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Brain imaging reveals possible depression signature in traumatic brain injury

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Approximately half of individuals who experience a traumatic brain injury (TBI) experience depression within a year. Those with TBI and depression are prone to poorer recovery, reductions in cognitive performance, greater functional disability, increased suicide attempts and other social and sexual difficulties. Since depression symptoms vary greatly, teasing apart a diagnosis in the context of traumatic brain injury is often difficult. However, researchers at the Center for BrainHealth at The University of Texas at Dallas have identified a potential brain-based biomarker for depressive symptoms that could simplify the process.

The study that published yesterday in *Frontiers in Neurology Neurotrauma* found that individuals with traumatic brain injury and depression exhibit increased brain connectivity between multiple regions and sub-networks of the brain and the amygdala, the part of the brain responsible for emotional processing, compared to people with minimal depressive symptoms. Researchers further observed differences in brain connectivity patterns that predicted the type of depressive symptoms, specifically whether individuals leaned toward cognitive symptoms (related to thought patterns) or affective symptoms (related to general mood).

"It is very difficult to tell the difference between traumatic brain injury symptoms and depression symptoms," explained Kihwan Han, Ph.D., study lead author and postdoctoral research associate at the Center for BrainHealth. "We are hopeful that our findings that illuminate changes in amygdala connectivity patterns will become a useful tool that will help

clinicians objectively diagnose subtypes of depressive symptoms in traumatic brain injury and create individualized treatment plans."

For the study, researchers analyzed MRI scans of 54 chronic TBI civilians and veterans (31 chronic TBI individuals with mild to severe depressive symptoms plus 23 chronic TBI individuals with minimal depressive symptoms) and compared depressive symptoms using the Beck Depression Inventory-II. Researchers also conducted neuropsychological measures. Individuals with TBI ranged from lower moderate disability to lower good recovery or 5-7 points on the 8-point Extended Glasgow Outcome Scale. Participants were ages 20-60. While all individuals in the TBI group were at least six months post-injury at the time of the study, the average length of time since injury was eight years with no history of any significant, clinically-diagnosed neurological or psychiatric disorders or history of depressive symptoms prior to their TBI. Primary causes of injury included blasts, blunt force trauma, falls, athletic impacts, vehicle accidents or combinations thereof.

Although individuals with depressive symptoms showed an overall increase between various brain regions and the amygdala, individuals who expressed a predominance of cognitive symptoms such as thoughts of guilt, worthlessness, self-dislike or suicidal ideation, demonstrated reduced amygdala connectivity with prefrontal cortices of the default mode and cognitive control networks. Individuals that showed greater depressive affective symptoms, such as crying, loss of interest, indecisiveness and loss of pleasure showed reduced amygdala connectivity with the brain regions of salience (e.g., the insula), attention (e.g., the parietal lobules) and visual networks.

This study is part of a larger research endeavor led by principal investigator Daniel Krawczyk, Ph.D., associate professor of cognitive neuroscience and cognitive psychology at the Center for BrainHealth. The Department of Defense funded study investigates the effects of a

strategy-based cognitive training in veterans and civilians who have sustained a traumatic brain injury.

"Our initial findings are very encouraging and reveal a pronounced decrease in depressive symptoms and reduction in stress-related symptoms in individuals with traumatic brain injury who participated in the Center for BrainHealth-developed brain training," said Krawczyk who holds the Debbie and Jim Francis chair at The University of Texas at Dallas. "We look forward to being able provide a more robust picture of how cognitive training may affect behavioral symptoms associated with structural brain change due to injury."

As part of future work, Han will analyze whether such reductions in depressive and stress-related symptoms after the training are associated with changes in amygdala connectivity.

"While this study is specific to traumatic brain injury, we believe this work will eventually be expanded to benefit the general public," said Sandra Bond Chapman, Ph.D., Center for BrainHealth founder and chief director. "This could have life-changing benefits for people months and even years after brain injury as well as for individuals affected by depression who have never had a brain injury."

More information: *Frontiers in Neurology Neurotrauma* , journal.frontiersin.org/articl … .2015.00231/abstract

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