

Race and Insurance Status as Risk Factors for Trauma Mortality

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Objective: To determine the effect of race and insurance status on trauma mortality.

Methods: Review of patients (aged 18-64 years; Injury Severity Score ≥ 9) included in the National Trauma Data Bank (2001-2005). African American and Hispanic patients were each compared with white patients and insured patients were compared with uninsured patients. Multiple logistic regression analyses determined differences in survival rates after adjusting for demographics, injury severity (Injury Severity Score and revised Trauma Score), severity of head and/or extremity injury, and injury mechanism.

Results: A total of 429 751 patients met inclusion criteria. African American (n=72 249) and Hispanic (n=41 770) patients were less likely to be insured and more likely to sustain penetrating trauma than white patients (n=262 878). African American and Hispanic patients had higher unadjusted mortality rates (white, 5.7%; African American, 8.2%; Hispanic, 9.1%; $P = .05$ for African American and Hispanic patients) and an increased

adjusted odds ratio (OR) of death compared with white patients (African American OR, 1.17; 95% confidence interval [CI], 1.10-1.23; Hispanic OR, 1.47; 95% CI, 1.39-1.57). Insured patients (47%) had lower crude mortality rates than uninsured patients (4.4% vs 8.6%; $P = .05$). Insured African American and Hispanic patients had increased mortality rates compared with insured white patients. This effect worsened for uninsured patients across groups (insured African American OR, 1.2; 95% CI, 1.08-1.33; insured Hispanic OR, 1.51; 95% CI, 1.36-1.64; uninsured white OR, 1.55; 95% CI, 1.46-1.64; uninsured African American OR, 1.78; 95% CI, 1.65-1.90; uninsured Hispanic OR, 2.30; 95% CI, 2.13-2.49). The reference group was insured white patients.

Conclusion: Race and insurance status each independently predicts outcome disparities after trauma. African American, Hispanic, and uninsured patients have worse outcomes, but insurance status appears to have the stronger association with mortality after trauma.

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IN 2003, THE AGENCY FOR HEALTHCARE Research and Quality¹ reported that, "Some ethnic minorities and low-income families of all races tend to be in poorer health." Subsequently, a body of literature has accumulated describing race-based outcome disparities in surgical populations.² In trauma care, racial disparities in posttraumatic functional outcomes have been described in both adult³ and pediatric trauma populations.⁴

Disparities based on health insurance status have also been demonstrated in the detection, treatment, and outcomes of several disease conditions, including cancer.⁵⁻⁸ Adult trauma studies have described differences in outcomes and discharge dispositions based on insurance coverage.^{3,9} In a study by Marquez de la Plata and colleagues,³ it was suggested that insurance status, rather than race, determined disparities in rehabilitation placement. Another

study of elderly patients hospitalized secondary to a traumatic fall also found that payment type was a factor in deciding a patient's discharge location.¹⁰

Current literature fails to adequately explain the interactions between race, insurance status, and outcomes following trauma. It is not clear whether the previously described racial disparities can be explained solely by insurance or socioeconomic status. We therefore endeavored to use a national database to determine the independent effects of race and insurance status on trauma mortality.

METHODS

STUDY DESIGN AND PATIENT POPULATION

This study involved a retrospective analysis of trauma patients entered in the National Trauma Data Bank, version 6.1, between 2001 and 2005.

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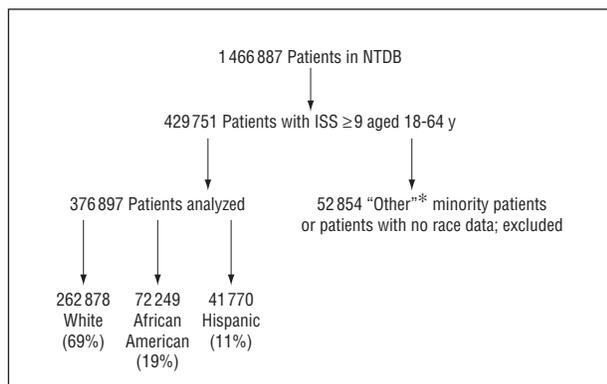


Figure 1. Flowchart of patient selection criteria. NTDB indicates National Trauma Data Bank; ISS, Injury Severity Score; "Other" * indicates patients who indicated racial or ethnic group other than African American, Hispanic, or white on survey.

The National Trauma Data Bank is maintained by the American College of Surgeons and is the largest repository of data on trauma inpatients in the United States, collecting data from approximately 700 trauma centers and hospitals that treat trauma patients.

Patients aged 18 to 64 years with moderate to severe injuries (Injury Severity Score [ISS] ≥ 9) caused by blunt or penetrating trauma were included in the study. Trauma patients with an ISS of 9 or higher were selected because these patients suffered at least moderate injury and would be at risk of dying of trauma. Mortality following trauma was our primary outcome measure. Pediatric trauma patients (aged ≤ 17 years) and elderly trauma patients (aged ≥ 65 years) were excluded from our analysis because trauma affects patients in these age groups differently¹¹ and because children or elderly patients could have government-sponsored insurance (State Children's Health Insurance Program and Medicare) that could confound our analysis. Burn patients were also excluded from this study. This study was reviewed by the Johns Hopkins University School of Medicine institutional review board and approved for exempt status.

Patients were grouped by self-reported race (African American, white, or Hispanic) and by insurance status of insured (commercial, health maintenance organization, workers compensation, managed care organization, Civilian Health and Medical Program of the Uniformed Services, automobile insurance, organ donor subsidy) or uninsured (Medicaid, self-paying, no insurance). To study the interaction between insurance and race, patients were further stratified into 6 categories: insured white, insured African American, insured Hispanic, uninsured African American, uninsured Hispanic, and uninsured white. Each of these groups was compared with insured white patients, which was chosen as the reference group during the stratified and multivariate analyses. Other races and ethnic groups (eg, Asian Americans, American Indians, Pacific Islanders) were excluded from the study owing to small sample sizes.

STATISTICAL ANALYSIS

Multiple logistic regression was used to analyze survival differences based on race and insurance status. Patient data were adjusted for age, sex, and several other factors known to affect outcomes after trauma.¹² Severity of anatomical and physiological injury was adjusted for using the ISS¹³ and revised Trauma Score (RTS),¹⁴ respectively. The ISS was treated as an ordinal variable with 3 groups (ISS of 9-15 indicates moderate injury; 16-24, severe injury; 25 and above, most severe in-

jury). Patients were also adjusted for the presence of severe head injury and/or severe extremity injury using the Abbreviated Injury Scale (AIS)¹⁵; an AIS score of 3 or higher in the head or extremity was deemed severe. Finally, patient data were adjusted for type of injury (blunt vs penetrating) and mechanism of injury. Mechanism of injury categories were created according to the Centers for Disease Control and Prevention's recommended framework for classifying injury data using *International Classification of Diseases, Ninth Revision E codes*.¹⁶

A *t* test was used to compare continuous variables, and a χ^2 test was done for comparison of categorical variables during univariate analysis. Odds ratios for mortality were calculated after adjusting for patient demographics and injury severity, as described in the previous paragraphs. Stata Version 10 (Stata, College Station, Texas) was used for all statistical calculations. Statistical significance was defined as a *P* value less than .05.

RESULTS

Of 1 466 887 patients in the National Trauma Data Bank during the years studied, 429 751 had moderate to severe injuries and were between the ages of 18 and 65 years, meeting our inclusion criteria. Of these, 12.2% were either in the "other" race category (eg, Asian, Pacific Islander, American Indian) that had small sample sizes or did not have race data reported. This yielded a sample of 376 897 (**Figure 1**) patients for analysis. Overall, the mean age was 37 years and more than two-thirds were male; 69% were white, 19% African American, and 11% Hispanic (**Table 1**). More than half of the total patients had insurance. The African American and Hispanic groups had more uninsured patients than the white group (Table 1).

Crude mortality rates were 5.7%, 8.2%, and 9.1% for the white, African American, and Hispanic groups, respectively. A statistically significant difference was found between the white group and the African American and Hispanic groups ($P < .005$). Crude mortality by insurance status was statistically lower for insured (4.4%) than for uninsured (8.6%) patients ($P < .005$).

In conducting the stratified and multivariate analyses, only patients with complete data for all variables were included in the regression models. Eighty-three percent of patients from the initial analysis had complete data, resulting in a final sample size of 311 503 (13% had missing insurance data and the rest had missing data regarding ISS, RTS, AIS score, age, or sex).

Table 2 provides injury severity characteristics stratified by race and insurance status. Penetrating trauma was highest in African American patients regardless of insurance status. Mortality rates were substantially higher for all uninsured patients, almost doubling for African American (4.9% to 11.4%) and Hispanic patients (6.3% to 11.3%) compared with white patients (4.2% to 7.9%). Anatomical injury severity scores were clinically similar across all race/insurance groups, while physiological injury scores were slightly worse among the uninsured.

After adjusting for demographic and injury severity variables, the odds of mortality had increased to 1.17 for African American patients (95% confidence interval [CI],

Table 1. Patient Demographics

Demographics	All Patients (n=376 897)	White (n=262 878)	African American ^a (n=72 249)	Hispanic ^a (n=41 770)
Men, %	73	71	78	83
Mean age, y	37	39	35	32
Uninsured, %	47	38	69	62

^aStatistically significantly different from insured white patients ($P < .05$).

Table 2. Injury Severity Characteristics Stratified by Race and Insurance Status

Injury Severity Characteristics	Percentage						
	All Patients (n=311 503)	Insured (n=165 097)			Uninsured (n=146 406)		
		White	African American	Hispanic	White	African American	Hispanic
Patients with penetrating injury	8.7	3.1	18.3 ^a	11.7 ^a	7.4 ^a	31.03 ^a	21.81 ^a
Patients with ISS of 16-24	23	24	24	22	21	23	23
Patients with ISS \geq 25	20	19	21	19	22	20	20
Mean (SD) RTS	7.1 (0.85)	7.18 (0.75)	7.18 (0.76)	7.2 (0.71)	6.9 (0.95) ^a	6.8 (1.05) ^a	7.0 (0.85) ^a
Mortality	6.4	4.2	4.9 ^a	6.3 ^a	7.9 ^a	11.4 ^a	11.3 ^a
Extremity injury	13.8	16.2	15	13.4	10.7 ^a	8.48 ^a	7.91 ^a
Head injury	12.8	13.5	10.2 ^a	11.8 ^a	12.7	7.2 ^a	9.4 ^a

Abbreviations: ISS, Injury Severity Score; RTS, revised Trauma Score.

^aStatistically significantly different from insured white patients ($P < .005$).

1.10-1.23) and 1.47 for Hispanic patients (95% CI, 1.39-1.57) when compared with white patients. Odds of death had increased to 1.46 for uninsured patients (range, 1.39-1.54) compared with insured patients. **Figure 2** shows the independent influence of insurance status on the odds of death compared with white patients with insurance (reference group).

Even with insurance, African American and Hispanic patients had a greater adjusted mortality rate than their white counterparts. However, the highest adjusted odds of death were for uninsured Hispanic patients (2.30; 95% CI, 2.13-2.49) followed by uninsured African American patients (1.78; 95% CI, 1.65-1.90) when compared with insured white patients, suggesting that insurance status has a stronger association with mortality after trauma.

COMMENT

Racial disparities have been previously described for outcomes and access to rehabilitation therapies following traumatic brain injury.^{3,4,9} To our knowledge, this is the first large study that identifies differences in mortality rates based on race following trauma of all types. In this study both race and insurance status independently predicted mortality following trauma. The absence of health insurance increased a trauma patient's adjusted odds of death by almost 50%. Of the insured patients, both Hispanic and African American patients had significantly higher odds of mortality compared with white patients. This confirms that racial disparities in trauma mortality cannot be completely explained by insurance status alone.

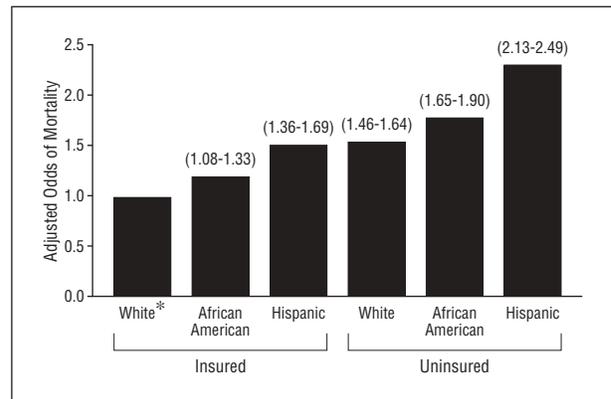


Figure 2. Adjusted odds of mortality by race and insurance status (n=311 503). Values in parentheses are 95% confidence intervals. * Indicates reference group.

Analyzing the unadjusted data, we found that the anatomical injury severity scores were similarly high across all race/insurance groups, suggesting that all patients were significantly injured. Uninsured patients had worse physiological injury severity scores, which is likely a result of the much higher prevalence of penetrating trauma in this group. Uninsured African American patients had a 10-fold higher prevalence of penetrating trauma when compared with insured white patients. Conversely, insured patients more frequently had severe head and extremity trauma. These findings underline the importance of controlling for both the anatomical and physiological severity of injury along with the type and mechanism of injury. The inclusion

of these parameters in our multivariate analytic model adequately controls for the effect on outcome of these observed differences.

In the trauma patients sampled, there was a much higher percentage of uninsured minorities than uninsured white patients. While about one-third of white patients were uninsured, approximately two-thirds of African American patients and two-thirds of Hispanic patients were uninsured. This insurance disparity is consistent with other studies of trauma care.^{3,9} Lack of medical insurance is most often associated with worse baseline health status, with increased and poorly recognized comorbidities. It is known that preexisting medical conditions are associated with poor outcomes after trauma,¹⁷ suggesting that an uninsured patient would do worse after traumatic injury. This may partially explain our finding that the adjusted odds of death substantially increased for all uninsured patients, even when we controlled for injury severity and other factors known to affect trauma outcomes.

Insurance coverage has had a similar effect on treatment use and mortality for certain cancer patients. Patients who were uninsured or covered by Medicaid had higher mortality rates from breast carcinoma⁸ and received guideline therapy less often¹⁸ than insured patients. This work suggests that quality of care issues for trauma patients are worthy of investigation. In a statewide study of trauma patients in Massachusetts,¹⁹ uninsured patients were less likely to receive an operation, less likely to receive rehabilitative therapies (in-house physical therapy), and more likely to die in the hospital. Similarly, in a medical study, minority patients received worse quality of care that, in turn, led to worse outcomes.²⁰ In a more recent quality-of-care study in the emergency department,²¹ researchers only found significant differences in the number of radiological studies ordered for trauma patients. However, this was a single-institution study, and the conclusions called for further study to determine whether race or insurance status led to these differences in quality of care.

Race persists as a risk factor for mortality in patients with and without insurance. Hispanic patients had worse outcomes in both the insured and uninsured groups. Shafi et al⁹ suggest that cultural barriers and language problems may contribute to similar observed racial disparities in traumatic brain injury outcomes. Our study likely provokes more questions than it provides answers for. It may be that insurance status is a surrogate for other factors that affect mortality in a critically injured patient (eg, health education, awareness and management of comorbidities, substance abuse, and risk-taking behaviors). In brief, insurance represents more than just the ability to pay a bill.

Further study is required to explore other potential issues that may contribute to these disparities, including mistrust, subconscious bias, and stereotyping that may be present in the health care system.²² However, multivariate analysis showed that insurance status had a stronger association than race, with worse outcomes. These data suggest that addressing disparities in health insurance status would have a significant effect on outcomes

of traumatic injuries for African American, Hispanic, and white patients.

There are limitations to our study. Because we used a retrospective registry, it was not possible to control for comorbidities, complications that may have occurred during hospitalization, and prehospital transit times that could influence our outcomes. Data to analyze prehospital mortality were also not available, and it could not be determined if prehospital mortality is higher for uninsured or African American and Hispanic patients. Finally, Medicaid patients were grouped with the uninsured. However, this was a very small group (<5%) and should not influence our results.

Both race and insurance status independently influenced mortality after moderate to severe trauma in adults aged 18 to 64 years. This study refutes the notion that racial disparities are merely a reflection of insurance status differences. Understanding insurance and race-dependent differences is a crucial first step toward ameliorating health care disparities. The next step will be to comprehend the underlying reasons for these differences, which will enable the development of interventions to close the gap between patients of different races and payer statuses.

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