African–American and Caucasian mortalities are the same after traumatic injury: pair matched analysis from a national data

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ABSTRACT

Background African–Americans have worse outcomes than Caucasians in many clinical conditions studied, including trauma. We sought to analyze if mortality is different in these groups through analysis of a national data set.

Methods Recent data from the national Trauma Quality Improvement Program were assessed with analysis, including all African–American or Caucasian patients who were brought to level I or level II trauma centers for care. Propensity scores were calculated for each African–American patient using age, sex, Injury Severity Score (ISS), Glasgow Coma Scale (GCS), injury type, insurance information and American College of Surgeons trauma level. The primary outcome of this study was in-hospital mortality, and the secondary outcomes were hospital length of stay and discharge disposition.

Results A total of 82,150 (13.65%) out of 601,768 patients who qualified for the inclusion in the study were African–American. The remaining 519,618 (86.35%) were Caucasian. The median age (IQR) of the patients was 54 (33 to 72) years old, and approximately two-thirds of the patients were male. The median ISS and GCS score were 12 (9 to 17) and 15 (15 to 15), respectively. More than 90% of patients sustained blunt injuries. Overall, there was no significant difference found in overall in-hospital mortality between Caucasians and African–American patients (3% vs. 2.9%, p=0.2); however, the median (95% CI) hospital length of stay was 1 day longer in African–American patients compared with Caucasian patients (5 (5.5) vs. 4 (4.4), p<0.001). When the discharged destinations between the two groups were compared, a higher proportion of Caucasians were discharged to home without services (66% vs. 33%).

Conclusion Our study showed that trauma mortalities among African–American and Caucasians are the same. Efforts to mitigate the ethnic and racial biases in the delivery of healthcare should continue, and these results (no differences in mortality) should be validated in other clinical settings.

Level of evidence Level II.

INTRODUCTION

The disparity in healthcare delivery and outcomes among ethnic minorities in the USA is not a new topic of discussion. Efforts have been implemented to mitigate ethnic and racial bias, including education and training, improvement of equity in access to care, enhancement of regulatory vigilance, monitoring of managed care and improvement of data systems to monitor the quality of medical care. These efforts have met with variable success, and recently, an analysis of hospital data accountability found that the algorithm used for the assigned risk score for the patients resulted in less access to specialized care for African–American patients. Disparities continue to exist.

Many studies have evaluated the impact of race on clinical outcomes. African–American race represents a significant risk factor for adverse outcome in many clinical diseases. When insurance coverage is taken into account, disparities in outcome between races remain. Acute trauma care represents a unique situation where delivery of healthcare is expected to be provided immediately without the patient’s race, ethnicity or insurance coverage. Compared with Caucasian patients, a recent study showed that there is increased mortality among African–American trauma patients. However, another recent population-based study found no significant difference in mortality between Caucasian and African–American patients after a traumatic injury.

The reasons behind the variability in mortality in different studies are not well understood. One explanation is that it may be the existence of implicit bias at the point of care towards certain races that affect outcome or the use of different variables and methodologies in the NTDB (National Trauma Data Bank) adopted in these studies to draw conclusions. This study was designed to answer the same question, whether African–American race has adversely impacted outcomes when compared with Caucasian counterparts after an injury using recent data from national Trauma Quality Improvement Program (TQIP) data set, and exact matching methodology was adopted to balance the characteristics.

METHODS

Data sources and data extraction

The adult TQIP database from 2011 to 2016 was accessed for the study. The TQIP is considered a quality improvement program by the American College of Surgeons (ACS). More than 825 trauma centers all across the USA currently participate in the TQIP program (https://www.facs.org/quality-programs/trauma/tqip/center-programs/tqip; accessed date December 3, 2019). The TQIP also provides feedback two times a year to participating institutions on certain quality indicators. All African–Americans and Caucasians who sustained injury and were treated at level I and level II trauma centers were included in the study. Other patient...
Characteristics included age (between 16 and 89 years), sex, Injury Severity Score (ISS), injury type, Abbreviated Injury Scale (AIS) of different body regions, Glasgow Coma Scale (GCS), initial vital signs (heart rate and initial systolic blood pressure (iSBP), presence of hypotension on initial presentation (defined as iSBP <90 mm Hg) and whether insurance coverage was present. Patients aged <16 years old and identified as members of other races (eg, Hispanic or Asian) were excluded from the study. Patients who presented with no signs of life were also excluded from the study (please see Table 1).

Outcomes
The primary outcome of this study was in-hospital mortality and the secondary outcomes were hospital length of stay and discharge disposition.

Statistical methods
Univariate analysis
The patient’s demographics, injury, insurance information and outcomes were compared between the African–American and Caucasian groups. Data were summarized using summary statistics (median with IQR (first quartile to third quartile) for continuous variables, and frequency and percentage for categorical variables) as described previously. The two groups were compared using the Wilcoxon rank-sum test for the continuous variables and the χ² test for the categorical variables. Since there were significant differences identified in univariate analysis on baseline patient characteristics, therefore matching methodology was used to balance the two groups.

Exact matching and pair matched analysis
The first step in performing the exact matching was to calculate the estimated propensity score for each African–American patient using age, sex, ISS, GCS score, injury type, insurance

Table 1 Characteristics of patients before matching

| Variable                  | Values                                  | Not African–American (n=519,618) | African–American (n=82,150) | P values | Exact matched analysis |
|---------------------------|-----------------------------------------|----------------------------------|-----------------------------|----------|------------------------|
| Age                       | Median (Q1 to Q3)                       | 57 (37 to 74)                   | 37 (25 to 55)              | <0.001   | 42 (27 to 59)          |
| Sex                       | Female                                  | 197,616 (38)                    | 20,014 (24.4)              | <0.001   | 14,808 (26.4)          |
|                           | Male                                    | 322,002 (62)                    | 62,136 (75.6)              | <0.001   | 41,353 (73.6)          |
| Hypotension               | 0                                       | 503,073 (96.8)                  | 77,937 (94.9)              | <0.001   | 55,546 (98.9)          |
|                          | 1                                       | 16,545 (3.2)                    | 4213 (5.1)                 |          | 615 (1.1)              |
| ISS                       | Median (Q1 to Q3)                       | 12 (9 to 17)                    | 12 (9 to 18)               | <0.001   | 10 (9 to 17)           |
| GCS score                 | Median (Q1 to Q3)                       | 15 (15 to 15)                   | 15 (14 to 15)              | <0.001   | 15 (15 to 15)          |
| Injury type               | Blunt                                   | 495,856 (95.4)                  | 56,859 (69.2)              | <0.001   | 46,300 (82.4)          |
| Penetrating               |                                         | 23,762 (4.6)                    | 25,291 (30.8)              |          | 9861 (17.6)            |
| Blue Cross/Blue Shield    |                                         | 23,915 (4.6)                    | 2181 (2.7)                 | <0.001   | 1433 (2.6)             |
| Medicaid                  |                                         | 49,081 (9.4)                    | 19,469 (23.7)              |          | 11,558 (20.6)          |
| Medicare                  |                                         | 175,971 (33.9)                  | 131,101 (15.9)             |          | 11,175 (19.9)          |
| No fault automobile       |                                         | 25,867 (5)                      | 2937 (3.6)                 |          | 2086 (3.7)             |
| Not billed (for any reason)|                                         | 1245 (0.2)                      | 492 (0.6)                  |          | 126 (0.2)              |
| Other                     |                                         | 15,181 (2.9)                    | 2721 (3.3)                 |          | 1420 (2.5)             |
| Other government          |                                         | 11,893 (2.3)                    | 2573 (3.1)                 |          | 1422 (2.5)             |
| Private/commercial insurance|                                         | 152,989 (29.4)                 | 18,005 (21.9)              | <0.001   | 14,039 (25)            |
| Self-pay                  |                                         | 54,497 (10.5)                   | 19,887 (24.2)              |          | 12,353 (22)            |
| Workers’ compensation     |                                         | 8979 (1.7)                      | 784 (1)                     |          | 549 (1)                |
| ACS trauma level          |                                         |                                 |                             | <0.001   | 1                      |
| I                         |                                         | 349,881 (67.3)                  | 64,041 (78)                |          | 44,347 (79)            |
| II                        |                                         | 169,737 (32.7)                  | 18,109 (22)                |          | 11,814 (21)            |

Hypotension denotes a systolic blood pressure of <90 mm Hg.
ACS, American College of Surgeons; GCS, Glasgow Coma Scale; ISS, Injury Severity Score.

Table 2 Abbreviated Injury Scale score of ≥2 different body regions

| Variable                  | Values | All (n=601,768) | Not African–American (n=519,618) | African–American (n=82,150) | P values |
|---------------------------|--------|----------------|----------------------------------|-----------------------------|----------|
| Abdomen                   | 0      | 531,137 (88.3) | 463,287 (89.2)                   | 67,850 (82.6)               |          |
|                           | 1      | 70631 (11.7)   | 56,331 (10.8)                    | 14,300 (17.4)               |          |
| Brain                     | 0      | 386,823 (64.3) | 329,046 (63.3)                   | 57,777 (70.3)               |          |
|                           | 1      | 214,945 (35.7) | 190,572 (36.7)                   | 24,373 (29.7)               |          |
| Face                      | 0      | 550,195 (91.4) | 475,352 (91.5)                   | 74,843 (91.1)               |          |
|                           | 1      | 51,573 (8.6)   | 44,266 (8.5)                     | 7307 (8.9)                  |          |
| Neck                      | 0      | 593,602 (98.6) | 513,082 (98.7)                   | 80,520 (98)                 |          |
|                           | 1      | 8166 (1.4)     | 6536 (1.3)                       | 1630 (2)                    |          |
| Pelvis                    | 0      | 571,990 (95.1) | 494,321 (95.1)                   | 77,669 (94.5)               |          |
|                           | 1      | 29,778 (4.9)   | 25,297 (4.9)                     | 4481 (5.5)                  |          |
| Spine                     | 0      | 586,322 (97.4) | 507,136 (97.6)                   | 79,186 (96.4)               |          |
|                           | 1      | 15,466 (2.6)   | 12,482 (2.4)                     | 2964 (3.6)                  |          |
| Thorax                    | 0      | 410,006 (68.1) | 355,054 (68.3)                   | 54,952 (66.9)               |          |
|                           | 1      | 191,762 (31.9) | 164,564 (31.7)                   | 27,198 (33.1)               |          |
| Extremities               | 0      | 385,543 (64.1) | 332,477 (64)                     | 53,066 (64.6)               |          |
|                           | 1      | 216,225 (35.9) | 187,141 (36)                     | 29,084 (35.4)               |          |

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Head injury and extremity injuries were the two most common organ-specific injuries sustained by these patients (please see tables 1 and 2).

Unmatched (univariate) analysis
There were significant differences found between the Caucasians and African–American groups with respect to age (57 (37 to 74) vs. 37 (25 to 53)), male gender (62% vs. 75.6%), ISS (12 (9 to 17) vs. 12 (9 to 18)), penetrating trauma (4.6% vs. 30.8%) and insurance coverage, respectively. All p values were <0.001 (please see table 1). When the two groups were compared on AIS score of ≥2 on different body regions, the African–Americans sustained more torso injuries, whereas the Caucasians suffered from more head injury (please see table 2 for detailed information).

Exact matching and pair matched analysis
After one-to-one exact matching, each group contained 56161 patients. No difference existed on the baseline patient’s characteristics after matching (please see table 1). The median age, ISS and GCS score in both groups were 42 (27 to 59) years, 10 (9 to 17) and 15 (10 to 18), respectively. However, after matching, the proportion of most of the body region injuries between the groups was balanced except extremity injury. A higher proportion of African–American patients sustained extremity injury compared with their Caucasians counterpart (37.7% vs. 34.2%; see table 3).

Outcomes
There were no significant difference in overall in-hospital mortality between Caucasians and African–American patients (3% vs. 2.9%, p=0.2); however, the median (95% CI) hospital length of stay was 1 day longer in African–American patients compared with Caucasians (5 (5.5) vs. 4 (4.4), p<0.001) (please see table 4). When the discharged destinations between the two groups were compared, a higher proportion of Caucasians were discharged to home without services (66% vs. 33%; please see table 5).

DISCUSSION
Our study analyzed the recent TQIP data set and found no significant difference in overall in-hospital mortality between African–American and Caucasians trauma victims. However, African–American patients stayed longer in the hospital and required more additional services at the time of hospital discharge.

Most prior studies reported higher mortality among ethnic minority patients after trauma.4 Haider and colleagues examined the NTDB data set almost 10 years ago and included only those patients aged 18–64 years who had an ISS of ≥9 and compared

Table 3: Abbreviated Injury Scale score ≥2 of different body regions

| Variable | Values | All (N=112322) | Not African–American (n=56161) | African–American (n=56161) |
|----------|--------|---------------|---------------------------------|--------------------------|
| Abdomen  | 0      | 98339 (87.6)  | 49157 (87.5)                    | 49182 (87.6)             |
|          | 1      | 13983 (12.4)  | 7004 (12.5)                     | 6979 (12.4)              |
| Brain    | 0      | 78805 (70.2)  | 39422 (70.2)                    | 39383 (70.1)             |
|          | 1      | 33517 (29.8)  | 16739 (29.8)                    | 16778 (29.9)             |
| Face     | 0      | 103794 (92.4) | 52133 (92.8)                    | 51661 (92)               |
|          | 1      | 8528 (7.6)    | 4082 (7.2)                      | 4500 (8)                 |
| Neck     | 0      | 110753 (98.6) | 55339 (98.5)                    | 55414 (98.7)             |
|          | 1      | 1569 (1.4)    | 822 (1.5)                       | 747 (1.3)                |
| Pelvis   | 0      | 106940 (95.2) | 53737 (95.7)                    | 53203 (94.7)             |
|          | 1      | 5382 (4.8)    | 2424 (4.3)                      | 2958 (5.3)               |
| Spine    | 0      | 109326 (97.3) | 54882 (97.7)                    | 54444 (96.9)             |
|          | 1      | 2996 (2.7)    | 1279 (2.3)                      | 1717 (3.1)               |
| Thorax   | 0      | 78062 (69.5)  | 38545 (68.6)                    | 39517 (70.4)             |
|          | 1      | 34260 (30.5)  | 17616 (31.4)                    | 16644 (29.6)             |
| Extremities | 0   | 71937 (64)    | 36952 (65.8)                    | 34985 (62.3)             |
|          | 1      | 40385 (36)    | 19209 (34.2)                    | 21176 (37.7)             |

RESULTS
A total of 82150 (13.65%) out of 601768 patients who qualified for the inclusion in the study were African–American. The remaining 519618 (86.35%) were Caucasian. The median age of the patients was 54 (IQR 33 to 72) years old, and approximately two-thirds of the patients were male. The median ISS and GCS score were 12 (IQR 9 to 17) and 15 (IQR 15 to 15), respectively. More than 90% of patients sustained blunt injuries.

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Table 4: Outcomes

| Variable | Before matching | All (N=601768) | Not African–American (n=519618) | African–American (n=82150) |
|----------|-----------------|----------------|---------------------------------|---------------------------|
|          | P value OR (95% CI) Absolute risk difference (95% CI) |
| Total death | 0 | 569649 (94.7) 491872 (94.7) | 77777 (94.7) | 0.852 0.997 (0.964 to 1.030) | −0.00017 (−0.0018 to 0.0015) |
| 1 | 32119 (5.3) 27746 (5.3) 4373 (5.3) |
| Exact matched | All (N=112322) | Not African–American (n=56161) | African–American (n=56161) | 0.2 0.95 (0.87 to 1.03) | −0.001 (−0.003 to 0.001) |
| Total death | 0 | 109014 (97.1) 54477 (97) | 54537 (97.1) | 0.2 0.95 (0.87 to 1.03) | −0.001 (−0.003 to 0.001) |
| 1 | 3308 (2.9) 1684 (3) 1624 (2.9) |
African–Americans, Hispanics and Caucasians. They included more than 400,000 patients in their analysis and found higher in-hospital mortality among the African–American and Hispanic populations in unadjusted and adjusted analyses. The uninsured Hispanic patients had the highest odd of mortality followed by African–Americans (2.30, 95% CI 2.13 to 2.49; 1.78, 95% CI 1.65 to 1.90), respectively. The same authors and colleagues later performed a systemic review; 7 out of initially 35 selected studies showed higher odds of mortality among African–American patients compared with Caucasian counterparts (1.19, 95% CI 1.09 to 1.31).9

Contrary to previous studies, our study used the ACS–TQIP database data. ACS sends the feedback to all participating trauma centers all across the USA on some of the quality matrix, including in-hospital mortality, using the same database. Our study clearly showed no significant difference in mortality outcome regardless of the patients being African–American or Caucasian. This result may surprise some of the readers, but the important point to note is that we used very recent national quality data. Furthermore, we also used exact matching methodology to balance the two ethnic groups (black and white patients). We matched insurance coverage as well to determine if disparity in race generated the disparity in mortality (no disparity was noted). This may reflect the positive influence of ongoing efforts to limit implicit or explicit biases at the point of care, at least among trauma providers. A recent survey study among clinicians in an acute care setting found no implicit bias in the decision-making process,15 which may represent more evidence of progress.

**Limitation**

Although the study was performed using a well-recognized national quality database, the retrospective nature of the study carries inherent limitations. We attempted to include all the available characteristics of the patients that can influence the mortality and did exact matching on one-to-one basis to balance the group; however, exact matching cannot account for unobserved variables.

**CONCLUSION**

Our study showed that trauma mortalities among African–American and Caucasians are the same. Efforts to mitigate the ethnic and racial biases in the delivery of healthcare should continue, and these results (no differences in mortality) should be validated in other clinical settings.

**Competing interests** None declared.

**Patient consent for publication** Not required.

**Provenance and peer review** Not commissioned; externally peer reviewed.

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