Head Injury with and without Hospital Admission: Comparisons of Incidence and Short-term Disability

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Abstract: All persons with head injuries (skull fracture or injury to the cranial contents resulting in a physician visit or at least one day of disability), regardless of treatment or hospital admission status, were identified from National Health Interview Survey data for the years 1977–81. Among those who reported such head injuries within the two weeks prior to interview, only 16 per cent were admitted to hospitals. Children, members of low-income families, and those injured at home, school, or in a recreatonal setting were less likely to be admitted to hospital than others. Among those who sustained a head injury in the previous three months and had some disability from that injury during the two weeks prior to interview, those not admitted to hospital included one-half of those with three to seven days of bed disability and one-third of those with more than seven days of bed disability; and they accounted for one-half of all disability days. These findings indicate that hospital-based head injury incidence data are incomplete and may contain substantial biases. (*Am J Public Health* 1987; 77:810–812.)

Introduction

Recent studies of head injury suggest that the annual incidence in the United States is between 180 and 294 per 100,000.[1–7] These studies vary somewhat in their methods and definitions, but all* were limited to persons injured seriously enough to be admitted to a hospital or to die of their injuries. These criteria provide a convenient and readily documented lower limit to the severity of injury and simplify case identificaton, but the incidence data provided by such studies do not include individuals with head injuries that did not lead to hospital admission or to death.

It seems reasonable to assume that those sustaining head injury who are neither killed nor hospitalized are predominantly those with relatively mild injuries; however, there are several reasons to reconsider their exclusion from incidence studies. First, there is evidence that even mild head injury may have significant consequences.[8–14] Second, although the persons who are not hospitalized are likely as a group to have less severe injuries than those who are hospitalized, little is known about the frequency with which people with head injuries causing substantial disability are not hospitalized, or the proportion of the total disability from head injury that is due to injuries that do not lead to hospitalization. Third, the published hospital-based studies of head injury report a wide range of incidence rates and substantially different case fatality rates; these variations could result from different hospital admission practices[15–18] in the regions studied. Finally, the compensation schemes for hospital care are undergoing extensive changes and these changes may lead to changes in hospital admission policies; such changes could distort head injury incidence rates derived from hospital admissions.

The present study uses data from the National Health Interview Survey[19] to document the extent to which substantial head injury morbidity is excluded from studies restricted to hospitalized patients and to describe some of the differences between the head-injured people who are and are not hospitalized.

Methods

The National Health Interview Survey contacts a sample of approximately 40,000 US households each year and inquires about illnesses and injuries to current household members during the two weeks prior to the interview.[19,20] Because the survey is limited to current household members, persons who died are excluded even if they died during the two weeks prior to interview. Thus, nearly all the injuries identified through the National Health Interview Survey are nonfatal. Members of the armed forces and persons residing in a long-term care institution at the time of the survey are also excluded.[20]

For the present study, head injury was defined by the answers to three questions asked of all persons who reported injuries: "At the time of the accident, what part of the body was hurt? What kind of injury was it? Anything else?" The answers were classified into diagnostic categories according to the standard National Center for Health Statistics (NCHS) methods. Those whose answers indicated skull fracture or damage to the cranial contents (ICD codes 800.0–801.9, 803.0–803.9, and 850.0–854.9)[21,22] were included in the present study. Those whose answers indicated scalp injury or other injury to the head or face were not included unless accompanying skull fracture or damage to the cranial contents was also indicated. These inclusion criteria correspond to those for hospital-based studies of head injury except that they do not include loss of consciousness or the presence of neurologic findings, features that are usually required in hospital-based studies.[1–7] Loss of consciousness and presence of neurologic findings could not be determined from the National Health Interview Survey data.

The accuracy and completeness of diagnostic data gathered by the National Health Interview Survey have been examined in several reports.[23–27] These reports suggest that although there is significant underreporting and overreporting of chronic conditions in the National Health Interview Survey data,[23,24] the overall estimates are close to those obtained from the medical records of survey participants;[27] recall is considerably more accurate for recent acute events than for other events;[25] and acute motor vehicle injuries reported for a two-week recall period are consistent with the broad descriptions of injuries given in police reports gathered at the scene of the same motor vehicle crashes.[26]

Data from the five National Health Interview Surveys for

*One study[1] included emergency department visits in its case ascertainment, but did not state the proportion of cases treated as outpatients. The relatively strict inclusion criteria and the incidence value consistent with inpatient studies suggest that nearly all the cases were inpatients.

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TABLE 1—Percentage Hospitalized among People with Morbidity* from Acute Head Injury by Duration and Type of Disability

Type of Disability	Duration of Disability		
	Less Than 3 Days**	3–7 Days	More than 7 days
Bed Disability	23 (17–30)	51 (34–68)	67 (46–89)
Restricted Activity	17 (9–24)	38 (24–52)	53 (41–64)

*Medical attention or at least one day of disability during the two weeks prior to interview due to acute head injury. Tabulation is based on the combined data of the Health Interview Surveys for 1977–81.

**Bed disability was less than three days for 77 per cent of all cases. Restricted activity disability was less than three days for 56 per cent of all cases.

NOTE: Figures in parentheses are 95% confidence intervals.

TABLE 2—Percentage* of Head-Injured Persons Hospitalized by Place and Class of Injury Event

Place of Injury Event	Per Cent Hospitalized	Class of Injury Event	Per Cent Hospitalized
Industrial	52 (24–80)	Work	43 (21–65)
Street, Highway	20 (8–31)	Moving Motor Vehicle	26 (12–41)
Home	11 (3–18)	Home	11 (3–18)
School, Place of Recreation	7 (0–17)	Other	9 (1–17)
Other**	16 (0–32)		

*Based on the combined data of the Health Interview Surveys for 1977–1981.

**A small number of head injuries occurring on farms are included in this category.

NOTE: Figures in parentheses are the 95% confidence intervals.

the years 1977–81 were pooled to produce a single sample of approximately 200,000 households. Appropriate variance estimates for this aggregate study were developed by the National Center for Health Statistics. Ninety-five per cent confidence intervals based on these variances are given in parentheses. In the present study, duration of disability, rather than injury severity was measured. Only injuries that resulted in a physician visit and/or at least one day of disability were recorded.

In a sample of people injured during the two weeks prior to interview, the measurement of duration of disability is subject to truncation error. To reduce this problem, duration of disability was determined from a sample of people who received medical attention or sustained at least one day of disability during the two weeks prior to interview due to an "acute" head injury, i.e., one that occurred within the three months prior to interview. This group is not an incidence sample and was used only to establish the relationship between duration of morbidity and per cent hospitalized as displayed in Table 1. Because they are not based on an incidence sample, the data of Table 1 are not appropriate for estimating the percentage of head-injured people admitted to the hospital. The findings on work/school disability were similar to those on bed disability and only the latter were cited.[19]

Except for the results on duration of disability, all results are based on the incidence sample of people who sustained head injuries within the two weeks prior to interview.

Results

An estimated 1.87 (1.64–2.11) million persons were head-injured annually, 89 (84–94) per cent consulted a physician, and 307,000 (194,000–420,000) of these were hospitalized. Thus, those hospitalized for head injury represent only 16 (11–22) per cent of all head-injured people who were medically attended or experienced disability of at least one day and only 18 (12–25) per cent of all medically attended head-injured people.

The estimated number of days of disability per year for persons who had sustained head injuries was 14 (10–19) million days of restricted activity including 5 (4–7) million days of bed disability. Those who were hospitalized accounted for 48 (41–56) per cent of all restricted activity days and 55 (43–67) per cent of all bed disability days. Thus, approximately half of all head injury disability days were attributable to nonhospitalized cases. The percentage of head-injrued persons who were hospitalized is shown in Table 1 for various durations of disability. Many persons with relatively brief disability after head injury were hospitalized and many with relatively extended disability were not hospitalized (Table 1). The percentage hospitalized increased as the duration of disability increased, however.

The likelihod that a head-injured person would be hospitalized varied with age, circumstances of injury, and family income. For those aged less than 15 years, 8 (2–15) per cent were hospitalized, whereas for those aged 15 or older, 22 (14–30) per cent were hospitalized.

Head injuries related to work and to motor vehicles, injury contexts likely to involve substantial impacts, were more likely than others to lead to hospitalization (Table 2).

Finally, only 8 (0–18) per cent of head injuries of persons from families with incomes of less than $7,000 per year lead to hospitalization, whereas 19 (12–27) per cent of head injuries among those from families with incomes of $7,000 or more per year lead to hospitalization. Eighty-one (68–93) per cent of those in the lower income group with head injuries and 92 (89–94) per cent of those in the higher income group consulted a physician. Among those who consulted a physician, 9 (0–20) per cent of those in the lower income group, and 21 (13–29) per cent of those in the higher income group were admitted to a hospital. This income-related difference in hospital admission rates cannot be attributed to a difference in the proportion of children injured in the two income groups. Children (who were less often admitted than were adults) constituted 33 per cent of the head injury cases among the lower income group and 42 per cent among the higher income group.

Discussion

The present study's estimate of 307,000 (194,000–420,000) people hospitalized annually in the United States for nonfatal head injury is consistent with the lowest incidence rates documented by hospital-based studies of head injury.[1–3,6]

The durations of disability among hospitalized and nonhospitalized head injury cases overlap. Thus, the hospital-based incidence of head injury reflects both the actual incidence of head injury and the admission policies of hospitals. Studies that compare head injury incidence rates at different times or places must take this into account. Studies limited to patients who, regardless of their duration of disability, were unconscious or only partially conscious when they first received medical attention or who required medical or surgical intervention may not need to consider nonhospitalized cases.[28]

Any study that examines a consequence (hospitaliza-

tion, physician visit, disability) from a specific injury (head injury) faces an ambiguity when it considers persons with multiple injuries for whom the consequence of interest may be due to the injury of interest or may be due to one or more of the other injuries. Thus, in the present study, some of the disability tabulated may have been related to accompanying injuries. However, when the injury of interest is head injury, this problem is relatively mild because the head injury (rather than some accompanying injury) accounts for most of the overall injury severity.[29]

It is possible that the low frequency of hospitalization among head-injured persons with low income represents a lower threshold for reporting head injuries; however, this is not a likely explanation. When self-reported rates for nonfatal injuries of all kinds[20] are compared to injury rates measured by counting deaths, hospital admissions , or both,[6,7,30–32] it appears that people with low incomes tend to underreport rather than overreport injuries relative to people with higher incomes. An alternative explanation is that low-income persons with head injuries are less often admitted to hospitals because they have relatively poor access to health care.[15,17]

Nonhospitalized cases constitute a high proportion of all head injured persons and include a substantial number of those who sustained prolonged disability. The incidence of head injury in these groups could be investigated further using medical outpatient data because the present study demonstrates that many nonhospitalized head injuries are medically attended. The quality of the data on each patient would not be as high as data available for hospitalized patients.[33]

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REFERENCES

1. Annengers JF, Grabow JD, Kurland LT, *et al:* The incidence, causes, and secular trends in head injury in Olmsted County, Minnesota, 1935–1974. Neurology 1980; 30:912–919.
2. Jagger J, Levine J, Jane J, *et al:* Epidemiologic features of head injury in a predominantly rural population. J Trauma 1984; 24:40–44.
3. Kalsbeek WD, McLauren RL, Harris BSH, *et al:* The national head and spinal cord injury survey: major findings. J Neurosurg 1980; 53(s):19–31.
4. Klauber MR, Marshall LF, Barrett-Conner E: Prospective study of patients hospitalized with head injury in San Diego County, 1978. Neurosurgery 1981; 9:236–241.
5. Cooper KD, Tabaddor K, Hauser WA: The epidemiology of head injury in the Bronx. Neuroepidemiology 1983; 2:70–88.
6. Kraus JF, Black MA, Hessol N, *et al:* The incidence of acute brain injury and serious impairment in a defined population. Am J Epidemiol 1984; 119:186–201.
7. Whitman S, Coonley-Hoganson R, Desai BT: Comparative head trauma experiences in two socioeconomically different Chicago-area communities: a population study. Am J Epidemiol 1984; 119:570–580.
8. Barth JF, Macciocchi SN, Giordani B, Rimel R, Jane JA, Boll TJ: Neuropsychological sequelae of minor head injury. Neurosurgery 1983; 13:529–533.
9. Gronwall D, Wrightson P: Delayed recovery of intellectual function after minor head injury. Lancet 1984; 7881–606–609.
10. Gronwall D, Wrightson P: Memory and information processing after closed head injury. J Neurol Psychiatry 1983; 44:889–895.
11. Plaut MR, Gifford RM: Trivial head trauma and its consequences in a perspective of regional health care. Milit Med 1976; 141:244–247.
12. Rimel RW, Giordani MA, Barth JT, Boll TJ, Jane JA: Disability caused by minor head injury. Neurosurgery 1981; 9:221–228.
13. Rutherford WH, Merrett JD, McDonald JR: Symptoms at one year following concussion from minor head injuries. Injury 1979; 10:225–230.
14. Rutherford WH, Merrett JD, McDonald JR: Sequelae of concussion caused by minor head injury. Lancet 1977; 1:1–4.
15. Annas GJ: Your money or your life: 'dumping' uninsured patients from hospital emergency wards. Am J Public Health 1986; 76:74–77.
16. Connell FA, Blide LA, Hanken MA: Clinical correlates of small area variations in population-based admission rates for diabetes. Med Care 1984; 22:939–949.
17. Himmelstein DU, Woolhandler S, Harnly M, Bader MB, Silber R, Becker HD, Jones AA: Patient transfers: medical practice as social triage. Am J Public Health 1984; 74:494–497.
18. Roos NP, Flowerdew G, Wajda A, Tate RB: Variations in physicians' hospitalization practices: a population-based study in Manitoba, Canada. Am J Public Health 1986; 76:45–51.
19. National Center for Health Statistics (Givens JD): Current Estimates from the Health Interview Survey, United States, 1978. Vital and Health Statistics. Series 10, No. 130. DHHS Pub. No. (PHS) 80-1551. Washington, DC: GPO, 1979.
20. National Center for Health Statistics (Collins JG): Persons Injured and Disability Days Due to Injuries, United States, 1980–81. Vital and Health Statistics. Series 10, No. 149. DHHS Pub. No. (PHS) 85–1557. Washington, DC: GPO, 1985.
21. National Center for Health Statistics: Eighth Revision International Classification of Diseases. Public Health Service Pub. 1693. Washington, DC: GPO, 1967.
22. World Health Organization: International Classification of Diseases, 1975 Revision. Geneva: WHO, 1977.
23. National Center for Health Statistics: Health Interview Responses Compared with Medical Records. US Department of Health, Education and Welfare, Vital and Health Statistics. Series 2, No. 7. Washington, DC: Public Health Service, 1965.
24. National Center for Health Statistics: Data on Chronic Conditions Compared with Information Derived from Medical Records. US Department of Health, Education, and Welfare, Vital and Health Statistics. Series 2, No. 23. Washington, DC: Public Health Service, 1967.
25. National Center for Health Statistics: Reporting Health Events in Household Interviews: Effects of an Extensive Questionnaire and a Diary Procedure. US Department of Health, Education, and Welfare, Vital and Health Statistics. Series 2, No. 49 Pub. (HSM) 72-1049. Washington, DC: Public Health Service, 1972.
26. National Center for Health Statistics: Optimum Recall Period for Reporting Persons Injured in Motor Vehicle Accidents. US Department of Health, Education, and Welfare, Vital and Health Statistics. Series 2, No. 50 Pub. (HSM) 72-1050. Washington, DC: Public Health Service, 1972.
27. National Center for Health Statistics: Net Differences in Interview Data on Chronic Conditions and Information Derived from Medical Records. US Department of Health, Education, and Welfare, Vital and Health Statistics. Series 2, No. 57 Pub. (HSM) 73-1331. Washington, DC: Public Health Service, 1973.
28. Rimel RW, Giordani NP, Barth JT, Jane JA: Moderate head injury: completing the clinical spectrum of brain trauma. Neurosurg 1982; 11:344–351.
29. Fife D, Jagger J: The contribution of brain injury to the overall injury severity of brain injured patients. J Neurosurg 1984; 60:697–699.
30. Mierly MC, Baker SP: Fatal house fires in an urban population. JAMA 1983; 249:1406–1408.
31. Wise PH: Differential childhood mortality in Boston. Am J Dis Child 1983; 137:538–543.
32. Baker SP, O'Neill B, Karpf RS: The Injury Fact Book. Lexington, MA: Lexington Books, 1984.
33. MacKenzie EJ, Shapiro S, Eastham JN: Rating AIS severity using emergency department sheets vs inpatient charts. J Trauma 1985; 25:984–988.