CSN Children's Safety Network

Non-Fatal Traumatic Brain Injury-Related Visits to the Emergency Department, U.S. Infants, Children, and Adolescents Ages 0 Through 19

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EDC Education Development Center

TRAUMATIC BRAIN INJURY

A traumatic brain injury (TBI) can be mild, moderate or severe. It is defined as a disruption in the normal functioning of the brain due to a bump, blow, or jolt to the head or a penetrating head injury (Centers for Disease Control and Prevention, 2022). It is a major cause of morbidity and mortality in the U.S. that can have life-long financial, cognitive, and physical costs. TBI contributes to approximately 1 in 3 of all injury deaths in infants, children, and adolescents (Cheng, Li, Schwebel, Zhu, & Hu, 2020), and those who survive TBI often experience cognitive, emotional, and physical impairment, and adverse outcomes, such as difficulty with everyday memory, educational performance, and adaptive skills.

The Children's Safety Network (CSN) explored emergency department (ED) visits related to TBI among 0 through 19-year-olds by demographics, activity and object involved, and intent. This information can be used by states and jurisdictions to guide their TBI prevention efforts. Unless otherwise noted, all data in this fact sheet came from the analysis of 2016-2019 NEISS[1] and NEISS-AIP[2] data. An injury[3] was identified as a TBI if the body part was head, and the injury diagnosis was concussion, fracture, or internal organ injury.

Methodology

For this analysis, CSN used data from the National Electronic Injury Surveillance System–All Injury Program (NEISS-AIP) and augmented it with product codes from the National Electronic Injury Surveillance System (NEISS) for the years 2016 through 2019. NEISS, operated by the U.S. Consumer Product Safety Commission (CPSC), is a weighted national probability sample of consumer product-related injury visits to emergency departments in a sample of 100 U.S. hospitals. 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, NEISS-AIP, collects data on more than 500,000 ED injury visits per year, both intentional and unintentional.

TBI-RELATED ED VISITS IN INFANTS, CHILDREN, AND ADOLESCENTS

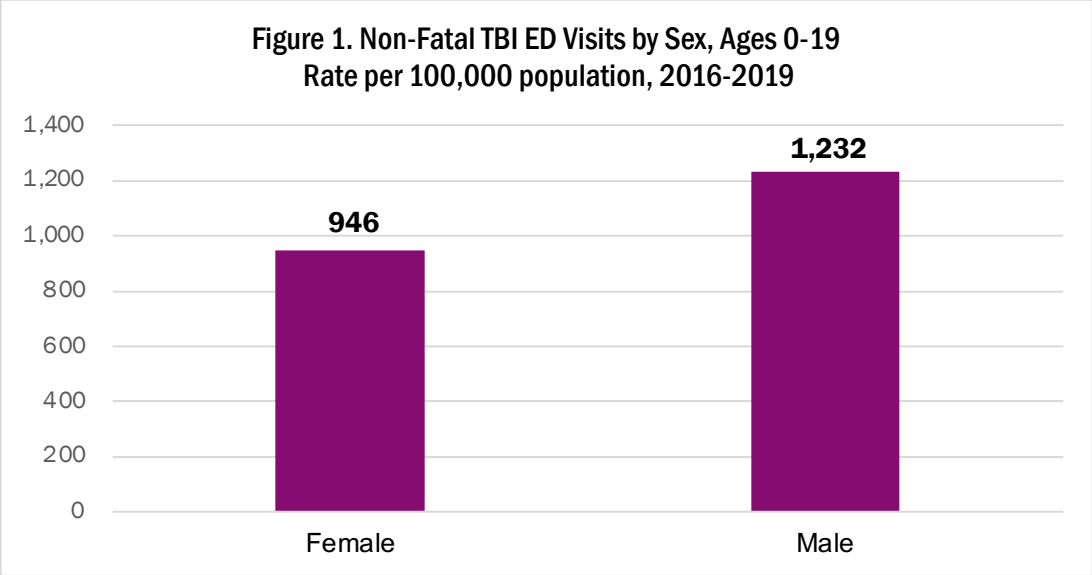
Between 2016 and 2019, approximately 3.6 million infants, children and adolescents visited the ED for treatment of a non-fatal TBI involving products under the purview of the CPSC. That is an average of 895,000 non-fatal TBI-related ED visits among 0 through 19-year-olds every year—a rate of 1,092 per 100,000 population.

1 NEISS data available to download from https://www.cpsc.gov/cgibin/NEISSQuery/home.aspx

2 NEISS-AIP data available to download from https://www.icpsr.umich.edu/web/NACJD/series/198

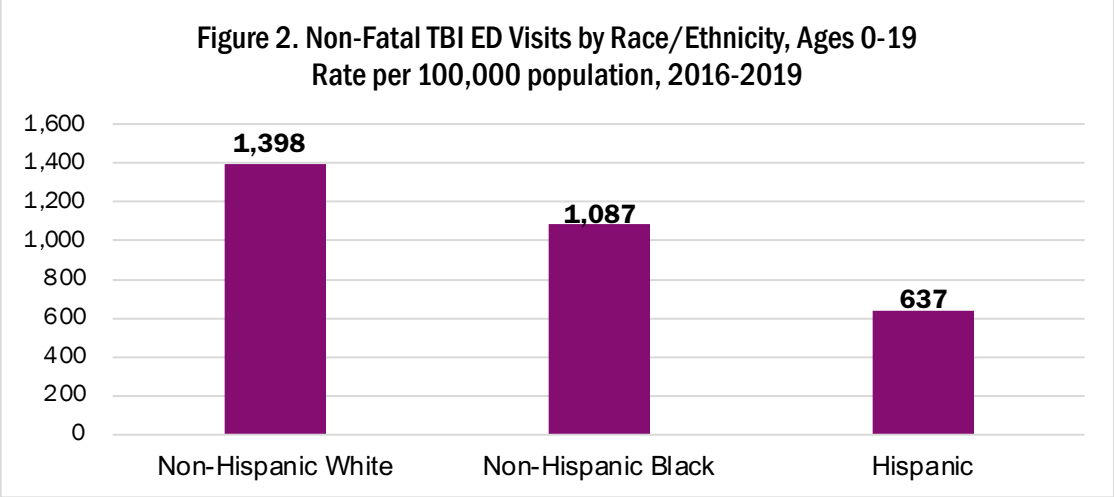
3 NEISS and NEISS-AIP data are based on ED surveillance data, but the system also has the flexibility to gather additional data at either the surveillance or the investigation level. Data are coded by an NEISS coordinator using guidelines provided in the NEISS Coding Manual. Most severe diagnosis associated with the consumer products/activities is coded in the system (www.cpsc.gov/Safety-Education/Safety-Guides/General-Information/National-Electronic-Injury-Surveillance-System-NEISS).

The rate of non-fatal TBI-related ED visits was higher for male (1,232 per 100,000) than female (946 per 100,000) infants, children, and adolescents, as shown in Figure 1.



Data Sources: 2016-2019 NEISS and NEISS-AIP

Non-Hispanic White had the highest rate of non-fatal TBI-related ED visits, followed by non-Hispanic Black and Hispanic infants, children, and adolescents (Figure 2).

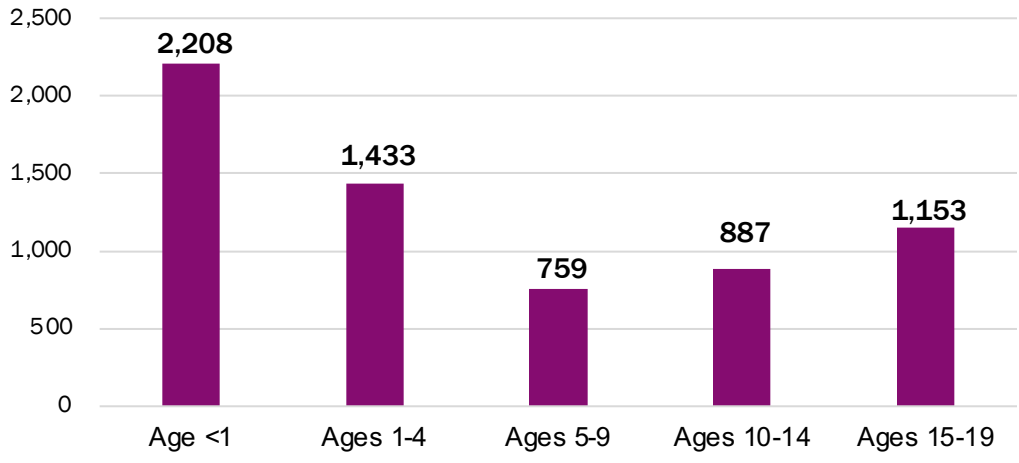


Note: Rate per 100,000 based on the racial distribution for the 71% of cases where race was reported.

Data Sources: 2016-2019 NEISS and NEISS-AIP

Infants under the age of 1 year had the highest rate of non-fatal TBI-related ED visits, followed by 1 through 4-year-olds, then 15 through 19-year-olds (Figure 3).

Figure 3. Non-Fatal TBI ED Visits by Age Group, Ages 0-19, Rate per 100,000 population, 2016-2019

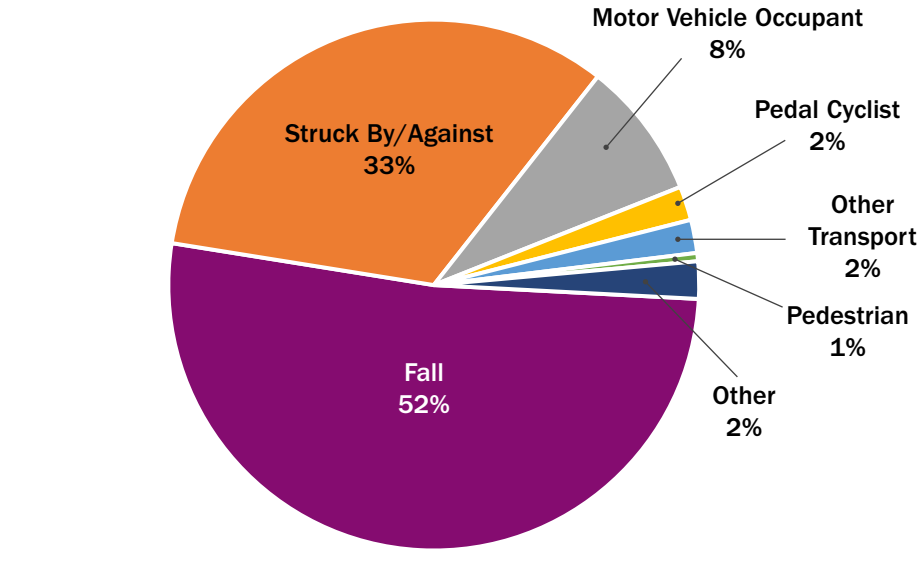


Data Sources: 2016-2019 NEISS and NEISS-AIP

THE CAUSES OF TBI-RELATED ED VISITS

Falls were by far the leading cause of non-fatal TBI-related ED visits among infants, children, and adolescents ages 0 through 19, representing 52% of all non-fatal TBIs seen in the ED. Being struck by or against something or someone was the second leading cause of non-fatal TBIs (33%). Motor vehicle occupant was the third leading cause (8%) of non-fatal TBIs, and pedal cyclist was the fourth leading cause of non-fatal TBIs (2%) (Figure 4)

Figure 4. Non-Fatal TBI ED Visits by Cause, Ages 0-19, 2016-2019



Data Sources: 2016-2019 NEISS and NEISS-AIP

ACTIVITIES AND OBJECTS INVOLVED IN TBI-RELATED ED VISITS

We identified the top 5 leading activities and objects associated with TBI-related ED visits in infants, children, and adolescents ages 0 through 19. Figure 5 shows the activities and objects associated with TBI shift from furniture and fixtures to sports, motor vehicle crashes, and assault as children grow and their behaviors change.

Figure 5. Five Leading Activities or Objects Involved in Non-Fatal TBI ED Visits by Age Group, Ages 0-19, 2016-2019

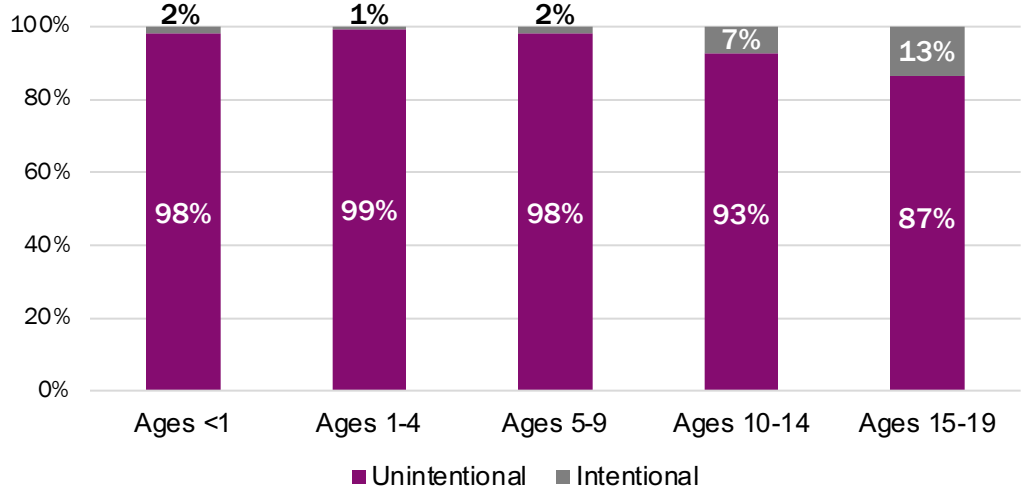
Ranking	Age <1 (n = 340,789)	Ages 1 to 4 (n = 913,704)	Ages 5 to 9 (n = 616,053)	Ages 10 to 14 (n = 737,527)	Ages 15 to 19 (n = 972,756)
1	Beds and bedding 30.5%	Beds and bedding 10.5%	Motor vehicle occupant 6.4%	Football 11.9%	Motor vehicle occupant 20.0%
2	Floors 12.2%	Floors 8.9%	Floors 6.0%	Basketball 7.4%	Assault-struck by/against 12.4%
3	Sofas 7.9%	Stairs 8.4%	Beds and bedding 5.0%	Assault-struck by/against 6.8%	Football 6.8%
4	Stairs 5.0%	Sofas 5.3%	Bicycles 3.8%	Motor vehicle occupant 5.7%	Basketball 4.7%
5	High chairs 3.1%	Tables 5.2%	Monkey bars 3.4%	Soccer 5.3%	Floors 3.9%

Data Sources: 2016-2019 NEISS and NEISS-AIP

INTENT TYPE ASSOCIATED WITH TBI-RELATED ED VISITS

Overall, 94% of non-fatal TBIs among infants, children, and adolescents ages 0 through 19 that were seen in the ED were unintentional.[4] The intentional[5] injuries (6%) were largely attributed to assault. Figure 6 shows the breakdown of unintentional and intentional TBIs by age group. The percentage of TBIs that were intentional was highest among 15 through 19-year-olds (13%).

Figure 6. Non-Fatal TBI ED Visits by Intent, Ages 0-19, 2016-2019



Data Sources: 2016-2019 NEISS and NEISS-AIP

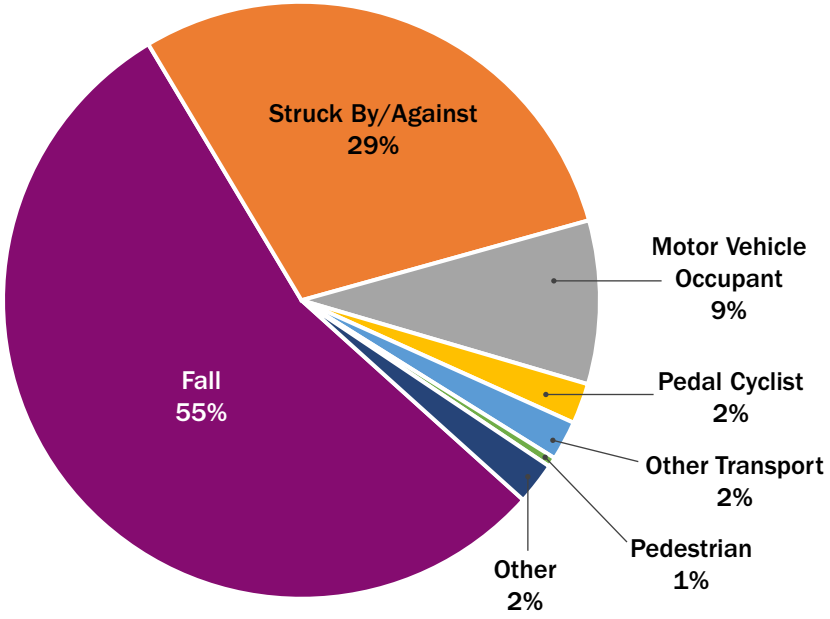
4 Unintentional injuries refer to injuries that are not inflicted by deliberate means (i.e., not on purpose).

5 Intentional injuries are broken into three main categories. (1) Assault: Injuries inflicted by one or more persons with the intent of causing harm, injury, or death to another person. (2) Self-Inflicted: Injuries resulting from a deliberate violent act inflicted on oneself with the intent to harm oneself or take one's own life. (3) Legal Intervention: Injuries inflicted by police or other legal authorities during law enforcement activities.

UNINTENTIONAL NON-FATAL TBI IN INFANTS, CHILDREN, AND ADOLESCENTS

Of the non-fatal unintentional TBIs sustained by infants, children, and adolescents ages 0 through 19 and seen in the ED (94% of all TBI-related ED visits in this population), the majority (55%) were the result of a fall. More than a quarter (29%) resulted from someone being struck by or against something or someone. And 9% occurred when the child or adolescent was the occupant of a motor vehicle (Figure 7).

Figure 7. Unintentional Non-Fatal TBI ED visits by Cause, Ages 0-19, 2016-2019



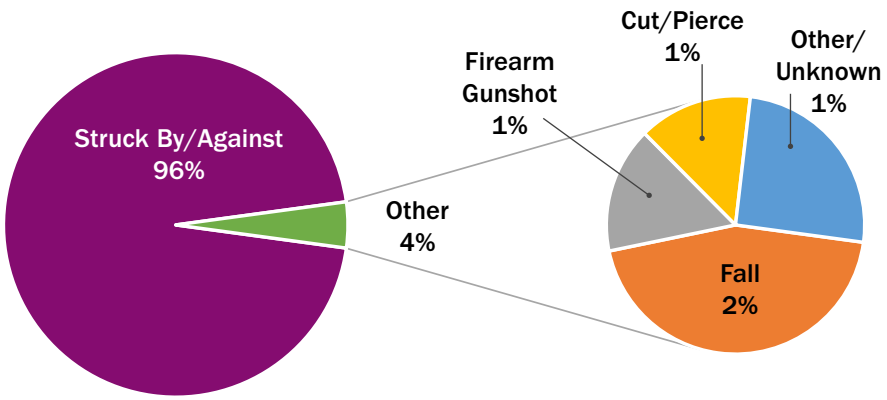
Data Sources: 2016-2019 NEISS and NEISS-AIP

INTENTIONAL NON-FATAL TBI-RELATED ED VISITS IN INFANTS, CHILDREN, AND ADOLESCENTS

Of the non-fatal intentional TBIs sustained by infants, children, and adolescents between the ages of 0 and 19 and seen in the ED (6% of all TBI-related ED visits in this population), the majority (96%) were the result of assault. Self-inflicted injuries (2%) and legal intervention (2%) accounted for the remainder of the non-fatal intentional TBIs.

Approximately 96% of the assaults leading to a TBI-related ED visit were the result of being struck by or against something or someone. The second leading mechanism of assault was falls, which represented only 2% of the assaults (Figure 8).

Figure 8. Assault-Related Non-Fatal TBI ED Visits by Mechanism, Ages 0-19, 2016-2019



Data Sources: 2016-2019 NEISS and NEISS-AIP

RECOMMENDATIONS FOR TBI PREVENTION

These recommendations are based on evidence-based and evidence-informed best practices (Centers for Disease Control and Prevention (2021) and American Academy of Pediatrics (2022).

- For infants and toddlers, caregiver education and home safety visits can help to reduce injuries. Education can focus on active supervision, not placing infants and young children on high surfaces, consistent and correct use of safety devices (e.g., stair guards, guard rails, window guards, bed rails, car seats, avoiding prefabricated stairs), and having home safety checklists.
- As children get older, playground and sports safety become important. Active supervision on the playground, enforcement of game and playground safety rules, and consistent use of protective equipment while playing sports, such as helmets, are important strategies.
- Also, as children get older and for adolescents, motor vehicle safety is necessary, including proper and consistent use of booster seats, seatbelt, and enforcement of graduated driver licensing laws.
- Older children and adolescents may also benefit from youth violence prevention programs and socio-emotional learning programs to promote resiliency and protection from risk-taking behavior and aggression.

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