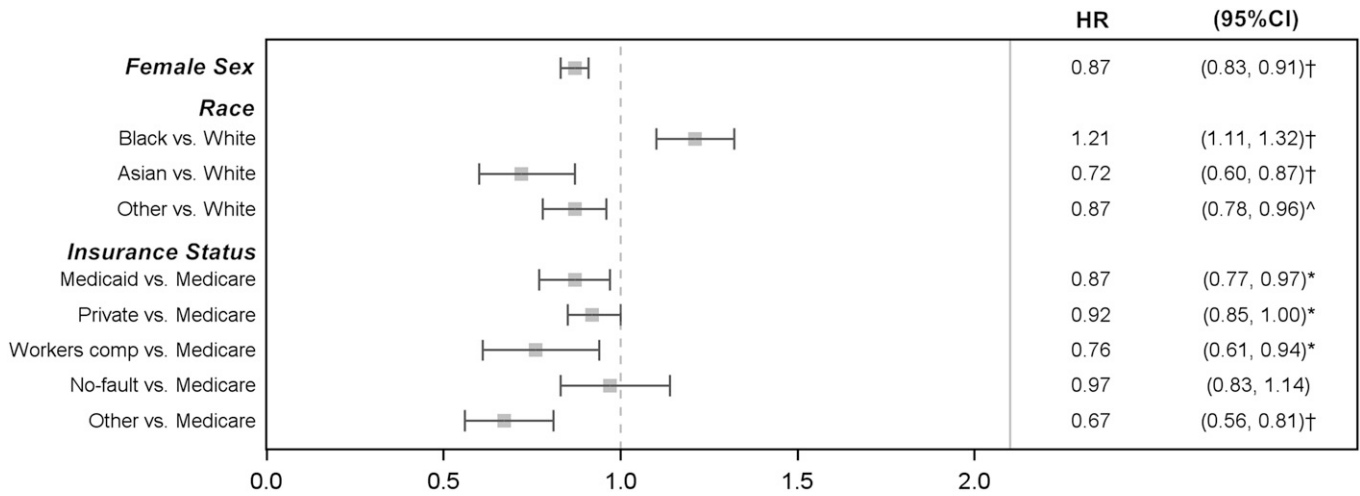


Fig. 3 Patient characteristics associated with a reoperation within 1 year after hip fracture surgery (multivariable logistic regression model adjusted for characteristics shown and age, Deyo Comorbidity Index, type of surgery, osteoporosis diagnosis present on admission, number of hospitals in hospital service area, number of beds at treating hospital, urban or rural type of treating hospital, teaching status of treating hospital, hospital volume of hip fracture cases, surgeon volume of hip fracture cases, and Area Deprivation Index). *P < 0.05; ^p < 0.01; †p < 0.001.

mortality (Fig. 4) but were at decreased risk for reoperations (Fig. 3). After adjusting for patient characteristics, type of surgery, hospital volume and other characteristics, surgeon volume, and Area Deprivation Index, black patients were at greater risk for delayed surgery (odds ratio [OR] = 1.49; 95% confidence interval [CI] = 1.42, 1.57), a reoperation (hazard ratio [HR] = 1.21; CI = 1.11, 1.32), readmission (OR = 1.17; CI = 1.11, 1.22), and 1-year in-hospital mortality (HR = 1.13; CI = 1.07, 1.21) than white patients. Black patients were not at increased risk for complications compared with white patients. Compared with white patients, Asian patients were at increased risk for delayed surgery (OR = 1.26; CI = 1.16, 1.37) but were at decreased risk

for a reoperation (HR = 0.72; CI = 0.60, 0.87) and readmission (OR = 0.86; CI = 0.80, 0.94) (see Appendix).

After adjusting for patient characteristics, type of surgery, hospital volume and other characteristics, surgeon volume, and Area Deprivation Index, Medicaid patients were at increased risk for delayed surgery (OR = 1.17; CI = 1.10, 1.24) but at decreased risk for complications (OR = 0.90; CI = 0.84, 0.95) and a reoperation (HR = 0.87; CI = 0.77, 0.97) compared with Medicare patients. Privately insured patients were at decreased risk for delayed surgery (OR = 0.77; CI = 0.74, 0.81), readmission (OR = 0.77; CI = 0.74, 0.81), complications (OR = 0.80; CI = 0.77, 0.84), and 1-year in-hospital

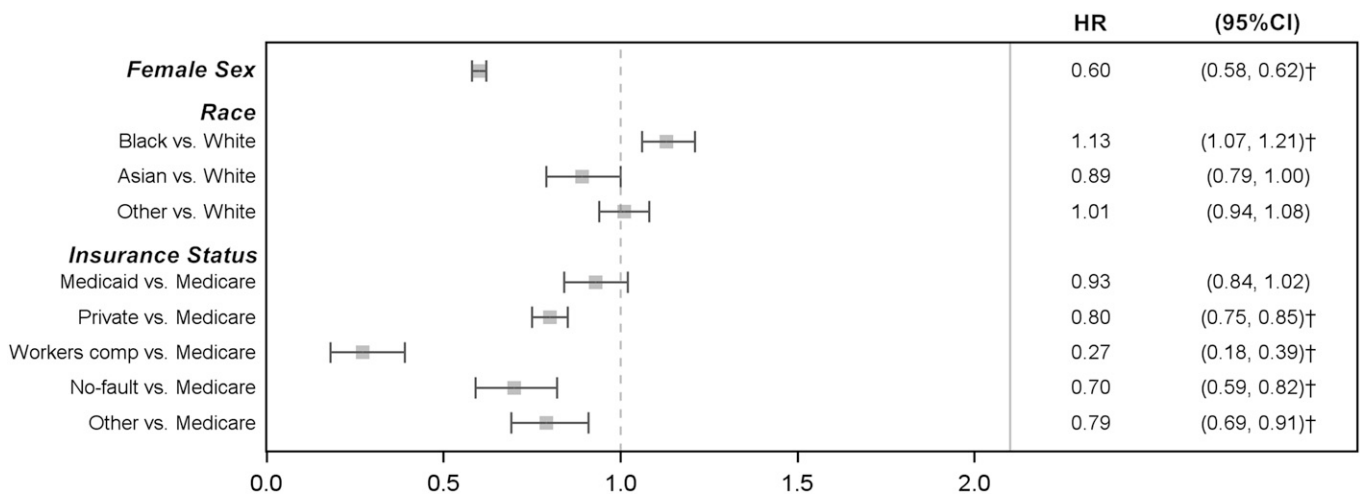


Fig. 4 Patient characteristics associated with inpatient mortality within 1 year after hip fracture surgery (multivariable logistic regression model adjusted for characteristics shown and age, Deyo Comorbidity Index, type of surgery, osteoporosis diagnosis present on admission, number of hospitals in hospital service area, number of beds at treating hospital, urban or rural type of treating hospital, teaching status of treating hospital, hospital volume of hip fracture cases, surgeon volume of hip fracture cases, and Area Deprivation Index). *P < 0.05; ^p < 0.01; †p < 0.001.

mortality (HR = 0.80; CI = 0.75, 0.85) compared with Medicare patients.

Our subgroup analyses, which compared patients by race within the same Area Deprivation Index grouping, indicated that black patients were at higher risk for delayed surgery than white patients in all social deprivation quartiles, including the least deprived quartile (OR = 1.44; CI = 1.37, 1.52), the middle quartiles (OR = 2.06; CI = 1.82, 2.32), and the most deprived quartile (OR = 1.44; CI = 1.18, 1.76). Similarly, Asian patients were at increased risk compared with white patients for delayed surgery in all social deprivation quartiles, including the least deprived quartile (OR = 1.14; CI = 1.05, 1.24), middle quartiles (OR = 1.55; CI = 1.02, 2.35), and most deprived quartile (OR = 2.12; CI = 1.22, 3.68). There was also an increased risk of 90-day readmission for black patients compared with white patients in all social deprivation quartiles, including the least deprived (OR = 1.14; CI = 1.07, 1.20), middle quartiles (OR = 1.32; CI = 1.17, 1.48), and most deprived (OR = 1.26; CI = 1.06, 1.49). The occurrence of the other outcome measures (complications, reoperation, and 1-year mortality) was not consistently increased in the black patients across social deprivation groups (Table II).

Discussion

While national trends indicate overall improvements in hip fracture care^{2,3}, we have demonstrated racial and socioeconomic disparities in the delivery of care. After multivariable adjustment, black patients were at significantly greater risk for delayed surgery, a reoperation, readmission, and 1-year in-hospital mortality than white patients. Our subgroup analysis indicated that race-based disparities in delivery of care persist for patients from communities of similar socioeconomic standing. The negative implications of delaying surgery beyond 48 hours after admission are confirmed by our findings and supported by a recent meta-analysis¹⁹. Our analysis corroborates the finding of Tsai et al. that black patients are at increased risk for postsurgical readmission²⁰, but the increased mortality risk for black patients after hip fracture indicates that race-based disparities may have dire consequences. The existing literature on race-based differences in mortality after hip fracture is both limited and conflicting. Penrod et al.⁶ and Lu-Yao et al.¹² indicated that black patients are at greater risk for mortality, while Jacobsen et al.¹¹ did not find a difference in mortality risk. Our findings corroborate the former but are based on a substantially larger sample size with incorporation of multiple payers and additional quality measures in the analysis. Despite an increased risk for delayed surgery, Asian patients were less likely to have a reoperation or readmission than white patients. Although prior studies have confirmed a lower hip fracture risk in Asian-American patients compared with white patients²¹, there has been little investigation of the post-fracture prognosis for this specific ethnicity. While it is possible that genetic differences in osseous microarchitecture, such as those noted in Chinese-American patients²², may contribute, it is likely that a multitude of other patient characteristics (e.g., physical attributes, cultural differences, and social determinants of health) more heavily influence

post-fracture prognosis and deserve further investigation. The contrasting findings between black and Asian patients emphasize the need for additional study of race/ethnicity and culture-based differences in quality of care.

Our analysis suggests that patients from economically disadvantaged backgrounds (in particular, those with Medicaid insurance) are at increased risk for undergoing delayed surgery for hip fractures. While use of Medicaid insurance as a marker of socioeconomic status is relatively crude, it is the only patient-level marker of socioeconomic status that is available in our data set. The income-level qualifications required to obtain Medicaid insurance during this study period (before implementation of the Affordable Care Act) accurately reflect lower socioeconomic standing. Lower socioeconomic status has been linked to increased hip fracture risk^{23,24}, but the association between socioeconomic factors and post-fracture outcomes is less clear. Studies from the United Kingdom indicate that patients with lower socioeconomic status are at increased risk for 1-year mortality^{7,8}, while investigators from the United States did not find an association between socioeconomic factors and mortality after hip fracture^{10,25}. The findings of the prior American studies may be related to the use of data from samples of healthy adults with a relatively low number of hip fracture events ($n = 730$ in the study by Tosteson et al.¹⁰ and $n = 495$ in the study by Bentler et al.²⁵). In addition to the greater statistical power provided by our larger sample of patients with hip fracture ($n = 197,290$), our inclusion of patients with all insurance types increases the generalizability of our findings. The current expansion of the Medicaid program in the United States emphasizes the urgency of exploring ways to mitigate, and eventually eliminate, socioeconomic disparities in hip fracture care. Aside from affecting patients individually, these disparities can drastically impact hospitals and health-care systems. Given that readmissions are increasingly regarded as a quality metric, our findings underscore the need to consider existing disparities during determination of risk adjustment for hospital and provider ratings. Furthermore, the recent emphasis on cost containment in health care has prompted a shift toward value-based payment, with financial penalties for events such as readmission²⁶. Given that these payment models may disproportionately affect hospitals that serve vulnerable populations²⁷ and exacerbate existing health-care disparities^{28,29}, there are multiple incentives for health-care leaders to dedicate resources to understanding and addressing the underlying reasons for disparities.

The 2 primary contributors to health-care disparities are differences among patients and differences in the medical care that they receive³⁰. While we incorporated all relevant patient information that was available to us, detailed analyses of additional characteristics that affect health and health-care utilization, such as social determinants and individual patient preferences, are needed. Additionally, the manner in which medical care is delivered should be further examined. Nonwhite patients are at significantly greater risk of undergoing surgery at low-quality hospitals^{31,32}. Investigators from Italy demonstrated that 2 policy-based adjustments—public reporting of outcomes³³ and pay-for-performance compensation—significantly improved the quality


of care for patients with hip fractures³⁴. Both of these principles are present in the United States Affordable Care Act, indicating that strategic implementation of these policies could address disparities in care for patients with hip fractures. More immediately, health-care leaders and providers should consider dedicating resources to process improvement³⁵ and utilizing multidisciplinary teams to improve the quality of acute and post-discharge care³⁶.

Our study had the limitations inherent to administrative data, such as the reliance on consistent and accurate entry of complication codes. Inconsistent reporting would have an unclear effect on our findings. A prior audit for complications after hip fractures demonstrated that administrative data had a 67% sensitivity and 76% specificity³⁷, whereas a recent analysis of total joint replacements showed that the sensitivity of administrative data, with regard to its ability to reflect complications, ranged from 29% to 100% and its specificity was consistently >92%³⁸. A low sensitivity combined with a high specificity would likely result in an accurate but conservative estimate of complications. Additionally, we were unable to capture complications that occurred outside of New York State. We attempted to minimize the effect of this limitation by including only New York State residents in our cohort. We were also unable to capture deaths that did not occur within a hospital in New York State, which led to an underestimation of 1-year mortality in this study compared with a recent meta-analysis¹⁹. Furthermore, our reliance on administrative data did not allow us to evaluate the association of individual income and education level with the risk of complications and mortality after hip fracture. While census-based approaches to indirectly measure socioeconomic status have been validated³⁹ and have been used in prior orthopaedic utilization studies^{40,41}, it would be ideal to evaluate socioeconomic variables on an individual level given their demonstrated influence on outcomes following other types of musculoskeletal trauma⁴². Lastly, the administrative nature of our data did not allow us to include relevant patient-reported outcomes, such as mobility and quality of life, after hip fracture treatment. Despite these drawbacks, using statewide data over a 12-year period allowed us to evaluate a large sample with a demographic composition and payer mix reflective of New York State. Our population-based results have greater generalizability than single-center or

single-payer series and provide data that are useful for counseling patients, designing interventions to address disparities, and informing policymakers.

While recent quality improvement efforts have been effective in improving overall delivery of care^{2,3,30}, there are racial and socioeconomic disparities in the treatment of and outcomes after hip fractures. Notwithstanding their tremendous effect on the lives of patients, these disparities have the potential to substantially affect both hospitals and health-care providers in an era of value-based payment. In addition to detailed investigation into the reasons contributing to disparities in hip fracture care, targeted interventions should be developed to mitigate the effects of these disparities on patients at greatest risk.

Appendix

 Tables showing the ICD-9-CM codes used for inclusion criteria and complications; the frequency of surgical delay and postoperative complications, reoperations, readmissions, and mortality; and patient characteristics associated with hip fracture outcomes are available with the online version of this article as a data supplement at jbjs.org. ■

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