Rehabilitation for traumatic brain injury in children and adolescents
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Authors' objectives
The goal was to conduct a systematic review of the literature on child and adolescent traumatic brain injury (TBI), oriented around five key research issues:

1. The effectiveness of early, intensive rehabilitation.
2. The referral of children with TBI to special education.
3. The effectiveness of special education for children with TBI.
4. The effect of the developmental phase on prediction and outcome.
5. The effect of support for families.

Searching
The following sources were searched: MEDLINE from 1976 to 1998, CINAHL from 1982 to 1998, HealthSTAR from 1995 to 1998, PsycINFO from 1982 to 1998, ERIC from 1996 to 1998, Current Contents (1998), and the Cochrane Library. This was supplemented by examining the reference lists of review articles and the bibliographies of book chapters, and by seeking the advice of peers. The complete search strategies were presented in the report.

Study selection
Study designs of evaluations included in the review
All study designs were considered. For question 2, studies were excluded if they were published before 1971 and conducted outside the US, if they relied on selected samples, and if they were prospective studies with a design that may have influenced school placement.

Specific interventions included in the review
Early, intensive medical rehabilitation in the acute care hospital (no details were provided). The Neuro-Cognitive Educational Project provides one-on-one tutoring for each child, with instruction at home and/or in the school setting, and includes a component to assist families in understanding the child's new disabilities. The curriculum and protocol were individually designed for each child to meet that child's needs, based on his or her strengths and weaknesses. The duration of the intervention varied from 3 to 7 months, and from 19 to 68 hours of tutoring. Studies looking at instrument development or alcohol or drug abuse were excluded.

Participants included in the review
Children and adolescents with TBI occurring between the ages of 2 and 18 years, whose injury severity warranted admission to a hospital emergency department and subsequent transfer to acute care.

Outcomes assessed in the review
Numerous outcome measures were recorded for each of the review's five questions. These were as follows:

1. The presence or absence of complications (skin problems and pneumonia); health status at discharge from hospital (age-appropriate motor skills, activities of daily living, play skills, social interaction, behaviour, communication, and measures of cognitive function); long-term measures of impairment and disability (reintegration into school, family, and social groups; academic achievement, transitions through developmental stages); and measures of functional independence.

2. Placement patterns for children diagnosed with TBI; and characteristics of special education, such as (a) was the
assessment appropriate to TBI, (b) was the assessment used to help create the programme, and (c) were the people who implemented the programme trained in caring for and educating children with TBI?

3. Academic achievement; activities of daily living; peer integration and social functioning; play skills; behaviour; communication and speech; motor skills; cognitive capabilities; functional capabilities; long-term disposition (i.e. do they remain in the school system or drop out; have they been referred to the mental health system; are they in the juvenile correction system?).

4. Predictability of the onset of deficits at specific ages or educational landmarks, measured by strength of the association between results of diagnostic or prognostic tests, and the actual manifestations of needs and deficits.

5. Measures of coping, adjustment, satisfaction, stress, and family and caregiver burden.

How were decisions on the relevance of primary studies made?
Two reviewers independently applied the predefined eligibility criteria for the selection of primary studies. The authors do not state how discrepancies were resolved.

Assessment of study quality
Only studies relating to question 3 were assessed for validity. The authors developed a set of fourteen quality criteria for this purpose. These were: the number of developmental categories included in the study; study duration; study design; study setting; sample selection method; the age range of participants in the sample at the time of measurement; the span of developmental stages covered by the age range; the comparison method; specification of injury severity; specification of location of injury; the span of developmental stages covered by the age range at injury; the time from injury to assessment; follow-up; and analysis methods. The authors do not state how the papers were assessed for validity, or how many of the reviewers performed the validity assessment.

Data extraction
The authors do not state how the data were extracted for the review, or how many of the reviewers performed the data extraction.

Data were extracted on study design, deficit, intervention, outcomes, and predictors.

Methods of synthesis
How were the studies combined?
The studies were grouped according to each of the review's objectives, and reviewed in a narrative summary.

How were differences between studies investigated?
The authors do not report any investigation of the differences between studies.

Results of the review
In total, 79 studies were included: 3 for question 1, 4 for question 2, 8 for question 3, 61 for question 4, and 3 for question 5.

1. Effectiveness of early intensive rehabilitation.

There was a lack of relevant trials. This meant that inferences about this intervention for children have been drawn from studies with adult samples. One prospective, uncontrolled observational study and two retrospective studies were reviewed for indirect information about the effects of the intervention. There was some evidence suggesting that early, thorough physical and occupational therapy evaluations that include bone scans may serve to identify otherwise undetected musculoskeletal trauma and heterotopic ossification, indirectly arguing for early physiatry intervention. 2. Use of special education for children diagnosed with TBI.
Three retrospective studies and one cross-sectional study suggested that between 9 and 38% of the students with identified brain injury received referral to special education. It was not possible to determine whether these reported referral rates indicated adequate referral, under-referral, or over-referral. No data were found to answer the question of whether the child with TBI who needs special services, actually receives them.

3. Outcomes of special education.

One non-randomised comparative study, one small case series, one survey, and five case studies provided limited data about the effects of special education programmes for children with TBI; the results were varied. No significant treatment effect was found in the comparative study. In the case series, there was significant improvement from pre- to post-treatment on one of the nine laboratory-based neuropsychological tests. In the five case studies, all patients showed improvement on measures taken during intervention, when compared with those taken pre-treatment.

4. Predicting needs, behaviours, and problems associated with TBI.

Sixty-one studies reported data related to the predictability of deficits based on developmental issues in child and adolescent TBI, though only the seven studies with the highest methodological scores were reviewed. One cross-sectional evaluation of language acquisition demonstrated a predictable pattern of delays and deficits in language acquisition for children up to the age of 3 years, when compared with uninjured children. Two additional cross-sectional studies established the base-rate measures of brain growth at each stage of development that were necessary to detect the developmental effects of injury. Two comparative studies revealed the presence of subtle, hidden deficits in cases of apparently normal performance in paediatric TBI with focal brain damage. Two studies identified systematic, non-linear changes in growth that were strongly related to injury variables.

5. Effects of providing support services to families.

One randomised controlled trial showed that an intervention for parents of children with brain injury may be more effective in reducing the burden of illness, if it focuses on the needs of the parents rather than those of the child. One prospective observational study found a significant, positive correlation between social support and family functioning at 3 years' post-injury.

Authors' conclusions

In general, studies have not been conducted with designs capable of providing evidence for the effectiveness of interventions for children and adolescents with TBI.

CRD commentary

The review aims were stated adequately, though the extent to which the aims were supported by the inclusion criteria was unclear. The literature search was reasonable, though attempts to identify unpublished literature were weak. The validity assessment of primary studies was, with the exception of studies relating to question 3, absent, and where it was presented it was poorly reported. Some details of the review methodology were not reported. It was difficult to determine the extent to which the included studies met the inclusion criteria, since the details of the individual studies were poorly reported. Similarly, more detailed information about the different interventions would have been beneficial. The potential causes of differences between studies were not investigated. This was a review of poor methodologic quality.

Implications of the review for practice and research

Practice: The authors did not state any implications for practice.

Research: The authors state that there are three gaps in the literature on child and adolescent TBI, which define priorities for future research.

1. There is insufficient evidence about the natural history of TBI in this population. Longitudinal, observational studies with large samples are needed to provide this information.

2. Interventions must be tested with experimental study designs.
3. The strong influence of development on all aspects of life for this population means that longitudinal and experimental studies must incorporate concepts of human development, as well as sophisticated analytical methods capable of accounting for individual variation.

Bibliographic details

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This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.