ARTICLE

Injuries to the Head Among Children Enrolled in Special Education

Mary Ann P. Limbos, MD, MPH; Marizen Ramirez, MPH, PhD; Laura S. Park, MPH; Corinne Peek-Asa, MPH, PhD; Jess F. Kraus, PhD

Background: Injuries to the head comprise 20% to 39% of all school-related injuries. Head injuries among special education students have not been adequately described.

Objectives: (1) To examine the incidence and characteristics of head injuries in children enrolled in special education and (2) to determine the factors that increase the risk of sustaining a head injury compared with an injury to another part of the body.

Methods: Pupil Accident Reports for 6769 students enrolled in 17 of 18 special education schools in 1 large urban school district during the academic years 1994-1998 were reviewed, and information on the nature of injury, external cause, and activity was abstracted. Head-injured and nonhead-injured cases were identified and compared by race, sex, age, characteristics of injury, and disability category.

Results: Six hundred ninety-seven injury events were reported during the 4-year study period. The overall injury rate was 4.7 injuries per 100 student-years. Two hundred five children (29.4%) sustained injuries to the head, and the rate of head injury was 1.3 injuries per 100 student-years. Falls were the leading cause of injury. Head injuries were most commonly associated with physical education and unstructured play and usually occurred on the playground. Disproportionately more head than nonhead injuries were sustained in the classroom (12% vs 8%) and the bathroom (9% vs 3%). Compared with children with emotional/mental disabilities, children with multiple disabilities had the highest risk of a head injury (incidence density ratio, 2.4 [95% confidence interval, 1.6-3.5]), followed by children with physical disabilities (incidence density ratio, 1.8 [95% confidence interval, 1.1-3.1]). There appeared to be no significant difference in the rate of head injury by sex and age.

Conclusions: Modifications of the classroom, bathroom, and playground environments might reduce the risk of head injuries in children enrolled in special education. Special modifications and increased supervision may, in particular, reduce the risk of head injury for children with physical and multiple disabilities.

Arch Pediatr Adolesc Med. 2004;158:1057-1061

Author Affiliations: Division of General Pediatrics (Dr Limbos), Division of Children, Youth, and Families (Dr Ramirez), Childrens Hospital Los Angeles, and Southern California Injury Prevention Research Center, Department of Epidemiology, University of California Los Angeles School of Public Health (Drs Ramirez and Kraus and Ms Park), Los Angeles, Calif; and the Department of Occupational and Environmental Health, College of Public Health, University of Iowa, Iowa City (Dr Peek-Asa).

ALMOST 20% OF CHILDREN younger than 18 years have a chronic physical, developmental, behavioral, or emotional condition and require more than the usual level of health and related services.[1] Children with disabilities have higher injury rates than their peers without disabilities.[2] Approximately 6 million children with developmental and physical disabilities are enrolled in US public schools.[3] These children sustain 17% of all school-related injuries[4] but comprise only 2% of the student population.[3,5] Ramirez et al[6] reported an overall rate of 4.7 school-related injuries per 100 student-years among children in special education. Children with multiple and physical disabilities had a higher risk of injury compared with other disabled groups.

Injuries to the head comprise from 20% to 39% of all school-related injuries among the general population of school-aged children.[2,4,7] National Pediatric Trauma Registry data reveal that injuries to the head and spinal cord account for the most severe injuries that occur at school. Head injuries among special education students have not been adequately described. Ramirez et al[6] found that almost half of all injuries to children with disabilities were to the face and 16% to the head. In a day-care setting, Leland et al[8] found that children with disabilities sustain 74% of injuries to the head. Head injuries also accounted for 42% of injuries among children with disabilities in a hospital sample, most commonly in children with epilepsy and cerebral palsy.[9]

Because of the frequency of head injuries and their potential for severe injury,

©2004 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 02/08/2016

Table 1. Selected Characteristics of 697 Students With Head Injury and Nonhead Injury, 1994-1998 Academic Years*

Characteristic	Students With Head Injury	Students With Nonhead Injury
Disability		
Developmental	32 (15.6)	79 (16.1)
Emotional/mental	59 (28.8)	210 (42.7)
Physical	35 (17.1)	64 (13.0)
Multiple	60 (29.3)	111 (22.6)
Other	19 (9.3)	28 (5.7)
Sex		
Male	132 (64.4)	312 (63.4)
Female	73 (35.6)	180 (36.6)
Age, y		
3-4	41 (20.0)	47 (9.6)
5-9	73 (35.6)	134 (27.2)
10-14	31 (15.1)	135 (27.4)
15-23	60 (29.3)	176 (35.8)
Race/ethnicity		
African American	42 (20.5)	130 (26.4)
Asian	6 (2.9)	20 (4.1)
Hispanic	123 (60.0)	299 (60.8)
Native American	0	0
White	34 (16.6)	43 (8.7)
Total	**205**	**492**

*Values are expressed as number (percentage) of students. Percentages may not add to 100.0 because of rounding.

we compared injuries to the head with other injuries sustained by children enrolled in special education schools in 1 large school district. In the special education population in particular, head injuries may result in disproportionately disabling sequelae because of the potential difficulty in assessing the severity of the injury and possible interaction with preexisting medical and developmental conditions. Describing characteristics of head injuries sustained at school by children with disabilities will focus prevention strategies and assist health care professionals in prescribing special precautions. The objectives of our study were to examine the incidence and characteristics of head injuries in this unique population and to determine the factors that increase the risk of sustaining a head injury compared with another injury.

METHODS

STUDY POPULATION

Data for this analysis were obtained from a database on school-related injuries to children with disabilities in special education schools.[6] The study population included 6769 students from 17 of all 18 special education schools in the Los Angeles Unified School District in California evaluated during the 1994-1998 academic years. One school was excluded because it is a medical provider to homebound students with severe medical needs.

DATA COLLECTION, DEFINITIONS, AND VARIABLES

Data collection procedures are detailed elsewhere,[6] but we describe relevant methods here. An injury was defined as an event resulting in physical trauma to a student sustained during a school-sponsored activity. Categories of injury types were created based on text descriptions by school staff on injury reports. We identified 697 injuries from Pupil Accident Reports completed during the 1994-1998 academic years. Head-injury cases were defined as physical injury to the head and scalp, including the frontal area, because these regions overlay the brain and injury to these areas has the potential for associated intracerebral injury. Nonhead-injury cases had trauma to other regions of the body exclusive of the head, scalp, and frontal area. We linked head-injured and nonhead-injured cases to demographic and disability data from the school district's Information Technology Division. Annually, students with possible disabilities are evaluated for special education eligibility and classified using California Department of Education definitions.[10] Based on these, we created 5 broad categories of disability types: (1) developmental disability; (2) cognitive disability (autism, learning disability, mental retardation, and emotional disturbance); (3) physical disability (orthopedic, aphasia, blindness, deafness and blindness, hearing impairment, language/speech impairment, partial sight); (4) multiple disability; and (5) other disability (established medical disability, other health impairment, undetermined disability, and traumatic brain injury). Students with multiple disabilities have diagnosed disabilities in more than 1 category.

The external cause of injury was the first event in the chain of injury events. For example, if a child hit a pole and then fell, the external cause was a collision. Intentionality was not assigned because of the limited cognition of many students. Thus, bites, pushes, or kicks were labeled "injuries by other students."

The population at risk was measured using the district's yearly enrollment. Person-time was corrected for absenteeism by multiplying accrued person-time by 1 minus the average absentee rate for each school. Incidence was calculated per 100 student-years.

This study was approved by the institutional review boards of the University of California, Los Angeles, and the Los Angeles Unified School District.

ANALYSIS

All 6769 students were included in regression models that examined head injury risk by age, sex, and disability category. Other variables, such as activity at the time of injury, could not be included in models because stratum-specific student time was not available. We calculated rate ratios for head injury using generalized estimating equations to account for repeated subjects during the 4-year study period. A Poisson link function was used to adjust for varying time at risk. The deviance test was used to assess model fit. The final model did not include interactions because of unstable estimates.

Our head-injury case definition included 52 cases with injuries to the head and nonhead body regions. We conducted a sensitivity analysis excluding these 52 cases from our regression models and found no differences in estimates. Therefore, children who sustained both head and nonhead injuries were excluded. We purport that the causal pathway to head injury is similar among cases with trauma only to the head and cases with trauma to the head plus other body regions.

RESULTS

During the 4-year study period, 6769 enrolled students experienced 697 events resulting in a physical injury, for an overall injury rate of 4.7 per 100 student-years. The rate of head injury in this population was 1.3 per 100 student-years. **Table 1** presents the characteristics of students with head injury and nonhead injury. One hun-

©2004 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 02/08/2016

Table 2. Number of Students With Head Injury and Head Injury Rates by Selected Characteristics, 1994-1998 Academic Years

Characteristic	Students With Head Injury (n = 194): No. of Student-Years*	No. of Students	No. of Head Injuries per 100 Student-Years
Disability			
Developmental	3021	30	1.0
Emotional/mental	6510	58	0.9
Physical	1844	32	1.7
Multiple	2720	57	2.1
Other	756	17	2.2
Sex			
Male	8817	125	1.4
Female	6034	69	1.1
Age, y			
3-4	2212	39	1.8
5-9	4351	70	1.6
10-14	3636	30	0.8
15-23	4651	54	1.2
Race/ethnicity			
African American	2854	40	1.4
Asian	800	6	0.8
Hispanic	9216	117	1.3
Native American	31	0	0.0
White	1950	31	1.6
Total	**14 851**	**194**	1.3

*Adjusted for absenteeism.

Table 3. Number and Percentage of Injury Types Among 801 Students With Head and Nonhead Injuries, 1994-1998 Academic Years*

Injury Type	Head Injuries	Nonhead Injuries	χ^2_4	*P* Value
Abrasions	11 (5.8)	127 (20.8)	97.63	<.001
Bruises, pinches	87 (46.0)	129 (21.1)		
Cuts, lacerations, punctures	58 (30.7)	125 (20.4)		
Other	4 (2.1)	152 (24.8)		
Unknown	29 (15.3)	79 (12.9)		
Total	**189**	**612**		

*Values are expressed as number (percentage) of injuries unless otherwise indicated. Percentages may not add to 100.0 because of rounding.

dred nineteen head-injury cases (about 60%) had either emotional/mental (59 [28.8%]) or multiple (60 [29.3%]) disabilities. In contrast, 210 nonhead-injured cases (more than 40%) had emotional/mental disabilities. **Table 2** presents the characteristics of children with head injuries. The crude rate of head injury by disability was greatest for children with other types of disabilities (2.2 per 100 student-years) and multiple disabilities (2.1 per 100 student-years). Children with emotional/mental disabilities had the lowest rates (0.9 per 100 student-years). Boys had a slightly higher rate (1.4 per 100 student-years) of head injury compared with girls (1.1 per 100 student-years) (Table 2).The 697 injury events led to 888 distinct physical insults to the body. One body region was

Table 4. Number and Percentage of Primary External Cause, School Activity, and School Location Among Injured Students, 1994-1998 Academic Years*

Variable	Head Injuries	Nonhead Injuries	χ^2 (*df*)	*P* Value
Primary external cause			18.54 (4)	.001
Falls	90 (43.9)	149 (30.3)		
Injuries by other students	36 (17.6)	152 (30.9)		
Collision with/ caught between/ cut by object	32 (15.6)	65 (13.2)		
Other	34 (16.6)	95 (19.3)		
Unknown	13 (6.3)	31 (6.3)		
School activity			19.45 (7)	.007
Before/after school, passing period	7 (3.4)	31 (6.3)		
Physical education/recess	42 (20.5)	144 (29.3)		
Class lesson/activity	25 (12.2)	41 (8.3)		
Breakfast/nutrition/lunch	8 (3.9)	25 (5.1)		
Toileting	18 (8.8)	16 (3.3)		
Off-campus/transport/ bus-loading	11 (5.4)	28 (5.7)		
Other	4 (2.0)	5 (1.0)		
Unknown	90 (43.9)	202 (41.1)		
School location			15.26 (7)	.03
Playground, equipment	17 (8.3)	28 (5.7)		
Playground, not equipment	21 (10.2)	72 (14.6)		
Classroom	28 (13.7)	64 (13.0)		
Bathroom	19 (9.3)	18 (3.7)		
Bus, loading area	9 (4.4)	20 (4.1)		
Hallway/corridor	4 (2.0)	19 (3.9)		
Other	58 (28.3)	130 (26.4)		
Unknown	49 (23.9)	141 (28.7)		
Total	**205**	**492**		

*Values are expressed as number (percentage) of injuries unless otherwise specified. Percentages may not add to 100.0 because of rounding.

affected in 547 events and multiple regions in 150 events. The distributions of injury type (**Table 3**) and external cause, associated activity, and school location (**Table 4**) differed significantly between head-injured and nonhead-injured cases.

The final model was mutually adjusted for disability, sex, age, year in school, and school of attendance (**Table 5**). Residual analysis indicated adequate fit. Compared with children with emotional/mental disabilities, children with multiple disabilities had the highest rate of a head injury (incidence density ratio, 2.4 [95% confidence interval, 1.6-3.5]), followed by children with physical disabilities (incidence density ratio, 1.8 [95% confidence interval, 1.1-3.1]). There appeared to be no substantial difference in the rate of injury by sex (incidence density ratio, 1.2 [95% confidence interval, 0.9-1.7]) or age. Rate ratios for injury comparing younger to older children ranged from 1.2 to 0.6, with wide confidence intervals.

COMMENT

Head injuries were frequent injuries in this population of children in special education schools. The head injury rate in this special education population was similar to

©2004 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 02/08/2016

Table 5. Rate Ratios (Incidence Density Ratios) and Confidence Intervals (CIs) for Sustaining an Injury to the Head, 1994-1998 Academic Years*

Variable	Incidence Density Ratio (95% CI)
Disability	
Developmental	1.0 (0.6-1.6)
Physical	1.8 (1.1-3.1)
Multiple	2.4 (1.6-3.5)
Other	1.7 (0.9-3.1)
Emotional/mental	1.0
Sex	
Boys	1.2 (0.9-1.7)
Girls	1.0
Age, y	
3-4	1.2 (0.7-2.1)
5-9	1.1 (0.7-1.9)
10-14	0.6 (0.4-1.1)
15-23	1.0

*Rate ratios were determined by Poisson regression adjusted for disability, sex, age, year in school, and school attendance.

the rate for children without disabilities. We found few age and no sex differences in the head injury rate. Studies of school-related injuries in children without disabilities report that boys have 2 to 3 times the injury rate of girls the same age.[11] In contrast, Dunne et al[2] found no sex difference in injury rates among children with developmental disabilities. However, none of these studies specifically addressed head injuries in the special education setting.The use of existing records can lead to the potential for reporting bias. District policy requires reporting injuries during or related to school activities, however slight. Despite this policy, there may be underreporting or overreporting of injuries within each individual school. Generally, however, school administrators acknowledge that children with special needs are much more closely monitored and reporting may be higher than for students in regular education settings. Furthermore, reporting across special education schools is likely consistent.

We define injuries to the head as cases resulting in any physical trauma to the head, scalp, and frontal region overlaying the intracerebral contents. This definition was designed to describe the epidemiology of impacts to the head, which have the potential for more severe outcomes like traumatic brain injury. Ultimately, uncovering the pattern of mild head injury events is a basis for understanding how to prevent more severe traumatic head injury events. However, this is not a standard classification used among populations of children who are hospitalized or fatally injured, in whom it is more common to examine traumatic brain injury.

We were unable to examine more severe outcomes because severity was not described in these records that were completed at school following the event. Cases may have received additional evaluation by a physician. Detailed medical records were not available to us but could be an important linkage for future research. Data on school location and activity were missing in at least 28% of cases. No significant missing data patterns were found by disability or demographics, and thus, we suspect no substantial biases from missing data.

Despite these limitations, we found several risk factors that have implications for prevention. First, students with physical and multiple disabilities had a significantly higher risk of sustaining a head injury than students with different disabilities. Ramirez et al[6] also reported that students with multiple disabilities had the highest risk of injury, followed by students with physical disabilities. This difference in risk may be related to physical limitations such as impaired balance and ambulation and/or to differences in exposure. Students with orthopedic handicaps and sensorimotor deficits may be less able to negotiate the school environment and protect themselves from falls, the leading cause of head injury. Additionally, their normal cognition may allow them to explore the environment as children without disabilities would, thus exposing them to potential injury hazards. Students with emotional/mental disabilities had the lowest risk of head injury. These children, although having impaired cognitive and social functioning, had no physical disabilities, suggesting that physical limitations more so than cognitive limitations place children at risk for head injury.

Contrary to studies of injury in children without disabilities, this study did not find sex and age to be associated with risk of head injury, which is consistent with 2 studies of special needs children.[2,8] Dunne et al[2] theorized that this population may be overprotected by caretakers, leading to fewer exposures typically associated with sex in the able-bodied population. We propose the same overprotection effect also results in restricted activity regardless of age. Hence, the presence of an impairment may reduce sex-injury and age-injury relationships, which typically appear in the general education population.

Our findings suggest modifications of the classroom environment might reduce the risk of head injuries in children enrolled in special education. Classrooms for students with physical and multiple disabilities might include padding for furniture edges and for floor surfaces. We found, in particular, that injuries sustained in the bathroom and during toileting were more likely to be injuries to the head rather than to other parts of the body. Interventions that might be implemented in this setting include fall-resistant surfaces and grab handles, in addition to padding of toileting and changing areas. Helmets might also be considered for children with greater risk for head injury. Staffing could be structured to maximize supervision for students, activities, and locations associated with greatest risk.

School is an important part of cognitive and social development for all children. However, children enrolled in special education are at increased risk of injury at school, in particular, head injury. Classroom modifications and policies regarding safety and supervision practices may help reduce the incidence of head injuries in this population and allow students with even complex medical conditions to more fully participate in the school experience.

©2004 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 02/08/2016

What This Study Adds

Head injuries comprise a significant number of the injuries sustained by children in the school setting and account for the most severe injuries that occur at school. Few data exist about the risk, characteristics, and circumstances of injury to the head among children with disabilities enrolled in special education. This study provides new information about the incidence and characteristics of head injuries in a large population of children with physical and/or developmental disabilities in the special education setting and determines the factors that increase the risk of sustaining a head injury. The study results have implications for developing prevention strategies in the classroom and playground environments of this unique population of children.

Accepted for Publication: May 13, 2004.
Correspondence: Mary Ann P. Limbos, MD, MPH, Childrens Hospital Los Angeles, 4650 Sunset Blvd, MS 76, Los Angeles, CA 90027 (mlimbos@chla.usc.edu).

REFERENCES

1. Newachek PW, Strickland B, Shonkoff JP, et al. An epidemiologic profile of children with special health care needs. *Pediatrics*. 1998;102:117-121.
2. Dunne R, Asher K, Rivara F. Injuries in young people with developmental disabilities: comparative investigation from the 1988 National Health Interview Survey. *Ment Retard*. 1993;31:83-88.
3. Snyder T, Hoffman C. *Digest of Education Statistics, 2001*. Washington, DC: National Center for Education Statistics; 2002. Report NCES 2002130.
4. Di Scala C, Gallagher S, Schneps S. Causes and outcomes of pediatric injuries occurring at school. *J Sch Health*. 1997;67:384-389.
5. Aron L, Loprest P, Steuerle C. *Serving Children with Disabilities: A Systematic Look at the Programs*. Washington, DC: Urban Institute Press; 1996.
6. Ramirez M, Peek-Asa C, Kraus J. Child disability and risk of school-related injury. *Inj Prev*. 2004;10:21-26.
7. Gibson H, Klassen TP. How safe are our schools? *Can J Public Health*. 1996;87:106-108.
8. Leland N, Gerrard J, Smith D. Comparison of injuries to children with and without disabilities in a day-care center. *J Dev Behav Pediatr*. 1994;15:402-408.
9. Berggreen S. Accidents and surgical emergencies in a population of mentally retarded children. *Acta Paediatr Scand*. 1973;62:289-296.
10. *California Special Education Programs: A Composite of Laws*. Sacramento: California Dept of Education, Special Education Division; 1998.
11. *Injuries in the School Environment: A Resource Guide (2nd ed)*. Newton, Mass: Children's Safety Network at Education Development Center Inc; 1997.

ANNOUNCEMENT

2005 Certifying Examinations of the American Board of Pediatrics, 111 Silver Cedar Court, Chapel Hill, NC 27514-1513; (919) 929-0461; fax (919) 918-7114 or 919-929-9255; www.abp.org

First-time applicants using training to qualify for most certifying examinations may complete applications online during the registration periods for new applicants. The final month of each registration requires payment of a late fee. The requirements for online applications may be found on the ABP Web site: (www.abp.org) or may be obtained by contacting the ABP. Additional information including eligibility requirements and registration dates may also be found on the ABP Web site.

GENERAL PEDIATRICS EXAMINATION

Examination Date: October 31 and November 1, 2005. Registration for first-time applicants: December 1, 2004, through May 2, 2005. Registration for re-registrants: February 15, 2005, through May 31, 2005.

SUBSPECIALTY EXAMINATIONS

Neurodevelopmental Disabilities (online registration is not available for this examination): Examination Dates: April 4-8, 2005. Registration for first-time applicants: July 1, 2004, through September 30, 2004. Registration for re-registrants: September 1, 2004, through December 1, 2004.

Sports Medicine: Examination Dates: To be determined by ABFP. Registration for first-time applicants: September 15, 2004, through December 15, 2004. Registration for re-registrants: December 16, 2004, through March 15, 2005.

Pediatric Endocrinology: Examination Date: August 18, 2005.

Pediatric Gastroenterology: Examination Date: August 17, 2005.

Pediatric Infectious Diseases: Examination Date: August 19, 2005 Registration for first-time applicants: September 15, 2004, through December 15, 2004. Registration for re-registrants: December 16, 2004, through March 15, 2005.

Adolescent Medicine: Examination Date: December 1, 2005.

Pediatric Nephrology: Examination Date: November 29, 2005.

Neonatal-Perinatal Medicine: Examination Date: November 30, 2005. Registration for first-time applicants: February 1, 2005, through May 2, 2005. Registration for re-registrants: March 14, 2005, through June 16, 2005.

©2004 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 02/08/2016