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Race/Ethnicity and Retention in Traumatic Brain Injury Outcomes Research: A Traumatic Brain Injury Model Systems National Database Study

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Abstract

Objective: To investigate the contribution of race/ethnicity to retention in traumatic brain injury (TBI) research at 1 to 2 years postinjury.

Setting: Community.

Participants: With dates of injury between October 1, 2002, and March 31, 2013, 5548 whites, 1347 blacks, and 790 Hispanics enrolled in the Traumatic Brain Injury Model Systems National Database.

Design: Retrospective database analysis.

Main Measure: Retention, defined as completion of at least 1 question on the follow-up interview by the person with TBI or a proxy.

Results: Retention rates 1 to 2 years post-TBI were significantly lower for Hispanic (85.2%) than for white (91.8%) or black participants (90.5%) and depended significantly on history of problem drug or alcohol use. Other variables associated with low retention included older age, lower education, violent cause of injury, and discharge to an institution versus private residence.

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Conclusions: The findings emphasize the importance of investigating retention rates separately for blacks and Hispanics rather than combining them or grouping either with other races or ethnicities. The results also suggest the need for implementing procedures to increase retention of Hispanics in longitudinal TBI research.

Keywords

cultural competency; follow-up studies; traumatic brain injury

COGNITIVE,[1] EMOTIONAL,[2] AND PHYSICAL[3] impairments resulting from traumatic brain injury (TBI) contribute to decreased independent living,[4] employment,[5] and participation in leisure activities.[6] Approximately 3.2 million US residents are estimated to have long-term or lifelong disability resulting from TBI.[7] Unfortunately, minorities are disproportionately represented among those who sustain TBI[8] and those with poor outcomes.[9] Blacks and Hispanics with TBI have been shown to have poorer outcomes compared with whites in overall functioning,[10] functional independence,[11] independence in home activities,[12] employment outcomes,[13,14] and satisfaction with participation.[15] Minorities have also been shown to utilize rehabilitation services less than whites in both civilian[16] and military[17] samples. These findings emphasize the need for inclusion of minorities in longitudinal research and clinical trials targeting TBI, as their exclusion can yield a biased view of outcomes.

Recruitment and retention of minorities is challenging for health research as a whole. National Institutes of Health investigators are less likely to meet recruitment goals for minorities compared with whites.[18] Minimal empirical evidence exists to support specific retention strategies.[19] Greater loss of minorities to follow-up is a common problem in research on TBI outcomes, posing a threat to internal and external validity.[20]

The relationship between race/ethnicity and loss to follow-up in TBI research has been investigated in prior studies. Corrigan and colleagues[21] studied predictors of loss to follow-up in 3 longitudinal samples, including the Colorado TBI registry, 5 TBI Model System (TBIMS) centers, and a single brain injury rehabilitation unit. Minorities with TBI were less likely to be followed up at 1 year compared with whites in 2 of the 3 samples investigated. Other variables that predicted loss to follow-up included violent injury, elevated blood alcohol level at hospital admission, lower FIM motor score at rehabilitation admission, nonprivate health insurance, and discharge to an institution. Krellman and colleagues[22] studied predictors of longitudinal follow-up patterns in the TBIMS National Database. Each participant had the opportunity to complete follow-up at 4 time points—1, 2, 5, and 10 years postinjury. Findings were that nonresponders (did not complete any follow-ups, but did not formally withdraw) and wave responders (completed some follow-ups and skipped others) were more likely to be minorities; however, whites were also more likely to be in one of these groups if they were missing data on preinjury education. Missing data on preinjury education, acute care payer, or preinjury employment status were also associated with nonresponding and wave responding. Recently, Jourdan and colleagues[23] studied a sample of 504 adults with severe TBI in Paris. While they did not include race/ethnicity as a variable, they found other associations with loss to follow-up that can inform covariate

analyses. Specifically, loss to follow-up at 1 year postinjury was associated with preinjury unemployment and violent mechanism of injury. Preinjury unemployment and alcohol abuse were predictive of loss to follow-up at 4 years postinjury.

Research findings to date indicate that race/ethnicity likely contributes to retention in longitudinal TBI research, with the pattern being lower retention of minorities; however, the extant research is limited by methodological issues. First, prior studies have either combined blacks with Hispanics or grouped Hispanics with other minorities and compared them with blacks and whites.[21,22] The importance of investigating retention of Hispanics as a separate group is justified by the fact that Hispanics currently represent the largest racial/ethnic minority group in the United States, comprising 17% of the total population.[24] Persons of Hispanic ethnicity make up approximately 10% of current enrollees in the TBIMS National Database.[25] Given their substantial numbers and their likelihood of having poor outcomes compared with whites, investigation of retention of Hispanics as a separate group is warranted. In addition, prior studies have not investigated the potential interaction of race/ethnicity with other variables that may impact retention in longitudinal TBI studies. For example, prior research has shown that minorities with TBI are more likely to be unemployed at the time of injury and to be injured via violence.[16,26] As these variables have also been shown to predict loss to follow-up, they may interact with race/ethnicity to impact retention.

The aims of the current study are to investigate (1) retention in the TBIMS database for whites, blacks, and Hispanics; (2) the contribution of being white, black, or Hispanic to retention at 1 or 2 years postinjury, after controlling for other variables that may impact retention; and (3) the interaction of race/ethnicity with other variables that may impact retention.

METHODS

Participants

Participants included were those enrolled in the National Database of the National Institute for Disability, Independent Living, and Rehabilitation Research (NIDILRR) TBIMS program. The TBIMS National Database includes individuals with newly acquired TBI who receive comprehensive inpatient rehabilitation services at one of the NIDILRR-funded centers in the United States. Twenty-two centers contributed to the dataset for this analysis, with 7685 individuals with dates of injury between October 1, 2002, and March 31, 2013. The start and end dates were selected based on the availability of key variables (variables are periodically added and deleted from the National Database) and to ensure all subjects had become eligible for 2-year follow-up.

Criteria for inclusion in the TBIMS National Database include 16 years and older at time of injury; medically documented complicated mild, moderate, or severe TBI (emergency department Glasgow Coma Scale score ≤12 or duration of posttraumatic amnesia (PTA) >24 hours or loss of consciousness >30 minutes, or evidence of intracranial trauma on neuroimaging); admission to a TBIMS acute care hospital within 72 hours of injury; completion of inpatient rehabilitation within the TBIMS; and informed consent obtained.

During the interval covered by this study, race/ethnicity was coded as a mixed variable rather than 2 separate variables in the TBIMS National Database. Race/ethnicity was coded as white, black, Asian/Pacific Islander, Native American, Hispanic origin, other, or unknown. Only participants coded as white, black, or Hispanic origin were included in the current analysis because the numbers in the other categories were too small to provide a meaningful comparison. As shown in Figure 1, 348 people were excluded for race/ethnicity other than white, black, or Hispanic.

Procedure

Institutional review board approval was obtained at all participating TBIMS institutions. Medical and injury information was abstracted from participants' medical records according to TBIMS National Database standardized procedures.[27] Demographic information was obtained by trained research personnel who interviewed the individual with TBI or a proxy.

Follow-up interviews were conducted in-person, via phone, or through the mail at 1 (±2 months) and 2 years (±3 months) postinjury. Sample derivation is shown in the flowchart in the Figure. In the TBIMS National Database, follow-up status is coded as followed, lost, refused, withdrew, expired, incarcerated, or follow-up not attempted due to a center losing TBIMS funding. Persons eligible for 1- or 2-year follow-up were excluded from the sample if they had expired prior to 1-year follow-up, were incarcerated at both follow-ups, or if no attempt was made to contact them at either follow-up due to loss of funding. Participants were considered to be retained if the interview status variable was coded as "followed" at either year 1 or year 2. Participants were considered to be not retained if interview status was coded as lost, refused, or withdrew at both year 1 and year 2.

Standard follow-up procedures used by all centers included (1) attempting contact as soon as the follow-up window opened; (2) making at least 12 phone contact attempts during various times of day and night and days of the week (including weekends) using the most reliable phone numbers available; (3) sending a letter to the participant and any known contacts at their last known mailing addresses; (4) using phone directory assistance in the last known city of residence, Internet searches, fee-based location services, and medical records to identify updated phone numbers, addresses, or other contact information; (5) conducting a search for potential death information; and (6) conducting a search of an inmate database to determine whether the participant was incarcerated.

Measures

The race/ethnicity category was preferentially determined by asking the persons with injury or their care-giver, but medical record information was used if information could not be obtained in the preferred way. The outcome variable, retention, was a dichotomous variable defined as completion of at least 1 question on either the 1- or 2-year follow-up interview by the person with TBI or a proxy.

Covariates

Injury severity was measured by the duration of PTA—a period marked by confusion and inability to form new memories after TBI that is predictive of global outcomes after

moderate-severe TBI.[28] Duration of PTA was calculated as the number of days between the TBI and the first of 2 occasions within a 72-hour period in which the participant was fully oriented, as defined by a score of 76 or more on the Galveston Orientation and Amnesia Test,[29] a score over 25 on the Orientation Log,[30] or documentation of 2 days with consistent orientation within a 3-day period in the acute medical record with no intervening days at less than full orientation. For the 1442 individuals discharged before emerging from PTA, missing values were imputed by using total length of stay (acute plus rehabilitation) +1 day.[31] Injury severity categories, based on the Mississippi PTA Intervals, were moderate (0–14 days); moderate-severe (15–28 days); severe (29–70 days); and extremely severe (>70 days).[32]

The FIM is an 18-item rating scale of functional independence.[33] Rasch analysis has indicated that items can be divided into a motor factor ranging from 13 to 91 and a cognitive factor ranging from 5 to 35.[34,35] Each item is rated on a scale of 1 (total assistance required) to 7 (complete independence), and higher scores indicate greater independence. FIM has good internal consistency (Cronbach α between 0.86 and 0.97) and has been shown to be sensitive to changes in functional ability from admission to discharge and follow-up.[36,37]

The history of problem substance use was determined by questions adapted from the Centers for Disease Control and Prevention's Risk Factor Surveillance System.[38] These questions pertain to frequency of alcohol consumption and average quantity consumed per occasion. Using established criteria,[38,39] participants were classified as having a history of problem substance use if they endorsed more than 7 drinks per week for women, more than 14 drinks per week for men, or had consumed more than 5 or more drinks on 1 occasion in the month prior to injury, or had used illicit drugs in the year before injury.

Residence at the time of rehabilitation discharge was categorized as private or nonprivate (nursing home, adult home, correctional institution, hotel/motel, homeless, hospital, subacute care, and other). Job stability was defined as the number of weeks worked in the year prior to injury. Cause of injury was classified as violent (gunshot wound; assault with blunt instrument; stabbing; impalement; explosions) or nonviolent (vehicular; sports-related; falls; autopedestrian; hit by falling or flying object). Sex and preinjury marital status, education, and incarcerations were categorized as shown in Table 1.

Data analysis

The demographic and injury characteristics of the sample were summarized separately for each of the 3 race/ethnicity groups using means and standard deviations for continuous variables and frequency counts and percentages for categorical variables. These characteristics were compared between the race/ethnicity groups using χ^2 tests and analysis of variance models.

The probability of being retained was initially modeled as a function of race/ethnicity using logistic regression unadjusted for other patient characteristics. Multivariate logistic regression was then used to model the relationship between race/ethnicity and retention status controlling for 12 patient characteristics that may impact retention in longitudinal studies (age,[40] gender,[41] marital status,[41] education,[40] residence at rehabilitation discharge,

[21] preinjury incarceration, problem substance use,[21,23] violent cause of injury,[21,23] PTA, FIM scores at rehabilitation discharge,[21] and job stability for the year prior to injury[23]). The assumption of linearity in the logit was assessed for all continuous variables and was found to be adequate. Significant interactions between race/ethnicity and patient characteristics were also examined and included in the final adjusted model if significant. All statistical analyses were conducted using SAS v.9.4 (SAS Institute, Cary, North Carolina), with a significance level of .05. Significant interactions were investigated using a Bonferroni correction for the level of significance, as shown in Table 2.

RESULTS

Description of the sample

The demographic and injury characteristics of the sample are summarized by race/ethnicity in Table 1. Overall, the sample was primarily white and single, with at least a high school education and moderate to severe TBI. A substantial number had a history of preinjury problem substance use and most were discharged from rehabilitation to a private residence. The race/ethnicity groups showed significant differences in all patient characteristics (all *P*s ≤ .0004) except for preinjury problem substance use ($P = .9906$). Compared with whites, blacks and Hispanics were less likely to be female, less likely to have a high school education, more likely to have been incarcerated prior to injury, and more likely to have violent cause of injury. Blacks were less likely to be married, and Hispanics were more likely to have less than an eighth-grade education.

Unadjusted relationship between race/ethnicity and retention status

As shown in Table 3, there was a significant difference in retention rates among the 3 race/ethnicity groups ($\chi^2 = 32.5$, $df = 2$, P value < .0001). Retention rates were 91.8% for whites, 90.5% for blacks, and 85.2% for Hispanics. The unadjusted odds of being retained were1.9 times greater for whites as compared with Hispanics (P value < .0001) and 1.7 times greater for blacks as compared with Hispanics (P value = .0002). There was not a significant difference in unadjusted retention rates between whites and blacks (odds ratio = 1.18, P value = .1239).

Adjusted relationship between race/ethnicity and retention status

There was a significant interaction effect between race/ethnicity and preinjury problem substance use ($P = .0330$) on retention rates. Table 2 shows the effects of race/ethnicity on retention status for those with and without a preinjury history of problem substance use, as well as the effect of a preinjury history of problem substance use on retention status for each race/ethnicity group. Odds ratios with a P value less than a Bonferroni-adjusted significance level of $\alpha = 0.05/9 = 0.0056$ were considered significant. For subjects without a history of preinjury problem substance use, the odds of being retained were 2.09 times greater for whites than for Hispanics and 2.45 times greater for blacks than for Hispanics; the odds of retention did not differ between whites and blacks without a history of substance problem use. For subjects with a history of preinjury problem substance use, the odds of being retained did not differ among the race/ethnicity groups. The odds of being retained were 1.28 greater for whites without a history of problem use as compared with those with a

history and 1.81 greater for blacks without a history of problem substance use as compared with blacks with a history. For Hispanics, the odds of retention did not differ between those with and without a history of problem substance use. The relationship between retention and race/ethnicity was not found to depend significantly on any of the other examined covariates.

Adjusted relationship between covariates and retention status

There was a significant relationship between retention status and age ($P = .0011$), education ($P < .0001$), residence ($P = .0019$), and violent cause of injury ($P = .0006$). As shown in Table 4, the odds of being retained were 0.99 times lower for each year increase in age at injury, 1.44 times greater for those discharged to a private versus nonprivate residence, and 1.57 times greater for those with injuries due to nonviolent causes. Furthermore, increases in levels of preinjury education were associated with increases in the odds of retention. No other variables were associated with retention status.

DISCUSSION

The findings are consistent with prior studies that have shown lower retention of minorities in TBI outcomes research[21,22]; however, the results are unique in showing that Hispanics are less likely to be retained compared with whites or blacks, with retention rates being similar for whites and blacks. The findings emphasize the importance of investigating blacks and Hispanics separately, rather than combining them or grouping either with other races or ethnicities, when investigating retention in longitudinal rehabilitation research. This would increase the probability of study samples accurately reflecting the broader population, as Hispanics are currently the largest minority group in the United States. The results justify efforts to facilitate Hispanics' participation in research through targeted retention strategies. A unique finding is that preinjury problem substance use interacts with race/ethnicity. Hispanics did not differ from whites or blacks in the group with pre-injury problem substance use. Problem substance use history was associated with a slight decrease in retention rates for whites and a more substantial decrease for blacks, while no decrease was noted for Hispanics. It is possible that sociocultural factors associated with Hispanic race/ethnicity impact retention in research to the extent that problem substance abuse does not have any additive predictive value. Such a hypothesis could be investigated in future research.

Findings are consistent with previous research that showed a lower retention rate for persons with TBI injured by violent means[21,23] and those discharged to an institution versus a private residence.[21] In addition, older persons and those with lower education were less likely to be retained. These variables were predictive of lower retention regardless of race/ethnicity and can be used to target retention strategies.

Factors influencing retention of study participants may be participant-specific or study-specific. Public health studies report a lesser likelihood of study retention for males and those with multiple comorbidities,[42] persons with low income,[43] and immigrants.[44] Our results showed no relationship between sex and retention, but the other factors were not included in our study and may have impacted retention, particularly for our Hispanic participants. Relocation to their country of origin is common among Hispanic research

participants at some centers included in this analysis and may have influenced retention. Study-specific factors that might have influenced lower retention of Hispanic participants include cultural and linguistic barriers between research staff and participants, inexperience of data collectors with the Hispanic population, and few bilingual data collectors. In recent years, the TBIMS national data and statistical center has implemented procedures to increase cultural competence of data collectors and investigators, including training in cultural sensitivity. However, this may not substitute for in-person contact with a bilingual research staff member and/or person of similar race/ethnicity.

Retaining participants from minority groups in rehabilitation research has been recognized as challenging.[20,45] Creative recruitment/retention strategies that focus on cultural factors, language preferences, and community resources are needed to maximize retention. To enhance retention of US-born and non-U.S-born Hispanic participants, acknowledging cultural values of *familismo* (importance of family), *personalismo* (building rapport or personal connection), *confiaza* (being trustworthy), and *respeto* (being respectful) is key to conducting culturally competent research.[43] Employing research staff from the same cultural and linguistic background as participants can increase rapport, reduce mistrust, and increase comfort with discussing sensitive information. These strategies have been shown to increase Hispanics' satisfaction with and motivation to participate in psychological research.[46] Community partnerships can also be effective for recruiting and retaining minority groups. Hispanic research participants referred by community agencies/activities have been shown to have greater engagement and study completion.[47] The researcher's connection with community-based organizations familiar to Hispanic participants fosters trust and motivates consistency in research involvement through social networking.[47]

Making research participation convenient and less burdensome can increase retention. Transportation can be a major problem for persons with TBI,[48] and this problem can be exacerbated for newer immigrants and persons with low income. Compensating participants for the cost of transportation and parking may increase engagement and retention. In addition, offering follow-up outside normal work hours could facilitate participation by those who work in industries with irregular work hours.

Study limitations

This study assessed the impact of race/ethnicity on study retention among individuals who received in-patient rehabilitation following primarily moderate-to-severe TBI and were enrolled in the TBIMS National Database. Findings may differ among individuals with mild TBI, veterans with TBI, and those with moderate-to-severe TBI who received acute care but not inpatient rehabilitation. Analyses were also limited to variables available in the TBIMS database during the study period. Retention was defined as being followed up at a specific time point (1 or 2 years postinjury). This study was also limited by using a combined race/ethnicity variable, not allowing for distinctions between white Hispanics and black Hispanics. Race and ethnicity are coded separately in other federally funded databases. The TBIMS has recently changed its coding to reflect this, although not for the period covered by current analyses. We also acknowledge that there is a plethora of environmental and sociopolitical factors that are associated with race/ethnicity and that may impact retention in

longitudinal rehabilitation research. These factors were not quantified in this retrospective database study, but are important to consider for future prospective studies.

CONCLUSIONS

Lower retention of Hispanic participants in TBI research can bias outcomes and threaten external validity. Researchers should implement strategies to improve retention of Hispanic participants in TBI research. Other variables, including primary language spoken, acculturation, citizenship or visa status, country of residence at time of injury, and proximity of residence to rehabilitation hospital, may contribute to retention and should be investigated in future studies. Future research should examine whether longitudinal patterns of retention differ for Hispanics compared with blacks and whites.

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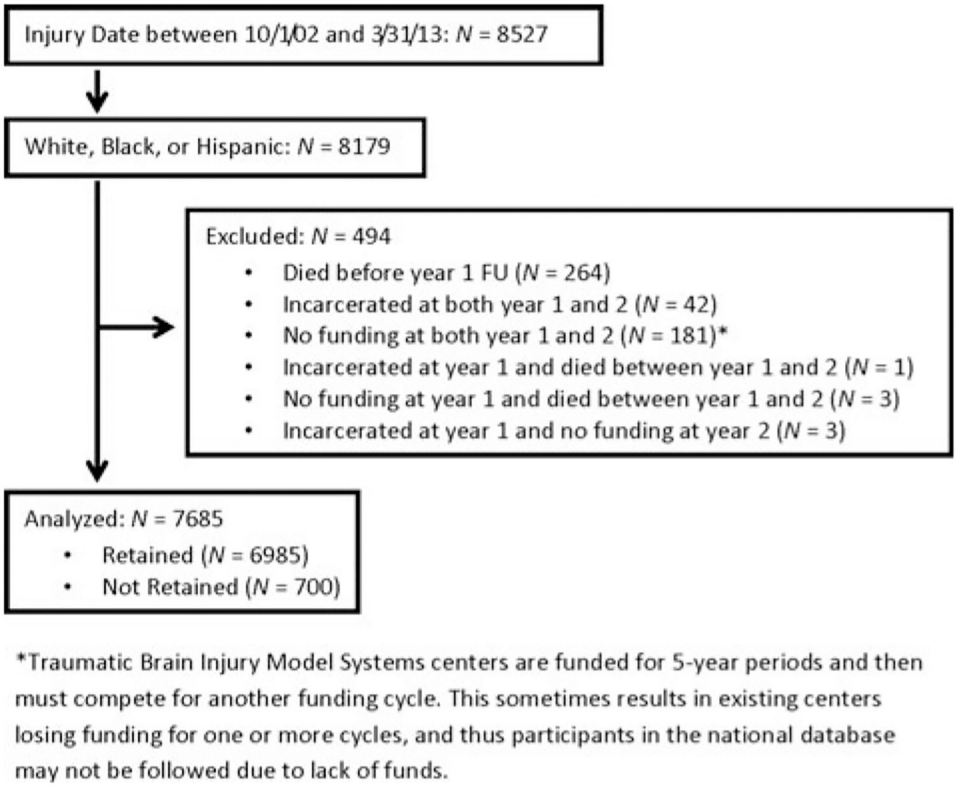

Figure 1.
Derivation of Sample.

TABLE 1

Summary of sample characteristics by race/ethnicity

	White (*N* = 5548) *n* (%)	Black (*N* = 1347) *n* (%)	Hispanic (*N* = 790) *n* (%)	Total *n*	*P* value
Sex					<.0001
Male	3991 (71.9)	1049 (77.9)	613 (77.6)	5653	
Female	1557 (28.1)	297 (22.1)	177 (22.4)	2031	
Preinjury marital status					<.0001
Married	2063 (37.2)	267 (19.9)	217 (27.5)	2547	
Not married	3485 (62.8)	1078 (80.1)	571 (72.5)	5134	
Preinjury education					<.0001
≤8th grade	186 (3.4)	84 (6.3)	196 (25.0)	466	
9th to 11th grades	844 (15.3)	366 (27.4)	199 (25.4)	1409	
12th grade (HS/GED)	2074 (37.7)	523 (39.1)	216 (27.6)	2813	
> 12th grade	2411 (43.6)	366 (27.3)	172 (22.1)	2950	
Residence at discharge[a]					.0004
Private residence	4549 (82.1)	1098 (81.8)	691 (87.7)	6338	
Nonprivate residence	989 (17.9)	244 (18.2)	97 (12.3)	1330	
Preinjury penal incarcerations					<.0001
No	5081 (92.9)	1080 (81.0)	691 (89.6)	6852	
Yes	390 (7.1)	254 (19.0)	80 (10.4)	724	
Preinjury substance problem use					.9906
No	3061 (57.8)	753 (57.9)	426 (57.6)	4240	
Yes	2236 (42.2)	548 (42.1)	314 (42.4)	3098	
PTA group					<.0001
Moderate	1852 (34.24)	384 (29.20)	207 (27.79)	2443	
Moderate/severe	1200 (22.19)	274 (20.84)	150 (20.13)	1624	
Severe	1247 (23.05)	321 (24.41)	183 (24.56)	1751	
Extremely severe	1110 (20.52)	336 (25.55)	205 (27.52)	1651	
Cause of injury					<.0001
Violent	336 (6.1)	318 (23.6)	136 (17.3)	790	

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	White (*N* = 5548) *n* (%)	Black (*N* = 1347) *n* (%)	Hispanic (*N* = 790) *n* (%)	Total *n*	*P* value
Not violent	5204 (93.9)	1029 (76.4)	651 (82.7)	6884	
	Mean (SD)	**Mean (SD)**	**Mean (SD)**		
Age, y	42.82 (19.96)	38.58 (17.03)	35.86 (17.56)		<.0001
FIM motor at discharge	66.44 (18.24)	63.22 (17.86)	66.02 (17.53)		<.0001
FIM cognitive at discharge	24.00 (6.72)	22.80 (6.63)	23.40 (6.82)		<.0001
Job stability[b]	29.87 (24.15)	23.41 (24.08)	30.76 (23.77)		<.0001

Abbreviations: GED, general educational development; HS, high school; PTA, posttraumatic amnesia; SD, standard deviation.

[a]Nonprivate residence = nursing home, adult home, correctional institution, hotel/motel, homeless, hospital, subacute care, or other.

[b]Number of weeks worked in the year prior to injury, modeled as a continuous variable.

TABLE 2

Odds ratios comparing race/ethnicity and preinjury problem substance use groups from adjusted[a] model

History of preinjury problem substance use	Race/ethnicity	OR[b] (95% CI)	*P* value
No	White vs black	0.853 (0.607–1.200)	.3608
	White vs Hispanic	2.091 (1.489–2.936)	<.0001[c]
	Black vs Hispanic	2.451 (1.607–3.739)	<.0001[c]
Yes	White vs black	1.212 (0.883–1.666)	.2347
	White vs Hispanic	1.341 (0.904–1.989)	.1453
	Black vs Hispanic	1.106 (0.710–1.723)	.6567
No vs yes	White	1.275 (1.012–1.606)	.0388
No vs yes	Black	1.812 (1.211–2.712)	.0038[c]
No vs yes	Hispanic	0.818 (0.518–1.290)	.3866

Abbreviations: CI, confidence interval; OR, odds ratio.

[a]Model variables include race/ethnicity, age, gender, marital status, education, residence at rehabilitation discharge, preinjury incarceration, problem substance use, violent cause of injury, PTA, discharge FIM, preinjury job stability, and race/ethnic by problem substance use.

[b]Odds ratios represent the odds of being retained versus not retained for one subgroup versus another subgroup.

[c]Significant at a Bonferroni-corrected level of significance $\alpha = 0.05/9 = 0.0056$.

TABLE 3

Differences in retention rates between whites, blacks, and Hispanics

	Retained		
Race	**No** ***n*** **(%)**	**Yes** ***n*** **(%)**	**Total** ***n***
White	455 (8.2)	5093 (91.8)	5548
Black	128 (9.5)	1219 (90.5)	1347
Hispanic	117 (14.8)	673 (85.2)	790
Total	700 (9.1)	6985 (90.9)	7075

TABLE 4

Odds ratios comparing covariate subgroups from adjusted[a] model

Variable	Comparison	OR[b] (95% CI)	*P* value
Age	1-y increase	0.991 (0.986–0.997)	.0011
Sex	Female vs male	1.193 (0.963–1.478)	.1070
Marital status	Married vs not married	1.232 (0.999–1.519)	.0512
Education	> 12th grade vs ≤8th grade	2.832 (2.042–3.927)	<.0001
	9th to 11th grades vs ≤8th grade	1.638 (1.177–2.279)	.0034
	12th grade (HS/GED) vs ≤8th grade	1.739 (1.279–2.365)	.0004
	> 12th grade vs 9th to 11th grades	1.730 (1.329–2.250)	<.0001
	12th grade (HS/GED) vs 9th to 11th grades	1.062 (0.838–1.347)	.6195
	> 12th grade vs 12th grade (HS/GED)	1.628 (1.309–2.026)	<.0001
Residence	Private vs not private	1.443 (1.145–1.818)	.0019
Incarcerated	No vs yes	1.013 (0.767–1.338)	.9275
PTA group	Moderate vs moderate/severe	0.855 (0.670–1.091)	.2082
	Moderate vs severe	0.813 (0.634–1.042)	.1019
	Moderate vs extremely severe	0.878 (0.649–1.189)	.4001
	Moderate/severe vs severe	0.951 (0.727–1.243)	.7112
	Moderate/severe vs extremely severe	1.027 (0.753–1.402)	.8664
	Severe vs extremely severe	1.081 (0.807–1.447)	.6038
FIM motor	1-unit increase	0.998 (0.992–1.005)	.6195
FIM cognitive	1-unit increase	0.991 (0.973–1.009)	.3050
Job stability	1-wk increase	1.003 (0.999–1.007)	.1170
Violent injury	No vs yes	1.565 (1.212–2.021)	.0006

Abbreviations: CI, confidence interval; GED, general educational development; HS, high school; OR, odds ratio; PTA, posttraumatic amnesia.

[a]Model variables include race/ethnicity, age, gender, marital status, education, residence at rehabilitation discharge, preinjury incarceration, problem substance use, violent cause of injury, PTA, discharge FIM, preinjury job stability, and race/ethnic by problem substance use.

[b]Odds ratios represent the odds of being retained versus not retained for one subgroup versus another subgroup.