PAPERS AND SHORT REPORTS

Epidemiology of head injury

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Abstract

To find the incidence of the various types of head injury that occur in the community separate yearly rates (per 10^5 population in Scotland) for deaths, admissions to hospital, and attendance at accident and emergency departments were estimated and compared (when possible) with rates in England and Wales and the United States.

Hospital admissions provide the best data for comparing incidences in different geographical areas and rates of attendance at accident and emergency departments the most reliable guide to incidences in the community. Admission rates, however, vary with local facilities and policies, and these also determine the proportion of patients referred to regional neurosurgical units.

Such epidemiological data must be sought both for planning health care for head injury and for monitoring the effectiveness of services.

> "The descriptive elements of the epidemiology of head injuries are woefully incomplete . . . because no single report includes all patients with head injuries (irrespective of severity), within a defined population."[1]

Introduction

Head injury is a major health problem in Westernised nations. The sheer volume of milder injuries poses a logistic problem for accident and emergency departments and surgical wards. Only a few such patients develop serious complications, but delayed diagnosis and treatment contributes appreciably to mortality and morbidity. The extent to which neurosurgeons should participate in the routine early care of head injuries is controversial; and this issue has been sharpened by the advent of computed tomography (CT), whose value in acute head injuries is already beyond doubt, but which is available (in Britain) only in regional neurosurgical units. Other matters for concern are the rehabilitation of disabled survivors—for whom there are few facilities—and the use of measures to prevent or minimise brain damage from accidents.

To manage these problems rationally we must have information on where, when, and how often head injuries of various kinds occur. Such information, however, is difficult to obtain because the victims are so dispersed: many deaths occur outside hospital and are therefore known only to coroners and pathologists; patients admitted to hospital are widely distributed among general, orthopaedic, accident, and paediatric surgeons, as well as neurosurgeons; most attenders at accident departments are sent home and are not included in statistical returns.

We report for the first time estimated yearly rates of death, hospital admission, and attendance after head injury in Scotland and England and Wales. We based the rates on routinely published statistics and on specially conducted surveys.

Sources of data and methods

Deaths recorded by the Registrars General in Britain include the E and N codes of the International Classification of Diseases (ICD).[2] The E code (cause) makes it possible to identify deaths due to head injury among the wider category of "accidents and violence," and also to locate those attributed to road accidents. The N code (location) enables head injuries to be found, even though there is no single rubric for this condition; for this study we aggregated rubrics N800, 801, 803, 804, and 850-4.

Hospital admissions for head injuries may be identified by the same ICD codes in the annual reports for Scotland[3] and England and Wales.[4,5] To expand the information from these statistics, and check their accuracy, we analysed a random sample of head-injured patients discharged from the primary surgical—that is, non-neurosurgical—wards of all Scottish hospitals during two two-week periods in 1974.[6] This yielded 1181 cases,[7] which corresponded closely in their features to 918 cases prospectively collected during the same year in one Glasgow hospital,[8] and also to the published statistics for Scotland as a whole. The annual admissions for head injury were estimated from the four-week sample as 15 000 compared with 15 229 actually recorded for that year. Admissions to three Scottish neurosurgical units during the whole of 1974 and 1975 were also surveyed (785 patients).[9]

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Attenders at accident and emergency departments throughout Scotland were also included in the retrospective study for 1974.[10] As no ICD codes were available for these cases a working definition of head injury was agreed. Patients with a history of a blow to the head or with altered consciousness after a relevant injury, or with a scalp or forehead laceration, or who had had a skull *x*-ray examination were included; we excluded those with only facial or jaw fractures, epistaxis, or foreign bodies in eyes, ears, or nose. The features of the 3558 cases from this retrospective survey corresponded closely to 784 cases prospectively collected in 1978 in the Glasgow Royal Infirmary.[11]

Cases of head injury treated in the hospitals of the Cleveland area of England were surveyed for 1974 using a similar technique after an invitation from the senior neurosurgeon there (Mr Patrick Clarke). This yielded 716 attenders and 335 primary surgical admissions, which were closely similar to those for Scotland (table I). One hundred and ninety-one patients were admitted to the neurosurgical unit, a proportion that was intermediate between those for Edinburgh and for the rest of Scotland.

TABLE I—*Comparison of head-injury rates in Scotland and Cleveland*

		Scotland	Cleveland
Yearly head-injury rates per 10^5 population	Attenders at accident and emergency department	1778	1620
	Admissions to primary surgical wards	313	350
	Admissions to neurosurgical units	10-116	65
Percentage of new accident and emergency attenders who have head injury		11%	11%
Percentage of attenders with head injury who are admitted		23%	22%

Results

DEATHS

Head injury accounts for nine deaths/10^5 population each year in Britain (table II),[12 13] which is less than 1% of all deaths; but in the age group 15 to 24 head injuries cause 15% of all deaths. Age-specific mortality analysis (fig 1) showed the expected excess of male patients at all ages. About a quarter of all accidental deaths, and 40% of those from road accidents, were due to head injuries. There has been a decline in the number of deaths ascribed to head injury each year since 1967. Standardised mortality ratios showed an appreciable fall (table III), indicating that this decrease in head-injury deaths was not due to the aging population. In England and Wales in 1972, 40% of deaths attributed to head injury occurred at the scene of the accident and 20% before the patient could be admitted to hospital[5]: in Scotland these proportions were lower. Fewer such early deaths now occur, and the difference between the countries has almost disappeared (table II).

PRIMARY SURGICAL WARD ADMISSIONS

The annual admission rate in England and Wales in 1974 was 270/10^5 population (range for regions 210-360); in Scotland it was 313 yearly, with a range of 306-404 for the catchment areas of the four neurosurgical units. As expected, rates were higher for men than for women, and for younger than for older sections of the community (fig 2). Between 1964 and 1972 the proportion of patients discharged in England and Wales with conditions assigned to the more severe ICD codes (N800-1, 803-4, 851-3) fell from 13% to 8%. Over the same period the proportion staying more than seven days in hospital fell from 20% to 11%.[5] These figures confirm the decline in *severe* head injury, already evident in the falling number of deaths (tables II, III). Nevertheless, the total discharges after head injury in England and Wales increased by more than 40% between 1963 and 1972, almost entirely due to patients with mild injuries who stayed for two days or less;[5] we found the same trend in Scotland for the decade up to 1976. The increase in admissions for mild injuries would explain the fall in the hospital case mortality for head injury to 1·5 in 1976.

The resources consumed by patients in hospital after recent head injury may seem falsely high if calculated on the number of admissions,

TABLE III—*Standardised mortality ratios for head injuries in Scotland*[13]

	1971	72	73	74	75	76
Male cases	101	99	99	97	91	88
Female cases	97	103	103	93	78	72

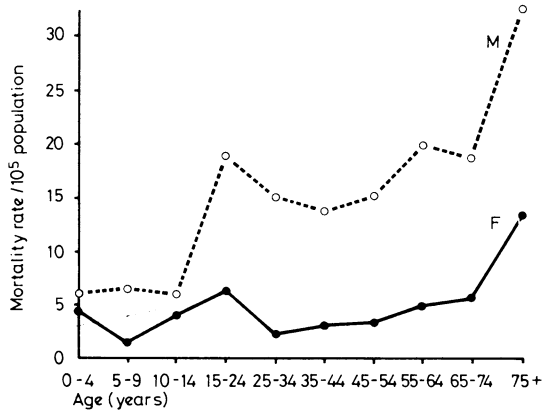

FIG 1—Age-specific mortality from head injury for Scotland (1976) including deaths in hospital and those occurring outside hospital.

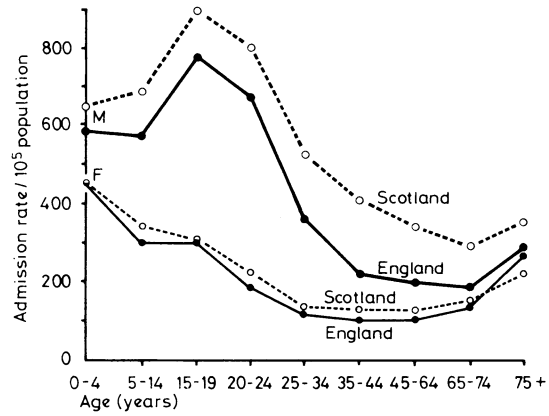

FIG 2—Age-specific admission rates from head injury for 1972.

TABLE II—*Head-injury deaths*

	No per 10^5 population		% of all deaths		% of accidental* deaths		% of road deaths		% of head-injury deaths occurring outside hospital	
	England and Wales	Scotland	England and Wales	Scotland	England and Wales	Scotland	England and Wales	Scotland	England and Wales	Scotland
1972	10·5	10·9	0·9	0·9	31	25	49	41	60	52
1974	9·5	10·5	0·8	0·8	29	23	44	36	57	51
1976	9·2	9·3	0·8	0·7	29	21	44	32	46†	43

*Excludes poisoning, drowning, and burns.
†1975.

because two-thirds of those admitted stay for two days or less. A more reliable guide is the number of occupied bed days ascribed to head-injured patients; but this figure includes patients whose prolonged stay is due to a major extracranial injury.[7] Patients with such an injury, but with only a minor head injury, accounted for a third of occupied bed days but for only 11% of admissions attributed to head injury in Scottish primary wards in 1974. Nevertheless, an important finding was that patients without major extracranial injury or skull fracture, nor any other evidence of brain damage, accounted for another third of occupied bed days and two-thirds of admissions for head injury.

NEUROSURGICAL WARD ADMISSIONS

In most of Britain only patients with the more severe injuries are transferred to regional neurosurgical units. Nevertheless, there is a surprising range in the proportion transferred, reflecting differences in neurosurgical facilities and in the policies of neurosurgeons. In the catchment areas of the regional units in Dundee, Aberdeen, and Glasgow 3%, 4%, and 5%, respectively, of patients admitted with head injuries went to neurosurgical wards in 1974; in Edinburgh the proportion was 35%.[9] In England and Wales as a whole 5% of all patients admitted with head injuries go to neurosurgical units, according to the published 10% sample of discharges.[4] Referral rates cannot be calculated for the catchment areas of all neurosurgical units from so limited a sample; but the Merseyside unit reported taking only 1·5% of the head injuries from its region,[14] while we found in Cleveland 25% of patients admitted for head injury went to the neurosurgical unit. The number of head-injured patients admitted to neurosurgical wards per 100 000 population clearly varies according to the referral rate. In England and Wales and most of Scotland this is 12 to 14 patients yearly—but in Edinburgh it is 10 times greater, without any evidence that head injuries are more common there.[9]

HEAD INJURY ATTENDERS

The survey of all Scottish hospitals for 1974 showed an annual attendance rate of patients with head injury of 1780/10^5 population (fig 3), with variations according to age and sex and the cause of injury (table IV). Head injuries accounted for about 10% of new attenders at accident and emergency departments in Scotland, and for 15% of those attending after recent trauma; about one attender in five was admitted. The findings in Cleveland were similar (table I).

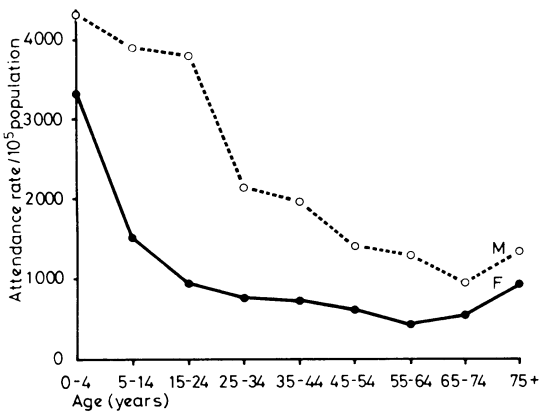

FIG 3—Age-specific attendance rates for head injury at Scottish accident and emergency departments for 1974.

TABLE IV—*Accident and emergency attendance rate per 10^5 population for Scotland, 1974*[10]

	Road accident	Assault	All causes
Age group (year):			
<15	265	94	3017
15-24	523	775	2359
25-64	298	215	1184
≥65	202	12	829
Mean rates:			
All male patients	415	405	2591
All female patients	216	94	1024
All cases	314	244	1778

CAUSES OF HEAD INJURY

Causes vary with age and sex (table IV). Local cultural influences are another factor; for example, assault is twice as common as road accident as the cause of head injuries among Scottish men aged 15 to 24 treated in accident departments. The distribution of causes varies also with the severity of the injury (fig 4). Thus road accidents account for only a small minority of accident and emergency attenders who are not admitted; but they account for over half the severe injuries and deaths.

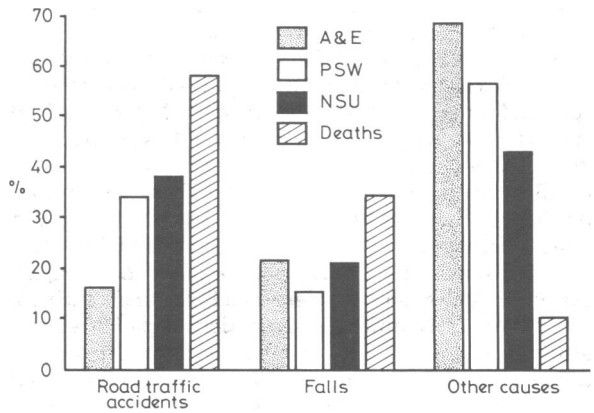

FIG 4—Proportion of head injuries caused by road-traffic accidents, falls, or other causes resulting in attendance at accident and emergency departments (A+E), admission to primary surgical wards (PSW), admission to neurosurgical units (NSU), or death (Deaths).

INTERNATIONAL COMPARISONS

World Health Organisation reports[15] show that the proportion of deaths attributable to accidents is lower in Britain than in most other countries. Officially recorded deaths in other countries do not include the N code, and head injuries cannot therefore be identified. Data are emerging about head-injury rates for parts of the US, where the National Institutes of Health has recently initiated surveys. These indicate 22 head-injury deaths/10^5 population for San Diego (L Marshall, personal communication, 1979) and 25 for central Virginia (J Jane, personal communication, 1979), more than twice the rate for Britain (9/10^5 population). Although the US has more 15 to 24-year-olds and fewer over-64s than Britain, this would not account for the pronounced differences in crude rates for head-injury deaths. Despite these higher death rates, however, the admission rates for head injury are somewhat lower than in Britain—for San Diego 245/10^5 and for Charlottesville 216/10^5 population (L Marshall and J Jane, personal communications, 1979). The likely explanation is that fewer patients with mild injuries are admitted to hospital in America, an assumption supported by the greater proportion of admitted patients who are in coma in San Diego (10%) and in Charlottesville (20%) than in Scotland (5%).

There are no data about attenders at hospital who are not admitted, but some clue to the incidence of milder injuries is provided by an annual household survey conducted in the US. This survey records illness or accident in the preceding two weeks that required medical attendance or limitation of activity for at least one full day.[16] Results of this survey indicate 3589 incidents of head injury/10^5 population, which is double the rate of attendance at accident and emergency departments for head injury in Scotland—in keeping with the difference in death rates from head injury in the two countries.

Discussion

It is not possible to state simply how frequently head injuries occur. No universal definition of practical value can be proposed to cover the many minor injuries known only to general practi-

tioners, traffic police, or officials at sporting events and those that are never reported unless complications develop. The actual incidence of head injury is therefore an abstraction. It is, however, reasonable for those concerned with preventing head injuries and planning health services for their care to focus on injuries that lead to death, hospital admission, or attendance at an accident department—as we have done.

Perhaps the most reliable guide to the incidence of head injuries in a community is the attendance rate (at accident and emergency departments), although this may be affected by the accessibility of the hospital. For example, the attendance rate at Scottish city hospitals was higher than in more rural areas, while more city injuries were trivial.[10] Data about accident attenders who are sent home (as most head-injured patients are) are not collected systematically. Deaths are routinely recorded and provide an index of the most severe injuries—but these represent a very small part of the problem. Moreover, there are inaccuracies in the figures due to the incidence of multiple injuries and varying practices in how these are recorded.

Hospital admissions provide the most readily available data for comparisons between different places, but as an index of the incidence of head injuries in a community they need to be interpreted in the light of local facilities and policies. Although the number of head-injured patients reaching hospitals is similar in different parts of Scotland, and between Cleveland and Scotland, the standardised admission rates for head injury in England and Wales show pronounced regional variations.[5] These and the widely differing proportion of patients referred to neurosurgical units reflect regional differences in how head injuries are managed. International comparisons show that in North America a much higher proportion of patients are in the care of neurosurgeons, who express surprise that in Europe so much responsibility is accepted by other specialists.[17]

This matter must now be considered in the light of the effectiveness of CT head scanners in detecting intracranial haematomas and of the continuing high mortality and morbidity from this complication.[18,19] Modern standards of care undoubtedly demand that more patients with recent head injuries ought to undergo CT soon after injury. It has been suggested that this might be achieved by siting head scanners in large general hospitals and screening head-injured patients there.[20] Our survey, however, indicates that even a general hospital that admits 1000 head-injured patients a year would have only two or three cases a week sufficiently severe to warrant scanning: this does not justify maintaining the necessary skills. Another disadvantage is that expert surgeons would not be available to deal with any lesions discovered. A more practical policy for most of Britain would be to ensure that more head-injured patients do reach neurosurgical units, and do so sooner. When such a policy was introduced in Glasgow the number of transfers doubled and so did the number of patients with intracranial haematomas requiring operation.

To judge the likely implications of such policy changes in terms of deploying resources and auditing their effects it is necessary to have data of the kind presented here. Unless there is reliable information about the distribution of head-injured patients in the whole community, and account is taken of all cases, comparisons of the results of alternative management policies may be quite misleading. This is particularly likely if mortality and morbidity in different hospitals or units are compared without accurate data about, for example, what proportion of all admitted patients with head injuries, or of head-injury deaths, are in the regional neurosurgical unit.

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ONE HUNDRED YEARS AGO The King and Queen's College of Physicians and the Council of the Royal College of Surgeons in Ireland, impressed with the necessity for inquiry into the causes of, and the remedies for, the excessive mortality in Dublin, have felt it their duty to consider a subject so intimately connected with the public health. Committees were, therefore, appointed by both Colleges to co-operate in forming a joint report. After a lengthened incubation, a report has been produced; and, having been adopted by both Colleges, has been issued as an expression of their opinion. As a concise and authoritative statement of previously well known and recognised causes of the established high mortality of Dublin, the report is valuable; and the "suggestions" for sanitary reforms in the city, if not novel, should be viewed with respect as coming from such high authorities. The Colleges, after careful consideration of all facts, gives expression to their deliberate opinion that "the City of Dublin is, and has been, unhealthy in an excessive degree; and its extraordinary death-rate is attributable, not to errors of computation or irremediable circumstances, but to long-continued disregard of sanitation, and the omission to enforce the legal means provided for a remedy." The Colleges are further of opinion that "the excessive mortality within the city demands from the civic sanitary authority the most firm, energetic, and persevering execution of the powers entrusted to it, to secure even a partial amelioration of the existing evils; and the health of the city will be likely to deteriorate still further unless dealt with by a new and radical method much more vigorous than that which has hitherto been adopted." An appendix gives the sections of the Public Health Act (Ireland) of 1878, which confer full legal powers on the sanitary authority for enforcing several of the various hygienic and sanitary measures referred to in the report. (*British Medical Journal*, 1881.)