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ORIGINAL RESEARCH

Resilience Following Traumatic Brain Injury: A Traumatic Brain Injury Model Systems Study

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Abstract

Objective: To examine resilience at 3 months after traumatic brain injury (TBI).

Design: Cross-sectional analysis of an ongoing observational cohort.

Setting: Five inpatient rehabilitation centers, with 3-month follow-up conducted primarily by telephone.

Participants: Persons with TBI (N = 160) enrolled in the resilience module of the TBI Model System study with 3-month follow-up completed.

Interventions: Not applicable.

Main Outcome Measure: Connor-Davidson Resilience Scale.

Results: Resilience scores were lower than those of the general population. A multivariable regression model, adjusting for other predictors, showed that higher education, absence of preinjury substance abuse, and less anxiety at follow-up were significantly related to greater resilience.

Conclusions: Analysis suggests that lack of resilience may be an issue for some individuals after moderate to severe TBI. Identifying persons most likely at risk for low resilience may be useful in planning clinical interventions.

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While there has been extensive research examining behavioral, environmental, and emotional factors predictive of poor outcome after traumatic brain injury (TBI), resilience, defined as the ability to "bounce back"[1,2] after a trauma or tragedy, has received relatively little attention.[3,4] Outside the brain injury field, psychologists have extolled the positive impact of improved resilience on stress management skills and overall health.[5] With a primary focus on risk factors that affect outcomes, models of treatment after brain injury designed to reduce disability have not historically focused on understanding and promoting resilience.

The contrast between common cognitive, behavioral, and emotional changes after TBI and the skills needed for resilience after experiencing trauma are striking. Increased rates of anxiety/depression,[6,7] irritability/aggressive behavior,[8] difficulty with socialization,[9] poor self-awareness,[10] impaired executive functioning,[11] and compromised communication skills[12] are all very common in persons with TBI. In contrast, emotional stability,[13] positive outlook/optimism,[14,15] self-regulatory skills,[16,17] social perception,[18] insightful modification of behavior,[19] good problem-solving skills,[20] and effective communication[21] have all been identified as skills necessary for resilience. Resilience and changes in resilience after TBI may potentially serve as a unifying construct, accounting for a wide variety of symptoms. Lack of focus on resilience may also help to explain why common

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postacute interventions such as cognitive rehabilitation do not produce gains in function that are maintained over time.[22] In fact, while research has not yet established the degree of resilience typically exhibited by adults with TBI,[23] pediatric research provides evidence that children with TBI are less resilient than their non−brain-injured counterparts.[24]

Several studies have pointed to potential benefits of targeted elevation of resilience skills as a method for minimizing stress-related symptom development and exacerbation. White et al[23] call for the generation of specific interventions that could enhance factors of resilience as a strategy to improve sustainable postinjury outcomes. Lefebvre and Levert[25] echo this sentiment, asserting that resilience is likely a primary factor in survivors' adjustment to injury and establishment of new competencies. To develop interventions that promote resilience and lead to the best possible outcomes after TBI, examination of differences in common symptoms between resilient and nonresilient survivors is a necessary step.

In a recent study, Lukow et al[26] investigated the relationship between resilience, emotional distress, and participation in a treatment-seeking outpatient sample with mild, moderate, and severe TBI. The investigators found a relationship between resilience, emotional adjustment, and depressive symptoms. Lower levels of resilience were associated with higher levels of psychological distress. The authors implied that interventions that successfully target resilience are likely to benefit emotional well-being. In another recent study, Losoi et al[27] examined postinjury resilience, comparing a select group of 74 patients with mild traumatic brain injury (mTBI) to a group of 34 orthopedic controls. For persons with mTBI, higher resilience was associated with fewer postconcussion symptoms and better quality of life. Sullivan et al[28] also examined resilience and postconcussion symptoms in persons 1 to 6 months after mTBI, comparing them to uninjured controls. Lower resilience scores were predictive of more postconcussion symptoms.

In summary, there is a general consensus that resilience is a quality likely to help persons with TBI better adjust to injury. There is a scarcity of research on resilience after TBI, with most studies conducted in a single center and focused on mTBI. Researchers also agree that a better understanding of resilience can aid the formulation of more effective intervention strategies.

The present investigation was designed to address shortcomings in the literature by incorporating the wealth of data provided by the Traumatic Brain Injury Model System (TBIMS) on participants with moderate and severe brain injuries. The resilience level of persons with brain injury early postdischarge was considered in the context of data derived from the general population. Identifying characteristics of resilience most often endorsed was another focus. Based on resilience studies with other populations, we hypothesized that participants who reported greater levels of resilience would report lower levels of emotional distress and better psychosocial outcomes.

List of abbreviations:

CD-RISC	**Connor-Davidson Resilience Scale**
DRS	**Disability Rating Scale**
mTBI	**mild traumatic brain injury**
PART-O	**Participation Assessment with Recombined Tools−Objective**
PROMIS	**Patient-Reported Outcomes Measurement Information System**
SWLS	**Satisfaction With Life Scale**
TBI	**traumatic brain injury**
TBIMS	**Traumatic Brain Injury Model System**
TBI-QOL	**Traumatic Brain Injury Quality of Life**

Methods

Participants

Participants were a subset of enrollees in the TBIMS National Database, a longitudinal, multicenter study of TBI funded by the National Institute on Disability, Independent Living, and Rehabilitation Research.[29] Inclusion criteria required an age >18 years, care in a TBIMS-affiliated trauma center within 72 hours of injury, receipt of inpatient TBIMS rehabilitation, and English speaking.

Eligible participants were recruited from 5 TBIMS centers. This study is cross-sectional and part of a larger cohort study whose sample size was based on assessing change in resilience over time in the larger study. A total of 223 participants were recruited, with each center contributing a minimum of 36 participants. Of the 223 participants recruited, data were obtained from 160 at 3 months postinjury. Of the 27% without data, 10% were still in the hospital, 6% were cognitively or physically unable, and 9% were lost to follow-up. Two percent either declined to participate or were incarcerated.

Average age ± SD was 41.8±18.5 years. Mean ± SD admission Glasgow Coma Scale score was 9.2±4.9, with a mean ± SD inpatient length of stay of 17.3±12.7 days. For those with a positive loss of consciousness on arrival to the emergency department (75%), the time to follow commands averaged 5.6±8.1 days (median 2.0; interquartile range: 1.0, 6.5). Length of posttraumatic amnesia was an average ± SD of 18.1±15.4 days. Primary cause of injury was motor vehicular (63%), followed by falls (23%), violence (7%), and other (7%). Additional information relating to demographic characteristics is provided in table 1.

Measures

The measures chosen for the present investigation were selected because of their relevance to study aims and evidence of sound psychometric properties.

Connor-Davidson Resilience Scale

The Connor-Davidson Resilience Scale (CD-RISC) is a 25-item Likert-type, self-report scale used to measure characteristics of resilience.[21] Respondents rate a series of descriptors, as shown in table 2, on a scale ranging from 0 (rarely true) to 4 (true nearly all the time). A total raw score is calculated, ranging from 0 to 100. Normative studies including factor analyses indicated that the CD-RISC is reliable, internally consistent, demonstrates construct validity, and is sensitive to treatment effects.[21,30,31] The scale has also been used with a variety of other neurologic conditions including brain injury.[32,33]

Disability Rating Scale

The Disability Rating Scale (DRS) is designed to measure general functional status (eg, arousability, awareness, and responsiveness; cognitive ability for self-care activities; dependence on others; employability) over the course of recovery.[34] Total scores range from 0 (no level of disability) to 29 (extreme vegetative state). The DRS has been widely shown to be reliable and valid for use with