



Traumatic Brain Injury (TBI)

TBI is an injury from some type of trauma, such as a blow, jolt, or penetrating object, that disrupts normal brain functions. Falls, car accidents, impact while playing sports, and objects piercing the skull are common causes of TBI. A TBI can range from mild, sometimes called a concussion, to serious, which can cause long-term problems. NICHD is one of many NIH institutes and other federal agencies working to understand and prevent TBI and to help people recover from TBI and related conditions.

About Traumatic Brain Injury (TBI)

TBI is an injury to the brain from some type of trauma or force, such as a bump or blow to the head or an object such as a bullet entering the skull. TBI can cause problems with brain function. Some TBIs result in mild, temporary problems. A more severe TBI can lead to serious physical, mental, and emotional symptoms; coma; and even death.¹ People or children who have already experienced brain injury or brain disease are at higher risk for developing TBI.

Traumatic Brain Injury (TBI) in Kids

<https://www.youtube.com/embed/OiLBPsTRLnQ>

A text alternative is available at:

http://www.nichd.nih.gov/news/resources/links/Pages/TBI_VTA.aspx
(/news/resources/links/Pages/TBI_VTA.aspx).

TBI includes (but is not limited to) several types of injury to the brain:

- **Skull fracture** occurs when the skull cracks. Pieces of broken bone from the skull may cut into the brain and injure it, or an object such as a bullet may pierce the skull and enter the brain.
- **Contusion** is a bruise of the brain, where swollen brain tissue combines with blood released from broken blood vessels to increase pressure on the brain. A contusion can occur from the brain shaking back and forth against the skull, such as from a car crash or sports injury or in shaken baby syndrome

(<https://www.ninds.nih.gov/Disorders/All-Disorders/Shaken-Baby-Syndrome-Information-Page>).

- **Intracranial hematoma** occurs when a major blood vessel in or around the brain is damaged and begins bleeding. The pooling of blood puts pressure on the brain.^{1,2}


Concussion is among the most common forms of TBI.¹ A concussion can happen when the head or body is moved back and forth quickly, such as during a car crash or sports injury, or from a blow to the head. Concussions are often called “mild TBIs,” because they are usually not life-threatening. However, they still can cause serious problems, especially if the person has experienced a concussion before.^{3,4}

People may also experience non-traumatic brain injuries that result from a problem, such as a stroke, infection, or broken blood vessel, inside the brain or skull. A person who has a non-traumatic brain injury may have some of the same symptoms as a person who has a TBI. Both traumatic and non-traumatic brain injuries can have serious, long-term effects on a person’s ability to think and function.^{5,6}

TBI can happen to anyone, but some people are more likely to experience a TBI than others. For example, according to the Centers for Disease Control and Prevention (CDC),¹ young children, teenagers, and adults age 65 or older are at higher risk for TBI. CDC statistics¹ also show that males are at higher risk than females in most age groups.

Citations



1. Centers for Disease Control and Prevention. (2019). *TBI: Get the facts*. Retrieved March 20, 2020, from https://www.cdc.gov/traumaticbraininjury/get_the_facts.html
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What are common symptoms of traumatic brain injury (TBI)?

TBI symptoms vary depending on:

- The type of injury
- How severe the injury is
- What area of the brain is injured

TBI injuries can be both local (the exact place on the brain where the injury occurred) and include the surrounding tissues, which can also be affected by the damage to the initial site. This means that some symptoms appear right away, while others may appear several days or even weeks later and evolve over time. A person with TBI may or may not lose consciousness. Loss of consciousness, sometimes called a blackout, does not necessarily mean the TBI is severe, especially if the blackout lasts for only a short time. [Learn about treatments for TBI \(/health/topics/tbi/conditioninfo/treatment\)](/health/topics/tbi/conditioninfo/treatment).

Symptoms of Mild TBI



A person with a mild TBI may experience any of the following:

- Headache
- Confusion
- Lightheadedness
- Dizziness
- Blurred vision
- Ringing in the ears, also known as tinnitus
- Tiredness or sleepiness
- A bad taste in the mouth
- A change in sleep habits
- Behavior or mood changes
- Trouble with memory, concentration, attention, or thinking
- Loss of consciousness lasting a few seconds to minutes¹
- Sensitivity to light or sound
- Nausea or vomiting²

Symptoms of Moderate or Severe TBI



A person with moderate or severe TBI may have some of the symptoms listed for mild TBI. In addition, the person may experience any of the following:

- Headache that gets worse or will not go away
- Loss of vision in one or both eyes
- Repeated vomiting or continued nausea
- Slurred speech
- Convulsions or seizures
- An inability to wake up from sleep
- Enlargement of the pupil (dark center) of one or both eyes
- Numbness or tingling of arms or legs
- Uncoordinated or “clumsy” movements
- Increased confusion, restlessness, or agitation
- Loss of consciousness lasting a few minutes to hours³

A person who suffers a blow to the head or other injury that may cause a TBI should seek medical attention, even if none of the symptoms listed are present.⁴ Sometimes symptoms do not appear until well after the injury.

Citations




1. National Institute of Neurological Disorders and Stroke. (2019). *Traumatic brain injury (TBI) information page*. Retrieved March 20, 2020, from <https://www.ninds.nih.gov/Disorders/All-Disorders/Traumatic-Brain-Injury-Information-Page>
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What causes traumatic brain injury (TBI)?

A TBI is caused by an external force that injures the brain. It can occur when a person's head is hit, bumped, or jolted. It also can occur when an object, such as a bullet, pierces the skull or when the body is shaken or hit hard enough to cause the brain to slam into the skull.

[Learn about the symptoms of TBI \(/health/topics/tbi/conditioninfo/symptoms\)](/health/topics/tbi/conditioninfo/symptoms).

Among the leading causes of TBI are falls, motor vehicle crashes and traffic-related accidents, being struck by or against an object, and assaults.¹

Many TBIs, especially in young people, happen while people are playing sports or doing recreational activities. Some activities that lead to emergency department visits for TBI are bicycling, football, playground activities, basketball, and soccer.² Learn more by viewing NICHHD's [video \(https://www.youtube.com/watch?v=OiLBPsTRLnQ&feature=youtu.be\)](https://www.youtube.com/watch?v=OiLBPsTRLnQ&feature=youtu.be)  [\(/external-disclaimer\)](/external-disclaimer) and [infographic \(/newsroom/digital-media/infographics/TBlinKids\)](/newsroom/digital-media/infographics/TBlinKids) on TBI in kids.

In the military, the leading causes of TBI are gunshots, fragments from an explosion, blasts, falls, motor vehicle crashes, and assaults.³

Citations



1. Centers for Disease Control and Prevention. (2019). *TBI: Get the facts*. Retrieved March 20, 2020, from https://www.cdc.gov/traumaticbraininjury/get_the_facts.html
2. National Institute of Neurological Disorders and Stroke. (2020). *Traumatic brain injury: Hope through research*. Retrieved March 20, 2020, from <https://www.ninds.nih.gov/Disorders/Patient-Caregiver-Education/Hope-Through-Research/Traumatic-Brain-Injury-Hope-Through>
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How do healthcare providers diagnose traumatic brain injury (TBI)?

Healthcare providers use different tests and measures to diagnose TBI. Often, multiple measures are used together to diagnose TBI and to map out a path for treatment and recovery. Some of these tests are described in the following sections. In addition to “neuro-checks”—a series of quick questions and tasks that help healthcare providers assess how well a TBI patient’s brain and body are working—some in-depth tests help reveal levels of injury or damage in TBI patients.

Please note: This website does not include all tests that may be used to diagnose TBI.

Imaging Tests

Healthcare providers who suspect TBI will usually take images of a person’s brain. These image tests can include:

- **Computerized tomography (CT).** A CT (or “CAT”) scan takes X-rays from many angles to create a complete picture of the brain. It can quickly show whether the brain is bleeding or bruised or has other damage.
- **Magnetic resonance imaging (MRI).** MRI uses magnets and radio waves to produce more detailed images than CT scans. An MRI likely would not be used as part of an initial TBI assessment, because it takes too long to complete. It may be used in follow-up examinations, though.¹

Glasgow Coma Scale (GCS)

The GCS gives healthcare providers a way to measure a person’s functioning in three key areas:

- **Ability to speak,** such as whether the person speaks normally, speaks in a way that doesn’t make sense, or cannot speak at all
- **Ability to open eyes,** including whether the person opens his or her eyes only when asked
- **Ability to move,** ranging from moving one’s arms easily and on purpose to not moving even in response to pain

A healthcare provider rates a person's responses in these categories and calculates a total score. A score of 13 or higher indicates a mild TBI, 9 through 12 indicates a moderate TBI, and 8 or below indicates severe TBI.² Doctors can also use the GCS to monitor a patient's recovery progress.³

Measurements for Level of TBI



Healthcare providers sometimes rank TBI by the person's level of consciousness, memory loss, and GCS score.

Mild TBI	Moderate TBI	Severe TBI
Did not lose consciousness or was unconscious for less than 30 minutes	Unconscious for more than 30 minutes and up to 24 hours	Unconscious for more than 24 hours
Memory loss lasted less than 24 hours	Memory loss lasted anywhere from 24 hours to 7 days	Memory loss lasted more than 7 days
GCS was 13 to 15	GCS was 9 to 12	GCS was 8 or lower. ⁴

Other Tests



Other tests for TBI may include:

- Speech and language tests to determine how well the patient can speak and use language, including how well the muscles needed to form words work and how well the patient can read and write⁵
- Social communication skills tests and role-playing scenarios to determine whether a person's behavior or actions have been affected
- Tests of swallowing abilities to ensure the patient can swallow safely and receive enough nutrition
- Tests of breathing abilities and lung function to find out whether breathing assistance or extra oxygen is needed
- Cognition tests or questions to see how the patient's thinking, reasoning, problem-solving, understanding, and remembering abilities are
- Neuropsychological assessments to learn more about the patient's brain and social functions, including the ability to control one's behavior and actions

Blood Tests



Blood tests to diagnose TBI are an emerging area of research. In 2018, the Food and Drug Administration approved a blood test that detects two proteins, UCH-L1 and GFAP, which are released by the brain into the bloodstream when a mild concussion occurs. The test can help identify individuals whose injury is unlikely to show up on a CT scan, eliminating the need for an unhelpful test. The blood test may also provide a way to quickly diagnose military personnel for a mild concussion.⁶

Researchers at the National Institute of Nursing Research and NICHD found that testing for the blood protein tau could help identify athletes who need more recovery time before they can safely return to play after a sports-related concussion.⁷

Citations



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What are the treatments for traumatic brain injury (TBI)?

A variety of treatments can help a person recover from TBI and can sometimes reduce or eliminate certain physical, emotional, and cognitive problems associated with TBI. The specifics of treatment, including the type, setting, and length, depend on how severe the injury is and the area of the brain that was injured.

Treatment for Mild TBI



Mild TBI, sometimes called concussion, may not require specific treatment other than rest. However, it is very important to follow a healthcare provider's instructions for complete rest and slow return to normal activities after a mild TBI. If a person returns to their normal activities too soon and starts experiencing TBI symptoms, the healing process may take much longer. Certain activities, such as working on a computer and concentrating hard, can tire the brain even though they are not physically demanding. A person with a concussion might need to reduce these kinds of activities or take frequent breaks to let the brain rest.

In addition, alcohol and other drugs can slow recovery and increase the chances of re-injury.¹ Re-injury during recovery can slow healing and increase the chances of long-term problems, including permanent brain damage and even death.²

Emergency Treatment for TBI



Emergency care generally focuses on stabilizing and keeping the patient alive, including making sure the brain gets enough oxygen, controlling blood and brain pressure, and preventing further injury to the head or neck.³ Once the patient is stable, other types of care for TBI can begin.

Sometimes surgery is needed as part of emergency care to reduce damage to the brain. Surgery may include:

- **Removing blood clots or pools.** Bleeding in the brain or between the brain and skull can lead to large areas of clotted blood, sometimes called hematomas. These areas of clotted or pooling blood put pressure on the brain and can damage brain tissues.¹
- **Repairing skull fractures.** Setting severe skull fractures or removing pieces of skull or other debris from the brain area can help start the healing process of the skull and surrounding tissues.³

- **Relieving pressure inside the skull (called intracranial pressure or ICP).** Increased pressure from swelling, blood, and other things in the skull damage the brain. A TBI patient's ICP is monitored during emergency care. In some cases, making a hole in the skull or adding a shunt or drain is needed to relieve pressure inside the skull and allow excess fluid to drain.⁴

Medications

Medications can help treat symptoms of TBI and lower the risk of some conditions associated with it. Some medications are useful immediately after a TBI, while others treat symptoms and problems related to recovery from TBI some time after the initial injury. These medications may include:

- **Anti-anxiety medication** to lessen feelings of nervousness and fear
- **Anticoagulants** to prevent blood clots and improve blood flow
- **Anticonvulsants** to prevent seizures
- **Antidepressants** to treat symptoms of depression and mood instability, also called mood swings
- **Diuretics** to help remove fluid that can increase pressure inside the brain¹
- **Muscle relaxants** to reduce muscle spasms and to relax constricted muscles
- **Stimulants** to increase alertness and attention⁵

Researchers continue to explore medications that may aid recovery from TBI.

Rehabilitation Therapies

Therapies can help people with TBI recover functions, relearn skills, and find new ways to do things that take their new health status into account. Rehabilitation can include several different kinds of therapy for physical, emotional, and cognitive difficulties and for a variety of activities, such as daily self-care, driving, and interacting with others. Depending on the injury, these treatments may be needed only briefly after the injury, occasionally throughout a person's life, or on an ongoing basis.

Therapy usually begins in the hospital and can continue in a number of places, including rehabilitation hospitals, skilled nursing facilities, homes, schools, and outpatient programs. Rehabilitation generally involves a number of healthcare specialists, the person's family, and someone who manages the team.⁶ They often work together to design a treatment program to meet a person's specific needs and to improve his or her abilities to function at home and in the community.

Rehabilitation therapy may include the following^Z:

- **Physical therapy** to build physical strength, balance, and flexibility and to help restore energy levels
- **Occupational therapy** to learn or relearn how to perform daily tasks, such as getting dressed, cooking, and bathing
- **Speech therapy** to improve the ability to form words, speak aloud, and use other communication skills; can include instruction on how to use special communication devices and treatment of trouble swallowing, called dysphagia
- **Psychological counseling** to learn coping skills, work on interpersonal relationships, and improve general emotional well-being; can include medication and other ways to address chemical imbalances that may result from TBI
- **Vocational counseling** to help a patient return to work and community living by finding appropriate work opportunities and ways to deal with workplace challenges
- **Cognitive therapy** to improve memory, attention, perception, learning, planning, and judgment

Citations



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What are the possible effects of traumatic brain injury (TBI)?

TBI can have a range of effects that depend on the type of injury, how severe the injury is, and what part of the brain is injured.¹ According to the Centers for Disease Control and Prevention, these health effects can sometimes remain for a long time or even be permanent.²

Immediate Problems

Sometimes, a person will have medical complications just after the injury. People with more severe TBI are more likely to have complications. Some complications of TBI include seizures, nerve damage, blood clots, narrowing of blood vessels, stroke, coma, and infections in the brain.¹

The likelihood of many of these problems decreases as more time passes and the person's condition stabilizes. However, some problems, such as seizures, may continue even after a person's condition is stable.

Longer-Term Effects

TBI may cause problems with various brain functions, and some of these problems do not appear until days or months after the injury. Some problems may be temporary, while others may persist throughout a person's life after the injury. Possible longer-term effects of TBI include problems with:

- **Cognition**, such as difficulty learning, remembering, making decisions, and reasoning
- **Senses**, such as double vision, a bitter taste in the mouth or loss of the sense of taste, ringing in the ears, and tingling or pain
- **Communication**, such as trouble talking, reading, writing, and explaining feelings or thoughts
- **Behavior**, including difficulty with social situations, relationships, self-control, and aggression
- **Emotions**, including depression, anxiety, mood swings, and irritability^{1,3}

Degenerative Effects

Research suggests that having one or more TBIs may increase the likelihood of later having a disease that causes the breakdown of brain cells. Some evidence indicates that TBI is linked to:

- Alzheimer’s disease (<https://www.ninds.nih.gov/Disorders/All-Disorders/Alzheimers-Disease-Information-Page>), which impairs memory, emotions, and thinking skills
- Parkinson’s disease (<https://www.ninds.nih.gov/Disorders/All-Disorders/Parkinsons-Disease-Information-Page>), which causes problems with motor skills and controlling body movement
- Chronic traumatic encephalopathy, which causes problems with memory, thinking, and motor skills. It is more common in those who have repeated TBIs or head impacts, including athletes involved in boxing, football, and hockey.⁴

Citations



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