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ORIGINAL RESEARCH

Acute Trauma Factor Associations With Suicidality Across the First 5 Years After Traumatic Brain Injury

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Abstract

Objective: To determine whether severity of head and extracranial injuries (ECI) is associated with suicidal ideation (SI) or suicide attempt (SA) after traumatic brain injury (TBI).

Design: Factors associated with SI and SA were assessed in this inception cohort study using data collected 1, 2, and 5 years post-TBI from the National Trauma Data Bank and Traumatic Brain Injury Model Systems (TBIMS) databases.

Setting: Level I trauma centers, inpatient rehabilitation centers, and the community.

Participants: Participants with TBI from 15 TBIMS Centers with linked National Trauma Data Bank trauma data (N=3575).

Interventions: Not applicable.

Main Outcome Measures: SI was measured via the Patient Health Questionnaire 9 (question 9). SA in the last year was assessed via interview. ECI was measured by the Injury Severity Scale (nonhead) and categorized as none, mild, moderate, or severe.

Results: There were 293 (8.2%) participants who had SI without SA and 109 (3.0%) who had SA at least once in the first 5 years postinjury. Random effects logit modeling showed a higher likelihood of SI when ECI was severe (odds ratio=2.73; 95% confidence interval, 1.55−4.82; $P=.001$). Drug use at time of injury was also associated with SI (odds ratio=1.69; 95% confidence interval, 1.11−2.86; $P=.015$). Severity of ECI was not associated with SA.

Conclusions: Severe ECI carried a nearly 3-fold increase in the odds of SI after TBI, but it was not related to SA. Head injury severity and less severe ECI were not associated with SI or SA. These findings warrant additional work to identify factors associated with severe ECI that make individuals more susceptible to SI after TBI.

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Individuals with traumatic brain injury (TBI) are 3 to 4 times more likely to die as a result of suicide compared with the general population.[1] TBI survivors also have a high rate of suicidal ideation (SI), which is known to carry a 5-fold increase in the risk of suicide attempt (SA), and these risks persist for up to 15 years after TBI.[2,3] Many of the risk factors for suicidality (a broader term used to incorporate both SI and SA) in noninjured populations overlap with chronic sequelae of TBI, including aggression, poor cognitive inhibition, poor problem-solving, reduced ability to benefit from predominantly verbal counseling interventions, impulsive behavior, substance abuse, and psychiatric disorders (eg, major depression).[3-7] Veterans with the polytrauma clinical triad of posttraumatic stress disorder, TBI, and chronic pain have significantly increased odds of suicidality, particularly in the setting of substance abuse.[8] Although chronic pain is common after TBI, its role in both SI and SA seems to be related more to an individual's perception or acceptance of pain, rather than pain severity,[9] which is in turn associated with disability,[10] an additional known risk factor for suicidality.[11,12] Severity of TBI has not been linked consistently to depression or risk of suicidality,[7,13,14] but other injury-related factors (eg, severity of extracranial injury [ECI]) that may lead to both increased distress and greater disability have not been assessed in previous studies.

March et al[15] reported that adults with unintentional major traumatic injuries, indicated by total Injury Severity Scores (ISSs) >12 (combined head and extracranial ISS), have >4 times the risk of SA or completed suicide compared with the general population, even after adjusting for psychiatric conditions (anxiety/mood disorders and substance abuse), physical comorbidities, and other psychosocial factors (income and residence). Similarly, those with life-threatening physical illness (eg, TBI, stroke, myocardial infarction, spinal cord injury [SCI]) have higher rates of SI (11.3%) developing up to 2 years after illness onset, compared with the general population.[16] Ryb et al[12] suggest that higher suicide rates among individuals who are traumatically injured compared with the general population may be caused primarily by a higher prevalence of alcohol abuse in those with traumatic injuries.

The goal of the study was to determine whether severity of head and ECIs were associated with SI or SA after TBI. We hypothesized that (1) severity of head injury would not have a significant association with SI or SA; (2) severity of ECI would be associated with and predictive of SI and SA; and (3) physical disability and substance abuse would be associated with an increased risk of SI and SA.

Methods

Participants and measures

Participants were recruited as part of the 20-site Traumatic Brain Injury Model Systems (TBIMS) National Database longitudinal study, the longest standing longitudinal database of TBI outcomes (currently with >25 years of data collected). This database has the following inclusion criteria: ≥16 years old and evidence of a moderate to severe TBI (defined as any one of the following: Glasgow Coma Scale score <13, loss of consciousness >30min, posttraumatic amnesia >24h, and/or trauma-related intracranial abnormality). Informed consent was provided by either participant or proxy as necessary, and all procedures were approved by each center's institutional review board. Information on data collection has been described previously[17] and can be found online (https://www.tbindsc.org/). Acute care data obtained from the National Trauma Data Base, the largest aggregation of trauma registry data (https://www.ntdbdatacenter.com/), were linked to the TBIMS National Database (data from 15 TBIMS Centers) through a probabilistic linkage based on common data elements across the TBIMS and National Trauma Data Bank databases using methods described previously.[18] Demographic, premorbid, clinical, mood, suicidality, functional impairment, and other outcome data collected acutely (National Trauma Data Bank and TBIMS National Database) and at 1, 2, and 5 years postinjury (TBIMS National Database) were used for analyses. The specific measures collected and their sources (TBIMS National Database vs National Trauma Data Bank) are summarized in table 1.

For the primary variables of interest, question 9 on the Patient Health Questionnaire-9 was used as a measurement of SI because this item is a direct scale question regarding how frequently respondents have had thoughts of hurting themselves or that they would be better off dead. This specific item captures suicidal thoughts and has been found to be associated with increased risk for SA.[19] Those endorsing a score ≥1 were categorized as positive for SI. SA in the last year was assessed via interview conducted as part of regular follow-up evaluation per the TBIMS protocol. Head injury severity was measured with the maximum Abbreviated Injury Scale head score. Injuries are ranked on the Abbreviated Injury Scale from 1 to 6, with increasing severity. The ISS is derived from the sum of the square of the Abbreviated Injury Scale in the 3 most severely injured body regions.[20,21] ECI was measured by the ISS (3 most severely injured body regions, excluding the head) and categorized as none (0), mild (1−8), moderate (9−15), or severe (>15).

Data analysis

We conducted an initial analysis comparing baseline demographic and injury characteristics of participants who reported no SI at all follow-up time points with participants with SI, but no SA, at any follow-up time point (1, 2, and/or 5y postinjury) and with those participants reporting SA at any follow-up time point. We used random effects models to identify predictors and associated factors of SI and SA across the first 5 years post-TBI, including both head and ECI severity, motor and cognitive disability, and substance abuse measures. This analytical approach controls for intrasubject correlation associated with repeated measures, while allowing for inclusion of multiple time points for covariates and outcomes. Coefficients can be exponentiated, allowing calculation of odds ratios for individual covariates across time. We first developed base models that included relevant demographic, acute trauma, and follow-up variables. We then added head and ECI severity to the base models, allowing us to conduct a likelihood ratio test to determine if the addition of these acute injury characteristics significantly improved model fit. Analysis was conducted with Stata version 13.[a] The *P* values ≤.05 were considered statistically significant.

List of abbreviations:

ECI	**extracranial injury**
ISS	**Injury Severity Score**
SA	**suicide attempt**
SCI	**spinal cord injury**
SI	**suicidal ideation**
TBI	**traumatic brain injury**
TBIMS	**Traumatic Brain Injury Model Systems**