# The Influence of Minority Status on Job Stability After Traumatic Brain Injury

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**Objective:** To determine the influence of minority status on job stability after traumatic brain injury (TBI).

**Setting:** TBI Model Systems Centers.

**Participants:** 633 individuals (414 Caucasians vs. 219 Minorities) with primarily moderate to severe TBI hospitalized at one of the TBI Model Systems Centers between 1988 and 2001 with 3 years of continuous follow up employment data after discharge.

**Main Outcome Measures:** Job stability was defined as "stable" (competitively employed at all three follow-up visits), "unemployed" (not competitively employed at all three visits), and "unstable" (any other mixture of competitively employed and not competitively employed over the three follow-up visits).

**Methods:** A multinomial logistic regression model was used to model the effect of ethnicity on job stability post TBI after adjusting for injury and demographic characteristics.

**Results:** Compared to Caucasians, the adjusted odds for minorities were 3.587 times greater for being unemployed versus being stably employed (95% CI = 1.930, 6.668), 1.911 times greater for being unstably employed versus being stably employed (95% CI = 1.006, 3.628), and 1.878 times more greater for being unemployed versus being unstably employed (95% CI = 1.157, 3.046) after adjusting for preinjury employment status, age, marital status, education, cause of injury, total length of stay in acute and rehabilitation hospitals, and DRS at discharge.

**Conclusions:** Minority status is an independent predictor of short-term job stability after TBI. Minority TBI survivors were more likely than Caucasians to be unemployed or unstably employed. Rehabilitation professionals should develop employment interventions that will address the specific needs of these racial/ethnic groups and facilitate optimal employment outcomes for minority TBI survivors.

## INTRODUCTION

Traumatic brain injury (TBI) is among the nation's leading causes of neurologic impairment, resulting in high rates of hospitalizations, disability, and death. Population-based data on TBI in the United States show that, each year, an estimated 1.4 million people sustain a TBI. Of those, 79% receive treatment in the emergency department and are subsequently released, 17% are admitted to the hospital for more extensive care, and 4% die [1]. For those who survive, many experience physical, cognitive, emotional, and behavioral deficits. Consequently, obtaining and maintaining gainful employment can be challenging. Research has shown that return-to-work outcomes after TBI can range from 29% to 88% [2-7]. This rate is significant because employment is considered a primary indicator of community reintegration after injury and is substantially linked to a person's well-being. For example, employment has been positively associated with an individual's social integration, financial viability, and perceived quality-of-life [8,9].

The wide range of employment rates after TBI is influenced by a variety of factors. Some of the most common predictors include injury severity, cognitive functioning, neurobehavioral factors, and differences in patient demographics [10-14]. Among the patient demo-

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graphic variables that affect return-to-work outcomes, several studies have identified race and ethnicity as a key influential factor. A recent study by Arango-Lasprilla et al [7] on racial difference in employment outcomes after TBI reported that the adjusted odds of minority subjects being unemployed are 2 times greater than the odds of white subjects being unemployed at 1 year postinjury after adjusting for sociodemographic, injury, and rehabilitation characteristics. Likewise, Sherer et al's [15] study of race and productivity after TBI included employment as part of the definition of productivity and found that black subjects and other racial minorities were at least 2 times more likely to be unproductive compared with white subjects after controlling for confounding factors. An examination of vocational outcomes for Hispanic subjects after TBI using a large archival database revealed that they were 1.27 times less likely to obtain employment and receive on-the-job support services, which is the most significant predictor of successful employment outcomes, than their white counterparts [16].

Clearly, returning to work is a very important outcome to address after TBI, and patient demographic factors largely influence results. However, less is known about the stability or longevity of employment once individuals with TBI return to work after injury. Johnson [17] examined 64 individuals for 10 or more years after they sustained a severe head injury. They were followed up at an average of 3.5 years and again at 10 years or more after injury. Of the total, results revealed that 42% had re-established themselves in employment, 20% showed irregular work patterns, and the remainder made little or no attempt to work at all. There were few changes in work status earlier postinjury (18 months to 2 years) and the pattern of employment, once established, tended to remain stable.

Another study investigated stability of employment for patients with different types of brain injury representing various patterns of neurobehavioral outcome. Pössl et al [18] followed 43 patients with severe TBI (n=24), cerebrovascular accident (n=15), and other acquired brain damage (n=4) 7 to 8 years after neuropsychological rehabilitation and participation in a vocational re-entry program. They found that 47% had persisting difficulties in maintaining work or had retired within 2 years after a work trial compared with 37% that reported a stable return to work.

In a similar study, McLeod et al [19] examined job retention of individuals with moderate-to-severe TBI by comparing employment retention of 564 patients with TBI, 368 with lower limb fractures, and 25,575 healthy soldiers in the British Army. Results showed younger soldiers with either TBI or lower-limb fractures are retained in Army employment longer than their healthy peers, possibly as the result of sheltered employment, the availability of ongoing support, or transience of the healthy population.

The relationship among employment patterns, demographic variables, and injury characteristics was explored in a multicenter longitudinal investigation of return to work and community integration after TBI. In a sample of 42 patients at 3 follow-up periods from 1 to 3 years after injury, Sander et al [20] found 23%, 17%, and 25% of these individuals, respectively, had returned to work. This study concluded that employment rates for individuals with TBI were dynamic over an extended period of time and that further research is needed to identify predictors of return to work and to determine their exact relationship to longitudinal employment outcomes.

More recently, Machamer et al [21] explored the relationships between employment stability outcomes and individual and injury characteristics for 165 workers with TBI. They concluded that the presence of mild-to-severe TBI has a significant and disruptive effect on employment of workers 3 to 5 years after injury, and the ability to maintain uninterrupted employment was related to being older, receiving greater income before injury, having employment with benefits before injury, and neuropsychological functioning after injury.

Multiple variables have been studied to determine the impact of TBI on work stability after TBI; however, the influence of minority status are not yet well understood. In fact, only 1 study has explored race in addition to other variables to determine the effect on return to work and job stability after TBI. Kreutzer et al [22] examined moderating variables and developed a postinjury prediction model with 186 people with TBI who returned to work from 1 to 4 years after TBI. Analyses revealed that nonminority group members were significantly more likely to be stably employed than minorities.

In summary, previous literature shows that minority subjects with TBI fare worse in employment outcomes compared with white subjects. Taking into account the evidence that maintaining uninterrupted employment is difficult after TBI and that race has been identified as a moderating factor in job stability 1, 2, and 3 years after injury, it is believed that long-term employment outcome is not as favorable for minorities as compared with nonminorities. No studies, thus far, have provided an in-depth examination in a large sample of minorities and nonminorities with TBI from multiple centers. Therefore, in this study we aimed to test the hypothesis that minority subjects are more likely to be unemployed and/or unstably employed 3 years after injury compared with white subjects, after adjusting for numerous covariates found to predict job stability.

## METHODS

### Subjects

The National Institute on Disability and Rehabilitation Research funds 16 comprehensive TBI rehabilitation programs known as the Traumatic Brain Injury Model Systems of Care (TBIMS). All funded centers contribute subjects to a prospective, longitudinal multicenter inception cohort study that examines the course of recovery and outcomes of persons after TBI. All persons admitted to the TBIMS must receive both acute hospital care and comprehensive rehabilitation in a designated brain injury inpatient rehabilitation program

within the Model System. Each funded TBIMS center obtained approval for informed consent by their individual institutional review board. Every patient (or the patient's legal guardian or family member if appropriate) provides informed consent to be enrolled in the study. For the present study, data from patients with primarily moderate-to-severe TBI from 1988 to 2001 were extracted from the TBIMS national database. According to the TBIMS, TBI is defined as trauma to brain tissue caused by an external mechanical force as evidenced by loss of consciousness, posttraumatic amnesia (PTA), skull fracture, or objective neurological findings that can be reasonably attributed to TBI on physical or mental status examination.

To be eligible for this study subjects had to have (1) occurred their injury between 1988 and 2001, (2) be between the ages of 18 and 65 at injury, (3) have complete race/ethnicity information available, (4) have complete employment information at admission, and (5) have complete employment information available for follow up years 1, 2, and 3 (to define job stability).

There were a total of 2810 participants in the TBIMS database whose injury occurred between 1988 and 2001 and were between the ages of 18 and 65 years at injury (criteria 1 and 2) and none of these subjects had missing race/ethnicity information (criteria 3). The sample further reduced to 633 as the result of missing employment information at admission and follow-up for 2177 subjects.

## Measures

***Sociodemographic Variables.*** Minority status was coded as a dichotomous variable: minority (those of self-reported African American, Hispanic, Asian, and Native American) and nonminority (white). Age was measured in years, and sex was a dichotomous variable. Years of education was dichotomized into less than a high school education (1 thru 8, 9 thru 11) and a high school degree/GED or greater (GED, GED/high school, high school, trade school, high school diploma, some college, Associate's degree, Bachelor's degree, Master's degree, Doctoral level degree). Marital status was dichotomized into married and not married (including the database categories single, divorced, separated, and widowed). Preinjury employment status was categorized as competitively employed and not competitively employed (full-time student and part-time student, unemployed, retired, homemaker, special employed, volunteer work, and others).

***Injury and Rehabilitation Characteristics.*** Injury severity was determined by the Glasgow Coma Score (GCS) score at admission to the emergency department and by the duration of PTA. The authors used PTA as a continuous variable in the regression analyses and GCS was categorized as mild (13 to 15), moderate (9 to 12), or severe (3 to 8). Etiology of injury was classified as either violent (assault) or nonviolent (vehicular, sports-related, fall, or pedestrian accident). Lengths of stay for acute care and inpatient rehabilitation were measured in days.

***Functional Status.*** ***Disability Rating Scale (DRS).*** The DRS has been used to measure general abilities in adolescents and adult TBI survivors from a coma state to activities at home. It is designed to reflect activity and participation via evaluation of physical impairment and cognitive ability. The DRS raters from the TBIMS are trained, certified, and periodically recertified through a standardized test administered through a single training center. The scale has 8 items for which raters must evaluate the patient's arousal and awareness, cognitive ability to handle self-care, physical dependence on others, and psychosocial adaptability. Scores on the DRS range from 0 (no disability) to a maximum of 29 (extreme vegetative state), and inter-rater reliability has been found to be high (kappa = 0.97 to 0.98) [23]. The total score on the DRS at admission and discharge were used in the analysis.

***Functional Independence Measure (FIM).*** The FIM is one of the most widely accepted functional assessments in the rehabilitation community. It is commonly used by trained physicians and other certified health care providers during inpatient rehabilitation to assess the patient's independent performance on 18 tasks related to daily living, including self-care, sphincter control, transfers, locomotion, communication, and social cognition. The rater then scores the patient's performance on a scale from 1 (total to 75% assistance needed to complete the task) to 7 (0% assistance is needed to complete the task—the person is completely independent in carrying out the task). Total scores range from 18 to 126 [24]. The scale also can be administered over the phone to the patient and/or family members by certified interviewers to determine postdischarge functioning. The total score on the FIM at admission and discharge was used in the analysis.

***Outcome Measures.*** ***Employment Status.*** Employment was dichotomized into 2 levels: competitively employed and not competitively employed (student, homemaker, specially employed, retired, unemployed, volunteer worker, and others). The distribution of preinjury employment and at each follow-up year by ethnicity is shown in Table 1.

***Job Stability.*** Job stability was defined as "stable" (competitively employed at all 3 follow-up visits), "unemployed" (not competitively employed at all 3 visits), and "unstable" (any other mixture of competitively employed and not competitively employed over the 3 follow-up visits). The distribution of collapsed employment status and job stability by ethnicity is summarized in Table 2.

## Statistical Analysis

The authors compared the 2177 ineligible participants missing employment data at any of the 3 follow-up years with the 633 eligible subjects by using analysis of variance and $\chi^2$ methods to ascertain the degree of bias the study sample may have the result of missing follow-up data.

**Table 1.** *Distribution of employment by ethnicity*

| | Student n (%) | Competitively Employed n (%) | Homemaker n (%) | Special Employed n (%) | Retired n (%) | Unemployed n (%) | Volunteer Work n (%) | Other n (%) |
|---|---|---|---|---|---|---|---|---|
| White (n = 414) | | | | | | | | |
| Adm. | 27 (6.52) | 311 (75.12) | 7 (1.69) | 0 (0.00) | 9 (2.17) | 52 (12.56) | 3 (0.72) | 5 (1.21) |
| Year 1 | 26 (6.28) | 153 (36.96) | 15 (3.62) | 0 (0.00) | 16 (3.86) | 168 (40.58) | 8 (1.93) | 28 (6.76) |
| Year 2 | 25 (6.04) | 182 (43.96) | 11 (2.66) | 3 (0.72) | 28 (6.76) | 124 (29.95) | 8 (1.93) | 33 (7.97) |
| Year 3 | 24 (5.80) | 174 (42.03) | 16 (3.86) | 3 (0.72) | 60 (14.49) | 111 (26.81) | 9 (2.17) | 17 (4.11) |
| Minority (n = 219) | | | | | | | | |
| Adm. | 14 (6.39) | 122 (55.71) | 5 (2.28) | 0 (0.00) | 4 (1.83) | 69 (31.51) | 2 (0.91) | 3 (1.37) |
| Year 1 | 15 (6.85) | 31 (14.16) | 10 (4.57) | 0 (0.00) | 7 (3.20) | 140 (63.93) | 2 (0.91) | 14 (6.39) |
| Year 2 | 10 (4.57) | 40 (18.26) | 10 (4.57) | 1 (0.46) | 14 (6.39) | 117 (53.42) | 2 (0.91) | 25 (11.42) |
| Year 3 | 17 (7.76) | 47 (21.46) | 12 (5.48) | 3 (1.37) | 33 (15.07) | 94 (42.92) | 4 (1.83 | 9 (4.11) |

In the analyses presented in this study, the authors combined the African American (n=164), Hispanic (n=35), Asian/Pacific Islander (n=13), Native American (n=5), and other subjects (n=2) into a single minority category because of the small sample sizes found within many of the minority ethnicities and to alleviate the difficulties in interpretation of the ethnicity effect in the primary multinomial logistic analysis. Because this combination may be problematic if differences among the minorities are present, a separate (unadjusted) multinomial logistic model was fit for the sample of minorities to model job stability with an effect for minority ethnicity (African American, Hispanic, or other, which encompasses the Asian/Pacific Islanders, Native Americans, and others). This model did not show evidence of differences in job stability among the 3 minority groups ($P$=.3561) thus justifying the collapse of the minorities into 1 category.

The authors conducted preliminary analyses using t-tests for continuous variables and $\chi^2$ tests for categorical variables to identify differences between white and minority groups with respect to demographic and injury characteristics.

The primary hypothesis addresses the effect of minority status on job stability 3 years after TBI. To correctly understand this effect, the effects of other variables on job stability should be adjusted for in the final analysis. The variables considered for adjustment were age at injury, sex, marital status, education level, employment status at admission, length of stay (LOS) in acute care, LOS rehabilitation, DRS at admission and discharge, FIM at admission and discharge, GCS at admission, and PTA.

Initially, a multinomial logistic regression model was fit to determine the unadjusted effect of ethnicity on job stability. Following this, the final adjusted model was obtained using model building strategies as outlined in Hosmer and Lemeshow [25]. This process involved the following steps: (1) univariate (unadjusted) logistic regression models for each covariate were fit and any covariate with a $P$ value $< .2$ in the univariate model was considered for the adjusted model, (2) the adjusted model was fit with all potential covariates obtained from step 1 and the adjusted effect of each variable was examined, (3) any covariate that no longer contributed to the fit of the model was then removed, (4) the assumptions of linearity in the logit for continuous covariate were assessed, and (5) the final adjusted model was then as assessed with respect to goodness of fit. The variables in the final model were tested with $\chi^2$ test statistics and corresponding $P$ values and the effects of each variable on job stability were interpreted with odds ratios and 95% confidence intervals (95% CI).

## RESULTS

The 2177 ineligible participants missing employment data at any of the 3 follow-up years were compared with the 633 eligible subjects with analysis of variance and $\chi^2$ methods to ascertain the degree of bias the study sample may have as the result of missing follow-up data. As compared with the subjects missing follow-up employment, those with complete employment data at all 3 follow-up years had signifi-

**Table 2.** *Distribution of collapsed employment and job stability by ethnicity*

| | White | | Minority | |
|---|---|---|---|---|
| | Competitively Employed n (%) | Not Competitively Employed n (%) | Competitively Employed n (%) | Not Competitively Employed n (%) |
| Admissions | 311 (75.12) | 103 (24.88) | 122 (55.71) | 97 (44.29) |
| Year 1 | 153 (36.96) | 261 (63.04) | 31 (14.1) | 188 (85.84) |
| Year 2 | 182 (43.96) | 232 (56.04) | 40 (28.26) | 179 (81.74) |
| Year 3 | 174 (42.03) | 240 (57.97) | 47 (21.46) | 172 (78.54) |
| Stable | 108 (26.09) | | 20 (9.13) | |
| Unstable | 109 (26.33) | | 41 (18.72) | |
| Unemployed | 197 (47.58) | | 158 (72.15) | |

cantly longer stays in rehabilitation care (difference=4.2; 95% CI=1.8-6.6; $P$=.0007), lower FIM scores at admission (difference=4.1; 95% CI=1.7-6.5; $P$=.0008), higher DRS scores at admission (difference=1.1; 95% CI=0.6; 1.6, $P$<.0001), and longer times PTA (difference=3.7; 95% CI=1.0-6.4; $P$=.0068). Furthermore, the eligible participants were more likely to be white (65.4% versus 59.1%; $P$=.0041) and more likely to have greater levels of education (71.6% versus 67.1%; $P$=.0332). The groups were similar with respect to age, LOS in acute care, FIM scores at discharge, DRS scores at discharge, gender, marital status, GCS at admission, and cause of injury (all $P$ values > .5).

The covariates are summarized by minority status in Table 3. The groups are similar in terms of age, LOS in acute care, LOS in rehabilitation, GCS at admissions, FIM admissions, DRS discharge, PTA, gender, and marital status (all $P$ values > .09). Minorities were more likely to have 1.11 units higher DRS admission scores (95% CI=0.19-2.04, $P$=.0187) and 3.98 units lower FIM discharge scores (95% CI=0.10-7.86, $P$=.0442), suggesting that minorities were more disabled on admission (higher DRS) and discharge (higher DRS and lower FIM). Minorities were also more likely to not have a high school degree (41.3% versus 21.5%; $P$<.0001) and have a violent cause of TBI (28.8% versus 11.3%; $P$<.0001).

The results of the preliminary simple multinomial logistic regression models for job stability are summarized in Table 4. The odds ratios and 95% CIs for unemployment versus stable employment, unstable employment versus stable employment, and unemployment versus unstable employment are summarized for each potential covariate. These results indicate that without adjusting for any covariates, minority status has a significant effect on job stability ($P$<.0001). The odds of being unemployed versus being stably employed are 4.330 times greater for minority than for white subjects (95% CI=2.572-7.291). The odds of being unstably employed versus being stably employed are 2.031 times greater for minority than for white subjects (95% CI=1.118-3.690). The odds of being unemployed versus being unstably employed are 2.132 times greater for minority than for white subjects (95% CI=1.407-3.231).

The result further indicate that age, LOS acute care, LOS rehabilitation, DRS at admissions, DRS at discharge, FIM at admissions, FIM at discharge, PTA, marital status, education, preinjury employment, and cause of injury all have significant effects on job stability without adjustment whereas sex and GCS at admissions do not (see Table 3). The PTA, DRS at admission, DRS at discharge, FIM at admissions, and FIM at discharge were all highly significant and representative of injury severity. Because DRS at discharge had the least amount of missing data, this variable was selected for inclusion in the adjusted model as a measure of injury severity. The fully adjusted model then contained effects for minority status, age, LOS acute care, LOS rehabilitation, DRS at discharge, marital status, education level, pre injury employment, and cause of injury.

All of the covariates remained significant predictors of job stability in the adjusted model with the exceptions of marital status ($P$=.0539) and cause of injury ($P$=.0563), which

**Table 3.** *Covariates by ethnicity*

| | White | | | Minority | | | |
|---|---|---|---|---|---|---|---|
| **Variable** | **n** | **Mean** | **SD** | **n** | **Mean** | **SD** | **T (DF), *P* value** |
| Age | 414 | 34.19 | 12.65 | 219 | 35.48 | 12.69 | 1.22 (631), $P$=.2212 |
| LOS acute | 414 | 22.72 | 20.29 | 219 | 22.21 | 17.11 | 0.32 (631), $P$=.7525 |
| LOS rehabilitation | 413 | 34.93 | 31.69 | 219 | 31.78 | 21.13 | 1.32 (630), $P$=.1871 |
| DRS at admissions | 400 | 12.82 | 5.78 | 215 | 13.93 | 5.18 | 2.36 (613), $P$=.0187 |
| DRS at discharge | 408 | 5.96 | 3.63 | 217 | 6.42 | 3.36 | 1.52 (623), $P$=.1286 |
| FIM at admissions | 384 | 54.07 | 27.25 | 206 | 51.35 | 25.91 | 1.18 (588), $P$=.2401 |
| FIM at discharge | 388 | 97.13 | 22.87 | 212 | 93.15 | 23.58 | 2.02 (598), $P$=.0442 |
| PTA | 300 | 32.56 | 28.62 | 132 | 30.81 | 22.63 | 0.62 (430), $P$=.5352 |
| | **n** | **%** | | **n** | **%** | | **$\chi^2$ (DF), *P* value** |
| Sex | | | | | | | |
| Female | 109 | 26.33% | | 45 | 20.55% | | 2.60 (1), $P$=.1069 |
| Male | 305 | 73.67% | | 174 | 79.45% | | |
| Marital status | | | | | | | |
| Married | 133 | 32.13% | | 56 | 25.69% | | 2.82 (1), $P$=.0929 |
| Not married | 281 | 67.87% | | 162 | 74.31% | | |
| Education | | | | | | | |
| HS or more | 321 | 78.48% | | 128 | 58.72% | | 27.34 (1), $P$<.0001 |
| Less than HS | 88 | 21.52% | | 90 | 41.28% | | |
| Cause of injury | | | | | | | |
| Nonviolent | 363 | 88.75% | | 156 | 71.23% | | 30.52 (1), $P$<.0001 |
| Violent | 46 | 11.25% | | 63 | 28.77% | | |
| GCS admission | | | | | | | |
| Mild | 71 | 22.83% | | 53 | 26.37% | | 1.41 (2), $P$=.4929 |
| Moderate | 55 | 17.68% | | 39 | 19.40% | | |
| Severe | 185 | 59.49% | | 109 | 54.23% | | |

DRS = Disability Rating Scale; FIM = Functional Independence Measure; HS = high school; LOS = length of stay; PTA = posttraumatic amnesia.

**Table 4.** *Unadjusted odds ratios*

| | n | $\chi^2$ (DF) *P* value | Unemployed vs. Stable OR (95% CI) | Unstable vs. Stable OR (95% CI) | Unemployed vs. Unstable OR (95% CI) |
|---|---|---|---|---|---|
| Age | 633 | 32.36 (2) *P*<.0001 | 1.018 (1.001-1.035) | 0.968 (0.948-0.988) | 1.051 (1.033-1.070) |
| LOS acute | 633 | 63.98 (2) *P*<0.0001 | 1.082 (1.058-1.106) | 1.035 (1.010-1.060) | 1.045 (1.029-1.062) |
| LOS rehabilitation | 632 | 58.22 (2) *P*<.0001 | 1.049 (1.035-1.065) | 1.022 (1.006-1.039) | 1.027 (1.016-1.037) |
| DRS at admissions | 615 | 60.97 (2) *P*<.0001 | 1.173 (1.123-1.225) | 1.066 (1.016-1.118) | 1.100 (1.060-1.142) |
| DRS at discharge | 625 | 53.51 (2) *P*<0.0001 | 1.432 (1.289-1.590) | 1.216 (1.087-1.360) | 1.178 (1.096-1.265) |
| FIM at admissions | 590 | 61.36 (2) *P*<.0001 | 0.968 (0.959-0.976) | 0.988 (0.978-0.997) | 0.980 (0.972-0.987) |
| FIM at discharge | 600 | 82.07 (2) *P*<.0001 | 0.940 (0.924-0.956) | 0.986 (0.968-1.004) | 0.954 (0.941-0.966) |
| PTA | 432 | 49.58 (2) *P*<.0001 | 1.043 (1.029-1.057) | 1.010 (0.994-1.025) | 1.033 (1.020-1.045) |
| Ethnicity (minority vs. white) | 633 | (2) *P*<.0001 | 4.330 (2.572-7.291) | 2.031 (1.118-3.690) | 2.132 (1.407-3.231) |
| Sex (female vs. male) | 633 | 2.66 (2) *P* = .2642 | 1.009 (0.623-1.635) | 1.417 (0.823-2.439) | 0.712 (0.463-1.095) |
| Marital status (not married vs. married) | 632 | 13.77 (2) *P* = .0010 | 1.489(0.978-2.265) | 2.764 (1.614-4.733) | 0.539 (0.339-0.857) |
| Education (Less than HS vs. HS or more) | 627 | 13.59 (2) *P* = .0011 | 2.567 (1.529-4.309) | 1.773 (0.980-3.211) | 1.448 (0.945-2.218) |
| Employment at admission (unemployed vs. employed) | 633 | 46.95 (2) *P*<.0001 | 9.900 (4.870-20.124) | 4.645 (2.152-10.028) | 2.131 (1.399-3.247) |
| Cause of injury (violent vs. nonviolent) | 628 | 12.44 (2) *P* = .0020 | 1.968 (1.100-3.519) | 0.782 (0.370-1.653) | 2.515 (1.394-4.537) |
| GCS admission (severe vs. mild) (severe vs. moderate) (moderate vs. mild) | 512 | 5.54 (4) *P* =.2362 | 1.606 (0.949-2.720)<br>0.818 (0.430-1.554)<br>1.965 (0.963-4.011) | 1.055 (0.572-1.948)<br>0.778 (0.366-1.656)<br>1.356 (0.593-3.099) | 1.522 (0.907-2.554)<br>1.051 (0.590-1.872)<br>1.449 (0.751-2.796) |

CI = confidence interval; DRS = Disability Rating Scale; FIM = Functional Independence Measure; HS = high school; LOS = length of stay; OR = odds ratio; PTA = posttraumatic amnesia.

remained marginally significant and hence retained in the model. The assumptions of linearity in the logit for the continuous predictors (age, LOS acute, LOS rehabilitation, and DRS at discharge) were found to be sufficient and the goodness of fit for the model was adequate as well.

The final multiple multinomial logistic regression model for job stability (n=612) is summarized in Table 5. The adjusted odds ratios and 95% CIs for unemployment versus stable employment, unstable employment versus stable employment, and unemployment versus unstable employment are summarized. This model indicates that after adjusting for preinjury employment, age, LOS in acute care and in rehabilitation, DRS at discharge, marital status, education, and cause of injury, minority status has a significant effect on job stability (*P*=.0001). The adjusted odds of being unemployed versus being stably employed are 3.587 times greater for minority than for white subjects (95% CI=1.930-6.668). The adjusted odds of being unstably employed versus being stably employed are 1.911 times greater for minority than for white subjects (95% CI=1.006-3.628). The adjusted odds of being unemployed versus being unstably employed are 1.878 times greater for minority than for white subjects (95% CI=1.157-3.046).

## DISCUSSION

The purpose of the present study was to determine the influence of minority status on employment outcomes at 3 years after injury. Specifically, employment status (competitive employment) and job stability were examined. Using a large, multicenter database, the authors found that minority subjects were 2-3.5 times more likely than white subjects to be unemployed or unstably employed within the first 3 years after TBI when adjusting for preinjury employment status, age, marital status, education, cause of injury, total LOS in acute care and rehabilitation hospitals, and DRS at discharge.

Of the 6 previous studies investigating job stability after TBI [17-22], only 2 examined racial/ethnic differences [20,22]. Kreutzer et al [22] found that minority status moderated job stability over a 3- to 4-year follow-up period after TBI in a sample of 186 TBI survivors treated at a TBI Model Systems Center. Data from the TBI Model Systems also were

**Table 5.** *Adjusted odds ratios*

| Variable | $\chi^2$ (DF) *P* value | Unemployed vs. Stable OR (95% CI) | Unstable vs. Stable OR (95% CI) | Unemployed vs. Unstable OR (95% CI) |
|---|---|---|---|---|
| Ethnicity (minority vs. white) | 17.83 (2) $P = .0001$ | 3.587 (1.930-6.668) | 1.911 (1.006-3.628) | 1.878 (1.157-3.046) |
| Age | 25.41 (2) $P<.0001$ | 1.037 (1.013-1.061) | 0.986 (0.963-1.010) | 1.052 (1.030-1.073) |
| LOS acute | 19.69 (2) $P<.0001$ | 1.055 (1.028-1.083) | 1.024 (0.997-1.053) | 1.030 (1.010-1.050) |
| LOS rehabilitation | 24.03 (2) $P<.0001$ | 1.035 (1.018-1.052) | 1.010 (0.992-1.028) | 1.025 (1.012-1.037) |
| DRS at discharge | 14.34 (2) $P = .0008$ | 1.256 (1.113-1.417) | 1.165 (1.031-1.318) | 1.078 (0.997-1.164) |
| Marital status (not married vs. married) | 5.84 (2) $P = .0539$ | 1.141 (0.643-2.054) | 2.008 (1.085-3.717) | 0.568 (0.322-1.002) |
| Education (Less than HS vs. HS or more) | 9.17 (2) $P = .0102$ | 2.427 (1.271-4.634) | 1.309 (0.686-2.498) | 1.854 (1.108-3.100) |
| Employment at admissions (employed vs. unemployed) | 42.97 (2) $P<.0001$ | 12.01 (5.472-26.38) | 4.496 (2.014-10.039) | 2.672 (1.615-4.421) |
| Cause of injury (violent vs. nonviolent) | 5.75 (2) $P = .0563$ | 1.147 (0.536-2.453) | 0.505 (0.220-1.163) | 2.270 (1.147-4.493) |

DRS = Disability Rating Scale; HS = high school; LOS = length of stay.

used in the present study, and the findings confirm that minority subjects are less likely to be stably employed after TBI, even after controlling for factors found to influence job stability. Sander et al [20] reported a lack of job stability in their sample of 42 individuals with TBI during a 3-year follow-up period; however, they found no significant racial differences in job instability. The findings of the present study coincide with the findings of Kreutzer et al [22] but not Sander et al [20], which is likely attributable to the fact that the latter study was underpowered for detecting racial differences in job stability. Our findings confirm and extend the generalizability of the racial differences in job stability reported by Kreutzer et al [22]. First, the population in the present study is more representative of TBIMS survivors receiving rehabilitation across the United States, with a larger sample size of minority individuals originating from 16 TBIMS centers, instead of only 6 as in the Kreutzer et al study [22]. Second, a more rigorous definition of job stability was used in the present study compared with the previous TBIMS studies. In Sander et al [20] and Kreutzer et al [22], job stability was defined as being competitively employed at years 1 and 2 and 3 or 4; if the person had no follow-up data at year 3 but was competitively employed at years 1, 2, and 4, competitive employment was assumed in year 3. In the present study, job stability was defined as being competitively employed at continuous follow-up years 1, 2, and 3. In other words, true 3-year job stability was assured for this sample.

Previous studies [26-29] report poorer outcomes in individuals with violent versus nonviolent TBI. It is well known that minority subjects are more likely than white subjects to suffer TBI as a result of violence [30,31]. Thus, if differences in employment outcomes are found between these 2 groups, it is possible that such disparities are caused by the etiology of the injury or the severity of the TBI. In the present study, racial differences in job stability were found after statistically controlling for factors that have a documented impact on employment outcomes, including cause of injury, injury severity, as well as education and DRS at discharge.

Individuals with disabilities are able to obtain competitive employment and become productive employees with appropriate accommodations and ongoing support from employers [32,33], often in conjunction with vocational rehabilitation or other community-based services. However, those who are hired with existing disabilities face challenges in retaining employment because of (1) inadequate intervention, accommodation, and support to maintain expected performance and attendance and (2) changes in work content, work conditions, health conditions, or personal circumstances [34-38].

Maintaining employment for minority TBI survivors is similarly a complex issue. With all TBI survivors, vocational rehabilitation counselors and other professionals must consider the individual's injury severity and neuropsychological functioning as well as examine job complexity to ensure that the employment contexts and goals match the individual's capabilities so that he or she may retain their employment for longer periods with necessary support. Also, other factors, including acculturation level, language proficiency, religious beliefs, family roles, cultural issues, and the expectations of persons with disabilities, may vary by racial group and may have a significant impact on vocational rehabilitation outcome in general and job stability in particular.

Although the present study is one of the largest studies examining racial differences in job stability after TBI, a majority of this sample suffered moderate-to- severe injuries and the results may not be easily generalizable to milder head injuries and by virtue of the TBIMS cohort, only patients with

TBI who were admitted to inpatient rehabilitation were included. Differences within the very severe and mild TBI populations that may not be admitted directly to inpatient rehabilitation should be investigated. Similarly, all participants in the present study received rehabilitation services for their TBI, and these differences may not generalize to the general population of TBI survivors. Marquez de la Plata et al [39] examined 476 moderate to severely injured TBI survivors and found approximately only 40% of subjects received rehabilitation services. Therefore, the results of the present study should be interpreted with caution.

On the basis of the comparisons between the study sample (n=633) and ineligible (n=2177) sample resulting from missing data, the subjects studied here were found to be more disabled, having significantly longer stays in rehabilitation, longer PTA lengths, greater FIM, and lower DRS at admission. However, the differences were not interpreted as being clinically meaningful, and the findings of statistical significance are likely the result of the large sample sizes in the 2 groups. In addition, there were significant differences between the eligible and ineligible samples with respect to education and ethnicity, with the eligible sample having significantly more white subjects and greater levels of education. Again, although the differences were not viewed as meaningful, on the basis of the differences described here, caution should be taken with inferences.

Furthermore, it is possible that additional confounding factors that were not measured, such as postdischarge therapy or vocational rehabilitation services, social support, indicators of socioeconomic status, neurobehavioral sequela, and comorbid medical disorders, could have influenced the results of the present study. The minority sample in the present study consists of 219 African American, Hispanic, Asian, and Native-American individuals. The analyses were conducted comparing this large, heterogeneous minority group with the white majority. Analyses of differences in job stability between white and individual minority groups were underpowered.

Future research should consider potential limitations in the definition and measurement of employment stability. For the present analyses, the definition of stability was determined based on previous studies. However, employment stability within the first 3 years after TBI may not be an ideal marker of stability. The survivors of TBI may not have adequate time to recover from their injuries and obtain employment. This argument is supported by data in Table 1 showing the rate of competitively employed individuals, independent of race, at year 1 is lower than the rate for years 2 and 3. Analyses of longer-term follow-up data, when available, in future studies of job stability would elucidate employment stability trends and possible disparities present 5 and 10 years after injury.

Moreover, future research should consider more frequent follow-up of employment status. For instance, in the present study, TBI survivors were asked about their employment status at 1 year, 2 years, and 3 years after injury. It is possible that a person could be considered stably employed by responding "yes" at each time point because they had just started a new job, despite not having employment during the previous year. Semi-annual, or even more frequent, observation points would ensure construct validity of the job stability construct.

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