Sports and Recreation-related Traumatic Brain Injuries among New Mexico Residents Aged 0 to 19 Years

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Office of Injury Prevention

Injury and Behavioral Epidemiology Bureau

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NEW MEXICO
DEPARTMENT OF
HEALTH

Traumatic Brain Injury (TBI) is caused by a blow to the head or a penetrating head injury that disrupts brain function. It can affect memory, judgment, sleep patterns, reflexes, speech, coordination, balance and behavior (personality changes, aggression, acting out, etc.). TBIs may range from mild to severe. Most cases of TBI are concussions or other types of mild TBI. [1]

Nationally, more than 7,100 children and adolescents ages 0-19 were treated in hospital emergency departments (EDs) for sports and recreation-related injuries each day in 2009, amounting to 2.6 million children a year. [2] Many more sports and recreation-related injuries are treated in doctor's offices and sports medicine clinics. Each year, an estimated 173,285 sports and recreation-related TBIs are treated in an ED.[2] These injuries include concussions. During the last decade, ED visits for sports and recreation-related TBIs among children and adolescents increased by 60%. [2]

According to the Centers for Disease Control and Prevention, children and teens are more likely to get a TBI, including concussion, and take longer to recover than adults. Deaths from participation in sports and recreation are uncommon.[3] However, children with nonfatal sports and recreation-related injuries may experience serious health consequences for the rest of their lives.

This report examines two years of emergency department visits for sports and recreation-related TBI during 2011-2012 and three years of hospitalizations for sports and recreation-related TBI during 2010-2012. Sports and recreation-related TBI included those injuries among children and adolescents aged 0 to 19 years that occurred during both organized and unorganized sport and recreation activities. Examples of recreation activities include bicycling, skate boarding, roller skating, and off-road vehicle use (See appendix for a complete list of sports and recreation activities).

Methods

The hospital inpatient discharge data (HIDD) for the years 2010-2012 and emergency department (ED) visit data for 2011-2012 were utilized. The HIDD and ED data do not include hospitalizations at the Veterans Administration and Indian Health Service hospitals in NM, and do not include hospitalizations and ED visits of NM residents that occurred at out-of-state hospitals. Both TBIs and their external causes were classified according to the International Classification of Disease Version 9 (ICD-9-CM). For this report, a case was defined as a New Mexico resident who was treated in an emergency department or hospitalized with a TBI and had an external cause of injury code designating a sports or recreation-related injury. The appendix contains the list of the ICD-9-CM diagnosis codes that were used to identify sports and recreation-related TBI hospitalizations for 2010-2012 and ED visits for 2011-2012. The number and rate of sports and recreation-related TBI injury hospitalizations and ED visits were calculated for this report. Data were stratified by age group, gender and external cause.

Executive Summary

This report examines sports and recreation-related emergency department visits for traumatic brain injuries (TBIs) during 2011 and 2012 and sports and recreation-related hospitalizations for TBIs during 2010-2012 among New Mexico residents 0 to 19 years of age.

Emergency Department Visits

- From 2011 through 2012, 1,579 sports and recreation-related TBI ED visits occurred among those aged 0 to 19 years.
- Over half (51%) of sports and recreation-related TBIs treated in EDs resulted from sports activities.
- The sports and recreation-related TBI ED visit rate was three times higher among persons aged 10-19 years than among younger persons.
- ED visits for sports and recreation–related TBI most commonly occurred due to falls from playground equipment among 0 to 4 year olds and most commonly occurred due to sports activities among those aged 5 to 19 years.
- Boys were two and one-half times more likely than girls to be treated in EDs for a sports and recreation-related TBI.

Hospitalizations

- From 2010 through 2012, 76 sports and recreation-related TBI hospitalizations occurred among 0 to 19 year olds.
- Pedal cycle-related TBIs (25%) accounted for the greatest number of sports and recreation-related TBI hospitalizations.
- Boys were three times more likely than girls to be hospitalized for a sports and recreation-related TBI.

Sports and Recreation-related Emergency Department Visits

There were 1,579 sports and recreation-related TBI ED visits among those aged 0 to 19 years during 2011-2012, accounting for 16% of all ED-treated TBIs in this age group (Table 1). Children and adolescents aged 10-17 years had the highest sports and recreation-related TBI ED visit rate and 85% of all sports and recreation-related TBI ED visits occurred among those aged 5-17 years. Boys accounted for 72% of the sports and recreation-related TBI ED visits and their rate was 2.4 times higher than the rate among girls. Sports activities accounted for 51% of the sports and recreation-related TBI ED visits (Figure 1). Sports and recreation were broken down into the following major categories: sports activities; pedal cycle; falls from playground equipment; roller skates, skateboards and non-motorized scooters; off-road vehicles; and animal riding. Minor categories included falls from skis and snowboards; falls from cliffs; off-road snow vehicles; and from diving/jumping into water/swimming pool. No TBI-related ED visits due to waterskiing, firearms (air gun, paintball), unpowered aircraft or ski chair lift/cable car occurred during 2011-2012 among those aged 0-19 years .

Figure 1. Sports and Recreation-related TBI ED Visit Rate among Children by Age and Sex, New Mexico, 2011-2012

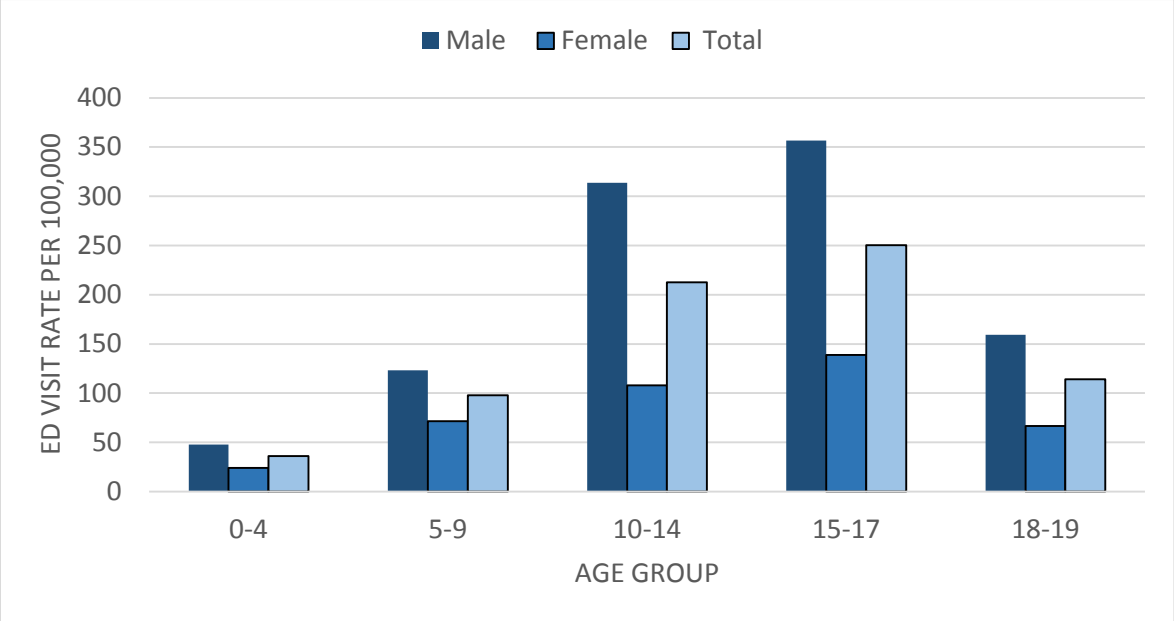
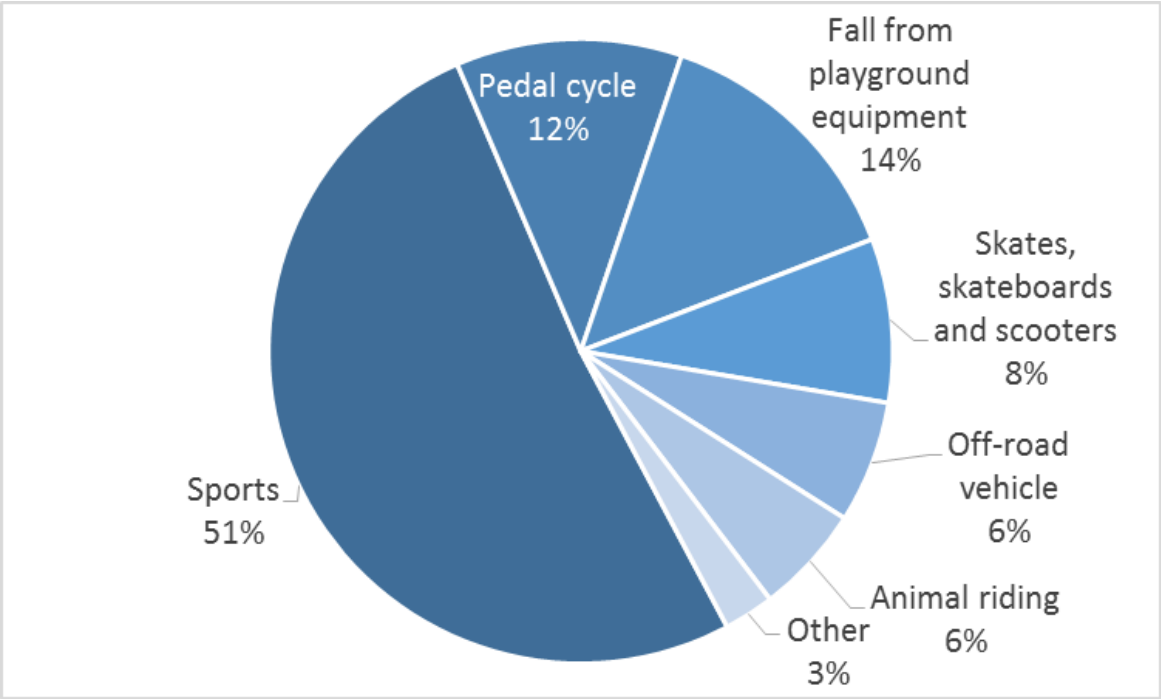


Table 1. ED Visit Numbers and Rates for Sports and Recreation-related TBIs among 0 to 19 Year Olds by Age Group and Sex, New Mexico, 2011-2012

	Male		Female		Total	
Age Group	Number	Rate/100.000	Number	Rate/100,000	Number	Rate/100,000
0-4	71	47.8	34	23.9	105	36.1
5-9	179	123.2	101	71.6	280	97.8
10-14	455	313.6	151	107.9	606	212.6
15-17	329	356.7	122	138.8	451	250.4
18-19	98	159.4	39	66.6	137	114.1
Total	1,132	191.0	447	78.5	1,579	135.9

Figure 2. ED visits for Sports and Recreation-related TBI among 0 to 19 Year Olds by Type of Activity, New Mexico, 2011-2012



ED Visits for TBIs caused by Sports Activities

Males accounted for 77% of sports-related injuries among those aged 0 to 19 years treated for a TBI in the ED. The male sports-related TBI injury ED visit rate was 3.3 times the female rate. The age groups with the highest sports-related TBI injury ED visit rate were those aged 15-17 years and 10-14 years. The rate of sports-related TBI injury ED visits among children and adolescents living in rural counties of NM was 10% higher compared to those living in urban counties.

Figure 3. Sports-related TBI ED Visit Rate by Age and Sex among 0 to 19 Year Olds, New Mexico, 2011-2012

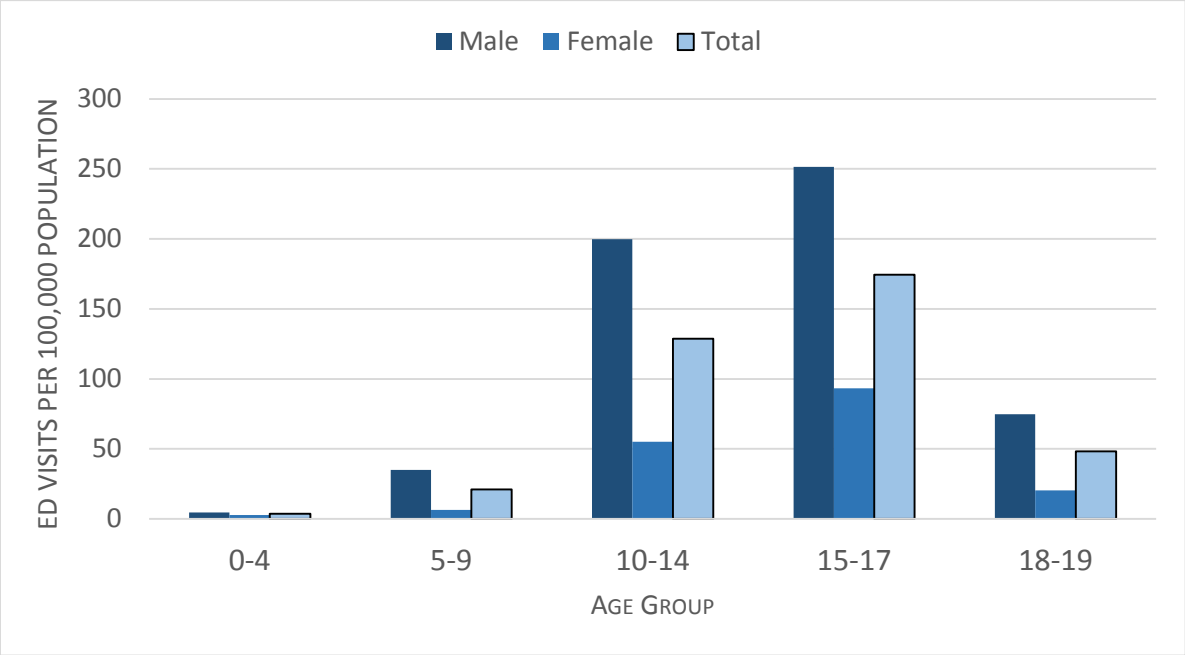


Table 2. ED Visit Numbers and Rates for Sports-related TBIs among 0 to 19 Year Olds by Age Group and Sex, New Mexico, 2011-2012

	Male		Female		Total	
Age Group	Number	Rate/100.000	Number	Rate/100,000	Number	Rate/100,000
0-4	7	4.7	4	2.8	11	3.8
5-9	51	35.1	9	6.4	60	21.0
10-14	290	199.9	77	55.0	367	128.8
15-17	232	251.5	82	93.3	314	174.3
18-19	46	74.8	12	20.5	58	48.3
Total	626	105.6	184	32.3	810	69.7

Note: Rates based on counts <20 might be unstable

Table 3. ED Visit Numbers and Rates for Sports-Related TBIs among 0 to 19 Year Olds by Area, New Mexico, 2011-2012

Area	Number	Rate/100,000
Urban	297	75.3
Rural	513	66.8
Total	810	69.7

ED Visits for Pedal Cycle-Related TBIs

Males accounted for 78% of pedal cycle-related injuries treated for a TBI in the ED. The male pedal cycle-related TBI injury ED visit rate was 3.4 times higher than the female rate. The age groups with the highest pedal cycle-related TBI injury ED visit rate were aged 10-14 years and 15-17 years. The rate of pedal cycle-related TBI injury ED visits among children and adolescents living in rural counties of NM was 10% higher compared to those living in urban counties. Most of the pedal cycle-related TBI injuries among children were non-traffic (96%), i.e., the injuries occurred off the public roadways.

Figure 4. Pedal Cycle-related TBI ED Visit Rate among 0 to 19 Year Olds by Age and Sex, New Mexico, 2011-2012

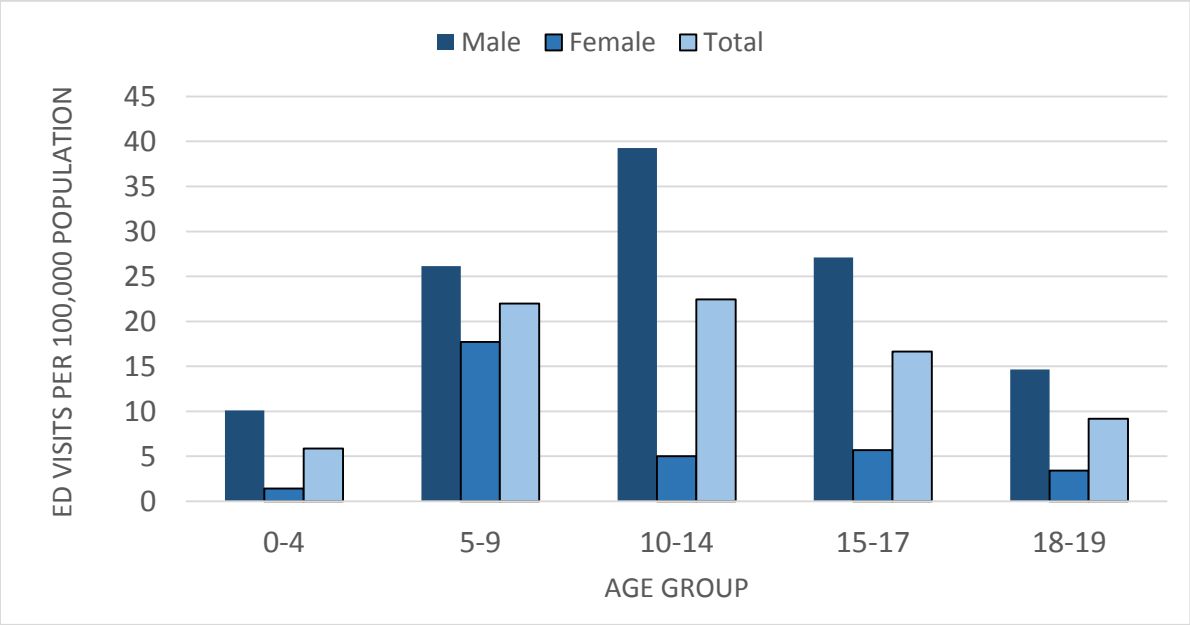


Table 4. ED Visit Numbers and Rates for Pedal Cycle-related TBIs among 0 to 19 Year Olds by Age Group and Sex, New Mexico, 2011-2012

	Male		Female		Total	
Age Group	Number	Rate/100,000	Number	Rate/100,000	Number	Rate/100,000
0-4	15	10.1	2	1.4	17	5.9
5-9	38	26.1	25	17.7	63	22.0
10-14	57	39.3	7	5.0	64	22.5
15-17	25	27.1	5	5.7	30	16.7
18-19	9	14.6	2	3.4	11	9.2
Total	144	24.3	41	7.2	185	15.9

Note: Rates based on counts <20 might be unstable

Table 5. ED Visit Numbers and Rates for Pedal Cycle-related TBIs among 0 to 19 Year Olds by Area, New Mexico, 2011-2012

Area	Number	Rate/100,000
Urban	60	15.2
Rural	125	16.3
Total	185	15.9

ED Visits for Fall from Playground Equipment-Related TBIs

Males accounted for 57% of falls from playground equipment-related injuries treated for a TBI in the ED. The male fall from playground equipment-related TBI injury ED visit rate was 30% higher than the female rate. The age groups with the highest fall from playground equipment-related TBI injury ED visit rate were aged 10-14 years and 5-9 years. The rate of fall from playground equipment-related TBI injury ED visits among children and adolescents living in rural counties of NM (18.8/100,000) was similar to the rate of those living in urban counties (19.0/100,000).

Figure 5. Fall from Playground Equipment-related TBI ED Visit Rate among 0 to 19 Year Olds by Age and Sex, New Mexico, 2011-2012

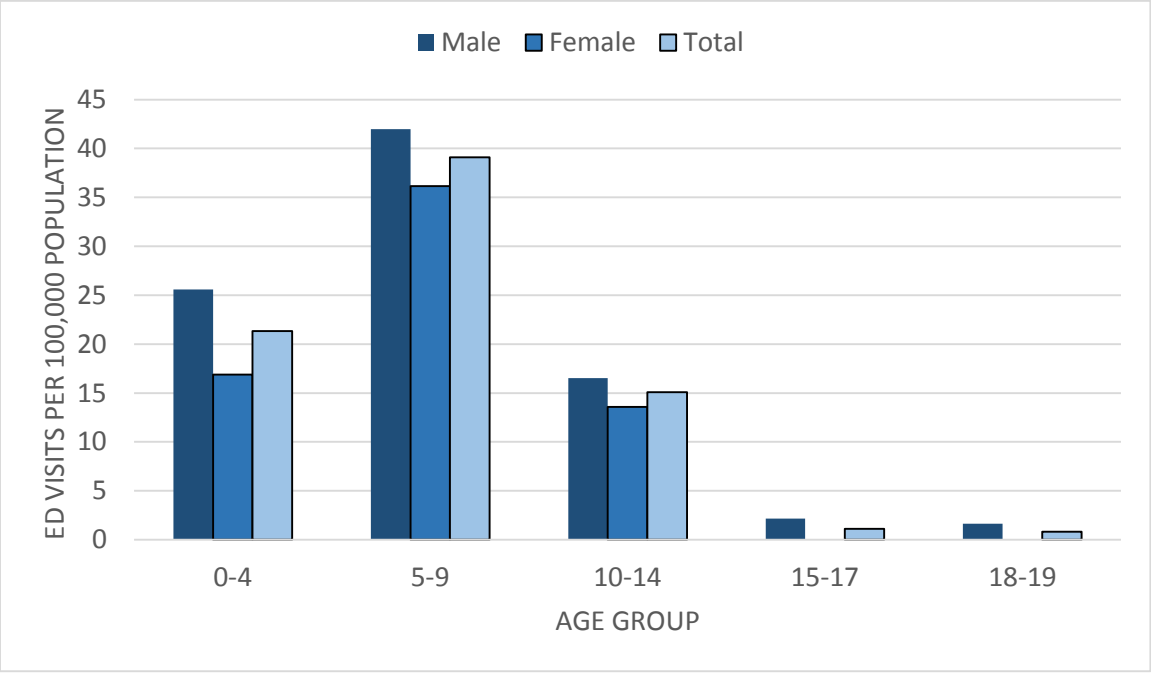


Table 6. ED Visit Numbers and Rates for Fall from Playground Equipment-related TBIs among 0 to 19 Year Olds by Age Group and Sex, New Mexico, 2011-2012

	Male		Female		Total	
Age Group	Number	Rate/100,000	Number	Rate/100,000	Number	Rate/100,000
0-4	38	25.6	24	16.9	62	21.3
5-9	61	42.0	51	36.2	112	39.1
10-14	24	16.5	19	13.6	43	15.1
15-17	2	2.2	0	0.0	2	1.1
18-19	1	1.6	0	0.0	1	0.8
Total	126	21.3	94	7.2	220	18.9

Note: Rates based on counts <20 might be unstable

Table 7. ED Visit Numbers and Rates for Fall from Playground Equipment-related TBIs among 0 to 19 Year Olds by Area, New Mexico, 2011-2012

Area	Number	Rate/100,000
Urban	74	18.8
Rural	146	19.0
Total	220	18.9

ED Visits for Roller Skates, Skateboards and non-Motorized Scooters-Related TBIs

Males accounted for 76% of skate/scooter-related injuries treated for a TBI in the ED. The male skate/scooter-related TBI injury ED visit rate was 3.1 times higher than the female rate. The age groups with the highest skate/scooter-related TBI injury ED visit rate were aged 15-17 years and 10-14 years. The rate of skate/scooter-related TBI injury ED visits among children and adolescents living in urban counties of NM was 1.5 times higher than that of those living in rural counties.

Figure 6. Skate, Skateboard and Scooter-related TBI ED Visit Rate among 0 to 19 Year Olds by Age and Sex, New Mexico, 2011-2012

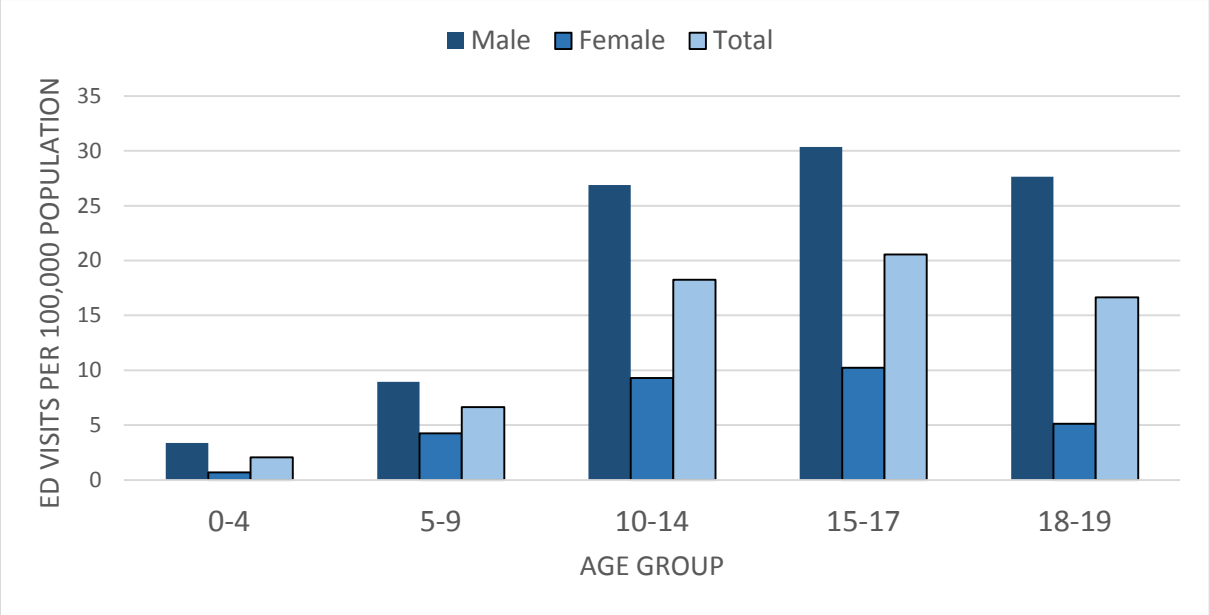


Table 8. ED Visit Numbers and Rates for Skate, Skateboard and Scooter-related TBIs among 0 to 19 Year Olds by Age Group and Sex, New Mexico, 2011-2012

	Male		Female		Total	
Age Group	Number	Rate/100,000	Number	Rate/100,000	Number	Rate/100,000
0-4	5	3.4	1	0.7	6	2.1
5-9	13	8.9	6	4.3	19	6.6
10-14	39	26.9	13	9.3	52	18.2
15-17	28	30.4	9	10.2	37	20.5
18-19	17	27.7	3	5.1	20	16.7
Total	102	17.2	32	5.6	134	11.5

Note: Rates based on counts <20 might be unstable

Table 9. ED Visit Numbers and Rates for Skate, Skateboard and Scooter-related TBIs among 0 to 19 Year Olds by Area, New Mexico, 2011-2012

Area	Number	Rate/100,000
Urban	35	8.9
Rural	99	12.9
Total	134	11.5

ED Visits for Off-road Vehicle-Related TBIs

Males accounted for 66% of off-road vehicle-related injuries treated for a TBI in the ED. The male off-road vehicle-related TBI injury ED visit rate was nearly two times higher than the female rate. The age groups with the highest off-road vehicle-related TBI injury ED visit rate were aged 15-17 years and 18-19 years. The rate of off-road vehicle-related TBI injury ED visits among children and adolescents living in rural counties of NM (13.7/100,000) was 2.3 times higher than the rate of those living in urban counties (6.0/100,000).

Figure 7. Off-Road Vehicle TBI ED Visit Rate among 0 to 19 Year Olds by Age and Sex, New Mexico, 2011-2012

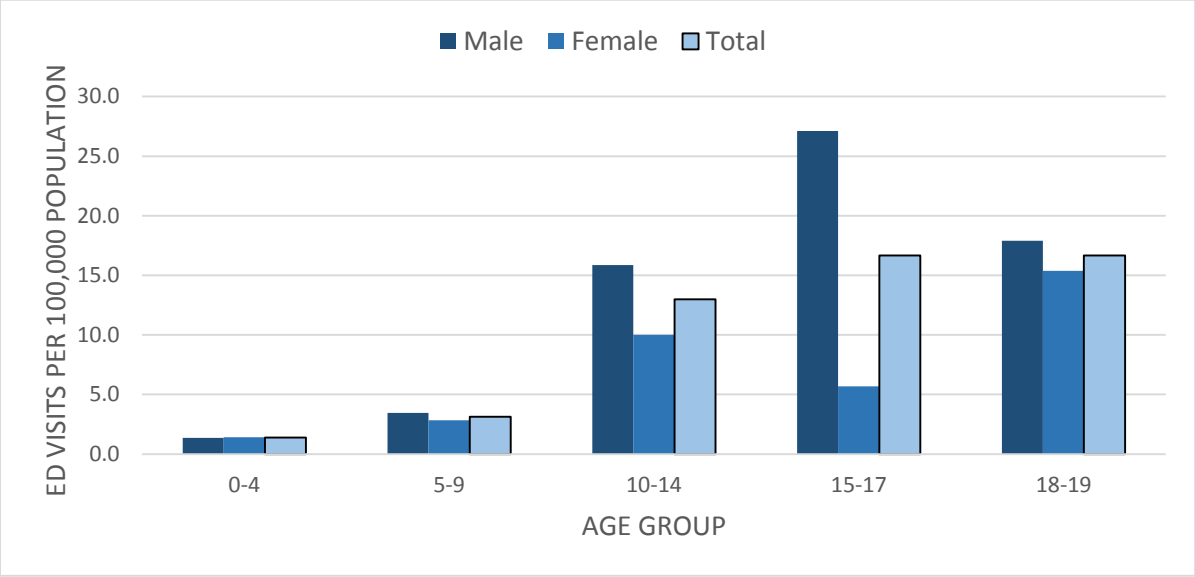


Table 10. ED Visit Numbers and Rates for Off-road Vehicle-related TBIs by Age Group and Sex among 0 to 19 Year Olds, New Mexico, 2011-2012

	Male		Female		Total	
Age Group	Number	Rate/100,000	Number	Rate/100,000	Number	Rate/100,000
0-4	2	1.3	2	1.4	4	1.4
5-9	5	3.4	4	2.8	9	3.1
10-14	23	15.9	14	10.0	37	13.0
15-17	25	27.1	5	5.7	3	16.7
18-19	11	17.9	9	15.4	20	16.7
Total	66	11.1	34	6.0	100	8.6

Note: Rates based on counts <20 might be unstable

Table 11. ED Visit Numbers and Rates for Off-road Vehicle-related TBIs among 0 to 19 Year Olds by Area, New Mexico, 2011-2012

Area	Number	Rate/100,000
Urban	54	13.7
Rural	46	6.0
Total	100	8.6

ED Visits for Animal Riding-Related TBIs

Females accounted for 53% of animal riding-related injuries treated for a TBI in the ED and their rate was 20% higher than the male rate. The age groups with the highest animal riding-related TBI injury ED visit rates were aged 18-19 years and 10-14 years. The rate of animal riding-related TBI injury ED visits among children and adolescents living in rural counties of NM was 2.6 times higher than for those living in urban counties.

Figure 8. Animal Riding-related TBI ED Visit Rate among 0 to 19 Year Olds by Age and Sex, New Mexico, 2011-2012

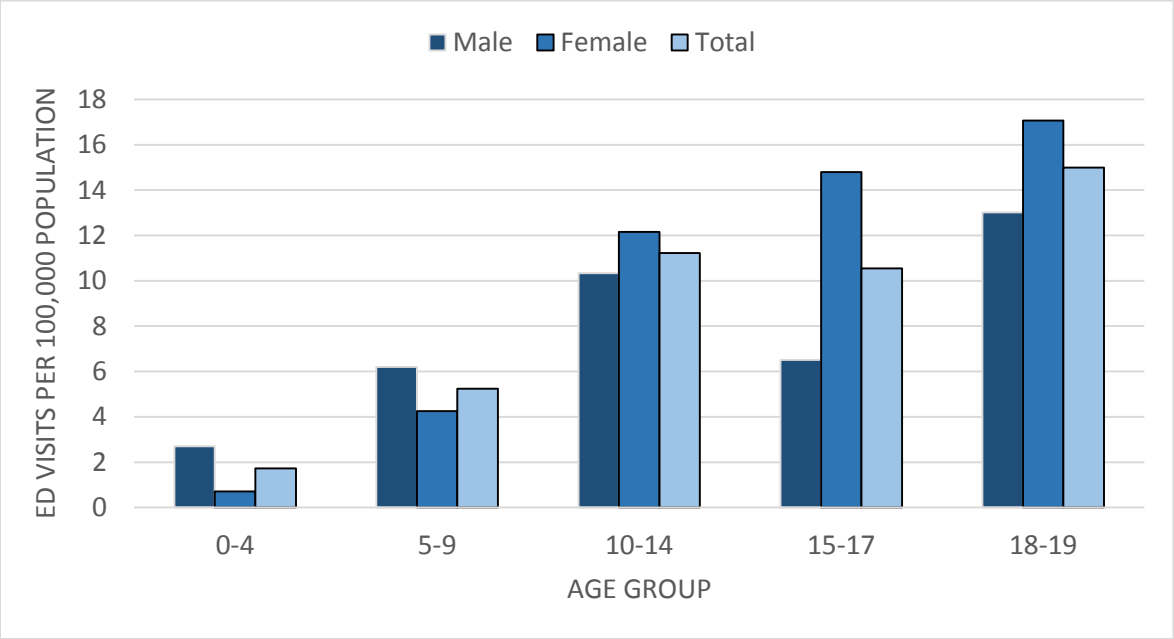


Table 12. ED Visit Numbers and Rates for Animal Riding-related TBIs among 0 to 19 Year Olds by Age Group and Sex, New Mexico, 2011-2012

	Male		Female		Total	
Age Group	Number	Rate/100,000	Number	Rate/100,000	Number	Rate/100,000
0-4	4	2.7	1	0.7	5	1.7
5-9	9	6.2	6	4.3	15	5.2
10-14	15	10.3	17	12.2	32	11.2
15-17	6	6.5	13	14.8	19	10.5
18-19	8	13.0	10	17.1	18	15.0
Total	42	7.1	47	8.3	89	7.7

Note: Rates based on counts <20 might be unstable

Table 13. ED Visit Numbers and Rates for Animal Riding-related TBIs among 0 to 19 Year Olds by Area, New Mexico, 2011-2012

Area	Number	Rate/100,000
Urban	47	11.9
Rural	42	4.5
Total	89	7.7

Other Recreation-related TBI ED Visits

During 2011-2012, 30 falls from ski or snowboard-related TBI ED visits occurred among those aged 10 to 19 years. The male falls from ski or snowboard-related TBI ED visit rate (3.2/100,000) was 1.7 times higher than the female rate (1.9/100,000).

Table 14. ED Visit Numbers and Rates for Fall from Ski or Snowboard-related TBI s among 0 to 19 Year Olds by Age Group and Sex, New Mexico, 2011-2012

	Male		Female		Total	
Age Group	Number	Rate/100,000	Number	Rate/100,000	Number	Rate/100,000
10-14	6		2		8	
15-17	7		6		13	
18-19	6		3		9	
Total	19	3.2	11	1.9	30	2.6

Note: Rates based on counts <20 might be unstable

During 2011-2012:

- 6 accidents from diving/jumping into water (swimming pool)-related TBI ED visits occurred among 5 to 17 year olds. Males accounted for 83% of the TBI-related ED visits treated for diving/jumping into water.
- 2 fall from cliff-related TBI ED visits occurred among 5 to 14 year olds. One of the injuries involved a male and the other involved a female.
- 2 off-road snow vehicle-related TBI ED visits occurred among 15-17 year olds. One of the injuries involved a male and the other involved a female.

- 1 boating-related TBI ED visit occurred among a 15 -17 year old male.

Sports and Recreation-related TBI hospitalizations

During 2010-2012, 76 sports and recreation-related TBI hospitalizations occurred among those aged 0 to 19 years, (Table 9) accounting for 14% of all hospitalization-related TBIs in this age group. The sports and recreation-related TBI hospitalization rate was 4.4/100,000. Males accounted for 76% of the sports and recreation-related TBI hospitalizations. The male sports and recreation-related TBI hospitalization rate (6.5/100,000) was three times higher than the female rate (2.1/100,000). The sports and recreation-related TBI hospitalization rate among those aged 10-17 years was 6.5/100,000, followed by those aged 18-19 years (5.6/100,000) and 0-9 years (2.4/100,000).

Table 15. Number of sports and recreation-related TBI hospitalizations among 0 to 19 Year Olds by age and sex, 2010-2012

Sports and Recreation	Ages 0-9	Ages 10-17	Ages 18-19	Male	Female
Animal riding	2	8	3	10	3
Fall from playground equipment	7	3	0	7	3
Off-road vehicle	3	11	2	10	6
Pedal cycle	7	10	2	15	4
Skates, skateboards, scooters	0	3	1	4	0
Sports	1	9	1	9	2
Other	1	1	1	3	0
Total	21	45	10	58	18

Prevention

People who engage in sports and recreation activities are at risk for TBI. Prevention strategies should be implemented to minimize TBI in sports and recreational activities.

Helmets help to protect the head and brain from injuries while playing sports and taking part in recreation activities. Helmet use is required for minors under age 18 in New Mexico when engaging in roller skating, skateboarding, scootering, biking and tricycling, as well as recommended, but not required for, skiing and snowboarding. It is mandatory for minors to wear helmets in New Mexico on every non-motorized vehicle, per the New Mexico Child Helmet Safety Act of 2007. It is also mandatory for minors to wear helmets in New Mexico on every motorized vehicle, unless it provides a seatbelt, including all-terrain vehicles, motorcycles, miniature motorcycles and snowmobiles, per amendments to existing law in 2006. Helmets also protect the head while playing contact sports such as football, baseball, soft ball,

field hockey, lacrosse and ice hockey. Helmets should be selected that are appropriate for the specific activity. The helmet should fit correctly, be well maintained and used correctly.

Besides wearing a helmet there are other prevention strategies to reduce the incidence of, and minimize the impact of, TBI while engaging in sports activities. During organized sports, coaches should teach sports-specific skills with an emphasis on safe practices and proper technique. Coaches should also emphasize adherence to rules of play with good sportsmanship.

Secondary prevention strategies are needed after a person experiences a TBI. Coaches and other adults who are supervising sports and recreation activities, as well as parents and teachers, should be aware of the signs and symptoms of TBI and respond quickly and appropriately to a suspected TBI. Participants suspected of having a TBI should be removed from the sports/recreation activity for a minimum of one day, and not allowed to return to play until after a complete evaluation and clearance by a health care provider who is experienced in diagnosing and managing TBI.

A New Mexico concussion law was also enacted in 2010 to establish safety protocols for head injury occurring during school athletic activity to be used by coaches. The law requires that a student athlete exhibiting signs of head injury must remain out of activity until at least the day after the athlete received a head injury, no longer exhibits signs, symptoms or behavior consistent with a head injury, and is cleared by a medical professional.

Limitations

Only children and adolescents who were treated and released in the hospital-based ED for sports and recreation-related TBI, or who were admitted to a hospital for sports and recreation-related TBI were included in the analysis. Many more children and adolescents are treated in doctor's offices, urgent care centers, athletic training settings and at home for sports and recreation-related TBI , or remain undiagnosed and untreated because they either did not display symptoms and/or failed to disclose non-overt symptoms to either adults overseeing the event or their parents. ED visits and hospital discharges from federal hospitals and hospitalizations and ED visits of NM residents that occurred at out-of-state hospitals were not included in the analysis.

During 2011-2012, about 95% of the ED-visits for a TBI were E-coded. During 2010-2012, 88% of the TBI-related hospitalizations were E-coded in 2010, 90% of the TBI-related hospitalizations were E-coded in 2011, and 93% of the TBI-related hospitalizations were E-coded in 2012. Incomplete E-coding most likely resulted in an underestimate of the number of sports and recreation-related TBI ED visits and hospitalizations.

A small proportion of some of the injury categories associated with recreation could be work-related instead of recreation-related, such as the off-road vehicle use and animal riding categories.

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2. Gilchrist J, Thomas KE, Xu L, McGuire LC, Coronado VG. Nonfatal sports and recreation related traumatic brain injuries among children and adolescents treated in emergency departments in the United States, 2001-2009. MMWR 2011: 60(39); 1337-1342.
3. Purvis JM, Burke RG. Recreational Injuries in Children: Incidence and Prevention. J Am Academy of Orthopedic Surgeons 2001; 9(6):365-374.

Appendix

ICD-9-CM codes used to define sports and recreation-related TBIs in ED visits and hospitalizations

ICD-9-CM Codes	Description of Injury
800-801	Fracture of the vault or base of the skull
803-804	Other and unqualified or multiple fractures of the skull
850	Concussion
851-854.19	Intracranial injury, including contusion, laceration and hemorrhage
950.1-950.3	Injury to the optic chiasm, optic pathways or visual cortex
959.01	Head injury, unspecified

ICD-9-CM external cause codes used to define sports and recreation-related TBIs in ED visits and hospitalizations

ICD-9-CM E-Codes	Description of Cause of Injury
810-819(.5), 822-825(.5), 826-629(.2)	Animal being ridden
830-838(.0, .1, .3, .5, .9)	Boating
883	Diving/jumping into water/swimming pool
910.2	Drowning in other sport/recreation
910.1	Drowning in sport/rec with diving equipment
884.1	Fall from cliff
884.0	Fall from playground equipment
886	Fall on same level in sports
820 (.0, .1, .5 - .9)	Off-road snow vehicle
821 (excluding .4)	Off-road vehicle, excluding snow
810-819(.6), 822-825(.6), 826-829(.1)	Pedal cycle
847	Ski chair lift/cable car
917(.0, .5)	Struck by or against object in sports
840-844(.6)	Unpowered aircraft
830-838(.4), 910(.0)	Waterskiing
922.4	Air gun
922.5	Paintball gun