Baseline Neuropsychological Performance in High School Students

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Background

• **Neuropsychology (NP)** is the study of brain-behaviour relationships (8).

• NP testing historically used for research purposes to begin to **understand the cognitive consequences of sport related concussion (SRC)** in the mid 1990’s (15).

• NP testing has evolved into a **clinical screening tool used in the overall concussion management strategy** (3,8).

• Provides **objective measures of several cognitive domains** (4,7).
The Baseline Approach

• ‘baseline’ testing involves mass pre-season NP testing and re-testing following head injury/SRC (5)

• Allows for direct comparison between cognitive ability before and after concussion

• Several factors have been suggested to affect baseline NP performance in university and professional level athletes
Why are adolescents unique?

- Adolescence is a **critical period for cognitive development** (2)
- Particularly **vulnerable to cognitive decline following concussion** (1)
- Typically **take longer to recover from concussion than adults** (7)
- **Majority of sport-related concussion (SRC) is reported to occur in high school athletes** (3)
- Little **normative baseline data exists for this population**
Purpose

1) To investigate the relationship between education level and baseline NP performance

2) To examine the relationship between baseline NP performance and two pre-existing factors:
   - Concussion History
   - Mood/developmental disorders
Methods

Participants
• high school students at a single institution (n=1037)

Design
• Retrospective cross-sectional design

Measure
• Automated Neuropsychological Assessment Metrics (ANAM)

Analysis
• Education: univariate ANOVA with Tukey-Kramer post hoc
• Concussion History and mood/developmental disorders: independent t-tests
ANAM

• **Brief screening tool** which addresses specific elements of cognition
• Originally developed by US military
• Made up of **9 subtests**, each intended to address a specific element of cognition:
  - Learning/information processing
  - Attention processing
  - Spatial processing/memory
  - Working memory
  - Math operations
  - Simple reaction time

• Includes an electronic demographic and health history form
• **Accuracy, Mean Reaction Time, and Throughput** (an index of cognitive efficiency) scores for all nine ANAM subtests were used for analyses
Participants

Population breakdown by grade level

- Grade 9: n=413
- Grade 10: n=197
- Grade 11: n=204
- Grade 12: n=223

Number of Subjects per grade
Population Breakdown by Sport Participation

- Contact Sports (i.e. hockey, football, rugby, MMA); n = 499
- Non-Contact Sports (i.e. baseball, basketball, golf, lacrosse, tennis, track and field, volleyball, skiing, swimming); n = 274
- Other; n = 264
Results

Percentage of population with self-reported concussion history and mood/developmental disorders

- Self-reported concussion history (n=169) - 4%
- Self-reported mood/developmental disorder (n=42) - 16%
- No concussion history or mood/developmental disorder (n=826) - 80%
Main Findings

• 1. Education

• 2. Concussion History

• 3. Mood/Developmental Disorders
Education Level and NP Performance

• Results from ANOVAs show significant differences in NP performance based on grade level for 7 of the 9 ANAM subtests.

• On average, older students (grades 11/12) scored better than younger students (grades 9/10) in almost every area of cognition.

• Supports existing literature examining the relationship between education level and NP performance in high school students.
  o Hunt et al., 2009
ST6
(Sternberg Memory Search)

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Mean Throughput Score</th>
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<tbody>
<tr>
<td>Grade 9</td>
<td>~60</td>
</tr>
<tr>
<td>Grade 10</td>
<td>~65</td>
</tr>
<tr>
<td>Grade 11</td>
<td>~70</td>
</tr>
<tr>
<td>Grade 12</td>
<td>~70</td>
</tr>
</tbody>
</table>

* denotes significant difference from Grade 9.
SPD
(Spatial Processing)

Mean Throughput Score

Education Level

GRADE 9  GRADE 10  GRADE 11  GRADE 12

* * *
Concussion History and NP performance

• Self-reported concussion history was generally not found to significantly affect NP performance
• Significance only found for 1 of the 9 ANAM subtests:
  o SRT (P < 0.001)
• Supports the existing literature which suggests there is a non-significant relationship between concussion history and NP performance at baseline in older populations (university athletes)
  o Brooks et al., 2013
  o Brown et al., 2007
Mood/developmental Disorders and NP Performance

- Results from independent t-tests suggest that mood/developmental disorders can affect baseline NP performance
- Significance found for three subtests:
  - MTH ($p \leq 0.01$) - mathematical operations
  - PRO ($p < 0.01$) - attention processing
  - SR2 ($p = 0.009$) – reaction time and attention processing
- Supports existing literature in older populations (university level)
  - Mood – Bailey et al., 2010; Convassín et al., 2012
  - ADD – Elbin et al., 2013; Zuckerman et al., 2013
  - Learning Disability – Collins et al., 1999; Elbin et al., 2013; Zuckerman et al., 2013
Limitations

- All boys
- Small sample population
- Self-reported?
Summary

- This study provided a unique opportunity to study NP performance in adolescent students

- Significant findings:
  1) Baseline NP performance is affected by education level in high school students
  2) Baseline NP performance is affected by the presence of mood/developmental disorders in high school students

- Concussion history not found to significantly affect NP performance at baseline in high school students (supports existing literature)

- Findings provide important clinical considerations for the interpretation of post-injury information

- Future Directions for research
  - Other potential factors affecting baseline NP performance in adolescent students
References

Thank you