

Traumatic Brain Injury

A traumatic brain injury (TBI) is caused by a bump, blow, jolt or penetration to the head disrupting the normal function of the brain.¹ When one or more of the following clinical signs is observed, it constitutes an alteration in brain function: a) any period of loss of, or decreased, consciousness; b) any loss of memory for events immediately before or after the injury; c) neurological deficits such as muscle weakness, loss of balance and coordination, disruption of vision, change in speech and language, or sensory loss; or d) any alteration in mental state at the time of the injury such as confusion, disorientation, slowed thinking, or difficulty concentrating.² Each year, TBIs contribute to a substantial number of deaths and cases of permanent disability.³ In 2010, 2.5 million TBIs occurred either as an isolated injury or along with other injuries resulting in hospitalizations, emergency department (ED) visits and death.³ The health effects resulting from TBIs vary and can be broadly categorized into cognitive, behavioral/emotional, motor and somatic symptoms.^{4,5}

How does traumatic brain injury affect the United States?

Fatal data

- Every day, 138 people in the United States die from injuries that include TBI. Nearly 53,000 died of TBI-related injuries in 2010.³
- Patients who sustained a TBI as a result of a motorcycle crash were three times as likely to die in the ED compared to those who suffered motorcycle injuries not involving a TBI.⁶
- Among adolescents and adults who received rehabilitation for TBI, 20% will have died at five years post-injury, and nearly 40% will have declined in function from the level of recovery attained one to two years post injury.⁷

Non-fatal data

- In 2010, approximately 2.2 million people were treated in and released from EDs and another 283,600 were hospitalized and discharged. These numbers underestimate the true burden of TBI because it does not account for individuals who did not receive medical care, had office-based visits, or received care at a federal facility such as through the Veterans Affairs.³
- Data estimates indicate 3.2–5.3 million persons in the United States are living with a TBI-related disability.³
- While the risk factors, health effects and long-term outcomes of TBI vary by person, some persons require special considerations, including children and older adults, rural residents, military service members and veterans and incarcerated populations. Children age 0–4 years, adolescents age 15–19 years and older adults age 75 years and older are among the most likely to have a TBI-related ED visit or hospitalization.³
 - Approximately 145,000 children and adolescents age 0–19 years are living with substantial and long-lasting limitations in social, behavioral, physical, or cognitive functioning following a TBI.⁸
 - Approximately 775,000 older adults live with long-term disability associated with TBI.⁸
 - The prevalence of TBI-related disability in rural geographical areas is estimated to be higher than urban and suburban areas (24% compared with 15% and 14%, respectively).⁹ Additionally, TBI-affected persons in rural areas are less likely to have access to specialized trauma care and rehabilitation professionals.^{10,11}
 - Those who serve in the U.S. military are at significant risk for TBI as Department of Defense data revealed that from 2000 through 2011, 235,046 service members were diagnosed with a TBI (or 4.2% of the 5.6 million who served in the Army, Air Force, Navy and Marine Corps).¹² Explosive blasts can also cause TBI, particularly among those who serve in the U.S. military.³
 - The estimated prevalence of TBI in imprisoned populations is 60.3%.¹³
- It is estimated 7% of all sports and recreation-related injuries treated in ED from 2001–2012 were TBIs. Nearly 70% of all sports and recreational-related TBIs were reported among persons 0 to 19 years of age.
- Males have about twice the rate of sports and recreational-related TBIs as females. The largest number of these TBIs among males occurred during bicycling, football and basketball. Among females, the largest number of these TBIs occurred during bicycling, playground activities and horseback riding.¹⁴

Cost data

- The estimated economic cost of TBI in 2010, including direct and indirect medical costs, is estimated to be approximately \$76.5 billion.^{15, 16}
- The cost of fatal TBIs and TBIs requiring hospitalization account for roughly 90% of the total TBI medical costs.^{15, 16}
- The societal and medical-care costs associated with TBI are more extensive for older adults than younger patients due to older adults needing longer hospital stays and having slower rates of functional improvement during inpatient rehabilitation.³
- Motorcycle crash-related hospitalizations with a TBI diagnosis had median hospital charges nearly \$9,000 greater than hospitalizations without a TBI diagnosis.⁶
- TBI may lead to long-term impairment, functional limitations and disability affecting quality of life. Approximately 60% of those of working age (16 to 60 years) who were discharged from inpatient rehabilitation following a TBI between 2001 and 2010 were still unemployed two years after their injury. However, more than a third of those who were employed were employed only in a part-time capacity.¹⁷

How does traumatic brain injury affect Indiana?

- In 2014, 1,108 Hoosiers died of TBI-related injuries. Nearly three-quarters of these deaths were among men.
- Rates of TBI death increased from 15.1 per 100,000 in 2011 to 16.2 per 100,000 in 2014.
- The highest number of TBI-related deaths were among 45-54 year olds, however, the highest rates of TBI-related deaths were among Hoosiers age 85 years and older.
- In 2014, there were 4,642 TBI-related hospitalizations. Nearly 60% of the hospitalizations were among men.
- The highest rate and number of TBI-related hospitalizations were among Hoosiers age 65 years and older.
- In 2014, there were 46,269 TBI-related ED visits due to TBI.
- Unintentional falls are the leading cause of injury among those who were hospitalized or treated and released from EDs with a TBI alone or in combination with other injuries or conditions.
- Adolescents and young adults have the highest rates of motor vehicle-related TBIs, while the youngest children and older adults are at highest risk for sustaining fall-related TBIs.

How do we address this problem?

Policy:

- Per [IC 16-41-42.2-4](#), the **Indiana Spinal Cord and Brain Injury Fund** is utilized to 1) establish and maintain a state medical surveillance registry for traumatic spinal cord and brain injuries; 2) fulfill the duties of the board; 3) fund research related to treatment and cure of spinal cord and brain injuries; 4) fund post-acute extended treatment and services for an individual with a spinal cord injury or facilities that offer long term activity based therapy services for spinal cord injuries requiring extended post-acute care; 5) fund post-acute extended treatment and services for an individual with a brain injury or facilities that offer long term activity based therapy services for brain injuries requiring extended post-acute care; and 6) develop a statewide trauma system. The fund is expected to generate \$1.6 million per year, with the majority of money generated to be allocated to research projects.
- Per [IC 16-41-40-5](#), **information and instructional materials concerning shaken baby syndrome** (abusive head trauma) must be provided to a parent or guardian of each newborn upon discharge from the hospital. The informational material must explain the medical effects of abusive head trauma on infants and children and emphasize preventive measures.
- Per [IC 20-34-7](#), a student athlete who is suspected of suffering a concussion may not return-to-play until the student athlete has been evaluated by a licensed health care provider trained in the evaluation and management of concussions and head injuries, receives a written clearance to return-to-play from the health care provider who evaluated the student athlete and not less than 24 hours have passed since the athlete was removed from play.
- Senate Bill 234 was signed by Governor Pence in 2016 to enact stronger protocols by requiring coaches to complete a certified player safety education course.

Data collection:

- The ISDH Division of Trauma and Injury Prevention conducts statewide injury surveillance through death certificates, hospitalizations and ED visits. The **Indiana Trauma Registry** is a repository into which statewide trauma data has been brought together to support three foundational activities: identification of the trauma population, statewide process improvement activities and research. Information about traumatic injuries, including spinal cord and brain injuries, is captured in the Indiana Trauma Registry.
- **State Injury Indicators Reports** track TBI hospitalizations and deaths in states to help states and the CDC Injury Center better identify and prevent TBIs. ISDH participates in the annual reporting.
- ***Pediatric Abusive Head Trauma: Recommended Definitions for Public Health Surveillance and Research*** provides standard definitions and data elements to improve the quality and consistency of data for public health surveillance purposes of abusive head trauma. Website: <http://www.cdc.gov/violenceprevention/pdf/pedheadtrauma-a.pdf>.

Programs:

- The **Indiana Department of Corrections** received funding from the U.S. Department of Health and Human Services/ Health Resources and Services Administration to help prison staff learn to identify inmates with brain injuries and provide treatment for released offenders with TBI.
- The **Indiana Trauma and Injury Prevention State Plan** includes facilitating opportunities for collaborative injury prevention efforts in traumatic brain injury.

Education:

- There are many simple ways to reduce the chance of sustaining a TBI, which include:
 - a. Buckling your child in the car using a size and age-appropriate child safety seat, booster seat, or seat belt.
 - b. Wearing a seat belt every time you drive or ride in a motor vehicle.
 - c. Never driving while under the influence of alcohol or drugs.
 - d. Wearing a helmet and making sure your children wear helmets while bicycling and playing contact sports
 - e. Making living areas safer for seniors through home modifications, such as
 - a. Removing tripping hazards such as throw rugs and clutter in walkways;
 - b. Using nonslip mats in the bathtub and on shower floors;
 - c. Installing grab bars next to the toilet and in the tub or shower and handrails on both sides of stairways;
 - f. Making living areas safer for children by installing window guards to keep young children from falling out of open windows and using safety gates at the top and bottom of stairs when young children are around.
 - g. Making sure the surface on your child's playground is made of shock-absorbing material, such as hardwood, mulch or sand.
- The CDC Injury Center developed ***Heads Up to Clinicians: Addressing Concussion in Sports among Kids and Teens***, a free online course developed with support from the National Football League (NFL) and CDC Foundation, teaches health care professionals how to recognize and manage concussion in young athletes. Website: <http://www.cdc.gov/HeadsUp/providers/training/index.html>.
- The Journal of Head Trauma Rehabilitation released a special issue highlighting work from CDC and CDC's partners to prevent traumatic brain injury (TBI) and to help people better recognize, respond and recover if a TBI occurs. Website: <http://journals.lww.com/headtraumarehab/toc/2015/05000>.
- The **CDC HEADS UP Concussion and Helmet Safety App** provides information for parents and coaches to instantly access concussion safety information to spot a potential concussion, respond if an athlete has a concussion or other serious brain injury and help an athlete safely return to school and play. Website: http://www.cdc.gov/headsup/resources/app.html?s_cid=headsup_govd106.
- Association of State and Territorial Health Officials Resources for Preventing Traumatic Brain Injuries provides links to TBI factsheets and prevention guides for specific populations, including infants, active military and veterans and

older adults. Website: <http://www.astho.org/Programs/Prevention/Injury-and-Violence-Prevention/Preventing-Traumatic-Brain-Injury/Preventing-Traumatic-Brain-Injuries/>.

Measures: Healthy People 2020:

Injury and Violence Prevention (IVP)-2 Reduce fatal and non-fatal traumatic brain injuries.

IVP-2.1 Reduce fatal traumatic brain injuries.

IVP-2.2 Reduce hospitalizations for non-fatal traumatic brain injuries.

IVP-2.3 Reduce ED visits for non-fatal traumatic brain injuries.

Additional resources:

- a. ISDH Division of Trauma and Injury Prevention: <http://www.in.gov/isdh/19537.htm>
- b. Indiana Special Emphasis Report on TBI: <http://www.in.gov/isdh/25396.htm>
- c. Brain Injury Association of Indiana: <http://biaindiana.org/>
- d. ASTHO Resources for Preventing Traumatic Brain Injuries: <http://www.astho.org/Programs/Prevention/Injury-and-Violence-Prevention/Preventing-Traumatic-Brain-Injury/Preventing-Traumatic-Brain-Injuries/>
- e. CDC Traumatic Brain Injury: <http://www.cdc.gov/traumaticbraininjury/>
- f. CDC's Heads Up to Concussion: <http://www.cdc.gov/headsup/index.html>
- g. CDC Injury Center and the American College of Emergency Physicians (ACEP)'s **Updated Mild Traumatic Brain Injury Management Guideline for Adults** to improve clinical management and to reduce adverse health outcomes among TBI patients: http://www.cdc.gov/concussion/HeadsUp/clinicians_guide.html
- h. Heads up to Clinicians: Concussion Training: <http://www.cdc.gov/concussion/HeadsUp/clinicians/index.html>
- i. CDC's **Report to Congress on Traumatic Brain Injury Epidemiology and Rehabilitation: Recommendations for Addressing Critical Gaps**: http://www.cdc.gov/traumaticbraininjury/pdf/TBI_Report_to_Congress_Epi_and_Rehab-a.pdf
- j. CDC's **Report to Congress on Traumatic Brain Injury in the United States: Understanding the Public Health Problem among Current and Former Military Personnel**: http://www.cdc.gov/traumaticbraininjury/pubs/congress_military.html
- k. National Center on Shaken Baby Syndrome: <http://www.dontshake.org/>

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