

Predictors of post-TBI Depression

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When an individual incurs a traumatic brain injury (TBI), there is a high likelihood that at some point, that person will suffer from depression. They may have a variety of depressive disorders including major depression.¹ Studies show that between 10 and 77 percent of TBI survivors report depressive disorders either very soon after their accident or during the “later” stages of recovery. Individuals with milder injuries, including sports concussions, and those classified with a “severe” brain injury have the greatest risk of developing depression.^{2,3} Depression is problematic because it contributes to the general symptoms of TBI including cognitive changes, fatigue, irritability, apathy (*lack of feeling, emotion, interest or concern*) and

lack of motivation. The combination of TBI and depression makes rehabilitation efforts quite challenging while adding to the overall functional disability of the survivor. It also greatly contributes to family and caregiver distress.⁴ Currently, standardized prevention methods to treat depression following a brain injury have not been clearly developed.

Causes of depression after TBI appear to have more than just psychological factors. Ricardo Jorge, MD and associates from the University of Iowa studied individuals with moderate to severe TBI. They report evidence suggesting that there is a greater vulnerability for depression after a TBI. Those who developed depression showed evidence of smaller hippocampal volumes

in the brain.⁵ The hippocampus is a major learning and memory structure in the brain associated with curbing stress hormone production. Investigators speculate that damage to areas of the brain that control stress hormones, including cortisol or glutamate, can contribute to the size reduction of the hippocampus.^{6,7} We hypothesize that sustained stress after TBI may contribute to depression disorders and may be harmful to the recovering brain.

Over the past decade, multiple risk factors have been identified for post-TBI depression. Those at the highest risk for chronic depression are individuals with pre-injury problems that include a neuropsychiatric history, substance abuse or those with high levels of perceived stress.⁸⁻¹¹ Depression also affects TBI survivors with post-injury psychosocial difficulties (*including somatic complaints*), those with slowing cognitive abilities and those suffering from pain.¹¹⁻¹⁸ Experts propose that chronic stress is a major factor

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contributing to post-TBI depression.^{11,19-21} Recognized in the field of clinical psychiatry,²²⁻²⁴ this idea is supported by Dr. McEwen's theory of allostasis load.⁷

Dr. McEwen of Rockefeller University in New York defines years of unresolved stress in terms of "allostatic load" — the wear and tear that results from chronic over activity or under activity of allostatic systems. Allostatic systems are the parts of the nervous system that control heartbeat, blood pressure and similar functions. These include the hypothalamus, pituitary and adrenal glands, which work together to produce a hormonal response, and the cardiovascular, metabolic and immune systems. McEwen's theory proposes that the brain, the immune and endocrine systems respond flexibly to daily stress. That is,

when adaptive systems are turned on and turned off again efficiently and not too frequently, the body is able to cope with stress. When stress becomes chronic, stress networks become impaired or dysregulated causing individuals to become vulnerable to stress-related disorders. Dysregulation is the result of an "allostatic load" — the physiological costs of chronic exposure of the neural or neuro-endocrine stress response. It is defined as a deterioration of biological mechanisms designed to withstand day-to-day stress. According to McEwen's model, vulnerability to stress is associated with a genetic predisposition, a decline in general health, poverty or even exposure to "risky families" (those with conflict, neglect and lack of nurturance).^{7,25-28} Causes of increased

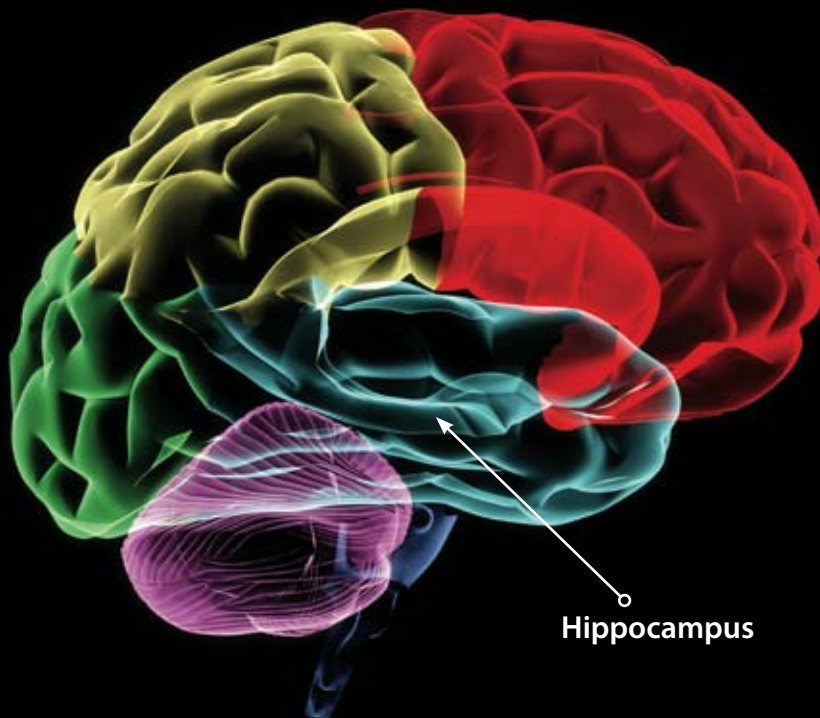
allostatic load include a sense of isolation and a perceived lack of control.

The allostatic load model is relevant to TBI. While there is no evidence supporting genetic predispositions toward post-TBI depression,³ there is evidence that those with chronic pre-injury difficulties^{11, 29-32} and/or chronic repeated stressors, including economic hardships, unemployment,³³ sustained difficulties such as pain, fatigue or other symptoms,^{29,34-39} or interpersonal conflicts^{16,40} are associated with post-TBI depression. There are other stress factors that may add to the effect of depression such as injury severity, litigation, fatigue and pain.

Study on the Risk Factors for Depression

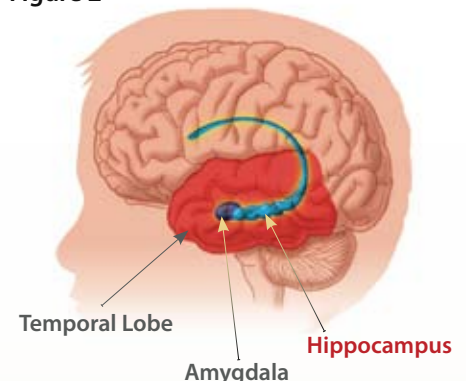
A study on the risk factors for depressive symptoms after mild-to-moderate traumatic brain injury was recently conducted by Esther Bay, PhD of Michigan State University in East Lansing, Michigan and Jacobus Donders of Mary Free Bed Rehabilitation Hospital in Grand Rapids, Michigan. The study focused on depression and stress in individuals who suffered a mild or moderate TBI. The results were published in the professional journal "Brain Injury," (2008, volume 22(3), pages 233-241).

Figure 1



The hippocampus is a C-shaped structure that curls from the temporal lobe in toward the center of the brain (also see Figure 2). It is one part of the limbic system, which is a group of brain structures associated with emotion, learning and memory.

Figure 2





Depression

The primary objective of this study was to determine the extent to which pre-injury psychosocial factors, injury-related variables and post-injury factors such as involvement in litigation, perceived stress, fatigue, pain and information processing speed contributed to depressive symptoms after traumatic brain injury (TBI).

The participants were recruited from outpatient rehabilitation centers throughout southeastern Michigan. In that study, the allostatic load was conceptualized as:

- 1) pre-injury 'fixed factors'
- 2) injury-related factors, and
- 3) post-injury factors, including chronic stress (*perceived global and event-related*)

Results in this sample indicated that "perceived" stress was the strongest risk factor for depressive symptoms as assessed with the depression subscale of the Neurobehavioral Inventory, a questionnaire designed to measure the frequency of brain injury symptoms and behaviors following a catastrophic injury. In our final analysis model, perceived stress, pain and involvement in litigation explained 70 percent of the depressive symptoms. It should be noted that these variables are relative and not absolute risk factors for depression.



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Based on observation and theory, these findings are compatible with TBI and other neurological conditions. First, chronic stress and depressive symptoms are clearly associated in studies on clinical depression. Chronic stress is often associated with relationship conflict, abuse, caregiver burden or difficult life events.^{22,24,41-45} Secondly, conditions of chronic stress (*abuse, childhood adversity, stressful life events*) and depressive symptoms are affiliated with neurological conditions such as traumatic brain injury,^{11,14,29,32} stroke, multiple sclerosis, spinal cord injury and polio.^{46,47} Our findings are consistent with the basic assumptions of allostatic load theory, linking chronic stress and depression disorders. It should be noted that improving the ability to detect stress development, including clinical interviews, biological stress correlates and longitudinal studies early after injury are required to further support this theory.^{7,26}

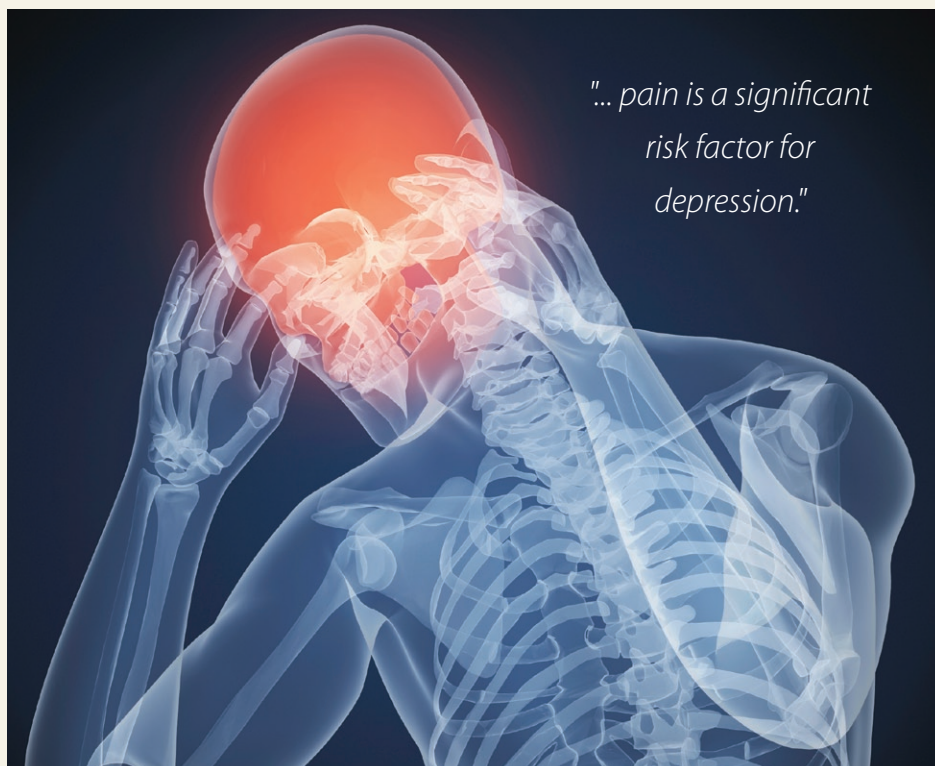
... findings [from the study] suggest that depression is elevated in people with mild TBIs due to perceived stress.



Our findings suggest that depression is elevated in people with mild TBIs due to perceived stress. Other studies have also noted this effect, particularly in individuals with complicated psychosocial histories.^{20,48} The findings may suggest that there is an increased risk for depressive symptoms in individuals with mild TBI because they are more vulnerable to additional stressors — perhaps because they lack adequate cognitive or psychosocial coping abilities. Another explanation is that the strong correlation between perceived stress and depressive symptoms suggests a shared mechanism. While further studies need to be completed, current data suggests early intervention focused on stress management may impact the development of depression. Stress management techniques are beneficial in promoting quality of life and limiting the development of chronic stress-related diseases.⁴⁹⁻⁵⁶ Whether or not techniques can be standardized still requires examination, but there is convincing research suggesting that even a single counseling session early in the recovery process can drastically reduce long-term symptoms of depression in individuals with mild TBIs.^{54,56-58}

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Another noteworthy finding of this study is that pain is a significant risk factor for depression. Despite significant research on post-TBI depression and post-traumatic stress disorder completed over the past decade^{3,59-61} and the likelihood that pain impacts both disorders^{37,62} and shares similar stress pathways,⁶³⁻⁶⁵ there has been



"... pain is a significant risk factor for depression."

little empirical work explaining how pain impacts post-TBI depression. However, two studies do support our findings that pain intensity is associated with depression, particularly chronic depression.^{14,15} Thus, based on the limited research on post-TBI pain, its high prevalence⁶⁶ and potential impact on depression³⁷— depression and pain should be examined and treated concurrently.

Limitations of the Study

Limitations of our study must also be acknowledged. A major weakness of this study is the cross-sectional approach to a phenomenon that is not static but dynamic: chronic stress. Our results can only be interpreted as a “snapshot” of a chronically evolving problem that

needs to be examined with a prospective longitudinal study. Secondly, a selection bias may be present because we relied on clinic staff to refer eligible people; even though we requested individuals with and without depression to participate. We acknowledge that our sample is unique:

- 25 percent were employed at the time of testing;
- 35 percent were involved in litigation;
- 36 percent were receiving medical disability;
- 45 percent were taking prescribed anti-depressants.

Despite access to treatment, many claimed to have significant levels of depressive symptoms. It should also be noted that our measure of these symptoms (NFI-D) does not have a validity check for the potential of over-reporting symptoms. We must ask the question whether people not included experience similar or different consequences from their injuries. This can only be resolved by performing a study on a non-referred sample. Given these limitations, our study suggests that in a



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referred sample with persistent subjective sequelae after a mild TBI, perceived stress was the most significant contributing factor for depression, with additional independent influences of pain and litigation.

Unfortunately, for individuals with a mild TBI, pain and stress management is not part of standardized treatment delivered by hospitals or emergency departments; rather the focus is on follow-up.⁶⁶ There is a need for early assessment guidelines, education, support and follow-up to prevent the development or persistence of depression for survivors of traumatic brain injury. ➤

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About the Author ...

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Esther Bay, PhD of Michigan State University has been involved in trauma care for many years and practiced as a critical care nurse and nurse practitioner. Currently, she is an assistant professor in the College of Nursing at Michigan State University where she has a teaching and research appointment. Dr. Bay is most interested in the stress experience of persons after brain injury and has published and spoken nationally and internationally on this topic, focusing on those in the chronic phase of recovery. She has begun to refocus her work on the early recovery process after mild brain injury and how stress impacts the recovery of physical, cognitive and psychological functioning in an effort to understand factors that contribute to poor outcomes after milder injuries. Additionally, she is working on a neuro-fatigue phenomenology study with a group of collaborators in the College of Osteopathy.

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