



## *Traumatic Brain Injury (TBI)*

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**T**raumatic brain injury (TBI), caused either by blunt force or acceleration/deceleration forces, is common in the general population. Homeless persons are at particularly high risk of head trauma and adverse outcomes to TBI. Even mild traumatic brain injury can lead to persistent symptoms including cognitive, physical, and behavioral problems. It is important to understand brain injury in the homeless population so that appropriate referrals to specialists and supportive services can be made. Understanding the symptoms and syndromes caused by brain injury sheds light on some of the difficult behavior observed in some homeless persons. This understanding can help clinicians facilitate and guide the care of these individuals.

### **Prevalence and Distribution**

Every year in the USA, approximately 1.5 million people sustain traumatic brain injury (TBI), 230,000 people are hospitalized due to TBI and survive, over 50,000 people die from TBI, and more than 1 million people are treated in emergency rooms for TBI. In persons under the age of 45 years, TBI is the leading cause of death. Health costs from TBI are estimated to be in the range of \$35 billion per year. Eighty to ninety thousand Americans experience the onset of long-term disability as a result of a TBI. TBI is classified into categories of severe, moderate, and mild. Mild traumatic brain injury (MTBI), often referred to interchangeably as a concussion, can cause persistent disabling problems such as headache, confusion, memory and cognitive problems, mood changes, changes in sleep pattern, or sensory problems. In most cases of MTBI patients

recover fully, but up to 15% of patients diagnosed with MTBI by a physician experience persistent disabling problems. Up to 75% of brain injuries are classified as MTBI. These injuries cost the US almost \$17 billion per year. The groups most at risk for TBI are those aged 15-24 years and those aged 65 years and older. Men are twice as likely to sustain TBI as women.

### **Causes**

TBI occurs either with blunt force trauma to the head or as a result of rapid acceleration/deceleration. Diffuse brain injury can occur when the brain moves back and forth within the skull. The greatest amount of damage is often in the temporal and frontal lobes where the brain comes into contact with bony structures. Localized injury can also occur with penetrating head injuries. The leading

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*TBI and Mood Swings. This man suffered a gunshot wound to the head and many subsequent traumatic brain injuries while homeless. These photographs show the rapid mood swings often seen after TBI.*

*Photos by Carol Waldmann MD*

*Brain Injury.*  
This long time patient of BHCHP had a resection of a subdural hematoma in 1995. Note the visible change in the shape of his skull from brain surgery, which included partial resection of the temporal lobe.



causes of TBI in the general population include motor vehicle accidents (MVAs), falls, firearm accidents, and sports/recreational injuries. Although no controlled studies have been done, homeless persons appear to be at high risk for TBI given that substance abuse, MVAs, and violence are common in this population. Substance abuse leads to a large number of falls. When a person passes out or “takes a header”, it is equivalent to being dropped on the head from their height. Half of all TBI is associated with alcohol use, either in the injured or the person causing the injury. Alcohol use is also shown to result in a higher level of post trauma disability.

**Diagnosis**

The definition of mild, moderate, and severe traumatic brain injury has varied slightly in different

studies, but the most frequent delineation of these categories is based on the Glasgow Coma Scale. Combined with the existence/duration of post-traumatic amnesia (PTA) and/or loss of consciousness (LOC), the following definitions are most useful:

- *severe brain injury* - GCS 8 or less, LOC >24 hrs, and/or PTA >24 hr;
- *moderate brain injury* - GCS 9-12, LOC 1/2-24hr, and/or PTA 1-24hr;
- *mild brain injury* - GCS of 13-15, LOC < 30 min, and PTA < 1hr

The Centers for Disease Control and Prevention (CDC) MTBI Working Group defined MTBI as “the occurrence of an injury to the head arising from blunt trauma or acceleration/deceleration forces” with one or more of the following conditions attributable to the head injury:

1. any period of observed or self reported:
  - transient confusion, disorientation, or impaired consciousness;
  - dysfunction of memory around the time of injury;
  - loss of consciousness lasting less than 30 minutes;
2. observed signs of other neurological or neuropsychological dysfunction, such as:
  - seizures acutely following injury to the head;
  - irritability, lethargy, or vomiting following head injury, especially among infants and very young children or;
  - headache, dizziness, irritability, fatigue, or poor concentration, especially among older children and adults.

Diagnostic tests and imaging can be useful, particularly in the case of sports-related injuries. Neuropsychological testing is appropriate when

Based on Luerksen TG. *Acute traumatic cerebral injuries*. In: Cheek WR (ed). *Pediatric Neurosurgery*. 3rd ed. Philadelphia: WB Saunders; 1994.

**Table 1: Glasgow Coma Scale**

Score	Eye-opening	Motor	Verbal	Verbal (young)
6		Obeys		
5		Localizes	Appropriate and oriented	Appropriate
4	Spontaneous	Withdraws	Confused conversation	Not consolable
3	Verbal	Flexion (decorticate)	Inappropriate words	Persistently irritable
2	Pain	Extension (decerebrate)	Incomprehensible	Restless, agitated
1	None	None	None	None

Mild	13-15
Moderate	9-12
Severe (coma)	≤ 8

## Grades of Concussion

Grade 1:	Grade 2:	Grade 3:
<ol style="list-style-type: none"> <li>1. Transient confusion (inattention, inability to maintain a coherent stream of thought and carry out goal-directed movements)</li> <li>2. No loss of consciousness</li> <li>3. Concussion symptoms or mental status abnormalities on examination resolve in <b>less than 15 minutes</b></li> </ol>	<ol style="list-style-type: none"> <li>1. Transient confusion</li> <li>2. No loss of consciousness</li> <li>3. Concussion symptoms or mental status abnormalities (including amnesia) on examination last <b>more than 15 minutes</b></li> </ol>	<ol style="list-style-type: none"> <li>1. Any loss of consciousness               <ol style="list-style-type: none"> <li>a) Brief (seconds)</li> <li>b) Prolonged (minutes)</li> </ol> </li> </ol>

## Features of Concussion Frequently Observed

1. Vacant stare (befuddled facial expression)
2. Delayed verbal and motor responses (slow to answer questions or follow instructions)
3. Confusion and inability to focus attention (easily distracted and unable to follow through with normal activities)
4. Disorientation (walking in the wrong direction, unaware of time, date and place)
5. Slurred or incoherent speech (making disjointed or incomprehensible statements)
6. Gross observable incoordination (stumbling, inability to walk tandem/straight line)
7. Emotions out of proportion to circumstances (distraught, crying for no apparent reason)
8. Memory deficits (exhibited by the athlete repeatedly asking the same question that has already been answered, or inability to memorize and recall 3 of 3 words or 3 of 3 objects in 5 minutes)
9. Any period of loss of consciousness (paralytic coma, unresponsiveness to arousal)

emotional or cognitive symptoms may be present. The primary tool for diagnosis remains careful history. All patients should be asked about injuries or accidents, as many patients do not spontaneously mention head injuries to their doctors. If they have had an injury a detailed history of signs and symptoms of head injury should be taken.

### Neuropsychiatric Sequelae of TBI

MTBI (with or without LOC or PTA) can result in long term sequelae including somatic, mood, anxiety, cognitive, and behavioral disorders. Psychosis also occurs in some cases. The major risk factors for neuropsychiatric disturbances after brain injury include age, atherosclerosis, and alcoholism. Premorbid personality, social stressors, and lack of social supports also play significant roles in the level and type of disturbance. One study of 100 subjects revealed post injury personality disorders in 66%, with a pre-TBI personality disorder diagnosis in 24% of the sample. Cognitive disturbances after head injury include dementia, delirium, amnesic disorder, and intellectual impairment. Mood

disorders are common, including major depression in 25% and mania in 9% of patients. Anxiety disorders range in frequency from 11-70%, depending on the study cited. 10% of patients have apathy without depression. Schizophrenia-like psychosis occurs in 0.7-9.8%; most of these patients did not have a family history of schizophrenia. Diffuse brain damage with predominance in the frontal and temporal lobes (at times caused by MTBI) is thought to cause behavioral dyscontrol disorders. Symptoms include: mood problems, such as irritability, rage, and anger; cognitive deficits, including impaired memory, attention, and judgment; and behavioral dysfunction, including impulsivity, aggressivity, hyperactivity, hyperphagia, and pica. A wide range of somatic symptoms with a neurological basis also occur.

### Management

The sequelae of TBI are diverse, and the management must be tailored to the individual. If individuals are seen soon after an injury, referral to a physician should be made as soon as possible. Base-

line neurological, emotional, and cognitive findings should be carefully recorded. Patients at any stage should be evaluated for the ability to resume risky activity, such as operating machinery, driving motor vehicles, or participating in sports. Most research in this area has been around returning to sports activities and may be applied to other settings.

When cognitive or emotional symptoms interfere with normal relationships and functioning, as is often the case in the homeless population, patients should be referred to a neurologist and/or a psychiatrist. Referral to specialized multidisciplinary cognitive therapy programs should be considered. Patients should be educated about their condition, treatment plan, and prognosis. It is often a relief to patients and their support systems to understand the probable relationship of a head injury to changes in functional level, memory, concentration, personality, and emotions. Support is often available at the local chapter of the Brain Injury Association, but homeless patients often need significant additional support and assistance in accessing such services. Patients may also be eligible for disability benefits and should be assisted in obtaining these benefits, which may enable them to access services and housing. MTBI results in diminished reaction time, and those with recent concussions are at high risk for secondary injury. Individuals should be educated about this risk. Assistance in getting into a safe environment for recovery and secondary prevention should be provided if appropriate. Patients should be given written instructions about what activities may be dangerous and when certain of these activities can be resumed.

### Summary

Brain injury is common in both the general population and specifically in the homeless population. Many homeless people are at risk of brain injury due to the high prevalence of accidents, substance abuse, and violence in this population. Persons with brain injury tend to decline in socioeconomic status due to neuropsychiatric disturbances following head injury. They are frequently unable to hold jobs or maintain interpersonal relationships, and are at increased risk of being involved in the criminal justice system. This increases the risk of becoming or remaining homeless. Alcoholism decreases the brain's ability to heal and increases the risk of neuropsychiatric and physical sequelae of brain injury. All head injuries in the homeless population, including MTBI, should be taken seriously. Referral to a health care clinician should be made as soon as possible after a head injury, and every effort should be made to find a safe environment for the injured person to recover. Physicians and mid-levels should routinely screen for past head injury and sequelae of TBI. Patients with evidence of ongoing symptoms should be referred to the appropriate services and counseled about secondary prevention, possible complications, and prognosis for recovery. ■■

**Table 2: Signs and Symptoms of TBI**

Behavior	Mood	Cognition	Somatic Symptoms
Impulsivity Aggressivity Hyperactivity Hyperphagia Pica Loss of initiative	Irritability Depression Mania Rage/ Anger Anxiety	Impaired memory Decreased attention Poor concentration Poor executive function Impaired judgment Distractibility Conceptual disorganization	Headache Nausea Dizziness Vertigo Diplopia Insomnia Deafness Tinnitus Light sensitivity Noise sensitivity Fatigue Dyscoordination Sleep disturbances Blurred vision Seizures

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