

*Pediatric Mild Traumatic Brain Injury:
Investigating outcomes and
predictors of outcome and recovery
following concussion*

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ACKNOWLEDGEMENTS TO

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Overview

- ▶ Head Injury and Concussion
- ▶ Rationale and Aims of ConlCA
- ▶ ConlCA Findings
- ▶ Key Themes



Head Injury & Concussion

- ▶ Head Injury is one of the most common injuries presenting at Emergency Departments in Australia.
- ▶ Outcomes and symptoms experienced vary significantly:

Somatic – Physical – Emotional
Cognitive – Sleep difficulties

- ▶ Recovery also varies in college athletes/adults compared to younger children and adolescents
- ▶ A greater proportion of children and adolescents experience persistent symptoms beyond 4 weeks.
- ▶ A significant minority (10-30%) still experience ongoing symptoms at three-months post-injury.



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- ▶ Limited studies, particularly in younger children, with an adequate comparison group
- ▶ Few studies utilise traditional neuropsychological testing
- ▶ Predictive factors for outcome are relatively unknown in children

My Project! - ConlCA

- ▶ 146 children aged 6-16
- ▶ 96 with concussion; 50 non-head injured controls
- ▶ Recruitment through Perth Children's Hospital ED
- ▶ Inclusion Criteria: Must meet American Congress of Rehabilitation Medicine definition of mTBI



ACRM Definition

- ▶ any period of loss of consciousness;
- ▶ any loss of memory for events immediately before or after the accident;
- ▶ any alteration in mental state at the time of the accident (e.g. feeling dazed, disoriented, or confused);
- ▶ any focal neurological deficit(s) that may or may not be transient;
- ▶ **but, the severity of the injury must not exceed the following:**
- ▶ loss of consciousness greater than 30 minutes;
- ▶ an initial Glasgow Coma Scale (GCS) of < 13 ;
- ▶ posttraumatic amnesia (PTA) for greater than 24 hours

Test Battery

- ▶ Assessment at UWA within 10 days of injury and three months post-injury

1. Visual Acuity test	8. WASI-II Matrix Reasoning
2. Word Pairs 1	9. WASI-II Similarities
3. WASI-II Block Design	10. WASI-II Vocab
4. Rey Complex Figure Copy	11. Rey Complex Figure Delay
5. WISC-IV Coding & Symbol Search	12. COWAT
6. Stroop Color and Word Test	13. WISC-IV Digit Span
7. Word Pairs 2 (Delay & Recognition)	14. Word Memory Test

Parental Measures

- ▶ 1. Symptom Scale
- ▶ 2. Conner's Behaviour Rating Scale
- ▶ 3. McMaster Family Assessment Device
- ▶ 4. State Trait Anxiety Inventory



"Are you *sure* you feel up to school today?"

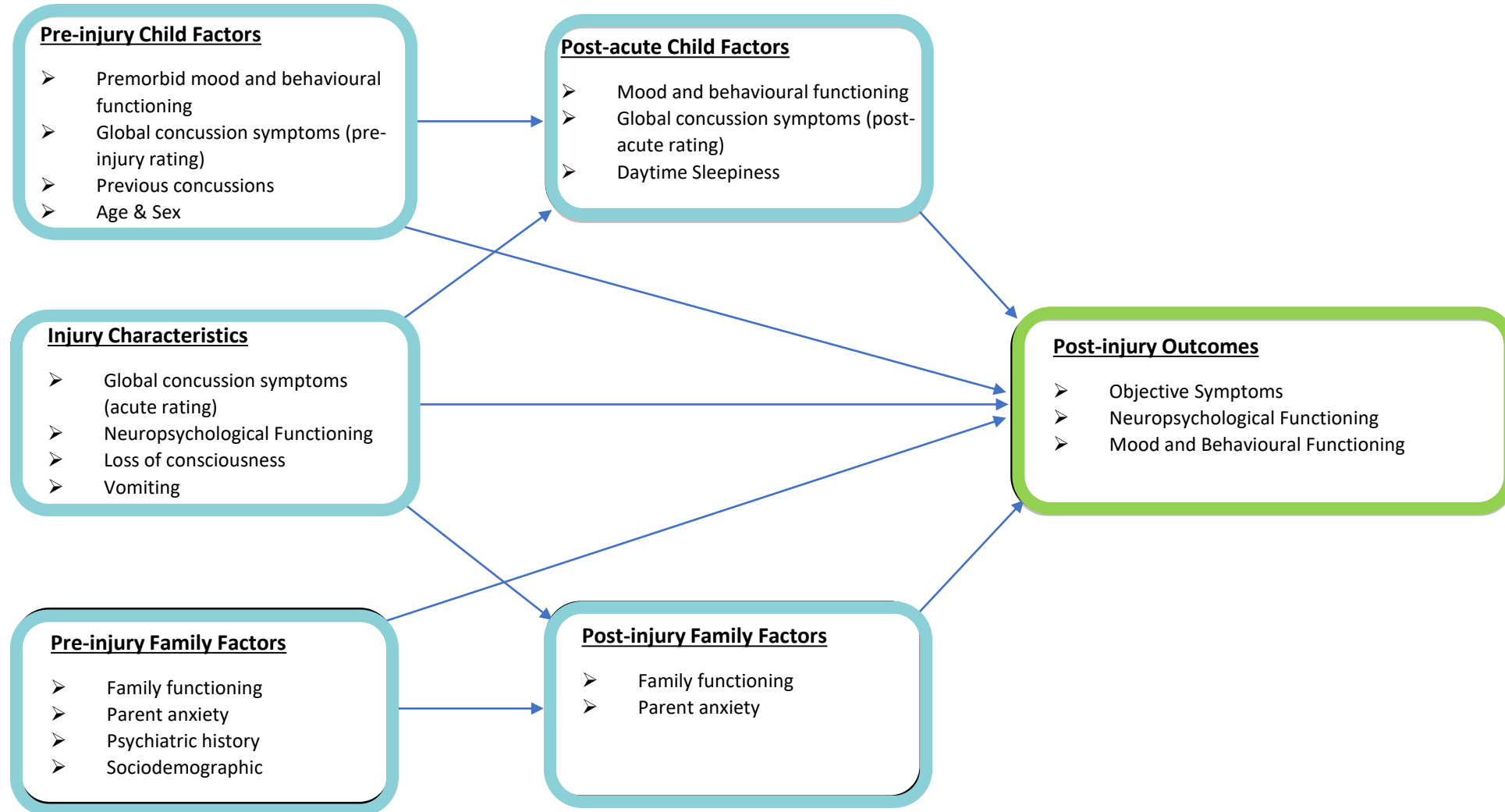
Aims of Thesis: Study 1

- Investigate typical outcomes at the acute stage of injury (within 10 days), and across a three-month post-acute recovery period.
 - Concussion symptom checklists (Sport Concussion Assessment Tool - SCAT)
 - Objective neuropsychological tests.
 - Measures of mood and behavioural functioning.
- Explore differences between age and sex.

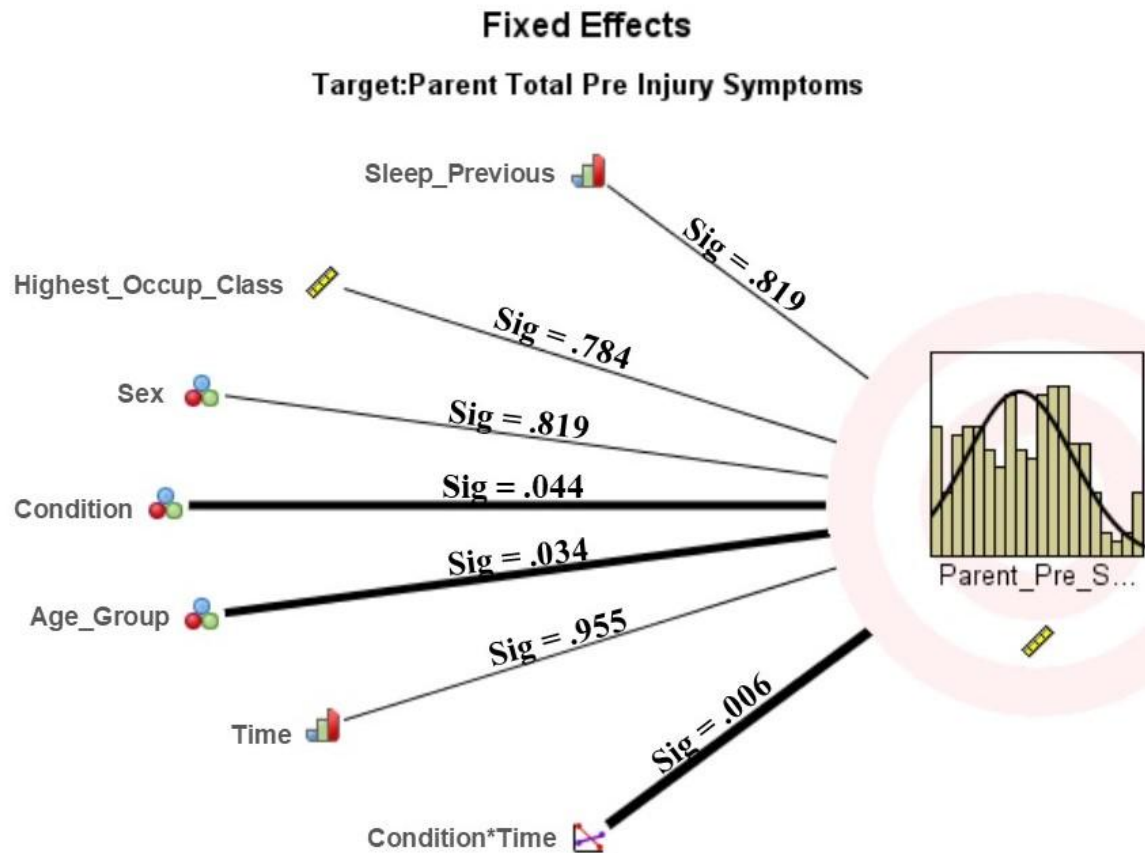
Aims of Thesis: Study 2

- Provide a greater insight into how both injury-related and non-injury related factors impact mTBI outcome and recovery at the acute and post-acute stage of injury.
- Highlight differences in predictors between younger children and adolescents, as well as sex differences.

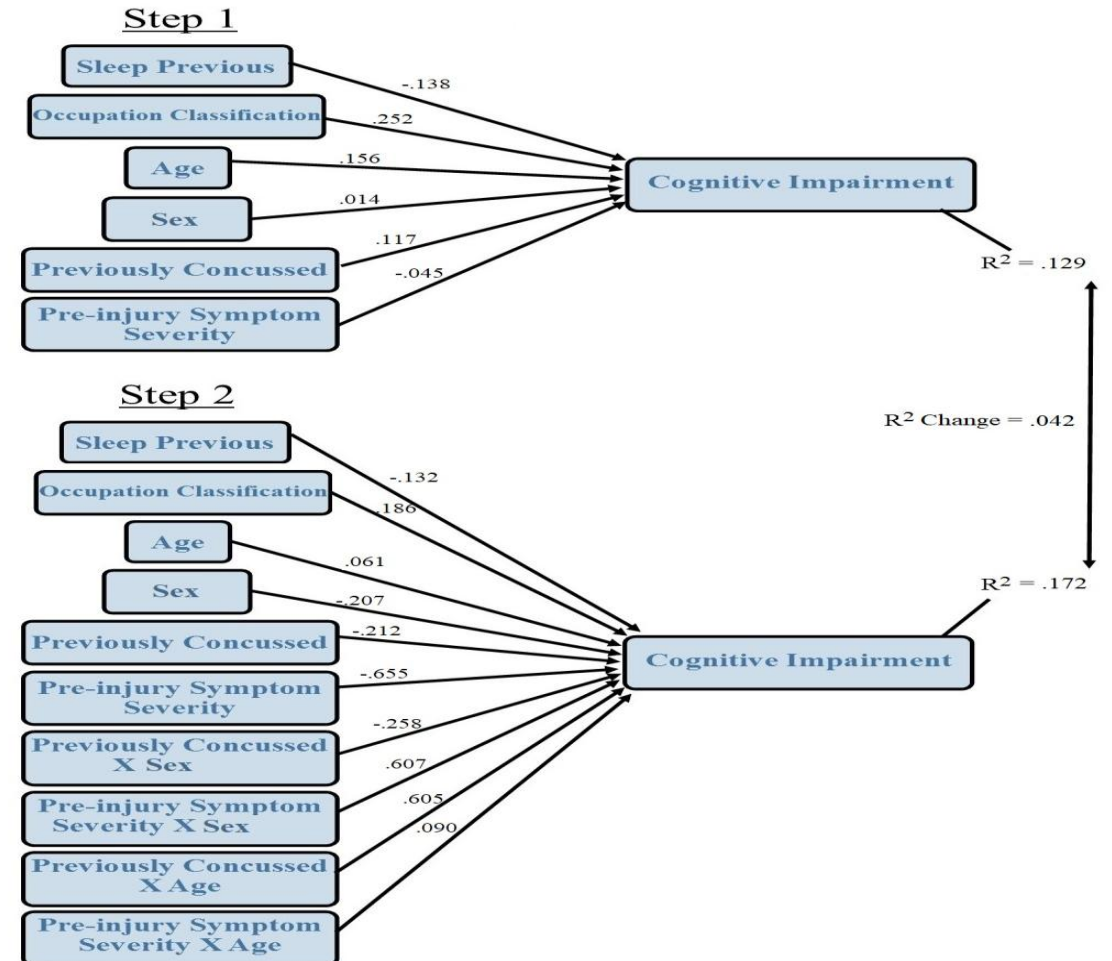
Variation of Yeates and Taylor (2005) model for study of post concussion symptoms



Statistical Analyses



Study 1: GLMM



Study 2: Hierarchical moderated regression

Study 1 Results

Post-injury Outcomes:

- ▶ As expected, mTBI group showed a significant increase in symptoms and severity at the acute assessment, compared to their own pre-injury reports, and compared to controls.
- ▶ mTBI group performed worse on verbal recognition memory and motor processing speed.
- ▶ No significant changes on measures of mood and behavioural functioning.
- ▶ 31.5% experienced **ongoing symptoms** at the three-month Ax.
- ▶ 14.6% **ongoing cognitive deficits**.

Study 1 Results

Age and sex differences:

- ▶ Adolescents from both injured and control groups fared worse on symptom checklists. Suggests that non-injury factors may play a part.
- ▶ Adolescents with mTBI fared worse on verbal processing speed measures, compared to younger children with mTBI.
- ▶ Females with mTBI self-reported more symptoms at the acute stage compared to males with mTBI.
- ▶ Females with mTBI were significantly worse on verbal and visual cognitive measures compared to males, and female controls.
- ▶ Younger children with mTBI experienced more ADHD inattentive symptoms and behaviours.

Reliable Change

- ▶ Demonstrated that visual-motor processing difficulties may persist throughout the three-month recovery period, and that symptoms of depression and anxiety may increase following injury.
- ▶ Showed that a quarter of the mTBI sample had reliable recovery in verbal memory function, from acute to three-months.

Study 2 Results

▶ **Pre-injury Child Predictors:**

- ▶ Pre-injury symptoms were the strongest predictor.
- ▶ Higher pre-injury mood and behavioural ratings predicted various outcomes
- ▶ History of previous mTBI predicted higher major depression symptoms.

▶ **Injury related:**

- ▶ Loss of consciousness predicted higher ratings of attention difficulties.

▶ **Post-injury child:**

- ▶ Higher post-acute attention ratings predicted higher concussion symptom totals and severity at three-month assessment.

▶ **Pre- and post-injury parent/family:**

- ▶ Parent anxiety or family functioning did not predict symptom or cognitive outcome. But poorer family functioning did predict attention difficulties.
- ▶ Parent occupation classification consistently predicted cognitive outcome.

▶ **Age & sex differences:**

- ▶ Loss of consciousness predicted higher acute symptom severity in younger children.
- ▶ Mood and behavioural factors commonly predicted outcome in adolescents
- ▶ Pre-injury and post-acute symptom severity predicted worse neurocognitive outcomes in adolescents.
- ▶ In males, higher post-acute daytime sleepiness predicted increased symptom totals at three-months .

Key Themes

1. Impact of mood and behavioral functioning

- ▶ Consistently seen to have an impact following mTBI and as a predictor
- ▶ Needs to be taken into consideration as part of assessment and treatment.

2. Impact of Cognitive Outcomes

- ▶ Specific cognitive difficulties identified in domains such as verbal memory and visuo-motor processing speed. Also verbal processing speed in adolescents only, and verbal and visual cognition in females.
- ▶ 14.6% of the mTBI group were still classified as cognitively impaired at three months.

3. Impact of Sociodemographic factors

- ▶ Lower skilled parent occupation consistently predicted worse cognitive outcomes, and some symptom and mood and behavioural outcomes.
- ▶ The link between sociodemographic factors and cognitive reserve
- ▶ Multiple sociodemographic factors should be considered

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Questions



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