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ORIGINAL RESEARCH

Functional Independence After Inpatient Rehabilitation for Traumatic Brain Injury Among Minority Children and Adolescents

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Abstract

Objective: To compare motor and cognitive functional independence scores between Hispanic, non-Hispanic black (NHB), and non-Hispanic white (NHW) children with traumatic brain injury (TBI) after discharge from inpatient rehabilitation.

Design: Retrospective cohort study using the Uniform Data System for Medical Rehabilitation national dataset from the years 2002 to 2012.

Setting: Inpatient rehabilitation units.

Participants: Children (N = 10,141) aged 6 months to 18 years who received inpatient rehabilitation for TBI.

Interventions: Not applicable.

Main Outcome Measures: Motor and cognitive functional independence after discharge from inpatient rehabilitation, adjusting for age, sex, admission function, length of stay, insurance, and region.

Results: Inpatient rehabilitation therapy improved functional independence for all children. Younger age, lower admission functional independence scores, and Medicaid insurance were associated with lower functional independence at discharge. Hispanic and NHB children had lower discharge cognitive scores compared with NHW children; however, differences were small and were partially explained by insurance status and region. Children who received rehabilitation therapy at pediatric facilities had greater cognitive improvement.

Conclusions: While racial/ethnic disparities are small, minority children are more likely to be younger, to have Medicaid, and to be cared for at nonpediatric facilities, factors that increase their risk for lower functional outcomes.

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Traumatic brain injury (TBI) disproportionally affects minority children. Hispanic and non-Hispanic black (NHB) children with TBI are more likely to be younger, and to sustain intentional and more severe injuries compared with non-Hispanic white children (NHW).[1] Prior studies[2,3] report a higher mortality rate for injured NHB children compared with Hispanic and NHW children. A retrospective study[2] using the National Pediatric Trauma Registry reported that NHB children experienced higher acute disability and were more likely to be discharged to inpatient rehabilitation services than were Hispanic and NHW children. While Haider et al[2] found no disparities in rates of acute disability and discharge rates to acute inpatient rehabilitation care for Hispanic patients relative to NHW patients, a recent prospective study[1] reported that Hispanic children compared with NHW children had significantly poorer functional outcomes for up to 3 years after a TBI. The reasons for these reported differences are not clear. The study did not have specific information regarding

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inpatient or outpatient rehabilitation services provided for these patients, and therefore it was not possible to ascertain whether poor outcomes were associated with lower access to rehabilitation services.

Acute inpatient rehabilitation after acute trauma care focuses on treatment of current impairments with the goal of maximizing a patient's functional potential. Comprehensive care and coordination of rehabilitation activities have been shown to improve functional status even among patients with severe injuries.[4,5] It is not known whether the benefit of acute inpatient rehabilitation results in similar functional improvements for all children. Poor minority children may be more likely to face psychosocial and family factors that may put them at risk of experiencing higher functional disability.[6]

In this study we compared motor and cognitive functional independence after inpatient rehabilitation for TBI, between Hispanic, NHB, and NHW children. We hypothesized that functional independence at discharge may be lower among minority children.

Methods

Patient population

This retrospective cohort study included patients aged 6 months to 18 years who had inpatient rehabilitation after TBI between 2002 and 2012. Data were extracted from the Uniform Data System for Medical Rehabilitation (UDSMR). The UDSMR collects demographic, clinical, and facility data from approximately 820 rehabilitation institutions in the United States representing approximately 70% of all U.S. inpatient rehabilitation facilities. Rehabilitation units report their pediatric data to the UDSMR system using 1 of 2 instruments to measure functional independence: the FIM instrument for children 8 years and older, or the pediatric derivative the WeeFIM instrument for all children regardless of their age. No identifiable data were used, and the study was therefore considered exempt from institutional review board review.

For the purpose of this study we included children who sustained a TBI and were identified as Hispanic, NHB, or NHW in the UDSMR database. We excluded participants of other racial backgrounds as well as multiracial patients. We used the racial and ethnic categories provided by the UDSMR dataset in which race and ethnicity are considered as mutually exclusive categories. We also excluded children younger than 6 months because the WeeFIM instrument is only validated for children 6 months and older. Our study is a secondary data analysis of an administrative cohort; therefore our sample size was predetermined. However, it was large enough to determine a minimum detectable difference between NHWs and Hispanics of 1.8, and between NHWs and NHBs of 1.7 points, with an alpha of .05 and a power of 80%.

Definition of injuries

We defined TBI as an injury coded with an impairment group code 2.2 (traumatic brain dysfunction), 6.2, or 14.2 (brain injury with multiple fractures for WeeFIM and FIM, respectively) by the UDSMR database. Under these categories, open, closed, and unspecified TBIs were included. We restricted the study population to those who had ICD-9 (*International Classification of Diseases, 9th Revision*) diagnosis codes consistent with traumatic injury (800–999).

List of abbreviations:

CI	**confidence interval**
DFQ	**developmental functional quotient**
NHB	**non-Hispanic black**
NHW	**non-Hispanic white**
TBI	**traumatic brain injury**
UDSMR	**Uniform Data System for Medical Rehabilitation**

Measures of disability

The UDSMR database includes functional independence measures at admission to the rehabilitation facility (within 3d of admission) and at discharge. All children younger than 8 years were evaluated using the WeeFIM instrument. Children 8 years and older were evaluated with the FIM or the WeeFIM instruments, depending on institutional practice. Both WeeFIM and FIM instruments evaluate 18 domains (13 motor, 5 cognitive). Each domain is scored from 1 (completely dependent) to 7 (completely independent).[7] Typically developing children are expected to achieve independence in all domains by 8 years of age. Children younger than 8 years are not expected to be independent in all domains; therefore, age norms are used to determine functional independence for these younger children.

Because child age is strongly associated with WeeFIM instrument ratings, we elected to use developmental functional quotients (DFQs) to standardize comparisons across age groups. Other investigators have used DFQs for TBI studies.[8,9] In brief, DFQs provide a quotient score based on age-norm scores, ranging from 14 (lowest possible quotient for a patient who receives a score of 1 in all domains and for whom the age norm is 7) to more than 100 (a patient who performs at a level that exceeds the age norm). DFQs are provided by UDSMR for all patients who were assessed using the WeeFIM instrument. For patients older than 8 years for whom the adult FIM instrument was used, we calculated DFQs using a maximum score of 126 following the same methodology of the WeeFIM instrument.

Covariates

In addition to evaluating the association of race/ethnicity to cognitive and motor discharge DFQs, we evaluated the association of other known risk factors for disability after injury in conjunction to race/ethnicity. Age was included as a categorical variable: 6 months to 3 years, 4 to 7 years, 8 to 14 years, and 15 to 18 years. Categories were constructed a priori based on age differences in injury mechanisms and age-development independence. Insurance status was included as a categorical variable: private, Medicaid/Medicare and other governmental insurance, and other (including Tricare, self-pay, and unreimbursed care). We included geographic region (Northeast, South, Midwest, West) in analyses to account for regional variation in clinical practices and insurance policies.

Data on the pediatric makeup of the rehabilitation facility (rehabilitation unit within a pediatric hospital, general hospital, or freestanding rehabilitation unit) were available only for patients whose information was recorded using the WeeFIM instrument. Because practices may vary between facilities, we conducted prespecified subanalyses among this subgroup of children to examine possible associations between rehabilitation outcomes and facility type.

Statistical analysis

Demographic and clinical characteristics were compared between Hispanic, NHB, and NHW children using the chi-square and analysis of variance F-test statistics for categorical and continuous variables, respectively. We used multiple linear regression models to assess the association between race/ethnicity and motor,