

Behavioral Health, Children and Youth: Pediatric Interventions for TBI



Drew Davis, M.D.
Professor
Pediatric Rehabilitation Medicine
Department of Pediatrics
Department of Physical Medicine and
Rehabilitation
University of Alabama at Birmingham

Jesse Martinez, MD
Assistant Professor
Department of Psychiatry
University of Alabama at Birmingham
Medical Director, Psychiatric Intake Response Center
And Consultation-Liaison and Emergency Psychiatry
Children's of Alabama



Children's
of Alabama

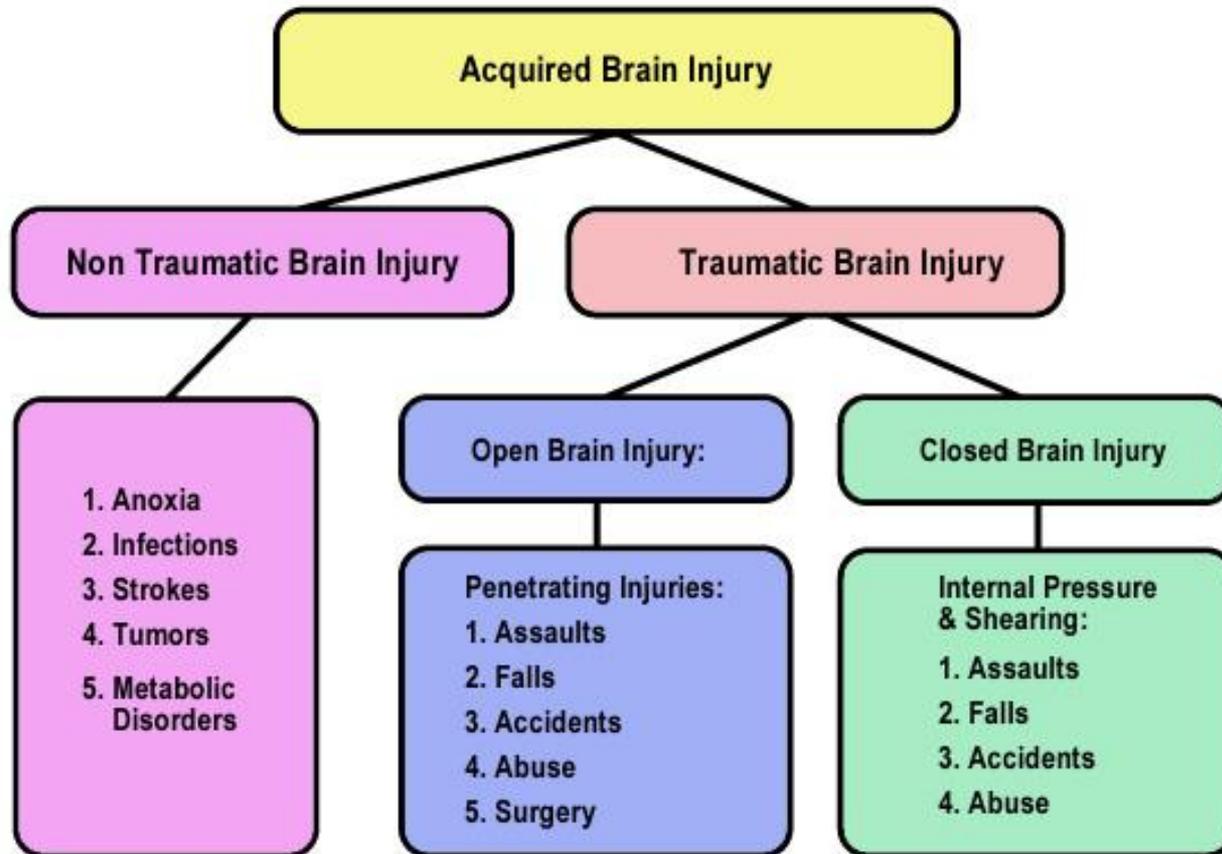
UAB MEDICINE
PEDIATRICS

Objectives

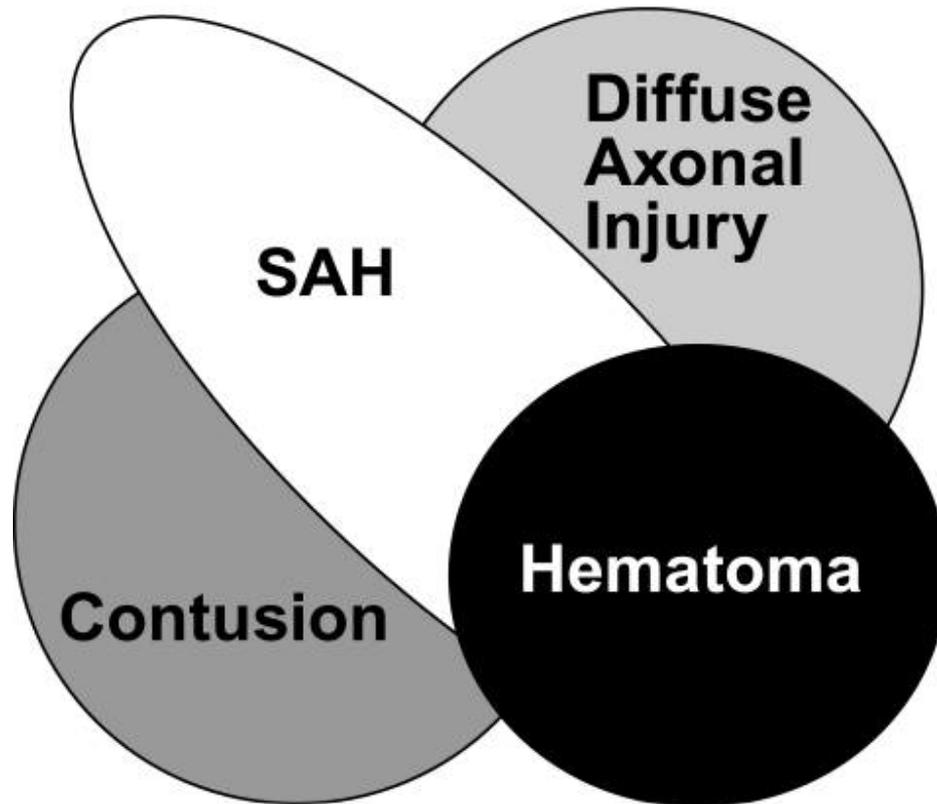
- Participants will be to discuss types of acquired brain injury including traumatic brain injury (TBI).
- Participants will be to compare behavioral issues for children and youth during acute care associated with TBI.
- Participants will have an understanding of challenges families face when a child has a mental health concern and are seeking assistance.
- Participants will have an understanding of the Psychiatric Intake Response Center's (PIRC) mission and goals to make an impact in the states of pediatric mental health in Alabama.
- Participants will be able to demonstrate the effectiveness of interventions utilizing COA Psychiatric Intake Response Center (PIRC) and assess benefits from clinic services and community referrals related to behavior and TBI.



Continuum of ABI



Continuum of ABI



Saatman, Kathryn E (07/2008). "Classification of traumatic brain injury for targeted therapies". *Journal of neurotrauma* (0897-7151), 25 (7), p. 719.



Children's
of Alabama

UAB MEDICINE
PEDIATRICS

Continuum of ABI

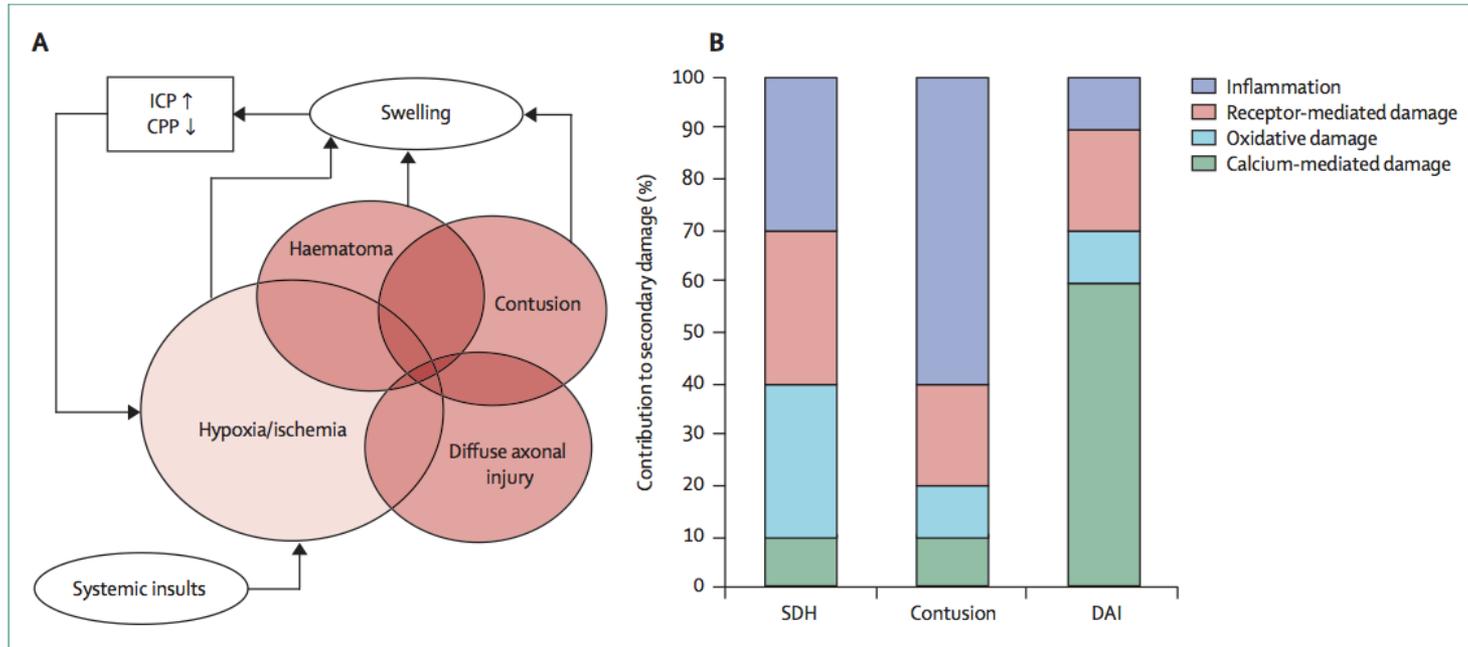


Figure 1: Components of TBI and importance of different pathophysiological mechanisms

(A) The different components of TBI with ischaemic damage are superimposed on the primary types of injury (haematoma, contusion, and diffuse axonal injury). Systemic insults and brain swelling contribute to ischaemic damage, which might in turn cause more swelling. (B) The relative importance of different pathophysiological mechanisms in various types of TBI. CPP=cerebral perfusion pressure. ICP=intracranial pressure. SDH=acute subdural haematoma. DAI=diffuse axonal injury. Adapted from Graham et al,²⁹ with permission from Hodder Arnold.

Maas, Andrew I R (08/2008). "Moderate and severe traumatic brain injury in adults". *The Lancet (British edition)* (0140-6736), 7 (8), p. 728.



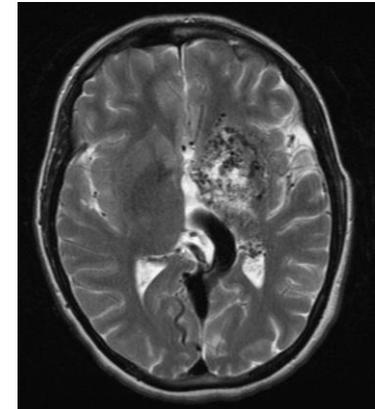
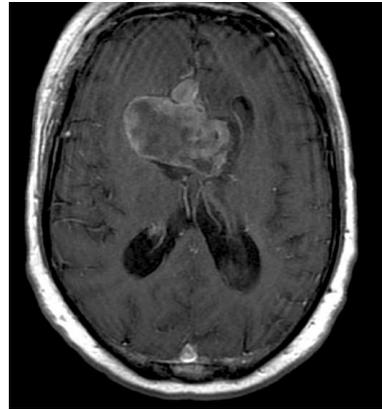
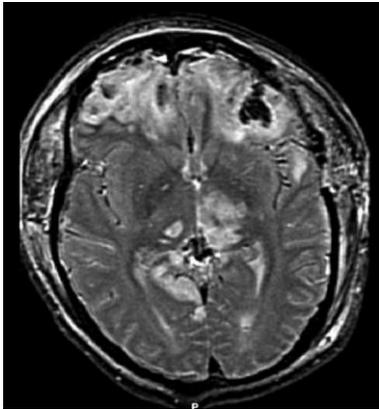
Continuums of ABI

1. Type injury
2. Location
3. Severity
4. Healthcare system and community



Continuum of ABI

“predictors of outcome cannot be generalized across the various etiologies of ABI...”



Johnson, Abigail R (2009). "Predictors of outcome following acquired brain injury in children". *Developmental disabilities research reviews (1940-5510)*, 15 (2), p. 124.

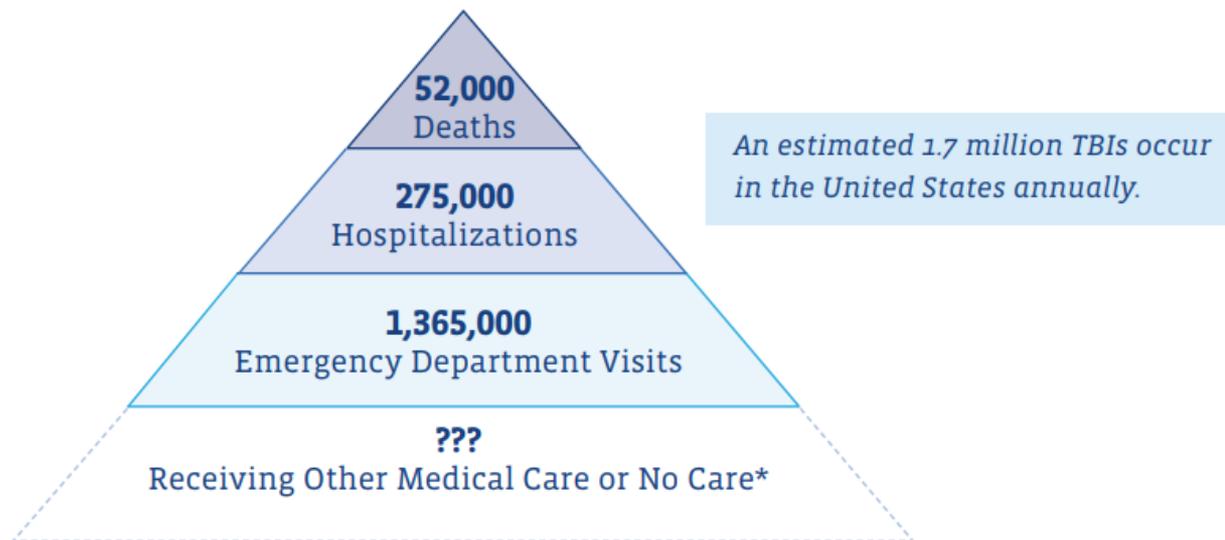


Children's
of Alabama

UAB MEDICINE
PEDIATRICS

ANNUAL NUMBER OF TBIs

Estimated Average Annual Number of Traumatic Brain Injury-Related
Emergency Department Visits, Hospitalizations, and Deaths, United States, 2002–2006



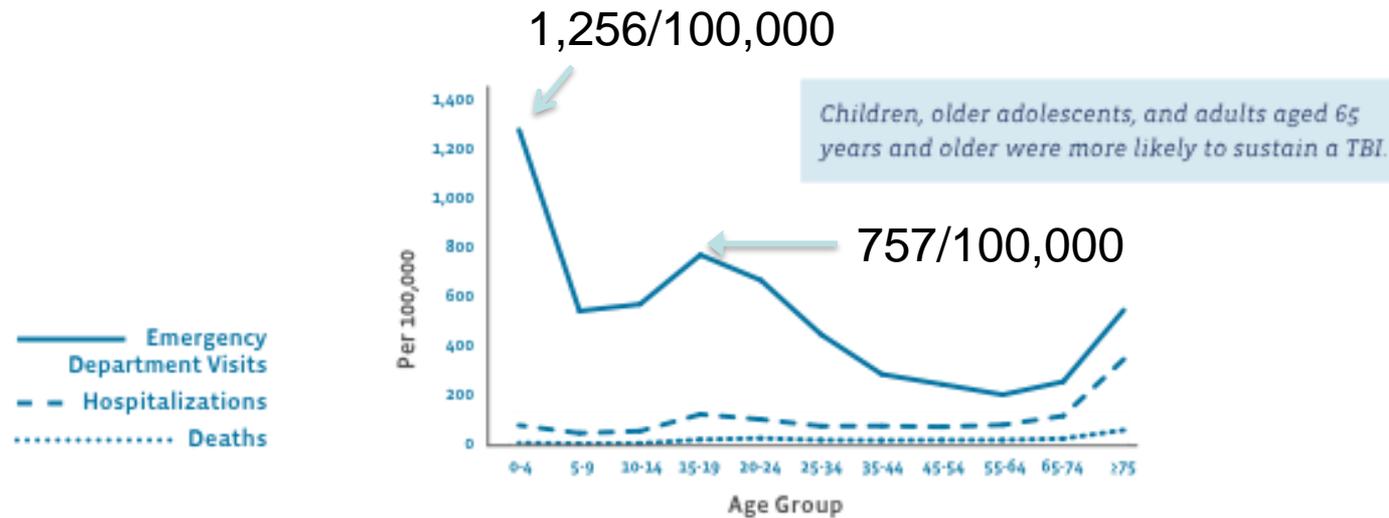
Of the 1.7 million TBIs occurring each year in the United States, 80.7% were emergency department visits, 16.3% were hospitalizations, and 3.0% were deaths.

* Data for this category are not included in this report. See "Limitations" in Appendix B for more information.

TBI BY AGE GROUP

COMPARING THE RATES

Estimated Average Annual Rates of Traumatic Brain Injury-Related Emergency Department Visits, Hospitalizations, and Deaths, by Age Group, United States, 2002–2006

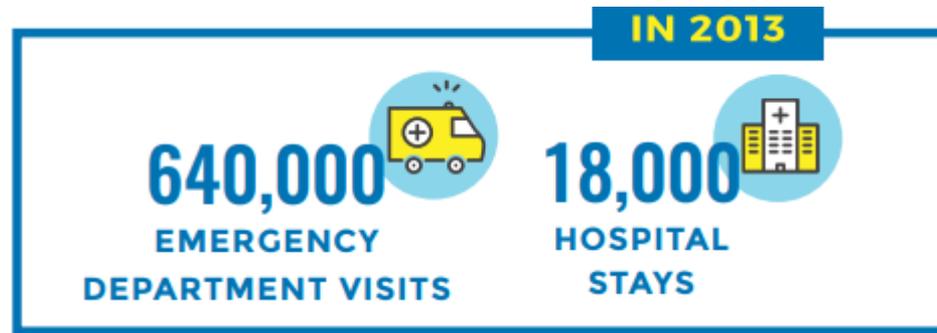


Very young children aged 0 to 4 years had the highest rate of TBI-related emergency department visits (1,256 per 100,000 population), followed by older adolescents aged 15 to 19 years (757 per 100,000). However, the highest rates of TBI-related hospitalization and death occurred among adults aged 75 years and older (339 per 100,000 and 57 per 100,000, respectively).

Annual Number of Pediatric TBIs

For individuals age 0-14

- 1,500 deaths



- 75-85% of all injuries are mild TBI

Centers for Disease Control and Prevention. (2018). Report to Congress: The Management of Traumatic Brain Injury in Children, National Center for Injury Prevention and Control; Division of Unintentional Injury Prevention. Atlanta, GA.

Source: Faul M, Xu L, Wald MM, Coronado VG. Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations and Deaths 2002 – 2006. Atlanta (GA): Centers for Disease Control and Prevention, National Center for Injury Prevention and Control; 2010.

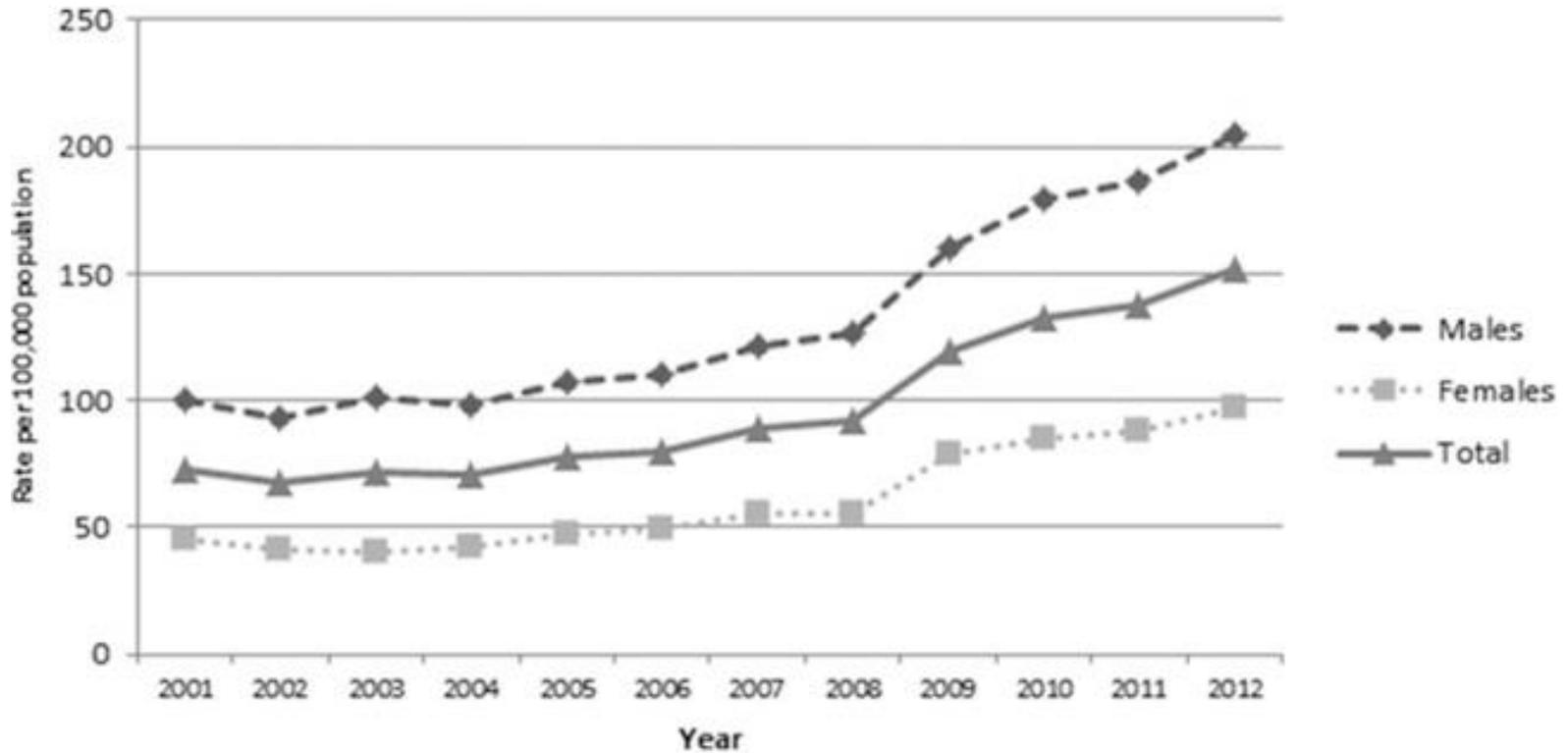
www.cdc.gov/TraumaticBrainInjury



Children's
of Alabama

UAB MEDICINE
PEDIATRICS

Sports and Recreation Related Traumatic Brain Injury



Age-adjusted rates of emergency department visits per 100 000 population of sports- and recreation-related traumatic brain injury, by year and sex, National Electronic Injury Surveillance System-All Injury Program, 2001-2012, United States.

Sports and Recreation Related Traumatic Brain Injury

Morbidity and Mortality Weekly Report

TABLE 1. Estimated annual number and rate* of emergency department visits for all nonfatal traumatic brain injuries (TBIs) related to sports and recreation activities among persons aged <18 years, by selected characteristics — National Electronic Injury Surveillance System—All Injury Program, United States, 2010–2016

Characteristic	2010		2011		2012		2013		2014		2015		2016	
	No.†	Rate (95% CI)												
Age group (yrs)														
0–4	24,161	119.6 (83.0–156.2)	23,485	116.7 (74.0–159.4)	23,957	119.9 (84.3–155.5)	20,553	103.6 (75.2–132.0)	20,930	105.3 (75.6–135.1)	20,983	105.4 (72.6–138.1)	23,232	116.6 (72.7–160.5)
5–9	52,536	258.2 (186.0–330.3)	55,800	274.4 (206.4–342.5)	61,011	298.1 (226.5–369.7)	59,690	290.2 (224.7–355.7)	56,837	277.0 (202.6–351.5)	62,175	303.6 (212.1–395.2)	58,899	288.3 (184.0–392.6)
10–14	105,736	511.4 (386.0–636.7)	109,112	526.7 (389.4–664.1)	128,672	622.5 (460.0–784.9)	125,588	608.1 (451.3–764.8)	122,359	592.0 (459.0–724.9)	125,446	608.7 (461.5–755.8)	113,664	551.0 (400.6–701.4)
15–17	80,686	622.9 (471.5–774.2)	84,836	665.9 (512.6–819.1)	89,327	709.7 (525.3–894.2)	89,466	715.4 (521.4–909.5)	89,355	714.0 (530.5–897.4)	78,655	622.9 (479.1–766.8)	77,477	610.9 (431.3–790.4)
Sex														
Male ^{§,¶}	184,651	486.6 (366.7–606.6)	191,341	506.4 (379.0–633.8)	210,569	559.1 (418.0–700.3)	202,575	539.0 (411.9–666.1)	198,678	528.7 (403.4–654.0)	190,943	507.7 (384.0–631.4)	181,623	482.7 (345.7–619.8)
Female ^{**}	78,468	216.5 (162.3–270.8)	81,891	226.7 (172.0–281.4)	92,398	256.4 (191.3–321.5)	92,723	257.6 (183.5–331.7)	90,803	252.3 (190.2–314.4)	96,317	267.4 (198.3–336.5)	91,649	254.3 (174.2–334.5)
Total	263,118	354.7 (267.7–441.6)	273,232	369.7 (278.7–460.7)	302,966	411.1 (308.1–514.0)	295,297	401.4 (301.4–501.3)	289,481	393.5 (300.1–486.9)	287,260	390.1 (294.2–486.1)	273,272	371.0 (262.2–479.8)

Abbreviation: CI = confidence interval.

* Per 100,000 population.

† Numbers might not sum to totals because of rounding.

§ Rate significantly increased from 2010 to 2012.

¶ Rate significantly decreased from 2012 to 2016.

** Rate significantly increased from 2010 to 2016.

An estimated, **283,000** children seek care in U.S. emergency departments each year for a sports- or recreation-related TBI.

REPORT TO CONGRESS

The Management of Traumatic Brain Injury in Children: Opportunities for Action



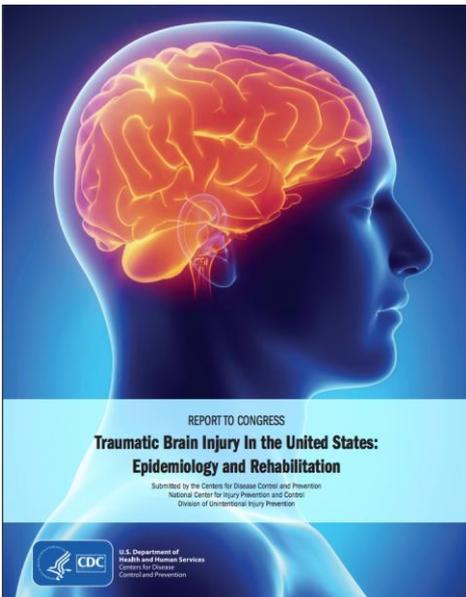
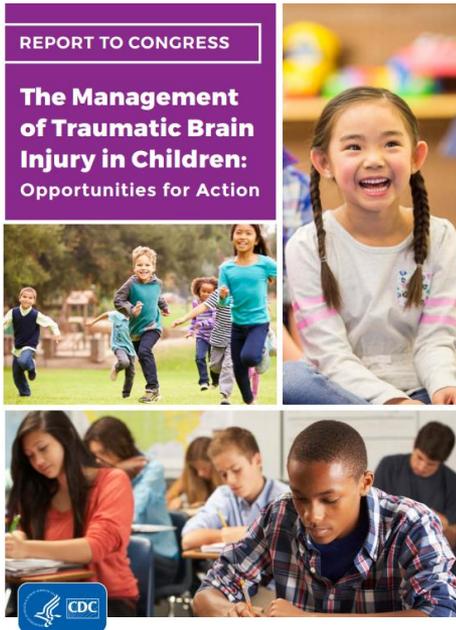
Table 3. Health effects associated with TBI

Category	Description
Cognitive	Deficits in: attention; learning and memory; executive functions like planning and decision-making; language and communication; reaction time; reasoning and judgment
Behavioral/ Emotional	Delusions; hallucinations; severe mood disturbance; sustained irrational behavior; agitation; aggression; confusion; impulsivity; social inappropriateness
Motor	Changes in muscle tone; paralysis; impaired coordination; changes in balance, or trouble walking
Sensory	Changes in vision and hearing; sensitivity to light
Somatic signs and symptoms	Headache; fatigue; sleep disturbance; dizziness; chronic pain

Sources: Anstey et al., 2004; Asikainen, Kaste, and Sarna, 1999; Clinchot, Bogner, Mysiw, Fugate, and Corrigan, 1998; Dikmen, Machamer, Fann, and Temkin, 2010; Granacher, 2005; Katz, White, Alexander, and Klein, 2004; Meares et al., 2011; Orff, Ayalon, and Drummond, 2009; Riemann and Guskiewicz, 2000; Riggio and Wong, 2009; Rogers and Read, 2007; Schmidt, Register-Mihalik, Mihalik, Kerr, and Guskiewicz, 2012; Silver et al., 2011; Williams, Morris, Schache, and McCrory, 2009; Ziino and Ponsford, 2006; Nampiaparampi, 2008.

Centers for Disease Control and Prevention. (2018). Report to Congress: The Management of Traumatic Brain Injury in Children, National Center for Injury Prevention and Control; Division of Unintentional Injury Prevention. Atlanta, GA.

Centers for Disease Control and Prevention. (2015). Report to Congress on Traumatic Brain Injury in the United States: Epidemiology and Rehabilitation. National Center for Injury Prevention and Control; Division of Unintentional Injury Prevention. Atlanta, GA.



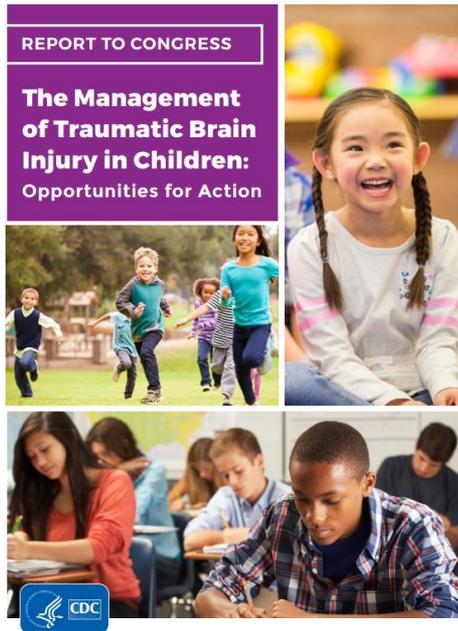
“Psychologicaldisorders....can develop following TBI, which also might contribute to varying degrees of long-term impairment.....These include **mood disorders.**”

Considerable gaps in the current understanding regarding the overlap and specific relations among TBI and these conditions.

Individual characteristics including **ADHD, anxiety, depression, mood disorders,** and migraines are potentially important determinants of outcomes following TBI.

Centers for Disease Control and Prevention. (2018). Report to Congress: The Management of Traumatic Brain Injury in Children, National Center for Injury Prevention and Control; Division of Unintentional Injury Prevention. Atlanta, GA.

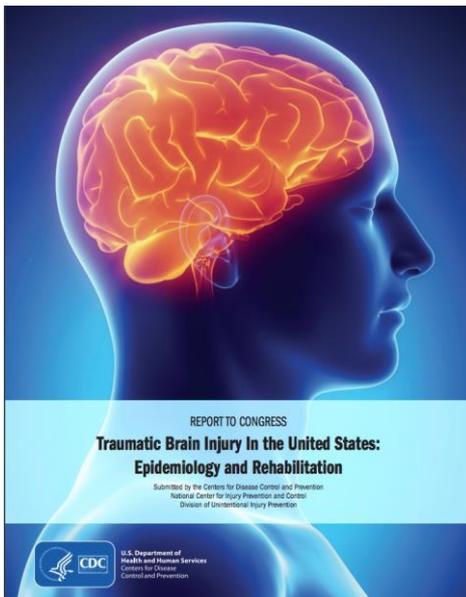
Centers for Disease Control and Prevention. (2015). Report to Congress on Traumatic Brain Injury in the United States: Epidemiology and Rehabilitation. National Center for Injury Prevention and Control; Division of Unintentional Injury Prevention. Atlanta, GA.



Risk for incarceration after a TBI increases with a h/o **substance abuse**, multiple TBIs, untreated TBI, **mental health diagnosis**, and family disadvantage (low socioeconomic status and parental education).

Mental health conditions, such as **depression and anxiety, poor problem-solving skills, and considerations aligned with suicide risk** are also associated with TBI in children.

Emotional symptoms after a sports-related mTBI can contribute to the **new psychiatric disorders, isolated suicidal ideation, and worsening symptoms of a pre-existing psychiatric disorder.**



Centers for Disease Control and Prevention. (2018). Report to Congress: The Management of Traumatic Brain Injury in Children, National Center for Injury Prevention and Control; Division of Unintentional Injury Prevention. Atlanta, GA.

Centers for Disease Control and Prevention. (2015). Report to Congress on Traumatic Brain Injury in the United States: Epidemiology and Rehabilitation. National Center for Injury Prevention and Control; Division of Unintentional Injury Prevention. Atlanta, GA.

Depression and Depressive Symptoms in Pediatric Traumatic Brain Injury: A Scoping Review.

- Studies have estimated the **rate of depression in children post-TBI between 33% and 50%**
- The relationship between TBI and depression has been more widely studied among adults. Little is known about the mechanisms responsible for the occurrence of depression in children after TBI.
- Depression in TBI may be a primary versus secondary outcome.
 - If a primary outcome, then depressive symptoms would be worse with severe TBI, however, the available research does not support a strong relationship in this regard. Depression might be a primary outcome following TBI in the early stages post injury but the long-term associations remain unclear.
- Might be due to interruptions of neural circuits or hormonal changes, or secondary to changes in the child's experiences or perceptions
- Studies that examined the **relationship of depression to other outcomes of TBI (eg, quality of life, school functioning) indicated that depression is predictive of other outcomes**, but the causal direction of these relationships was not addressed. Mostly likely, the effects are bidirectional.
- Factors such as age at injury and the family environment may interact with injury severity to predict depression.
- Existing literature suggests that depression is largely a secondary outcome of childhood TBI, although further research is needed before any definitive conclusion can be drawn.
- **“Directing research toward untangling the complexities of this issue can help guide treatments with the goal of producing better functional outcomes for children who sustain a TBI.”**

Thank You!



Children's
of Alabama

UAB MEDICINE
PEDIATRICS