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Differences in employment outcomes 10 years after traumatic brain injury among racial and ethnic minority groups

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Abstract. Employment outcomes of racial and ethnic minority groups with traumatic brain injury (TBI) have not been thoroughly examined in the research literature beyond five years. The objective of this study was to examine differences in employment outcomes 10 years after TBI among racial and ethnic minorities. Using a multi-center, nationwide database, 382 participants (194 minorities and 188 whites) with primarily moderate to severe TBI from 16 TBI Model System Centers were examined. A logistic regression model indicated that the odds of being competitively employed versus not competitively employed at 10 years follow-up were 2.370 times greater for whites as compared to minorities after adjusting for age at injury, pre-injury employment status, cause of injury, and total length of stay (LOS). In addition, the odds of being competitively employed at 10 years follow-up versus not being competitively employed ranged from being 1.485 to 2.553 greater for those who were younger, employed at injury, had shorter total LOS, and non-violent injuries, respectively. This study supports previous research illustrating that compared to whites, employment is less promising for minorities after TBI both short and long term. Recommendations are suggested to help rehabilitation professionals target the specific needs of minorities with TBI in order to address employment disparities through culturally-based interventions and service delivery.

Keywords: Traumatic brain injury, employment, minorities

1. Introduction

It has been generally acknowledged that minorities with disabilities often face greater barriers to successful outcomes compared to whites. Minorities with health care problems and disabilities are less likely than whites to receive acute medical care and rehabilitative services, do not receive the same quality and quantity of services, and have poorer outcomes after rehabilitation [21, 28, 30]. Among the myriad of disabling conditions that have a deleterious effect on post-injury outcomes, traumatic brain injury (TBI) is one of the most prevalent. Approximately 3.17 million residents in the U.S. are estimated to have long-term or life-long disability from TBI [42]. In addition, TBI tends to result in a wide range of cognitive, physical, and emotional deficits that often makes community reentry challenging [5, 38, 40]. Unfortunately like other medical conditions, racial and

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ethnic minority groups are disproportionately at risk of sustaining TBI [7, 16].

Emerging evidence indicate poorer short-term and long-term functional outcomes after TBI for minorities. For example, blacks and Hispanics with TBI show worse functional and community outcomes at 1 year post-TBI compared to their white counterparts even after controlling for age, length of post traumatic amnesia (PTA), severity of injury, cause of injury, pre-injury educational level, pre-injury marital status, and pre-injury employment [3, 4]. Similarly, Staudenmayer et al. [32] found that whites compared to minorities were more dependent on others in long-term functional outcomes such as standard of living, leisure, and work/school even after controlling the effects of age, gender, Glasgow Coma Scale (GCS) score, Injury Severity Score (ISS), and head Abbreviated Injury Score (AIS). Of these outcomes mentioned above, employment is regarded as a primary indicator of community re-integration that accurately measures people re-entering the mainstream of American society [22]. Given the importance of employment to the American society at large and the increasing evidence of differential outcomes among races and ethnicities in the area of TBI, researchers have started to devote more attention to exploring various aspects of post-injury employment in minority groups.

In the past decade, the majority of the TBI employment research with minorities has been conducted using the TBI Model Systems (TBIMS). The TBIMS program offers a comprehensive longitudinal database that has a wealth of data for the research of TBI. The database contains over 8,000 cases with up to 20 years of follow-up data [34]. Employment research indicates that compared to whites, minorities are more likely to be unemployed up to five years post injury. In 2003, Sherer et al. [29] were the first to use the TBIMS database to examine minorities for productivity outcomes post-TBI in a multicenter sample consisting of 1,083 adults (32% blacks, 13% other minorities, 55% whites). Employment was included in the definition of productivity and categorized as those who were competitively employed at least part-time, full-or part-time students, and full-time homemakers. Participants were considered non-productive if they were unemployed, retired, specially employed, in special education, or volunteers. Initial findings indicated that whites were much more likely (43%) to be productive than blacks (22%). A simple logistic regression model indicated that race was significantly associated with productivity and blacks were almost three times more likely to be non-productive than whites. However, when pre-injury productivity (e.g., education, cause of injury, sex, age and LOS) were taken into account, the odds of blacks being non-productive were reduced. Nonetheless, they were still two times more likely to be non-productive than whites. Kreutzer et al. [19] published the first multicenter study of its kind to investigate job stability after 4 years post injury using the TBIMS database. Their sample consisted of 186 participants (34% minorities, 66% non-minorities). Productive activity was labeled as competitively employed, specially employed (e.g., sheltered workshop, supported employment), unemployed, student, retired, homemaker, and volunteer. Chi-square analyses indicated that minorities compared to non-minorities were significantly less stably employed (19% vs. 43%) and more unemployed (50% vs. 31%). Although this study's primary purpose was to examine several factors that could moderate return to work and job stability (e.g., demographic and injury characteristics), it was clear that race/ethnicity negatively influenced employment and job stability after TBI.

Later, da Silva Cardosa et al. [6] examined 5,831 (437 Hispanics and 5,394 Whites) clients with TBI extracted from the Rehabilitation Service Administration (RSA) dataset who received state vocational services in the U.S. They found that Whites were 1.27 times more likely to be employed than Hispanics. Hispanics who had work disincentives (e.g., government assistance due to disability) were less likely to return to work and to have their basic needs met. Furthermore, Hispanics were 20% less likely to receive on-the-job support services – the most significant predictor of successful employment outcomes after TBI in this sample. Also, using a large dataset from the TBIMS, Arango-Lasprilla et al.'s [2] examined race/ethnicity and competitive employment in a sample consisting of 5,259 participants (1,238 African Americans, 384 Hispanics, 142 Asians, and 27 Native Americans). The dependent variable was competitive employment versus unemployment. Competitive employment was classified as those engaged in paid full or part-time employment and the unemployment category consisted of those who were full- or part-time students, homemakers, volunteers and others. After controlling for confounding variables known to affect employment outcome, i.e., gender, age, education, marital status, cause of injury, pre-injury employment, and disability rating scale (DRS) scores, minorities were two times more likely to be unemployed at one year post-injury than whites.

Recently, Arango-Lasprilla et al. [1] replicated Kreutzer et al.'s study on job stability after TBI with a larger and more diverse sample using the TBIMS database. With a sample of 633 participants (219 minorities, 414 whites), they found minorities were 4.92 times more likely to be unemployed vs. stably employed, 2.37 times more likely to be unemployed vs. unstably employed and 2.08 times more likely to be unstably employed vs. stably employed compared to whites. Demographic and injury characteristics such as pre-injury employment status, age, gender, marital status, education, cause of injury, total LOS in acute and rehabilitation hospitals and the Functional Independence Measure (FIM) score at discharge were controlled for during the analyses. In another recent study, Gary et al. [9] were the first to examine competitive employment outcomes specifically among blacks and whites at one, two, and five years post-TBI using the TBIMS database. In a sample of 2,022 participants (615 blacks and 1,407 whites), they adjusted for demographic and injury characteristics that were significantly different between blacks and whites, as well as those that may have affected postinjury competitive employment and changes in postinjury competitive employment over time. Results revealed blacks compared to whites were 2.61 times less likely to be not competitively employed vs. competitively employed at year one, 2.10 times at year two, and 3.15 times at year five. Although the odds of being not competitively employed vs. competitive employed declined for blacks and whites over time, there continues to be a distinct gap in employment outcomes for each year examined with blacks doing worse than whites. The changes were not significant between races indicating a gradual improvement for both groups. In summary, there is clear evidence that between years one and five post-injury, employment outcomes are less favorable for minorities with TBI compared to their white counterparts.

This study was undertaken to determine if the gap between minorities and whites in employment outcomes after TBI continue to exist after five years with minorities at the lower end of the spectrum. The primary objective was to examine differences between minorities and whites in competitive employment outcomes 10 years after injury while controlling for demographic and injury characteristics that may affect employment or differ significantly between minorities and whites. The authors intend to use the data as a platform to discuss implications for practice and offer recommendations that will inform and prepare physical and vocational rehabilitation professionals to address disparities in short and long-term employment after TBI.

2. Method

2.1. Participants

The U.S. Department of Education, National Institute on Disability and Rehabilitation Research (NIDRR), funds the TBIMS. The TBIMS are 16 Level 1 trauma centers that initiate care in the emergency room followed by acute neurotrauma management to interdisciplinary inpatient rehabilitation, followed by long-term outpatient services [11]. In addition, the TBIMS collect data for prospective, longitudinal, multicenter studies that examine numerous aspects of recovery and outcomes following TBI via a centralized database. Eligibility criteria for inclusion in the database are post-traumatic amnesia (PTA) greater than 24 hours, trauma related intracranial neuroimaging abnormalities, loss of consciousness exceeding 30 minutes (unless due to sedation or intoxication), or GCS in the emergency department of less than 13 (unless due to intubation, sedation, or intoxication). Enrollment is limited to those 16 years of age or older at the time of injury.

A sample of 823 participants was initially selected from the TBIMS database based on the following criteria: (a) less than or equal to 55 years of age at injury; (b) injury occurred before January 1, 1999; and (c) not classified as retired at injury or at 10 years follow-up. The end date of January 1, 1999 was chosen as 10 years of follow-up would have been due before January 1, 2009 and available in the current version of the database. In order for participants to be included in the analyses, employment status at 10 years follow-up must be available (not missing). There were 441 (53.6%) participants out of the 823 who were not included because employment information was missing for year 10. Thus, 382 participants were selected for analysis.

2.2. Measures

The measures and modeling types for the independent and dependent variables used in this study are summarized below.

2.2.1. Dependent variable

The dependent variable used for this analysis was a categorical variable indicating if the participant was

competitively employed (only participants categorized as engaging in paid employment full-time or part-time) or not competitively employed (unemployed, full-time student, part-time student, special education, homemaker, volunteer work, and others) at 10 years follow-up.

2.2.2. Independent variables

The primary independent variable was categorical indicating the participant's race/ethnicity as white or minority (black, Hispanic origin, Asian/Pacific Islander, or other). Other demographic variables available for analyses included age at injury, gender, pre-injury employment status, pre-injury level of education, and pre-injury marital status. With the exception of age, all demographic variables were categorical. Pre-injury employment status was dichotomized into competitively employed and not competitively employed, in the same manner as the dependent variable. Education was categorized into three groups: (a) less than high school (8th grade or less, or grades 9 through 11); (b) high school (GED, GED/high school, high school, HS diploma, or trade school); and (c) more than high school (some college, Associate's degree, Bachelor's degree, Master's degree, Doctoral level degree). Marital status was dichotomized as married or not married (single, divorced, separated and widowed). All demographic information was obtained during interviews and based on self-reports by the survivor.

Measures of injury characteristics obtained from the database were based on medical records and included cause of injury, Post Traumatic Amnesia (PTA), GCS at admission, FIM at admission and discharge, Disability Rating Scale (DRS) at admission and discharge, and total LOS in acute and rehabilitation care. Cause of injury was the only categorical injury characteristic and was dichotomized as violent (gunshot wound, assault with blunt instrument, or other violence) or not violent (vehicular, sports-related, fall, or pedestrian accident). All other injury-related characteristics were continuous. PTA and LOS were measured in days. Both are measures of TBI severity; whereas, PTA is a state of confusion and disorientation immediately after the injury has occurred and LOS is the duration of stay in acute and inpatient hospital settings in one episode [17, 18]. GCS is a discrete continuous variable with a range from 3 (lowest) to 15 (highest) [35]. The FIM and DRS are discrete continuous variables and psychometrically sound assessment scales. The FIM measures level of independence related to activities of daily living (ADLs), mobility, and cognition with scores ranging from 1 (total assistance) to 7 (complete independence) for a total range of 18 (lowest) to 126 (highest) [31]. Reliability for the FIM was reported as 0.86 to 0.97 [33]. The DRS consists of eight items on a 30 point scale where lower numbers denote higher levels of function and the scale measures patients' abilities from a coma state to activities in the home or community [25]. The DRS demonstrates a good inter-rater agreement of 0.98 [10, 41].

2.3. Statistical analysis

All statistical analyses were conducted with SAS v.9.2 [27]. There were a total of 441 participants who could have been eligible for this study if their 10 year post-injury employment status had been available. These participants were compared to the 382 eligible participants with respect to demographic and injury characteristics using Chi-square analyses for categorical variables and *t*-tests for continuous variables to assess for retention bias.

To test the hypothesis of interest, a logistic regression model was used to model the probability of employment at 10 years follow-up for whites and minorities. In order to correctly understand the differences between whites and minorities in employment probabilities at 10 years follow-up, the model should adjust for relevant demographic and injury characteristics (covariates). Specifically, the model adjusted for those covariates that were significantly different between whites and minorities (since the design was not randomized) as well as those that may affect employment probabilities at 10 years post-injury. Since there are a variety of potential covariates that could be added to this model, model-building strategies for logistic regression as outlined by Hosmer and Lemeshow [14] were utilized. The steps are briefly outlined as follows: (1) *t*-tests and Chi-square tests were used to identify differences between whites and minorities with respect to each covariate. Any covariate demonstrating differences between the groups (p-value <0.10) was considered for the adjusted model; (2) Chi-square tests and simple logistic regression models were used to identify covariates that were significantly related to employment status at 10 years follow-up. Any covariate demonstrating a significant relationship (p-value <0.10) was considered for the adjusted model; (3) the adjusted model was initially fit with effects for race/ethnicity and each covariate identified in steps 1 and 2; and (4) any covariate that no longer contributed to the fit of the model (p-value <0.05) was

removed in a manual backwards selection manner. Differences in the probability of employment at 10 years follow-up between groups were summarized with odds ratios and 95% confidence intervals.

3. Results

3.1. Description of the sample

The demographic and injury characteristics of the sample are summarized in Table 1. Approximately half of the sample was white (49.2%) and half was minority (50.1%). At injury, participants average age was 28, they were primarily male (76%), employed (63%), had at least a high school level of education (66%), and not married (81%). Injuries were predominately due to non-violent causes (73%) and approximately 79% of the participants had moderate or severe GCS at admission. There was a large degree of missing data (>10%) for GCS at admission ($n = 40$) and PTA ($n = 91$). Thus to avoid biasing the final conclusions, these variables were not included. It is expected that the other injury characteristics in the final model will be able to describe the same types of variations that these variables would have explained.

3.2. Included versus excluded participants

The 441 participants who were excluded due to missing employment information at 10 year follow-up were compared to the 382 included participants with respect to the demographic and injury characteristics to assess for potential retention bias. There were no significant differences between the groups with respect to gender, race/ethnicity, marital status, employment status at admission, cause of injury, GCS at admission, FIM at admission, DRS at admission (all p-values ≥ 0.05). Included and excluded subjects were significantly different with respect to level of education at injury (p-value = 0.0036), age at injury (p-value = 0.0013), FIM at discharge (p-value = 0.0094), DRS at discharge (p-value = 0.0421), LOS total (p-value = 0.0464). Specifically, the group of

Table 1
Demographic/injury characteristics of the sample

	White ($N = 188$)		Minority ($N = 194$)		Overall ($N = 382$)		Comparison	
	Count	Percent	Count	Percent	Count	Percent	χ^2 (DF)	p-value
Gender								
Male	133	70.74	156	80.41	289	75.65	4.84 (1)	0.0277
Female	55	29.26	38	19.59	93	24.35		
Pre-injury employment								
Employed	139	73.94	102	52.85	241	63.25	18.22 (1)	<0.0001
Not employed	49	26.06	91	47.15	140	36.75		
Pre-injury level of education								
Less than high school	47	25.41	83	42.78	130	34.30	14.00 (2)	0.0009
High school	72	38.92	66	34.02	138	36.41		
More than high school	66	35.68	45	23.20	111	29.29		
Pre-injury marital status								
Married	50	26.60	22	11.34	72	18.85	14.53 (1)	0.0001
Not married	138	73.40	172	88.66	310	81.15		
Cause of injury								
Not violent	165	87.77	112	57.73	277	72.51	43.21 (1)	<0.0001
Violent	23	12.23	82	42.27	105	27.49		
Admission GCS								
Mild	24	14.91	49	27.07	73	21.35	11.56 (2)	0.0031
Moderate	27	16.67	40	22.10	67	19.59		
Severe	110	68.32	92	50.83	202	59.06		
	Mean	SD	Mean	SD	Mean	SD	T (DF)	p-value
Age at injury (years)	28.31	9.66	28.29	8.76	28.30	9.20	–0.02 (380)	0.9832
PTA (days)	31.59	25.10	26.61	22.94	29.12	24.14	–1.76 (289)	0.0788
Admission FIM	54.51	27.55	60.81	26.94	57.77	27.38	2.19 (358)	0.0289
Discharge FIM	103.00	18.80	102.40	20.06	102.68	19.42	–0.33 (357)	0.7440
Admission DRS	12.87	5.59	12.68	4.89	12.78	5.24	–0.36 (372)	0.7222
Discharge DRS	5.20	3.10	5.28	3.31	5.24	3.20	0.23 (370)	0.8199
Total LOS (days)	58.30	37.40	49.69	33.33	53.93	35.62	–2.38 (380)	0.0180

excluded participants were more likely to have below a high school level of education (46% vs. 34%), a higher mean age at injury (30.5 vs. 28.3 years), lower FIM (less independence) at discharge (98.7 vs. 102.7), higher DRS (more disability) at discharge (5.7 vs. 5.2), and greater total LOS in acute and rehabilitation care (59 vs. 54 days).

3.3. Unadjusted changes in employment status

Cross-tabulations of pre-injury employment status by 10 year follow-up employment status, separately for whites and minorities are shown in Table 2. At injury, approximately 74% of white participants were employed while only 53% of minorities were employed. At 10 years follow-up, 61% of whites were employed while only 37% of minorities were employed. Approximately 48% of whites and 24% of minorities were employed both at injury and at follow-up while 13% of whites and 35% of minorities were not employed both at injury and at follow-up. A similar percentage of whites (26%) and minorities (28%) changed from being employed at injury to not being employed at 10 years follow-up and a similar percentage of whites (13%) and minorities (12%) changed from not being employed at injury to being employed at 10 years follow-up. Note, however, that these raw unadjusted percentages do not adjust for the effect of demographic and injury characteristics on employment status.

3.4. Differences in demographic/injury characteristics (step 1)

The demographic and injury characteristics of the sample are summarized separately for whites and minorities in the first two columns in Table 1 and compared in the last column of Table 1. There were no significant differences between whites and minorities with respect to age at injury, discharge FIM, admission DRS, or discharge DRS (all p-values $\geq$0.10). Whites and minorities were significantly different with respect to gender, employment at injury, level of education at injury, cause of injury, GCS at admission, PTA, FIM at admission, and total LOS (all p-values <0.10). Specifically, compared to whites, minorities had greater percentages of males (80% vs. 70%), were less employed at injury (53% vs. 74%), fewer had a high school education (34% vs. 39%) or more than high school education (23% vs. 36%) and fewer were married (11% vs. 27%). In addition, compared with whites, minorities had higher percentages of violent injuries (42% vs. 12%), lower percentages with severe GCS (51% vs. 68%), lower PTA (26.6 vs. 31.6 days), higher admission FIM (60.8 vs. 54.5), and lower total LOS (50 vs. 58 days).

Table 2
Observed employment status pre-injury by 10 years follow-up

Employed pre-injury	Whites Employed at follow-up		Total
	Yes	No	
Yes	90	49	139 (73.9%)
No	25	24	49 (26.1%)
Total	115 (61.2%)	73 (38.8%)	188
Employed pre-injury	Minorities Employed at follow-up		Total
	Yes	No	
Yes	47	55	102 (52.8%)
No	24	67	91 (47.2%)
Total	71 (36.8%)	122 (63.2%)	193

3.5. Univariate effects of covariates on employment at 10 years follow-up (step 2)

The univariate tests of the effects of race/ethnicity and the demographic and injury characteristics on employment at 10 years follow-up are summarized in Table 3. There was no evidence of a significant relationship between employment status at 10 years follow-up and gender, marital status at injury or admission GCS (all p-values $\geq$0.10). The unadjusted odds of employment at 10 years follow-up were 2.73 times greater for whites than minorities. In addition, the unadjusted odds of employment at 10 years follow-up were greater for those who were younger, employed at injury, had higher levels of education, had non violent injuries, lower PTA, greater admission and discharge FIM, and lower total LOS (all p-values <0.10).

3.6. Adjusted model (steps 3 and 4)

A logistic regression model was fit to compare the probability of employment at 10 years follow-up between whites and minorities. The model initially included effects for race/ethnicity and adjusted for the following demographic and injury characteristics identified in steps 1 and 2: age at injury, gender, pre-injury employment, education level, marital status, cause of injury, discharge FIM, discharge DRS, and total LOS. As indicated earlier there was a high degree of missing data (>10%) for PTA and GCS, so these variables were not considered for the multivariate analysis. In

Table 3
Univariate effects of race/ethnicity and the demographic/injury characteristics on employment status at 10 years follow-up

	χ^2 (DF)	p-value	Odds ratio	95% CI
Race/ethnicity	22.59 (1)	<0.0001		
White vs. minority			2.732	(1.805, 4.132)
Gender	2.55 (1)	0.1101		
Female vs. male			1.467	(0.917, 2.348)
Pre-injury employment	16.56 (1)	<0.0001		
Employed vs. not employed			2.446	(1.590, 3.764)
Pre-injury level of education	6.19 (2)	0.0452		
More than HS vs. less than HS			1.908	(1.142, 3.185)
More than HS vs. HS			1.312	(0.794, 2.169)
HS vs. less than HS			1.453	(0.896, 2.358)
Pre-injury marital status	<0.01 (1)	0.9880		
Not married vs. married			1.004	(0.601, 1.678)
Cause of injury	22.33 (1)	<0.0001		
Not violent vs. violent			3.223	(1.984, 5.237)
Admission GCS (cat)	2.40 (2)	0.3009		
Mild vs. moderate			1.699	(0.869, 3.323)
Mild vs. severe			1.292	(0.756, 2.209)
Severe vs. moderate			1.316	(0.751, 2.304)
Age at injury (years)	2.72 (1)	0.0990		
21 vs. 34			1.274	(0.956, 1.695)
PTA (days)	5.24 (1)	0.0220		
12 vs. 40			1.388	(1.048, 1.836)
Admission FIM	5.46 (1)	0.0195		
79.5 vs. 34			1.516	(1.069, 2.148)
Discharge FIM	9.51 (1)	0.0020		
115 vs. 96			1.443	(1.143, 1.823)
Admission DRS	6.48 (1)	0.0109		
9 vs. 17			1.509	(1.099, 2.069)
Discharge DRS	10.63 (1)	0.0011		
3.5 vs. 6			1.378	(1.136, 1.671)
Total LOS (days)	15.29 (1)	<0.0001		
28 vs. 71			1.719	(1.310, 2.254)

addition, the discharge FIM and DRS measures were chosen over the admission FIM and DRS measures to avoid issues of multicollinearity. When the adjusted model was initially fit, FIM at discharge, gender, marital status at injury, level of education at injury, and DRS at discharge did not significantly contribute to the fit of the model and were thus removed. The final model then included effects for race/ethnicity, age at injury, employment status pre-injury, cause of injury, and total LOS. The adjusted effects of race/ethnicity and the relevant demographic and injury characteristics are summarized in Table 4.

The odds of employment at 10 years follow-up (versus not being employed) were 2.370 times greater for

Table 4
Adjusted effects of race/ethnicity and the demographic/injury characteristics on employment status at 10 years follow-up

	χ^2 (DF)	p-value	Odds ratio	95% CI
Race/ethnicity	12.49 (1)	0.0004		
White vs. minority			2.370	(1.468, 3.831)
Pre-injury employment	9.39 (1)	0.0022		
Employed vs. not employed			2.117	(1.310, 3.419)
Cause of injury	11.36 (1)	0.0008		
Not violent vs. violent			2.553	(1.480, 4.403)
Age at injury (years)	5.53 (1)	0.0187		
21 vs. 34			1.485	(1.068, 2.063)
Total LOS (days)	25.02 (1)	<0.0001		
28 vs. 71			2.187	(1.612, 2.968)

whites as compared to minorities (95% CI = 1.468, 3.831), after adjusting for age at injury, pre-injury employment status, cause of injury, and total LOS. In addition, the odds of employment at 10 years follow-up (versus not being employed) were 2.117 times greater for those employed at injury as compared to those not employed, 2.553 times greater for those with non violent injuries as compared to those with violent injuries, 1.485 times greater for those who were younger (25th percentile = 21 years) versus those who were older (75th percentile = 34 years), and 2.187 times greater for those with shorter total LOS (25th percentile = 28 days) as compared to those with longer total LOS (75th percentile = 71 days).

4. Discussion

The purpose of the present study was to examine racial and ethnic differences in employment outcomes 10 years after TBI. It was found that after adjusting for age at injury, pre-injury employment status, cause of injury, and total LOS the odds of being competitively employed versus not being competitively employed at 10 years post injury were 2.370 times greater for whites as compared to minorities (95% CI = 1.468, 3.831). These results confirm and extend previous studies [2, 9] that have shown minorities fare worse in short and long term employment outcomes post TBI. The current findings have shown that the problems with employment for minorities after TBI in comparison to their white counterparts continue up to 10 years post injury.

The results of this study substantially contribute to research literature that illustrates the ongoing issues related to employment disparities encountered by racial and ethnic minorities. The minority sample in this study, on average, appeared to be mired in a confluence of difficult circumstances, including limited education, limited social support (judging from the small percentage that were married), low employment, and violence at time of injury. The TBI further undermined their potential for employment. It is particularly disconcerting that the employment outcome for the minority group was worse than the white group, even though the injuries sustained by the minority group (judging from GCS scores that were available) were actually less severe, on average, than for the white group.

It is imperative that rehabilitation professionals assume responsibility for addressing employment disparities and utilize information and resources that will enhance that effort in their treatment planning and services delivery. This study provides insight for rehabilitation professionals to work with minorities after TBI throughout the rehabilitation continuum to address short and long term employment outcomes. The following recommendations are suggested to assist rehabilitation professionals target the specific needs of minorities with TBI in order to address these employment disparities through culturally-based interventions and service delivery.

1. Rehabilitation professionals working with clients following TBI need to be fully cognizant of inequities in employment outcomes among minorities and whites as an important first step in addressing disparities. Increasing the awareness among rehabilitation professionals can be done at the pre-professional and professional level. At a pre-professional level, information about racial/ethnic and cultural issues related to disparities should be a formalized part of the educational curricula. If formalized educational programs are not available, rehabilitation educators should, at least, incorporate specific workshops and lectures regarding disparities within their own curriculum or encourage students to obtain the knowledge elsewhere by providing educational incentives (i.e., extra credit). On a professional level, continuing education for rehabilitation professionals is effectively disseminated through organized grand rounds. The field of medicine and nursing have found that grand rounds is considered an important tool to update providers in diagnosis and treatment of various areas relevant to practice in academic medical settings [23]. This technique has been used less for allied health professionals and would promote an atmosphere of continued learning about disparities in addition to introducing rehabilitation strategies and techniques that enhance functional outcomes for minorities following TBI.
2. Increased recruitment of minorities into rehabilitation fields is warranted. Despite the growth of the minority populations in the U.S. [37], minorities continue to be underrepresented in health care professions [12, 26]. Recruitment strategies for minority students by allied health programs should focus on early exposure to rehabilitation professions and effective outreach through summer enrichment programs, pre-matriculation, establishment of social networks, and collaboration with historically black colleges and

universities and minority organizations [36, 39]. The benefit of having more minorities in rehabilitation professions is to create a therapeutic milieu that fosters a better comfort level and communication with minority clients. Hence, this would facilitate better outcomes.

3. Rehabilitation professionals should incorporate culturally appropriate strategies into treatment to ensure successful employment outcomes after injury. It appears that standard approaches to vocational rehabilitation are unlikely to be as successful with minority populations, in general. Different approaches need to be considered which might also apply to non-minority clients with a poor employment history and other negative circumstances. For instance, faith-based institutions have been a very important network and healthcare resource for African Americans [13, 15]. Hispanic culture places a huge emphasis on the inclusion of family, extended family, and friends within their communities in their care and recovery [24]. Rehabilitation professionals must be willing to include these support networks for job seeking opportunities, survival skills, job placement and maintenance. A vocational counselor may want to focus on daily functional activities for a person of minority status who is recovering from a TBI as a means of encouraging a mindset of recovery based on effort and documentable progress. Setting short and long terms goals, may have to be introduced and encouraged, beginning with concrete goals that are relatively easily achieved to build confidence and investment in the rehabilitation process. Understanding of these issues by a person of minority status should not be taken for granted. Attention needs to be given to social support for the injured person, to hopefully generate positive social encounters. Initiating work activity with volunteer positions may also be helpful in this population to develop necessary work skills that may not have existed prior to the trauma, such as timeliness, responsibility, and appropriately interacting with supervisors and coworkers. It needs to be emphasized that these suggestions are not based solely on minority status; there are people of minority status who do not have a background of difficult circumstances and for whom established vocational interventions are suitable. Potentially, this would also apply to whites who suffer similar social setbacks as those in minority communities. Any population with limited work skills prior to brain injury will have difficulty benefiting from typical vocational rehabilitation interventions.
4. Rehabilitation professionals should provide assistance and guidance to minorities with TBI and employers once they are placed in employment situations at early and later phases. Employment planning should start early in the rehabilitation process particularly once information is ascertained that clients were employed pre-injury and financially responsible for households. Vocational rehabilitation specialists should be involved in their clients' progress once they are placed in the VR system. However after a certain amount of time (90 days after job placement), the case will be considered successful and closed as rehabilitated [8]. Although minorities with TBI can successfully return to employment, many have problems with maintaining a job once employed 1 to 4 years post-injury [1, 19]. Thus, rehabilitation professions should place extra efforts in developing long-term follow-up systems for minority clients with TBI initially placed in employment and after their case has been successfully closed.

The present investigation has a number of limitations which must be considered. Data for a substantial number of patients was unavailable (54%). A vast majority of patients had moderate or severe injuries and the authors had little information on persons with mild injuries. All of the patients were treated at TBIMS centers. The authors did not have data on patients with injuries who were not treated in comprehensive rehabilitation centers. Another limitation of the paper is the focus solely on whether people were employed or not. Other specific aspects of employment were not examined. Although there can be many advantages to using a large, nationwide database, examination of data is limited to variables included in database. There are more factors that are not extensively measured in the TBIMS database that were not controlled for, like annual income, post-discharge rehabilitation care, and insurance limitations.

Future research could focus on members of minority groups who seek and obtain employment after injury, particularly those not employed steadily at the time of their trauma. It might be beneficial to determine what seemed to make a difference in those cases in terms of obtaining and maintaining employment. The influence of financial support might also be a focus of study. For those not employed and presumably hav-

ing no income prior to injury, receiving some type of disability payment, such as Social Security, may be an improvement in financial stability and a deterrent in the pursuit of employment following injury. Additional research is needed that includes minority patients with mild injuries and who were treated in acute care medical centers and did not receive inpatient rehabilitation. Researchers are also encouraged to consider other important employment outcomes measures including number of hours worked per week, the types of jobs held, and wages received. Collecting information on job satisfaction could be very useful as well.

In conclusion, based on available information, the authors believe that this study is the first to specifically examine employment outcomes of racial and ethnic minorities 10 years after TBI. It is evident that rehabilitation professionals need to place more rigorous attention on the specific needs of minorities during treatment planning and service delivery to optimize short and long-term employment outcomes. Lewis [20] suggests that rehabilitation professionals begin the process of addressing disparities using a comprehensive framework to explain why disparities exist in many disability areas. The five domains are: (a) factors that account for high incidence of disabilities among minorities; (b) the minority group's views on disability; (c) minorities access to formal services/systems; (d) the quality of the service experience; (e) the individual level outcomes across specific minority groups. The five domains should be researched to determine if they are valid and reliable predictors for disparities of disability among minorities. Such research holds promise for developing recommendations to enhance employment outcomes for racial and ethnic minority groups with TBI.

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