The Effect of Concussion and Concussion Prevention Strategies on Performance in Youth Ice Hockey

Paul Eliason, Carly McKay, Willem Meeuwisse, Brent Hagel, Luc Nadeau, Carolyn Emery
Disclosures

• Nothing to disclose
Background

• Hockey is one of the most popular winter sports in Canada
  – 634,892 registered players in 2013-2014 season

• Concussion is the most common specific injury in youth hockey (up to ~30% of all injuries)

Hockey Canada Annual Report; Emery et al. 2006, 2008
Background

• Hockey is one of the most popular winter sports in Canada
  – 634,892 registered players in 2013-2014 season
• Concussion is the most common specific injury in youth hockey (up to ~30% of all injuries)
  – Body checking is the primary mechanism of injury
  – Previous concussion is a significant risk factor for incurring another concussion
    • → HC policy change

Hockey Canada Annual Report; Emery et al. 2006, 2008, 2010
Background

- Acute period post concussion:
  - Impaired reaction time and memory scores (Collins et al. 2003)
  - Balance deficits (Guskiewicz et al. 2001)
  - Cognitive impairments (McCrea et al. 2003)
Background

• Lack of concussion research investigating:
  – Long term effects
  – Youth (exception: epidemiology)
  – Effects on sport-specific skill performance
Hockey Canada Skills Test (HCST)

- A way to measure skill acquisition and development in youth ice hockey players
- May be instrumental in detecting possible effects of a previous concussion on sport-specific skill performance
Components of the HCST

- Forward agility weave
Components of the HCST

- Forward agility weave
- Forward/backward speed skate
Components of the HCST

- Forward agility weave
- Forward/backward speed skate
- Transition agility
Components of the HCST

- Forward agility weave
- Forward/backward speed skate
- Transition agility
- 6-Repeat endurance skate
Objectives

• To determine the:
  – Test-retest reliability of the HCST
  – Association between previous history of concussion and HCST
Methods

• On-ice
  – 4 HCST components

• Off-ice
  – Players completed a baseline questionnaire regarding any and all previous concussions they have received prior to HCST
## Recruitment

<table>
<thead>
<tr>
<th>Year</th>
<th>Group Description</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-2013</td>
<td>Elite Bantam &amp; Midget (upper 20%)</td>
<td>n=113</td>
</tr>
<tr>
<td>2013-2014</td>
<td>Elite &amp; non-elite Pee Wee &amp; Bantam</td>
<td>n=231</td>
</tr>
<tr>
<td>2014-2015</td>
<td>Elite &amp; non-elite Pee Wee &amp; Bantam</td>
<td>n=252</td>
</tr>
</tbody>
</table>
### HCST Demographics

<table>
<thead>
<tr>
<th></th>
<th>Pee Wee (n=348)</th>
<th>Bantam (n=175)</th>
<th>Midget (n=73)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Conc. (n=246)</td>
<td>Conc. (n=102)</td>
<td>No Conc. (n=108)</td>
</tr>
<tr>
<td><strong>Age (mean, in years)</strong></td>
<td>11.60</td>
<td>11.63</td>
<td>13.66</td>
</tr>
<tr>
<td><strong>Sex:</strong></td>
<td>Male: 234 (95%)</td>
<td>99 (97%)</td>
<td>86 (79%)</td>
</tr>
<tr>
<td></td>
<td>Female: 12 (5%)</td>
<td>3 (3%)</td>
<td>22 (21%)</td>
</tr>
<tr>
<td><strong>Division of Play:</strong></td>
<td>Elite: 74 (30%)</td>
<td>32 (32%)</td>
<td>49 (50%)</td>
</tr>
<tr>
<td></td>
<td>Non-elite: 170 (70%)</td>
<td>69 (68%)</td>
<td>49 (50%)</td>
</tr>
<tr>
<td><strong>Number of Previous Concussions:</strong></td>
<td>1x: 88 (86%)</td>
<td>2x: 13 (13%)</td>
<td>1x: 56 (85%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3x: 1 (1%)</td>
<td></td>
</tr>
</tbody>
</table>
HCST Test-Retest Reliability

Forward Agility Weave

Without Puck:
Mean Difference: 0.099 s
LOA: -1.257 to 1.454 s
ICC: 0.89 (95% CI 0.81-0.98)

With Puck:
Mean Difference: 0.303 s
LOA: -1.897 to 2.507 s
ICC: 0.85 (95% CI 0.74-0.97)

Transition Agility

Without Puck:
Mean Difference: 0.117 s
LOA: -1.193 to 1.427 s
ICC: 0.92 (95% CI 0.85-0.98)

With Puck:
Mean Difference: -0.397 s
LOA: -3.892 to 3.098 s
ICC: 0.74 (95% CI 0.56-0.93)
HCST Test-Retest Reliability

Forward/Backward Speed Skate

**Forwards Without Puck:**
- Mean Difference: 0.019 s
- LOA: -0.520 to 0.558 s
- ICC: 0.82 (0.68-0.95)

**Forwards With Puck:**
- Mean Difference: 0.033 s
- LOA: -0.664 to 0.729 s
- ICC: 0.75 (0.58-0.93)

**Backwards Without Puck:**
- Mean Difference: 0.001 s
- LOA: -0.723 to 0.726 s
- ICC: 0.81 (0.67-0.95)

**Backwards With Puck:**
- Mean Difference: 0.072 s
- LOA: -0.604 to 0.748 s
- ICC: 0.86 (0.76-0.97)

6 Repeat Endurance Skate

**Without Puck:**
- Mean Difference: 0.200 s
- LOA: -1.480 to 1.881 s
- ICC: 0.50 (95% CI 0.19-0.80)
Mean HCST Scores

• Comparing the mean times of the various HCST components by history of concussion and:
  – Level of play (Pee Wee, Bantam, Midget)
  – Sex
• No statistically significant differences
Exploratory Results

• Multiple linear regression:
  – History of concussion was not a significant independent variable of performance

• Significant variables:
  – Position
  – Elite/non-elite
  – Level of play (Pee Wee, Bantam, Midget)
  – Sex
  – Age (some outcomes)
  – Previous MSK injury within last 1 year
Take Home Points

• HCST is a reliable way to measure on-ice sport specific skill performance
• Post-concussion persistent deficiencies
  – No deficiencies?
  – Test not sensitive enough?
Limitations/Future Outcomes

• Cross-sectional study
  – Use HCST scores to predict future risk of injury?
• History of concussion at any time
  – Other ways to look at concussion
• Survivor bias
The Effect of Body Checking Policy Change on Game Skill Performance in 11-12 Year Old Ice Hockey Players

Ash Kolstad, Luc Nadeau, Paul Eliason, Luz Palacios-Derflingher, Claude Goulet, Carolyn Emery
Objective

• To compare offensive performance measures in elite (upper 30% by division of play) Pee Wee ice hockey players that have one-year BC experience (Calgary) to players without BC experience (Québec City)
Offensive Performance

• **Outcome Measures**: Games were analyzed for offensive performance metrics for the puck carrier using the ice hockey adapted Team Sport Assessment Procedure

Nadeau et al., 2008
Offensive Performance

Puck Possession

- Conquered Puck
- Received Pass

Puck Outcome

- Successful Shot
- Lose Puck
- Offensive Pass
Methods

Design
• Prospective cohort study

Participants
• 12 elite Pee Wee games were filmed in Québec City (n=333 players)
• 11 elite Pee Wee games were filmed in Calgary (n=309 players)

Analysis
• Poisson regression, clustered by game
• Unadjusted incidence rate ratios (IRRs) of each puck action per team game between players in Calgary and Québec City for the 2013-14 season
Results

IRR=0.99
(95% CI: 0.89-1.10)

IRR=0.98
(95% CI: 0.88-1.10)

Québec
Calgary

Possession Variables
IRR= Incidence rate ratio Québec vs Calgary
IRR= Unadjusted for covariates but adjusted for cluster
Results

Outcome Variables

IRR= Incidence rate ratio Québec vs Calgary
* 95% CI does not include 1

IRR= Unadjusted for covariates but adjusted for cluster

 Québéc  

Lost Puck

Offensive Pass

IRR=0.97  
(95%CI: 0.81-1.15)

IRR=0.98  
(95%CI: 0.86-1.12)

IRR=0.98  
(95%CI: 0.86-1.12)
Limitations

• **Camera angle**
  – Differed between games depending on arena

• **Video quality**
  – Quebec City poorer visual quality

• **Field of view**
  – Single view can lead to missed actions
Conclusions

• No evidence of a difference between those with and without a previous history of concussion on HCST component scores.

• No differences found across all offensive performance metrics between those with and without one-year BC experience in Pee Wee.

• Suggests that offensive performance is not negatively affected by Hockey Canada’s decision to delay BC to Bantam.
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