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Title: Behaviour and school performance after brain injury

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Running head: **behaviour and school performance after brain injury**

Abstract

Primary Objective: To examine the relationship between behavioural problems and school performance following traumatic brain injury (TBI)

Methods and Procedures: Subjects: 67 school-age children with TBI (35 mild, 13 moderate, 19 severe), and 14 uninjured matched controls. Parents and children were interviewed at a mean of two years post-TBI. Teachers reported on academic performance and educational needs. Children were assessed using the Vineland Adaptive Behaviour Scales (VABS) and the Weschler Intelligence Scale for Children (WISC-III).

Main Outcomes and Results: Two-thirds of children with a TBI exhibited significant behavioural problems, significantly more than controls (p=0.02). Children with behavioural problems had a mean IQ approximately 15 points lower than those without (p=0.001, 95% CI:7 to 26.7). At school, 76%(19) of children with behavioural problems also had difficulties with schoolwork. Behavioural problems were associated with social deprivation and parental marital status ($p \leq 0.01$).

Conclusions:

Children with TBI are at risk of developing behavioural problems which may affect school performance. Children with TBI should be screened to identify significant behavioural problems before they return to school.

Introduction

Traumatic brain injury (TBI) is a major public health problem and a significant cause of mortality and permanent disability amongst children and adolescents.[1-3] In the United Kingdom it has been estimated that approximately 3000 children acquire significant new neurological or cognitive disability as a result of TBI each year.[4]

Children with brain injury are at risk of developing cognitive, emotional and behavioural impairments which may persist or even worsen over time.[5-12] A variety of behavioural problems have been reported after paediatric TBI. These include impulsivity and social disinhibition, [13,14] hyperactivity,[14,15] poor temper control,[15] mood swings,[16] and psychiatric disorders [13]. High rates of post-injury behaviour problems have been observed amongst children with both mild and severe TBI.[17]

TBI has been associated with a decline in academic functioning and school performance.[9,16] Scott Jupp and colleagues found that children with brain injury were significantly disadvantaged compared with controls in terms of information processing and classroom performance.[18] They reported that teachers were particularly concerned about memory and attentional deficits, cognition, behaviour and personality problems. It has also been reported that children who underachieve at school are often those who are easily distractible.[19,20]. Children with head injuries may therefore present with a variety of complex difficulties and problems, all of which may interact to affect their school performance.[21]

For children with TBI, a return to mainstream school is associated with good recovery. However, the classroom environment, typically with one teacher to ~30 pupils, is likely

to place at a disadvantage those children who are less able to focus and sustain attention.[22] Despite this, many children return to school after brain injury without adequate assessment or support.[18,23]

Children who return to school following a TBI may therefore have residual cognitive and behavioural deficits which prevent them from performing at previous educational levels. Several studies have identified behavioural problems after paediatric TBI, but the effect of these problems on subsequent educational performance has received little attention. Consequently, there is a need to examine the relationship between behavioural problems and school performance after mild, moderate and severe brain injury.

The current study was designed to investigate the prevalence of behavioural problems amongst children who have suffered a TBI and to relate these to intellectual and school performance, taking account of the perspectives of both parents and teachers.

Methods

Participants

Eighty-two children admitted to North Staffordshire Hospital NHS Trust with brain injury, between November 1992 and December 1998, aged 5-15 years at injury. Recruitment was prospective for those injured during 1998, and retrospective for the remainder. All were of school-age at the time of the interviews and consented to their teachers being contacted by the research team.

Injury severity was determined according to the British Society of Rehabilitation Medicine classification [24]: Severe = an injury causing unconsciousness for >6 hours and a Glasgow Coma Scale (GCS) [25] after initial resuscitation of 3-8; Moderate = an injury causing unconsciousness between ≥15 minutes and <6 hours and a GCS after initial resuscitation of 9-12; Mild = an injury causing unconsciousness for <15 minutes and a GCS after initial resuscitation of 13-15. In the study group, 21 (25.6%) had severe brain injuries, 16 (19.5%) moderate, and 45 (54.9%) mild.

Interviews

Interviews and assessments took place between October 1998 and April 1999. Children and their families were interviewed face-to-face in their own homes by a trained interviewer using a semi-structured questionnaire. Areas covered included behaviour, emotion, cognition, schoolwork and school problems. Parents and children

identified the head teacher of the child's school and a key teacher who knew the child well.

Control group

Sixty-two families identified a child to act as a control, who was of the same age, sex and social background, and was working at a similar educational level (i.e. attending the same school class) as the injured child. Thirty-one control children agreed to participate in the study, none had a history of head injury nor any neurological impairment, and none had any known disorders likely to affect behaviour. The control group was of similar size to the moderate and severe TBI groups, with approximately the same age profile. Control families were interviewed between November 1998 and June 1999. Twenty control children, and their parents, gave permission for the research team to contact their teachers.

Teacher Questionnaires

Questionnaires were sent to the head teacher of each child's school with a request to pass it to the teacher who knew the child best, as nominated by the child and his/her family, usually the form teacher. Teachers who failed to return the questionnaire were telephoned and reminded. Of the 82 questionnaires posted, 67 were completed and returned, giving a response rate of 81.7%. The response rate was highest for teachers of children with severe TBI (90.5%,19 teachers) and lowest for teachers of children with mild TBI (77.8%,35 teachers). Questionnaires were sent to the head teachers of 20 control children, 14 were completed and returned giving a response rate of 70%.

Teachers were asked if pupils had any difficulties with school work, paid attention in class, had problems with behaviour, had been formally disciplined for behavioural problems, been excluded from school, or had special educational needs. Teachers were also asked to rate this pupil against the ability of his/her peers in the class.

Ethical approval

This study was approved by the Local Research Ethics Committee. Informed, written consent was obtained from the parent, and for children aged ≥13 from the child him/herself, prior to their participation in the study.

Measures

The King's Outcome Scale for Childhood Head Injury (KOSCHI) [26] was used to measure clinical outcomes following the TBI. KOSCHI scores were derived from interviews with parents and children. All children were scored by one member of the team (CH), experienced in the use of the KOSCHI. The KOSCHI 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 disability and b) less disability.

Social deprivation

The Townsend Deprivation Index [27] was used to measure social deprivation amongst the study group, using postcodes. The higher the positive score the more deprived an

area, and the higher the negative score the more prosperous. For the UK, the mean score is zero, for North Staffordshire the mean score is –0.49.

Behaviour

The Vineland Adaptive Behaviour Scales (VABS) Interview Edition, Survey Form [28] were used to assess maladaptive behaviour amongst children with TBI and controls. The VABS relies on parental report, and interviews with parents were carried out by trained clinical psychology assistants supervised by a consultant clinical neuropsychologist. Raw scores on the Maladaptive Behaviour Domain were converted into age-adjusted maladaptive levels according to published norms. Individuals were categorised into one of three maladaptive levels: 'Non-significant' (scores at or below the 50th percentile of a standardized population); 'Intermediate' (scores within the 51st-84th percentile range of a standardized population); and 'Significant' (scores at or above the 85th percentile of a standardized population).[28]

Intellectual ability

The Wechsler Intelligence Scale for Children – Third Edition UK (WISC-III) [29] assessed general intelligence. The seven index scores were used in analyses: Full Scale Intellectual Quotient (FSIQ), Verbal IQ (VIQ), Performance IQ (PIQ), Verbal Comprehension (VC), Perceptual Organisation (PO), Processing Speed (PS) and Freedom from Distractibility (FD).

Statistical analyses

Analyses were performed on data for children with completed teacher questionnaires, 67 in the TBI group and 14 in the control group. Descriptive statistics including means and standard deviations were calculated for continuous variables. Where appropriate, means were compared using the independent samples t-test. Cross-tabulations were carried out on categorical data and the Pearson Chi-Square statistic calculated, all using SPSS Version 9.0.

Results

Characteristics of the Study Group

Characteristics of the school study group are shown in table 1. Townsend deprivation scores were calculated for 62 families in the TBI group, postcodes were missing for 5. The majority of families lived in areas with positive scores (40, 64.5%). Nine families (14.5%) lived in considerably deprived areas (scores of $\geq$+3.55), 10 families (16.1%) lived in affluent areas (scores of $\leq$–2.4), the remainder (43, 69.4%) lived in middle-range areas (scores between -2.3 and +3.54). In the control group, eight families (57.1%) lived in areas with positive scores. One family (7.1%) lived in a considerably deprived area, four families (28.6%) in affluent areas, and nine in middle-range areas.

Table 1 about here please

Clinical Recovery

The majority of children in the TBI group (68.7%) had moderate disability following the injury, 19 (28.4%) made a good recovery, and one child made a full recovery with no discernable sequelae. KOSCHI scores are shown in table 2. There were no significant differences between severity groups.

Table 2 about here please

Psychological input following the TBI

Parents of all 67 children were asked whether their child had been assessed by a psychologist following the TBI. Three children in the severe group, none in the moderate group and three in the mild group had been assessed and had received clinical input from a psychologist. One child in the mild group was currently seeing a psychiatrist for behavioural problems and one child had been assessed by an educational psychologist.

Behaviour and school difficulties reported by teachers and parents

The results of the teachers' questionnaire are shown in table 3. Approximately one third of children with TBI were identified by teachers as having current behavioural problems, and half had difficulties with their schoolwork. In separate interviews, parents reported these problems for a similar proportion of children, as shown in table 4.

Table 3 about here please

Table 4 about here please

Special educational needs

Teachers reported that 16 children in the TBI group (23.9%) were currently on the school's Special Educational Needs (SEN) Register. Seven of these (43.8%) were on the Register prior to the TBI. General intellectual functioning was measured by the WISC-III for the 16 children identified as having SENs, and 54 children (TBI and control) without SENs. A significant relationship was observed between IQ and provision of SENs. The mean FSIQ was 79.6 (SE=2.4) for children with SENs, and 96.0 (SE=2.2) for children without SENs (p=0.0001, 95%CI: 9.8-23.0).

Behaviour

In the TBI group, 25 children (37.3%) were identified by their teachers as having behavioural problems within the school environment. Most of these children exhibited disruptive behaviours (19, 76%), the remaining children were very withdrawn (6, 24%). There were no significant differences between the severity groups.

For the study group (TBI and control), there was a significant association between the number of children identified by teachers as having behavioural problems, and the number identified by parents (p=0.0001, X^2=21.38, df=1, n=81). Teachers and parents agreed in 84% of cases for children without behavioural problems, and 68% agreed for children with behavioural problems. In the TBI group (n=67), 16 children (23%) exhibited behavioural problems at both home and school, eight (11.9%) only at home, nine (13.4%) only at school, and 34 (50.7%) had no behavioural problems at home or school.

A significant relationship was observed between school difficulties and behaviour ($p=0.04$, $X^2=4.33$, $df=1$). Of the 25 children with TBI identified by teachers as having behavioural problems, 76% (19) were also identified as having some school difficulties.

A significant association was observed between behavioural problems at school and parental marital status ($p=0.002$, $X^2=9.31$, $df=1$). In the TBI group, 27 children had parents who were divorced or separated. Of these, 16 (59.3%) exhibited behavioural problems at school compared to only nine (22.5%) of the 40 children whose parents were not divorced or separated.

The Maladaptive Behaviour Scale, part of the Vineland Adaptive Behaviour Scales (VABS), was used as a more objective measure of behavioural problems for 63 children with TBI and 11 control children. The results are shown in table 5. There was a statistically significant difference in the number of children with TBI exhibiting 'Significant' behavioural problems compared to controls ($p=0.02$, $X^2=7.98$, $df=2$).

Table 5 about here please.

For those children scoring at the 'Significant' level on the maladaptive behaviour domain of the VABS, their parents and teachers had identified behaviour as a specific problem in only 50% of cases. However, for those children whose parents *did* identify behaviour as a particular problem during the interview, 87.5% scored at the 'Significant' level on the VABS. This suggests that parents tend to report behaviour as a problem only when it is of considerable importance. Furthermore, all of the children excluded from school scored at the 'Significant' level on the VABS. A strong association was also observed

between KOSCHI scores and VABS scores. The lower (worse) the KOSCHI score, the higher (worse) the VABS score (p=0.002, X^2=25.0, df=8).

Social deprivation and behaviour

For the study group (TBI and control), there was a significant relationship between social deprivation and behavioural problems measured by the VABS. Children from deprived areas were more likely to exhibit significant behavioural problems than children from less deprived areas (p=0.012, t = -2.62, 95%CI: -3.97 to –0.52, n=74). Children with significant behavioural problems had a mean Townsend score of +1.72 (SD=2.82), and those without significant behavioural problems had a mean score of –0.53 (SD=2.56).

Intellectual ability and behaviour

The WISC-III assessed general intelligence for 53 children with TBI and 14 controls (table 6). Children with severe TBI had a mean FSIQ 13.5 points lower than controls (p=0.03, 95%CI: 1.7 - 25.1). Children with mild to moderate TBI had a mean FSIQ 6 to 8 points lower than controls (not significant).

Table 6 about here please

In the TBI group, intellectual ability was compared with behavioural problems identified by teachers (table 7), and with significant behavioural problems identified by the VABS (table 8). Children with behavioural problems, however identified, had a mean FSIQ

score approximately 15 IQ points lower than children without behavioural problems (p=0.001).

Table 7 about here please

Table 8 about here please

Discussion

In the TBI group, almost two-thirds of children were currently exhibiting significant behavioural problems as measured by the VABS. At least some maladaptive behaviours were identified for over 80% of children in the moderate and severe groups and 73% of children in the mild group. Significantly more children with TBI had behavioural problems compared to controls (p=0.02). There was also a significant relationship between social deprivation and behavioural problems. There was a strong relationship between clinical outcome assessed by the KOSCHI and maladaptive behaviours assessed by the VABS. In the TBI group, 16 children (23%) exhibited serious behavioural problems at both home and school, 8 (11.9%) only at home, 9 (13.4%) only at school. Children with behavioural problems had a significantly lower mean FSIQ than children without behavioural problems (p=0.001). There was a strong link between school performance and behavioural problems, 76% (19) of the 25 children identified by teachers as having serious behavioural problems also had difficulties with schoolwork. Special Educational Needs (SENs) were identified for 16 children in the TBI group (24%), of these, the majority had been placed on the SEN register following the TBI. Few children had been formally assessed following the TBI. However, seven children in the TBI group (10.5%) had been formally disciplined by the school for

problem behaviour and five (7.5%) had been permanently excluded from school since the TBI.

Behavioural problems were frequently reported within our TBI group, even several years post injury, which is consistent with the findings of other investigators.[6,14] The incidence of behavioural problems reported within the mild group is higher than reported by some other studies.[9,13] A possible explanation is that our mild group were at the more severe end of the spectrum of 'mild' TBI as all our subjects had been admitted to hospital following the injury. It is also possible that parents participated in this research because of their concerns about the behaviour of their child. However, other researchers have also found high rates of behavioural and academic problems amongst children with mild TBI.[30]

The VABS gives a global measure of maladaptive behaviours and correlates well with other measures of behavioural problems, it has also been found to be an appropriate measure of behaviour within a TBI population.[31] On the VABS, children with TBI demonstrated significantly higher levels of maladaptive behaviour than controls, yet there were no significant differences between the mild, moderate and severe TBI groups, a finding consistent with other studies.[30] Two thirds of children, up to 5 years post-TBI, were exhibiting 'significant' maladaptive behaviour compared to 18% of controls. The majority of children in the moderate and severe groups (82-85%) exhibited some maladaptive behaviours. This is consistent with the findings of Green et al who found that 79% of their children with acquired brain injury had impaired behaviour.[31] The authors of the VABS recommend that children who score in the 'Significant' range should be offered further clinical assessment.[28] Parents were given copies of the results of all assessments carried out for this study to share with

their general practitioner (GP) or school as they wished, and were invited to discuss the results with a psychologist.

Not all of the parents of children scoring at the ‘significant’ level on the VABS maladaptive behaviour domain had identified behaviour as a particular problem at the interview. However, when parents did report that their child had behavioural problems, most of those children scored at the ‘significant’ level on the VABS. It is possible that some parents reported behavioural problems only if they were causing concern. These findings suggest an element of under-reporting amongst parents, which has also been noted by other investigators.[6] Some parents may have accepted their child’s challenging behaviours and may not perceive them as abnormal, particularly if there are no other children in the family for comparison. Another factor may be that some unusual behaviours were identified only when parents were asked specific questions as part of the VABS assessment, for example: ‘is your child negativistic or defiant?’, or ‘is your child stubborn or sullen?’.

According to parents, only three children in the severe group, and three in the mild group had been assessed and had received clinical input from a psychologist following the TBI. One of these children was seeing a psychiatrist for behavioural problems. This left 34 children currently exhibiting significant maladaptive behaviours who had apparently never received a psychological assessment following their TBI until this research project was carried out. Indeed, for several parents, the fact that their child would be formally assessed was perceived as an advantage of taking part in this study.

We found that not all teachers knew about the TBI, particularly if it occurred over a year ago. Consequently, teachers rarely associated behavioural problems and poor school

performance with the TBI, and allowances were often not made. If left unresolved, behavioural problems could lead to the child being formally disciplined by school-teachers. Teachers gave the following examples of difficult children: *"A is very difficult to cope with in class, argues, is late, refuses to work, inappropriate behaviour, singing, laughing, loud, mood swings"; "B can be very disruptive and aggressive, he will attack other pupils without provocation"; "C can be disruptive, calling out, argumentative; he finds it difficult to accept praise or help", "D is disruptive, lacks co-operation, is aggressive, has inability to complete work"; "E has a poor attention span, is very quick to retaliate to small things i.e. hits someone for calling him a name"; "F is withdrawn at times, non-responsive, with occasional violence".*

Behavioural problems could lead to permanent exclusion from school. This was often due to poor anger management coupled with violence. Teachers gave examples of the reasons for permanent exclusion: "X: *attack on acting head and class teacher"; "Y: extreme rudeness to staff, refused to work in class"; "Z: extreme violence towards another pupil."*

The children in this study were of differing ages, therefore it was not possible to use the results of standard school examinations and assessments to measure school performance. However, teachers reported that the majority of children in the severe group (79%), and half of the children in the mild and moderate groups, were having difficulties with their schoolwork, and approximately 40% of those with a TBI of any severity were performing below the average level for the class. It is possible that, following a brain injury, some school-children may develop behavioural problems because they have difficulties keeping up with schoolwork, and may respond by becoming rude and disruptive in class.[32] Other children may respond by becoming

withdrawn, or avoiding school by truanting. Although it was not possible within the limitations of this study to identify cause and effect, it is likely that cognitive and behavioural issues are inter-related. Such a relationship is also noted by Ylvisaker and colleagues [33] who suggest that behaviour problems may be associated with general cognitive weakness, particularly if parents and teachers have inappropriate expectations for the child.

There is evidence from the literature to suggest that pre-morbid characteristics of children suffering from TBI may have a significant effect on subsequent outcome.[13] Many of the children participating in this study had been injured more than one year before the interviews, consequently pre-morbid characteristics were difficult to ascertain with complete accuracy. It was therefore not possible to clearly differentiate between behavioural problems which existed pre-morbidly and those which were caused by the TBI, and this is a limitation of the current study. However, none of the children were described by their parents as having significant behavioural problems prior to the TBI. Special Educational Needs (SENs) had been identified for seven children (10.5%) in the TBI group prior to the injury, indicating some pre-morbid learning difficulties. This figure is not particularly high as, for England and Wales, on average approximately 20% of children aged 2-19 are identified as having some special educational needs.[34]

At the time of the interviews almost half the children in the mild group, and one third of children in the severe group, had parents who were not living together. Although attempts were made to match the control group to the TBI group according to number of parents, many single parents who were approached to join the control group did not wish to be interviewed. Behavioural problems at school were reported by teachers for over half the children with divorced or separated parents. Five of these marital

breakdowns occurred after the child's TBI. High levels of stress have been observed amongst parents of children after TBI which may contribute to marital breakdown.[35] Kinsella et al found that the presence of two parents in a household was associated with lower ratings of behaviour problems in the child.[36] Therefore the absence of one parent may place a child with TBI vulnerable to the development of behavioural problems.

A limitation of this study is the small number of parents and children in the control group who permitted the research team to contact teachers. However, the WISC-III, VABS and Townsend Index all have published normative values which permit comparison of the TBI group with a normal population of young people.

Although the WISC-III is often used in studies of intellectual recovery after TBI, it is not particularly sensitive to neuropsychological sequelae of TBI. It has been suggested that WISC scores may remain relatively high after TBI because of the nature of the test, part of which measures previously learned material, and because of the structured way in which it is administered whereby distractions are minimised, unlike in real-world situations.[37] Therefore, although the mean WISC scores of our mild and moderate TBI groups were not significantly different from those of control children, this does not necessarily imply that these children were intellectually unimpaired. It is therefore important that when individual children are being assessed, particularly with a view to the planning of therapeutic or educational interventions, a wide range of neuropsychological assessments should be used.[38]

The development of behaviour problems can be affected by numerous factors, as described by Ylvisaker and colleagues [33], including academic failure, vulnerability

related to the environment, pre-injury characteristics such as communication difficulties, post-injury interventions or expectations, social relationships and family relationships. In this study, we found associations between behavioural problems following TBI and school performance, intellectual ability, social deprivation and parental marital status. It was not possible to identify exactly how these elements are inter-related. Behavioural problems after TBI have been linked with pre-injury behavioural and family functioning by several authors [16,39,40] and with social deprivation.[30] Ewing-Cobbs et al [37] emphasise the importance of assessing the impact of moderator variables such as family environment and socioeconomic background on both cognitive and behavioural outcomes after TBI. It is likely, therefore, that social deprivation and parental separation are risk factors for behavioural problems. Future research should examine these issues in more detail using a group of children recruited prospectively.

Children with behavioural problems disrupt not only their own education, but also that of their classmates.[22] Consequently, it is important that children at risk of these problems are identified and supported. In the USA, Ylvisaker and colleagues have proposed a school-based system for monitoring academic and behavioural performance amongst children with TBI as part of a school re-entry programme, designed as a safety net to avoid the potential downward spiral of academic failure and negative behaviours in response to such failure.[32,41] The findings of the current study provides some evidence for the need for such a programme in the UK.

Conclusions

Children who have significant behavioural problems after TBI tend to perform poorly at school compared to their classmates, and are more likely to be excluded from school.

They are likely to have experienced parental separation or are being cared for by a single parent. They are also likely to come from an area with some degree of social deprivation. We identified a large group of children, currently exhibiting significant maladaptive behaviours, who had never received a psychological assessment following their TBI. It is recommended that children are screened for behavioural problems prior to their return to school, and school-teachers informed of the TBI, to ensure that these children receive the support they need to prevent failure at school and a possible deterioration in behaviour and academic performance.

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References

1 Kraus, J.F., Rock, A., Hemyari, P.: Brain injuries among infants, children, adolescents, and young adults. *American Journal of Diseases in Children*, **144**: 684-691, 1990.

2 Guyer, B. and Ellers, B.: Childhood injuries in the United States. *American Journal of Diseases in Children*, **144**: 649-652, 1990.

3 Snow, J.H. and Hooper, S.R.: *Pediatric Traumatic Brain Injury*. California: Sage Publications, 1994.

4 Sharples, P.M.: Head injury in children. In: Little and Ward Platt, eds. *Injury in the young*. Cambridge: Cambridge University Press, 1998:151-75.

5 Ewing-Cobbs, L., Miner, M.E., Fletcher, J.M .et al.: Intellectual, motor, and language sequelae following closed head injury in infants and preschoolers. *Journal of Pediatric Psychology*, **14**: 531-537, 1989.

6 Klonoff, H., Clark, C., Klonoff, P.S.: Long-term outcome of head injuries: a 23 year follow up study of children with head injuries. *Journal of Neurology, Neurosurgery and Psychiatry*, **56**: 410-415, 1993.

7 Ewing-Cobbs, L., Thompson, N.M., Miner, M.E. et al.: Gunshot wounds to the brain in children and adolescents: age and neurobehavioural development. *Neurosurgery*, **35**: 225-233, 1994.

8 Parmelee, D.X.: Neuropsychiatric sequelae of traumatic brain injury in children and adolescents. *Psychiatric Medicine*, **7**(1): 11-16, 1989.

9 Fletcher, J.M., Ewing-Cobbs, L., Miner, M.E., Levin, H.S., Eisenberg, H.M.: Behavioural changes after closed head injury in children. *Journal of Consulting and Clinical Psychology*, **58**: 93-98, 1990.

10 Levin, H.S., Benton, A.L.,Grossman, R.G.: *Neurobehavioural consequences of closed head injury.* New York: Oxford University Press, 1982.

11 Taylor, H.G. and Alden, J.: Age-related differences in outcomes following childhood brain insults: An introduction and overview. *Journal of the International Neuropsychological Society*, **3**: 555-567, 1997.

12 Andrews, T.K., Rose, F.D., Johnson, D.A.: Social and behavioural effects of traumatic brain injury in children. *Brain Injury*, **12**(2): 133-138, 1998.

13 Brown, G., Chadwick, O., Shaffer, D., Rutter, M., Traub, M.: A prospective study of children with head injuries: II Psychiatric sequelae. *Psychological Medicine*, **11**: 49-62, 1981.

14 Knights, R.M., Ivan, L.P., Ventureyra, E.C.G., Bentivoglio, C., Stoddart ,C., Winogron, W., Bawden, H.N.: The effects of head injury in children on neuropsychological and behavioural functioning. *Brain Injury*, **5**: 339-351, 1991.

15 Basson, M.D., Guinn, J.E., McElligott, J., Vitale, R., Brown, W., Fielding, L.P.: Behavioural disturbances in children after trauma. *Journal of Trauma*, **31**:1363-1368, 1991.

16 Rivara, J.B., Jaffe, K.M., Polissar, N.L., Fay, G.C., Martin, K.M., Shurtleff, H.A., Liao, S.: Family functioning and children's academic performance and behaviour problems in the year following traumatic brain injury. *Archives of Physical Medicine and Rehabilitation*, **75**: 369-379, 1994.

17 Asarnow, R.F., Satz, P., Light, R., Lewis, R., Neumann, E.: Behaviour problems and adaptive functioning in children with mild and severe closed head injury. *Journal of Pediatric Psychology,* **16**: 543-555, 1991.

18 Scott-Jupp, R., Marlow, N., Seddon, N., Rosenbloom, L.: Rehabilitation and outcome after severe head injury. *Archives of Disease in Childhood*, **67**: 222-226, 1992.

19 Martin, R.P., Gaddis, L., Drew, D., Moseley, M.: Prediction of elementary school achievement from preschool temperament: Three studies. *School Psychology Review*, **17**: 125-137, 1988.

20 Martin, R.P., Nagle, R., Paget, K.: Relationships between temperament and classroom behaviour, teacher attitudes and academic achievement. *Journal of Clinical Psychology,* **39**: 1013-1020, 1983.

21 Middleton, J.A.: Practitioner review: psychological sequelae of head injury in children and adolescents. *Journal of Child Psychology and Psychiatry*, **42**: 165-80, 2001.

22 Bevington, J. and Wishart, J.G.: The influence of classroom peers on cognitive performance in children with behavioural problems. *British Journal of Educational Psychology*, **69**: 19-32, 1999.

23 Jones, A. and Johnson, D.: A study of the educational provision for head-injured children. *British Journal of Special Education*, **21**: 113-117, 1994.

24 British Society of Rehabilitation Medicine.: *Rehabilitation after Traumatic Brain Injury*. A Working Party Report of the British Society of Rehabilitation Medicine. London, 1998.

25 Teasdale, G. and Jennett, B.: Assessment of coma and impaired consciousness: a practical scale. *Lancet*, **2**: 81-83, 1974.

26 Crouchman, M., Rossiter, L., Colaco, T., Forsyth, R.: A practical outcome scale for paediatric head injury. *Archives of Disease in Childhood* , **84**: 120-4, 2001.

27 Townsend, P., Phillimore, P., Beattie, A.: *Inequalities in health in the Northern region*. Newcastle upon Tyne: Northern Regional Health Authority and University of Bristol, 1986.

28 Sparrow, S.S., Balla, D.A., Cicchetti, D.V.: *Vineland Adaptive Behavior Scales: Interview Edition Survey Form Manual.* Minnesota: American Guidance Service, 1984.

29 Wechsler, D.: *Manual for the Wechsler Intelligence Scale for Children – Third Edition UK, WISC-III(UK)*. Sidcup: The Psychological Corporation Limited, 1991.

30 Greenspan, A.I. and MacKenzie, E.J.: Functional outcome after paediatric head injury. *Pediatrics*, **94**: 425-432, 1994.

31 Green, M.L., Foster, M.A., Morris, M.K., Muir, J.J., Morris, R.D.: Parent assessment of psychological and behavioural functioning following pediatric acquired brain injury. *Journal of Pediatric Psychology*, **23**(5): 289-299, 1998.

32 Ylvisaker, M., Feeney, T., Mullins, K.: School re-entry following mild traumatic brain injury: A proposed hospital-to-school protocol. *Journal of Head Trauma Rehabilitation*, **10**(6): 42-49, 1995.

33 Ylvisaker, M., Feeney, T.J., and Szekeres, S.F.: Social-environmental approach to communication and behaviour. In: M. Ylvisaker (editor) *Traumatic Brain Injury Rehabilitation Children and Adolescents* (second edition). (Butterworth-Heinemann, Boston), pp. 271-302, 1998.

34 Audit Commission: *Statutory assessment and statements of Special Educational Needs: in need of review?* The Audit Commission, London, 2002.

35 Hawley, C.A., Ward, A.B., Magnay, A., Long, J.: Parental stress and burden following traumatic brain injury amongst children and adolescents. *Brain Injury*, **17**(1): 1-23, 2003.

36 Kinsella, G., Ong, B., Murtagh, D., Prior, M., Sawyer, M.: The role of the family for behavioral outcome in children and adolescents following traumatic brain injury. *Journal of Consulting and Clinical Psychology*, **67**(1): 116-123, 1999.

37 Ewing-Cobbs, L., Levin, H.S. and Fletcher, J.M.: Neuropsychological sequelae after pediatric traumatic brain injury: advances since 1985. In: M. Ylvisaker (editor) *Traumatic Brain Injury Rehabilitation Children and Adolescents* (second edition). (Butterworth-Heinemann, Boston), pp. 11-26, 1998.

38 Semrud-Clikeman, M. *Traumatic Brain Injury in Children and Adolescents: Assessment and Intervention* (New York, The Guildford Press), 2001.

39 Anderson, V.A., Catroppa, C., Haritou, F., Morse, S., Pentland, L., Rosenfeld, J., Stargatt R.: Predictors of acute child and family outcome following traumatic brain injury in children. *Pediatric Neurosurgery*, **34**(3): 138-148, 2001.

40 Max, J.E., Lindgren, S.D., Knutson, C., Pearson, C.S., Ihrig, D. and Welborn, A.: Child and adolescent traumatic brain injury: correlates of disruptive behaviour disorders. *Brain Injury*, **12**: 41-52, 1998.

41 Ylvisaker, M., Feeney, T., Maher-Maxwell, N., Meserve, N., Geary, P.J., DeLorenzo, J.P.: School re-entry following severe traumatic brain injury: Guidelines for educational planning. *Journal of Head Trauma Rehabilitation,* **10**(6): 25-41, 1995.

Table 1 Characteristics of the School Study Group

Variable	*Mild TBI n =35*	*Moderate TBI n = 13*	*Severe TBI n= 19*	*Control n = 14*
Gender: number male (%)	21 (60%)	11 (84.6%)	8 (42.1%)	6 (42.9%)
Age at injury (years)				
Mean (SD)	8.89 (2.99)	8.31 (2.98)	9.79 (2.35)	NA
Range	5-14	5-15	6-14	
Age at interview (years)				
Mean (SD)	11.69 (2.89)	11.85 (3.34)	12.79 (2.49)	11.93 (2.79)
Range	6-18	7-16	8-17	7-16
Years between injury and follow-up				
Mean (SD)	2.03 (1.47)	2.85 (1.77)	1.95 (1.39)	NA
Range	0-5	0-6	0-5	
Divorced/separated parents (%)	17 (48.6%)	3 (23.1%)	7 (36.8%)	0
Social deprivation				
Mean (SD)	+1.13 (2.53)	-0.21 (3.64)	+1.49 (2.71)	-0.64 (2.5)
Mechanism of injury				N/A
Fall (%)	16 (45.7%)	3 (23.1%)	2 (10.6%)	
RTA pedestrian (%)	6 (17.1%)	4 (30.8%)	13 (68.4%)	
RTA in vehicle (%)	0 (0%)	1 (7.7%)	3 (15.8%)	
RTA cyclist (%)	3 (8.6%)	0	1 (5.3%)	
All RTAs	9 (25.7%)	5 (38.5%)	17 (89.5%)	
Fall from bicycle (%)	7 (20%)	2 (15.4%)	0	
Assault (%)	1 (2.9%)	1 (7.7%)	0	
Sport (%)	0	1 (7.7%)	0	
Collision with another child (%)	2 (5.7%)	0	0	
Kicked by horse (%)	0	1 (7.7%)	0	
Total	35 (100%)	13 (100%)	19 (100%)	

Table 2 Clinical recovery after brain injury (n = 67)

KOSCHI Score	*Mild TBI (n = 35)*	*Moderate TBI (n = 13)*	*Severe TBI (n = 19)*
Severe disability (3B)	0	0	1 (5.3%)
Moderate disability (4A)	8 (22.9%)	3 (23.1%)	5 (26.3%)
Moderate disability (4B)	16 (45.7%)	5 (38.5%)	9 (47.4%)
Good recovery (5A)	10 (28.6%)	5 (38.5%)	4 (21.1%)
Full recovery (5B)	1 (2.9%)	0	0

Table 3 Responses to Teacher Questionnaire

Variable	*Mild n = 35*	*Moderate n = 13*	*Severe n = 19*	*Control n = 14*	*Significance*
All teachers knew of child's TBI	14 (40%	7 (53.8%)	15 (78.9%).	N/A	P = 0.02 X^2 = 7.51
Special educational needs identified prior to TBI	3 (8.6%)	0	4 (21.1%	N/A	Not sig.
Special educational needs currently identified	7 (20%)	1 (7.7%)	8 (42.1%)	2 (14.3%)	P = 0.09 X^2 = 6.54
Difficulties with schoolwork	18 (51.4%)	6 (46.2%)	15 (78.9%)	4 (28.6%)	P = 0.03 X^2 = 8.73
Performing below class average	15 (42.9%)	5 (38.5%)	8 (42.1%)	2 (14.3%)	Not sig.
Doesn't pay attention or listen	15 (42.9%)	8 (61.5%)	12 (63.2%)	5 (37.5%)	Not sig.
Lacks confidence	17 (53.1%)	8 (61.5%)	13 (68.4%)	5 (35.7%)	Not sig.
Has mood swings	9 (25.7%)	7 (53.8%)	10 (52.6%)	2 (14.3%)0	P = 0.0001 X^2 = 31.10
Current behaviour problems identified by teachers	13 (37.1%)	4 (30.8%)	8 (42.1%)	1 (7.1%)	Not sig.
Disciplined for behaviour	3 (8.6%)	1 (7.7%)	3 (15.8%)	0	Not sig.
Excluded from school	3 (8.6%)	0	2 (10.5%)	0	Not sig.

Table 4 *Parental reports of child's difficulties*

Difficulties	*Mild N = 35*	*Moderate N = 13*	*Severe N = 19*	*All TBI N = 67*	*Control N = 13*	*Significance*
Behaviour at home	13 (37.1%)	5 (38.5%)	6 (31.6%)	24 (35.8%)	1 (7.1%)	Not sig.
Behaviour at school	8 (22.9%)	4 (30.8%)	2 (10.5%)	14 (20.9%)	2 (14.3%)	Not sig.
Attention/concentration	20 (57.1%)	8 (61.5%)	14 (73.7%)	42 (62.7%)	4 (30.8%)	Not sig.
Mood swings	21 (60%)	6 (46.2%)	10 (52.6%)	37 (55.2%)	6 (42.9%)	Not sig.
School work	23 (65.7%)	7 (53.8%)	14 (73.7%)	44 (65.7%)	3 (23.1%)	$p = 0.02$ $X^2 = 9.4$

Table 5 *Vineland Maladaptive Behaviours (n = 74)*

Vineland Maladaptive Behaviours	*Mild N = 33*	*Moderate N = 13*	*Severe N = 17*	*All TBI N = 63*	*Control N = 11*
Non-significant	9 (27.3%)	2 (15.4%)	3 (17.6%)	14 (22.2%)	6 (54.5%)
Intermediate	3 (9.1%)	4 (30.8%)	2 (11.8%)	9 (14.3%)	3 (27.3%)
Significant	21 (63.6%)	7 (53.8%)	12 (70.6%)	40 (63.5%)	2 (18.2%)

Table 6 Intellectual performance according to injury severity

WISC-III Index Scores	Mild TBI (n = 28)	Moderate TBI (n = 11)	Severe TBI (n = 14)	Controls (n = 14)
FSIQ mean (SD)	91.57 (18.6)	93.82 (14.9)	86.43 (14.6)	99.93 (15.4)
VIQ mean (SD)	89.96 (18.2)	97.09 (17.9)	89.14 (17.9)	100.21 (15.9)
PIQ mean (SD)	94.96 (17.3)	91.36 (9.7)	87.21 (15.5)	99.2 (17.1)
PO mean (SD)	93.5 (18.4)	91.09 (9.0)	86.21 (14.9)	97.71 (15.9)
VC mean (SD)	89.71 (18.4)	96.91 (17.9)	88.93 (12.6)	100.36 (15.3)
PS mean (SD)	99.32 (15.8)	94.64 (12.9)	86.57 (17.8)	103.93 (12)
FD mean (SD)	95.21 (14.7)	100.82 (14.6)	97.86 (15.3)	104.79 (17.3)

SD = standard deviation

Table 7 Intellectual ability and behavioural problems identified by teachers (TBI group n = 53)

WISC-III Index Scores	*Behaviour Problems (n = 20)*	*No Behaviour Problems (n = 33)*	*95% Confidence Interval of the Difference*	*Significance*
FSIQ mean (SE)	81.15 (2.8)	96.45 (2.9)	6.65 – 23.96	p = 0.001 t = 3.55
VIQ mean (SE)	82.7 (3.5)	96.39 (2.8)	4.68 – 22.71	p = 0.004 t = 3.05
PIQ mean (SE)	83.3 (2.4)	97.55 (2.7)	6.19 – 22.29	p = 0.001 t = 3.55
PO mean (SE)	82.88 (2.8)	96.58 (2.8)	4.82 – 22.56	p = 0.003 t = 3.1
VC mean (SE)	81.90 (3.1)	96.52 (2.9)	5.79 – 23.44	p = 0.002 t = 3.33
PS mean (SE)	85.5 (3.0)	98.42 (3.8)	2.11 – 23.74	p = 0.02 t = 2.4
FD mean (SE)	95.5 (3.9)	98.03 (2.2)	-5.89 – 10.95	p = 0.5 t = 0.6

Table 8 Intellectual ability and Vineland maladaptive behaviours (TBI group n = 45)*

WISC-III Index Scores	*Significant Behaviour Problems (n = 32)*	*No Significant Behaviour Problems (n = 13)*	*95% Confidence Interval of the Difference*	*Significance*
FSIQ mean (SE)	83.78 (2.2)	100.69 (5.3)	7.09 – 26.73	p = 0.001 t = 3.47
VIQ mean (SE)	84.38 (2.4)	100.54 (5.3)	5.92 – 26.41	p = 0.003 t = 3.18
PIQ mean (SE)	87.06 (2.3)	100.0 (4.9)	3.20 – 22.68	p = 0.01 t = 2.68
PO mean (SE)	86.48 (2.3)	99.62 (5.1)	3.35 – 22.91	p = 0.01 t = 2.71
VC mean (SE)	84.28 (2.5)	100.54 (5.2)	5.98 – 26.53	p = 0.003 t = 3.19
PS mean (SE)	90.47 (3.9)	103.0 (3.5)	-0.80 – 25.86	p = 0.07 t = 1.9
FD mean (SE)	93.31 (2.2)	101.31 (4.4)	-0.99 – 16.98	p = 0.08 t = 1.8

*significant and non-significant Vineland scores only