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Social Determinants of Trauma Care: Associations of Race, Insurance Status, and Place on Opioid Prescriptions, Post-Discharge Referrals, and Mortality

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Abstract

Background: Racial disparities in trauma care have been reported for a range of outcomes, but the extent to which these remain after accounting for socioeconomic and environmental factors remains unclear. The objective of this study was to evaluate the unique contributions of race, health insurance, community distress, and rurality/urbanicity on trauma outcomes after carefully controlling for specific injury-related risk factors.

Methods: All adult (age >=18) trauma patients admitted to a single Level 1 trauma center with a statewide, largely rural, catchment area from January 2010 to December 2020 were retrospectively reviewed. Primary outcomes were mortality, rehabilitation referral, and receipt of opioids in

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Author Contributions
All authors contributed to the drafting and critical revision of the manuscript. In addition, the following authors were involved in study design (EG, MK, AK, MCM), interpretation of data (EG, MK, WH, CI, SB, BG, HM, UR, MCM), data acquisition (EG, AK, HD, MCM), and data analysis (MCM).

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the emergency department. Demographic, socioeconomic, and injury characteristics as well as indicators of community distress and rurality based on home address were abstracted from a trauma registry database.

Results: Analyses revealed that Black patients (n=13,073) were younger, more likely to be male, more likely to suffer penetrating injuries, and more likely to suffer assault-based injuries compared to White patients (n=10,946; all p<0.001). In adjusted analysis, insured patients had a 28% lower risk of mortality (odds ratio=0.72, p=0.005) and were 92% more likely to be referred for post-discharge rehabilitation than uninsured patients (odds ratio=1.92, p=0.005). Neither race nor place-based factors were associated with mortality. However, post hoc analyses revealed a significant race by age interaction, with Black patients exhibiting more pronounced increases in mortality risk with increasing age.

Conclusions: The present findings help disentangle the social determinants of trauma disparities by adjusting for place and person characteristics. Uninsured patients were more likely to die and those who survived were less likely to receive referrals for rehabilitation services. The expected racial disparity in mortality risk favoring White patients emerged in middle age and was more pronounced for older patients.

Level of Evidence: Level III

Study Type: Prognostic and Epidemiological

Keywords

trauma care; injury; disparity; race; social determinants

INTRODUCTION

Traumatic injuries result in approximately 27 million emergency department (ED) visits, 3 million hospitalizations, and 192,000 deaths each year in the United States (1). The annual cost of fatal and non-fatal injuries in the United States is estimated to be $671 billion in medical costs and lost productivity (2). Recent data from the Centers for Disease Control & Prevention indicate accidental injury is the third leading cause of death, and the number one leading cause of death among individuals below age 45 (3). Traumatic injuries occur in the population regardless of age, sex, or race; however, disparities in health outcomes after these injuries persist (4). Identifying risk factors that contribute to health disparities can guide actions to reduce and eliminate the disparities present in our current health care system.

One risk factor that may drive trauma outcome disparities is race. Racial disparities in trauma care have been reported for a range of outcomes assessed from pre-admission to post-discharge. For instance, Black patients are less likely to be admitted to trauma centers (5), more likely to experience longer wait times for care (6), less likely to undergo pain assessments or receive pain medications (7), less likely to receive computerized tomography scans or emergency surgery (8, 9), less likely to be referred for post-injury rehabilitation services (10), and more likely to die from their injuries than White patients (11). The undertreatment of pain among Black patients in ED settings has received considerable attention over the past two decades, with studies suggesting pronounced racial disparities in ED opioid prescriptions (12). Black patients are also more likely to be transported by emergency medical services (EMS) to safety-net EDs (i.e., those that deliver a significant level of care to patients who are uninsured or have Medicaid) than White patients living within the same zip code (13). Regardless of the healthcare destination, Black patients are less likely than White patients to be delivered to trauma centers with sufficient resources to manage their injuries - a phenomenon referred to as *undertriage* (14). This latter situation in particular would be expected to lead to worse trauma outcomes in Black patients. Nonetheless, although research supports socioeconomic status (SES) (4) as a contributor to racial differences in trauma outcomes, SES alone does not fully account for racial disparities (15).

Insurance status is also a factor contributing to trauma outcome disparities. An individual's access to health insurance can determine their odds of survival following a traumatic injury: uninsured patients are 50% more likely to succumb to their injuries compared to insured patients (15). A meta-analysis showed that uninsured patients had a higher mortality rate, and were less likely to undergo operative procedures and participate in (or qualify for) physical therapy, compared to patients with private insurance (11). Uninsured patients and those with Medicare not only exhibit higher overall mortality rates compared to the privately insured, but also have shorter lengths of stay in the intensive care unit and are less likely to be discharged to rehabilitation facilities compared to insured patients (16). Worse mortality outcomes for uninsured compared to insured patients may be more pronounced for blunt rather than penetrating injury types (17). These findings have implications for research design, highlighting the importance of adjusting for injury characteristics in order to disentangle the independent effects of race and insurance status on trauma outcomes (15).

Disparities in trauma outcomes may also be influenced by the social context in which the trauma occurs. For example, emerging evidence suggests that geographic location is associated with trauma outcomes and racial disparities (18). Trauma center proximity, which influences time to treatment, is a well-stablished determinant of trauma outcomes: studies suggest an 8% increase in mortality risk for each 5-mile increase in distance to nearest trauma center (19). Residents living in more rural areas experience greater mortality risk than those in more urban areas, with this “rural mortality penalty” being higher for Black patients (20, 21). Composite measures that seek to quantify the adverse social characteristics of a community such as the Area Deprivation (22) and Distressed Community (23) indices incorporate information on income, education, employment, and housing quality, at the address- and zip code-levels, respectively. Research on these indices shows that residents of distressed communities exhibit higher risks for mortality and re-hospitalization (24, 25). These studies point to geospatial features, including rurality/urbanicity and community distress, as potential social determinants of trauma outcomes that may contribute to trauma disparities. Deficits in our understanding of trauma disparities largely stem from methodological challenges in disentangling the overlapping effects of multiple determinants. Independent contributions of race and insurance status have received substantial attention in the literature (26). Despite prior work on trauma center proximity as a determinant of trauma outcomes (27), other aspects of ‘place’ – including socioeconomic characteristics of the communities in which injuries occur and to which discharged patients must return for recovery – are less well understood. This study sought to extend prior work on trauma disparities by evaluating the unique contributions of race, health insurance status, community distress, and rurality/urbanicity, on trauma outcomes after carefully controlling for specific injury-related risk factors including injury type, intent, and severity. We hypothesized that being Black, uninsured, and residing in more distressed and rural areas, would each independently contribute to worse trauma care outcomes, as evident in higher mortality rates, lower likelihood of referrals to rehabilitation services, and lower likelihood of receiving opioid prescriptions in the ED.

METHODS

Data source

A retrospective review was conducted of all adult patients (age ≥ 18 years) who were admitted from January 2010 to December 2020 to the University of Mississippi Medical Center (UMMC), a level 1 trauma center. Study data were extracted directly from the UMMC institutional trauma registry or were determined through linkage to patient addresses. Eligibility criteria for inclusion in the trauma registry were an applicable ICD-10 Code (i.e., injuries to specific body parts, unspecified multiple injuries, injury of unspecified body region, traumatic compartment syndrome) in addition to at least one of the following: trauma team activation; transfer between acute care facilities by EMS; hospital admission; transfer to a facility by Air Ambulance; triaged to hospital by EMS; death. Patients were excluded from the trauma registry due to late effects (≥ 30 days posttraumatic amnesia), foreign bodies, and extremities or hip fractures from same height (i.e., no elevation) falls in patients over 70 years old. This study was reviewed and approved by the UMMC institutional review board.

Study population

The study population included all trauma registry patients who self-reported their race as either Black/African American or White/Caucasian; patients who self-identified as Hispanic were excluded. This study focused on patients with blunt and penetrating injuries; those with burn injuries were excluded due to the small number of cases available relative to other trauma types. Data extracted from the trauma registry included demographic information, injury characteristics, insurance status, and home address to determine indicators of community distress and rurality.

Predictor variables

Demographic data included race (non-Hispanic Black or White), gender, and age. Injury characteristics included type (i.e., blunt, penetrating), intent (i.e., accidental, assault, self-inflicted), severity (i.e., Injury Severity Score [ISS]), vital signs obtained in the ED (i.e., heart rate, systolic/diastolic blood pressure), time spent in the ED, ventilator use, intubation, and year of admission. Socioeconomic information included insurance coverage (presence/absence) and Distressed Communities Index (DCI) scores. Patient zip codes were used to calculate DCI scores (https://eig.org/dci/interactive-map), which are a composite of seven indicators obtained from the U.S. Census Bureau's Business Patterns and American Community Survey 5-year Estimates (2014–2018): percentage of adults ages 25 and older without a high school diploma or equivalent; percentage of population living below the federal poverty line; percentage of adults ages 25–54 not working; percentage of housing units that are vacant; median household income as percentage of the state median household income; percent change in number of employees working; and percent change in number of business establishments (23). DCI scores range from 0 (*no distress*) to 100 (*severe distress*). Rurality/urbanicity for patient residence counties were computed using the 2013 Department of Agriculture Rural-Urban Continuum Codes (RUCC). RUCC codes range from metropolitan areas with a population of 1 million or more (code=1) to completely rural areas with a population less than 2,500 and not adjacent to a metropolitan area (code=9) (28). A categorical variable reflecting time from injury to the ED (i.e., *less than 1 hour, 1–6 hours, 7–12 hours, 13–24 hours, more than 24 hours, unknown*) was included in sensitivity analyses.

Outcome variables

Primary outcomes included in-hospital mortality, post-discharge rehabilitation referrals, and opioid medications prescribed in the ED. Rehabilitation services included rehabilitation centers, home health, skilled nursing facilities, and trauma centers (1 = referral to rehabilitation services; 0 = no referral to rehabilitation services). Opioid medications included, but were not limited to, oxycodone, hydrocodone, morphine, buprenorphine, fentanyl, and methadone (1 = one or more opioid medications were prescribed; 0 = no opioid medications prescribed).

Data analysis

Potential disparities in trauma care outcomes were evaluated by testing the independent influence of each social determinant (race, gender, insurance status, community distress, rurality/urbanicity) on worse trauma outcomes when the effects of other social determinants, injury characteristics, clinical factors, and demographics were statistically controlled. In line with prior work in this area (29), we constructed models using multiple steps to account for associations among social determinants. Multivariate logistic regression analyses were conducted using SPSS 27 (IBM Corp., Armonk, NY) to examine associations between patient-level predictors and three dichotomous outcomes: mortality (yes/no); referral to rehabilitation services (yes/no); and receipt of any opioid medications in the ED (yes/no). Model 1 included demographic (age, gender, race [(non-Hispanic Black or White]), injury characteristics (type, intent, severity), ED vitals (heart rate, systolic/diastolic blood pressure), time in the ED, and year of admission. Model 2 added the impact of insurance status (insured/uninsured). Multilevel logistic regression analyses were conducted using HLM 8 (30) to account for patients living in the same areas (i.e., zip codes, counties) sharing the same area-level predictors. Model 3 added the area-level impact of community distress (DCI scores) to Model 2. Model 4 added the area-level impact of rurality/urbanicity (RUCC codes) to Model 2. Selection of trauma-relevant covariates for risk adjustment was guided by the recommendations of Haider and colleagues (26, 31). Whereas analysis of mortality included the full sample (n=24,019), analysis of post-discharge referrals included only patients who survived (n=21,211) and analysis of opioid medication receipt in the ED included only patients who were never intubated or placed on ventilators (n=3,572). The latter restriction was based on standardized ED protocols for managing pain in cases of intubation/ventilation that are unlikely to be influenced by social determinants of health.

Sensitivity analyses tested models controlling for time from injury to ED; this variable was not included in primary analyses due to substantial missing data (30%).

Given the pronounced racial differences in patient and injury characteristics described below, post-hoc tests included race as a moderator of trauma care outcomes (i.e., race X gender, race X age, and race X injury type interactions). This approach is consistent with recent studies of racial disparities in trauma outcomes (32). To account for multiple testing, we used the Benjamini-Hochberg false discovery rate correction to control for the rate of Type I errors by adjusting the *p*-value based on the number of significant results in a family of tests (33).

RESULTS

Patient and Injury Characteristics

Descriptive statistics for traumatic injury patients admitted to the UMMC level 1 trauma center from 2010 to 2020 are presented in Table 1, including tests for differences between non-Hispanic White (n=10,946) and Black (n=13,073) patients in categorical (chi-square) and continuous (*t*-test) variables. These between-group tests did not adjust for the covariates included in the logistic regression analyses presented below. Non-Hispanic Black patients were younger (t=43.1, p<.001) and included a higher proportion of males (χ^2=221.6, p<.001) compared to non-Hispanic White patients. Regarding injury type, Black patients were less likely to experience blunt injuries and more likely to experience penetrating injuries (χ^2=1,775.9, p<.001). Regarding injury intent, Black patients were less likely to experience accidental injuries and more likely to experience assault-related injuries (χ^2=2,143.3, p<.001). Black patients overall exhibited lower ISS scores compared to White patients (t=10.0, p<.001). In addition, Black patients exhibited higher systolic (t=5.8, p<.001) and diastolic blood (t=13.8, p<.001) pressure and spent less time in the ED (t=7.8, p<.001) compared to White patients. Regarding individual- and place-based socioeconomic indicators, Black patients were more likely to be uninsured (χ^2=548.8, p<.001) and to live in distressed communities (t=47.2, p<.001) compared to White patients. Black patients were also more likely than White patients to reside in urban areas (t=10.8, p<.001). Most patients (50.4%) arrived at the ED between 1 and 6 hours after their injury. Sensitivity analyses including time to ED as a covariate revealed no impact on patterns of findings in subsequent logistic regression analyses.

Area Characteristics

Community distress in this sample covered almost the full range of DCI scores from 0.1 (*no distress*) to 99.9 (*severe distress*), with a mean DCI score of 76.3 (*SD*=25.5). DCI quintiles in this sample were as follows: prosperous (4.3%); comfortable (8.5%); mid-tier (6.5%); at risk (18.1%); distressed (62.6%). Rurality/urbanicity covered the full range of RUCC codes from 1 to 9, with a mean RUCC code of 4.0 (*SD*=2.4). A slight majority of participants resided in metropolitan (53.2%) as compared to nonmetropolitan (46.8%) counties; 8.8% resided in completely rural areas.

Mortality

Results of logistic regression analyses predicting mortality are presented in Table 2. Adjusting for demographic and injury characteristics (Model 1), Black patients had lower overall mortality rates compared to White patients (OR=0.81, p=.025). Greater risk of mortality was associated with older age, more recent admission year, penetrating compared to blunt injuries, assault compared to accidental injuries, self-inflicted compared to accidental injuries, higher ISS scores, lower ED heart rate, and lower ED systolic blood pressure. Model 2 further revealed that insured patients had a 28% lower risk of mortality compared to uninsured patients (OR=0.72, p=.005); racial differences were rendered non-significant. Models 3 and 4, which accounted for nesting of patients with zip codes and counties, respectively, revealed that neither community distress nor rurality/urbanicity were independently associated with risk of mortality (p's>0.33).

Moderation by Race.—Post-hoc analysis simultaneously tested for race moderation of age, gender, and injury type effects on mortality risk (independent of the effects of the covariates noted above) in a multivariate logistic model. Results revealed a significant race X age interaction (b=−.01, SE=.01, p=.009), with Black patients exhibiting more pronounced increases in mortality risk with increasing age (Figure 1). Race did not significantly moderate gender (b=.09, SE=.21, p=.6569) or injury type (b=.03, SE=.26, p=.924) effects on mortality risk.

Post-Discharge Rehabilitation Referral

Results of logistic regression analyses predicting post-discharge rehabilitation referral are presented in Table 3. Adjusting for demographic and injury characteristics (Model 1), women were more likely to be referred for rehabilitation services than men (OR=1.20, p<.001). Greater likelihood of rehabilitation referrals was associated with older age, more recent admissions, blunt compared to penetrating injuries, self-inflicted compared to accidental injuries, accidental compared to assault injuries, higher ISS scores, higher ED heart rate, and lower ED systolic blood pressure. Race was not independently associated with likelihood of receiving a rehabilitation referral. Model 2 further revealed that insured patients had a 92% greater likelihood of receiving a rehabilitation referral compared to uninsured patients (OR=1.92, p=.005). Model 3, which accounted for nesting of patients with zip codes, revealed that community distress was not independently associated with rehabilitation referrals. Model 4, which accounted for nesting of patients within counties, revealed that patients living in more rural areas were also more likely to receive a rehabilitation referral compared to patients living in more urban areas (OR=1.03; p=.027).

Moderation by Race.—Post-hoc analysis simultaneously tested for race moderation of age, gender, and injury type effects on rehabilitation referrals in a multivariate logistic model. Results revealed a significant race X age interaction (b=−.01, SE=.00, p=.043), with Black patients being less likely to receive referrals at younger ages but more likely to receive referrals at older ages. Race did not significantly moderate gender (b=−.18, SE=.14, p=.199) or injury type (b=.13, SE=.25, p=.609) effects on likelihood of rehabilitation referrals.

Opioid Prescriptions in the Emergency Department

Results of logistic regression analyses predicting opioid prescription received in the ED (yes/no) are presented in Table 4. Adjusting for demographic and injury characteristics (Model 1), greater likelihood of receiving opioid medication was associated with younger age, more recent admissions, and lower ISS scores. There were no racial or gender differences in likelihood of receiving ED opioid prescriptions. Model 2 revealed that insurance status was not associated with ED opioid prescriptions. Models 3 and 4, which accounted for nesting of patients with zip codes and counties, respectively, revealed that neither community distress nor rurality/urbanicity were independently associated with likelihood of being prescribed an opioid medication in the ED (p's>0.57).

Moderation by Race.—Post-hoc analysis simultaneously tested for race moderation of age, gender, and injury type effects on opioid prescribing in a multivariate logistic model. Results revealed a significant race X injury type interaction (b=.83, SE=.41, p=.046), with Black patients being more likely to be prescribed opioids for penetrating injuries than White patients. Race did not significantly moderate age (b=−.00, SE=.01, p=.854) or gender (b=−.52, SE=.30, p=.079) effects on likelihood of being prescribed an opioid in the ED.

DISCUSSION

Traumatic injuries disproportionately impact racial/ethnic minorities, the poor, and the uninsured (4). Disparities based on race, socioeconomic status (SES), and insurance status, have been documented for a range of health outcomes across the continuum of trauma care (11). A recent systematic review found that racial minority and uninsured patients were 18% and 22% more likely to die from a traumatic injury than their White/Caucasian and insured counterparts, respectively (34). One critical challenge for research on trauma disparities is to account for the overlapping and potentially confounding effects of race, SES, and insurance status on outcomes, while adjusting for patient-level (e.g., demographic) and often-overlooked geographic (e.g., neighborhood deprivation) factors that may differentially impact patient population subgroups (26). Despite evidence that apparent racial disparities in trauma mortality are eliminated after controlling for neighborhood poverty levels and insurance status (29), a review of National Trauma Data Bank studies found that almost half did not adequately control for disparity-relevant factors (26). The present study sought to address this methodological challenge, and thereby further our understanding of trauma disparities, in three key aspects. First, data on outcomes and patient-level covariates were obtained from a single level 1 trauma center registry serving a diverse and underserved catchment area. This approach ensured high methodological quality, avoided difficulties integrating data across multiple trauma centers (e.g., unique patient populations, different policies/protocols), and permitted a focus on patients at elevated risk for trauma care disparities. Second, consistent with recent recommendations for research on social determinants of trauma (4), contextual factors (i.e., community distress and rurality) were included as predictors in models assessing trauma disparities. Third, although data were cross-sectional, models included ED admission year as a covariate across 11 years of data collection to account for well-established temporal trends in trauma care and outcomes (35).

Contrary to expectations, Black patients had lower overall mortality rates compared to White patients after adjusting for demographic and injury characteristics. However, the main effect for race was no longer observed in the logistic regressions that carefully adjusted for insurance alone (Model 2) and in combination with socio-contextual factors (Models 3 and 4), in line with recent methodological recommendations for trauma disparities research (4). Previous studies have reported that racial disparities in mortality rates are diminished when controlling for insurance status (36) and eliminated after adjusting for both insurance status and neighborhood poverty (29). Moreover, racial disparities in mortality among children with severe traumatic brain injury were largely explained by differences in injury characteristics (i.e., severity, mechanism), with insurance and demographic variables also playing a role (37). Notably, more pronounced racial disparities emerged as a function of age in the present study, with Black injury patients being more likely to die than their White counterparts starting in middle age (at approximately 35 years of age) and this disparity becoming more pronounced in old age. Together, these findings suggest that racial disparities in mortality differ according to patient age and may be driven, in part, by differences in insurance status.

Trauma patients with insurance were less likely to die than uninsured patients, controlling for established mortality risk factors such as race, age, community distress, and injury characteristics (i.e., type, severity). This finding adds to prior research documenting higher mortality rates for adult and pediatric trauma patients lacking health insurance, adjusting for race, injury type, and injury severity (11, 34, 38, 39). The effect size reported in the present study (28% greater odds of death for uninsured) is comparable to the aggregate effect size reported for studies published between 2009 and 2019 (22% greater odds of death for uninsured) (34) but lower than the aggregate effect size reported for studies published between 1990 and 2011 (117% greater odds of death for uninsured) (11). Research further suggests that insurance type impacts mortality, with uninsured and publicly insured trauma patients being more likely to die than those with private insurance (40). A study examining the impact of the Patient Protection and Affordable Care Act on trauma outcomes and care for young adults found that Medicaid expansion/open enrollment was associated with an 18% reduction in uninsured individuals and concomitant 25% reduction in mortality (41). Together, these findings suggest that regardless of race, patients who present to a trauma center with similar injuries, risk profiles, and from similar neighborhoods, will nevertheless differ in mortality risk based on whether or not they have access to health insurance.

Several potential explanations have been offered for the increase in mortality risk observed for uninsured traumatic injury patients. Patients without health insurance are less likely to receive health risk assessments and to engage in preventive healthcare services (42), which may result in higher rates of comorbidities at the time of traumatic injury. In addition, uninsured trauma patients are more likely to suffer from undiagnosed and untreated medical comorbidities, which, in turn, are associated with increased mortality risk (43). For example, having health insurance was associated with lower mortality risk for patients without medical comorbidities but was not linked to mortality risk among trauma patients with one or more pre-trauma comorbidities (43). Another possibility is that uninsured status may serve as a proxy for higher chronic stress levels, driven by unmeasured SES-related stressors such as financial strain and unemployment (44). Uninsured patients in the present study were living in more distressed communities compared to those with insurance. Despite strong evidence from observational, quasi-experimental, and randomized controlled trials supporting the hypothesis that health insurance reduces mortality (45), the mechanisms that may account for this association have yet to be elucidated.

Rehabilitation services are often critical in the aftermath of traumatic injury for improving long-term functional outcomes and health-related quality of life (46). Insured trauma patients were more likely than uninsured patients to receive referrals for rehabilitative services even after controlling for race and injury characteristics. This finding is consistent with prior work showing uninsured trauma patients are 53% less likely to be transferred to rehabilitative facilities (47) and to utilize post-hospital care (39) and 32% more likely to be discharged directly home (48). Factors that may have contributed to lower likelihood of rehabilitative services referrals for uninsured patients in the present study remain unclear. Prior work suggests that transfers to rehabilitation facilities are more likely for patients with commercial insurance than those with Medicare (47), suggesting that reimbursement-related barriers play an important role. Another possibility is that uninsured patients in the present study were more likely to reside in areas with poorer access to rehabilitation services. However, results of the present study do not support this interpretation: patients living in more rural areas were 3% *more* likely to be referred to rehabilitation services. Future studies are needed to identify and overcome barriers to uninsured patients receiving post-discharge rehabilitation services that likely contribute to post-injury health disparities.

This study advanced understanding regarding potential determinants of racial disparities in trauma care and outcomes by adopting a robust risk adjustment methodology (26). Nevertheless, limitations remain that provide directions for future research. First, cross-sectional data obtained from trauma center admissions in the current study preclude examination of disparities in post-discharge health outcomes including (but not limited to) long-term functioning and quality of life, development of posttraumatic stress disorder and/or chronic pain, pain medication misuse, and likelihood of utilizing rehabilitation services. Second, the present findings may not generalize to trauma centers without the resources to participate in the Trauma Quality Improvement Program. Third, analyses examined disparities in whether or not opioid medications were prescribed in the emergency department but could not address potential differences in the amount prescribed. Future studies should evaluate potential disparities in opioid medication dosages prescribed using standardized quantitative measures such as morphine milligram equivalents. Fourth, the lack of geocoded traumatic injury location data precluded analyses of how trauma center proximity was associated with key outcomes. That is, analyses of community distress and rurality/urbanicity evaluated the influence of “where you’re from” on trauma outcomes but not “how long it took for you to get here.” Moreover, geocoded patient address data were also unavailable, precluding evaluation of community distress at more precise levels (e.g., census tracts). Future research on how place influences trauma care and outcomes should be conducted using datasets that allow for greater spatial resolution (e.g., Area Deprivation Index) (22). Finally, there is the possibility that potentially confounding variables were omitted from the trauma registry and, hence, from this study. Two such variables with potential implications for discharge disposition and post-injury recovery are acute pain levels and social support (4).

Disentangling the social determinants of trauma disparities requires careful attention to place and person characteristics. The present study demonstrated that non-Hispanic Black and White patients presenting to a level 1 trauma center differed in their injury types, intent, and severity. After controlling for injury-related differences and other risk factors (i.e., social determinants, clinical and demographic factors), insurance status emerged as an independent predictor of mortality and rehabilitation services: uninsured patients were more likely to die and those who survived were less likely to receive referrals for rehabilitation services. Despite well-documented racial disparities in trauma care and outcomes from pre- to post-discharge (49), non-Hispanic Black and White trauma patients did not differ in adjusted models with regard to mortality, rehabilitation referrals, or opioid medication prescribing in the emergency department. However, the expected racial disparity in mortality risk favoring White patients emerged in middle age and was more pronounced for older patients. Results of this study highlight the need for additional research on the mechanisms that account for reduced mortality among insured as compared to uninsured trauma patients.

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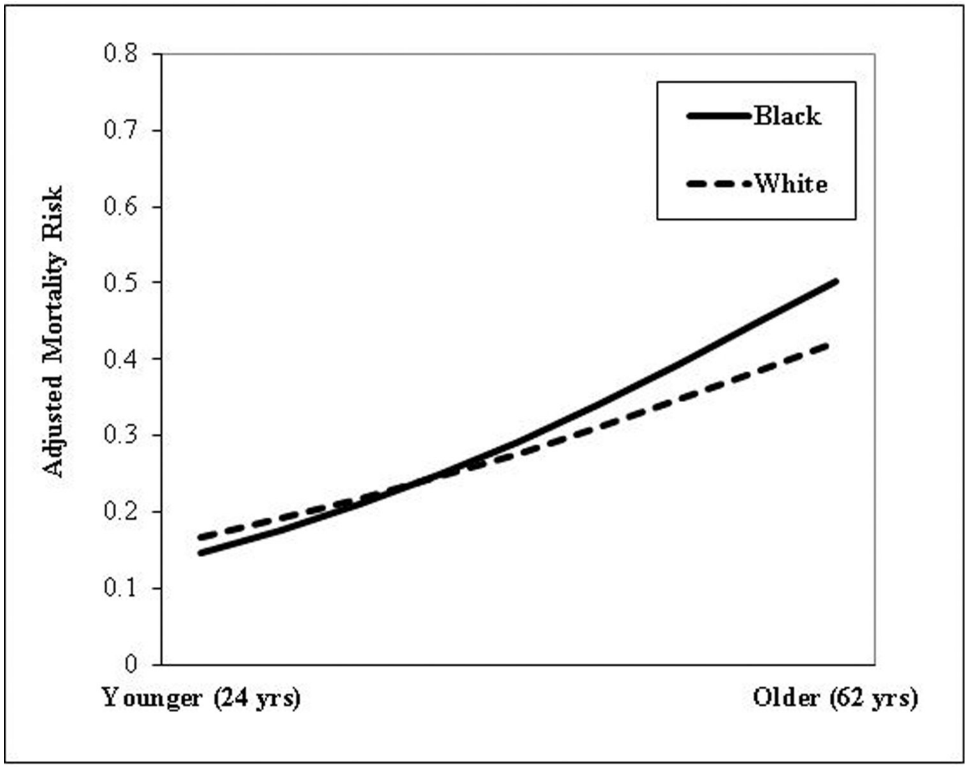

Figure 1.

Differences in adjusted mortality risk across ages for Non-Hispanic Black and White trauma patients.

Table 1.

Descriptive Statistics Summary for Traumatic Injury Patients.

	Total (n=24,019)	Non-Hispanic White (n=10,946)	Non-Hispanic Black (n=13,073)	White vs. Black patients	
	M (*SD*) or N (%)	M (*SD*) or N (%)	M (*SD*) or N (%)		
Demographics				t or χ^2	p
Age	42.8 (18.9)	48.4 (20.6)	38.1 (15.9)	43.1	<.001
Gender				221.6	<.001
Female	7,010 (29.2)	3,718 (34.0)	3,292 (25.2)		
Male	16,997 (70.8)	7,226 (66.0)	9,771 (74.8)		
Injury Characteristics				t or χ^2	p
Type				1,775.9	<.001
Penetrating	5,498 (22.9)	1,139 (10.4)	4,359 (33.3)		
Blunt	18,521 (77.1)	9,807 (89.6)	8,714 (66.7)		
Intent				2,143.3	<.001
Accidental	17,942 (75.4)	9,621 (88.2)	8,321 (63.7)		
Assault	5,281 (22.2)	941 (8.6)	4,340 (33.2)		
Self-inflicted	586 (2.5)	340 (3.1)	246 (1.9)		
Injury Severity (ISS)	10.9 (9.6)	11.6 (9.5)	10.3 (9.6)	10.0	<.001
Vitals in ED					
Heart rate	90.8 (22.0)	90.8 (22.3)	90.8 (21.7)	0.1	.948
Systolic blood pressure	134.6 (27.7)	133.4 (26.6)	135.5 (28.5)	5.8	<.001
Diastolic blood pressure	81.4 (20.6)	79.3 (20.0)	83.1 (20.9)	13.8	<.001
Time in ED (minutes)	358.7 (253.2)	372.6 (254.2)	347.0 (251.8)	7.8	<.001
Socioeconomic/Geographic				t or χ^2	p
Insurance				548.8	<.001
Insured	8,727 (36.3)	4,767 (43.6)	3,960 (30.3)		
Uninsured	6,777 (28.2)	2,420 (22.1)	4,357 (33.3)		
Unspecified	8,515 (35.5)	3,759 (34.3)	4,756 (36.4)		
Community distress	76.3 (25.5)	67.9 (28.0)	83.4 (20.7)	47.2	<.001
Rural-Urban Continuum	4.0 (2.4)	4.2 (2.4)	3.9 (2.3)	10.8	<.001

	Total (n=24,019)	Non-Hispanic White (n=10,946)	Non-Hispanic Black (n=13,073)	White vs. Black patients	
	M (*SD*) or N (%)	**M (*SD*) or N (%)**	**M (*SD*) or N (%)**		
Trauma Care Outcomes				χ^2	*p*
Mortality (died)	1,171 (4.9)	614 (5.6)	557 (4.3)	23.4	<.001
Rehabilitation (referred)[a]	2,345 (10.3)	1,315 (12.7)	1,030 (8.2)	139.3	<.001
Opioid in ED (prescribed)[b]	885 (24.8)	338 (22.2)	547 (26.8)	10.1	.002

*** $< p .001$;

** $p < .01$.

Note. ISS = Injury Severity Score; ED = emergency department.

[a] sample size without deaths = 21,211

[b] sample size without intubations, ventilations, or deaths = 3,572

Table 2.

Logistic Regression Models for Mortality

	Model 1		Model 2		Model 3		Model 4	
	OR [95% CI]	***p***	**OR [95% CI]**	***p***	**OR [95% CI]**	***p***	**OR [95% CI]**	***p***
Demographics								
Age	1.04 [1.04–1.05]	<.001	1.04 [1.04–1.05]	<.001	1.04 [1.04–1.05]	<.001	1.04 [1.04–1.05]	<.001
Female	1.07 [0.88–1.29]	.604	1.08 [0.86–1.36]	.501	1.05 [0.86–1.28]	.664	1.07 [0.88–1.31]	.475
Black	0.81 [0.67–0.97]	.025	0.82 [0.65–1.03]	.082	0.87 [0.71–1.07]	.186	0.88 [0.73–1.07]	.203
Injury								
Admission year	1.17 [1.14–1.20]	<.001	1.21 [1.18–1.25]	<.001	1.16 [1.13–1.19]	<.001	1.16 [1.13–1.19]	<.001
Type								
Blunt	Reference		Reference		Reference		Reference	
Penetrating	1.58 [1.14–2.20]	.006	1.58 [1.06–2.36]	.025	1.82 [1.29–2.57]	.001	1.64 [1.17–2.31]	.004
Intent								
Accidental	Reference		Reference		Reference		Reference	
Assault	1.85 [1.34–2.56]	<.001	1.62 [1.09–2.40]	<.001	1.17 [0.83–1.65]	.375	1.26 [0.90–1.75]	.180
Self-inflicted	5.21 [3.37–8.06]	<.001	5.50 [3.21–9.42]	<.001	4.24 [2.66–6.78]	<.001	4.35 [2.75–6.90]	<.001
Injury Severity (ISS)	1.14 [1.13–1.15]	<.001	1.13 [1.12–1.15]	<.001	1.13 [1.12–1.14]	<.001	1.13 [1.12–1.14]	<.001
Vitals in ED								
Heart rate	0.99 [0.98–0.99]	<.001	0.99 [0.98–0.99]	<.001	0.99 [0.99–0.99]	<.001	0.99 [0.99–0.99]	<.001
SBP	0.98 [0.97–0.98]	<.001	0.98 [0.97–0.98]	<.001	0.98 [0.97–0.98]	<.001	0.98 [0.97–0.98]	<.001
DBP	1.00 [0.99–1.01]	.980	1.00 [0.99–1.01]	.393	0.99 [0.99–1.01]	.723	0.99 [0.99–1.01]	.678
Time in ED (mins)	0.88 [0.77–1.01]	.063	0.88 [0.74–1.03]	.112	0.99 [0.99–0.99]	<.001	0.99 [0.99–0.99]	<.001
Socioeconomic								
Insured			0.72 [0.57–0.90]	.005	0.73 [0.60–0.90]	.003	0.76 [0.62–0.92]	.006
Geographic								
Community distress					1.00 [0.99–1.01]	.412		
Rural-Urban							0.98 [0.95–1.02]	.335

Note. OR = odds ratio; CI = confidence interval; ISS = Injury Severity Score; ED = emergency department; SBP = systolic blood pressure; DBP = diastolic blood pressure.

Table 3.

Logistic Regression Models for Post-Discharge Rehabilitation Referral

	Model 1		Model 2		Model 3		Model 4	
	OR [95% CI]	***p***	**OR [95% CI]**	***p***	**OR [95% CI]**	***p***	**OR [95% CI]**	***p***
Demographics								
Age	1.04 [1.04–1.05]	<.001	1.04 [1.03–1.04]	<.001	1.04 [1.03–1.04]	<.001	1.04 [1.03–1.04]	<.001
Female	1.20 [1.08–1.33]	.001	1.15 [1.00–1.31]	.043	1.13 [0.99–1.30]	.069	1.15 [1.01–1.32]	.037
Black	1.05 [0.95–1.17]	.358	1.03 [0.90–1.18]	.647	1.02 [0.89–1.18]	.752	1.03 [0.90–1.18]	.638
Injury								
Admission year	1.06 [1.04–1.08]	<.001	1.06 [1.04–1.08]	<.001	1.07 [1.04–1.09]	<.001	1.06 [1.04–1.08]	<.001
Type								
Blunt	Reference		Reference		Reference		Reference	
Penetrating	0.74 [0.58–0.93]	.009	0.74 [0.56–0.99]	.039	0.73 [0.55–0.97]	.032	0.73 [0.55–0.97]	.031
Intent								
Accidental	Reference		Reference		Reference		Reference	
Assault	0.65 [0.52–0.81]	<.001	0.76 [0.59–0.99]	.045	0.77 [0.59–1.01]	.057	0.78 [0.60–1.02]	.066
Self-inflicted	1.79 [1.19–2.69]	.005	2.22 [1.35–3.65]	.002	2.15 [1.29–3.59]	.004	2.31 [1.40–3.80]	.001
Injury Severity (ISS)	1.12 [1.11–1.13]	<.001	1.12 [1.12–1.13]	<.001	1.12 [1.12–1.13]	<.001	1.12 [1.11–1.13]	<.001
Vitals in ED								
Heart rate	1.01 [1.00–1.01]	<.001	1.01 [1.00–1.01]	<.001	1.01 [1.00–1.01]	<.001	1.01 [1.00–1.01]	<.001
SBP	0.99 [0.99–0.99]	<.001	0.99 [0.99–0.99]	.001	0.99 [0.99–0.99]	.001	0.99 [0.99–0.99]	.001
DBP	0.99 [0.99–1.00]	.716	1.00 [0.99–1.00]	.830	0.99 [0.99–1.00]	.780	0.99 [0.99–1.00]	.881
Time in ED (mins)	1.00 [1.00–1.00]	.184	1.00 [1.00–1.00]	.333	1.00 [1.00–1.00]	.188	1.00 [1.00–1.00]	.357
Socioeconomic								
Insured			1.92 [1.66–2.22]	.005	1.90 [1.64–2.21]	<.001	1.90 [1.64–2.20]	<.001
Geographic								
Community distress					1.00 [0.99–1.00]	.626		
Rural-Urban							1.03 [1.00–1.06]	.027

Note. OR = odds ratio; CI = confidence interval; ISS = Injury Severity Score; ED = emergency department; SBP = systolic blood pressure; DBP = diastolic blood pressure.

Table 4.

Logistic Regression Models for Any Opioid Prescription in the Emergency Department

	Model 1		Model 2		Model 3		Model 4	
	OR [95% CI]	***p***	**OR [95% CI]**	***p***	**OR [95% CI]**	***p***	**OR [95% CI]**	***p***
Demographics								
Age	0.99 [0.98–0.99]	<.001	0.98 [0.98–0.99]	<.001	0.98 [0.98–0.99]	<.001	0.98 [0.97–0.99]	<.001
Female	0.99 [0.81–1.21]	.919	1.12 [0.85–1.50]	.422	1.03 [0.77–1.38]	.842	1.11 [0.83–1.47]	.482
Black	1.08 [0.90–1.31]	.411	1.08 [0.82–1.42]	.595	1.01 [0.76–1.36]	.930	1.08 [0.83–1.43]	.561
Injury								
Admission year	1.39 [1.33–1.44]	<.001	1.20 [1.15–1.26]	<.001	1.21 [1.15–1.27]	<.001	1.21 [1.15–1.27]	<.001
Type								
Blunt	Reference		Reference		Reference		Reference	
Penetrating	0.91 [0.68–1.22]	.524	1.13 [0.74–1.72]	.569	1.23 [0.81–1.87]	.331	1.19 [0.79–1.79]	.408
Intent								
Accidental	Reference		Reference		Reference		Reference	
Assault	0.87 [0.66–1.15]	.333	0.94 [0.63–1.39]	.748	0.84 [0.57–1.25]	.400	0.87 [0.59–1.29]	.490
Self-inflicted	0.60 [0.31–1.16]	.126	0.58 [0.21–1.59]	.291	0.59 [0.21–1.64]	.312	0.54 [0.20–1.47]	.227
Injury Severity (ISS)	0.97 [0.96–0.98]	<.001	0.98 [0.96–0.99]	.010	0.98 [0.96–0.99]	.008	0.98 [0.96–0.99]	.010
Vitals in ED								
Heart rate	0.99 [0.99–1.00]	.138	0.99 [0.99–1.00]	.332	0.99 [0.99–1.00]	.344	0.99 [0.99–1.00]	.352
SBP	0.99 [0.99–1.00]	.706	1.00 [0.99–1.01]	.794	1.00 [0.99–1.01]	.753	1.00 [0.99–1.01]	.825
DBP	1.01 [1.00–1.01]	.041	1.01 [0.99–1.01]	.266	1.01 [0.99–1.02]	.205	1.01 [0.99–1.01]	.261
Time in ED (mins)	1.00 [1.00–1.00]	<.001	1.00 [1.00–1.00]	.355	1.00 [1.00–1.00]	.290	1.00 [1.00–1.00]	.364
Socioeconomic								
Insured			1.06 [0.82–1.38]	.650	1.13 [0.86–1.47]	.380	1.09 [0.84–1.41]	.538
Geographic								
Community distress					1.00 [0.99–1.01]	.604		
Rural-Urban							0.99 [0.94–1.04]	.576

Note. OR = odds ratio; CI = confidence interval; ISS = Injury Severity Score; ED = emergency department; SBP = systolic blood pressure; DBP = diastolic blood pressure.