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Disability in young people and adults one year after head injury: prospective cohort study

Sharon Thornhill, Graham M Teasdale, Gordon D Murray, James McEwen, Christopher W Roy, Kay I Penny

Abstract

Objective To determine the frequency of disability in young people and adults admitted to hospital with a head injury and to estimate the annual incidence in the community.

Design Prospective, hospital based cohort study, with one year follow up of sample stratified by coma score.

Setting Five acute hospitals in Glasgow.

Subjects 2962 patients (aged 14 years or more) with head injury; 549 (71%) of the 769 patients selected for follow up participated.

Main outcome measures Glasgow outcome scale and problem orientated questionnaire.

Results Survival with moderate or severe disability was common after mild head injury (47%, 95% confidence interval 42% to 52%) and similar to that after moderate (45%, 35% to 56%) or severe injury (48%, 36% to 60%). By extrapolation from the population identified (90% of whom had mild injuries), it was estimated that annually in Glasgow (population 909 498) 1400 young people and adults are still disabled one year after head injury.

Conclusion The incidence of disability in young people and adults admitted with a head injury is higher than expected. This reflects the high rate of sequelae previously unrecognised in the large number of patients admitted to hospital with an apparently mild head injury.

Introduction

More than 150 000 patients with a head injury are known to be admitted to hospital each year in the United Kingdom, but estimates of the frequency of subsequent disability in such patients range from two or three to 45 per 100 000 population per year (see table A on website).[1–4] This variation reflects limitations in previous studies, particularly the lack of data on patients with an apparently mild injury, who account for 80% of admissions.[1] One review concluded that "given the human and economic importance of head injury, there is an urgent need to acquire more epidemiological information on the management and outcome of head injury of all grades of severity."[5] We aimed to identify a representative cohort of young people and adults admitted to hospital with a head injury within a geographically identified population, determine their outcome, and estimate the incidence of disabled survivors in the community one year later.

Subjects and methods

Study protocol

Approval for our study was obtained from ethics committees of the five general hospitals to which patients with acute head injuries are admitted in Glasgow. Cooperation with ward and accident and emergency staff was also secured. Between February 1995 and February 1996, research staff visited each hospital fre-

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Additional tables and the problem orientated questionnaire appear on the BMJ's website

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quently to identify young people and adults (aged 14 years or more) admitted with head injury. Children were not studied because services for their care are separate and assessment of outcome is more difficult than with older subjects. Patients identified by the research team were compared with routine hospital statistics (Scottish morbidity records) on patients admitted under ICD-9 (international classification of diseases, ninth revision) codes 800-804 (skull fractures) and 850-854 (brain injuries).

Data were extracted from case records to characterise the patient and the cause and severity of injury on arrival at hospital. These were stratified according to the Glasgow coma score as mild (scores 13-15), moderate (9-12), or severe (3-8).[6–8] We provided written information about our study to the patients or relatives and obtained their consent for participation at the time of admission, or as soon as possible after discharge, and at further contact at three and six months. By using standard, structured questionnaires, we obtained information from the patients, relatives, or carers by telephone interview or postal questionnaire one year after the injury. This was supplemented by personal interview when additional data were needed.

Glasgow outcome scale

Overall outcome was assessed with the Glasgow outcome scale, which is a widely used measure of the outcome of patients with head injuries: people rated as severely disabled are unable to support themselves for 24 hours in society; those rated as moderately disabled have significant restrictions in lifestyle or work capacity, or both; and those rated as good recovery have resumed their previous lifestyle.[9 10] Changes in activities, including employment, and services received were assessed by questionnaires derived from the McKinlay relatives questionnaire (see figure A on website).[11]

Table 1 Severity of head injury in young people and adults admitted to hospital over one year in Glasgow, in the cohort selected for follow up, and in those successfully followed up. Values are numbers (percentages) unless stated otherwise

Initial severity	Glasgow coma score	Patients (n=2962)	Selected sample (n=769)	Followed up (n=549)
Mild	13-15	2668 (90)	507 (66)	362 (66)
Moderate	9-12	133 (5)	133 (17)	97 (18)
Severe	≤8	102 (3)	101 (13)	73 (13)
Unclassified	NA	59 (2)	28 (4)	17 (3)

NA=not applicable.

Table 2 Early characteristics of patients selected for follow up and those successfully followed up. Values are numbers (percentages) unless stated otherwise

Characteristics	Selected sample (n=769)	Followed up (n=549)
Median age (years) (range)	38 (14-98)	39 (14-98)
Men	613 (80)	442 (81)
Women	156 (20)	107 (19)
Cause of injury:		
Fall	354 (46)	245 (45)
Assault	219 (28)	156 (28)
Road traffic accident	82 (11)	F63 (12)
Other injury:		
Minor	362 (47)	250 (46)
Moderate to major	167 (22)	130 (24)
Alcohol involved or suspected	529 (69)	368 (67)
Drinking excessive or requiring treatment	301 (39)	227 (41)
Physical limitations	215 (28)	154 (28)
Previous head injury	229 (30)	162 (30)
Previous brain illness*	207 (27)	154 (28)

*Mental problems, stroke, or other condition requiring medical attention.

Statistical analysis

We assessed the association between initial severity of injury and outcome one year later with χ^2 tests for trend. Predictors of death or disability in patients with mild injuries were identified by using logistic regression with forward stepwise selection of variables. The overall proportion of patients surviving with disability was estimated by extrapolating the proportions observed in the three strata of severity, taking account of the differing sampling fractions.

Results

Population

We identified 2995 young people and adults admitted to hospital with a head injury, of whom 2962 lived in Glasgow. Comparison with routine hospital data showed that we had identified more than 99% of relevant cases, but 20% of those we had identified were not contained in health service statistics.

The characteristics of the cohort agreed with previous surveys[1]: 1255 (42%) were men aged 40 years or less, 575 (19%) were men and women aged 65 years or more, and most (90%) were classified as having a mild injury. The most common causes of injury were falls (43%) or assaults (34%); alcohol was often involved (61%), and a quarter reported treatment for a previous head injury. Most (83%) were discharged within 48 hours (see table B on website).

We excluded the 33 patients who lived outside Glasgow. We aimed to follow up all patients with severe (102 patients) or moderate (133) head injuries and a random sample of patients with mild (507) and unclassified (28) injuries, stratified by presenting hospital and randomly selected by using a computer generated list (table 1). For logistical reasons we excluded one of the severely injured patients. We successfully followed up 549 (71%) of the 769 patients selected. The rate of follow up was similar for the categories of severity (mild 71%, moderate 73%, severe 72%), and the characteristics of those successfully followed up were closely representative of the randomly selected group (table 2), apart from those who were not traced having a shorter hospital stay (80% *v* 71% for a stay of ≤2 days) and being given a return appointment less often (9% *v* 22%).

Outcome at one year

Increased severity of injury on admission (table 3) was associated with an increased rate of death or vegetative state ($\chi^2=42.7$, 1df, $P<0.001$) and a decreased rate of good recovery (20.6, $df=1$, $P<0.001$). In contrast, the initial severity of injury was not related to late disability (0.00, $df=1$, $P=0.95$), which occurred in almost half of each group: mild (47%, 95% confidence interval 42% to 52%), moderate (45%, 35% to 56%), and severe injury (48%, 36% to 60%). Most survivors of severe head injury (78%) were disabled; disability was also common and occurred at a similar rate in survivors of mild (51%) and moderate injuries (54%).

Table 3 Outcome related to initial severity of head injury one year later. Values are numbers (percentages) unless stated otherwise

Initial severity	Glasgow coma score	No of patients	Outcome			
			Dead or vegetative	Severe disability	Moderate disability	Good recovery
Mild	13-15	362	29 (8)	71 (20)	100 (28)	162 (45)
Moderate	9-12	97	16 (16)	21 (22)	23 (24)	37 (38)
Severe	3-8	73	28 (38)	21 (29)	14 (19)	10 (14)
Uncertain or not obtained	NA	17	4 (24)	4 (24)	4 (24)	5 (29)

NA=Not applicable.

Specific problems were reported most often after severe injury, but were also common in survivors of moderate or mild injury (table 4) (see table C on website). Increased dependency was reported in 15 of 33 survivors of severe injury (45%), 21 of 70 (30%) survivors of moderate injury, and 88 of 310 (28%) survivors of mild injury. Employment status before injury was known for 407 patients (39 severe, 77 moderate, 291 mild). The number of patients who were in paid employment, were housewives, or were in further education decreased from 173 (42%) before injury (18 severe, 30 moderate, 125 mild) to 116 (28%) after injury (5 severe, 25 moderate, 79 mild). The number of patients unfit for work increased from 64 (16%; 5 severe, 8 moderate, 52 mild) to 130 (32%; 22 severe, 17 moderate, 91 mild) including 43 (33%; 12 severe, 3 moderate, 29 mild) of those previously employed.

Follow up

Of the disabled survivors, less than half (114, 47%) were seen in hospital after discharge, and only 71 (28%) were reported as having received input from rehabilitation services. Despite the predominance of "mental" sequelae, the most commonly provided service was physiotherapy. Only 37 patients (15%) had contact with social work services. The most common contact reported for disabled survivors was with their general practitioner (91%), but only 117 (54%) of such contacts were related to the head injury

Incidence of disability

Of the initial cohort, 2668 had mild injuries, 133 moderate injuries, and 102 severe injuries; in 59 severity was unknown. On the basis of the proportion of patients assessed at one year to be severely or moderately disabled (47%, 45%, 48% and 47% respectively in the four categories), we estimate that 1397 survived with disability. Of these, 1260 (90%) had had mild injuries. In the Glasgow population of 909 498 (statistics for 1995-6 from the general register office, Scotland) this corresponds to a rate of 154 per 100 000 population (95% confidence interval about 138 to 169, taking account only of the statistical variability in the rates of survivors with disability). Even assuming that all patients not assessed at one year had made a good recovery, a rate of more than 100 per 100 000 population can still be projected.

Predictors of death or disability in mildly injured patients

A univariate analysis restricted to patients who were mildly injured identified age, sex, cause of injury, pre-existing physical limitations, and a documented history of brain illness as significant predictors of death or disability at one year (table 5). A multivariate logistic regression analysis identified age of more than 40 years (odds ratio 1.80, 1.11 to 2.91), pre-existing physical limitations (2.24, 1.30 to 3.86), and a history of brain illness (2.07, 1.33 to 3.21) as independent predictors of a poor outcome. Nevertheless, 107 of the 362 mildly injured patients had none of these predisposing risk factors, yet 37 (35%) still failed to achieve a good recovery. In these analyses patients with missing data on medical history were assumed not to have a history of the relevant condition, but this applied to only 10 of

Table 4 Distribution of outcome and problems reported for survivors of mild, moderate, and severe head injuries. Values are numbers (percentages) unless stated otherwise

	Mild* (n=333)	Moderate† (n=81)	Severe‡ (n=45)
Glasgow outcome scale			
Severe disability	71 (21)	21 (26)	21 (47)
Moderate disability	100 (30)	23 (28)	14 (31)
Good recovery	162 (49)	37 (46)	10 (22)
Percentage of patients with specific problems§			
Activities of daily living¶:			
In home	22	28	42**
Outside	34	38	67**
Physical	58	66	82**
Mental:			
Cognitive	43	49	76**
Mood	47	48	76**

Glasgow coma scores: *13-15; †9-12; ‡≤8.
§No of patients responding in each group varied: mild, 321-333; moderate, 77-80; severe 41-45.
¶Eating, dressing, using the telephone, housework (in home); shopping, transport, leisure (outside); vision, hearing, fits, sleep, tiredness, balance, headache, speech (physical); decision making, memory, concentration (cognitive); anxiety, pressure, depression, irritability, temper (mood).
**Excess of patients in severe group with problems was significant (P<0.01 by χ^2 test comparing severe group with pooled mild to moderate group). All comparisons between mild and severe groups were highly significant (P<0.01). Comparisons between moderate and severe groups were significant (P<0.01) for activities of daily living, outside, cognitive, and mood. Comparisons were borderline but non-significant for activities of daily living in home (P=0.11) and physical (P=0.06).

Table 5 Predictors of death and disability in 362 mildly injured patients. Values are numbers (percentages)

	Moderate disability or worse	Good recovery
Age (years):		
≤40	93 (46)	111 (54)
>40	107 (68)	51 (32)
Sex:		
Men	149 (52)	137 (48)
Women	51 (67)	25 (33)
Cause of injury:		
Fall	97 (60)	65 (40)
Assault	67 (55)	54 (45)
Road traffic accident	13 (36)	23 (64)
Other or missing	23 (53)	20 (47)
Pre-existing physical limitations:		
No	122 (48)	134 (52)
Yes	78 (74)	28 (26)
History of brain illness:		
No	90 (46)	105 (54)
Yes	110 (66)	57 (34)

the 107 patients and should not have introduced substantial bias.

Discussion

Principal findings

This is the first study of the outcome of a representative cohort of adult patients with head injuries admitted to hospital from an identified population in the United Kingdom. The high frequency of sequelae, particularly among patients with an apparently mild injury, leads to an estimate of the incidence of disability which is higher than in previous reports from the United Kingdom or other countries.[2–4 12]

Strengths and weaknesses of study

Recognised challenges in research into head injuries are the large numbers of patients admitted out of hours for short periods to several different wards and the difficulties in follow up.[13] Reliance on routine hospital data would have substantially underestimated the incidence of admissions, as noted by others.[14] In contrast, we identified almost all appropriate patients, and our rate of follow up—particularly for mild injuries (71%)—compares well with previous reports (32% to 79%).[6 15] The distribution of early characteristics in our initial cohort, including those predictive of sequelae, was closely representative of the randomly selected cohort. Although caution is needed,[8] we doubt that substantial bias exists.

The Glasgow outcome scale is the most widely used measure of the outcome of patients with head injuries and is well suited to large cohorts.[16] The structured approach we used counteracts previously reported shortcomings from low observer agreement and subjective application, which are likely to have led to underestimation of disability in previous work.[10 17] The classes of severe or moderate disability show strong correlations with neuropsychological limitations and with ratings for impaired social functioning and other components of the short form 36 questionnaire.[16] Concordance was found between the occurrence of disability in survivors and specifically reported problems, which had a pattern and frequency similar to those found in previous investigations.[18] Although some of the problems reported to us may have been experienced before injury, the Glasgow outcome scale is assessed in comparison to the state before injury. Reported disability is an addition to any pre-existing problems. Limitation in the information obtained by structured telephone interviews and questionnaires, or lack of insight as a consequence of injury, are likely to have led to us underestimating rather than overestimating problems in patients.[17]

Relation to other studies

Differences in methods make comparisons with previous work difficult; moreover, local variations in the populations affected and the type of injury are possible. Although a substantially lower rate of disability was found in a French study that included children,[12] our findings concur with the original report of mild injuries in the United States, in which 49% of survivors had a worse financial status than before the injury, 34% were no longer employed, and only 16% were free of sequelae.[6] The report of persisting disability in 40-50% of patients with moderate injury in the east of Scotland suggests that our results are not unrepresentative of urban British populations.[19]

What is already known on this topic

Disability one year after admission to hospital is as common after apparently mild head injuries as after more serious ones

Reduced prospects of employment and increased dependency are often reported for survivors of mild head injuries

Provision of support and rehabilitation for disabled survivors is inadequate

What this paper adds

The annual incidence of disability in adults with head injuries admitted to hospital is 100-150 per 100 000 population, much greater than previously anticipated

Classing a head injury as "mild" when the Glasgow coma score is 13-15 on admission to hospital is inappropriate in many instances

The increased frequency of disability in patients with apparently mild head injuries but who were aged 40 years or more or who had a previous head injury or other health problems accords with previous work.[19] Such patients formed a substantial proportion of our cohort and if excluded would have led to an inappropriately low estimate of frequency of disability. Nevertheless, even among our patients aged less than 40 years with no "adverse" factors, a third (35%) failed to achieve a good recovery. We support the view, based on findings such as abnormalities on computerised tomograms in 31% of similar patients, that it may be inappropriate to class these injuries as "mild."[20]

Implications of study

The range of estimates of the incidence of newly disabled young people and adults after a head injury yielded by our data (100-150 per 100 000 population per year) is substantially higher than previous estimates. We believe that earlier data were based on less representative populations. In particular, previous UK studies were limited to patients with more serious injuries admitted to a neurosurgical unit.[2 3 5]

We did not investigate the extent to which persisting disability might have been influenced by management. Structured rehabilitation is advocated for more seriously injured patients, and comparatively simple follow up has been reported to be beneficial to mildly injured patients.[18 21 22] The paucity of follow up reported by patients or their carers in this study is likely to reflect the recognised lack of facilities for support of patients with head injuries rather than a lack of need or of potential to benefit.[23 24] Further investigations should seek to confirm if our findings apply widely and should aim to evaluate services to promote recovery and reduce sequelae of head injuries of all severities.

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Contributors: GMT, JMcE, and CWR designed the study, ST supervised collection of the data, and GDM and KIP analysed the results. All authors contributed to the interpretation and drafting of the paper and will act as guarantors for the paper.

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Competing interests: GMT has been reimbursed by government and professional scientific bodies and commercial organisations for attending scientific symposiums. Other research into head injuries by his department has been supported by the Scottish Health Department, the Medical Research Council, and Bayer, Novartis, Parke-Davies, and Cambridge Neuroscience. The University of Glasgow has received fees on GMT's behalf for advice and consultancy work to the foregoing bodies and Pharmos, SmithKline Beecham, GlaxoWellcome, and Pfizer, and for providing reports on medicolegal cases. GMT is director of three charitable organisations: the Head Injury Trust, Scotland; the European Brain Injury Consortium; and the International Neurotrauma Society.

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US women's attitudes to false positive mammography results and detection of ductal carcinoma in situ: cross sectional survey

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Abstract

Objective To determine women's attitudes to and knowledge of both false positive mammography results and the detection of ductal carcinoma in situ after screening mammography.

Design Cross sectional survey.

Setting United States.

Participants 479 women aged 18-97 years who did not report a history of breast cancer.

Main outcome measures Attitudes to and knowledge of false positive results and the detection of ductal carcinoma in situ after screening mammography.

Results Women were aware that false positive results do occur. Their median estimate of the false positive rate for 10 years of annual screening was 20% (25th percentile estimate, 10%; 75th percentile estimate, 45%). The women were highly tolerant of false positives: 63% thought that 500 or more false positives per life saved was reasonable and 37% would tolerate 10 000 or more. Women who had had a false positive result (n = 76) expressed the same high tolerance: 39% would tolerate 10 000 or more false positives. 62% of women did not want to take false positive results into account when deciding about screening. Only 8% of women thought that mammography could harm a woman without breast cancer, and 94% doubted the possibility of non-progressive breast cancers. Few had heard about ductal carcinoma in situ, a cancer that may not progress, but when informed, 60% of women wanted to take into account the possibility of it being detected when deciding about screening.

Conclusions Women are aware of false positives and seem to view them as an acceptable consequence of screening mammography. In contrast, most women are unaware that screening can detect cancers that may never progress but feel that such information would be relevant. Education should perhaps focus less on false positives and more on the less familiar outcome of detection of ductal carcinoma in situ.

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