Traumatic Brain Injuries Evaluated in U.S. Emergency Departments, 1992–1994

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Abstract. **Objective:** To describe the incidence and patient characteristics of traumatic brain injuries (TBIs) treated in U.S. emergency departments (EDs). **Methods:** A secondary analysis was performed on data from the National Hospital Ambulatory Medical Care Survey administered from 1992 to 1994. An ED visit was determined to represent a case of TBI if the case record contained ICD-9-CM codes of 800.0–801.9, 803.0–804.9, or 850.0–854.1. **Results:** The average annual estimate of new TBI treated in U.S. EDs was 1,144,807, equaling 444 per 100,000 persons (95% CI = 390 to 498), which represents approximately 3,136 new cases of TBI per day and accounts for 1.3% of all ED visits. Males were 1.6 times as likely as females to suffer TBI until the age of 65 years, when the female rate exceeded the male. The rate for blacks was 35% higher than that for whites. The highest overall incidence rate of TBI occurred in the less-than-5-year age group (1,091 per 100,000), closely followed by the more-than-85-year age group (1,026 per 100,000). Falls represented the most common mechanism of TBI injury, followed by motor vehicle-related trauma. **Conclusions:** This study underscores the ongoing need for effective surveillance of all types of TBI and evaluation of prevention strategies targeting high-risk individuals. It serves as a clinically grounded and ED-based corroboration of prior survey research, providing a basis for comparison of incidence rates over time and a tool with which to measure the efficacy of future interventions. **Key words:** traumatic brain injury; incidence; emergency department. ACADEMIC EMERGENCY MEDICINE 2000; 7:134–140

TRAUMATIC brain injury (TBI) is a significant source of morbidity and mortality in the United States, accounting for approximately one-third of injury-related deaths.[1] The magnitude of TBI mandates a thorough understanding of the epidemiology of these injuries, in order to elucidate risk factors for TBI and design appropriately targeted prevention programs.

Data on TBI-related mortality are readily available.[2] Estimates of the incidence of nonfatal TBI have been reported through population surveys, medical record reviews, and hospital and trauma registries. Though methodologies and case definitions vary considerably, hospital admission studies conducted in the 1970s and 1980s revealed an overall incidence rate of approximately 200 per 100,000. Sixteen studies reviewed by Kraus showed that the rate varied from 152 to 376 per 100,000.[3]

Few studies have specifically analyzed the presentation of TBI to emergency departments (EDs). Most have relied on hospital admission data,[4] although one study conducted in Minnesota included ED visits and outpatient examinations involving residents in a single county.[5] Diamond reviewed data from the Virginia Brain Injury Central Registry for 1988–1993, which included ED visits, and found the incidence highest for children less than 6 (237 per 100,000) and lowest for ages 40–69 (56 per 100,000).[6]

Sosin et al. performed an analysis of the 1991 National Health Interview Survey (NHIS) (a nationally representative random household survey), and used the Injury Supplement data to characterize the national incidence of mild and moderate TBI. The principal outcome measure was a report of head injury resulting in a loss of consciousness within the previous 12 months. Their results revealed an annual brain-injury rate of 618 per 100,000 persons, of which 25% did not receive medical care, 14% were treated on an outpatient basis, 35% were treated and released from EDs, and 25% were admitted to a hospital. Medically attended brain injuries were found to involve 1.16 million civilians, corresponding to an annual rate of 465

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per 100,000 persons. Cases of TBI in which patients were treated in EDs or admitted to hospitals numbered 935,000, for a rate of 376 per 100,000 persons.[7]

To our knowledge, no other nationally representative population-based study of TBI incidence among patients presenting to EDs has been published. The purpose of the current study, therefore, is to quantify the incidence and describe the characteristics of patients who experience TBI and are seen in EDs using a national database.

METHODS

Study Design. We conducted a secondary analysis of the ED component of the 1992–1994 National Hospital Ambulatory Medical Care Survey (NHAMCS). The original intent of the NHAMCS was to provide national estimates of the care provided in hospital EDs and outpatient departments. Our goal was to describe the incidence, demographics, and characteristics of patients diagnosed as having TBI who present to U.S. EDs. The study was approved by the Institutional Review Board of Allegheny University of the Health Sciences.

Data Source. As detailed elsewhere,[8–11] the NHAMCS is a national probability survey of visits to emergency and outpatient departments of noninstitutional, general and short-stay hospitals (excluding federal, military, and Veterans Affairs hospitals) located within the 50 states (and the District of Columbia). The NHAMCS is administered by the Division of Health Care Statistics, Centers for Disease Control and Prevention (CDC). It uses a four-stage probability design that includes geographic primary sampling units (PSUs), hospitals within PSUs, EDs within hospitals, and patients within EDs. The first-stage sample consisted of 112 PSUs comprising a probability subsample of the 1,900 geographically defined PSUs used in the 1985–1994 National Ambulatory Medical Care Survey (NAMCS). The PSUs used in the NHAMCS were then selected with a probability proportional to their size. The intent of this complex sampling design was to establish the generated data as representative of the U.S. population.

In the recruitment and orientation phase of the survey, the National Center for Health Statistics (NCHS) employed experienced interviewers specially prepared for recruiting hospitals and training hospital personnel in survey-specific data collection procedures. Data collection occurred over a randomly assigned four-week period for each hospital and was the responsibility of the hospital staff. A separate data collection form was filled out at or near the time of the visit. A total of 91,935 patient forms were processed for 1992–1994. Once completed, the forms were sent to the NCHS, where ICD-9-CM diagnosis codes and E-codes (external cause) were assigned using the data collection form—not the original medical record. Coding from the data collection forms was done centrally by experienced NCHS nosologists. Quality assurance procedures included a 10% sample of independently processed survey records to ascertain coding quality. Coding error rates are reported in the NHAMCS as no more than 2% for the different fields.[12] The combined 1992–1994 data set represents approximately 274 million ED visits (close to 91 million visits per year). Each visit was assigned a statistical weight in order to generate annual national estimates for the three-year period.

Definition and Case Selection. In accordance with the CDC surveillance guidelines for TBI,[13] an ED visit was classified as a case of TBI if it contained one of the following ICD-9-CM codes within the primary, secondary, or tertiary diagnosis fields: 800.0–801.9, "fracture of the vault or base of the skull"; 803.0–804.9, "other and unqualified and multiple fractures of the skull"; or 850.0–854.1, "intracranial injury, including concussion, contusion, laceration, and hemorrhage." More than 92% of the cases were identified from the primary diagnosis field. Although "injury, first visit" and "injury, follow-up" data items were included in the 1992 data collection forms, these variables were not present in the 1993 and 1994 data forms. Given that only 4.5% of ED visits for TBI were listed as "injury, follow-up" visits in the 1992 data set, it was not deemed necessary to adjust data from subsequent years to avoid double counting of follow-up visits to determine incidence. Out-of-hospital deaths and injuries treated in non-ED outpatient settings were excluded from this data set. Estimates of payments for TBI-related ED visits were determined using a payment model based on the average reimbursement of a non-NCHS/NHAMCS sample of actual ED visits for the same ICD-9- coded injuries. This model did not include follow-up visits, inpatient care, or non-ED-related charges.

Data Analysis. Data were obtained from the NCHS on diskette in ASCII format and analyzed using SPSS software (SPSS Inc., Chicago, IL). Information from all three years was combined and averaged to provide mean annual estimates of national ED visits. The entire database was searched using the ICD-9-CM codes defining TBI, 1,141 of which met the case definition. Rates were calculated using mid-year 1993 population figures from the U.S. Census Bureau. Confidence intervals were calculated using approximate relative standard errors as percentages (based on recommen-

TABLE 1. Traumatic Brain Injury Incidence by Patient and Injury Characteristics

Characteristic	Estimated Number of Cases (95% CI)		Estimated Rate per 100,000 Persons (95% CI)	
All	1,144,807	(1,004,902, 1,284,711)	444	(390, 498)
Race				
White	921,580	(801,131, 1,042,029)	429	(373, 485)
African American	187,167	(141,209, 233,125)	582	(439, 725)
Nonblack, nonwhite	36,059	(16,724, 55,395)	333	(155, 512)
Gender				
Male	701,060	(600,571, 801,549)	557	(477, 637)
Female	443,747	(368,257, 519,237)	336	(279, 393)
Age				
0 to 4 yr	214,833	(165,230, 264,436)	1,091	(839, 1,343)
5 to 14 yr	211,617	(162,428, 260,805)	571	(438, 704)
15 to 24 yr	230,422	(178,839, 282,004)	639	(496, 782)
25 to 34 yr	151,200	(110,294, 192,105)	361	(263, 459)
35 to 44 yr	136,576	(97,855, 175,297)	335	(240, 430)
45 to 54 yr	51,739	(28,472, 75,005)	181	(99, 262)
55 to 64 yr	34,539	(15,624, 53,454)	165	(75, 255)
65 to 74 yr	43,392	(22,136, 64,648)	233	(119, 347)
75 to 84 yr	35,453	(16,284, 54,621)	331	(152, 509)
85+ yr	35,037	(15,984, 54,091)	1,026	(468, 1,584)
Total	1,144,807	(1,004,902, 1,284,711)	444	(390, 498)
Time of week				
Weekend	387,394	(317,806, 456,982)	150	(123, 177)
Weekday	757,413	(651,730, 863,096)	294	(253, 335)
Place of injury				
Home	261,590	(206,181, 317,000)	101	(80, 123)
Work	47,010	(24,863, 69,158)	18	(10, 27)
School–day care	46,416	(24,413, 68,420)	18	(9, 27)
Street–highway	226,620	(175,516, 277,724)	88	(68, 108)
Other	108,526	(74,278, 142,774)	42	(29, 55)
Unspecified and missing	454,644	(378,036, 531,252)	176	(147, 206)
Mechanism				
Falls	412,107	(339,904, 484,310)	160	(132, 188)
Motor vehicle trauma	246,004	(92,488, 299,520)	95	(75, 116)
Pedestrian/bicyclist	65,257	(39,024, 91,489)	25	(15, 35)
Struck	243,377	(190,184, 296,571)	94	(74, 115)
Other	92,505	(61,028, 123,981)	36	(24, 48)
Diagnosis (ICD-9 codes)				
All skull fractures (800, 801, 803)	41,112	(20,436, 61,788)	16	(8, 24)
Concussion (850)	155,642	(114,089, 197,195)	60	(44, 76)
Intracranial injury without concussion (851–853)	28,169	(11,119, 45,219)	11	(4, 18)
Intracranial injury, other and unspecified (854)	621,165	(528,180, 714,149)	241	(205, 277)
All other diagnoses	298,719	(238,942, 358,496)	116	(93, 139)
Admission or transfer	231,471	(179,757, 283,185)	90	(70, 110)

dations from the NCHS that the minimum reliable estimate for the combined data set is 30,000 visits, corresponding to a relative standard error of 30%). Head injuries were also characterized according to their reported external cause of injury using ICD-9-CM E-codes; 93% of cases had been assigned such codes.

RESULTS

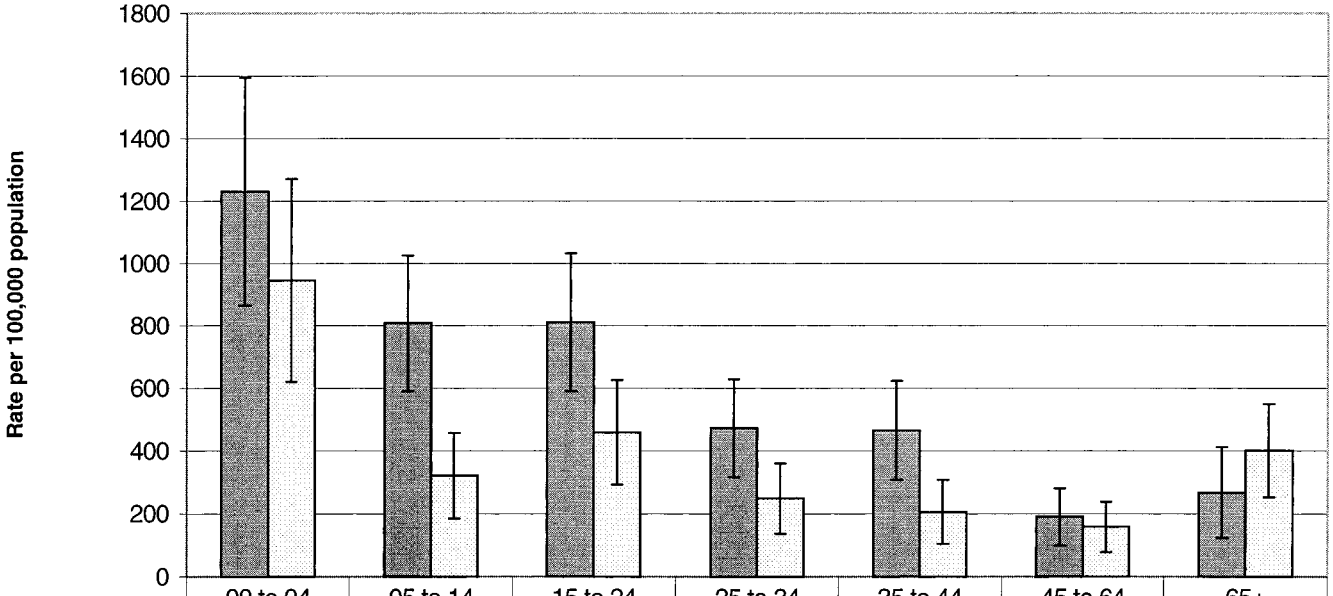
The estimated number of annual ED visits carrying a diagnosis consistent with TBI was 1,144,807 (95% CI = 1,004,902 to 1,284,711), corresponding to a rate of 444 (95% CI = 390 to 498) per 100,000 persons. These visits accounted for approximately

1.3% of all ED visits during the period of study. Table 1 contains numbers and rates for age, sex, race, weekday or weekend, place of injury, mechanism, diagnosis, and whether the patient was admitted or transferred. Three incidence peaks were present: the highest was for children in the first five years of life (1,091 per 100,000), closely followed by adults aged 85 years and older (1,026 per 100,000), and finally adolescents and young adults aged 15 to 24 years (639 per 100,000). Incidence rates by age and sex are shown in Figure 1. The overall TBI incidence rate for males (557 per 100,000; 95% CI = 477 to 637) was 1.6 times that for females (336 per 100,000; 95% CI = 279 to 393). The sex ratio varies by age grouping and is highest in the 5–14-year age group (2.5 times), is less pronounced in children aged 0–4 years (1.3 times), and is reversed in the more-than-65-year age category, where the female rate (402 per 100,000) is 1.5 times that of the male (268 per 100,000). A subgroup of women aged more than 85 years showed a rate of 1,303 per 100,000 persons, and more than 70% of these cases were fall-related. Although the frequency of TBI in the white population (921,580 per year) was five times that in the black population (187,167), the population-based incidence rate of TBI among blacks (582 per 100,000; 95% CI = 439 to 725) was 35% higher than that among whites (429 per 100,000; 95% CI = 375 to 485). The rate of TBI among nonblack, nonwhites was 333 per 100,000 (95% CI = 155 to 512). One third of total TBI cases occurred on Saturday and Sunday. The incidence of head injury was highest from May through October and was lowest from January through March.

For those cases of head trauma carrying a "place of injury" designation (66%), one-fifth took place at a home and one-fifth occurred on a street or highway. More than half of the TBIs sustained at a home were in the 0–9-year age group, and represented 62% of head injuries within this group.

Most TBI cases (93%) were assigned a "cause of injury" designation. Falls represented the most common cause of injury (39%), followed by motor vehicle-related trauma (23%) and the category "struck by or against" (23%). Pedestrian and bicycle-related injuries accounted for 6.2% of all injuries, and three-fourths of these (77%) occurred in the 0–14-year age group. The "other" category represented 8.7% of injuries. Assault-related injuries (8.9% of the total) were contained in both the "struck by and against" category and the "other" grouping. These findings are summarized in Figure 2. Examination by specific age groups reveals that falls constituted the most common mechanism of head injury in children less than 9 years of age (50% of all falls) and in those aged more than 50 years. Three-fourths of motor vehicle-related TBI occurred in the 15–44-year age groups and males accounted for 60% of these injuries.

More than one-half (54%) of ICD diagnoses in the primary diagnosis field were coded as "intracranial injury of other or unspecified nature" (ICD 854). An additional 14% comprised concussion



	00 to 04	05 to 14	15 to 24	25 to 34	35 to 44	45 to 64	65+
male rate	1229	809	811	473	466	190	268
female rate	946	322	459	249	206	159	402

Figure 1. Traumatic brain injury-related visits to U.S. emergency departments: incidence by age and sex—U.S. annual average, 1992–1994 (approximate 95% confidence intervals are shown).

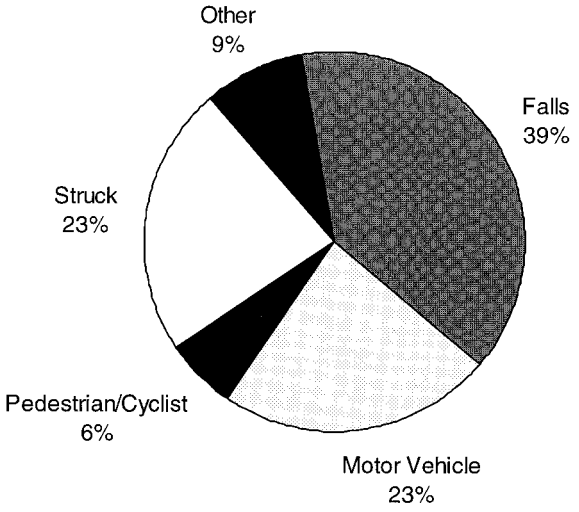


Figure 2. Traumatic brain injury emergency department visits by injury mechanism—excludes cases in which mechanism was not assigned (7%).

(ICD 850), 3.5% were skull fractures (ICD 800, 801, 803), and 2.5% were coded as cerebral laceration, contusion, or intracranial hemorrhage (ICD 851–853). The remaining 26% represented all other diagnoses meeting the case definition in the primary diagnosis field.

One-fifth of the total patients were either admitted, transferred to another facility, or found to be dead upon arrival to the ED. Cardiopulmonary resuscitation and endotracheal intubation were performed in 3% of the cases. Initial ED triage classified 71% of visits as urgent-emergent and 29% as nonurgent. Although 17.3% of the patients were coded as "admission to hospital," it is reasonable to conclude that the 2.9% of the patients who were transferred to another facility were ultimately admitted as well, leading to a total admission rate of 20.2%, or 90 per 100,000 persons.

Medicaid, Medicare, and other government sources were indicated as payors in 30% of TBI cases seen in the ED. The total dollar estimate for annual TBI-related ED charges was $346 million.

DISCUSSION

Our study reveals that every year, 444 of every 100,000 persons are evaluated in EDs for TBI. Males and blacks were found to have higher overall rates of TBI. Rates of TBI were highest among the very young and elders; and a smaller peak was present within the 15–24-year age group. Falls represented a larger proportion of TBI than has been seen in other studies. The majority of these occurred in younger children and elders. The subgroup of women older than 85 years represents the highest rate of TBI, the majority of which were due to falls (71%). Motor vehicle-related trauma accounted for 23% of TBI and, although present in all age groups, was most common in men between the ages of 16 and 45 years.

The current study supports several of the conclusions reached by Sosin et al. in the NHIS.[7] A comparison of the two also helps put our data in perspective. The estimate of 1.14 million annual cases of TBI with a corresponding rate of 444 per 100,000 persons found in the present study is 18% higher than that extrapolated from rates determined by Sosin et al. Rates of TBI by sex were comparable. The male rate was 3.8% lower in our study (579 vs 557), and the female rate was 5.8% lower (336 vs 357). Comparative rates of TBI differed more by race; the rate for whites was 8% lower and that for blacks was 23% higher in the present study. The estimated hospital admission rate of 90 per 100,000 persons (including admissions and transfers) is significantly lower than that found in the NHIS analysis (158 per 100,000), but is closer to rates found in the five-state survey where rates between 84 and 112 per 100,000 were noted.[4] Sosin et al. found assaults to represent 9% of total TBI cases in the NHIS study, similar to our study. Several explanations for the discrepancies found between these two studies exist, including somewhat different case definitions, the potential for recall bias when using telephone survey methods, and the potential imprecision of using ICD-9 codes to quantify TBI. Nevertheless, the majority of findings of these two population-based ED studies were similar, thereby strengthening our understanding of the epidemiology of TBI.

The injury pyramid provides a model whereby the burden of an injury on a population may be evaluated at different levels of medical treatment. The height represents increasing injury severity and the width corresponds to the total number of cases in each level. Waxweiler and associates describe an injury pyramid for TBI in which the tip represents mortality (before and after hospital admission), the mid-portion contains cases for which medical care was sought (including hospital admissions), and the base corresponds to those persons suffering disability from TBI without consulting a physician.[4] Sosin et al. amend this concept by noting that the NHIS revealed that more persons suffering head injuries sought medical attention than did not.[7] Whether or not the burden of TBI is pyramidal, the visual concept is useful in describing the medical care provided to those suffering the injury. Our study serves to further define the mid-portion of this injury construct, describing those who seek medical care in EDs following TBI. Using Waxweiler et al.'s estimate that TBI results in 51,600 deaths per year (1990 data) and the 1992–1994 NHAMCS data for those patients suffering TBI who are either hospitalized

(231,471) or treated and released from EDs (913,336), it appears that for every U.S. TBI fatality there are roughly 5 hospitalizations and 18 ED visits. This does not include those patients either seen in outpatient clinics or not medically evaluated for their injuries.

National costs for head injury have been estimated to be $54 billion annually in the United States.[14] The average estimated annual cost of $346 million (1993 dollars) for TBI-related ED visits is small in comparison, but it represents only the initial charge for those hospitalized, and the first payment for those who continue to require outpatient services.

Limitations and Future Questions

One of the problems found in TBI case ascertainment is the fact that case definitions may lead to the inclusion of those suffering only injury to the skull (i.e., skull fracture) without intracranial or neurologic damage. Likewise, if objective evidence of TBI is not present, the diagnosis of TBI rests on clinical judgment, which may vary by practitioner and by patient report. The lower limit of TBI is thus not clearly delineated by most case-finding definitions. Following an impact to the head, one may simply experience a brief episode of disorientation or not be able to recall the specific details of the incident to the clinician's satisfaction, in order to be viewed as one of the "traumatic brain-injured." The 1995 CDC case definition of TBI is susceptible to the above concerns, and may not prove to be representative of actual cases of TBI when it is applied to an ED population of head-injured patients. In the present study more than half of the cases were coded as "intracranial injury of other or unspecified nature." Examples of these cases might include those with a clinical diagnosis of "mild closed head injury" or "head injury—possible concussion," and it is unfortunate that limited diagnostic and prognostic information may be gleaned from this classification. Patients who are hospitalized following head injury frequently receive more specific diagnoses, and may be more appropriately represented by the CDC case definition.

Several other limitations of the present study deserve mention. Underascertainment of cases was possible since a multiply injured patient may not receive an initial ED diagnosis consistent with TBI. The random hospital sampling design was not structured to account for the location of trauma centers, and this may have led to biased ascertainment. The ED NHAMCS data set did not provide the more precise and complete ICD-9-CM diagnoses typical of hospital discharge data, and this precluded accurate assignation of severity scores. The data set provides no estimate of out-of-hospital deaths, which are believed to account for up to 65% of all TBIs, and thus does not quantify the most severe injuries. Brain injuries sustained by firearms are not described in the NHAMCS data subset representing TBI due to their relatively rare occurrence and the sample size of the survey, although selection bias cannot be ruled out. Finally, the database does not include fields pertaining to restraints or other protective devices, and thus no mention of their utility may be made.

It is reasonable to assume that the majority of all TBI cases in the current study were of mild severity, given that 80% of the patients were discharged directly from the ED. The long-term sequelae of mild TBI have not been adequately characterized in the literature and are worthy of further study. Evidence from other studies suggests that a clinically significant number of patients with mild TBI (up to 40%) remain impaired from both a neuropsychological and an occupational standpoint up to at least one year post injury.[15,16] In addition to examining the long-term sequelae of mild TBI, future research should determine the effectiveness of preventive interventions for TBI, examine the influences of managed care and health care financing on the treatment of TBI, and evaluate the impact of new therapeutic modalities for those who have sustained TBI.

Conclusions

Traumatic injuries to the brain are commonplace and their potential to cause prolonged impairment is a source of concern for health care providers, the injured, their family members, and the community at large. This study corroborates prior research defining the incidence of ED-treated TBI. While motor vehicle-related trauma represents the most important cause of fatal and severe TBI, other injury mechanisms such as falls represent a significant source of potential TBI-related disability. Young children and the elders were found to be at significantly increased risk for ED-treated TBI, suggesting the need to target these high-risk subgroups in the population with prevention programs.

References

1. Sosin DM, Sniezek JE, Waxweiler RJ. Trends in death associated with traumatic brain injury, 1979 through 1992: success and failure. JAMA. 1995; 273:1778–80.
2. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. Traumatic Brain Injury, Injury Atlas: 1986–1994. Atlanta, GA: Office of Statistics and Programming and Office of Health Communications, National Center for Injury Prevention and Control, Apr 1997.
3. Kraus JF. Epidemiology of head injury. In: Cooper PR (ed). Head Injury, ed 3. Baltimore, MD: Williams and Wilkins, 1993, pp 1–25.
4. Waxweiler RJ, Thurman D, Sniezek J, et al. Monitoring the

impact of traumatic brain injury: a review and update. J Neurotrauma. 1995; 12:509–16.
5. Annegers JF, Grabow JD, Kurkland L, et al. The incidence, causes and secular trends of head trauma in Olmsted County Minnesota, 1935–1974. Neurology. 1980; 30:912–9.
6. Diamond P. Brain injury in the Commonwealth of Virginia: an analysis of central registry data, 1988–1993. Brain Inj. 1996; 10:413–9.
7. Sosin DM, Sniezek JE, Thurman DJ. Incidence of mild and moderate brain injury in the United States, 1991. Brain Inj. 1996; 10:47–54.
8. McCaig LF, McLemore T. Plan and operation of the National Hospital Ambulatory Medical Care Survey. National Center for Health Statistics. Vital Health Stat 1. 1994; 34:1–78.
9. McCaig LF. National Hospital Ambulatory Medical Care Survey: 1992 emergency department summary. Advance data from Vital and Health Statistics; no. 245. Hyattsville, MD: National Center for Health Statistics, 1994.
10. Stussman BJ. National Hospital Ambulatory Medical Care Survey: 1993 emergency department summary. Advance data from Vital and Health Statistics; no. 271. Hyattsville, MD: National Center for Health Statistics, 1996.
11. Stussman BJ. National Hospital Ambulatory Medical Care Survey: 1994 emergency department summary. Advance data from Vital and Health Statistics; no. 274. Hyattsville, MD: National Center for Health Statistics, 1996.
12. Nourhah P. National Hospital Ambulatory Medical Care Survey: 1997 emergency department summary. Advance data from Vital and Health Statistics; no. 304. Hyattsville, MD: National Center for Health Statistics, 1999.
13. Thurman DJ, Sniezek JE, Johnson D, et al. Guidelines for Surveillance of Central Nervous System Injury. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, CDC, 1995.
14. Max W, MacKenzie EJ, Rice DP. Head injuries: costs and consequences. J Head Trauma Rehabil. 1991; 6:76–91.
15. Macciocchi SE, Reid DB, Barth JT. Disability following head injury. Curr Opin Neurol. 1993; 6:773–7.
16. Alves WA, Macciocchi SN, Barth JT. Postconcussive symptoms after uncomplicated mild head injury. J Head Trauma Rehabil. 1993; 8(3):48–59.

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REFLECTIONS

In your opinion, what was the most important obstacle that had to be overcome in the development of emergency medicine as a specialty board?

"The most important obstacle which had to be overcome in the developing of emergency medicine as a specialty board was the perception of emergency medicine as lacking in content and needing lengthy and unnecessary periods of training within multiple other specialties."

GEORGE PODGORNY, MD
First President of ABEM, 1976–1981
ABEM Director, 1976–1988