



# Brain Injury: THE TEENAGE YEARS

## Understanding and Preventing Teenage Brain Injury

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### Introduction

According to the Centers for Disease Control and Prevention (CDC), **an estimated 5.3 million Americans, a little more than 2 percent of the U.S. population**, currently live with disabilities resulting from brain injuries. The CDC also reports that of the one million people who are treated in and released from hospital emergency rooms each year:

- 230,000 will be hospitalized and survive
- 80,000 will experience an onset of disabilities resulting from their brain injuries
- 50,000 will die

After many years of studies, the following findings have been released about the prevalence of brain injury:

- The risk of having a brain injury is especially high among adolescents and young adults, as well as people older than 75 years (CDC, 1999). In fact, it is males 14 to 24 years of age who are at the highest risk for sustaining a brain injury, followed by infants and the elderly (Kraus, 1993)
- For persons of all ages, the risk of brain injury among males is twice the risk among females, due to differences in risk exposure and lifestyle (CDC, 1999; Kraus, 1993)
- The leading causes of brain injury are motor vehicle crashes, violence and falls (CDC, 1999)
- The leading causes of brain injury vary by age. Falls are the leading cause among persons aged 65 years and older and 5 years of age and under, whereas transportation-related injuries are most frequent among persons ages 5 to 64
- The outcome of these injuries varies greatly depending on the cause: 91% of firearm-related brain injuries resulted in death, but only 11% of fall-related ones proved fatal (CDC, 1999)



## What Is Brain Injury?

**Traumatic brain injury (TBI)** has been defined as a physiological disruption of brain function resulting from trauma both external (an object striking the head or the head striking an object) and/or internal (the rapid acceleration/deceleration of the brain within the skullcap).

There are two basic types of brain injury. Open head injuries are caused by bullets or other penetrating objects. Closed head injuries are the more common of the two and usually are caused by a rapid movement of the head during which the brain is bounced back and forth within the skullcap. Closed head injuries often result from motor vehicle crashes, falls and injuries sustained during sports and other recreational activities (i.e., football, bicycling).

Brain injuries are classified in terms of severity (i.e., mild, moderate, severe):

### MILD BRAIN INJURY

Also known as concussion, a mild brain injury is defined as one in which an individual experiences at least one of the following: 1) any period of loss of consciousness; 2) any loss of memory of events immediately preceding and/or following the injury; 3) any alteration in mental state at the time of the injury and 4) focal neurological deficit(s) that may or may not be transient.

The most common symptoms of mild brain injury fall into the following categories:

- **Physical** (headache, dizziness, nausea, sleep problems, fatigue)
- **Cognitive** (decreased attention span, concentration, mental speed and short-term memory)
- **Behavioral** (irritability, emotional lability, depression, anxiety)

The majority of individuals who sustain a mild brain injury will recover spontaneously and with no residual deficits within one to three months, although some individuals may require a longer length of time. Even with a mild brain injury or concussion, a relatively subtle amount of damage occurs and a small subset of people will be left with permanent disability or deficits.



## MODERATE BRAIN INJURY

Although a mild brain injury can be identified and documented easily, distinctions between moderate and severe brain injury are less clear-cut. Generally, a moderate brain injury is one that results in a loss of consciousness lasting only a few minutes to a few hours, followed by days and/or weeks of confusion. Persons sustaining a moderate brain injury usually have physical, cognitive and/or behavioral impairments which can last for many months and even become permanent. Although to a lesser extent, these impairments are similar to those experienced by individuals with severe brain injury. With treatment, however, individuals with moderate brain injuries usually are able to make a complete recovery or successfully learn to compensate for their deficits. (For more information about deficits after brain injury, see the “Consequences” section on page 9.)

## SEVERE BRAIN INJURY

Severe brain injury almost always results in prolonged unconsciousness or coma lasting days, weeks and even months after the injury. Coma is defined as a state of unconsciousness from which the individual cannot be awakened; in which the individual responds minimally or not at all to stimuli and initiates no voluntary activities. Although persons who sustain a severe brain injury can make significant improvements in the first year after the injury and continue to improve at a much slower rate for many years, these individuals often will be left with permanent physical, cognitive or behavioral impairments. (For more information about deficits after brain injury, see the “Consequences” section on page 9.)

## Brain Injury And The Teenager

The causes of brain injury in teenagers differ from both pediatric and adult brain injury. The teenage years bring the special problems of peer pressure, underage drinking, abuse of alcohol and drugs and inexperienced and impaired driving. Because of this, teenagers are very vulnerable to brain injuries and other serious injuries.

## Causes

### MOTOR VEHICLE-RELATED

**Impaired Driving**—Although alcohol-related traffic deaths have been on the decline for the past decade, the most recent statistics show that decline has stopped (NHTSA, 1998). Despite this decline and the fact that alcohol-related fatalities for all other ages decreased, youth-related fatalities (ages 15 through 20) increased by almost 5% in 1996 (NHTSA, 1999a). In that same time period, teenage binge drinking was estimated to have increased by 30% (NHTSA, 1999a).



Additionally, the 21-34 and the 15-21-year-old age groups continue to be over-represented in impaired driving crashes, deaths and injuries. Driving impaired is dangerous because it slows reaction time, impairs judgment and affects alertness and coordination.

***Inexperienced driving***—Motor vehicle crashes are the leading cause of brain injuries and death in teenagers 15-20 years of age, causing roughly one-third of all fatalities in this age group (NHTSA, 1999b). Even though this age group only makes up 7% of the driving population, they are involved in 14% of all traffic fatalities (NHTSA, 1999b). On the basis of miles driven, teenagers are involved in three times as many fatal crashes as are all other drivers (NHTSA, 1999b). Inexperienced driving is one factor for these dangerous statistics, the other two being risk-taking behavior and greater risk exposure (NHTSA, 1999b).

Most young drivers start out with very little knowledge or understanding of the complexities of driving an automobile or motorcycle. Like any other skill, it takes time and practice for the teenage driver to master the skills of driving. The way the licensing system works now, it is easy for teenagers to gain their licenses and access to a car. Without requiring an extended period of supervised practice driving time, teenagers are being set up for the risk of making a fatal mistake (NHTSA, 1999b).

Because of this inexperience, the crashes that teenagers are in differ from those of other drivers. In fact, a NHTSA study (1999b) compared teenagers to drivers from other age brackets and found teens are responsible for their fatal crashes because of their own driving errors.

- A larger percentage of fatal crashes involving teenage drivers are single vehicle crashes compared to other drivers
- Compared to other drivers, a smaller percentage of teens wear their seat belts
- A larger proportion of teenage crashes involve speeding or going too fast for road conditions, compared to other drivers

Adolescent impulsiveness is a natural behavior, but it results in poor driving judgment and participation in high-risk behaviors such as:

- Speeding
- Inattention
- Drinking and driving
- Not using a seat belt

***Alcohol and Motorcycles***—Similar to driving an automobile, driving a motorcycle requires excellent coordination and motor skills. Alcohol greatly inhibits the coordination needed to maneuver a motorcycle and the decision-making skills necessary to handle complex traffic situations (NHTSA, 1998). Data clearly shows that drinking alcohol and riding a motorcycle is a deadly combination. In 1997, approximately 30% of motorcycle operators involved in fatal crashes were intoxicated (NHTSA, 1998).



## Preventing Inexperienced and Impaired Driving

To combat the problems of inexperienced teenage drivers, the National Highway Traffic Safety Administration (NHTSA) encourages all states to implement a graduated licensing system. The purpose of this system is to ease young drivers into the driving environment through more controlled exposure to progressively more difficult driving experiences or driving licensing stages, prior to full licensing (NHTSA, 1999b). For more information about this program, visit NHTSA's web site at <http://www.nhtsa.dot.gov>.

Ways to prevent sustaining a brain injury from impaired driving include:

- Encourage police to be proactive in the enforcement of laws prohibiting teenagers to drive while under the influence of alcohol
- Support the enactment of laws that will reduce impaired teenage driving
- Support primary seat belt laws as teenagers continue to sustain brain injuries, other serious injuries and even death at greater rates than other age groups because they do not wear seat belts
- Support the efforts of teenagers and groups such as Mothers Against Drunk Driving (MADD) that are attempting to reduce and prevent alcohol use and impaired driving

## PEDESTRIAN

In 1996, there were approximately 82,000 pedestrians injured in traffic crashes, the majority of whom sustained a brain injury.

**Impaired Pedestrian**—The dangers of driving intoxicated are well known, but what many people are unaware of is that excessive drinking can have the same deadly consequences for pedestrians. Almost one-third of all pedestrians who die in traffic-related crashes are intoxicated, and alcohol involvement either for the pedestrian or driver was reported in nearly half of all pedestrian fatalities (NHTSA, 1998).

## Preventing Impaired Pedestrian Injury

To prevent sustaining a brain injury as a pedestrian follow these simple rules:

- Remember that alcohol affects balance, impairs judgment and reduces alertness and coordination. It can also affect vision
- Limit alcohol consumption, especially if you plan to walk. Do not fool yourself about your ability to walk in traffic safely
- Be more visible to traffic by carrying a flashlight or wearing reflective clothing at night and wearing bright colors during the day
- If you know someone who has been drinking and plans to walk, call them a cab or escort them home



## DRUGS & ALCOHOL

**Alcohol**—Abuse of alcohol can result in health consequences, social problems and/or both. Short-term effects of alcohol can include: 1) distorted vision, hearing and coordination, 2) altered perception and emotions and 3) impaired judgment. Alcohol is connected with over half of all traumatic brain injuries (National Clearinghouse for Alcohol and Drug Information (NCADI), 1999c).

**Underage Drinking**—Despite the fact that the purchase of alcohol is illegal for most college students, alcohol is the most widely used drug on college campuses with 41% of college students reporting binge drinking—consuming five or more drinks in a row—at least once in the prior two-week period (NCADI, 1999d). Binge drinking increases the risk of alcohol-related brain injury, especially for young people, who often combine alcohol with other high-risk activities such as impaired driving (NCADI, 1999d).

Although great strides have been made in addressing the problem of underage drinking and driving, teenagers are still over-represented in motor vehicle crashes when compared to adults. One of the most successful efforts to deal with the problem of underage drinking and driving is the passage of zero tolerance laws, which makes it illegal for persons under the age of 21 to drive with any measurable amount of alcohol in their blood.

### Preventing Underage Drinking

- If you have a drinking problem, seek help by talking to a school counselor, friend or parent. If you know a person who has a problem with alcohol assist them in finding professional help
- Be aware of the risks. Drinking increases the risk of brain injury in car crashes, falls, drowning and suicide by firearms
- Be aware that brain injury sometimes leads to decreased judgment, poor memory and difficulty in concentration, and the individual with brain injury may not listen to advice or accept that they have a problem with alcohol (NCADI, 1999c)
- Remove all alcohol, tobacco and other drugs from the house. If that is not possible, keep them away from your teenager

**Marijuana**—Marijuana is the most widely used illicit drug in the United States and tends to be the first illegal drug teens use (NCADI, 1999a). The physical effects of marijuana use, particularly in developing adolescents, can be acute. Marijuana blocks the messages going to the brain and alters the perceptions, emotions, vision, hearing and coordination.

Among the short-term effects of marijuana are several that have a direct influence on and/or injury to the brain including: 1) difficulty keeping track of time, 2) impaired or reduced short-term memory, 3) reduced ability to perform tasks requiring concentration and coordination, 4) decreased social inhibitions and 5) paranoia and hallucinations. Prolonged use also will induce a psychological dependence requiring more of the drug to get the same effect (NCADI, 1999a).



**Cocaine & Crack**—Cocaine belongs to a class of drugs known as stimulants, which tend to give a temporary illusion of limitless power and energy that leave the user feeling depressed, edgy and craving more (NCADI, 1999b). Crack is a smokeable form of cocaine that has been chemically altered. Both cocaine and crack are highly addictive, eroding physical and mental health and injuring the brain. Effects of these drugs on individuals can include: 1) brain seizures, 2) violent, erratic or paranoid behavior, 3) hallucinations, 4) confusion, anxiety and depression and 5) a loss of touch with reality (NCADI, 1999b).

**Inhalants**—Substances that are sniffed to give the individual using it a head rush or high are in a drug category called inhalants. They can include a diverse group of chemicals that are found in consumer products such as aerosols and cleaning solvents (NCADI, 1999c). With only one use these drugs are very dangerous to an individual and his/her brain putting the individual at risk for 1) sudden death, 2) suffocation and 3) visual hallucinations and mood swings. Prolonged use can result in: 1) violent behaviors, 2) irreversible brain damage, 3) nervous system damage and 4) dangerous chemical imbalance in the body.

### Preventing Drug Use

- If you have a problem with drugs seek help by talking to a school counselor, friend or parent
- If you know a person who has a problem with drugs assist them in finding professional help
- Be aware of the risks. Taking drugs increases the risk of brain injury in car crashes, falls, drowning and suicide by firearms

## VIOLENCE/FIREARMS

In 1992, firearms surpassed motor vehicles as the number one cause of brain injury fatalities in the United States (Sosin et al., 1995). When studying deaths by firearms, it is the 15-24-year olds who have the highest death rate.

In a study conducted by the Centers for Disease Control and Prevention (1988), almost one-fifth or 18.3% of the students nationwide carried a weapon (e.g., a gun, knife or club) on greater than or equal to one of the thirty days preceding the survey. According to this same study males were more likely (27.7%) than females (7%) to have carried a weapon. In 1994, firearms were the number two killer of men and women 10-24 years of age—second only to motor vehicle crashes. In that same year, however, firearm injury death rate and brain injury among males 15-24 years of age was 32% higher than the motor vehicle traffic injury death rate (Center for Handgun Control, 1999).



***Preventing Violence/Firearms Injury***—An estimated 30% of all unintentional shootings could be prevented by the presence of safety features such as trigger locks and loading indicators, but American-made guns are not subject to federal safety standards like other consumer products. To help prevent someone from sustaining a brain injury from firearms, follow these simple steps:

- Always keep your gun unloaded and locked up. Lock and store bullets in a separate location and make sure teenagers do not have access to the keys
- Talk with your teenager about his/her thoughts and feelings – depressed teens commit suicide with guns more often than any other method
- Talk with your teenager about ways to solve arguments and fights without guns or violence
- The best way to reduce gun risks is to remove the gun from your home

## **SPORTS AND RECREATION**

Each year, more than 750,000 Americans report injuries sustained during recreational sports, with approximately 82,000 involving brain injuries. According to the National Football League Commissioner's Office, football injuries associated with the brain occur at a rate of one in every 3.5 games. Brain injuries also cause more deaths than any other sports injury.

A mild brain injury or concussion is the most common consequence of brain injury in contact sports. In any given season, 10% of all college players and 20% of high school players sustain brain injuries (Zemper, 1994). Among teenagers, brain injury is the most common injury in winter sports such as skiing, sledding, ice skating or ice hockey, accounting for 46% of all injuries (Research and Training Center in Rehabilitation and Childhood Trauma, 1993).

Brain injury is responsible for more than 17% of all horseback riding injuries and more than 60% of equestrian-related deaths (National Electronic Survey System, 1991-1992). Brain injury is also the leading cause of death in bicycle crashes and the most important determinant of permanent disability (National Safe Kids Campaign, 1999).

### **Preventing Sports and Recreational Injuries**

- To reduce the risks of concussion, athletic trainers and coaches should follow the *Guidelines for the Management of Concussion in Sports* developed by the American Academy of Neurology and the Brain Injury Association to identify concussions, and make decisions about when to remove and return an athlete from the playing field
- Teens should always wear appropriate safety gear when participating in sports and recreational activities
- Appropriate safety equipment, a safe playing environment and adequate adult supervision should be included in any sport



## Consequences

Impairments from brain injury can be divided into three major categories: physical, cognitive and behavioral.

### Physical Impairments

- Speech, vision, hearing and other sensory impairments
- Headaches
- Lack of coordination
- Muscle spasticity (A condition that causes stiff, tight muscles, especially in the arms and legs, making movements stiff, jerky or uncontrollable)
- Paralysis
- Seizure disorders
- Problems with sleep
- Dysphagia (a disorder of swallowing)
- Dysarthria (a disorder of articulation and the muscular/motor control of speech)

### Cognitive Impairments

- Short- and long-term memory deficits
- Slowness of thinking
- Problems with reading and writing skills
- Difficulty maintaining attention and concentration
- Impairments of perception, communication, reasoning, problem solving, planning, sequencing and judgment
- Lack of motivation or inability to initiate activities

### Behavioral Impairments

- Mood swings
- Denial
- Depression and/or anxiety
- Lowered self esteem
- Sexual dysfunction
- Restlessness and/or impatience
- Inability to self-monitor, inappropriate social responses
- Difficulty with emotional control and anger management
- Inability to cope
- Excessive laughing or crying
- Difficulty relating to others
- Irritability and/or anger
- Agitation
- Abrupt and unexpected acts of violence
- Delusions, paranoia, mania



## OUTCOME AFTER TEENAGE BRAIN INJURY

The teenager with a brain injury is unique not only in comparison with younger children and adults, but also to other teenagers with brain injuries. Each teenager's recovery process, outcome and family are different and unique. Investigations of outcome on adolescents with severe brain injury have documented persistent cognitive, academic and behavioral impairments (Ewing-Cobbs et al., 1985). Following brain injury, deficits in function are likely in wide-ranging areas involving everyday skills that require differing degrees of mental alertness, information processing, planning, execution and mental monitoring of daily actions (Mattson, 1999). Owing to the different methods used to grade severity of brain injury and the lack of reliable outcome studies, however, it is not possible to accurately predict outcome in teenagers with brain injury.

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