

## **The Institute of Medicine's Committee on Gulf War and Health: Brain Injury in Veterans and Long-Term Health Outcomes**

The IOM's Committee on Gulf War and Health: Brain Injury in Veterans and Long-Term Health Outcomes was commissioned to examine the strength of the evidence of an association between TBI and potential long-term health effects (Gulf War and Health Volume 7: Long-Term Consequences of Traumatic Brain Injury National Academy Press, 2009). The committee conducted a review of the scientific literature including all relevant studies of adult, human TBI in any population (civilian or military) caused by any mechanism (e.g., motor-vehicle crashes, falls, etc.) and came to a number of conclusions about the strength of the relationship between sustaining a TBI and experiencing a specific health outcome six months or later post-injury.

### **Long-Term Effects of TBI**

The committee's conclusions that TBI is associated with later seizures, cognitive deficits, depression, aggression, unemployment or social isolation were not surprising. However, they also found that premature death, declines in cognitive function, progressive dementia, Parkinsonism and endocrine dysfunction, particularly hypopituitarism, also are associated with penetrating and non-penetrating moderate to severe TBI. These conditions depart from the commonly cited long-term cognitive, behavioral and social problems and suggest that TBI is a chronic health condition that has a long-term, deleterious effect on overall health for some individuals.

## **Consequences of TBI Persisting or Developing Six or More Months Post-Injury**

- Seizures
- Ocular- & visual-motor disturbances
- Cognitive deficits
- Post-concussive symptoms
- Depression
- Aggression
- Suicide
- Unemployment
- Social isolation
- Psychosis
- Premature death
- Progressive dementia
- Parkinsonism
- Diabetes insipidus
- Endocrine dysfunction
- Hypopituitarism
- Growth hormone insufficiency

## **Moderate and Severe Injury Have More Consequences**

The relationship between TBI and various health conditions was highly dependent on the type and severity of injury. All three conclusions made with the highest level of certainty--definitive evidence of a causal relationship--were consequences of penetrating TBI, though the development of unprovoked seizures also was considered to have a causal relationship with moderate and severe, non-penetrating TBI. For other consequences of non-penetrating TBI, the degree of certainty regarding an association was very much a function of the severity of the original injury. With three exceptions, most conclusions for which sufficient evidence of an association was present were limited to moderate or severe TBI and not mild. (For cognitive deficits, severe but not moderate TBI was concluded to have sufficient evidence; however, the committee observed that inconsistencies across studies in the definition of moderate TBI were largely to blame for the weaker evidence.)

The three notable exceptions for which an association was observed for all TBI, including mild, were depression, aggressive behaviors and post-concussive symptoms. For each, sufficient evidence was found to conclude an association exists between any TBI (i.e., mild, moderate, severe or penetrating) and these conditions. There were multiple additional conditions for which the research suggested a relationship with TBI's of various severities, however studies were too limited in number or strength of finding to allow the conclusion that a relationship definitely exists.

## **Consequences of Mild TBI**

- Seizures
- Ocular- & visual-motor disturbances
- Post-concussive symptoms
- Depression
- Aggression
- Suicide
- Progressive dementia
- Parkinsonism

## **Consequences of TBI Emerging or Re-Emerging Later in Life**

The associations observed between TBI and later health outcomes differed in their natural course. Most long-term consequences were observed at time of injury, or soon after, and persisted, presumably indefinitely. However, some consequences were observed to re-emerge or develop later. Conditions found in at least some studies to emerge or re-emerge in later life included cognitive deficits, depression, suicide, premature death, progressive dementia and Parkinsonism. This list of late developing conditions is likely incomplete as not all consequences were studied in later life. For instance, finding regarding development of endocrine disorders were based on studies conducted one to two years post-injury. These deficiencies may provide a gateway for further complications over time, an outcome that was not studied.

The results of the 2009 Institute of Medicine Committee study was the basis of a recommendation made to the Veterans Administration in a 2010 IOM report on service member readjustment ("Preliminary Assessment of Readjustment Needs of Veterans, Service Members, and Their Families" IOM, 2010):

## **Consequences of TBI Emerging or Re-Emerging Later in Life**

- Cognitive deficits
- Depression
- Suicide
- Premature death
- Progressive dementia
- Parkinsonism

## **A Pro-Active Approach to Managing Chronic TBI**

"The committee recommends that the Department of Veterans Affairs conduct research to determine the potential efficacy and cost-effectiveness of developing protocols for the long-term management of service members who have polytrauma and traumatic brain injury. The approaches considered should include:

- Prospective clinical surveillance to allow early detection and intervention for health complications;
- Protocols for preventive interventions that target high incidence or high risk complications;
- Protocols for training in self-management aimed at improving health and well-being;
- Access to medical care to treat complications; and
- Access to rehabilitation services to re-optimize functional abilities" (page 66).

This recommendation reflects the potential for improving quality of life and extending health and function by using a "disease management" approach to chronic TBI as is used with diabetes and hypertension. Given a certain likelihood or severity of a later developing consequence, a system of education and supports are provided to, if possible, prevent or delay the problem. For other complications, early detection and treatment may prevent or reduce more severe manifestation.

## **Findings Published in 2011**

- Widespread Tau and Amyloid-Beta Pathology Many Years After a Single TBI in Humans--Johnson, Stewart and Smith Brain Pathology, in press
- Brain Injury May More Than Double Dementia Risk in Older Veterans--Yaffe et al. Alzheimer's Association International Conference 2011
- TBI Increases Risk of Parkinson's Disease--Hutson et al. Journal of Neurotrauma 2011
- Traumatic Brain Injury Is a Risk Factor for Schizophrenia--Molloy et al. Schizophrenia Bulletin 2011

- TBI Linked with Tenfold Increase in Stroke Risk--Chen, Kang & Lin Stroke 2011