

# The Epidemiology and Impact of Traumatic Brain Injury

## A Brief Overview

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Traumatic brain injury (TBI) is an important public health problem in the United States and worldwide. The estimated 5.3 million Americans living with TBI-related disability face numerous challenges in their efforts to return to a full and productive life. This article presents an overview of the epidemiology and impact of TBI. **Key words:** *closed head injury, craniocerebral trauma, epidemiology, traumatic brain injury*

**T**RAUMATIC BRAIN INJURY (TBI) is an important global public health problem. At least 10 million TBIs serious enough to result in death or hospitalization occur annually. An estimated 57 million people worldwide have been hospitalized with one or more TBIs,<sup>1</sup> but the proportion living with TBI-related disability is not known.

In the United States, an average of 1.4 million TBIs occur each year, including 1.1 million emergency department visits, 235,000 hospitalizations, and 50,000 deaths (Fig 1).<sup>2</sup> However, routinely reported US national data<sup>2</sup> underestimate the true burden of TBI for several reasons. First, they do not include persons treated for TBI in other settings. A recent study suggests that an additional 200,000 Americans with TBI are treated each year in hospital outpatient settings or physicians' offices.<sup>3</sup> Second, TBIs treated in military facil-

ities both in the United States and abroad are not included. Finally, the number of persons who receive medical care but the TBI is not diagnosed, or who sustain a TBI but do not seek care, is not known.

Overall, males are about twice as likely as females to experience a TBI.<sup>2</sup> For emergency department visits, hospitalizations, and deaths combined, children aged 0 to 4 years and older adolescents aged 15 to 19 years are more likely to sustain a TBI than persons in other age groups.<sup>2</sup> For hospitalizations only, adults aged 75 years or older have the highest incidence of TBI.<sup>2</sup>

Traumatic brain injury is an increasing concern among certain groups. On the basis of studies of convenience samples, as many as 87% of persons incarcerated in prison or jail report a history of head injury, including TBI.<sup>4,5</sup> Military personnel serving in Iraq and Afghanistan<sup>6,7</sup> and rescue workers and victims of terrorism-related attacks<sup>8-10</sup> are also at risk of sustaining a TBI.

The leading causes of TBI are falls, motor vehicle crashes, struck by or against events, and assaults, respectively (Fig 2).<sup>2</sup> Blasts are a leading cause of TBI among active duty military personnel in war zones.<sup>7,11</sup>

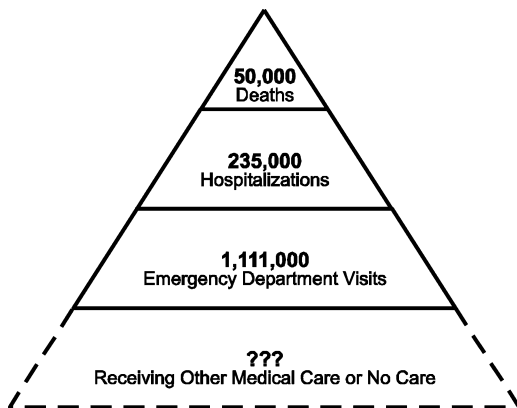
Sports and recreation activities are also a major cause of TBI, including concussions, and are severely underestimated using existing national data sets. Although a previous

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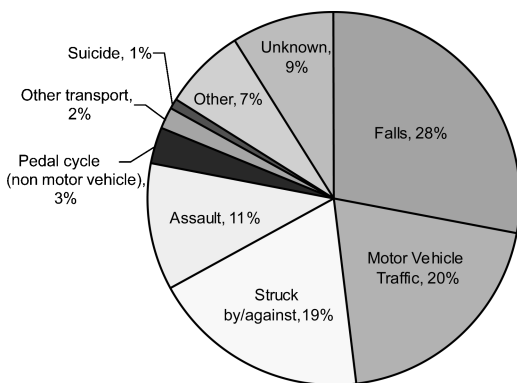
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**Figure 1.** Average annual number of traumatic brain injury-related emergency department visits, hospitalizations, and deaths, United States, 1995-2001.

Centers for Disease Control and Prevention study estimated that approximately 300,000 such injuries occur each year,<sup>12</sup> it included only TBIs for which the person reported a loss of consciousness. Other studies suggest that injuries involving loss of consciousness may account only for between 8%<sup>13</sup> and 19.2%<sup>14</sup> of sports-related TBIs. Taking this into account, a more accurate approximation may be that 1.6 million to 3.8 million sports-related TBIs occur each year, including those for which no medical care is sought. This estimate might still be low because many of these injuries go unrecognized and thus uncounted.



**Figure 2.** Percentage of average annual traumatic brain injury-related emergency department visits, hospitalizations, and deaths by external cause, United States, 1995-2001.

Traumatic brain injury can result in long-term or lifelong physical, cognitive, behavioral, and emotional consequences.<sup>15</sup> Even mild TBI, including concussion, can cause long-term cognitive problems that affect a person's ability to perform daily activities and to return to work.<sup>16-18</sup> As a result of these consequences, TBI is one of the most disabling injuries. Although similar to that for several other types of injuries, the percentage (15.7%) of injury-related productivity loss attributed to TBI is 14 times that associated with spinal cord injury,<sup>3</sup> another important disabling condition. At least 5.3 million Americans, approximately 2% of the US population, are living with long-term or lifelong disability associated with a TBI that resulted in hospitalization.<sup>19</sup> Because the prevalence of disability associated with TBIs treated in other healthcare settings and those that are not treated is not known, the true number of persons living with TBI-related disability likely is much higher.

In addition to disability, TBI can lead to increased risk for other health conditions. Results from a recent population-based study indicate that from 1 to 3 years postinjury, compared with the general population, people with TBI are 1.8 times as likely to report binge drinking,<sup>20</sup> 11 times as likely to develop epilepsy (P. L. Ferguson, written communication, February 2006), and 7.5 times as likely to die.<sup>21</sup> Furthermore, new health problems associated with TBI may also arise in conjunction with the aging process. These include a 1.5 times increased risk of depression,<sup>22</sup> and a 2.3 and 4.5 times increased risk of Alzheimer's disease associated with moderate and severe head injury, respectively.<sup>23</sup> Future studies are needed to further quantify the increased risk of health problems, both short- and long-term after TBI, and their relationship to aging.

To facilitate recovery, minimize the adverse outcomes of TBI, and promote overall health, timely and appropriate access to both medical care and nonmedical services are critical.<sup>24</sup> According to the *Surgeon General's Call to Action to Improve the Health and Wellness of Persons With Disabilities*,<sup>25</sup> all persons with

disabilities must have “accessible, available, and appropriate healthcare and wellness promotion services [to ensure that] they have a full life in the community.” Although we estimate that 1 in 10 (5.3 million)<sup>19</sup> of the 54 million Americans with disabilities<sup>25</sup> have a disability related to TBI, little is known about the difficulties obtaining appropriate healthcare among persons with TBI compared with other disabilities.<sup>25,26</sup> However, anecdotal reports and the limited research to date suggest that the “invisible disability” that persons with cognitive but not obvious physical problems experience poses unique problems for persons with TBI in accessing health services

and maintaining a healthy lifestyle.<sup>26,27</sup> Other barriers include lack of medical insurance<sup>28</sup> and the limited awareness of TBI among some healthcare providers.<sup>27</sup>

Until these and other challenges are met, TBI will continue to exact an enormous toll. The lifetime costs of TBI in the United States, including medical costs and lost productivity, total an estimated \$60 billion annually.<sup>3</sup> This does not begin to address the indirect impact on friends, families, and caregivers and the community. The medical, public health, and brain injury communities must work together to prevent TBI and to ensure a healthier future for persons with TBI.

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