Effect of one season of tackle football on young athletes’ cognitive function: A novel use of NIH Toolbox Cognition Battery

Carly Strohbach
Lurie Children’s Institute for Sports Medicine

Malekian S, Burgess JK, McCracken K, Turner J, Labella CR
• The potential risks of concussions and impaired cognitive function for youth participating in tackle football has created large public concern.

Playing football young may mean earlier cognitive, emotional problems.
Background

• US youth sports- and recreation-related concussions: ~1-2 million sustained each year
• ~3-5/100 youth tackle football players suffer concussion during season
  – Short-term impacts on school and social functioning\(^1,^2\)
  – Long-term negative outcomes?
• Controversies in youth football
  – Tackling
  – Effects of subconcussive blows to the head\(^3\)
## Season length and level of contact for each age group

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Season Length (weeks)</th>
<th>Non-contact weeks (drills only)</th>
<th>Full contact onset</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>2</td>
<td>Start of Week 3</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td>End of Week 2</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
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</tbody>
</table>
1. Novel application of the NIH Toolbox Cognition Battery on youth football players in a community setting
2. Evaluate the effects of a season of football on cognitive function in children and adolescents

*Hypothesis: No negative impact of a season of football on cognition*
What is the NIH Toolbox?

- A comprehensive set of neuro-behavioral measurements that quickly assess cognitive, emotional, sensory, and motor functions
- iPad administration
- Cognition Battery
- Pros/Cons
Relationship between Lurie Children’s and Northside Youth Football League

• What is NSYF?
• What role does Lurie Children’s Sports Medicine play?
METHODS
I/E Criteria

• Included:
  – Male youth football players from community football league
  – Aged 7-14
  – English-speaking

• Excluded:
  – Diagnosed hearing loss, epilepsy, or developmental disability
Study Design

• Testing within one week of both the beginning and the end of the 2018 football season (12 weeks)
• Setting
• NIH Toolbox Cognition Battery
Enrollment

250 invited

176 did not respond (70%)

74 enrolled (30%)

34 did not complete both pre- and post-testing (14%)

40 included in analysis (16%)
Scoring

- Fluid Cognition Composite Score
- Crystallized Cognition Composite Score
- Cognitive Function Composite Score (Fluid + Crystallized)
- Age-Corrected Standard Scores
  - Adjusts by age
- Fully-Corrected T-Scores
  - Adjusts for age, gender, race, ethnicity, and educational attainment
Statistical Analyses

• Descriptive analyses of cohort
• Paired T-Tests (p=0.05) between pre- and post-season scores
RESULTS
Subject Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age: median (range)</td>
<td>11 (7-14)</td>
</tr>
<tr>
<td>Gender, N (%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Male</td>
<td>40 (100)</td>
</tr>
<tr>
<td>Self-reported Ethnicity, N (%)</td>
<td></td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>6 (15)</td>
</tr>
<tr>
<td>Not Hispanic or Latino</td>
<td>32 (85)</td>
</tr>
<tr>
<td>Self-reported Race, N (%)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>26 (65)</td>
</tr>
<tr>
<td>Black or African American</td>
<td>4 (10)</td>
</tr>
<tr>
<td>Asian</td>
<td>2 (5)</td>
</tr>
<tr>
<td>American Indian or Alaska Native</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Native Hawaiian or Other Pacific Islanders</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Other including multiple races</td>
<td>8 (20)</td>
</tr>
</tbody>
</table>

- No head injuries sustained during season
Age-Corrected Standard Scores

N=44

<table>
<thead>
<tr>
<th></th>
<th>PRE-SEASON</th>
<th>POST-SEASON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid Composite Score</td>
<td>97.9</td>
<td>102.4</td>
</tr>
<tr>
<td>Crystallized Composite Score</td>
<td>110.8</td>
<td>112.3</td>
</tr>
<tr>
<td>Cognitive Function Composite Score</td>
<td>104.9</td>
<td>108.6</td>
</tr>
</tbody>
</table>
Fully Corrected T-Scores

N=40

**Fluid Composite Score**
- PRE-SEASON: 46.7
- POST-SEASON: 50.1

**Crystallized Composite Score**
- PRE-SEASON: 52.6
- POST-SEASON: 54.6

**Cognitive Function Composite Score**
- PRE-SEASON: 49.2
- POST-SEASON: 52.7

*Significant difference
Conclusions

• No negative effect on cognitive function from season of play
• Improvements in fluid and overall cognitive function composite scores
• No improvements in crystallized composite scores
Discussion

• NIH Toolbox Cognition Battery successful in community setting
• No evidence of cognitive impairment during season of play
• Extensive literature documenting benefits of youth sports participation
  – Teamwork
  – Mental health
  – Physical activity
• Youth football has relatively low rates of injuries
Practice Effects

- Practice effects expected with repeated measures using NIHTB-CB
- Familiarity with assessment
Limitations

- Lack of control group
- High attrition rate/Low enrollment
  - Lengthy wait times
- Noisy testing environment
- Forces of impact not measured
- No reported concussions
Future Directions

• Control group

• Effect of multiple football seasons
  – Longitudinal follow-up

• Bigger, more inclusive cohort including athletes with documented concussions
Tips for Implementation of NIH Toolbox Cognition Battery in a Community Setting

- Flexible scheduling
- Test administration setting
- Reception for parents
- Encouragement for participants
Thank you!

Northside Youth Football participants and their families and director Mike Lohman

Orthopaedics and Sports Medicine Research Group members, past & present

Cynthia LaBella, MD
Jamie Burgess, PhD
Kristi McCracken, ATC
Maddy McHugh, ATC
Emily Worobec, ATC, MSEd
Jacqueline Turner, APN
Adam Potteiger, MS, ATC
Sina Malekian
Ayesha Maqsood, MD
Jake Wild
Kiana King
Sigi Wolf, MD
References