

# THE INSURANCE IMPLICATIONS OF TRAUMATIC BRAIN INJURY



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## Causes of Traumatic Brain Injury

Falls are the most common cause of traumatic brain injury in the United States. According to the Centers for Disease Control and Prevention (CDC), over 35% of all TBIs are the result of falls, and the rate of fall-related TBIs is highest among young children and older adults. Approximately 50% of all TBIs among children under age 15 are due to falls, while falls account for more than 60% of all TBIs experienced by adults over age 65. Motor vehicle accidents are the second leading cause of TBI with the highest rate experienced by 15- to 24-year-olds. Additionally, motor vehicles accidents are a leading cause of death resulting from traumatic brain injury. Accidents classified as resulting from a strike to the head (struck by/against) tend to receive the most attention, but account for about 16.5% of all TBIs. This category would include sports-related injuries as well as many occupational injuries. Assaults account for roughly 10% of all TBIs, with the highest rate of injury among 15- to 24-year-olds.<sup>2</sup> [See Figure 1]

While over 80% of people who experience a traumatic brain injury are treated and released from an emergency room, an estimated 52,000 deaths occur annually as a direct result from traumatic brain injury.<sup>2</sup>

Injuries from firearms are the leading cause of death from TBI. This includes both suicides and homicides, where suicides comprise roughly 75% of all firearm fatalities. Causes of traumatic brain injury resulting in death vary by age group. People aged 15-24 are more likely to die in a motor vehicle accident, and older adults are more likely to die as the result of a fall.<sup>4</sup> [See Figure 2]

## At-Risk Activity and Ways to Prevent Injury

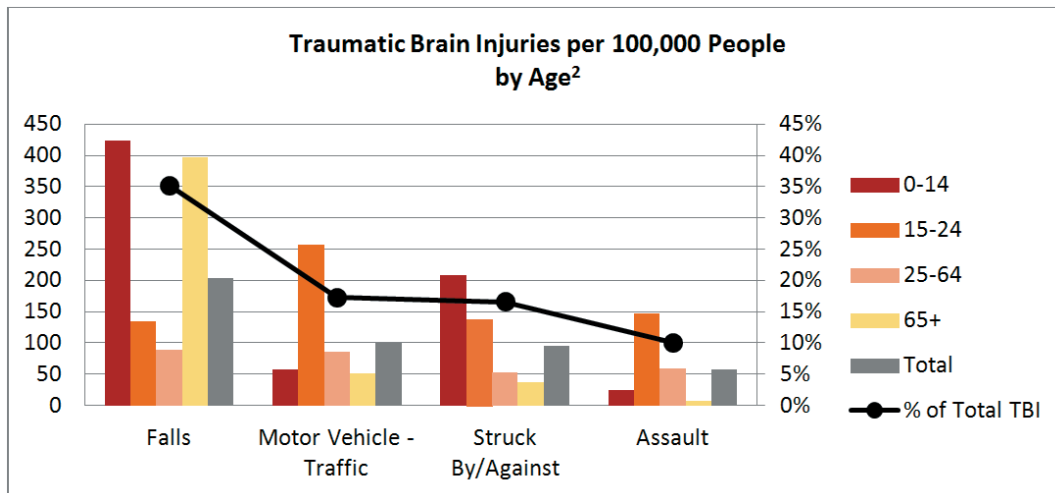
Falls are the leading cause of TBI in the elderly and children. People can decrease the risk of falling by considering prior falls and making modifications to mitigate the factors that contributed to the fall. Older adults can reduce the risk of falling by considering

**Executive Summary** *Traumatic brain injuries (TBI) affect millions of American families each year. Injuries can range in severity from mild to severe to penetrating. Mild traumatic brain injuries are commonly referred to as concussions and account for approximately 75% of all traumatic brain injuries. These injuries can result in persistent neuropsychological problems and impede the injured person from returning to a pre-accident level of ability.<sup>1</sup> There are approximately 1.7 million traumatic brain injuries in the U.S. annually, many injuries result in a long-term disability and approximately 52,000 TBIs are fatal.<sup>2</sup> In fact, more people die each year in the United States from TBI than from HIV, prostate cancer and skin cancer combined.<sup>3</sup> Everyone is exposed to the risk of injury, from children and older adults who are more likely to fall, to young adults who are disproportionately injured in motor vehicle accidents. People who experience a TBI have increased mortality and morbidity. Therefore, TBI may be a consideration for many insurance products including life, accidental death, disability, critical illness and long-term care.*

health conditions, and improving mobility through exercise and use of assistive devices.<sup>5</sup> Parents can reduce the risk of injury to children by appropriately child-proofing the home as well as carefully supervising play.<sup>6</sup> While falls are the primary source of TBIs among younger children, the overwhelming majority of TBIs for youth aged 15-19 years are transportation-related. The rate of TBI from transportation incidents for youth aged 15-19 is 2.5 times as high as the overall transportation average.<sup>2</sup> Appropriate use of seatbelts can greatly reduce injury in automobile accidents.

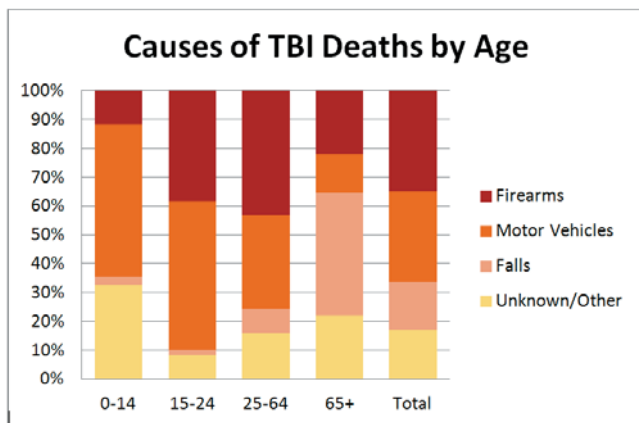
Participation in sports and recreation activities exposes people to risk of TBI. For children under age 19, the most common activity associated with a TBI treated in an emergency room (ER) is a bicy-

Figure 1



Source: <sup>2</sup>

Figure 2



Source: <sup>4</sup>

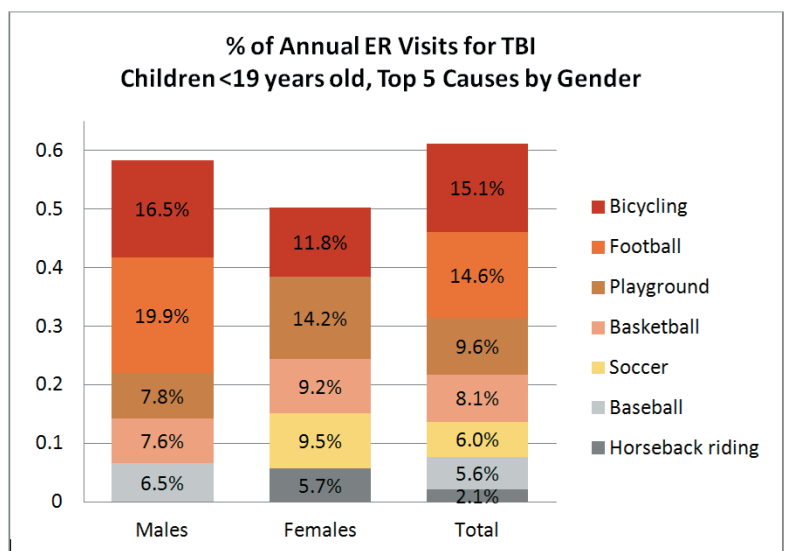
cling accident. Children should wear an appropriate helmet any time they are on a motorcycle, bicycle, skateboard, snowmobile, scooter, skates or an all-terrain vehicle.<sup>4</sup> The rate of injury from sports and recreation activity varies by age and gender. The most common activity resulting in a traumatic brain injury in 10- to 19-year-old US boys is football, while playground accidents are the cause of the most TBIs in all children under age 4. The chart at right [Figure 3] shows the five most common activities for boys and girls under age 19 resulting in a TBI-related ER visit. These activities in total account for over 60% of all TBI-related ER visits for children.<sup>7</sup>

The remaining 39% of annual emergency room TBI visits for children are due to a wide range of various other causes, each accounting for 0.1-4% of ER visits.

*Fatal TBIs are a consideration for both accidental death and life insurance policies. Motor vehicle accidents are the leading cause of TBI-related death in young adults and children, under age 24. Roughly 50% of these fatalities occur from being an occupant of the motor vehicle, while approximately 10% are accidents involving bicycles and pedestrians.<sup>4</sup>*

Each year, more than 300,000 people experience a sports-related TBI.<sup>8</sup> Use of protective equipment and adopting safety measures can minimize the number and severity of sports-related injuries. When a head injury has occurred, it is imperative that the symptoms are recognized and the player is removed from a game. Evaluation should consider concussion history because it can affect the severity and duration of symptoms. A player should only return to play after all symptoms have resolved and an evaluation with an experienced healthcare provider has determined it is safe for the player to return to the game. By

Figure 3



Source: <sup>7</sup>

increasing awareness of TBI risks from sports and recreation, employing proper technique and protective equipment, and quickly responding to injuries, the incidence, severity and long-term negative health effects of TBIs among athletes can be reduced.<sup>7</sup>

Occupational injuries also pose a risk for traumatic brain injury. It is estimated that 20% of workplace traumatic brain injuries are caused by slips and falls.<sup>9</sup> Additionally, workers over the age of 65 are the most at risk to experience a fatal TBI. The occupations with the highest risk of brain injury include construction, transportation, agriculture, forestry and fishing. These industries also pose the greatest risk of death from TBI, accounting for roughly half of all workplace TBI fatalities.<sup>10</sup>

The causes of traumatic brain injury are diverse, yet all people who experience a TBI are exposed to an increased likelihood of long-term sequelae resulting from the injury.

#### Consequences Resulting from Traumatic Brain Injury

The majority of people who experience a TBI expect a full recovery with no long-term consequences; however, approximately 15% of traumatic brain injuries result in long-term disability or impairment.<sup>11</sup> The residual cognitive impairment, emotional disturbances and behavioral changes after head injury can continue long after the physical disabilities have resolved.

Post-concussion syndrome occurs when concussion symptoms persist for weeks, months or, rarely, years following a brain injury. Approximately 60% of those with a concussion will continue to experience symptoms 1 month after injury. For 15%, concussion symptoms continue for a year or more.<sup>11</sup> The most common persistent symptom is a headache. A study of children and adolescents who were seen in an emergency room for TBI found that those patients who had a headache and required hospitalization were most likely to experience post-concussion syndrome.<sup>12</sup>

One of the consequences of severe traumatic brain injury may be a shortened expected life. One study estimated the remaining life expectancy for a severely brain-damaged 30-year-old man is 18.6 years shorter than an average 30-year-old man. Further, a severely brain-damaged 30-year-old man is 10 times more likely to die in the next 12 months than an average man of the same age.<sup>13</sup>

People who experience repeated traumatic brain injury may have increased likelihood for neurodegenerative diseases, such as Alzheimer's disease, Parkin-

*Traumatic brain injuries that result in long-term impairment may be a consideration for disability insurance. Likewise, shortened life expectancy resulting from TBI impacts life insurance experience. Additionally, people with impairment or subsequent neurodegenerative diseases may have increased long-term care benefits.*

son's disease and amyotrophic lateral sclerosis (ALS), later in life. A study of former professional football players found that their neurodegenerative mortality was four times higher than the general population for Alzheimer's disease and ALS, and three times higher for Parkinson's disease.<sup>14</sup>

There is increasing research around the long-term consequences of repetitive TBI. Athletes who participate in contact sports and have experienced several traumatic brain injuries may be at risk for developing chronic traumatic encephalopathy (CTE). Many of the same symptoms of neurodegenerative diseases, as well as depression, aggressive and suicidal behavior, are present in people who are later determined to have had CTE.<sup>15-16</sup>

Because traumatic brain injuries can result in persistent neuropsychological problems, a comprehensive neuropsychological evaluation may be appropriate. A neuropsychologist can measure cognitive and behavioral functions using a set of standardized tests and procedures to confirm or clarify a diagnosis, track progress in rehabilitation, guide effective treatment methods, and localize organic abnormalities in the central nervous system.<sup>17</sup> An additional value of neuropsychological testing is to document persistent cognitive changes which, even while subtle, may have an impact on expected mortality. A neuropsychological evaluation may be used to identify neuropathological impairments in specific cognitive domains, as well as relate the test results to an individual's ability to perform everyday tasks. This evaluation is beneficial in rehabilitation to assess the functional abilities of the injured person and develop an individualized treatment plan.<sup>18</sup>

#### Factors That Influence Recovery

There is evidence that age is a factor contributing to recovery from a TBI. A study comparing length of recovery following a concussion of collegiate and high school athletes found that high school students had a significantly longer recovery period than college age athletes.<sup>19</sup> The younger brain may be more vulnerable to injury because it is not fully developed, it is protected by thinner cranial bones, and youths have a higher head-to-body ratio.<sup>8</sup> However, while children take longer to recover, the elderly are more likely to die or require hospitalization for an injury.<sup>2</sup>

Males account for the majority of traumatic brain injuries in the US.<sup>2</sup> However, in sports in which both genders participate, women have a higher rate of injury.<sup>20</sup> Additionally, women have a longer recovery time than men. Studies have shown that women take longer for symptoms to resolve and are more likely to experience long-term cognitive difficulties.<sup>11</sup>

Concussion history also affects recovery. People with prior concussions take longer to recover and experience more severe symptoms compared with those without prior concussions. Additionally, a study that compared athletes without a history of concussion with those that had three or more previous concussions found that those with a history of concussion were 7.7 times more likely to have a drop in memory abilities a few days after a concussion.<sup>21</sup> Athletes with a history of concussions are more likely to experience a prolonged length of recovery as well as an increased likelihood of experiencing a subsequent concussion.<sup>22</sup>

**Trends**

Over the period from 1997 to 2007, the average annual death rate associated with TBIs declined by 8.2%, from 19.2 to 18.1 per 100,000 population. The TBI death rate decreased over this period for all causes of injury except falls. However, the overall decline was not consistent by age group. While TBI-related death rates decreased over 25% for people under age 25, they increased by 14% for older adults over age 65. This increase was especially high for those over age 85.<sup>4</sup>

While TBI-related deaths declined in recent years, especially for youth, the number of TBI-related ER visits for children related to sports and recreation accidents increased. From 2001 to 2007, the annual number of non-fatal sports and recreation TBI ER visits for children under age 20 increased 20%; the annual number of visits increased by more than 60% when comparing 2001 to 2009. Interestingly, the overall number of sports-related ER visits for children under age 20 from all types of injury declined from 2001 to 2009. In 2001, just over 5% of children seen in the ER for sports-related injuries had experienced a TBI; by 2009 that number had increased to almost 10%.<sup>7</sup> Also, over the same period, the annual number of deaths from TBI for children under age 20 declined by 18%.<sup>4</sup>

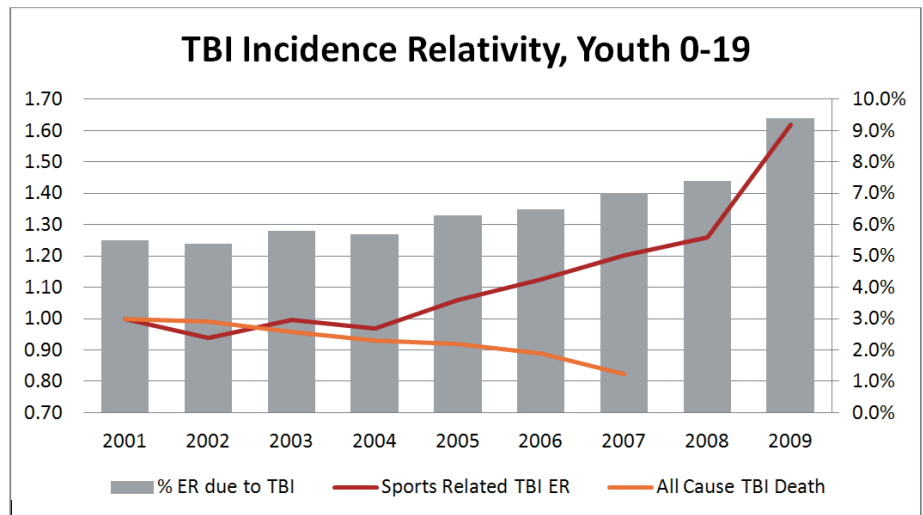
Additionally, from 2005 to 2009, the overall annual number of adolescents, aged 10-19, hospitalized due

*According to the CDC, fall-related TBI rates for adults over age 65 increased from 2002 to 2006. Emergency department visits increased 46% and the rate of hospitalization increased 34%.<sup>2</sup> These costs have an impact on the benefits insurers provide, such as long-term care.*

to TBI decreased by more than 20%. The rates of hospitalization from TBI declined for all severities, from mild to severe.<sup>23</sup> Therefore, while there has been a significant increase in sports-related TBI ER visits by children in recent years, it should be noted that it is unclear whether the rise is due to an increase in incidence or heightened awareness of TBI and concussions. [Figure 4]

The trends in traumatic brain injury incidence vary by age and activity. While the overall rate of TBI fatalities has declined in recent years, several groups of people have experienced an increase in injuries. The elderly, who are a growing segment of our population, have seen a rise in TBI fatalities. Children participating in sports and recreation have experienced an increase in the number of TBI-related emergency room visits. Therefore, it is clear that the effects of TBI will be present for many Americans in the years to come.

**Figure 4**



Source: <sup>4,7</sup>

**Future**

There is currently no consensus regarding a safe level of head trauma. No standard exists to assess the number or severity of hits that will lead to impairment or cognitive problems. Researchers have used sensors in helmets to assess the level of impact a player experiences in a game. There is evidence that concussions can result from the cumulative total of smaller events, rather than a single impact.<sup>24</sup>

Researchers are investigating the relationship between repeated head trauma and neurodegenerative diseases. Many people who experience multiple concussions develop diseases such as Alzheimer's, Parkinson's and ALS later in life. In a recent study, autopsies were conducted on brains of 85 people who had experienced repeated mild TBI. The study found that 80% of these people showed signs of chronic traumatic encephalopathy, (CTE).<sup>25</sup> Therefore, there is some evidence that suggests repeated minor impacts may have long-term neurological consequences.

On April 2, 2013, US President Barack Obama announced plans for an initiative, Brain Research through Advancing Innovative Neurotechnologies (BRAIN). The ultimate goal of the initiative is to identify ways to better understand neurological and psychiatric disorders in order to treat, cure and, perhaps, prevent brain disorders such as Alzheimer's disease, Parkinson's disease and traumatic brain injury.<sup>26</sup>

### Insurance Implications

Millions of Americans experience traumatic brain injuries each year. While most expect a full recovery, many will experience long-term sequelae from their injury. Because the causes of TBI are diverse and affect people of all ages, the insurance implications of traumatic brain injury are far-reaching. While the numbers of deaths and hospitalizations have decreased in recent years, traumatic brain injuries continue to have significant implications for multiple product lines within the insurance industry. Life insurance and accidental death products are exposed to the 52,000 Americans who die annually as a direct result of a TBI. Further, some people who survive a traumatic brain injury may have a shortened life expectancy, thus resulting in an increase in mortality experience. Similarly, people who experience a TBI may have increased morbidity, impacting products such as long-term care, disability and critical illness.

Various occupations and avocations may be worth considering in the underwriting process, given the increased exposure risk involving specific activities. When underwriting a risk with a history of traumatic brain injury, the most important prognostic factors include age, mechanism of injury, post-resuscitation GCS (Glasgow Coma Scale) score, post-resuscitation pupillary reactivity, post-resuscitation blood pressures, intracranial pressures, duration of post-traumatic amnesia or confusion, sitting balance and intracranial pathology identified on neuroimaging.<sup>27</sup>

Although TBI currently represents a considerable risk to the insurance industry, increased public awareness, combined with the advancement of technology

and research, will play a vital role in mitigating the risk of traumatic brain injuries in the future.

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