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**Title: OUTCOMES FOLLOWING CHILDHOOD HEAD INJURY – A  
POPULATION STUDY**

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**Running head: Outcomes following childhood head injury**

## **Abstract**

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

### **Methods:**

A postal follow-up of children admitted with HI to one NHS Trust, between 1992-1998, 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 attentional 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), 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 which place children with mild HI at risk of late morbidity.

Key words: head injury, outcomes, long-term follow-up

## Introduction

Head injury (HI) is a leading cause of mortality or permanent disability in children and adolescents.[1-3] In the United Kingdom 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.[15,16,17]

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.

## **Method**

The population forming the study group was identified utilising 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 to 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 an major longitudinal study on trauma.

Table 1 about here

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 identify a child without history of head injury, and the same age and sex as the injured child to act as a control. Forty-five control children participated in the study, none had a history of head injury, nor any neurological abnormality. Parents of control children completed the same checklist of current symptoms as parents of the HI group.

### *Measures*

#### *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 (e.g. 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), experienced in using the KOSCHI and 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.

Table 2 about here

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 zero, for North Staffordshire the average score is -0.49.

Statistical analyses were carried out using SPSS Version 9.0. Categorical data were analysed using Chi-squared tests, the Chi-squared test for trend was used to determine whether there was a linear trend across severity groups. Normally distributed continuous data was analysed using the 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), 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. 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  $\leq 1$  year post-injury (106,

20.2%) to 6 years post injury (57, 10.8%), with a mean of 2.2 years (SD=1.7).

Characteristics of participants are shown in table 3.

Table 3 about here

The mean Townsend deprivation score for families in the HI group was +0.69 (SD=2.9). This was compared to 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%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  $\leq -2.4$ ). In the control group the mean Townsend deprivation score was -0.103 (SD=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*

Two hundred and nine children (39.8%) had suffered other injuries at the time of the HI, such as fractures, chest or facial injuries. Other injuries were suffered by 145 children (34.6%) with mild HI, 28 (49.1%) moderate, and 36 (73.5%) severe. There was a significant linear trend across severity groups ( $p=0.0001$ ,  $X^2=35.16$ ,  $df=1$ ). 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 ( $p=0.0001$ ,  $X^2=14.3$ ,  $df=1$ ). Overall, 10 children (1.9%) suffered from epilepsy, a new problem since the HI for eight (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*

Thirty percent (158) of the study group were followed-up by the admitting hospital after the head injury. 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 ( $p=0.0001$ ,  $X^2=71.37$ ,  $df=1$ ).

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 ( $p=0.0001$ ,  $X^2=71.25$ ,  $df=1$ ). 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 group, 23 (40.4%) moderate, and 28 (57.1%) severe. There was a significant linear trend across severity groups ( $p=0.0001$ ,  $X^2=13.69$ ,  $df=1$ ).

### *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 school

teachers 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 ( $p=0.0001$ ,  $X^2=40.62$ ,  $df=1$ ).

Following the HI, special educational needs (SENs) 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 ( $p=0.0001$ ,  $X^2=28.44$ ,  $df=1$ ). However, according to parents, SENs were 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 ( $p=0.0001$ ,  $X^2=19.0$ ,  $df=1$ ).

At follow-up, 98 children (18.7%) were currently having difficulties with school work and there was a significant linear trend across severity groups: 65 mild (15.5%), 16 moderate (27.6%), and 17 severe (35.4%) ( $p=0.0001$ ,  $X^2=14.5$ ,  $df=1$ ). 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%)). Twenty-seven (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 son/daughter had changed since the HI. Of these, 88 (20.9%) had a mild HI, 26 (46.4%) moderate, and 34 (69.4%) severe. There was a significant linear trend across severity groups ( $p=0.0001$ ,  $X^2=61.25$ ,  $df=1$ ).

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 Chi-squared 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.

Table 4 about here.

Current reported symptoms were compared for children  $\leq 1$  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 ( $p=0.008$ ), in the moderate group they experienced more nightmares and tiredness ( $p=0.005$ ). In the severe group, a higher proportion of those  $\leq 1$  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 ( $p=0.0001$ ,  $X^2=61.64$ ,  $df=4$ ). There was also a significant trend across severity groups ( $p=0.0001$ ,  $X^2=37.66$ ,  $df=1$ ). When compared over the 6 sub-categories, most children in the mild group scored at 4B or 5A, most of the moderate group scored between 4A and 5A, and most of the severe group scored at 4A or 4B ( $p=0.0001$ ,  $X^2=87.22$ ,  $df=10$ ).

Table 5 about here.

Outcomes for children followed-up within one year of injury were also analysed (table 5). There were significant differences between severity groups for the 3 main categories ( $p=0.0001$ ,  $X^2=26.71$ ,  $df=4$ ) and 6 sub-categories ( $p=0.0001$ ,  $X^2=31.57$ ,  $df=10$ ). A higher proportion of children in the moderate and severe groups had slightly worse outcomes at  $\leq 1$  year post-injury than the group as a whole. However, no significant differences in outcome were observed for children  $\leq 1$  year post-injury compared to 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 ( $p=0.006$ ,  $X^2=10.37$ ,  $df=2$ ). 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 was missing for 6). The difference was not significant ( $p=0.18$ ,  $X^2=1.79$ ,  $df=1$ ).

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 six 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 symptomatology. 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 discernable 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 which 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 which may interfere with their school 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'. [24,25,26,27] 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.[17,30,31,32] 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 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.

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] Ninety-six children had been disciplined for problem behaviour since returning to school after the HI, approximately 20% of children in each severity group. Twenty-seven children had been excluded from school. Recent research has found inadequate educational provision for children after head injury, largely due to inaccurate information, communication and training.[33,34] We found that even when special educational needs (SENs) were identified, according to parents they were only actually provided for in 65% of cases. The statutory

framework for identification and provision of SENs 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 were 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 and may, therefore, be a way of using scarce NHS resources effectively.

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*Table 1: Definitions of Injury Severity*

<i>Severity of Traumatic Brain Injury</i>	<i>Definition</i>
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

Table 2 KOSCHI category definitions

<i>Category</i>		<i>Definition</i>
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. His behavioural problems may have caused him to be disciplined or excluded from school.
	Moderate disability B	Age-appropriately independent for daily living, but with neurological sequelae frequently affecting his daily life, including behavioural and learning difficulties. He 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. He may suffer headaches which do not affect his 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.

Table 3 Characteristics of the study group

Variable	Mild HI n = 419	Moderate HI n = 58	Severe HI n = 49	Control n = 45
Gender: number 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: number white (%)	397 (94.7%)	58 (100%)	47 (95.9%)	44 (97.8%)
Mechanism of injury				N/A
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%)	

**Table 4** *Current symptoms frequently experienced by the child, as reported by parents*  
(Not all parents answered every question, the total number of respondents is shown for each question.)

<i>Current Symptom</i>	<i>Mild HI</i>	<i>Moderate HI</i>	<i>Severe HI</i>	<i>Control</i>	<i>Significance (df=1)</i>
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

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)
<b>3 Severe Disability</b>	<b>0</b>	<b>0</b>	<b>4 (8.2%)</b>	<b>0</b>	<b>0</b>	<b>2 (16.7%)</b>
3A	0	0	1 (2.0%)	0	0	1 (8.3%)
3B	0	0	3 (6.1%)	0	0	1 (8.3%)
<b>4 Moderate Disability</b>	<b>181 (43.2%)</b>	<b>37 (63.8%)</b>	<b>34 (69.4%)</b>	<b>33 (41.8%)</b>	<b>12 (80%)</b>	<b>8 (66.7%)</b>
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%)
<b>5 Good Recovery</b>	<b>238 (56.8%)</b>	<b>21 (36.2%)</b>	<b>11 (22.4%)</b>	<b>46 (58.2%)</b>	<b>3 (20%)</b>	<b>2 (16.7%)</b>
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%)