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Racial and Ethnic Differences in the Prevalence of Do-Not-Resuscitate Orders among Older Adults with Severe Traumatic Brain Injury

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Abstract

Background: Older adults suffering from traumatic brain injury (TBI) are subject to higher injury burden and mortality. Do Not Resuscitate (DNR) orders are used to provide care aligned with patient wishes, but they may not be equitably distributed across racial/ethnic groups. We examined racial/ethnic differences in the prevalence of DNR orders at hospital admission in older patients with severe TBI.

Methods: We conducted a retrospective cohort study using the National Trauma Databank (NTDB) between 2007 to 2016. We examined patients ≥ 65 years with severe TBI. For our primary aim, the exposure was race/ethnicity and outcome was the presence of a documented DNR at hospital admission. We conducted an exploratory analysis of hospital outcomes including hospital mortality, discharge to hospice, and healthcare utilization (intracranial pressure monitor placement, hospital LOS, and duration of mechanical ventilation).

Results: Compared to White patients, Black patients (OR 0.48, 95% CI 0.35-0.64), Hispanic patients (OR 0.54, 95% CI 0.40-0.70), and Asian patients (OR 0.63, 95% CI 0.44-0.90) had decreased odds of having a DNR order at hospital admission**.** Patients with DNRs had increased odds of hospital mortality (OR 2.16, 95% CI 1.94-2.42), discharge to hospice (OR 2.08, 95% CI 1.75-2.46), shorter hospital LOS (−2.07 days, 95% CI −3.07 to −1.08) and duration of mechanical ventilation (−1.09 days, 95% CI −1.52 to −0.67). There was no significant difference in the utilization of ICP monitoring (OR 0.94, 95% CI 0.78-1.12).

Conclusions: We found significant racial and ethnic differences in the utilization of DNR orders among older patients with severe TBI. Additionally. DNR orders at hospital admission were associated with increased in-hospital mortality, increased hospice utilization, and decreased healthcare utilization. Future studies should examine mechanisms underlying race-based differences in DNR utilization.

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Introduction

Traumatic brain injury (TBI) is among the leading causes of death and disability worldwide, with older adult TBI patients experiencing significantly higher morbidity and mortality compared to younger patients.[1] Older adults suffering from TBI are more likely to sustain a severe injury, incur longer ICU stays, have increased severity of disability, and increased mortality.[1–3] Despite their increased risk profile, the prevalence of completed advance directives (ADs) in older adult trauma patients ranges from 6-18%[4,5] and the prevalence of a pre-existing Do Not Resuscitate (DNR) order is as low as 7%.[6] Having a DNR order may reduce undesired escalation of care and align treatment with goals of care in a population that is often incapable of expressing these desires following injury. Additionally, there is evidence of inequitable rates of AD and DNR completion rates in primary care populations across different races and ethnicities;[7–10] however, there is little data examining racial and ethnic differences in DNRs in the TBI population.

To address this gap in knowledge, the aim of this study was to examine racial/ethnic differences in the prevalence of DNR orders at hospital admission in older adult patients with severe TBI.

Methods

Database and Study Design

We conducted a retrospective cohort study, using data from the National Trauma Databank (NTDB) between 2007 to 2016. The NTDB houses the largest collection of trauma data in the United States, including data on over 7.5 million patients across 700 trauma centers in the United States. The NTDB is fully de-identified; therefore, this study was exempt from Institutional Review Board (IRB) review by the Duke University Health System IRB.

Study Population

Using the NTDB dataset, we identified adult patients who suffered severe TBI, using International Classification of Disease ninth Revision (ICD-9) and 10th Revision (ICD-10) diagnosis codes. Severity of TBI was assessed using the emergency department Glasgow Coma Scale (GCS) score, and we excluded patients with mild and moderate TBI (with GCS > 8). We further excluded patients who were not admitted to the hospital, patients < 65 years of age, patients who died in the emergency department or within 24 h of hospital admission (as this likely indicates death from head injury alone, without time for a DNR to contribute meaningfully to clinical outcome).

Exposure, Outcomes, and Covariates

For our primary research objective (to examine racial/ethnic differences in the prevalence of DNR orders at hospital admission), the exposure was race/ethnicity and the primary outcome was DNR utilization, defined as the presence of a DNR order at to hospital admission. The data on race and ethnicity is self-reported by the patient or identified by a family member. The fields include Asian, American Indian, Black, Native Hawaiian or Other Pacific Islander, White, or Other race. Field values for ethnicity are limited to "Hispanic or Latino" or "Not Hispanic or Latino." We classified race/ethnicity into the following groups: White, Black, Hispanic, Asian, and Other Race.[11] Our subcategory of "Other race" combines patients that self-identified as "Other race" or Native Hawaiian and Pacific islander.

We conducted a second exploratory analysis (examination of clinical outcomes associated with admission DNR orders in older patients with severe TBI), our exposure was DNR utilization and our outcomes included hospital mortality, discharge to hospice and health care utilization [intracranial pressure monitoring, duration of mechanical ventilation (among patients receiving invasive mechanical ventilation), and hospital length of stay (among survivors)]. Additional covariates examined included demographic (age, sex, insurance status), clinical (co-morbidities, Glasgow Coma Scale score, injury severity score, injury mechanism, emergency department vital signs, mechanical ventilation), and facility (hospital size, hospital level 1 trauma designation, hospital teaching status, hospital census region) characteristics.

Statistical Methods

Descriptive statistics were used to examine demographic, clinical, facility, and outcome characteristics. Patients were stratified by the presence of a DNR order at admission. We examined differences across race/ethnicity over time (calendar year) using descriptive statistics. Continuous data was summarized using means and standard deviations and categorical data was summarized as counts and percentages. To examine univariate associations across variables, a Chi-squared test was used to examine categorical variables and a Student's t-test was used to examine continuous variables. To examine the association of race/ethnicity with DNR utilization, we used a multivariable mixed-effects logistic regression model (with individual hospital modeled as a random effect to account for clustering at the hospital level), adjusted for the following co-variates (modeled as fixed effects), selected a priori, based on a prior literature[12] and study team subject matter expertize: age, sex, need for mechanical ventilation, emergency department GCS score, injury severity score, insurance status, treatment calendar

Table 1. Demographic, Clinical, and Facility Characteristics of Study Population Stratified by Presence of a pre-Existing Do Not Resuscitate Order.

Variable	**Total**	**DNR**		***p* value**
		No	**Yes**	
Subjects	30 660	28 782	1878	<.001
Age				
Mean (SD)	75.9 (7.2)	79.2 (6.8)	75.6 (7.2)	<.001
Gender [no. (%)]				
Male	18 639 (61%)	17 621 (61%)	1018 (54%)	<.001
Female	12 013 (39%)	11 153 (39%)	860 (46%)	
Race [no. (%)]				
White	24 822 (80.1%)	23 159 (80.5%)	1663 (88.6%)	<.001
Black	1943 (6.3%)	1880 (6.5%)	63 (3.4%)	
Hispanic	1988 (6.5%)	1922 (6.68%)	66 (3.5%)	
Asian	1000 (3.3%)	946 (3.29%)	54 (2.9%)	
Other	907 (3.0%)	875 (3.0%)	32 (1.7%)	
Injury Mechanism [no. (%)]				
MVT	6165 (20.1%)	5984 (20.8%)	181 (9.6%)	<.001
Fall	18 258 (59.6%)	16 995 (59.0%)	1263 (67.0%)	
Firearm	502 (1.6%)	477 (1.7%)	25 (1.3%)	
Cyclist/Pedestrian	935 (3.1%)	911 (3.2%)	24 (1.3%)	
Struck by, against	583 (2%)	569 (2.0%)	14 (0.8%)	
Other	4217 (13.8%)	3846 (13.4%)	371 (19.8%)	
Admission GCS				
Mean (SD)	4.26 (1.8)	4.23 (1.8)	4.64 (1.9)	<.001
Injury Severity Score				
Mean (SD)	22.7 (10.5)	22.7 (10.6)	22.4 (9.5)	.23
ER arrival SBP				
Mean (SD)	147.6 (39.8)	147.4 (39.9)	149.6 (37.5)	.024
ER arrival heart rate				
Mean (SD)	88.9 (23.4)	89.0 (23.5)	88.1 (22.4)	.12
Comorbidities [no. (%)]				
CHF	2279 (7.4%)	974 (3.4%)	72 (3.8%)	<.001
History of MI	1046 (3.4%)	974 (3.4%)	72 (3.8%)	.298
Dialysis/CKD	546 (1.8%)	489 (1.7%)	57 (3%)	<.001
History of CVA	2090 (6.8%)	1902 (6.6%)	188 (10.1%)	<.001
History of DM	6913 (22.6%)	6410 (22.3%)	503 (26.8%)	<.001
Respiratory Disease	2601 (8.5%)	2390 (8.3%)	211 (11.2%)	<.001
Dementia	1297 (4.2%)	1019 (3.5%)	278 (14.8%)	<.001
Disseminated Cancer	593 (1.9%)	522 (1.8%)	71 (3.8%)	<.001
History of PVD	235 (0.8%)	199 (0.7%)	36 (1.9%)	<.001
Hypertension	15 654 (51.1%)	14 495 (50.4%)	1159 (61.7%)	<.001
Composite Vascular Risk	4992 (16.3%)	4556 (15.8%)	436 (23.2%)	<.001
Facility [no. (%)]				
Northeast	5758 (18.9%)	5393 (19.0%)	365 (19.5%)	.063
Midwest	7344 (24.2%)	6860 (24.1%)	484 (25.9%)	
West	5886 (19.4%)	5512 (19.4%)	374 (20.0%)	
South	11 343 (37.4%)	10 697 (37.6%)	646 (34.6%)	
Hospital Bed Size [no. (%)]				
≤ 200	1009 (3.3%)	937 (3.3%)	72 (3.8%)	.307
201-400	7057 (23.0%)	6624 (23.0%)	433 (23.1%)	
401-600	9319 (30.4%)	8776 (30.5%)	543 (28.9%)	
> 600	13 275 (43.3%)	12 445 (43.2%)	830 (44.2%)	
Teaching Hospital [no. (%)]				
Yes	16 320 (53.2%)	15 471 (53.7%)	849 (45.2%)	<. 001
Level I Trauma Center				
Yes	12 291 (40.1%)	11 570 (40.2%)	721 (38.4%)	.122
Payor				
Private/Commercial	3727 (12.2%)	3527 (12.3%)	200 (10.7%)	<.001
Medicare	20 667 (67.4%)	19 203 (66.7%)	1474 (78.5%)	

(continued)

Table 1. (continued)

Variable	Total	DNR	*p* value
Medicaid	662 (2.1%)	635 (2.2%)	27 (1.4%)
Other	3904 (12.7%)	3766 (13.1%)	138 (7.4%)
None	1690 (5.5%)	1651 (5.7%)	39 (2.1%)

Table 2. Association of DNRs with Race and Ethnicity.

Race	Effect	95% CI	*p*
White (Reference)	-	-	-
Black	Odds ratio 0.48	Odds ratio 0.35-0.64	<.001
Hispanic	Odds ratio 0.54	Odds ratio 0.40-0.74	<.001
Asian	Odds ratio 0.63	Odds ratio 0.44-0.90	.001
Other	Odds ratio 0.49	Odds ratio 0.33-0.74	<.001

year, emergency department hypotension (defined as systolic blood pressure < 90 mm Hg), emergency department heart rate, co-morbidities (respiratory disease, cancer, diabetes, dementia), hospital census region, hospital bed size, hospital teaching status, and hospital level 1 trauma center designation. To examine the association of DNR utilization with clinical outcomes, we used multivariable mixed-effects logistic regression models for binary outcomes and multivariable mixed-effects linear regression for continuous outcomes, adjusted for the above co-variates. Given that we pre-specified a single primary outcome (with the remainder of secondary outcomes considered as exploratory/hypothesis generating), no additional adjustments were made for multiple testing. All analyses were conducted using STATA 15.0 (College Station, Texas).

Results

Demographic and Clinical Characteristics of Study Population

The final cohort consisted of 30,660 patients. Details on the demographic, clinical, and facility characteristics of the population stratified by the presence of a DNR on admission are found in Table 1. The mean age of patients with DNR was 79.2 ± 6.8 years, 860 (45.79%) were female, 1018 were (54.21%) male; 1663 (88.55%) were White, 63 (3.35%) were Black, 66 (3.51%) were Hispanic, 54 (2.88%) were Asian, and 32 (1.70%) were classified as Other Race. The mean age of patients without DNR was 75.7 ± 7.2 years, 11 153 (38.75%) were female, 17 621 were (61.22%%) male; 23 159 (80.46%) were White, 1880 (6.53%) were Black, 1922 (6.68%) were Hispanic, 946 (3.29%) were Asian, and 875 (3.04%) were classified as Other Race.

Racial/Ethnic Differences in the Prevalence of DNRs

Table 2 shows the relationship of race/ethnicity with the prevalence of DNR orders at hospital admission. Compared to White patients, all racial/ethnic groups had decreased odds of having a pre-existing DNR including Black (OR 0.48, 95% CI 0.35-0.64), Hispanic (OR 0.54, 95% CI 0.40-0.74), Asian (OR 0.63, 95% CI 0.44-0.90) and Other race (OR 0.49, 95% CI 0.33-0.07) groups. Figure 1 depicts the percentage of patients with DNRs, stratified by race and ethnicity. Figure 2 depicts the percentage of patients with DNRs across time, stratified by race and ethnicity. The proportion of patients with DNR orders increased over time across all groups. White patients demonstrated the greatest increase in DNR orders over time compared to all other racial and ethnic groups.

Association of Admission DNRs and Clinical Outcomes

Table 3 shows the in-hospital outcomes among patients who presented with an advanced directive and those who did not. Compared to patients without admission DNR orders, patients with admission DNR orders had increased odds of in-hospital mortality (OR 2.16, 95% CI 1.94-2.42) and discharge to hospice (OR 2.16, 95% CI 1.94-2.42). There was no difference in the utilization of invasive ICP monitoring for patients with and without admission DNR orders. (OR 0.94, 95% CI 0.78-1.12). Compared to patients without admission DNR orders, total ventilator duration was shorter among patients who were mechanically ventilated (mean difference −1.09, 95% CI −1.52 to −0.67) and hospital LOS was decreased among patients who survived to hospital discharge (mean difference −.207, 95% CI −.31 to −1.08, $P < .001$) in patients with admission DNR orders.

Discussion

Our retrospective multi-center cohort study examined the relationship between race and ethnicity and the prevalence of DNRs in older adults who sustained severe TBI. In a further exploratory analysis, we investigated the association of DNRs and clinical outcomes. We found significant racial/ethnic differences in DNR utilization, as well as an association of DNR orders with decreased healthcare utilization.

Our results suggest an association between DNR utilization and race and ethnicity

Additionally, we show that while DNR prevalence has increased across all groups from 2008 to 2016, the rate of change is not equal across races and ethnicities. There is a large body of evidence suggesting that race and ethnicity

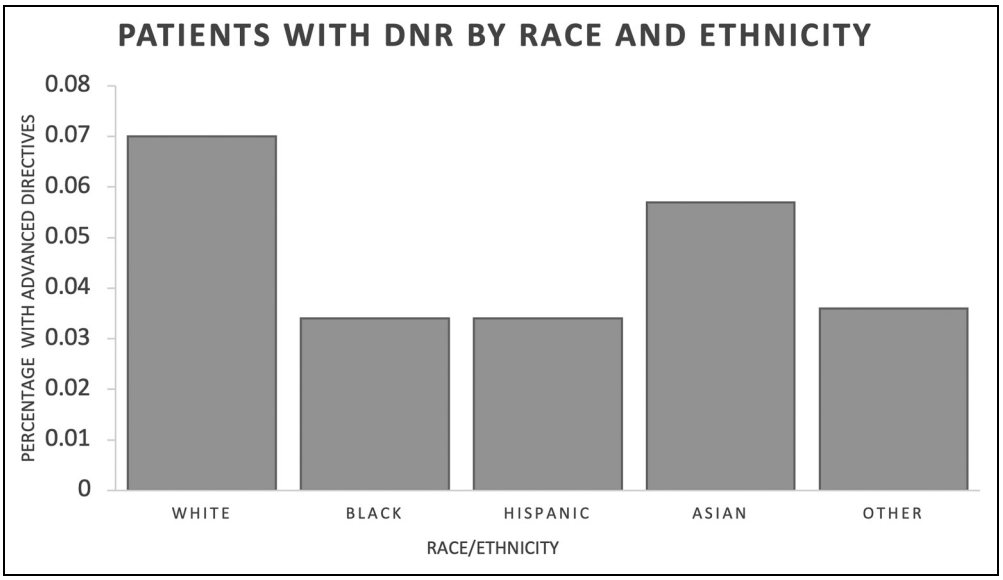

Figure 1. Percentage of patients with DNR by race and ethnicity.

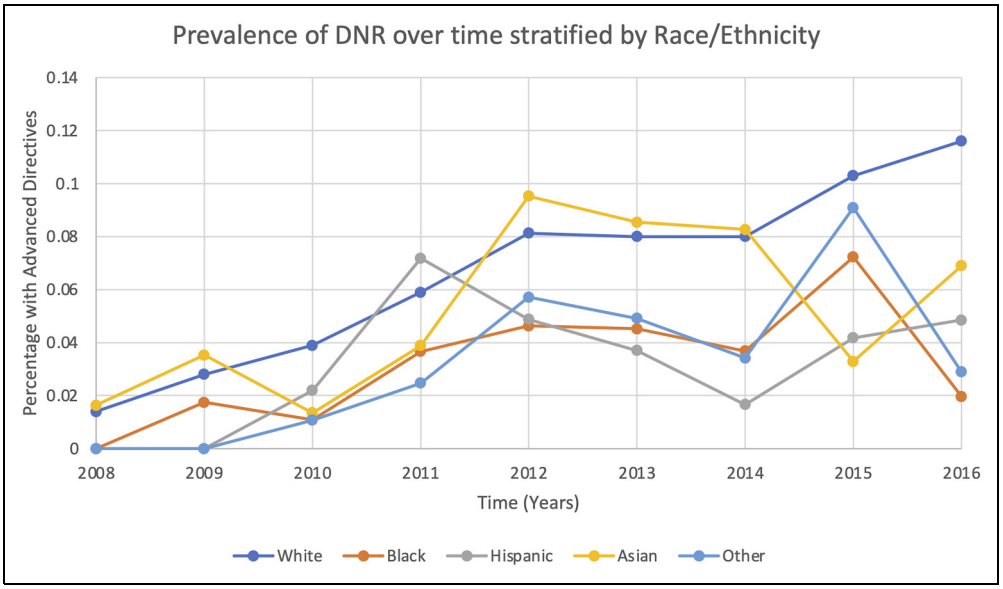

Figure 2. Percentage of patients with DNR over time stratified by race and ethnicity.

influences AD and DNR completion rates, and while our findings are unique to our older adult TBI patients, they are consistent with previous studies that demonstrated decreased AD completion rates in Black and Hispanic populations.[7–10,13,14] A study by Johnson et al demonstrated that Black patients were less likely to have an advanced directive and held less favorable beliefs about hospice care compared to White patients.[13] After a comprehensive assessment of beliefs and values between populations such as preferences for life-sustaining treatments, comfort discussing death, levels of trust of the healthcare system, and spiritual beliefs, race was no longer a significant predictor. Other studies have posited that cultural and spiritual beliefs regarding death and dying play a role in advance care planning differences between Black and White patients, but these are compounded by systemic challenges including inequitable barriers to utilization and mistrust of health care providers.[14–17] Future studies are required to wholistically understand the pre-admission interactions between provider and patient that may be underlying racial and ethnic differences in DNR utilization. Additionally, while our data is demonstrates a statistically significant association between race and DNR use in the severe TBI older adult population, our results must be interpreted with discretion given the limited sample size. Follow-up studies conducted with larger census-based datasets that more accurately reflect the proportion of non-white patients may strengthen this claim.

Table 3. Association of DNRs with Treatments and Outcomes.

Outcomes	Effect	95% CI	*p*
Hospital Mortality	Odds ratio 2.16	Odds ratio 1.94-2.42	<.001
Discharge to Hospice	Odds ratio 2.08	Odds ratio 1.75-2.46	<.001
ICP Monitoring	Odds ratio 0.94	Odds ratio 0.78-1.12	0.465
Hospital LOS	Diff. in Means −2.07	Diff. in Means −.31 to −1.08	<.001
Ventilator Duration	Diff. in Means −1.09	Diff. in Means −1.52 to −0.67	<.001

Older adults are known to have worse outcomes following TBI. The interplay between several factors such as increased baseline co-morbidities, the incidence of falls, and the use of anticoagulants are linked with dramatic differences in morbidity in older adult TBI.[1–3] Age alone is an independent risk factor for worsened long-term functional outcomes.[1] Given the longer hospitalizations, lengthened recovery, and worsened outcomes in this population, goals of care discussions in the primary care setting are critically important to provide care that is concordant with patients' wishes in the event of critical illness or injury.

In addition to our primary outcomes, we found several clinical outcomes that related to DNR status. A common theme in the literature is concern from providers and patients that the presence of an AD or DNR may lead to inadvertent undertreatment or sub-standard care.[18,19] There was no statistically significant difference in the placement of invasive ICP monitoring, which suggests that despite the presence of DNRs, these patients received equitable acute care. Metrics such as these may be additive in building patient-provider trust and play crucial a role in the narrative of end-of-life conversations. Further, this may serve to alleviate provider concerns that DNR orders diminish the use of life-prolonging treatments.[18,20] Patients with a DNR demonstrated higher mortality and increased likelihood of discharge to hospice, which may reflect adherence to goal-appropriate care. Patients with a higher comorbidity burden may be more likely to complete a DNR and this may influence the differences seen in mortality. Additionally, patients with a DNR experienced fewer days on the ventilator and decreased hospital LOS. Future studies should further examine the impact of DNRs on the timing of the withdrawal of life-sustaining therapy.

The nature of brain injury often results in families making difficult goals of care decisions after admission.[21] Studies have shown that adherence to advanced care practices reduces anxiety, depression, and PTSD for relatives.[22,23] Ultimately, the highest priority of DNR documentation is to exercise the right of patient autonomy and to best align care with the wishes of the patient. This is particularly salient in the older adult TBI population given the dramatically increased odds of morbidities and poor return to function compared to their younger counterparts.

There are several limitations to our study. First, given the administrative nature of our database, detection of variables depended on accurate coding; and it was not possible to confirm these variables given the nature of our data and inability to access patient charts. Therefore, the data may be subject to misclassification of exposures, outcomes, or covariates. For example, misclassifying dually enrolled patients as Medicare only may have led to the underrepresentation of patients with Medicaid within our cohort. Second, the NTDB lacks functional outcomes, so our outcomes data is restricted to admission through discharge and long-term functional implications could not be examined. Third, while our paper highlights differences in the prevalence of DNR stratified by race and ethnicity, it is limited in its scope and our analysis could not explore additional variables such as religion, spirituality, cultural preferences, area deprivation, and income. Fourth, given that the NTDB is not a population-based database, the distribution of Black and Hispanic patients is not representative of the US census data. This carries the risk of oversampling and may impact the applicability of our study. Fifth, patients who obtained DNRs after admission were not included in the cohort and therefore our study is limited to pre-existing DNRs. Finally, the retrospective and observation nature of our study places the analysis at risk for additional confounding for unmeasured covariates and limits the conclusions that may be established.

Conclusion

We found significant racial and ethnic differences in the utilization of DNR orders among older patients with severe TBI. Additionally, DNR orders at hospital admission were associated with increased in-hospital mortality, increased hospice utilization, and decreased healthcare utilization. Future studies should examine mechanisms underlying race-based differences in DNR utilization.

Declaration of Conflicting Interests

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Supplemental Material

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