

# Racial inequality in the trauma of women: A disproportionate decade

Shawn N. Izadi, BS, Niral Patel, BBA, Demba Fofana, PhD, Anghela Z. Paredes, MD, MS, Samuel K. Snyder, MD, Annelyn Torres-Reveron, PhD, and Jeffrey J. Skubic, DO, McAllen, Texas

<b>BACKGROUND:</b>	Historically, women have been largely underrepresented in the body of medical research. Given the paucity of data regarding race and trauma in women, we aimed to evaluate the most common types of traumas incurred by women and analyze temporal racial differences.
<b>METHODS:</b>	A 10-year review (2007–2016) of the National Trauma Data Bank was conducted to identify common mechanisms of injuries among women. Trends of race, intent of injury, and firearm-related assaults were assessed using the Cochran-Armitage Trend test. Multivariable multinomial logistic regressions were utilized to examine the association between race and trauma subtypes.
<b>RESULTS:</b>	Of the 2,082,768 women identified as a trauma during this study period, the majority presented due to an unintentional injury (94.5%), whereas fewer presented secondary to an assault (4.4%) or self-inflicted injury (1.1%). While racioethnic minority women encompassed a small percentage of total traumas (19%), they accounted for roughly three fifths of assault-related traumas ( $p < 0.001$ ). Though total assaults decreased by 20.8% during the study period, black and Hispanic women saw a disproportionately smaller decrease of 15.1% and 15.8%, respectively. On regression analysis, compared with white women, black women had more than four times the odds of being an assault-related trauma compared with unintentional trauma (odds ratio, 4.48; 95% confidence interval, 4.41–4.55). On subset analysis, firearm-related assault was 17.3 times more prevalent among black women (white, 0.3% vs. black: 5.2%; $p < 0.001$ ). In fact, history of alcohol abuse was found to be an effect modifier of the association of race/ethnicity and firearm-related trauma.
<b>CONCLUSION:</b>	Compelling data highlight a disproportionate trend in the assault-related trauma of minority women. Specifically, minority women, especially those with a history of alcohol abuse, were at increased risk of being involved in a firearm assault. Further studies are essential to help mitigate disparities and subsequently develop preventative services for this diverse population. ( <i>J Trauma Acute Care Surg.</i> 2020;89: 254–262. Copyright © 2020 Wolters Kluwer Health, Inc. All rights reserved.)
<b>LEVEL OF EVIDENCE:</b>	Epidemiological, Level III.
<b>KEY WORDS:</b>	Disparities; women; assault; firearms; race.

Prior studies have predicted that by the year 2020, white/Caucasians will constitute 46% of the total population of the United States.<sup>1</sup> As such, individuals traditionally labeled as “minorities” will constitute 54% of the total population.<sup>1</sup> Given this predicted shift in population composition, we believe it is important to better understand how injuries affect people belonging to diverse populations.

Among all age groups, traumatic injuries are the third leading cause of death.<sup>2</sup> Furthermore, prior studies surrounding trauma patients have identified race, socioeconomic status (SES), and insurance status as independent risk factors of death following trauma.<sup>3–6</sup> For example, in a study of hospitalizations from the

National Hospital Discharge Survey, Kalesan et al.<sup>7</sup> noted a six-fold greater firearm-related hospitalization rate among blacks than among whites from 2000 to 2010. Moreover, the impact of violent assault in minority populations has been greater than in the white population. In a separate study of health and law enforcement surveillance systems, Sumner and colleagues<sup>8</sup> found that the homicide ratio of non-Hispanic blacks was five times greater compared with non-Hispanic whites.

However, due to sociocultural barriers and other factors, women are largely underrepresented in both trauma and non-trauma-related studies.<sup>9,10</sup> This, consequently, has led to significant information deficits which has adversely affected subsequent evidence-based public health initiatives.<sup>11</sup> When women report events involving trauma, they tend to do it with uncertainty, minimization, and self-blame.<sup>12</sup> Moreover, trauma recidivism in women compared with men is shorter in time and is usually associated with assault or domestic violence.<sup>13</sup> As such, several organizations, including the World Health Organization, have called to improve the health care system to address violence among women.<sup>14</sup> Based on the Status of Black Women Report by the Institute for Women's Policy Research, black women experience partner violence at higher rates than women overall.<sup>15</sup> They also experience a higher percentage of lifetime physical and psychological aggression compared with white, Hispanic, or Asian/Pacific Islander women.<sup>15</sup>

Submitted: December 1, 2019, Revised: February 16, 2020, Accepted: March 14, 2020, Published online: March 30, 2020.

From the Department of Surgery (S.N.I., N.P., S.K.S., J.J.S.), School of Mathematical and Statistical Sciences (D.F.), University of Texas Rio Grande Valley, Edinburg, Texas; Department of Surgery (A.Z.P.), The Ohio State University, Wexner Medical Center and James Comprehensive Cancer Center, Columbus, Ohio; and Doctors Hospital at Renaissance Health Institute for Research and Development (A.T.-R.), Edinburg, Texas.

Presented at the 33rd Eastern Association for the Surgery of Trauma Annual Scientific Assembly, January 14–18, 2020 in Orlando, FL.

Address for reprints: Jeffrey J. Skubic, DO, MSc, The University of Texas Rio Grande Valley School of Medicine, DHR Health Surgery Institute, Suite 300, 1100 E. Dove Ave, McAllen, TX 78504; email: jeffrey.skubic@utrgv.edu.

DOI: 10.1097/TA.0000000000002697

To date, however, limited data exist characterizing trauma in women and how racioethnic associations have changed over time. In addition, whether specific subgroups of women are disproportionately affected by firearm-related injuries remains largely unknown. To this end, the objective of the current study was to characterize trauma in women using the National Trauma Data Bank (NTDB). Specifically, we sought to examine the changes of trauma characteristics, as well as the rates of firearm-related injury among women over a 10-year period. We hypothesized that the incidence of self-inflicted, assault, and unintentional trauma among women will vary based on race and ethnicity.

## METHODS

### Data Source and Study Population

Trauma patients 18 years or older, who were included in the NTDB between 2007 and 2016, were identified. The NTDB is a national multi-institutional database providing the largest registry of trauma patients in the United States. It additionally collects information on trauma patients admitted to all Level I and Level II trauma centers in the United States as well as some Level III and Level IV centers voluntarily.<sup>16</sup> The NTDB contains trauma registry information on the circumstances, treatments, and outcomes for each patient along with collecting data on many other clinicopathologic factors relating to the trauma.<sup>17</sup> The present study was reviewed by the institutional review board at the University of Texas Rio Grande Valley and approved for exempt status.

Similar to previous studies examining race, only individuals with a race/ethnicity of black, white, or Hispanic were included in the analytic cohort.<sup>18</sup> Individuals with missing or unknown age, race, ethnicity, or International Classification of Diseases—9th Rev./10th Rev—Clinical Modification external cause of injury code were excluded. Individuals younger than 18 years were also excluded from the analytic cohort.

### Study Variables

Using previously reported methods, individuals were classified based on their respective intent of injury: unintentional, assault, and self-inflicted traumas.<sup>19</sup> Unintentional injury, as defined by the CDC, is characterized as a trauma that was unplanned, whereas assault is defined as an intentional act of physical harm.<sup>20</sup> Self-inflicted trauma is defined as injury with intention to harm oneself.<sup>20</sup> Abstracted data included age, sex, race, ethnicity, abbreviated injury severity score, the presence of shock (<90 mm Hg systolic blood pressure), highest Glasgow Coma Scale on admission recorded, and the clinical presence of alcohol or drugs on admission. Other variables examined included medical history of alcohol abuse, payer status, length of stay, emergency department (ED) disposition, and hospital disposition.

### Statistical Analysis

The cohort was first subdivided based on sex, race, and intent of injury (self-inflicted vs. assault vs. unintentional). Descriptive statistics for demographics and clinical characteristics were presented as frequency (%) and median (interquartile range [IQR]) for categorical and continuous variables, respectively. Demographics and clinical characteristics were compared across different periods using Kruskal-Wallis tests for continuous and  $\chi^2$  tests for categorical variables. Additional subset analyses were

then completed on individuals identified as women. Trends of race, intent of injury, and firearm-related assaults were assessed using the Cochran-Armitage Trend Test. A multivariable multinomial logistic regression was utilized to assess the association between race and intent of injury. The aforementioned model adjusted for age, payer status, clinical drug or alcohol use at time of admission, history of alcohol abuse, and year of injury. To assess the association between race and firearm-related assaults, a multivariable logistic regression was utilized and adjusted for age, payer status, clinical drug or alcohol use at time of admission, history of alcohol abuse, and year of injury among women presenting as an assault. To accommodate for factors known to be social determinants of health, sensitivity analyses were performed to accommodate any potential effect modification between history of alcohol abuse and race through the creation of an interaction term.<sup>21,22</sup> Statistical significance was assessed at  $\alpha = 0.05$ . All analyses were performed using SAS v9.4 (SAS Institute Inc., Cary, NS).

## RESULTS

### Characteristics of the Analytic Cohort

Between 2007 and 2016, a total of 5,655,340 trauma encounters in the NTDB were identified that met inclusion criteria. Of these, median patient age was 49 years (IQR, 31–68) and roughly one third (36.8%) were women. The most common intent of injury was unintentional (86.8%), while fewer presented secondary to an assault (12.1%) or self-inflicted injury (1.7%). Only a minority of the cohort had any form of drugs (13.3%) or alcohol (7.9%) present in their system on admission.

Baseline characteristics of patients stratified by sex are provided in Table 1. Compared with men, women trauma victims were older (44; IQR, 44–80, vs. 60; IQR, 39–78;  $p < 0.001$ ) and were less likely to experience an assault (men, 16.6% vs. women, 4.4%;  $p < 0.001$ ). More commonly, men presented with alcohol (men, 19.9% vs. women, 9.1%;  $p < 0.001$ ) or drugs (men, 15.5% vs. women, 9.6%;  $p < 0.001$ ) in their system and had a history of alcohol use disorder (men, 10.0% vs. women, 4.3%;  $p < 0.001$ ). Women had similar injury severity scores in comparison to men and over half of women (63.6%) had some sort of commercial or government insurance ( $p < 0.001$ ).

Among women, specifically, baseline characteristics stratified by intent of injury are provided in Table 2. Women who presented secondary to an unintentional trauma were older (62 years; IQR, 42–79 years), whereas women who suffered an assault were younger (33 years; IQR, 24–45 years,  $p < 0.001$ ). More than half of women presenting secondary to an assault were minorities (black or Hispanic) (57.2%), whereas black and Hispanic women only encompassed 20.3% and 17.2% of self-inflicted injuries and unintentional traumas, respectively. Women afflicted by an assault-related trauma were more likely to be black (44.1%) and have a payer status of Medicaid/Uninsured (55.8%;  $p < 0.001$ ). This is in stark contrast to women presenting with self-inflicted trauma who were more commonly white (79.7%), had clinically detectable blood levels of drugs on admission (30.8%), and required an operation after ED evaluation (26.1%;  $p < 0.001$ ).

To further explore the racioethnic associations amidst intent of injury among women, the cohort was stratified by race/ethnicity as seen in Table 3. Nearly one fifth ( $n = 394,934$ ) of

**TABLE 1.** Trauma Characteristics Stratified by Sex Across Entire Study Period

Variable	Total N = 5,655,340	Men n = 3,572,572	Women n = 2,082,768	p Value
Age, y				
18–34	1,700,999 (30.1%)	1,272,769 (35.6%)	428,230 (20.6%)	<0.001
35–49	1,129,674 (20%)	821,195 (23%)	308,479 (14.8%)	
50–64	1,199,720 (21.2%)	780,652 (21.9%)	419,068 (20.1%)	
>65	1,624,947 (28.7%)	697,956 (19.5%)	926,991 (44.5%)	
Race/ethnicity				
White	4,158,309 (73.5%)	2,470,475 (69.2%)	1,687,834 (81%)	<0.001
Black	857,087 (15.2%)	623,723 (17.5%)	233,364 (11.2%)	
Hispanic	639,944 (11.3%)	478,374 (13.4%)	161,570 (7.8%)	
Intent of trauma				
Self-inflicted	95,719 (1.7%)	72,977 (2%)	22,742 (1.1%)	<0.001
Assault	682,839 (12.1%)	592,038 (16.6%)	90,801 (4.4%)	
Unintentional	4,876,782 (86.2%)	2,907,557 (81.4%)	1,969,225 (94.5%)	
Insurance				
Private/commercial	1,537,870 (27.2%)	993,299 (27.8%)	544,571 (26.1%)	<0.001
Medicare	1,401,682 (24.8%)	620,369 (17.4%)	781,313 (37.5%)	
Medicaid/uninsured	1,444,152 (25.5%)	1,070,805 (30%)	373,347 (17.9%)	
Other/unknown	1,271,636 (22.5%)	888,099 (24.9%)	383,537 (18.4%)	
Drug use on admission				
No	4,901,020 (86.7%)	3,018,352 (84.5%)	1,882,668 (90.4%)	<0.001
Yes	754,320 (13.3%)	554,220 (15.5%)	200,100 (9.6%)	
Alcohol use on admission				
No	4,754,016 (84.1%)	2,860,854 (80.1%)	1,893,162 (90.9%)	<0.001
Yes	901,324 (15.9%)	711,718 (19.9%)	189,606 (9.1%)	
History of alcohol use disorder				
No	5,207,347 (92.1%)	3,215,160 (90%)	1,992,187 (95.7%)	<0.001
Yes	447,993 (7.9%)	357,412 (10%)	90,581 (4.3%)	
Abbreviated Injury Severity				
Minor to moderate	1,174,792 (20.8%)	746,215 (20.9%)	428,577 (20.6%)	<0.001
Serious to severe	1,115,331 (19.7%)	694,312 (19.4%)	421,019 (20.2%)	
Critical to maximal	118,023 (2.1%)	86,301 (2.4%)	31,722 (1.5%)	
Unassigned	3,247,194 (57.4%)	2,045,744 (57.3%)	1,201,450 (57.7%)	
Glasgow Coma Scale				
Mild	4,831,598 (85.4%)	3,005,411 (84.1%)	1,826,187 (87.7%)	<0.001
Moderate	182,145 (3.2%)	124,986 (3.5%)	57,159 (2.7%)	
Severe	419,139 (7.4%)	317,642 (8.9%)	101,497 (4.9%)	
Unknown	222,458 (3.9%)	124,533 (3.5%)	97,925 (4.7%)	
Shock				
No	5,092,977 (90.1%)	3,210,213 (89.9%)	1,882,764 (90.4%)	<0.001
Yes	183,945 (3.3%)	130,287 (3.6%)	53,658 (2.6%)	
Unknown	378,418 (6.7%)	232,072 (6.5%)	146,346 (7%)	
ED disposition				
Home	491,213 (8.7%)	337,620 (9.5%)	153,593 (7.4%)	<0.001
Floor	2,536,493 (44.9%)	1,449,211 (40.6%)	1,087,282 (52.2%)	
Intensive care unit	1,518,872 (26.9%)	1,010,192 (28.3%)	508,680 (24.4%)	
Operating room	657,870 (11.6%)	481,790 (13.5%)	176,080 (8.5%)	
Deceased	65,341 (1.2%)	50,753 (1.4%)	14,588 (0.7%)	
Other/unknown	385,551 (6.8%)	243,006 (6.8%)	142,545 (6.8%)	
Hospital disposition				
Home	3,036,419 (53.7%)	2,090,924 (58.5%)	945,495 (45.4%)	<0.001
Escalated discharge	1,606,762 (28.4%)	781,687 (21.9%)	825,075 (39.6%)	
Deceased	164,672 (2.9%)	113,917 (3.2%)	50,755 (2.4%)	
Other/unknown	847,487 (15%)	586,044 (16.4%)	261,443 (12.6%)	

**TABLE 2.** Trauma Characteristics for Women Stratified by Intent of Injury Across Study Period

Variable	Self-Inflicted n = 22,742	Assault n = 90,801	Unintentional n = 1,969,225	p Value
Age, y				
18–34	8,878 (39%)	49,190 (54.2%)	370,162 (18.8%)	<0.001
35–49	7,514 (33%)	26,561 (29.3%)	274,404 (13.9%)	
50–64	4,907 (21.6%)	11,509 (12.7%)	402,652 (20.4%)	
>65	1,443 (6.3%)	3,541 (3.9%)	922,007 (46.8%)	
Race/ethnicity				
White	18,116 (79.7%)	38,831 (42.8%)	1,630,887 (82.8%)	<0.001
Black	2,527 (11.1%)	40,016 (44.1%)	190,821 (9.7%)	
Hispanic	2,099 (9.2%)	11,954 (13.2%)	147,517 (7.5%)	
Insurance				
Private/commercial	5,976 (26.3%)	16,626 (18.3%)	521,969 (26.5%)	<0.001
Medicare	3,378 (14.9%)	6,688 (7.4%)	771,247 (39.2%)	
Medicaid/uninsured	9,644 (42.4%)	50,709 (55.8%)	312,994 (15.9%)	
Other/unknown	3,744 (16.5%)	16,778 (18.5%)	363,015 (18.4%)	
Drug use on admission				
No	15,734 (69.2%)	70,952 (78.1%)	1,795,982 (91.2%)	<0.001
Yes	7,008 (30.8%)	19,849 (21.9%)	173,243 (8.8%)	
Alcohol use on admission				
No	17,127 (75.3%)	69,392 (76.4%)	1,806,643 (91.7%)	<0.001
Yes	5,615 (24.7%)	21,409 (23.6%)	162,582 (8.3%)	
History of alcohol use disorder				
No	19,727 (86.7%)	82,244 (90.6%)	1,890,216 (96%)	<0.001
Yes	3,015 (13.3%)	8,557 (9.4%)	79,009 (4%)	
Abbreviated Injury Severity				
Minor to moderate	5,349 (23.5%)	24,142 (26.6%)	399,086 (20.3%)	<0.001
Serious to severe	3,003 (13.2%)	13,319 (14.7%)	404,697 (20.6%)	
Critical to maximal	1,147 (5%)	1,827 (2%)	28,748 (1.5%)	
Unassigned	13,243 (58.2%)	51,513 (56.7%)	1,136,694 (57.7%)	
Glasgow Coma Scale				
Mild	15,734 (69.2%)	78,570 (86.5%)	1,731,883 (87.9%)	<0.001
Moderate	1,280 (5.6%)	2,832 (3.1%)	53,047 (2.7%)	
Severe	5,196 (22.8%)	6,762 (7.4%)	89,539 (4.5%)	
Unknown	532 (2.3%)	2,637 (2.9%)	94,756 (4.8%)	
Shock				
No	18,502 (81.4%)	80,177 (88.3%)	1,784,085 (90.6%)	<0.001
Yes	2,619 (11.5%)	4,815 (5.3%)	46,224 (2.3%)	
Unknown	1,621 (7.1%)	5,809 (6.4%)	138,916 (7.1%)	
ED disposition				
Home	848 (3.7%)	15,092 (16.6%)	137,653 (7%)	<0.001
Floor	5,816 (25.6%)	35,929 (39.6%)	1,045,537 (53.1%)	
Intensive care unit	6,819 (30%)	18,199 (20%)	483,662 (24.6%)	
Operating room	5,936 (26.1%)	14,374 (15.8%)	155,770 (7.9%)	
Deceased	1,127 (5%)	1,769 (1.9%)	11,692 (0.6%)	
Other/unknown	2,196 (9.7%)	5,438 (6%)	134,911 (6.9%)	
Hospital disposition				
Home	7,127 (31.3%)	58,462 (64.4%)	879,906 (44.7%)	<0.001
Escalated discharge	7,114 (31.3%)	8,987 (9.9%)	808,974 (41.1%)	
Deceased	1,892 (8.3%)	1,933 (2.1%)	46,930 (2.4%)	
Other/unknown	6,609 (29.1%)	21,419 (23.6%)	233,415 (11.9%)	

traumas were among minority women. Minority trauma victims were more likely to be younger compared with white trauma patients with a larger proportion of victims in the 18 years to 34 years age bracket (minority, 38.1% vs. white, 16.5%;  $p < 0.001$ ). Additionally, minority women were also more likely to experience

assault-related trauma. Specifically, assault-related trauma was 7.4 and 3.2 times more common in black and Hispanic women, respectively, compared with white women ( $p < 0.001$ ). A small subset (13.6%) of white women had Medicaid or were uninsured, whereas more than one third (36.5%) of minority patients had

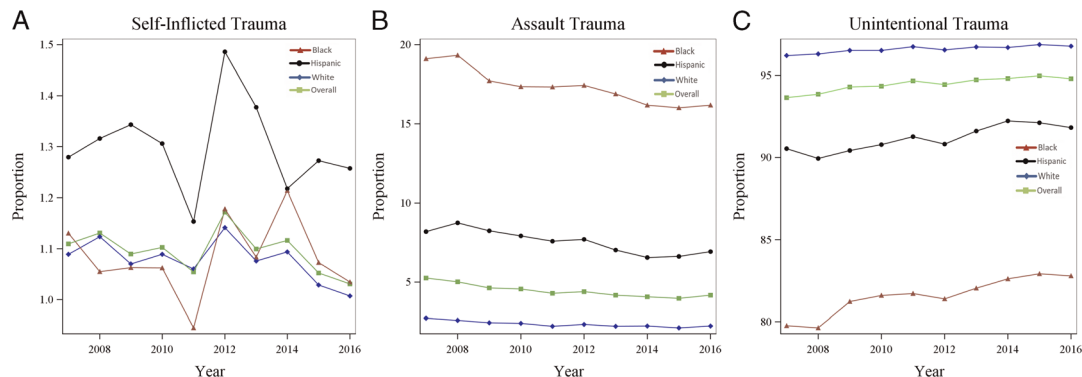
**TABLE 3.** Trauma Characteristics for Women Stratified by Race/Ethnicity Across Study Period

Variable	White n = 1,687,834	Black n = 233,364	Hispanic n = 161,570	p Value
Age, y				
18–34	277,846 (16.5%)	91,137 (39.1%)	59,247 (36.7%)	<0.001
35–49	224,483 (13.3%)	51,391 (22%)	32,605 (20.2%)	
50–64	344,573 (20.4%)	46,383 (19.9%)	28,112 (17.4%)	
>65	840,932 (49.8%)	44,453 (19%)	41,606 (25.8%)	
Intent of trauma				
Self-Inflicted	18,116 (1.1%)	2,527 (1.1%)	2,099 (1.3%)	<0.001
Assault	38,831 (2.3%)	40,016 (17.1%)	11,954 (7.4%)	
Unintentional	1,630,887 (96.6%)	190,821 (81.8%)	147,517 (91.3%)	
Insurance				
Private/commercial	453,760 (26.9%)	54,427 (23.3%)	36,384 (22.5%)	<0.001
Medicare	707,076 (41.9%)	43,686 (18.7%)	30,551 (18.9%)	
Medicaid/uninsured	229,187 (13.6%)	85,340 (36.6%)	58,820 (36.4%)	
Other/unknown	297,811 (17.6%)	49,911 (21.4%)	35,815 (22.2%)	
Drug use on admission				
No	1,541,363 (91.3%)	198,785 (85.2%)	142,520 (88.2%)	<0.001
Yes	146,471 (8.7%)	34,579 (14.8%)	19,050 (11.8%)	
Alcohol use on admission				
No	1,549,594 (91.8%)	199,752 (85.6%)	143,816 (89%)	<0.001
Yes	138,240 (8.2%)	33,612 (14.4%)	17,754 (11%)	
History of alcohol use disorder				
No	1,615,473 (95.7%)	220,920 (94.7%)	155,794 (96.4%)	<0.001
Yes	72,361 (4.3%)	12,444 (5.3%)	5,776 (3.6%)	
Abbreviated Injury Severity				
Minor to moderate	327,946 (19.4%)	59,759 (25.6%)	40,872 (25.3%)	<0.001
Serious to severe	353,322 (20.9%)	35,389 (15.2%)	32,308 (20%)	
Critical to maximal	25,571 (1.5%)	3,333 (1.4%)	2,818 (1.7%)	
Unassigned	980,995 (58.1%)	134,883 (57.8%)	85,572 (53%)	
Glasgow Coma Scale				
Mild	1,480,294 (87.7%)	203,765 (87.3%)	142,128 (88%)	<0.001
Moderate	43,563 (2.6%)	8,013 (3.4%)	5,583 (3.5%)	
Severe	78,769 (4.7%)	13,244 (5.7%)	9,484 (5.9%)	
Unknown	85,208 (5%)	8,342 (3.6%)	4,375 (2.7%)	
Shock				
No	1,524,867 (90.3%)	210,049 (90%)	147,848 (91.5%)	<0.001
Yes	41,298 (2.4%)	7,281 (3.1%)	5,079 (3.1%)	
Unknown	121,669 (7.2%)	16,034 (6.9%)	8,643 (5.3%)	
ED disposition				
Home	102,521 (6.1%)	32,934 (14.1%)	18,138 (11.2%)	<0.001
Floor	900,638 (53.4%)	110,331 (47.3%)	76,313 (47.2%)	
Intensive care unit	419,679 (24.9%)	49,252 (21.1%)	39,749 (24.6%)	
Operating room	136,124 (8.1%)	23,975 (10.3%)	15,981 (9.9%)	
Deceased	10,242 (0.6%)	2,871 (1.2%)	1,475 (0.9%)	
Other/unknown	118,630 (7%)	14,001 (6%)	9,914 (6.1%)	
Hospital disposition				
Home	725,218 (43%)	124,429 (53.3%)	95,848 (59.3%)	<0.001
Escalated discharge	728,737 (43.2%)	58,960 (25.3%)	37,378 (23.1%)	
Deceased	42,840 (2.5%)	4,484 (1.9%)	3,431 (2.1%)	
Other/unknown	191,039 (11.3%)	45,491 (19.5%)	24,913 (15.4%)	

Medicaid or were uninsured ( $p < 0.001$ ). Additionally, minority women had higher rates of hospital nonadmittance (12.9%) and home discharge without services (55.8%) when compared with white women (6.1% and 43%, respectively;  $p < 0.001$ ).

### Temporal Trends Based on Race and Ethnicity

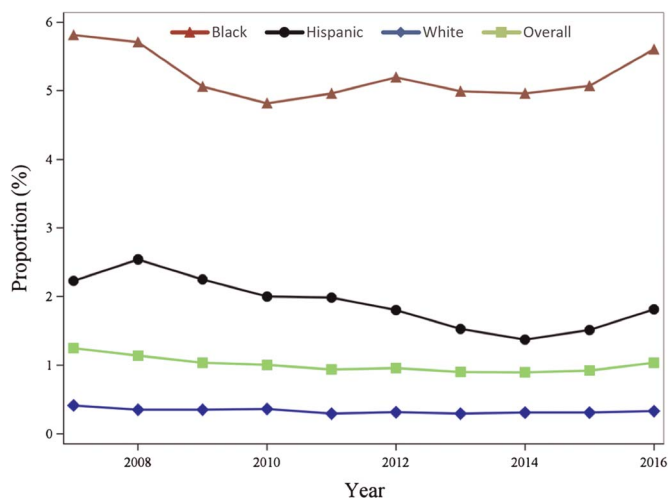
Figures 1A–C depict the race/ethnic temporal trends in respect to the different intents of trauma. Over the 10-year study period, the overall prevalence of self-inflicted trauma remained



**Figure 1.** 10-year racioethnic trend illustrating intent of trauma (A, self-inflicted; B, assault; C, unintentional) as a percentage of total trauma among women.

relatively unchanged at roughly 1.1% ( $p > 0.05$ ). This was similarly noted when further examining the prevalence of self-inflicted trauma stratified by racioethnicity. On the contrary, over the 10-year period, women experienced a 20.8% decrease in the proportion of assault-related traumas ( $p < 0.001$ ) (Fig. 1B). When stratified on the accordance of racioethnicity, while white women saw a 22.2% decrease in their proportion of assault-related trauma, there was a disproportionate decrease in minority women ( $p < 0.001$ ). Specifically, black and Hispanic women saw a disproportionately smaller decrease of 15.1% and 15.8% in their proportion of assault-related trauma, respectively ( $p < 0.001$ ). Unintentional trauma saw minimal variation throughout the 10-year period ( $p > 0.05$ ; Fig. 1C).

When specifically examining firearm-related assaults, similar trends were noted (Fig. 2). Across the study period, women saw a 16.8% decline in the proportion of firearm-related assaults ( $p < 0.001$ ). But again, when stratified based on racioethnicity, white women saw a 19.5% decline in their proportion of firearm-related assaults compared with the disproportionately smaller decrease of 3.4% and 14.8% among black and Hispanic women, respectively ( $p < 0.001$ ).



**Figure 2.** 10-year racioethnic trend illustrating firearm-related assault as a percentage of total trauma among women.

### Impact of Racioethnicity on Intent of Injury

On multivariable multinomial regression analysis, after adjusting for age, payer status, clinical drug or alcohol use at time of admission, history of alcohol abuse, and year of injury, race was found to be associated with the trauma subtype. Compared with white women, black women were less likely to present as a self-inflicted trauma compared with an unintentional trauma (odds ratio [OR], 0.68; 95% confidence interval [CI], 0.65–0.71). On the contrary, black trauma victims had more than four times the odds of being an assault-related trauma compared with unintentional trauma (OR, 4.48; 95% CI, 4.41–4.55). Furthermore, Hispanic women were associated with 21% decreased odds of being a self-inflicted trauma compared with an unintentional trauma (OR, 0.79; 95% CI, 0.76–0.83), whereas they were associated with 78% increased odds of being an assault-related trauma (OR, 1.78; 95% CI, 1.74–1.82). In addition, women who tested positive for drug use on presentation had increased odds of being an assault-related trauma compared with an unintentional trauma (OR, 1.30; 95% CI, 1.27–1.32). This similar increase in assault-related trauma was also noted in women who tested positive for alcohol use on presentation (OR, 1.54; 95% CI, 1.51–1.57).

On subset analysis, to examine the association between racioethnicity and firearm-related trauma, a multivariable logistic regression analysis was conducted. The interaction term between racioethnicity and history of alcohol abuse was statistically significant at the  $p$  less than 0.05 level. As such, the association between racioethnicity and firearm-related trauma, in fact, depended on whether the woman had a history of alcohol abuse (Table 4).

**TABLE 4.** Among Women Presenting Due to an Assault, the Association Between Racioethnicity, Firearm-Related Assault, and History of Alcohol Use Disorder

	History of Alcohol Abuse	OR	95% CI
Black	No	2.37	2.28–2.46
	Yes	3.024	2.56–3.57
Hispanic	No	1.79	1.70–1.89
	Yes	1.98	1.53–2.55

For example, if a black woman had a history of alcohol abuse, the odds of being a firearm-related assault was three times higher compared with a white woman (OR, 3.02; 95% CI, 2.56–3.57), whereas only two times higher if the woman did not have a history of alcohol abuse (OR, 2.37; 95% CI, 2.28–2.46). Similar trends were noted for Hispanic women ( $p < 0.05$ ).

## DISCUSSION

The health care outcomes of minorities, despite increased access to health care resources, remains inequitable compared with those of whites.<sup>23</sup> This trend continues in respect to trauma. In the current study, NTDB registries from 2007 to 2016 were used to characterize trauma in women and explore racioethnic temporal trends of injury. Of note, nearly 60% of women who experienced assault-related trauma were minority women despite them only comprising 19% of total traumas in women. Firearm-related assault was also 17.3 times more common in minority women compared with white women. Furthermore, the proportion of assault-related traumas in women decreased by 20.8% during the study period with minority women seeing a smaller, disproportionate decrease. Analysis showed that these trends were in fact disparate based on a woman's racioethnicity. Lastly, on regression analysis, minority race and ethnicity were independent predictors of assault and firearm-related trauma. To our knowledge, this is the first study to explore the differential trauma experiences of women and to explore the racioethnic associations on intents of injury, including firearm-related assaults.

We present analytic evidence concerning racial inequalities related to traumatic injuries among women, specifically the disproportionate rates of assault-related trauma among black and Hispanic women. The current study helps to highlight this racial inequality. The present authors note that despite minority women representing less than 20% of the cohort, they encompass the majority of violent trauma reported to the NTDB. Furthermore, prior work has noted that, though firearm homicides declined by 51% from 1993 to 2010, minority women did not experience similar trends.<sup>24</sup> Specifically, for the same period, the proportion of homicides was disproportionately higher for blacks (regardless of sex) with a rate five to six times higher compared with any other racial group.<sup>25</sup> Similarly, our study shows that from 2007 to 2016, minority women did not experience a similar decline in the proportion of assault and firearm-related trauma compared with white women. This is specifically highlighted by the 3.5% decrease in firearm-related assault for black women compared with the 19.5% decrease seen by white women. The cause of these differing results is undoubtedly multifactorial and requires further research. Medical societies and organizations including the American College of Physicians, American College of Surgeons, and the Centers for Disease Control and Prevention have advocated for the need to address firearm-related injuries through advocacy and research to determine effective and durable strategies for reducing firearm injury.<sup>26–28</sup> One proposed approach has been through the employment of community engagement and partnership.<sup>27</sup> As such, Stewart et al.<sup>27</sup> suggest that to spark change, active engagement is required by the community of interest to develop strategies that “(1) change behavior, (2) improve and modify the “vehicle” causing the injury (firearms), (3) modify

the environment (physical and social determinants of health), and (4) politically advocate for the people who are impacted and those who care about the patients.”

Finally, these findings expand important prior work characterizing the influence of alcohol and firearm-related traumas.<sup>22,29</sup> Numerous state laws and ordinances exist to detract individuals from the concomitant use of firearms and alcohol.<sup>30</sup> Despite this, the current study demonstrates that the use of alcohol, either as a comorbidity or clinical presence at time of admission, is directly correlated to increased rates of firearm-related assaults. This association is particularly prevalent in minority women where the rates of alcohol use are higher. The current study noted that, at baseline, a black woman who did not have a history of alcohol abuse had two times the odds being a firearm-related assault compared with a white woman. This effect measure significantly increased if she had a history of alcohol abuse. Prior studies have attempted to characterize this relationship. For example, Wintemute<sup>29</sup> noted that prior alcohol-related convictions were associated with a five-fold increase in the risk of firearm-related assault. Although this relationship does not equate to causation, future studies should explore the interconnection between alcohol use and firearm violence.<sup>22</sup> Numerous initiatives and measures have been established to mitigate violence across the country. Some hospitals fund programs focused on primary, secondary, and tertiary prevention of violence that have been proven to be effective.<sup>31</sup> A key component to the hospital approach to violence prevention includes pinpointing risk factors and determining target populations.<sup>31</sup> By revealing current trends and prevalence of trauma-related injuries, programs intended to prevent violence can design approaches that can be most effective for at-risk populations like women.<sup>32</sup> In addition, the aggregate work-loss and medical costs for violent injuries in the United States in 2010 were estimated to be US \$42.4 billion and US \$7.1 billion, respectively, indicating the additional importance of violence prevention translating into substantial cost savings.<sup>33</sup> Our study illustrated that over 50% of assault-related trauma victims were underinsured (Medicaid/uninsured) and minority women, in any trauma setting, were predominantly underinsured as well. Collectively this may shed light on the financial burden trauma places on victims along with the hospital system.<sup>34,35</sup> Based on the aforementioned information, insurance status may present a unique modality to identify at-risk populations, either as a whole or within their geographic location. Unfortunately, the NTDB does not provide much information related to SES. Previous studies have acknowledged that the use of insurance status could be used as a proxy for SES since socioeconomic information is usually limited in electronic medical records,<sup>36</sup> but with corresponding confounding factors. Until records capture a more ample description of SES, understanding its relationship to health inequalities will be imperfect. Several limitations should be considered when interpreting the results of the present study. Similar to other retrospective studies using large databases, the NTDB is subject to information bias. To limit information bias, only data sets after the creation of the National Trauma Data Standard were utilized.<sup>36</sup> Despite the NTDB collecting extensive information on over seven million trauma incidents annually throughout the United States from Levels I, II, and III trauma centers alongside many nontrauma centers, the NTDB lacks information regarding laboratory values,

functional status, and long-term outcomes such as readmissions.<sup>37</sup> Additionally, information delving into social determinants of health, such as marital status, income, and education level, which may be important to consider when examining the association between race and trauma subtype, are not available in the NTDB. As such, to limit the effect of confounding bias, we utilized a multivariable multinomial regression analysis which is well equipped to determine factors of association of a dependent variable with multiple discrete, noncontinuous outcomes.<sup>38</sup> Given that the NTDB represents a convenience sample of traumas nationally and the ethnic heterogeneity in individuals who identify as black and Hispanic, the results may not be able to be extrapolated to all traumas.<sup>39</sup> When extrapolating the results presented, investigators should take into consideration environmental as well as other contextual variables within their population of interest.

In conclusion, from 2007 to 2016, the proportion of unintentional and self-inflicted trauma in women remained relatively unchanged. However, although the proportion of assault-related trauma in women decreased during the study period, the magnitude of change was significantly less profound in minority women compared with white women. Consequentially, racioethnic minorities were found to be a compelling predictor of assault and firearm-related assault with a history of alcohol abuse more strongly binding the association between minority women and firearm-related assault. Our findings should prompt the development of additional studies leading to changes in social policies that address the consequences of racioethnic disparities in traumatic events among women. Further studies are essential to help mitigate disparities and subsequently develop preventative services for this diverse population.

#### AUTHORSHIP

S.N.I. participated in the literature search, study design, data collection, data analysis, data interpretation, writing, critical revision. N.P. participated in the literature search, study design, writing, critical revision. D.F. participated in the data collection, data analysis, data interpretation. A.Z.P. participated in the study design, data collection, data analysis, data interpretation, writing, critical revision. S.K.S. participated in the study design, critical revision. A.T.R. participated in the literature search, writing, critical revision. J.J.S. participated in the literature search, study design, writing, critical revision.

#### DISCLOSURE

The authors declare no funding or conflicts of interest.

#### REFERENCES

1. United States Census Bureau. U.S. Census Bureau Projections Show a Slower Growing, Older, More Diverse Nation a Half Century from Now [Internet]. Newsroom Archive. 2012. Available from: <https://www.census.gov/newsroom/releases/archives/population/cb12-243.html>. Accessed Nov. 18, 2019.
2. Centers for Disease Control and Prevention National Center for Injury Prevention and Control. *Leading Causes of Death Reports, 1981–2017* [Internet]. *WISQARS*. Atlanta, GA; 2019. Available from: <https://webappa.cdc.gov/sasweb/ncipc/leadcause.html>. Accessed Nov. 18, 2019.
3. Haider AH, Chang DC, Efron DT, Haut ER, Crandall M, Cornwell EE 3rd. Race and insurance status as risk factors for trauma mortality. *Arch Surg*. 2008;143(10):945–949.
4. Loberg JA, Hayward RD, Fessler M, Edhayan E. Associations of race, mechanism of injury, and neighborhood poverty with in-hospital mortality from trauma: a population-based study in the Detroit metropolitan area. *Medicine (Baltimore)*. 2018;97(39):e12606.
5. Bedri H, Romanowski KS, Liao J, Al-Ramahi G, Heard J, Granchi T, Wibbenmeyer L. A National Study of the effect of race, socioeconomic status, and gender on burn outcomes. *J Burn Care Res*. 2017;38(3):161–168.
6. Schoenfeld AJ, Belmont PJ Jr, See AA, Bader JO, Bono CM. Patient demographics, insurance status, race, and ethnicity as predictors of morbidity and mortality after spine trauma: a study using the National Trauma Data Bank. *Spine J*. 2013;13(12):1766–1773.
7. Kalesan B, Zuo Y, Vasan RS, Galea S. Risk of 90-day readmission in patients after firearm injury hospitalization: a nationally representative retrospective cohort study. *J Inj Violence Res*. 2019;11(1):65–80.
8. Sumner SA, Mercy JA, Dahlberg LL, Hillis SD, Klevens J, Houry D. Violence in the United States: status, challenges, and opportunities. *JAMA*. 2015;314(5):478–488.
9. Hoel AW, Kayssi A, Brahmanandam S, Belkin M, Conte MS, Nguyen LL. Under-representation of women and ethnic minorities in vascular surgery randomized controlled trials. *J Vasc Surg*. 2009;50(2):349–354.
10. Jagsi R, Motomura AR, Amarnath S, Jankovic A, Sheets N, Ubel PA. Under-representation of women in high-impact published clinical cancer research. *Cancer*. 2009;115(14):3293–3301.
11. Institute of Medicine (US) Committee on the Ethical and Legal Issues Relating to the Inclusion of Women in Clinical Studies. In: *Women and Health Research: Ethical and Legal Issues of Including Women in Clinical Studies: Volume 2: Workshop and Commissioned Papers*. Mastroianni CA, Faden R, Federman D, eds. Washington, DC; 1999.
12. Brown C. Women's narratives of trauma: (re) storytelling. *Narrat Work Issues, Investig Interv*. 2013;3(1):1–30.
13. Kwan RO, Cureton EL, Dozier KC, Victorino GP. Gender differences among recidivist trauma patients. *J Surg Res*. 2011;165(1):25–29.
14. World Health Organization. Strengthening the role of the health system in addressing violence, in particular against women and girls, and against children. *67th World Heal Assem*. 2014;1–6.
15. DuMonthier A, Childers C, Milli J. The Status of Black women in the United states [Internet]. 2017 [cited 2019 Nov 25]. Available from: [www.iwpr.org/www.statusofwomendata.org](http://www.iwpr.org/www.statusofwomendata.org). Accessed Nov. 19, 2019.
16. Chang MC. National Trauma Data Bank 2016 Annual Report [Internet] 2016. Available from: <https://www.facs.org/-/media/files/quality-programs/trauma/ntdb/ntdb-annual-report-2016.ashx>. Accessed Nov. 29, 2019.
17. Bergen G, Chen LH, Warner M, Fingerhut LA. *Injury in the United States: 2007 Chartbook*. Hyattsville, MD: National Center for Health Statistics. 2008.18.
18. Hicks CW, Hashmi ZG, Velopulos C, Efron DT, Schneider EB, Haut ER, Cornwell EE 3rd, Haider AH. Association between race and age in survival after trauma. *JAMA Surg*. 2014;149(7):642–647.
19. Bennett KM, Vaslef SN, Shapiro ML, Brooks KR, Scarborough JE. Does intent matter? The medical and societal burden of self-inflicted injury. *J Trauma*. 2009;67(4):841–847.
20. Department of Health and Human Services Centers for Disease Control and Prevention. Definitions of WISQARS Nonfatal [Internet]. WISQARS Nonfatal Navigation. 2007. Available from: <https://www.cdc.gov/ncipc/wisqars/nonfatal/definitions.htm#nonfatalinjury>. Accessed Nov. 19, 2019.
21. McKee J, Widder SL, Paton-Gay JD, Kirkpatrick AW, Engels P. A ten year review of alcohol use and major trauma in a Canadian province: still a major problem. *J Trauma Manag Outcomes*. 2016;10:2.
22. Branas CC, Han S, Wiebe DJ. Alcohol use and firearm violence. *Epidemiol Rev*. 2016;38(1):32–45.
23. Zhang X, Pérez-Stable EJ, Bourne PE, Peprah E, Duru OK, Breen N, Berrigan D, Wood F, Jackson JS, Wong DWS, Denny J. Big data science: opportunities and challenges to address minority health and health disparities in the 21st century. *Ethn Dis*. 2017;27(2):95–106.
24. Planty M, Truman JL. *Firearm violence, 1993–2011. Measures of Violent Crime: Select Reports from the Bureau of Justice Statistics*. U.S. Department of Justice; 2013:1–57.
25. Cooper A, Smith E. Homicide trends in the United States, 1980–2008. Annual rates for 2009 and 2010. *Patterns & Trends*. 2011;17(2):1–36.
26. Butkus R, Doherty R, Bornstein SS, Health and Public Policy Committee of the American College of Physicians. Reducing firearm injuries and deaths in the United States: a position paper from the American College of Physicians. *Ann Intern Med*. 2018;169(10):704–707.



27. Stewart RM, Kuhls DA. Firearm injury prevention: a consensus approach to reducing preventable deaths. *J Trauma Acute Care Surg.* 2016;80(6):850–852.
28. Talley CL, Campbell BT, Jenkins DH, et al. Recommendations from the American College of Surgeons Committee on Trauma's Firearm Strategy Team (FAST) workgroup: Chicago Consensus I. *J Am Coll Surg.* 2019;228(2):198–206.
29. Wintemute GJ. Alcohol misuse, firearm violence perpetration, and public policy in the United States. *Prev Med.* 2015;79:15–21.
30. Carr BG, Porat G, Wiebe DJ, Branas CC. A review of legislation restricting the intersection of firearms and alcohol in the U.S. *Public Health Rep.* 2010;125(5):674–679.
31. Health Research and Educational Trust. Hospital Approaches to Interrupt the Cycle of Violence [Internet]. Chicago, IL; 2015. Available from: www.hope.org. Accessed Nov 19, 2019.
32. Purtle J, Dicker R, Cooper C, Corbin T, Greene MB, Marks A, Creaser D, Topp D, Moreland D. Hospital-based violence intervention programs save lives and money. *J Trauma Acute Care Surg.* 2013;75(2):331–333.
33. Monuteaux MC, Fleegler EW, Lee LK. A cross-sectional study of emergency care utilization and associated costs of violent-related (assault) injuries in the United States. *J Trauma Acute Care Surg.* 2017;83(2):310–315.
34. Bell TM, Zarzaur BL. Insurance status is a predictor of failure to rescue in trauma patients at both safety net and non-safety net hospitals. *J Trauma Acute Care Surg.* 2013;75(4):728–733.
35. Englum BR, Hui X, Zogg CK, et al. Association between insurance status and hospital length of stay following trauma. *Am Surg.* 2016;82(3):281–288.
36. Casey JA, Pollak J, Glymour MM, Mayeda ER, Hirsch AG, Schwartz BS. Measures of SES for electronic health record-based research. *Am J Prev Med.* 2018;54(3):430–439.
37. Hashmi ZG, Kaji AH, Nathens AB. Practical guide to surgical data sets: National Trauma Data Bank (NTDB). *JAMA Surg.* 2018;153(9):852–853.
38. Coughenour C, Paz A, de la Fuente-Mella H, Singh A. Multinomial logistic regression to estimate and predict perceptions of bicycle and transportation infrastructure in a sprawling metropolitan area. *J Public Health (Oxf).* 2016;38(4):e401–e408.
39. Griffith DM, Johnson JL, Zhang R, Neighbors HW, Jackson JS. Ethnicity, nativity, and the health of American blacks. *J Health Care Poor Underserved.* 2011;22(1):142–156.