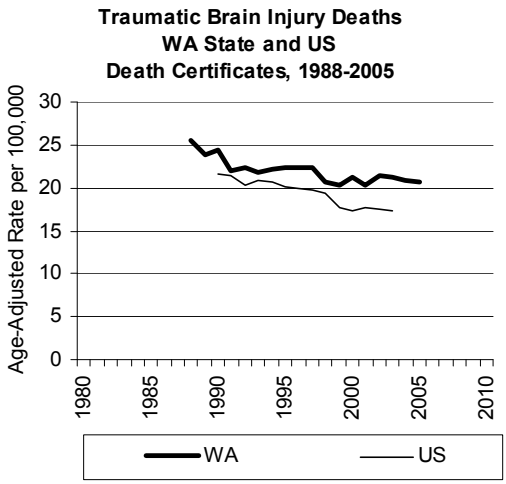
Traumatic Brain Injury

Definition: Traumatic brain injury hospitalizations for 1989–2005 include records with an ICD 9 code of 800.0-801.3, 803.0-804.3, 850.0-854.1, and 959.01. TBI deaths for 1988–1998 include records with an ICD 9 code of 800.0-801.3, 803.0-804.3, 850.0-854.1, 873.0- 873.9, 905.0, and 907.0 in any of the multiple cause fields. For 1999–2005, the ICD 10 codes include S01.0-S01.9, S02.0-S02.1, S02.3, S02.7-S02.9, S06.0-S06.9, S07.0-S07.1, S07.8-S07.9, S09.7-S09.9, T01.0, T02.0, T04.0, T06.0, T90.1 – T90.2, T90.4-T90.5, or T90.8-T90.9 in any of the multiple cause fields.

Summary

In 2005, 1,304 Washington residents died from traumatic brain injuries (age-adjusted rate: 21 per 100,000). Men 65 years and older are at the highest risk of traumatic brain injury death. Most traumatic brain injury deaths to those in this age group result from falls. For all age groups combined, motor vehicle crashes and suicide (most with firearms) are the leading causes of traumatic brain injury deaths.

Using seat belts or protective headgear greatly reduces the risk of brain injury in motor vehicle crashes. Strength and balance for older adults can help prevent falls and fall-related injuries.



Time Trends

Data needed to identify deaths from traumatic brain injury (TBI) have been available since 1988. Overall, TBI deaths among Washington residents have decreased since 1988. But while TBI death rates have decreased among people 5–44 years old, they have increased among people 85 years and older. Washington's TBI death rates are higher than the nation's as a whole, and the gap appears to be widening.

The decrease in TBI deaths since 1988 reflects our state's progress in reducing the incidence and severity of motor vehicle crashes, one of the leading contributors to TBI deaths. Much of that success is attributable to increased use of occupant protection devices, such as seat belts and protective headgear, efforts to discourage drinking and driving, more safety features in cars, and highway engineering improvements.

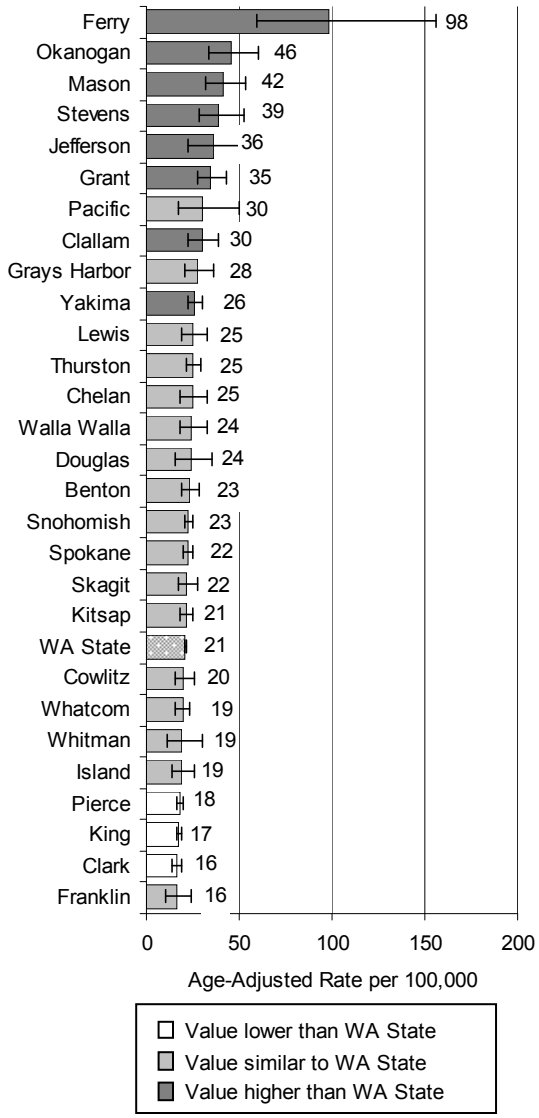
Year 2010 Goals

During the past two decades, the methods for identifying and tracking TBI have changed. *Healthy People 2010* includes a national goal for nonfatal head injury; this goal has not been included in this report because the case definition does not comply with U.S. Centers for Disease Control and Prevention (CDC) guidelines for TBI surveillance. There are no national goals for TBI deaths.

Geographic Variation

In 11 Washington counties, fewer than 20 residents died of TBI from 2003–2005. Death rates for these counties fluctuate even when combining three years, and the following chart does not include them. In 2003–2005, in eight of the remaining 28 counties, age-adjusted TBI death rates were higher than the state rate. They include Ferry, Okanogan, Mason, Stevens, Jefferson, Grant, Clallam, and Yakima counties. Pierce, King, and Clark counties had lower TBI death rates than the state rate.

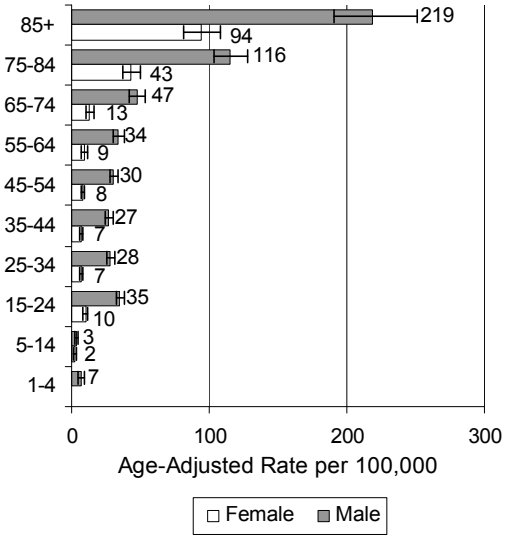
Traumatic Brain Injury Deaths
County Data
Death Certificates, 2003-2005



Age and Gender

From 2003–2005, males accounted for 74% of all TBI deaths. Males at all ages are at higher risk for death from TBI. Men ages 65 years and older were at the highest risk of TBI death. Girls younger than five years old and boys younger than one year old had fewer than 20 deaths and are not included on the following chart.

Traumatic Brain Injury Deaths
Age and Gender
Death Certificates, 2003-2005

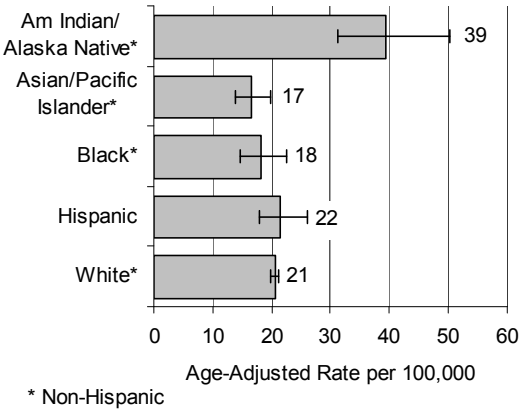


For all age groups combined, motor vehicle crashes and suicide (most involving firearms) are the leading causes of TBI death. Falls are the leading cause of fatal TBI among people ages 75 and older.

Race and Hispanic Origin

In Washington, age-adjusted death rates from TBI are higher for American Indians and Alaska Natives than for people in other racial and ethnic groups. Nationally, age-adjusted death rates from TBI are higher for American Indians and Alaska Natives and blacks than for non-Hispanic whites.[1] The interactions of race, Hispanic origin, poverty, and education for TBI have not been widely researched.

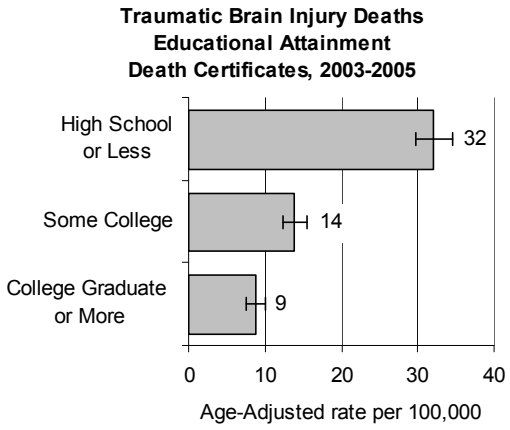
Traumatic Brain Injury Deaths
Race and Hispanic Origin
Death Certificates, 2003-2005



* Non-Hispanic

Income and Education

In Washington during 2003–2005, TBI death rates were lowest among those who had completed college and highest among those with a high school education or less. Direct measures of an individual's income and TBI rates are not available in Washington. But in Washington during 2000–2002, as the proportion of people living in poverty in a community increased, the age-adjusted death rate from TBI also increased.[2] Nationally, hospitalization and emergency department visit rates for TBI are higher among those with annual household incomes of less than $20,000 than those with higher incomes. Also, mild and moderate TBI incidence is lower among people living in households where at least one member had some college education compared to those with no college education.[3]



Other Measures of Impact and Burden

Nonfatal TBI injuries and disabilities. In 2005, there were 5,375 nonfatal TBI-related hospitalizations in Washington. Nationally, for every TBI death, about five people are hospitalized for nonfatal TBI, and about 22 people visit an emergency department. Nationally, children 0–4 years old are at the highest risk of TBI-related emergency department visits.[4] The most common external causes of these injuries are falls and being struck by or striking against objects or persons.

Each year, 80,000–90,000 people become disabled from TBI, and today about 5.3 million Americans are living with a TBI-related disability.[5,6] Nationally, more than 85% of the TBIs that occur are considered mild.[7] The possible consequences of both severe and mild TBI include impaired cognition (concentration, memory, judgment, and mood), physical movement abilities (strength, coordination, and balance), sensation (tactile sensation and special senses such as vision), and psychological and social dysfunction. Despite the label of "mild TBI," many of these injuries result in long-term consequences and ultimately result in disability and unemployment.[7] TBI sometimes results in epilepsy and increases the risk for conditions such as Alzheimer's disease, Parkinson's disease, and other brain disorders that become more prevalent with age.[8] About 1% of people with severe TBI survive in a persistent vegetative state.

Repeated mild brain injuries occurring over months or years can result in cumulative neurologic and cognitive deficits,[9] but repeated mild brain injuries occurring within hours, days, or weeks can be catastrophic.

Cost. There is no way to describe fully the human costs of TBI, the burdens borne by those who are injured and their families. In the United States for TBI injury that occurred in 2000, the estimated lifetime direct medical costs and indirect costs such as lost productivity amounted to $60 billion.[10] One major part of the indirect costs for TBI survivors is unemployment after the injury. Some factors that predict employment after TBI include severity of injury, types and degrees of impairments, pre-injury occupation or educational characteristics, and age at injury.[11]

Intentional TBI in infants. Physical abuse is a leading cause of serious head injury in children ages two years and younger.[12] There are various forms of inflicted TBI, including shaken infant syndrome. Very limited research has been conducted on the outcome of inflicted TBI in infants. The reported mortality rate for intentional TBI in infants ranges from 13% to 36%, and morbidity ranges from 59% to 100%.[13]

Risk and Protective Factors

Those at risk for motor vehicle crashes, falls, and suicide are also at high risk for TBI.

Motor vehicle crashes. The risk factors for motor vehicle crash injury include driving while impaired, not using occupant protection when driving or riding in an automobile, speeding, driving a motorcycle, being a teen driver, and driving on rural roads.

Falls among older adults. The risk factors for falls among older adults include a history of previous falls, muscle weakness, certain chronic conditions,

gait deficit, balance deficit, use of assistive devices, taking four or more medications or any psychoactive medications, cognitive impairment, visual deficit, sensory impairments, postural hypotension, depression, and being older than 80 or female.

Suicide. Risks associated with suicide and suicidal behavior include previous suicide attempt(s), history of mental disorders, particularly depression, history of alcohol and substance abuse, family history of suicide, history of child maltreatment, feelings of hopelessness, impulsive or aggressive tendencies, barriers to accessing mental health treatment, personal losses (relational, social, work, or financial), physical illness, easy access to lethal methods, unwillingness to seek help because of the stigma attached to mental health and substance abuse disorders or suicidal thoughts, some cultural and religious beliefs, local epidemics of suicide, and feeling cut off from other people.

Sports and recreation. Participation in sports and recreational activities can lead to TBI, most of which are mild to moderate in severity. These are usually classified as concussions and can occur from sports in which a blow to the head is likely. Examples of these sports include boxing, football, ice or roller hockey, soccer, baseball, basketball, and snow sports.

Intervention Strategies

CDC recommends the following strategies to reduce the risk of traumatic brain injuries.[14]

Strategies to reduce TBI deaths caused by motor vehicle collisions:

1. Wearing a seat belt every time you drive or ride in a motor vehicle
2. Buckling your child in the car using a child safety seat, booster seat, or seat belt (according to the child's height, weight, and age):

   Children should start using a booster seat when they outgrow their child safety seats (usually when they weigh about 40 pounds). They should continue to ride in a booster seat until the lap/shoulder belts in the car fit properly, typically when they are 4'9" tall.
3. Never driving while under the influence of alcohol or drugs
4. Wearing a helmet and making sure children wear helmets when:
   - Riding a bike, motorcycle, snowmobile, scooter, or all-terrain vehicle
   - Playing a contact sport, such as football, ice hockey, or boxing
   - Using in-line skates or riding a skateboard
   - Batting and running bases in baseball or softball
   - Riding a horse
   - Skiing or snowboarding.

Strategies to reduce TBI deaths caused by falls:

1. Make living areas safer for older people by:
   - Removing tripping hazards such as throw rugs and clutter in walkways
   - Using nonskid mats in the bathtub and on shower floors
   - Installing grab bars next to the toilet and in the tub or shower
   - Installing handrails on both sides of stairways
   - Improving lighting throughout the home
   - Maintaining a regular physical activity program, with approval from a primary care provider, to improve lower body strength and balance.
2. Adults 65 years and older should:
   - Have their health care provider review their medicines
   - Have their vision checked at least once a year.
3. Make living areas safer for children by:
   - Installing window guards to keep young children from falling out of open windows
   - Using safety gates at the top and bottom of stairs when young children are around.
4. Make sure the surface on children's playgrounds is made of shock-absorbing material, such as hardwood mulch or sand.

See Related Chapters: Falls Among Older Adults, Motor Vehicle Crashes, Suicide, and Washington's Trauma System

Data Sources (For additional detail, see Appendix B.)

Washington State Death Certificate Data: Washington State Department of Health, Vital Registration System Annual Statistical Files, Deaths 1980–2005, released December 2006.

Washington Hospitalization Data: Dataset compiled by the Washington State Department of Health Center for Health Statistics from the Washington Comprehensive Hospitalization Abstract System, Oregon Hospital Discharge data, and Veterans Hospital Administration datasets, December 2006.

National data: National Center for Injury Prevention and Control, National Centers for Health Statistics.

For More Information

Department of Health Injury and Violence Prevention Program, (360) 236-2855
http://www.doh.wa.gov/hsqa/emstrauma/injury/

Brain Injury Association of Washington, http://www.biawa.org.

Brain Injury Resource Center, http://www.headinjury.com/.

National Center for Injury Prevention and Control traumatic brain injury fact sheet, http://www.cdc.gov/ncipc/factsheets/tbi.htm.

TBI Model Systems at University of Washington, http://depts.washington.edu/uwtbi/.

Technical Notes

The procedures for coding injury deaths require that the underlying cause be coded to the external cause of injury (such as motor vehicle, firearm, and fire). Only examining the multiple cause files, which list all contributing factors, can identify the presence of a traumatic brain injury death. These multiple cause files have been available in computerized form since 1988.

Endnotes

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[4] Langlois, J. A., Rutland-Brown, W., & Thomas, K. E. (2006). *Traumatic Brain Injury in the United States: emergency department visits, hospitalizations, and deaths.* U.S. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Atlanta, GA. Retrieved April 2, 2007 from http://www.cdc.gov/ncipc/tbi/TBI.htm

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[12] Keenan, H. T., Runyan, D. K., Marshall, S. W., Nocera, M. A., Merten, D. F., & Sinal, S. H. (2003). A population-based study of inflicted traumatic brain injury in young children. *Journal of the American Medical Association, 290*(5), 621-626.

[13] Barlow, K. M., Thomson, E., Johnson, D., & Minns, R. A. (2005). Late neurologic and cognitive sequelae of inflicted traumatic brain injury in infancy. *Pediatrics*, *116*(2), e174-e185.

[14] U.S. Centers for Disease Control and Prevention. *Traumatic Brain Injury Prevention*. Retrieved December 6, 2006 from http://www.cdc.gov/ncipc/tbi/Prevention.htm.