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Racial disparities exist among burn patients despite insurance coverage

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ABSTRACT

Background: Age, total burn surface area (TBSA), and inhalation injury are proven predictors of mortality and morbidity following burn injury. Most previous studies have also found that African Americans and females with burns also fare worse. We sought to determine whether these disparities were reduced when burn victims were analyzed separately by categories of insurance coverage.

Methods: We evaluated records in the National Burn Registry (NBR) from 2002 to 2011. Multivariate logistic regression was performed to determine factors associated with inpatient mortality, including age, TBSA, inhalation injury, race, and sex, and allowing for clustering by hospital. Separate models were constructed for each category of insurance. 95% confidence intervals (CI) not including 1 for any odds ratio were considered evidence of statistical significance (designated by * in the table below).

Results: NBR included records from 172,640 patients (55.8% Caucasian, 18.1% African American, 14.2% Hispanic, 6.4% other minority groups, 5.4% unknown). Age, TBSA, and inhalation were strong predictors of mortality as expected. Non-African American males were the largest group for all insurance categories, and had the lowest mortality. Controlling for these factors, and compared with non-African American males, African American males had consistently increased odds of mortality regardless of insurance coverage. African American females had increased odds of mortality if they had Private, Medicare, or Medicaid insurance, and Non-African American females had increased odds of mortality if they had Private or Medicaid insurance.

Insurance Category	African American Males	African American Females	Non-African American Females
Private	1.74 (CI 1.19, 2.55)*	1.58 (CI 1.02, 2.46)*	1.54 (CI 1.15, 2.05)*
Medicare	1.80 (CI 1.41, 2.30)*	1.36 (CI 1.02, 1.80)*	1.04 (CI 0.90, 1.21)
Medicaid	1.65 (CI 1.12, 2.42)*	1.94 (CI 1.44, 2.62)*	1.61 (CI 1.13, 2.31)*
Worker's Comp	1.69 (CI 1.06, 2.69)*	1.04 (CI 0.27, 3,92)	0.70 (CI 0.37, 1.33)
Uninsured	1.91 (CI 1.06, 3.46)*	1.37 (CI 0.95, 1.97)	1.13 (CI 0.90, 1.42)

The association of Hispanic ethnicity with mortality was inconsistent or insignificant, and other minority groups had too few members to evaluate. Most patients were missing comorbidity data, and no other socioeconomic or hospital data were available in NBR.

Conclusions: African American males with burn injury are at increased risk of mortality regardless of insurance coverage, and most females are at increased risk regardless of race. Analyzing the reasons for these disparities will require databases containing more complete comorbidity, socioeconomic, and/or hospital data.

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Introduction

An estimated 180,000 deaths per year are attributable to burn

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injury according to the World Health Organization (WHO).[1] According to the American Burn Association, approximately 486,000 burn injuries received care annually at U.S. healthcare facilities and roughly 40,000 burn patients were hospitalized for treatment of their injuries.[2] Despite Caucasian males statistically being the largest burn patient population in the United States, women and people of color - specifically African American males - have been shown in research to have poorer outcomes after trauma.[3] While poverty and socio-economic status does play a significant role in a patient's access to care, outcomes are notably worse for people of color.[3] Even when controlling for comorbid disease, these racial and ethnic disparities often persist.[4] In an article by Lucas et al., evaluating race and its role in determining surgical outcomes in the U.S., a group of Medicare patients 65 years and older showed a disproportionate increase in mortality amongst African Americans in seven of eight surgical procedures evaluated during a 1 year time span.[5] This study further stated that those of African American race were more likely to have surgery in hospitals with lower volume and high mortality rates due to accessibility.[5] Access to health care and insurance coverage availability, has been postulated as a means to improve morbidity and mortality outcomes.[6] To our knowledge, no study has determined if trauma patients of different races with similar insurance types have similar mortality odds when adjusting for specific insurance coverage. In this study, we explored the impact of insurance on burn mortality odds, to determine whether insurance type could mitigate racial and ethnic disparities after burns injury.

Methods

National Burn Repository (NBR) records for 2002–2011 were obtained from the American Burn Association (ABA). Information on admission year, age, sex, total burn surface area (TBSA), inhalation injury, burn etiology, insurance type, survival status, and hospital identification number were obtained from and interpreted with reference to the National Burn Data Standard Dictionary (NBDS) published by the ABA. In total, 172,640 patients were stratified based on race, gender, TBSA, inhalation injury and insurance type. Caucasian males were the dominant group in the dataset (55.8% Caucasian, 18.1% African American or Black, 14.2% Hispanic, 2.2% Asian, 0.7% Native American/Pacific Islander, and 3.5% other minority groups). Native American and Asian race were excluded from the study due to limited numbers in the cohort. Comorbid disease was considered “present” if any of the categorical entries associated with a patient was something other than “0”, “not available” or “UNKNOWN”.

Multivariate analysis was performed using statistical software (STATA v12.1; Statcorp, College Station, Texas). Statistical significance was set at $\alpha = 0.05$.95% confidence intervals (CI), as odds ratio were considered evidence of statistical significance. Logistic regression models predicting mortality were constructed with several combinations of the above variables as independent variables. Standard errors were calculated with allowance for clustering by hospital. Only cases with complete data were used for estimation. Separate models were also constructed for each category of insurance. Chi-squared tests and ANOVA were performed using Stata software.

Results

The NBR data analyzed had 172,640 unique patient records. Of these, there was no recorded age for 37,090 (21.5%), no recorded sex for 1445 (0.8%) and no recorded TBSA for 6903 (4.0%). Insurance category unknown or missing was noted for 19,246 (11.2%), and no recorded survival status for 2325 (1.4%). 77,567 patients (44.9%) had comorbidities present in our cohort. In total 108,722 actual cases were used for our analysis.

African American males consistently had increased mortality when compared with any of the other racial or gender groups when adjusting for insurance type, age, TBSA, or inhalation injury. African American male mortality was two times the odds of the reference group, Caucasian males (OR 1.48, CI 1.22–1.82). Females had a higher mortality trend, but did not meet statistical significance (OR 1.095, CI 0.957–1.25). Medicare patients had increased odds of burn mortality compared to all other types of insurance, with an OR of 1.37, and an alpha of 0.054 [See Table 1]. In subjects with private insurance, African American males had 1.42 times higher odds of increased mortality (1.42 OR; CI 1.005–2.022). Females were also noted to have increased odds of mortality (1.40 OR; CI 1.09–1.81) in the private insurance category.

In the worker's compensation group ($n = 11,711$), African American males had significantly increased odds of mortality (1.52 OR; CI 1.22–1.81). Hispanic status exhibited a protective effect with one-third the odds of mortality with a significant confidence interval (0.53 OR; 0.29–0.97) [See Table 2].

In the Medicare group ($n = 9632$), African American males continued to have the highest odds of mortality when compared with the Caucasian male reference group (1.52 OR; CI 1.26–1.88) [See Table 3]. Female gender or Hispanic ethnicity was potentially protective in this group. Both categories had mortality odds lower

Table 1
Odds ratio of mortality for select groups after burn injury.

Category	Odds Ratio	p >|z|	95% Confidence Interval
Age	1.05	0.00	1.04 - 1.05
TBSA	1.06	0.00	1.05 - 1.07
Inhalation	3.18	0.00	2.48 - 4.07
Black	1.48	0.00	1.22 - 1.81
Hispanic	1.06	0.78	0.68 - 1.66
Female	1.09	0.18	0.95 - 1.25
Uninsured	1.66	0.07	0.94 -2.91
Workman's compensation	0.67	0.04	0. 45 - 0.98
Medicare	1.37	0.05	0.99 - 1.89
Medicaid	1.08	0.63	0.77 - 1.51

Table 2
Burn mortality outcomes for patients with Workmen's compensation (Insurance provided by employer for workplace injuries).

Category	Odds Ratio	p >|z|	95% Confidence Interval
Age	1.03	0.00	1.01 - 1.04
TBSA	1.07	0.00	1.05 - 1.08
Inhalation	2.02	0.01	1.33 - 3.07
Black	1.52	0.10	1.22 - 1.81
Hispanic	0.54	0.78	0.29 - 0.97
Female	0.68	0.18	0.38 - 1.20

Table 3
Medicare and Burn injury mortality.

Category	Odds Ratio	p >|z|	95% Confidence Interval
Age	1.05	0.00	1.04 - 1.06
TBSA	1.07	0.00	1.05 - 1.08
Inhalation	2.02	0.01	1.33 - 3.07
Black	1.54	0.00	1.26 - 1.88
Hispanic	0.54	0.64	0.446 - 1.64
Female	0.97	0.69	0.856 - 1.11

Table 4
Burn mortality and Medicaid Insurance.

Category	Odds Ratio	p >|z|	95% Confidence Interval
Age	1.05	0.00	1.04 - 1.06
TBSA	1.04	0.00	1.05 - 1.07
Inhalation	3.31	0.00	2.28 - 4.81
Black	1.47	0.03	1.04 - 2.07
Hispanic	1.30	0.29	0.789 - 2.15
Female	1.45	0.02	0.789 - 2.15

than the reference group at 0.97 and 0.85, respectively. However, the results were statistically insignificant given the confidence intervals (CI 0.85–1.108; CI 0.44–1.644). Of the 15,545 patients identified with Medicaid as their primary insurance, African American males had significantly increased odds of mortality (1.47 OR; CI 1.049–2.07) [See Table 4].

Finally, 15,176 patients had no documented form of insurance. African American males had 1.6 times the odds of mortality compared to the reference group (1.6 OR; CI 0.94–2.65) without statistical significance. Interestingly, Hispanic ethnicity again experienced a protective effect with decreased odds of mortality versus the reference group (0.53 OR; CI 0.34–0.94). Females experienced minimal effect with no insurance, with odds very close to that of the reference group, with an insignificant confidence interval (OR 0.97 CI 0.75–1.24).

Discussion

The National Burn Repository dataset demonstrates consistently that African Americans, with male gender in particular - disproportionately have increased odds of mortality even after controlling for total body surface area burned (%TBSA), inhalation injury, age, and insurance type. Previous studies in burn injury and other disease states have consistently shown African Americans and females often have worse outcomes when compared with Caucasian males.[3,7] However, teasing out root causation has remained elusive. This is complicated by the paucity of 'granular' details in the available large clinical databases.[8]

Our primary hypothesis for this study was that those with identical insurance status would likely have similar socio-economic status, and therefore similar outcomes. Nevertheless, our analysis has shown that insurance status likely does not have a mitigating effect on racial and ethnic disparities in this trauma population. Thus, the root cause of these persistent racial and ethnic outcome disparities leads us to believe that there are likely patient care factors and/or patient comorbidities that lead to differing outcomes. We felt that given this relatively uniform group of high performing burn centers, we should have little to no disparity between treatment groups. The results of our analysis were not consistent with this initial hypothesis. There must be patient factors that are critical to these persistent disparities because caregiver biases should be less likely in an otherwise aggressive, highly specialized care setting. However, potential patient care delivery biases cannot be ignored. Cooper-Patrick et al. established that when surveying patients in the primary care setting post clinical visit, that African Americans disproportionately reported less perceived participation during visits.[9] When adjusted for age, gender, education level, and marital and health status, higher satisfaction rates were noted when care was given by either a female provider or a provider of the same race.[9] Burn patients with life threatening injuries usually convalesce for several months while receiving intensive treatment for their burns during prolonged inpatient care and rehabilitation. If there is a disconnect between the provider team and the patient as described above – particularly when considering illicit biases - it could impact the outcome for the patient regardless of insurance status. Speculating about caregiver biases in burn care, we thought the impact would be more apparent in measures of morbidity over mortality; however, it is plausible that minority patients who are severely burned are more likely to be transitioned to comfort measures or denied resuscitation for apparent "futility". The NBR dataset is not adequate to evaluate this decision-making. Another factor to consider would be pre-existing health conditions prior to the injury. Haider et al. looked at race and insurance status for trauma mortality.[10] They noted that African Americans and Hispanics, had increased odds of death versus Caucasians when adjusting for insurance and racial background. They also noted that insurance status was the greatest predictor of mortality. However, they mentioned that pre-existing conditions prior to the injury, which could be attributable to socio-economic status of the patient could play a role in mortality outcomes.[11] Previous research has similarly shown that African Americans with burn injuries are more likely to have pre-existing renal disease and a post injury course that includes urinary tract infections.[3] Our current dataset limitations, however, do not allow for detailed analysis of comorbid disease severity or prevalence. Furthermore, it was difficult to quantify in this study - given limitations in coding - discrepancies in data between each NBR reporting hospital. The question remains as to what factors in burn patient care can be intervened upon to improve racial and gender outcomes.

Our study has several limitations. While the NBR represents the largest and most extensive database for burn specific epidemiology and outcomes, the national burn repository data set used in this analysis, assumes that all the facilities associated with the ABA participating in data collection have the same practices and capabilities when treating patients as well as similar data collection and registry practices. This is unlikely. The NBR dataset had numerous data inconsistencies including missing data, duplicate patient information and non-uniformity of disease and condition definitions. While, we took care to interrogate the dataset to eliminate duplicate and missing entries for our analyses, there likely remains some errors. Some of the issues, such as multiple documented encounters for a single patient, differences in reporting software, the quality of data reporting, and lack of data altogether were highlighted in an NIH funded validity review performed by Taylor et al., which showed that data inconsistencies within the registry might be deleterious to statistical analyses performed.[12] We utilized these

recommendations in our data review, but recognize the inherent limitations of the dataset. Additionally, there were a large number of patients with "unknown" race or ethnicity. This likely has some unknowable impact on the potential significance of our findings.

Conclusion

Using the National Burn Repository, we have shown that the increased odds of mortality for African American burn patients persists despite uniformity of insurance type. The disparity persists even when controlling for the common factors associated with burn injury mortality (burn size, inhalation injury, age, and gender). Healthcare access factors, at a system level, are unlikely to provide targets for intervention to improve outcomes in these severely injured burn patients. More research on burn center care provider practices – at the patient care and hospital level - will be required to elucidate the modifiable factors that may reduce these glaring health care disparities.

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Conflicts of interest statement and disclosure

- None of the authors of this manuscript has any conflicts of interest to disclose.
- All data were derived from a publicly available de-identified patient data repository – The National Burn Repository.

Appendix A. Supplementary data

Supplementary data related to this chapter can be found at https://doi.org/10.1016/j.amjsurg.2018.08.013.

References

1. Rybarczyk MM, Schafer JM, Elm CM, et al. Prevention of burn injuries in low- and middle-income countries: a systematic review. *Burns*. 2016 September;42(6):1183–1192.
2. Burn Incidence Fact Sheet. American Burn Association, www.ameriburn.org/resources_factsheet.php..
3. Bedri H, Romanowski K, Liao J, et al. A national study of the effect of race, socioeconomic status, and gender on burn outcomes. *J Burn Care Res*. 2017 June;38(3):161–168.
4. Dissanaike S, Ha D, Mitchell D, Larumbe E. Socioeconomic status, gender, and burn injury: a retrospective review. *Am J Surg*. 2017 October;214(4):677–681.
5. Lucas FL, Stukel TA, Morris AM, Siewers AE, Birkmeyer JD. Race and surgical mortality in the United States. *Ann Surg*. 2006 February;243(2):281–286.
6. Zogg CK, Jiang W, Chaudhary MA, et al. Racial disparities in emergency general surgery: do differences in outcomes persist among universally insured military patients. *J. Trauma Acute Care Surgery*. 2016 May;80(5):764–777.
7. Rangrass G, Ghaferi AA, Dimick JB. Explaining racial disparities in outcomes after cardiac surgery: the role of hospital quality. *JAMA Surgery*. 2014;149:223–227.
8. Haskins AE, Clark DE, Travis LL. Racial disparities in survival among injured drivers. *Am J Epidemiol*. 2013 March;177(5):380–387.
9. Cooper-Patrick L, Gallo JJ, Gonzales JJ. Race, gender, and partnership in the patient-physician relationship. *J Am Med Assoc*. 1999;282(6):583–589.
10. Haider AH, Chang DC, Efron DT, Haut ER, Crandall M, Cornwell EE. Race and insurance status as risk factors for trauma mortality. *Arch Surg*. 2008;143(10):945–949.
11. Kerby JD, McGwin G, George RL, Cross JA, Chaudry IH, Rue L. Sex differences in mortality after burn injury: results of analysis of the national burn repository of the american burn association. *J Burn Care Res*. 2006 August;27(4):452–456.
12. Taylor SL, Lee D, Nagler T, Lawless MB, Curri T, Palmieri T. A validity review of the national burn repository. *J Burn Care Res*. 2013 March;34(2):274–280.