

Outcomes following childhood head injury: a population study

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Objectives: To identify outcomes following head injury (HI) among a population of children admitted to one hospital centre and to compare outcomes between different severity groups.

Methods: A postal follow up of children admitted with HI to one National Health Service Trust, between 1992 and 1998, was carried out. Children were aged 5–15 years at injury (mean 9.8), followed up at a mean of 2.2 years post-injury. Parents of 526 injured children (419 mild, 58 moderate, 49 severe) and 45 controls completed questionnaires. Outcomes were assessed using the King's Outcome Scale for Childhood Head Injury (KOSCHI).

Results: Frequent behavioural, emotional, memory, and attention problems were reported by one third of the severe group, one quarter of the moderate, and 10–18% of the mild. Personality change since HI was reported for 148 children (28%; 21% mild HI, 46% moderate, 69% severe). There was a significant relationship between injury severity and KOSCHI outcomes. Following the HI, 252 (48%) had moderate disability (43% mild HI, 64% moderate, 69% severe), while 270 (51%) made a good recovery (57% mild HI, 36% moderate, 22% severe). There was a significant association between social deprivation and poor outcome ($p=0.002$). Only 30% (158) of children received hospital follow up after the HI. All children with severe disability received appropriate follow up, but 64% of children with moderate disability received none. No evidence was found to suggest a threshold of injury severity below which the risk of late sequelae could be safely discounted.

Conclusions: Children admitted with mild HI may be at risk of poor outcomes, but often do not receive routine hospital follow up. A postal questionnaire combined with the KOSCHI to assess outcomes after HI may be used to identify children who would benefit from clinical assessment. Further research is needed to identify factors that place children with mild HI at risk of late morbidity.

Head injury (HI) is a leading cause of mortality or permanent disability in children and adolescents.^{1–3} In the UK, it has been estimated that each year, approximately 3000 children acquire significant new neurological or cognitive disability as a result of HI.⁴ Head injury has been the subject of a recent UK Government Enquiry,⁵ which called for research on the incidence of HI and subsequent disability, to help inform planning for community based health care.

For children, a head injury can lead to persistent cognitive and neurobehavioural deficits, intellectual, academic, and personality adjustment problems,^{6–10} and family stress.^{11–13} Children with head injuries may present with a variety of prolonged difficulties and problems, all of which may interact in a complex manner.¹⁴ Even mild HI may lead to persistent cognitive and behavioural deficits.^{15–17}

The measurement of outcomes following childhood head injury has been hampered by the absence of simple but reliable measures and this has hindered direct comparisons between different studies. For adults, the Glasgow Outcome Scale (GOS)¹⁸ is widely used, but until recently, there has been no equivalent scale for children. A new scale, the King's Outcome Scale for Childhood Head Injury (KOSCHI), has been developed to measure outcomes following HI in children, based on the GOS, but with extra sensitivity at the milder end of the disability range.¹⁹

The current study was designed to carry out a postal follow up of all children admitted with a head injury to a single hospital centre serving one health region. The aim was to compare outcomes between different severity groups using the KOSCHI.

METHODS

Subjects

The population forming the study group was identified by using a comprehensive Head Injury Register of all children admitted to North Staffordshire Hospital NHS Trust with a head injury. The Register is maintained by a dedicated head injury nurse and linked to the Trauma Centre. Patients were identified retrospectively from November 1992–December 1997, and prospectively from January–December 1998. During this period, there were 986 children on the register. Of these 12 (1.2%) died as a result of the HI. In 1998, a postal questionnaire was sent to the parents of all 974 surviving children aged 5–15 years at injury. All children had been discharged from acute hospital care. Questionnaires were completed by 526 parents. The children of 523 respondents were living in the community at the time of the survey.

For all surviving children, injury severity was determined by Glasgow Coma Scale (GCS)²⁰ scores and/or duration of loss of consciousness, using the classification of mild, moderate, or severe head injury defined by the British Society of Rehabilitation Medicine (table 1).²¹ In North Staffordshire, GCS is reliably recorded as it is used routinely in a major longitudinal study on trauma.

A control group was identified by interviewing a sub-group of 97 questionnaire respondents (49 mild HI, 19 moderate, and 29 severe). The family was asked to give details of a child without history of head injury, and of the same age and sex as the injured child to act as a control. Forty five control

Abbreviations: GOS, Glasgow Outcome Scale; HI, head injury; KOSCHI, King's Outcome Scale for Childhood Head Injury; SEN, special educational needs

Table 1 Definitions of injury severity

Severity of traumatic brain injury	Definition
Mild	An injury causing unconsciousness for less than 15 minutes and a GCS after initial resuscitation of 13–15
Moderate	An injury causing unconsciousness for more than 15 minutes and a GCS after initial resuscitation of 9–12
Severe	An injury causing unconsciousness for more than 6 hours and a GCS after initial resuscitation of 3–8

children participated in the study; none had a history of head injury or any neurological abnormality. Parents of control children completed the same checklist of current symptoms as parents of the HI group.

Questionnaire content

A list of symptoms was devised using commonly reported problems identified from the literature and the King's HI outpatient follow-up checklist.¹⁹ The questionnaire explored changes in the child post-HI, and covered mobility, behaviour, personality, mood, depression, anxiety, memory, attention, communication, comprehension, sleep pattern, nightmares, headaches, sensory difficulties, epilepsy, other injuries (for example, orthopaedic), return to school, learning difficulties, special educational needs status, and school related problems.

Questionnaires were sent to parents/guardians together with a letter explaining the study and inviting them to discuss issues raised by the survey with a head injury nurse. Four weeks later, non-responders were sent a second letter and another copy of the questionnaire. Four weeks after this, non-responders were telephoned by the head injury nurse inviting them to participate.

Measurement of outcome

Outcomes were calculated using KOSCHI scores derived from questionnaire responses. All questionnaires were scored, without knowledge of injury severity, by one team member (CH), who is experienced in using the KOSCHI and was a participant in the KOSCHI inter-rater reliability exercise.¹⁹ The KOSCHI (table 2) contains five main categories: 1 = death, 2 = vegetative, 3 = severe disability, 4 = moderate disability, and 5 = good recovery. Categories 3, 4, and 5 are sub-divided into (a) more deficits and (b) fewer deficits.

The Townsend Deprivation Index was used to measure social deprivation, using postcodes.²² The higher the positive score the more deprived an area and the higher the negative score the more prosperous. For the UK, the average score is 0, for North Staffordshire the average score is -0.49 .

Statistical analyses were carried out using SPSS Version 9.0. Categorical data were analysed using χ^2 tests; the χ^2 test for trend was used to determine whether there was a linear trend across severity groups. Normally distributed continuous data was analysed using Student's *t* test.

RESULTS

Forty eight envelopes were returned as undeliverable (addressee untraceable). Of the 926 presumed valid addresses, completed questionnaires were returned by 526 families, an overall response rate of 56.8%, averaged over 6 years of recruitment between 1992 and 1998. Response rates for different severity groups were: mild 55.6% (419 returned/753 sent); moderate 57.4% (58 returned/101 sent); severe 68.1% (49 returned/72 sent). Within 2 years of injury the overall response rate was 62.8% (218 returned/347 sent),

Table 2 KOSCHI category definitions

Category	Definition
1 Death	
2 Vegetative	Breathes spontaneously. No evidence of verbal or non-verbal communication or response to commands.
3 Severe disability A	Conscious, totally dependent. May be able to communicate. Requires specialised educational/rehabilitation setting.
Severe disability B	Limited self care abilities and predominantly dependent. May have meaningful communication. Requires specialised educational/rehabilitation setting.
4 Moderate disability A	Mostly independent for daily living, but needs a degree of supervision/help for physical or behavioural problems. Has overt problems. May be in specialised rehabilitation/educational setting or in mainstream school requiring special needs assistance. Behavioural problems may have caused patient to be disciplined or excluded from school.
Moderate disability B	Age appropriately independent for daily living, but with neurological sequelae frequently affecting daily life, including behavioural and learning difficulties. May also have frequent headaches. Likely to be in mainstream school with or without special needs assistance.
5 Good recovery A	Appears to have made a full functional recovery, but has residual pathology attributable to head injury. May suffer headaches that do not affect school or social life, and may occasionally have some of the problems listed on the head injury checklist.
Good recovery B	The information available implies that child has made a complete recovery. No sequelae identified.

representing 173 (62.8%) mild, 23 (62.2%) moderate, and 22 (68.8%) severe.

In order to ensure that responders were representative of all children admitted to North Staffordshire NHS Trust with HI, patient characteristics of questionnaire responders were compared with those of non-responders. There were no statistically significant differences between groups. Responders were virtually identical to non-responders for sex (male: responders 70%, non-responders 67%), injury severity (responders: 80% mild, 11% moderate, 9% severe; non-responders: 83% mild, 11% moderate, 6% severe), age at injury (mean of 9.8 years, both groups), ethnicity (97% white, both groups), time since injury (mean no. of years post-injury: responders 2.1, non-responders 2.5) and social deprivation (Townsend means: responders: +1.0, non-responders: +1.4).

Participants

Participants were 526 children with HI, aged 5–15 years at injury. The most common causes of HI were falls (213, 40.5%) and road traffic accidents (144, 27.4%), especially as pedestrians (92, 17.5%). At follow up, children ranged from ≤ 1 year post-injury (106, 20.2%) to 6 years post-injury (57, 10.8%), with a mean (SD) of 2.2 (1.7) years. Characteristics of participants are shown in table 3.

The mean (SD) Townsend deprivation score for families in the HI group was +0.69 (2.9), compared with the mean score (-0.49) for the general population of North Staffordshire using the one sample *t* test. The difference was significant ($p = 0.001$, $t = 9.08$, 95% confidence interval (CI) 0.92 to 1.44). The majority of families lived in areas with positive scores (60.6%); 62 families (10.9%) lived in considerably deprived areas (scores of $\geq +3.55$), whereas 95 families (19.2%) lived in the most affluent areas (scores of ≤ -2.4). In the control group, the mean (SD) Townsend deprivation

Table 3 Characteristics of the study group

Variable	Mild HI n=419	Moderate HI n=58	Severe HI n=49	Control n=45
Gender: no. male (%)	292 (69.7)	47 (81)	29 (59.2)	27 (60)
Age at injury (years)				NA
Mean	9.6	10.12	11.24	
Median	9.0	11.0	11.0	
SD	3.08	3.0	3.16	
Range	5–15	5–15	5–15	
Age at time of follow-up (years)				
Mean	12.31	12.81	13.76	11.91
Median	12.0	13.0	13.0	12.0
SD	3.52	3.46	3.52	2.89
Range	5–21	7–21	7–21	5–17
Years between injury and follow-up				NA
Mean	2.23	2.29	1.86	
Median	2.0	2.0	2.0	
SD	1.64	1.77	1.51	
Range	0–5	0–5	0–5	
Ethnicity: no. white (%)	397 (94.7%)	58 (100%)	47 (95.9%)	44 (97.8%)
Mechanism of injury				NA
Fall (%)	193 (46.1%)	16 (27.6%)	4 (8.2%)	
RTA pedestrian (%)	48 (11.5%)	15 (25.9%)	29 (59.2%)	
RTA in vehicle (%)	8 (1.9%)	4 (6.9%)	8 (16.3%)	
RTA cyclist (%)	22 (5.3%)	4 (6.9%)	6 (12.2%)	
Fall from bicycle (%)	44 (10.5%)	3 (5.2%)	0	
Assault (%)	20 (4.8%)	4 (6.9%)	0	
Hit by object	60 (14.3%)	3 (5.2%)	1 (2%)	
Sport	17 (4.1%)	5 (8.6%)	0	
Other	7 (1.7%)	4 (6.9%)	1 (2%)	
Total	419 (100%)	58 (100%)	49 (100%)	

NA, not available.

score was -0.103 (2.6). Townsend scores were compared for the control and HI groups using the independent samples *t* test; there was no significant difference between groups ($p = 0.114$, $t = 1.58$, 95% CI: -0.19 to 1.76).

Other injuries

Along with the HI, 209 (39.8%) had suffered other injuries at the time, such as fractures, chest, or facial injuries. Other injuries were suffered by 145 children (34.6%) with mild, 28 (49.1%) with moderate, and 36 (73.5%) with severe HI. There was a significant linear trend across severity groups ($p = 0.0001$, $\chi^2 = 35.16$, $df = 1$). At follow up, other injuries were still affecting 62 (14.8%) of the mild, 16 (28.1%) of the moderate, and 15 (30.6%) of the severe groups. There was a significant linear trend across severity groups ($p = 0.0001$, $\chi^2 = 14.3$, $df = 1$). Overall, 10 children (1.9%) suffered from epilepsy, which was a new problem since the HI for 8 of them (5 mild (1.2%), 1 moderate (1.8%), 2 severe (4.1%)). There were no significant differences between groups. The incidence of epilepsy amongst children in the UK as a whole is 0.7–0.8%.²³

Hospital follow up post-injury

After hospital discharge, 30% (158) of the study group were followed up by the admitting hospital. In the mild group, 91 children (21.7%) were followed up; however many of these appointments were due to accompanying other injuries. Half of the moderate group (29, 50.9%), and 38 of the severe group (77.6%) had a follow up appointment. There was a significant linear trend across severity groups ($p = 0.0001$, $\chi^2 = 71.37$, $df = 1$).

Only 40 children (7.6%) received any form of therapy following their head injury: 14 mild (3.3%), 8 moderate (14%), and 14 severe (36.7%). There was a significant linear trend across severity groups ($p = 0.0001$, $\chi^2 = 71.25$, $df = 1$). Questionnaire respondents were invited to discuss issues raised by the questionnaire with a head injury nurse. One third of parents (182, 34.6%) accepted this offer: 131 (31.2%) in the mild, 23 (40.4%) in the moderate, and 28 (57.1%) in

the severe group. There was a significant linear trend across severity groups ($p = 0.0001$, $\chi^2 = 13.69$, $df = 1$).

Return to school and identification of special needs

Most children (475, 90.6%) returned to the same school after the injury, those who did not were 40 mild (9.5%), 2 moderate (3.4%) and 8 severe (16.3%). For the mild group, the most usual reason for not returning to the same school was moving from junior to high school rather than because of the injury. At the time of the survey, current schoolteachers knew of the child’s head injury in only 209 cases (39.8%), (140 (33.4%) mild, 32 (55.2%) moderate, and 37 (77.1%) severe). There was a significant linear trend across severity groups ($p = 0.0001$, $\chi^2 = 40.62$, $df = 1$).

Following the HI, special educational needs (SEN) were identified for 40 children (7.6%): 23 mild (5.5%), 2 moderate (3.4%), and 15 severe (31.3%). There was a significant linear trend across severity groups ($p = 0.0001$, $\chi^2 = 28.44$, $df = 1$). However, according to parents, SEN help was actually provided for only 26 children (65%): 15 mild (3.6%), 2 moderate (3.4%) and 9 severe (18.8%), also showing a significant linear trend across groups ($p = 0.0001$, $\chi^2 = 19.0$, $df = 1$).

At follow up, 98 children (18.7%) were currently having difficulties with schoolwork and there was a significant linear trend across severity groups: 65 mild (15.5%), 16 moderate (27.6%), and 17 severe (35.4%) ($p = 0.0001$, $\chi^2 = 14.5$, $df = 1$). Since the HI, 96 children (18.3%) had been disciplined by the school for problem behaviour (71 mild (16.9%), 14 moderate (24.1%), 11 severe (22.9%)); 27 (5.1%) had been excluded from school (21 mild (5%), 3 moderate (5.2%), 3 severe (6.3%)). There were no significant differences between groups.

Current symptoms

Parents of 148 children (28.1%) believed that the personality of their child had changed since the HI. Of these, 88 (20.9%) had mild, 26 (46.4%) moderate, and 34 (69.4%) severe HI.

Table 4 Current symptoms frequently experienced by the child, as reported by parents

Current symptom	Mild HI	Moderate HI	Severe HI	Control	Significance (df = 1)
Headaches (n = 565)	65 (15.6%)	9 (16.4%)	13 (27.7%)	2 (4.4%)	p = 0.002
Dizziness (n = 559)	12 (2.9%)	2 (7.5%)	3 (6.4%)	0	p = 0.009
Temper outbursts (n = 560)	54 (13%)	17 (31.5%)	16 (34%)	0	p = 0.0001
Mood swings (n = 563)	76 (18.2%)	17 (31.5%)	17 (36.2%)	1 (2.2%)	p = 0.0001
Anxiety (n = 559)	25 (6.1%)	13 (23.6%)	12 (26.1%)	1 (2.2%)	p = 0.0001
Nightmares (n = 557)	15 (3.6%)	4 (7.7%)	3 (6.4%)	1 (2.2%)	p = 0.218
Aggressive behaviour (n = 562)	38 (9.2%)	13 (23.6%)	12 (25.5%)	0	p = 0.0001
Feels down or depressed (n = 561)	25 (6%)	10 (18.5%)	9 (19.1%)	0	p = 0.0001
Clumsiness (n = 563)	25 (6%)	7 (13%)	9 (19.1%)	0	p = 0.0001
Tiredness (n = 565)	48 (11.5%)	9 (16.1%)	16 (34%)	1 (2.2%)	p = 0.0001
Balance and co-ordination (n = 562)	9 (2.2%)	3 (5.5%)	10 (20.8%)	0	p = 0.0001
Receptive language (n = 565)	23 (5.5%)	8 (14.5%)	7 (14.6%)	1 (2.2%)	p = 0.0001
Word finding difficulties (n = 562)	15 (3.6%)	7 (13%)	6 (12.8%)	0	p = 0.0001
Expressive language (n = 564)	14 (3.4%)	7 (12.7%)	8 (16.7%)	0	p = 0.0001
Attention (n = 566)	59 (14.1%)	14 (25%)	14 (29.2%)	1 (2.2%)	p = 0.0001
Memory for what has been told (n = 564)	39 (9.4%)	13 (23.2%)	15 (31.9%)	1 (2.2%)	p = 0.0001
Inappropriate behaviours (n = 561)	22 (5.3%)	7 (13%)	10 (21.7%)	0	p = 0.0001

Not all parents answered every question, the total number of respondents is shown for each question.

There was a significant linear trend across severity groups (p = 0.0001, $\chi^2 = 61.25$, df = 1).

The questionnaire contained a list of symptoms and problems associated with head injury. Parents were asked if, during the past few weeks, their child had experienced any of the symptoms "not at all", "occasionally", or "frequently". Children with mild, moderate, and severe HI and control children were compared using the χ^2 test for trend (table 4). There was a significant trend across severity groups for all symptoms except nightmares. Children in the moderate and severe groups experienced most symptoms significantly more frequently than those in the mild group. Only two control children experienced any symptoms frequently.

Current reported symptoms were compared for children ≤ 1 year post-injury and > 1 year post-injury at follow up. There were few significant differences in the frequency of reporting. Recently injured children in the mild group experienced more nightmares (p = 0.008), while the moderate group experienced more nightmares and tiredness (p = 0.005). In the severe group, a higher proportion of those ≤ 1 year post-injury experienced all symptoms more frequently, but significant differences were found for only

headaches (recent injuries 54.5%, less recent injuries 18.9%; p = 0.05) and clumsiness (recent injuries 45.5%, less recent injuries 10.8%; p = 0.02).

KOSCHI outcomes

KOSCHI outcome scores for all children in the mild, moderate, and severe HI groups are shown by main category and sub-category in table 5. Four children with severe HI (8.2%) had severe disability at follow up. Overall, 252 children (47.9%) had moderate disability following the HI, of these 181 (43.2%) had a mild HI. Greater injury severity was associated with worse outcomes (p = 0.0001, $\chi^2 = 61.64$, df = 4). There was also a significant trend across severity groups (p = 0.0001, $\chi^2 = 37.66$, df = 1). When compared over the six sub-categories, most children in the mild group scored 4B or 5A, most of the moderate group scored between 4A and 5A, and most of the severe group scored 4A or 4B (p = 0.0001, $\chi^2 = 87.22$, df = 10).

Outcomes for children followed up within 1 year of injury were also analysed (table 5). There were significant differences between severity groups for the three main categories (p = 0.0001, $\chi^2 = 26.71$, df = 4) and six sub-categories

Table 5 KOSCHI scores by injury severity and time since injury

KOSCHI score	All mild HI (n = 419)	All moderate HI (n = 58)	All severe HI (n = 49)	Mild HI ≤ 1 year post-HI (n = 79)	Moderate HI ≤ 1 year post-HI (n = 15)	Severe HI ≤ 1 year post-HI (n = 12)
3 Severe disability	0	0	4 (8.2%)	0	0	2 (16.7%)
3A	0	0	1 (2.0%)	0	0	1 (8.3%)
3B	0	0	3 (6.1%)	0	0	1 (8.3%)
4 Moderate disability	181 (43.2%)	37 (63.8%)	34 (69.4%)	33 (41.8%)	12 (80%)	8 (66.7%)
4A	34 (8.1%)	15 (25.9%)	17 (34.7%)	10 (12.7%)	5 (33.3%)	5 (41.7%)
4B	147 (35.1%)	22 (37.9%)	17 (34.7%)	23 (29.1%)	7 (46.7%)	3 (25%)
5 Good recovery	238 (56.8%)	21 (36.2%)	11 (22.4%)	46 (58.2%)	3 (20%)	2 (16.7%)
5A	149 (35.6%)	15 (25.9%)	9 (18.4%)	29 (36.7%)	3 (20%)	2 (16.7%)
5B	89 (21.2%)	6 (10.3%)	2 (4.1%)	17 (21.5%)	0	0
Total	419 (100%)	58 (100%)	49 (100%)	79 (100%)	15 (100%)	12 (100%)

($p = 0.0001$, $\chi^2 = 31.57$, $df = 10$). A higher proportion of children in the moderate and severe groups had slightly worse outcomes at ≤ 1 year post-injury than the group as a whole. However, no significant differences in outcome were observed for children ≤ 1 year post-injury compared with children > 1 year post-injury.

KOSCHI scores were compared for children who, according to parental report, had or had not received follow up after hospital discharge. There were significant differences between outcome groups ($p = 0.006$, $\chi^2 = 10.37$, $df = 2$). In the moderate disability group 64% had no follow up, and in the good recovery group 76% had no follow up.

For the mild HI group ($n = 419$), KOSCHI outcomes were analysed according to whether or not the child sustained a skull fracture. Moderate disability was observed for 50.8% (30) of the 59 children with skull fracture and 41.5% (147) of the 354 without (data were missing for 6 children). The difference was not significant ($p = 0.18$, $\chi^2 = 1.79$, $df = 1$). Approximately 20% of both groups made a full recovery (5B).

KOSCHI outcomes were analysed according to Townsend deprivation scores ($n = 495$) using the independent samples t test. Children with good recovery (KOSCHI 5A/5B, $n = 252$), were compared with children with moderate/severe disability (KOSCHI 3A–4B, $n = 243$). A significant relationship was observed between social deprivation and outcomes ($p = 0.001$, $t = -3.27$, 95% CI: -1.4 to -0.3).

DISCUSSION

The postal survey revealed a large group of children with residual symptoms following HI, even up to 6 years post-injury. According to their parents, 148 children had a changed personality following the HI. As a result of the HI, almost half the study group had moderate disability according to the KOSCHI. Of these, one third of the severe group and one quarter of the moderate group had overt problems requiring assistance or supervision. Severe disability was rare, and 270 children (51%) had made a good recovery, yet two thirds of these had some residual symptoms. The profile of questionnaire responders was virtually identical to that of non-responders. Furthermore, half the responders had children with few or no residual problems, indicating that the sample is probably representative of the whole population of head injured children admitted to hospital in North Staffordshire.

The KOSCHI is a simple outcome scale, which proved relatively easy to score by a single experienced rater. However, differences between sub-categories would benefit from further clarification. Most of our respondents (99%) were living with their parents in the community at the time of the survey, most were functionally independent, and few had physical problems. In this group, the classification of "moderate disability" was usually applied to children with learning, behavioural, or neurological sequelae affecting function. Children with severe behavioural problems or learning difficulties requiring supervision or help were placed in category 4A, even though the child was otherwise independent. Children with frequent temper tantrums, mood swings, aggressive behaviours, communication or concentration problems, and mild learning difficulties were placed in 4B. Half the study group had made a good recovery, but only 97 (18.4%) made a full recovery with no discernible sequelae. The most usual reason for placing a child in category 5A (good but not full recovery) was the presence of headaches not interfering with functioning.

The relatively high proportion (43%) of children with mild HI but moderate disability was surprising. Furthermore, evidence of skull fracture was not associated with worse outcomes. The majority of children with mild HI had made a good functional recovery, but had difficulties that interfered

with their daily lives, such as temper outbursts, mood swings, memory problems, and learning difficulties. The authors of the KOSCHI emphasise that relatively minor residual deficits are potentially more destructive to children than to adults, and the scale acknowledges this by identifying sequelae that may interfere with schoolwork and social functioning.¹⁹

The literature is inconclusive regarding the impact of mild HI on outcome, largely because of inconsistencies in the definition of "mild".^{24–27} Our "mild" group are at the more severe end of the spectrum of mild HI, as all had been admitted to hospital, which may help to explain the high proportion of those with moderate disability. However, further prospective research is required to address the important issue of residual disability after mild HI in greater depth, using clearly defined injury severity.

A relationship was observed between social deprivation and outcomes; children from deprived areas were significantly less likely to achieve a good recovery. Other investigators have observed an association between outcome and parental socioeconomic status and deprivation.^{13 28 29}

Cognitive and behavioural problems were frequently reported by our study group, even several years post-injury, a finding consistent with that of other investigators.^{17 30–32} Although data on the frequency of symptoms were reliant upon parental report and thus subjective, it has been argued that parents are more likely to under-report than to exaggerate symptoms.¹⁷ In our study, the mild HI group experienced many symptoms "occasionally" as often as the moderate and severe groups; however, for most symptoms, children in the moderate and severe groups experienced them "frequently", far more often. We observed a significant linear trend across severity groups; increased injury severity was associated with increased symptom reporting.

The teachers of only 209 (39.8%) children were aware of the HI. Given the persistent nature of cognitive and behavioural problems following a moderate or severe HI identified by other studies, this is of concern.^{11 12 31} Following their return to school after the HI, 96 children had been disciplined for problem behaviour, approximately 20% of children in each severity group, and 27 children had been excluded from school. Recent research has found inadequate educational provision for children after head injury, largely due to inaccurate information, and inadequate communication and training.^{33 34} We found that even when SEN were identified, according to parents they were only actually provided for in 65% of cases. The statutory framework for identification and provision of SEN has accepted limitations and the system is currently under review.³⁵ The KOSCHI takes account of educational and behavioural difficulties, and may provide a means of identifying those children at risk of school underachievement, so that extra support can be arranged.

CONCLUSIONS

A significant proportion of children admitted with mild HI was found to have moderate disability at follow up. Given the large numbers of children presenting with mild HI, this represents a high prevalence of persistent problems. We were unable to identify a threshold of injury severity below which the risk of late morbidity could be discounted; however, children from deprived areas may have an increased risk of a poor outcome. It is recommended that further research be carried out to identify alternative risk factors. Although all children in the study had been admitted to hospital following the HI, only 30% of parents reported that their child had been offered a follow up appointment by the hospital. Furthermore, 161 children with moderate disability following HI received no follow up. A solution may be for clinicians to use a postal follow up to assess outcomes after hospital

discharge, using a structured questionnaire incorporating the Kings' HI outpatient follow up checklist. KOSCHI outcome scores may then be used to identify those children who could benefit from follow up assessment; it may therefore be a way of using scarce NHS resources effectively.

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