

Relationship Between Hispanic Nativity, Residential Environment, and Productive Activity Among Individuals with Traumatic Brain Injury: A TBI Model Systems Study

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Conflicts of Interest and Sources of Funding

This work was funded by grants from the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR) to the following:

Northern New Jersey Traumatic Brain Injury System (Grant Number 90DP0032)
Rusk Rehabilitation Traumatic Brain Injury Model System (Grant Number 90DP0047)
Texas Traumatic Brain Injury Model System of TIRR (Grant Numbers 90DP0028 &
90DPTB001601), New York Traumatic Brain Injury Model System at Mount Sinai (Grant
Number 90DP0038), Indiana Traumatic Brain Injury Model System (Grant number 90DP0036),
South Florida Traumatic Brain Injury Model System (Grant Number 90DP0046), Rocky
Mountain Regional Brain Injury System (Grant #90DP0034-01-00), Traumatic Brain Injury
Model Systems National Data and Statistical Center (Grant # 90DP0084-01-00)

Authors have no conflicts of interest to disclose. The research was conducted consistent with ethical guidelines for the conduct of research.

This is the author's manuscript of the article published in final edited form as:

Lequerica, A., Botticello, A., O'Neill, J., Lengenfelder, J., Krch, D., Chiaravalloti, N., ... Johnson-Greene, D. (2019). Relationship Between Hispanic Nativity, Residential Environment, and Productive Activity Among Individuals With Traumatic Brain Injury: A TBI Model Systems Study. *Journal of Head Trauma Rehabilitation*, 34(1). <https://doi.org/10.1097/HTR.0000000000000398>

ABSTRACT

Objective: To examine the influence of nativity and residential characteristics on productive activity among Hispanics at 1 year after traumatic brain injury (TBI).

Setting: Acute rehabilitation facilities and community follow-up.

Participants: 706 Hispanic individuals in the TBI Model Systems National Database.

Design: Secondary data analysis from a multicenter longitudinal cohort study.

Main Measures: Nativity (foreign-born or US native), productive activity derived from interview questions regarding employment status, and other demographic information. Census data was extracted by zip code to represent residential characteristics of aggregate household income and proportion of foreign language speakers (FLS).

Results: Among foreign-born individuals with TBI, those living in an area with a higher proportion of FLS were 2.8 times more likely to be productive than those living in areas with a lower proportion of FLS. Among individuals living in an area with a lower proportion of FLS, US-born Hispanics were 2.7 times more likely to be productive compared with Hispanic immigrants.

Conclusion: The relationship between nativity and productive activity at 1 year post-TBI was moderated by the residential proportion of FLS. Findings underscore the importance of considering environmental factors when designing vocational rehabilitation interventions for Hispanics after TBI.

Key Words: Traumatic Brain Injury, Ethnicity, Social Environment, Productivity

INTRODUCTION

Traumatic Brain Injury (TBI) is a major contributor to mortality, morbidity, and disability in the United States (US), where at least 5.3 million are living with a TBI-related disability¹⁻³. The costs associated with TBI are staggering; direct medical costs combined with indirect costs, such as lost productivity total an estimated \$60 billion in the United States in a single year⁴.

Individuals who sustain moderate or severe injuries often face longstanding cognitive, physical, emotional, behavioral, and functional problems that can negatively impact educational and occupational achievement⁵. Involvement in productive activities such as school and work are central to a person's identity and sense of engagement in a community. Previous research has demonstrated that those who are able to work or attend school have higher life satisfaction after the TBI⁶. Unfortunately, a large proportion (over 60%) of individuals of working age are unable to return to work within two years after discharge from inpatient rehabilitation⁵. A variety of factors have been found to be associated with unemployment outcomes after TBI; these include older age, injury severity, alcohol use, less than high school education, under-employment or unemployment at the time of injury, and race/ethnicity⁷⁻¹³

With the US population becoming increasingly diverse, it is important to understand how issues of race/ethnicity impact outcomes after TBI. Hispanics are the second-largest racial/ethnic group after Whites. In 2016, the Hispanic population in the US reached almost 58 million (18% of the nation's population), and is projected to grow to 107 million (24% of the population) by 2065^{14,15}. The US Hispanic population is comprised of individuals with ancestry from various countries, with those of Mexican and Puerto Rican descent accounting for greater than two thirds of all US Hispanics. Five other Hispanic origin groups have populations of greater than 1 million – Salvadorans, Cubans, Dominicans, Guatemalans and Colombians¹⁶. With respect to

employment, the US Census reports that 62.4% of Hispanics 16 and older were employed in 2016¹⁷. Sevak and colleagues analyzed disability employment data from the 2009-2011 American Community Survey (ACS) data, and found that 36.6% of Hispanics aged 25 to 64 with disabilities were employed, whereas 73.8% of those without disabilities were employed¹⁸.

Productive Activity among Hispanics after TBI

Research has indicated that employment rates are lower¹⁹ and less stable over time^{20,21} for minorities compared to Whites. Unfortunately, earlier studies aggregated Hispanics and Blacks into a single category for analysis, so the specific employment trends for Hispanics after TBI was not consistently reported across studies. In a sample of 3,940 persons with moderate-severe TBI enrolled in the TBI Model Systems database and followed at 1, 2, or 5 years post-injury, Arango-Lasprilla and colleagues (2011) specifically demonstrated that Hispanics have lower odds of being employed compared to Whites at 1 and 2 years post-injury, even after adjusting for demographic and injury characteristics²². Conclusions of this study were limited by the lack of inclusion of a measure of socioeconomic status in the database at that time.

Sander *et al.* (2009) controlled for household income when studying the relationship between race/ethnicity and productivity following TBI in a non-rehabilitation trauma sample. Results showed that there were no differences between Whites and Hispanics on the Community Integration Questionnaire (CIQ)²³ Productive Activity subscale²⁴. However, these authors found a trend indicating that U.S. born Hispanics had higher scores on the CIQ Productive Activity subscale than non-U.S. born Hispanics.

Less understood is the role that differences in the residential community may play in community participation and integration outcomes after TBI. Rehabilitation research has broadly established that individual perceptions of better environmental quality increase functioning, independence,

and community reintegration²⁵. Specific to TBI, Whiteneck and colleagues reported that perceived barriers in the physical environment, transportation, and healthcare decrease participation after TBI²⁶. Although studies of the specific relationship between environmental characteristics and employment after TBI outcomes are scant, there is reason to believe that successful community reintegration for vulnerable groups, such as racial and ethnic minorities, is particularly sensitive to the economic and social segregation that may be present in the places where people live. Research in the general population demonstrates that neighborhood racial and socioeconomic composition influences how minorities search for and acquire employment, with Hispanics more likely to obtain work through social contacts²⁷. Although ethnic enclaves have demonstrated protective effects for many health outcomes, the residential segregation experienced by minorities may place Hispanics with TBI at an added disadvantage for returning to work after injury²⁸.

Location and the Influence of Language

According to the Pew Research Center, the percentage of individuals who speak English in the home or are proficient in English increases with time in the US. However, the rate of increase for adults is well below that of children who are exposed to English in the school system²⁹.

Immigrants often gravitate to locations where there are high concentrations of immigrants³⁰.

There is some evidence that living in ethnic enclaves hinders the development of language skills as well as earnings^{31,32}. Bauer, Epstein, and Gang (2005) provided some clarification to prior studies and showed that this effect is dependent on the size of the enclave and the level of English proficiency. They concluded that immigrants with low English proficiency tend to gravitate toward larger enclaves out of necessity, whereas individuals with a greater command of

the English language are attracted to smaller ethnic enclaves, with the latter being a factor in improved language acquisition³⁰.

Presently, there are no studies in the research literature that have examined the influence of communities on productive activity outcomes among Hispanic immigrants who have sustained a TBI. The present study sought to better understand how productive activity after TBI may be associated with a complex combination of factors among Hispanics, taking into account the influence of characteristics of the residential community. The National Institute on Disability Independent Living and Rehabilitation Research (NIDILRR) TBI Model Systems (TBIMS) National Database was combined with census data to test the following hypothesis: Differences in the proportion of Spanish-language speakers in the residential community will moderate the relationship between nativity and productive activity at 1 year post-TBI among Hispanics under age 65 (average age of retirement).

Methods

Participants

Participants were individuals from the TBIMS National Database. Each TBIMS center was approved by their individual Institutional Review Boards. The TBIMS National Database enrollment criteria include: age at least 16 years at time of injury, moderate to severe TBI (as defined by at least one of the following: post-traumatic amnesia greater than 24 hours, trauma-related intracranial neuroimaging abnormalities, loss of consciousness exceeding 30 minutes, or Glasgow Coma Scale score in the emergency department of less than 13); and received acute care hospitalization within 72 hours, followed by inpatient rehabilitation at a TBI Model System of care.

The present study focused on individuals who identified as Hispanic on a question about Hispanic origin and/or on a question regarding race/ethnicity. Participants were included if they were under age 65 (average retirement age), responded to a question about their place of birth (nativity variable), had complete injury data and productive activity data at 1 year follow-up, and provided their zip code. The sample derivation for the $N = 706$ cases included for analysis is illustrated in Figure 1.

Insert Figure 1 About Here.

The nativity variable was added to the TBIMS National Database in 2012. Due to the longitudinal design of the database with ongoing follow-up (1, 2, or 5 years post-injury with additional interviews every 5 years), nativity information was collected retrospectively for existing participants enrolled between 1991-2012.

Measures

The FIM™ was used to assess functional ability³³. It indicates the amount of assistance that is required in performing activities of daily living through an 18-item ordinal scale. Each item is rated on a scale of 1 (requires total assistance) to 7 (completely independent). Total scores range from 18 to 126. FIM™ scores obtained at the one-year follow-up time point were used in the present analysis.

Date of emergence from PTA was defined as the first day on which two consecutive passing scores on either the Orientation Log³⁴ or the Galveston Orientation and Amnesia Test³⁵, with no more than 72 hours between assessments, was achieved. The number of days in PTA was calculated as the difference between the date of injury (onset of PTA) and the date of emergence from PTA. For individuals who were still in PTA at discharge, length of stay + 1 day was

imputed as has been described previously³⁶. This value was used to categorize participants into levels of TBI severity based on the Mississippi intervals³⁷. For parsimony in the current analysis, the moderate and moderate-to-severe categories were collapsed into a “moderate” group and the severe and extremely severe categories were collapsed into a “severe” group.

Nativity, education level, and productivity were obtained via interview with the participant or a surrogate. Report of the country of birth was recorded, and for purposes of the present analysis, nativity was divided into two categories: born in the US or born outside of the US. Education level at the time of injury was also divided into two categories for analysis: less than 12 years of education or 12 or more years of education. Productive Activity was obtained at the one-year follow-up, and was operationally defined as being employed, a full-time student, or a volunteer. Residential area characteristics: Residential areas were defined using zip codes reported from participants’ home addresses. *Aggregate Median Household Income* in 2015 inflation-adjusted dollars for participants’ zip code was extracted from data collected for the U.S. Census Bureau’s American Community Survey (ACS) 5-year estimates obtained from 2011 to 2015. Aggregate Median Household Income was skewed. This variable was categorized using tertile scores representing lower (< \$41,426), middle (\$41,426-\$56,838), and higher (> \$56,838) levels of income within the zip codes included in the sample³⁸.

Proportion of Foreign Language Speakers (FLS) was calculated as the population estimates of Hispanic individuals speaking a foreign language divided by the total population of Hispanics in each zip code. Residential area data were extracted from the National Historical Geographic Information System (NHGIS; Minnesota Population³⁹). Proportion of FLS also showed a skewed distribution. A median split was used to dichotomize this variable into lower ($\leq 80.7\%$) and higher ($> 80.7\%$) proportion groups.

Analysis

A hierarchical logistic regression was performed with Productive Activity at 1 year post-TBI as the dependent variable. Nativity and Proportion of FLS were entered on Block 1 with the following covariates: age, PTA classification, education level, Productive Activity at injury, and FIM™ at follow-up. The interaction between Nativity and Proportion of FLS was entered on Block 2 to determine whether this added any additional predictive value to the model. A Box-Tidwell test for linearity within the logit was used for the continuous covariates in the model. Age was linear within the logit but FIM™ at follow-up was not. Rather than fitting FIM™ at follow-up as a continuous variable that would require a transformation, it was found that a median split created a sufficient theoretical distinction between those with a mean item score of greater than or less than 6.667, between the rating categories of complete independence or less than complete independence (modified independence or less), respectively. This dichotomized variable was labeled as Functional Independence.

Results

Demographics and Sample Characteristics

Of the total sample of 706 participants, 152 (21.5%) were female. Almost half of the sample had less than a 12th grade education. Vehicular accidents accounted for the largest proportion of the sample. Sample characteristics are shown in Table 1.

Insert Table 1 About Here.

Slightly over half of the sample was born in the US (57.9%). Of those who were born elsewhere, individuals of Mexican origin made up the largest subgroup, accounting for 52.1% of foreign-born participants. This was followed by Cuba (8.2%), Puerto Rico (5.1%), El Salvador (5.1%),

Honduras (5.1%), and the Dominican Republic (5.1%). Table 2 shows the breakdown of foreign-born participants by region.

Insert Table 2 About Here.

Relationships between Nativity and Proportion of FLS with Productivity at 1 year follow-up

On Block 1 of the logistic regression, entry of Nativity and Proportion of FLS with the covariates resulted in a model significantly predicting Productive Activity at 1 year post-TBI ($\chi^2 = 305.6$, $df = 10$, $p < 0.001$). As can be seen in Table 3, neither Nativity nor Proportion of FLS showed any significant association with Productive Activity in Block 1.

Insert Table 3 About Here.

On Block 2, the interaction between Nativity and Proportion of FLS was added to the model, resulting in a significant change in the overall model from Block 1, ($\Delta\chi^2 = 5.3$, $\Delta df = 1$, $p = 0.022$). The complete model with the interaction included, significantly predicted Productive Activity at 1 year post-TBI ($\chi^2 = 310.8$, $df = 11$, $p < 0.001$).

As can be seen in Table 3, the interaction term was significant ($p = 0.023$); thus the relationships between Nativity and Proportion of FLS with Productivity at 1 year follow-up are interdependent. To further examine the significant interaction effect, the relationship between Proportion of FLS and Productivity was first examined separately for US and non-US born individuals. For those born in the US, there was not a significant relationship between Proportion of FLS and Productivity at 1 year ($p = 0.630$). However, for those who were born outside of the US, there was a significant relationship ($p = 0.018$), such that individuals living in areas with a higher Proportion of FLS were 2.82 times more likely to be engaged in Productive Activity at 1 year follow-up compared to those living in areas with a lower proportion of FLS (95% CI = 1.19, 6.68). Next, the relationship between Nativity and Productivity was examined separately for

those individuals living in areas with lower and higher Proportions of FLS. For those living in areas with higher Proportion of FLS, there was not a significant relationship between Nativity and Productivity ($p = 0.806$). However, for those living in areas with lower Proportion of FLS there was a significant relationship ($p = 0.005$), such that US born individuals were 2.70 times more likely to be engaged in Productive Activity at 1 year follow-up compared to non-US born individuals (95% CI = 1.34, 5.56). These relationships are summarized in Table 4 and illustrated in Figure 2.

Insert Table 4 About Here.

Insert Figure 2 About Here.

Discussion

This study examined the complex relationship between nativity and productive activity among Hispanics with TBI by considering the influence of living amongst a higher or lower proportion of FLS. After controlling for demographic characteristics, neither nativity nor proportion of FLS was independently associated with productive activity at 1-year post-TBI. However, this analysis found a contingency between nativity and living in a community with a higher proportion of FLS in the likelihood of productive activity at one-year post-TBI. Among foreign-born individuals with TBI, those living in an area with a higher proportion of FLS were 2.8 times more likely to be productive at 1 year follow-up than those living in areas with a lower proportion of FLS. Among individuals living in an area with a lower proportion of FLS, US born Hispanics were 2.7 times more likely to be productive at 1 year follow-up compared with Hispanic immigrants. In addition to the unique findings regarding the impact of proportion of FLS on productivity status, the current results are consistent with prior findings that age^{8,40-43}, education^{21,41,43-46},

injury severity^{41,42,47,48}, productivity at the time of injury^{8,43}, and functional or cognitive status^{40,46,49} are associated with productivity status in adults with TBI.

Predictors of productivity specifically for Hispanics have not been investigated in many studies. Ketchum and colleagues (2012) studied predictors of employment in 418 Hispanics with 1 year follow-up data in the TBIMS National Database. The results of the current study are consistent with the findings of Ketchum et al. (2012) in showing that productivity at injury, education, and PTA duration are predictive of productivity in Hispanics; however, the current study builds upon this research by demonstrating that even after controlling for these common predictors of productivity, sociodemographic variables and characteristics of the residential community are significantly associated with outcome.

The results of the present study suggest that, for Hispanics who were not born in the US, living in an area with a higher proportion of FLS appears to convey important benefits in terms of productive activity (being engaged in work, education, or volunteer activity) following TBI. Related findings have been published that show a health-protective effect (i.e., decreased likelihood of problem drinking) of living in neighborhoods with those of similar ethnicity for older Mexican-American men who are non-English speaking⁵⁰. For instance, the better productivity outcomes for foreign-born Hispanics with TBI living in high foreign language dense areas may be due to greater social support being conveyed for members of their community with TBIs.

Future research on this topic is needed to help identify what characteristics of the cultural context in residential areas with higher proportions of FLS play a role in improving return to productivity outcomes in foreign born Hispanics with TBI in the US.

Limitations and Future Directions

The sample in the current study represented individuals who were admitted to selected inpatient rehabilitation facilities that are part of the TBIMS program. Findings may not generalize to people with TBI treated in other facilities or who did not undergo inpatient rehabilitation after their TBI. Additionally, the analyses in the current study were restricted to those variables collected as part of the TBIMS so information regarding level of literacy or level of English proficiency were not assessed. Therefore, we cannot interpret the impact or contribution of other cultural variables on productivity status. Individuals were only included in the current study if they were younger than 65 years old. As there are individuals who work well beyond 65 years old, the current findings may not be generalizable to the population who works beyond the age of 65 years. Finally, the analysis was limited by missing data. Of the individuals for whom Nativity data was available, 69% had complete data and were included in the analysis for the current study ($N = 706$).

The findings of this study suggest that systematic differences in the social stratification of the places where people live may partially explain differences in community participation outcomes for Hispanics living with TBI. Within the state/federal vocational rehabilitation program, da Silva Cardoso and colleagues (2007) found that a number of demographic factors (female gender, older age, lower levels of education, work disincentives and co-occurring alcohol and other drug abuse) and the need for transportation services were associated with a decreased odds of employment among Hispanics⁵¹. Various services - substantial counseling, university training, vocational training, job search assistance, job placement assistance, on-the-job support, maintenance, assistive technology and technical assistance to start a business - were related to

increased odds of Hispanics being employed. These factors may be useful to include in a vocational rehabilitation program for Hispanics striving to return to productive activity after TBI. In light of the current findings, a comprehensive program should take into account the differences in the composition of the communities where people live post-discharge. Hispanic immigrants living in areas with lower proportions of FLS may be at a particular disadvantage. Language barriers for those with limited English proficiency and other obstacles such as cultural isolation may require more specialized services to achieve equity in productivity outcomes. For many of these individuals, it may be helpful for a vocational rehabilitation program to include training, not only in basic English, but in teaching individuals specific terminology helpful to seeking and acquiring employment, such as what would be necessary for a job interview. In addition, training in health literacy and brain injury education may be beneficial. Inadequate health literacy is associated with poor disease knowledge for some chronic conditions,⁵²⁻⁵⁴. A study by Pappadis et al. (2011) found that misconceptions regarding TBI were higher among Hispanics who were Spanish-speakers and those who were born outside of the U.S.⁵⁵. Improving health literacy and providing education about TBI may help Hispanic immigrants to better understand the nature of TBI and how it might impact a return to productive activity. Culturally tailored educational interventions have shown promise in reducing misconceptions about TBI⁵⁶. This educational element can be a part of a comprehensive vocational rehabilitation program to empower individuals toward self-advocacy by not only increasing knowledge, but providing training in how to convey this information to employers. Future research could examine issues associated with the residential community in greater depth and involve measures to capture the perspective of the participants with regard to the barriers and facilitators of productive activity within their communities. Collectively, these studies could

inform current practices to incorporate additional culturally appropriate elements into patient-centered interventions designed to improve productive activity outcomes within the Hispanic population after TBI.

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Figure Captions

Figure 1: Sample Derivation

Figure 2: Productive Activity as a Function of Nativity and Proportion of Foreign Language Speakers

Table 1: Demographics, Descriptive Statistics, and Injury Characteristics

Nominal Variables	<i>N</i>	Percent
Sex		
Female	152	21.5
Male	554	78.5
Nativity		
Born in the US	409	57.9
Foreign-born	297	42.1
Education		
Less Than 12th Grade	334	47.3
High School Diploma	174	24.7
Beyond High School	198	28.0
Severity of Injury		
Moderate	374	53.0
Severe	332	47.0
Cause of Injury		
Vehicular	443	63.7
Assault	104	14.9
Sports or other	19	2.7
Fall	130	18.7
[Unknown]	[10]	
Continuous Variables	Mean	SD
Age at Injury	32.6	13.4
FIM™ Total at Admission	48.4	21.6
FIM™ Total at Discharge	88.4	22.1
FIM™ Total at Follow-up	111.8	19.7

Note: SD = standard deviation

Table 2: Place of Birth for Hispanics Born Outside of the US

Region of Birth	<i>N</i>	Percent
Central America	198	67.6
Caribbean	59	20.1
South America	30	10.2
Europe	4	1.4
Asia	1	0.3
Africa	1	0.3
[Unknown]	[4]	

Table 3: Logistic Regression Predicting Productive Activity at 1 Year Follow-Up

Block 1: Variables Entered	<i>p</i> -value	OR	95% CI
Age	0.016	0.98	(0.97, 0.99)
Severe Injury compared with Moderate Productive Activity at Injury	<0.001	0.33	(0.22, 0.49)
Education ^a			
High School	0.741	1.09	(0.66, 1.78)
Beyond High School	<0.001	2.36	(1.46, 3.82)
Functional Independence at Follow-up	<0.001	9.88	(6.58, 14.85)
Aggregate Median Household Income			
Middle compared with Low	0.055	1.63	(0.99, 2.69)
High compared with Low	0.083	1.63	(0.94, 2.85)
Foreign Born compared with US Native	0.135	0.72	(0.46, 1.11)
Higher Proportion of FLS	0.274	1.30	(0.81, 2.06)
Block 2: Variables Entered	<i>p</i> -value	OR	95% CI
Age	0.012	0.98	(0.96, 0.99)
Severe Injury compared with Moderate Productive Activity at Injury	<0.001	0.32	(0.21, 0.48)
Education ^a			
High School	0.616	1.14	(0.69, 1.87)
Beyond High School	0.001	2.35	(1.45, 3.82)
Functional Independence at Follow-up	<0.001	10.03	(6.65, 15.11)
Aggregate Median Household Income			
Middle compared with Low	0.035	1.72	(1.04, 2.83)
High compared with Low	0.062	1.70	(0.97, 2.96)
Foreign Born compared with US Native	0.008	0.40	(0.20, 0.79)
Higher Proportion of FLS	0.696	0.89	(0.51, 1.57)
Nativity × Proportion of FLS	0.023	2.77	(1.15, 6.67)

Note: OR= Odds Ratio, CI= Confidence Interval, FLS = Foreign Language Speakers

^aReference category: Less than 12 years of education/no diploma

Table 4: Odds Ratios for Nativity by Proportion of FLS Interaction on Productive Activity at 1 Year Follow-Up

Nativity	Proportion FLS	<i>p</i> -value	OR	95% CI
US Born	High vs. Low	0.630	0.87	(0.49, 1.54)
Non-US Born	High vs. Low	0.018	2.82	(1.19, 6.68)
US-Born vs. Non-US Born	Low	0.005	2.72	(1.36, 5.44)
US-Born vs. Non-US Born	High	0.806	0.93	(0.51, 1.69)

Note: OR = Odds Ratio, CI = Confidence Interval, FLS = Foreign Language Speakers



