

Traumatic Brain Injury among Children and Adolescents Treated in Emergency Departments, United States 2007-2010

A Note about the Methodology

For this analysis, CSN pulled data from the National Electronic Injury Surveillance System-All Injury Program and augmented it with data from the National Electronic Injury Surveillance System (NEISS) for the years 2007 through 2010. NEISS is a weighted national probability sample of consumer product-related injury visits to emergency departments (ED) in a sample of 100 U.S. hospitals. Overall, NEISS includes data on approximately 400,000 ED injury visits per year. Since 2000, 66 of the 100 NEISS hospitals have participated in an expanded collection effort that covers all injuries, not just those involving consumer products. This expanded system, called the NEISS All Injury Program (NEISS-AIP), collects data on more than 500,000 ED injury visits per year, both intentional and unintentional.



Traumatic Brain Injury (TBI), defined here as a concussion, skull fracture¹, or internal brain injury, can have life-long cognitive, physical, and financial impacts. Preventing these injuries requires an understanding of what causes them. To understand the causes of TBI, the Children's Safety Network (CSN) explored emergency department (ED) treated TBIs among 0 through 19 year olds in terms of intent, activity, and object involved. Unless otherwise noted, all data in this fact sheet come from analysis of NEISS and NEISS-AIP data.

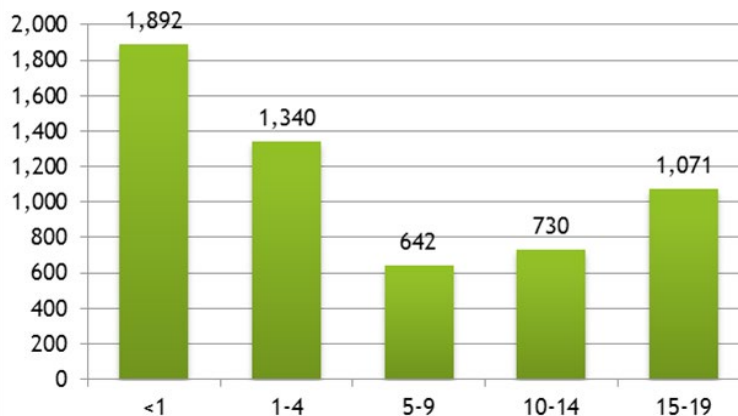
¹ Skull fractures were included due to the high likelihood of bruising on the surface of the brain.

The Burden of TBI in Children and Adolescents Ages 0 Through 19

On average between 2007 and 2010, 4,754 children and youth between the ages of 0 and 19 died from a TBI each year. During the same time period, 3.24 million children and adolescents visited the ED for treatment of a non-fatal TBI. That's an average of 810,000 ED-treated non-fatal TBIs among 0 through 19 year olds every year—a rate of 974 TBIs per 100,000 population.²

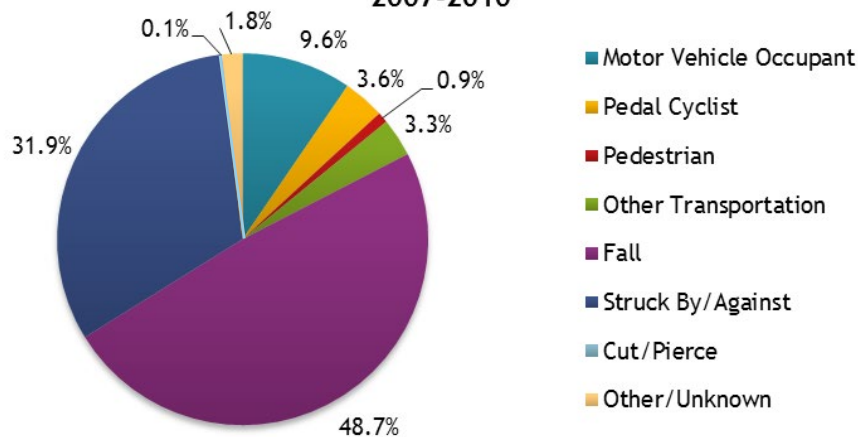
Fifteen through 19 year olds sustained 236,916 non-fatal TBIs while those aged one and under sustained 76,759 non-fatal TBIs on annual average between 2007 and 2010. When these numbers are translated into rates per 100,000 population, we see that the under one year old population sustained the highest rate of TBIs, followed by 1 through 4 year olds, and then 15 through 19 year olds.

Figure 1. Non-Fatal ED-treated TBIs, Ages 0-19
(Annual rate per 100,000 population)
2007-2010



The Causes of ED-Treated TBI in Children and Adolescents Ages 0 Through 19

Figure 2. Non-Fatal TBIs in Children and Adolescents
Ages 0-19 by Cause
2007-2010



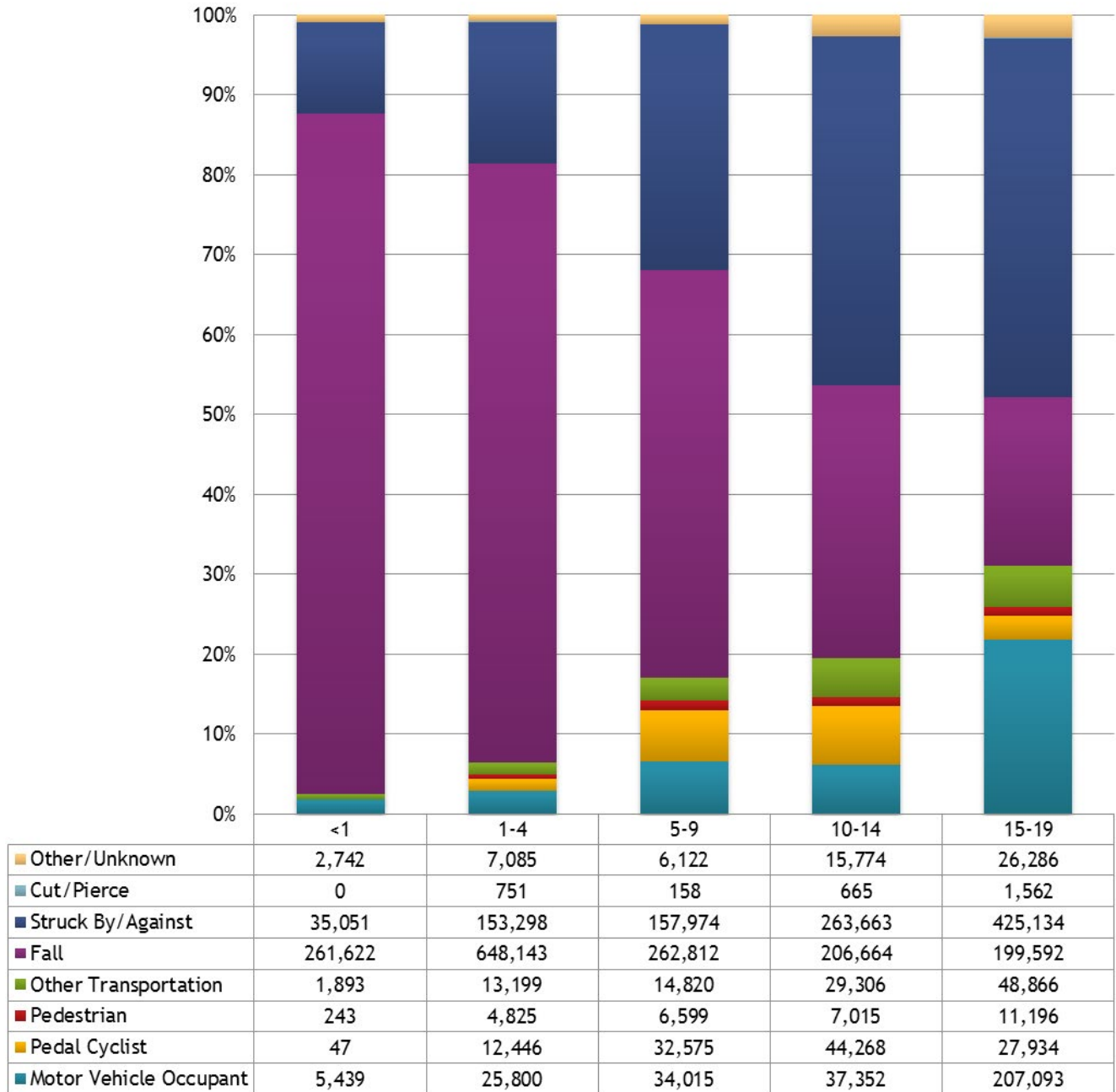
Falls are by far the leading cause of non-fatal ED-treated TBIs among children and adolescents ages 0 through 19, representing 48.7% of all non-fatal TBIs treated in the ED. Being struck by or against something or someone is the second leading cause of non-fatal ED-treated TBIs (31.9%). Motor vehicle crashes are the third leading cause (9.6%) of non-fatal TBIs and pedal cyclist injuries are the fourth leading cause of non-fatal TBIs (3.6%).

The causes of TBI change as children and youth grow and their skills and behaviors change. The number of non-

fatal TBIs caused by falls is far less in 15 through 19 year olds than in those under age one, while motor vehicle crashes cause more TBIs in 15 through 19 year olds than in those under age one. Similarly, intentional injuries, particularly assaults, increase substantially in 10 through 14 year olds and 15 through 19 year olds.

² CPSC's Injury Cost Model (ICM) estimates non-NEISS incidence—i.e., injuries that bypass the ED and are admitted directly to the hospital or treated in a facility other than an ED—by applying a set of ratios to NEISS injury incidence by diagnosis, age, and sex. By applying the appropriate ICM ratios to our NEISS-AIP subset of head injuries suffered by minors, we estimate that this number captures 66.5% of all non-fatal head injuries resulting in medical care.

Figure 3. Non-Fatal TBIs in Children and Adolescents by Cause and Age Group, 2007-2010



Overall, 92% of non-fatal TBIs among children and youth ages 0 through 19 that were treated in an ED were unintentional, and only 8% were a result of intentional injuries. The percentage of TBIs that are intentional is lowest among 1 through 4 year olds (0.5% intentional), and highest among 15 through 19 year olds (18% intentional).

Unintentional Non-Fatal TBIs

Of the non-fatal ED-treated TBIs sustained by children and adolescents ages 0 through 19, 92% were unintentional. Over half of those (52%) resulted from falls. More than a quarter (27%) resulted from someone being struck by or against something or someone. And 10% occurred when the child or adolescent was the occupant of a motor vehicle.

Figure 4. Intentional and Unintentional Non-Fatal TBIs, Ages 0-19, 2007-2010

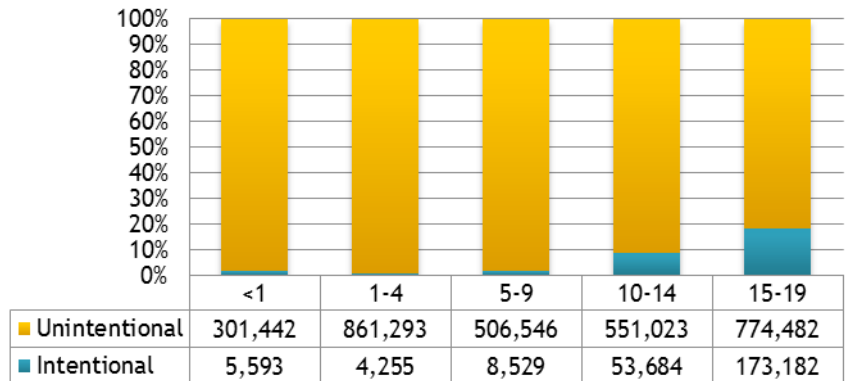


Figure 5. Unintentional Non-Fatal TBIs, Ages 0-19 by Cause 2007-2010

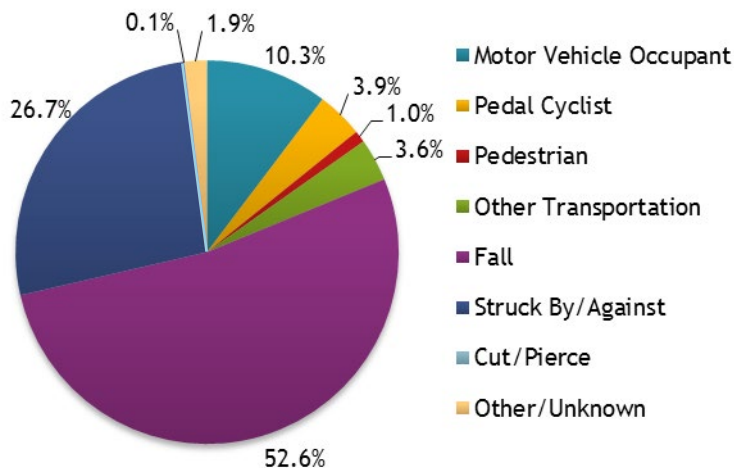
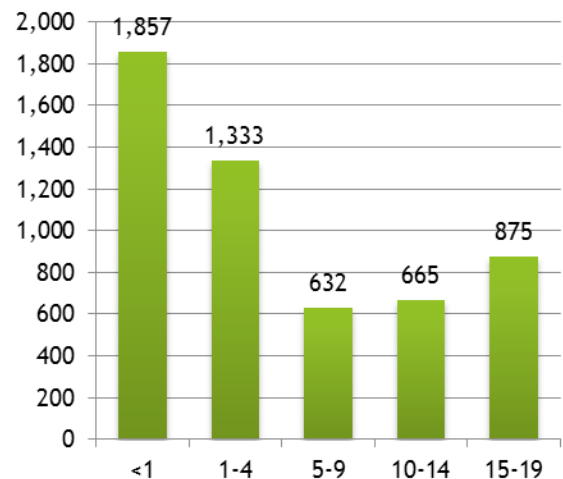


Figure 6. Unintentional Non-Fatal TBIs by Age (Annual rate per 100,000 population) 2007-2010



Activities and Objects Involved in Unintentional, ED-Treated Non-Fatal TBIs

Another way to look at the causes of TBI is to examine the activities and objects involved. Using the NEISS and NEISS-AIP datasets,³ we identified the 5 leading causes of unintentional TBIs in children and adolescents ages 0 through 19 according to the activity and the object involved at the time of the TBI. Figure 7 shows how the causes of TBI shift from furniture and fixtures to sports and motor vehicle crashes as children grow and their behaviors change.

³ See note on methodology, page 1

Figure 7. 5 Leading Activities or Objects Involved in Unintentional Non-Fatal TBIs among Ages 0-19 by Age Group 2007-2010

Ranking	<1 Total: 301,442	1 to 4 Total: 861,293	5 to 9 Total: 506,546	10 to 14 Total: 551,023	15 to 19 Total: 774,482
1	Beds & Bedding N=70,413	Stairs N=90,802	Motor Vehicle Occupant N=34,015	Football N=60,534	Motor Vehicle Occupant N=206,161
2	Floors N=44,086	Floors N=77,441	Bicycles N=32,233	Bicycles N=43,647	Football N=76,317
3	Stairs N=19,816	Beds & Bedding N=74,023	Floors N=27,293	Motor Vehicle Occupant N=37,320	Basketball N=22,764
4	Sofa N=18,264	Tables N=44,743	Beds & Bedding N=22,272	Basketball N=32,126	Soccer N=31,261
5	Car seats N=15,317	Chairs N=42,206	Stairs N=16,266	Baseball/Softball N=26,163	Bicycles N=26,343

Intentional⁴ Non-Fatal TBIs

Of the non-fatal ED-treated intentional TBIs sustained among children and youth between the ages of 0 and 19 (8% of all ED-treated non-fatal TBIs in this population), the majority (97%) were the result of assault. Self-inflicted injuries accounted for 0.2% of the non-fatal intentional TBIs in this age group.

Figure 8. Intentional Non-Fatal TBIs, Ages 0-19 by Cause 2007-2010

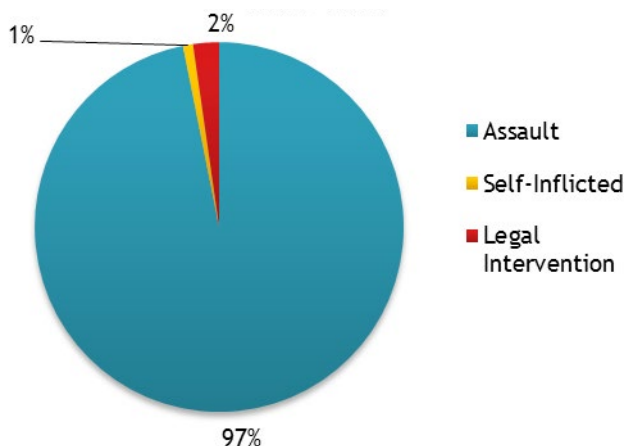
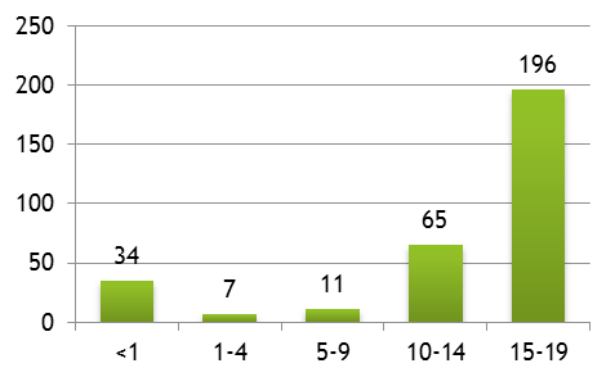


Figure 9. Intentional Non-Fatal TBIs by Age (Annual rate per 100,000 population) 2007-2010



⁴ Intentional injuries are broken into 3 main categories with the following definitions:

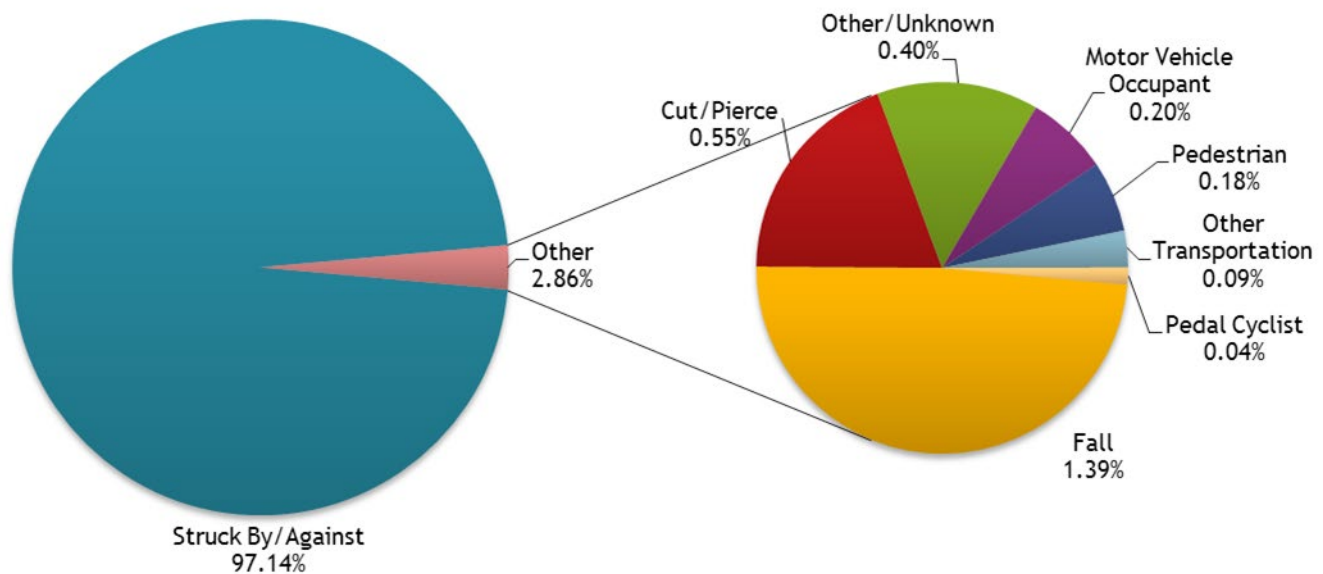
Assault: "Injury from an act of violence where physical force by one or more persons is used with the intent of causing harm, injury, or death to another person"

Self-Inflicted: "Injury...resulting from a deliberate violent act inflicted on oneself with the intent to take one's own life or with the intent to harm oneself."

Legal Intervention: "Injury...caused by police or other legal authorities (including security guards) during law enforcement activities." <http://www.cdc.gov/ncipc/wisqars/nonfatal/definitions.htm>

About 97% of the assaults leading to a TBI in this age group were the result of being struck by or against something or someone. The second leading mechanism of assault was falls, which represent only 1.3% of the assaults. The third leading mechanism of assault, cut/pierce, represents 0.04% of these injuries.

**Figure 10. Intentional Non-Fatal TBIs from Assault, Ages 0-19 by Cause
2007-2010**



TBI Prevention

No one is immune to TBIs, but there are steps that parents, caregivers, and youth can take to reduce the likelihood of experiencing a TBI and to decrease the severity of these injuries. Because of age group differences in the causes of TBI, prevention efforts must focus on the activities in which specific age groups engage and the risks those activities pose.

The youngest children (ages 0 through 4) have the highest rates of non-fatal TBIs, and their injuries are most often caused by falls, being struck by/against something or someone, and mishaps involving furniture and fixtures. Parent education programs on the importance of active supervision and not placing babies and young children on high surfaces can decrease the burden of these injuries. Home safety checklists and the consistent and correct use of safety devices such as stair guards, window guards, corner guards, furniture straps, bed rails, and car seats can also help reduce these injuries.

Although 5 through 14 year olds have the lowest rates of non-fatal TBIs, they are still at risk. This age group is continually engaging in more complex recreational activities and learning new skills. When acquiring a new skill, they are at increased risk for injuries, including TBIs. These children benefit from active supervision on the playground and on the go, using bicycle helmets and booster seats, and wearing protective equipment while playing sports. This is also a prime age for educational programs that support the emotional wellbeing of the child, such as the *Good Behavior Game* and the *Incredible Years*, which provide increased resiliency and protection from risk taking behavior and aggression. Understanding the child's physical and emotional development can help parents and caregivers recommend activities that are suitable for the child and discourage them from those likely to result in injury.

Adolescents, ages 15 through 19, are at high risk for sustaining a TBI. Their injuries are more likely to be caused by motor vehicle crashes, sports, and assaults. Enforcement of graduated driver licensing laws, consistent and correct use of safety devices such as helmets and seatbelts, and implementation of youth violence prevention programs can help reduce the burden and severity of TBIs in this population.

Above all, parents, caregivers, and youth should be prepared by knowing the signs and symptoms of concussion and by knowing what to do if a concussion or other TBI occurs. If you suspect someone has sustained a concussion, seek medical attention as soon as possible. The Centers for Disease Control and Prevention lists the following symptoms of a concussion:

Table 2. Symptoms of a Concussion

Thinking/Remembering	Physical	Emotional/Mood	Sleep
Difficulty thinking clearly	Headache Fuzzy or blurry vision	Irritability	Sleeping more than usual
Feeling slowed down	Nausea or vomiting (early on) Dizziness	Sadness	Sleeping less than usual
Difficulty concentrating	Sensitivity to noise or light Balance problems	More emotional	Trouble falling asleep
Difficulty remembering new information	Feeling tired, having no energy	Nervousness or anxiety	

Source: http://www.cdc.gov/concussion/signs_symptoms.html



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