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ORIGINAL ARTICLE

Prior History of Traumatic Brain Injury Among Persons in the Traumatic Brain Injury Model Systems National Database

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Abstract

Objective: To determine the association between demographic, psychosocial, and injury-related characteristics and traumatic brain injury (TBI) occurring prior to a moderate or severe TBI requiring rehabilitation.

Design: Secondary data analysis.

Setting: TBI Model System inpatient rehabilitation facilities.

Participants: Persons (N=4464) 1, 2, 5, 10, 15, or 20 years after TBI resulting in participation in the TBI Model System National Database.

Interventions: Not applicable.

Main Outcome Measures: History of TBI prior to the TBI Model System Index injury, pre-Index injury demographic and behavioral characteristics, Index injury characteristics, post-Index injury behavioral health and global outcome.

Results: Twenty percent of the cohort experienced TBIs preceding the TBI Model System Index injury—80% of these were mild and 40% occurred before age 16. Pre- and post-Index injury behavioral issues, especially substance abuse, were highly associated with having had a prior TBI. Greater severity of the pre-Index injury as well as occurrence before age 6 often showed stronger associations. Unexpectedly, pre-Index TBI was associated with less severe Index injuries and better functioning on admission and discharge from rehabilitation.

Conclusions: Findings suggest that earlier life TBI may have important implications for rehabilitation after subsequent TBI, especially for anticipating behavioral health issues in the chronic stage of recovery. Results provide additional evidence for the potential consequences of early life TBI, even if mild.

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Although clinicians have long thought that sustaining >1 traumatic brain injury (TBI) is associated with poorer outcomes, research on repeated TBI has been limited[1] and largely focused on sports-related concussions.[2] However, even these sparse findings suggest that a history of TBI prior to the injury that brought the individual to the attention of the researcher or clinician (hereafter termed Index TBI) is associated with decreased life satisfaction,[3] depressed mood and anxiety,[4] and increased risk for subsequent TBIs.[1,5]

In population-based studies of persons referred for an Index TBI, medical record reviews have shown that 4% sustained TBIs prior to the Index injury,[1] and 7% sustained TBIs subsequent to it.[1,6] In contrast, population-based studies using 1 or 2 items querying TBI history provide estimates of TBI occurring prior to a person's Index injury (hereafter referred to as prior TBIs) as high

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as 25% to 29%.[7,8] The large discrepancy in rates is likely the result of limitations inherent in methods, whether medical record review[9] or retrospective self-report.[10-12] A structured interview conducted by an informed professional can mitigate many of the difficulties of self-report and remains the best method available for measuring lifetime TBI.[12]

Based on the Centers for Disease Control and Prevention recommendations for surveillance of TBI, the Ohio State University Traumatic Brain Injury Identification Method (OSU TBI-ID)[13,14] is a standardized structured interview designed to elicit a lifetime history of TBI, including the presence, severity, and nature of altered consciousness and the age(s) at which injury occurred. The interview uses validated injury recall methods,[11,15] avoids the need for knowledge of TBI terminology, and can be administered to the person or a proxy. TBIs reported by the OSU TBI-ID have shown associations between important outcomes and age at first TBI with loss of consciousness (LOC), worst injury, number of TBIs with LOC, and other summary indices of lifetime TBI history.[13,14] For example, in a study of prisoners, age at first TBI with LOC was associated with self-reported cognitive symptoms, whereas the number of TBIs with LOC predicted working memory, risk taking, and disinhibition.[14] A recent cluster analysis identified patterns of lifetime history (eg, people first injured between ages 6−10y, who were also more likely to be hospitalized; people who sustained a number of mild injuries) that were predictive of current functioning.[13]

The OSU TBI-ID was recently added to the Traumatic Brain Injury Model Systems (TBIMS) National Database, replacing a single yes or no question about prior TBI requiring hospitalization, which had revealed a rate of 7%.[16] The purpose of the current study was to use the data on lifetime TBI, gathered with the OSU TBI-ID method, to describe relations between TBI prior to the Index TBI, and other variables in the TBIMS National Database[16] that capture both case mix and outcomes relative to the Index injury (ie, demographics, injury characteristics, rehabilitation characteristics, postrehabilitation functioning). The TBIMS National Database variables chosen for examination were the most commonly used to operationalize these domains. To somewhat limit the number of comparisons, we did not examine scale items and included only those variables that are typically the best representation of a construct (eg, days to follow commands and length of posttraumatic amnesia are superior to Glasgow Coma Scale scores because of the number of subjects who do not have the latter because of intubation or chemical paralysis).

We examined relations associated with the presence of at least 1 prior TBI, age at first TBI, and the worst severity of injury. Given the paucity of previous literature, we had no a priori hypotheses beyond the expectation that events preceding the Index injury (hereafter referred to as pre-Index injury) TBIs would further exacerbate negative influences of experiencing a TBI. Specifically, we expected that (1) patients with a TBI that preceded their TBIMS Index injury would have worse pre- and post-Index injury sequelae; (2) the worse the pre-Index injury, the worse the pre- and post-Index injury sequelae; and (3) early childhood pre-Index injuries would result in worse pre- and post-Index injury sequelae than pre-Index injuries that occurred later in life.

List of abbreviations:

BAC	**blood alcohol content**
LOC	**loss of consciousness**
OSU TBI-ID	**Ohio State University Traumatic Brain Injury Identification Method**
TBI	**traumatic brain injury**
TBIMS	**Traumatic Brain Injury Model Systems**

Methods

Participants

The sample was drawn from the TBIMS National Database. As such, all participants were over age 15 years, incurred a moderate or severe TBI, and received comprehensive rehabilitation in a TBIMS site. Complete inclusion criteria can be found on the website for the TBIMS National Data and Statistical Center.[16] The sample consisted of 4464 TBIMS participants who received a follow-up interview between April 1, 2010, when the OSU TBI-ID was adopted, and March 31, 2012. Eligible participants or their proxies could have been interviewed at any of the following follow-up time points: 1, 2, 5, 10, 15, or 20 years post-Index injury. If >1 interview had been conducted using the OSU TBI-ID, data from the most recent interview were used. All TBIMS participants provide informed consent directly or by proxy, and the study is overseen at all TBIMS centers by institutional review boards. The overall follow-up rate for all years in the TBIMS National Database is 79%. The TBIMS data collection protocol uses a best source policy[16] for interviewing a proxy when the individual is not able to provide valid information. Measures that require reporting of a subjective state (eg, life satisfaction, emotional state) are only collected from the individual with a TBI.

The sample was composed of 73.5% men, with 69.1% non-Hispanic whites, 18.4% non-Hispanic blacks, 8.4% Hispanic, and 4.1% all other racial/ethnic categories. The average age ± SD at injury was 39±18.2 years (range, 16−94y). The proportion of participants interviewed at each follow-up was 17% at 1 year post-Index injury, 31% at 2 years post-Index injury, 28% at 5 years post-Index injury, 18% at 10 years post-Index injury, 4% at 15 years post-Index injury, and 3% at 20 years post-Index injury.

Measures

OSU TBI-ID Short Form

The OSU TBI-ID Short Form is a structured interview designed to elicit lifetime history of TBI. Interrater and test-retest reliability

Glossary

Terms used to reference injuries:

Index injury: the TBI requiring rehabilitation and qualifying a person for the TBI NDB

Pre-index injury or prior TBI: **TBIs occurring prior to the Index injury**

Pre-injury: **events preceding the Index injury**

Post-index injury: **TBIs occurring after the Index injury**

Terms used to describe effect sizes:

Immaterial: **effect sizes with values of Cohen's *h* or *d* less than .10**

Modest: **effect sizes =.10 but =.20**

Important: **effect sizes >.20 but =.30**

Very Important: **effect sizes >.30 but =.40**

Substantial: **effect sizes >.40**