Cycling Injuries Treated in Emergency Departments

Need for Bicycle Helmets Among Preschoolers

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Objectives: To describe the incidence, circumstances, and severity of bicycle-related injuries among children treated in US emergency departments (EDs) and to compare injuries in children aged 1 to 4 years (young children) with those in children and adolescents aged 5-9 and 10-14 years (intermediate-age and older children, respectively).

Design: Emergency department survey from the National Center for Health Statistics National Hospital Ambulatory Medical Care Survey for January 1, 1992, through December 31, 1997.

Patients: National probability sample of patients who sought care in EDs; data for children 1 to 14 years old were used.

Outcome Measures: Incidence and description of bicycle-related injuries among children grouped by age treated in US EDs.

Results: The 6-year weighted estimate of bicycle-associated injuries was 2,176,173. Young children had 270,098 ED visits; their average annual incidence was 45,016, a rate of 28.8 per 10,000 (95% confidence interval [CI], 19.1-38.5). Children in the intermediate-age and older groups had an incidence of 82.0 (95% CI, 66.6-97.4) and 86.4 (95% CI, 70.4-102.4) per 10,000, respectively. The highest rates of bicycle-related injuries were observed among boys in the intermediate-age group (108.3 per 10,000 per year) and older groups (123.8 per 10,000 per year). Few injured children were involved in collisions with motor vehicles (<1% of young and 4% of intermediate-age groups). The annual incidence of head trauma was 4.0 per 10,000 (95% CI, 0.4-7.5) for young children, 9.3 per 10,000 (95% CI, 4.3-14.2) for intermediate-age children, and 8.1 per 10,000 (95% CI, 3.5-12.8) for older children. Children aged 5 to 9 years had the highest rates of face trauma (estimated 29.8 per 10,000). The incidence of extremity fractures (range, 6.9-17.6 per 10,000) was similar for all groups.

Conclusions: Although boys in the intermediate-age and older groups have the highest incidence of bicycle-related injuries, young children are also commonly injured. The anatomic sites of injury among young cyclists (head and face trauma and extremity fractures) are similar to those observed in both other groups. Bicycle helmets are indicated for the youngest children as well.


INJURIES ASSOCIATED with bicycle riding are common among children. However, information about the national incidence and circumstances of injury requiring emergency department (ED) care is limited. Case series reports from the EDs of single institutions provide detailed injury information; they are not useful in determining incidence. Trauma registry data are not population based and are biased toward children with more severe injuries requiring admission to the hospital. National estimates of bicycle-related injuries among children treated in EDs have been limited to data collected by the US Consumer Product Safety Commission (CPSC) using the National Electronic Injury Surveillance System. Our purpose was to estimate the incidence, circumstances, and severity of bicycle-related injury among children treated in EDs during a 6-year period using a population-based stratified random sample of US EDs.

We were specifically interested in bicycle-related injuries among young cyclists. Reports that include preschool children usually do not provide specific information by age about the circumstances or types of injuries.1,3 We looked at motor vehicle involvement, the place of injury occurrence, the types of injuries, and hospital admission rates and compared children aged 1 to 4 years (young children) with children and young adolescents aged 5-9 and 10-14 years (intermediate-age and older children, respectively).

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SUBJECTS AND METHODS

Data were obtained from the ED component of the National Hospital Ambulatory Medical Care Survey (NHAMCS), a population-based stratified sample of US ED visits, from January 1, 1992, through December 31, 1997. This survey is directed by the Centers for Disease Control and Prevention National Center for Health Statistics (NCHS), and it has been conducted annually since 1992. The NHAMCS is a national probability sample of noninstitutional general and short-stay hospitals (n = 600), excluding federal, Veterans Affairs, and military hospitals. It uses a 4-stage probability sample; data collection occurs during a randomly assigned 4-week data period for each of the sampled hospitals. Data collection is performed by hospital staff. The data collection forms are sent to the NCHS, where a maximum of 3 external cause-of-injury (E-codes) and 3 diagnosis (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM]) codes are assigned.4-7

Data were obtained from the NCHS on CD-ROM by year for 1992-1995 and via the Internet for 1996-1997; data were combined for analysis using SPSS statistical software (SPSS Inc, Chicago, Ill). A bicycle-related injury was defined as any ED visit with an E-code of E810-819.(6) (motor vehicle traffic accidents involving a pedalcyclist [includes bicycle, tricycle, pedalcycle]), E800-807.(3) (railway accidents involving a pedalcyclist), E820-825.(6) (motor vehicle nontraffic accidents involving a pedalcyclist), E826.1 (pedalcycle accident involving a pedalcyclist), or E826.9 (pedalcycle accident involving an unspecified person) in any E-code field.8 To avoid inclusion of follow-up visits in incidence estimates, records from the 1992 data set were excluded if they were not designated as ‘injury, first visit.’ This excluded 3.9% of the bicycle-related injuries from the 1992 data. The data collection instruments for 1993-1997 did not include information about whether the visit was a first visit or a follow-up visit. Thus, all visits were considered to be first ED visits for care of an acute injury.

Case information analyzed included age, sex, place of injury, E-codes, need for intubation or cardiopulmonary resuscitation, and disposition (admitted to the hospital, transferred to another hospital, or discharged to home). Diagnosis codes were used to describe the type and identify the anatomic site of injury. We combined reported codes for ease of description. A head injury was defined as skull fracture (ICD-9-CM codes N800.0-N801.9 and N803.0-N804.9), intracranial injury (ICD-9-CM codes N850.0-N854.9), or cervical spine injury (ICD-9-CM codes N805.0-N805.1 and N806.0-N806.19). Additional information about the designation of type and site of injury is available from the authors by request. Information about place of injury was not collected for 1992; place of injury estimates (coded by NHAMCS as home, work, school or day care, street or highway, other specified, unspecified, and sport or recreation area [1995-1997 only]) were made using data from 1993-1997. There is no separate E-code for tricycle-related injuries; like bicycle-related injuries, they are assigned an E-code as pedalcycle injuries. Therefore, when we refer to bicycle-related injuries among young children, the reference likely includes tricycle- and bicycle-related injuries.

To calculate average annual national estimates, we combined data for the 4-year period. The NCHS suggests national estimates based on fewer than 30 cases in the sample data cannot reliably approximate the population estimate.9 Rates were computed by dividing incidence estimates by the appropriate population estimate. We used US population estimates for 1992-1997 for all calculations.10 The results are presented using weighted values to reflect annual national estimates. Relative SEs in percentages used for calculating 95% confidence intervals (CIs) for reported aggregate estimates and rates are based on a model suggested by the NCHS.9 Bicycle-related mortality data were also obtained from the NCHS for 1992-1997.10

RESULTS

There were 581 bicycle-related injuries to children and adolescents aged 1 to 14 years during the 6-year study period. Using the NHAMCS weightings, there were an estimated 2176173 bicycle-related injuries, an average annual incidence of 362696 (rate of 68.0 [95% CI, 59.1-76.9] per 10000 children). Injury incidence by age and sex is shown in Table 1. Boys in the intermediate-age and older groups had the highest rates of bicycle-related injury.

The circumstances of injury differed with age: a motor vehicle was involved in fewer than 5% of cases overall, and it was involved in fewer than 1% of cases among young children (Table 2). Most injured young children had falls around the home; however, the incidence of injury around the home was higher for intermediate-age children. Older children had a higher incidence of injury in the street than did intermediate-age children (47.2 vs 34.5 per 10000), but the CIs for these rates overlapped.

The pattern of anatomic injuries is shown in Table 3. The average annual incidence of head trauma among children in all groups was 7.3 per 10000. Head trauma occurred in 14% of injured children in the young group (4.0 per 10000). The head trauma rates were higher among the intermediate-age and older groups (9.3 and 8.1 per 10000, respectively). The incidence of extremity fracture was somewhat lower among young children; however, the CIs overlap those for children in the other age groups.

Measures of injury severity used by NHAMCS included need for cardiopulmonary resuscitation and need for intubation; no child required these interventions. There were no deaths in the ED. Overall, during the 6-year study period, an estimated 77 181 children (all age groups) were admitted to the hospital (2.4 per 10000 per year). This included 4.1% of young children (1.2 per 10000) who sought care in the ED for bicycle-related injuries, 4.2% of intermediate-age children (3.5 per 10000), and 2.7% of older children (2.4 per 10000).

We used US mortality data to compare bicycle-related fatalities, hospital admission rates, and ED use (Table 4). Among all age groups, there were an average of 252 cycling-related deaths per year (0.05 per 10000). For each death, there were an estimated 51 admissions to the hospital and 1437 ED visits. Young chil-
These NHAMCS data complement available information concerning the incidence of bicycle-related injuries among children treated in US EDs; information about nonfatal injuries is crucial, as fatal injuries are infrequent. The NHAMCS data also allow us to examine the circumstances and types of injuries among children treated in EDs. The data yield an annual incidence of bicycle-related injury among young children of 29 per 10 000. This is similar to US CPSC data for incidence for the same age group for 1990, 33 per 10 000. The incidence among both other groups is also similar to the age and sex information reported by US CPSC.11(p51-54)

Young children in this series were infrequently involved in collisions with motor vehicles. This is in contrast to the frequency of motor vehicle involvement among injured young children admitted to the hospital: collisions with motor vehicles accounted for 9% to 31% of injuries with motor vehicles, overall, collisions were an infrequent circumstance of injury. Most children in each age category were injured in falls. Fewer than a quarter of young children were injured in the street. These data in-
dicate that most young children are not injured in a traffic environment, but rather are injured at home.

Among intermediate-age children, the incidence of injury in the street was somewhat higher than that observed around the home. The street was the most common place of injury for older children. It is likely that these patterns concerning location of bicycle-related injury reflect exposure: young children are more likely to ride near home and on sidewalks or paths, while older children are more likely to be riding in the street. This has implications for the content of educational interventions; programs aimed at young children should focus on safety around the home as well as in the street.

The frequency of head trauma ranged from 9% to 14% among the age groups. Not surprisingly, the frequency of head trauma was much lower than previously reported for injured cyclists requiring admission to the hospital (45%-56%) or among those with fatal injuries (65%). Comparisons are difficult, as data concerning the incidence of head trauma among cyclists treated in the ED as well as among hospitalized cyclists are limited.

We report head trauma incidence in the range of 4.0 to 9.3 per 10,000 per year, with higher rates among intermediate-age children. Face trauma was also common in this group. Almost a fourth of injured young children had extremity fractures; the fracture incidence was somewhat higher among both other groups.

As head trauma occurs among young children treated in the ED for bicycle-related injuries, it is appropriate to direct head injury prevention messages to them. Although injuries to young children tend to occur in a nontraffic environment, this does not appear to be protective for head injury. Young children need head injury protection whenever and wherever they are cycling.

The data we report herein do not contain information about helmet use. Unfortunately, few school-age children or adolescents wear helmets. Although recent legislation and intensive education have improved helmet use rates in some specific geographic areas, we can assume most of the injured cyclists we described herein were not wearing helmets. Previous studies involving adolescents and adults have demonstrated that safety helmets greatly reduce the risk of head injury. The data also suggest that helmets reduce face trauma, common among injured children. It has been shown that classroom education can increase helmet use by elementary school children. Children younger than 5 years have not been targets of school or community-based education programs. Data from the NHAMCS, the US CPSC, and the National Pediatric Trauma Registry indicate that young children need head injury protection when cycling. Helmet use by young children would likely prevent most head injuries and might help form habits that would result in improved helmet use rates as these young cyclists grow older. Thus, injury prevention messages must be designed for children of all ages and their parents, and strategies are needed to increase helmet use by the youngest cyclists.

Although institutions use a standard reporting form, it is impossible to know the accuracy of information contributed by specific institutions to the NHAMCS. Although it is possible that we overestimated incidence for some years (those in which there was no field for “injury, first visit”), the data suggest that follow-up visits accounted for fewer than 5% of the cases. Undercounting was possible because of missing or inaccurate E-codes.

Because of sample size issues, subgroup analysis was limited. We were unable to calculate the age-specific incidence of motor vehicle involvement for the younger age groups. In addition, the sample size resulted in wide 95% CIs for many subgroup distributions. Because NHAMCS has no measures of exposure, and to facilitate comparison with other data, we have reported frequency and incidence information for specific age groups.

As E-codes do not distinguish bicycles from tricycles, the contribution of each to the data set is unknown. This is particularly relevant to a full understanding of injuries to cyclists aged 1 to 4 years. However, the incidence we report is similar to the CPSC ED estimates, which distinguish bicycle- from tricycle-related injuries. Also, we have no information about supervision of these young injured children. Nevertheless, the NHAMCS data provide incidence information about bicycle-related injuries in children, and ongoing analysis of these data will allow trends to be followed. These data indicate that bicycle helmets should be emphasized as a preventive measure for children of all ages.

CONCLUSIONS

Our description and comparison of bicycle-related injuries show that although the highest incidence of injury is in boys in the intermediate-age and older groups, injuries are common among young children. Injured young children frequently experienced head trauma, face trauma, and extremity fractures. Young children were more likely to be injured in falls in nontraffic locations around the home. Nonfatal injuries far outnumber fatalities, particularly among young children. Thus, health education materials can emphasize the large number of nonfatal cycling injuries rather than the much smaller number of deaths.

The data suggest that helmets are indicated for all children riding bicycles and probably for children riding tricycles. Education to promote helmet use must be designed for children of all ages and their parents. Further study is needed to evaluate the efficacy of helmets in preventing serious head injury in young cyclists and to determine if establishing the helmet habit at a young age will result in continued use during adolescence and adulthood.

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REFERENCES


Joint Theme Issue

Human Genomics and Genetics

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