The accuracy of adult recall for early mild traumatic brain injury

Audrey McKinlay a
L. John Horwood b

a Melbourne School of Psychological Science, University of Melbourne, Australia
b Christchurch Health and Development Study, University of Otago, Christchurch, New Zealand
Abstract

**Background:** Childhood TBI has been associated with negative adult outcomes. Effective interventions require identification of the injury event. There is currently little information regarding the accuracy of adult recall of childhood TBI.

**Method:** Prospectively collected information from a large birth cohort was used to examine adult recall accuracy at age 25 for 161 childhood TBI events occurring before age 10.

**Results:** At age 25 cohort members recalled 11 Outpatient injuries and 17 Inpatient injuries. Recall accuracy increased with age. Logistic regression analysis distinguished between respondents who reported and did not report a childhood TBI event correctly classifying 84.5% of cases. Age at injury, injury severity and LoC made a unique statistically significant contribution to the model.

**Conclusions:** Most childhood TBI events are not recalled in adulthood. Age at injury, injury severity and LoC significantly increase likelihood of recall and should be used in measures that evaluate whether injury has occurred.

**Key words:**
Traumatic Brain Injury, Childhood, Adult Recall, Longitudinal, Prospective;

**Declaration:**
The authors have no conflict of interest to declare.
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Introduction:

Paediatric traumatic brain injury (TBI) is associated with a number of negative outcomes that in some instances are detectable into adolescence [1-3]. There is also increasing concern regarding the consequences of these childhood injuries in adulthood, with some studies demonstrating that early TBI may result in increased rates of antisocial and offending behaviour [4-6]. Such adverse outcomes have serious implications for the individual in terms of their education and employment opportunities, but also for society as a whole, given the cost of deterring individuals who engage in criminal activity or are unable to maintain a productive work life.

Early injury appears to be a risk fact for negative outcomes, perhaps as a result of early vulnerability [7]. However, the link between the TBI and long-term negative outcomes is often lost, and when psychosocial or antisocial problems emerge these may be attributed to the characteristics of the young person or their family [8,9]. Further, problems that are evident may not receive any treatment until the young person reaches the attention of the justice system.

The lack of recognition of an earlier TBI event may also result in ineffective interventions and treatment plans that do not accommodate the increased likelihood of problems with attention, concentration, planning, memory and impulsivity [1,10-13]. Understanding the needs of adults with a history of TBI firstly requires the ability to accurately identify that the TBI event took place.

Unfortunately, accurate identification of a history of early TBI for an adult is difficult for a number of reasons. Firstly, clinicians working with individuals with a history of TBI are often reliant on self-report of TBI or a review of hospital files. However, the individual may forget that the event took place, and opportunity to retrospectively review hospital files may be limited. Moreover, hospital records are often not obtainable many years after the injury or are incomplete, particularly if the original event was considered to be medically minor. Research has demonstrated that using hospital records to assess whether an TBI has occurred is problematic as children rely on parents to recognise that an injury has occurred and to present their child to the ED for treatment, which in many cases this does not occur [14]. Further, as many of the injuries that occur during the preschool
period occur in a pre-verbal child and are relatively mild, symptoms of TBI may not be identified, resulting in the injury being misclassified or overshadowed by a more overt associated injury.

Therefore, the aim of this study was to examine the accuracy of adult recall at 25 years of age for TBI events that occurred over 0-9 years of age. And further, to identify what factors increase the accuracy of adult recall.

Methods:

Participants:

The data were gathered as part of the Christchurch Health and Development Study (CHDS), a 35-year longitudinal study of a birth cohort of 1265 children born in Christchurch (New Zealand) during mid 1977. These children represented 97% of all births occurring in Christchurch during the recruitment period for the study. Cohort members have been studied at birth, four months, one year and at yearly intervals to age 16, then again at ages 18, 21, 25, 30 and 35 years. Data have been gathered using information from a combination of sources including parental interview, self-report, psychometric assessments, teacher questionnaires, medical records and other official records. All data gathered as part of the study gained signed consent from the research participants. The research was granted ethics approval by the Canterbury Ethics Committee.

Due to attrition (as a result of death, refusal or loss to follow-up) the initial cohort of 1265 children had reduced to 1003 by age 25 years (79.3% of the initial cohort).

Traumatic Brain Injury events:

Information regarding TBI events was collected in a number of ways. At each assessment from age 4 months to 10 years, comprehensive information was obtained on the child’s history of medical attendances (GP, specialist and hospital attendances) since the previous assessment. As part of this information, details were obtained on all injury events that resulted in medical attendance. Injury events were divided into two groups. The first were all seen in emergency department or treated by the GP and sent home (Outpatient Injury). The second group consisted of all those who
had been hospitalisation for a brief period of observation (Inpatient injury). All reported hospital attendances both Inpatient and Outpatient were verified against hospital records.

At the 25 year follow up participants were asked to recall if they had ever visited a doctor or hospital as a result of an injury to the head injury, including when they were a child. If they said yes, they were asked whether they had ever been diagnosed as having a concussion, brain injury or fracture to their skull, and for details of each incident reported (age, nature of accident, nature of injury, hospital attended and how long they were hospitalised). The definition and usage of terms in this questionnaire was guided in part by the Centre’s for Disease control 2003 report to Congress on mTBI in the United States [15].

As most TBI events that occurred between 0-9 years of age were mild, recall was considered accurate if the year recalled was within 1 year of when the event actually took place. Both Inpatient (hospitalised) and Outpatient (seen briefly in the Emergency Department and discharged or seen by a general practitioner) were included in the analyses to ensure that events classified as “false memories” were not a result of incorrectly recalling a visit to a general practitioner as a hospitalization.

Statistical Analysis

Data was analyses using descriptive statistics, counts and percentages, with chi square being used to test for significance. Binary logistic regression was used to assess which factors increased the likelihood that a TBI event would be recalled.

Results:

Over the first 10 years of life, 161 mild traumatic brain injury events were recorded in the cohort. The majority of injury events were dealt with in the Outpatient setting (N=121, 75.2%) the remainder, (N=40, 24.8%) were Inpatient.

As shown on Table 1, 102 injury events were recorded as occurring in the first five years of the cohort. At age 25, members of the cohort recalled 14 TBI events, four of these recalled events
were incorrect (2 Inpatient and 2 Outpatient visits). Of the remaining 10 TBI events recalled (9.4%), 6 were Inpatient and 4 were Outpatient. The majority of the TBI events were accurately recalled (7 accurate and 3 inaccurate). There were ten instances where records indicated a loss of consciousness or suspected loss of consciousness for the children injured over 0-4 years; of these 5/10 (50.0%) were recalled.

Fifty-nine injury events occurred over ages 5-9 years. Cohort members recalled 32 injury events, 14 of which had not taken place. For correctly recalled events, 18/59 (30.5%), 9 were accurately recalled and 9 inaccurately recalled. There were 16 instances where a LoC occurred with 9/16 (56.3%) of these being recalled.

A Chi square test for independence (with Yates Continuity Correction) indicated no significant association between the sex of the individual and recall for TBI events $\chi^2 (1, n=161) =.00, p=1.0, \phi=-.008$. As can be seen in Table 1 and Figure 1 there was a gradual increase in the number of injuries recalled with increasing age. However, incorrect recall also increased with age, and by the time the young person was over 4 years of age over 17% of the recalled injuries were false recollections.

Direct logistic regression was performed to assess the impact of a number of factors on the likelihood that cohort members would recall a childhood a TBI event. The model contained 4 independent variables (sex, age at injury, treatment (Inpatient/Outpatient) and whether they experienced a LoC). The full model containing all predictors was statistically significant $\chi^2 (4, N=161) =42.07, p<.001$, indicating that the model was able to distinguish between respondents who reported and did not report a childhood TBI event. The model as a whole explained between 23.0% (Cox and Snell R square) and 38.6% (Nagelkerke R squared) of the variance in recall and correctly classified 84.5% of the cases. As shown on Table 2, only three of the independent variables made a unique statistically significant contribution to the model (age at injury, Treatment (Inpatient/Outpatient) and whether they experienced a LoC). The strongest predictor of being able to recall a childhood TBI event in adulthood was LoC.
Discussion:

An examination of adult recall of childhood TBI demonstrated that many of the injury events were not recalled or incorrectly recalled. When asked at age 25 years to remember instances of TBI over 0-4 years only 9.4% of known events were recalled. An increase in ability to recall was seen for older children, with those in the 5-9 year age range recalling 30.5% of known events. Several factors increased the likelihood of recall including age at injury, injury severity and a LoC, with LoC being the strongest predictor of recall.

Inability to remember early events of childhood (childhood amnesia) is a well-reported phenomenon. Previous research has demonstrated that childhood amnesia is eclipsed by personal memories in adulthood from about 4-5 years of age, which is consistent with the data presented here. Previous research has reported that this age related phenomenon appears robust regardless of the significance of the trauma, again consistent with our findings [for review on this topic see 16]. There were few occurrences of TBI that occurred in the 0-3 year age bracket that were recalled in adulthood, and recall was likely due to parental rehearsal of the event with the young person. However, we also found that as the age at which the individual experienced a TBI event increased, factors such as loss of consciousness and increased injury severity made recall more likely. These findings have implications for research as well as clinical and legal practice.

While adult outcomes of childhood TBI are not yet fully understood, there is increased research interest as evidence mounts that the pre-school age group may be particularly vulnerable to the effects of injury [17, 18]. However, adult outcomes of pre-school injury is difficult to assess as deficits may not manifest for many years after the injury event, often when the individual may not be able to recall that the injury has taken place. Our findings suggest that evaluating adult outcomes of childhood injury requires a systematic approach to identification to avoid recruitment of a biased sample. This caveat is particularly true when evaluating outcomes of very early injury. For example, it is important to be aware that any prevalence studies based on recall may underestimate occurrence of pre-school injury.

In terms of clinical implications, it is often standard practice to enquire about a client’s history of TBI as the consequences of these injuries may impact on treatment presentation.
However, as demonstrated by this research, questioning clients about early TBI is unlikely to elicit the required information due to a lack of recall. Information may need to be sought from multiple sources and questionnaires designed for this purpose should elicit information regarding any injury events where a LoC could assist recall.

This research has a number of limitations. The use of a birth cohort may produce a higher level of recall as individuals in the cohort have been followed regularly since birth and they are frequently asked to recall injury events, which is likely to make them more vigilant about recalling this type of information. Further, participation in the CHDS may have made the parents in the cohort more likely to share stories of early injury with their children, increasing recall of early injuries. However, the possibility of overestimating recall by using a birth cohort is outweighed by the advantages of having prospectively collected information.

The evidence presented here regarding adult recall of childhood injury events is important, particularly as there is a greater emphasis on examining the long-term outcomes of childhood injury. However, care needs to be taken when recruiting individuals for studies which examine long-term outcomes as adult recall of early injury is unreliable. Clinically it is important to be aware that an adult may not have an independent recollection of a childhood TBI event and other sources may need to be accessed for this information. In the longer term, appropriate measures and methods need to be developed to accurately elicit adult report of childhood TBI.
References.


Table 1:
Number and percentage of childhood injuries recalled at age 25 years displayed in yearly intervals over 0-9 years.

<table>
<thead>
<tr>
<th>Age at injury</th>
<th>Number of known TBI events</th>
<th>Number correctly recalled (%)*</th>
<th>Number incorrectly recalled (%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-&lt;1</td>
<td>15</td>
<td>0 (0.0%)</td>
<td>1 (6.3%)</td>
</tr>
<tr>
<td>1-&lt;2</td>
<td>25</td>
<td>1 (4.0%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>2-&lt;3</td>
<td>21</td>
<td>2 (9.5%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>3-&lt;4</td>
<td>22</td>
<td>4 (18%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>4-&lt;5</td>
<td>19</td>
<td>3 (13.6%)</td>
<td>3 (13.6%)</td>
</tr>
<tr>
<td>5-&lt;6</td>
<td>10</td>
<td>1 (8.3%)</td>
<td>2 (16.7%)</td>
</tr>
<tr>
<td>6-&lt;7</td>
<td>12</td>
<td>3 (18.8%)</td>
<td>4 (25.0%)</td>
</tr>
<tr>
<td>7-&lt;8</td>
<td>12</td>
<td>5 (35.7%)</td>
<td>2 (14.3%)</td>
</tr>
<tr>
<td>8-&lt;9</td>
<td>16</td>
<td>4 (21.1%)</td>
<td>3 (15.8%)</td>
</tr>
<tr>
<td>9-&lt;10</td>
<td>9</td>
<td>5 (41.7%)</td>
<td>3 (25.0%)</td>
</tr>
</tbody>
</table>

*Percentage of known TBI events
Figure 1: Correct and incorrect childhood TBI events recalled at 25 years of age as a percentage of actual TBI events
Table 2:
Logistic Regression predicting the likelihood of recalling a childhood TBI in adulthood

<table>
<thead>
<tr>
<th>Step 1a</th>
<th>Variable(s) entered on step 1: Treatment, Age, Sex, LOC.</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>S.E.</td>
</tr>
<tr>
<td>Treatment(1)</td>
<td>1.618</td>
</tr>
<tr>
<td>Age</td>
<td>.333</td>
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<tr>
<td>Sex(1)</td>
<td>.580</td>
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<tr>
<td>LOC(1)</td>
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<tr>
<td>Constant</td>
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</tbody>
</table>

95% C.I.