Effectiveness of a Cognitive Training Program in Reducing Head Impact Kinematics in Youth Ice Hockey

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ABSTRACT

OBJECTIVE: To determine the effectiveness of cognitive training in reducing youth ice hockey head impact kinematics. **BACKGROUND**: There is growing concern that repetitive head impacts are associate with later life neuropathologies and primary prevention strategies to reduce these impacts are limited. **DESIGN/METHODS**: Participants on two youth ice hockey teams (U16 and U18) were randomly assigned to either a Cognitive Training (CT) group (Intelligym, Applied Cognitive Engineering) (N=8) or Control group (N=9). The CT group performed two 30 minute sessions per week of the computerized training program which utilizes a video-game like platform to train attentional capacity and working memory. The Control group performed two 30 minute sessions of hockey videos weekly and recorded player performance characteristics. All participants wore accelerometers (Triax Technologies) for all practices and home games and impacts were confirmed via video recordings. The dependent variables were 1) number of impacts per player per week, 2) cumulative linear acceleration per player, and 3) cumulative rotational accelerations per player. As the study's goal was to evaluate the cognitive training effectiveness, the first half of the season (weeks 1-10) served as a covariate and group performance during the second half of the season (weeks 11-20) was compared with three ANOVAs. **RESULTS**: There were significant group differences for number of impacts (CT: 8.0 + 4.5 and Control: 15.0 + 9.1 impacts, P=0.039) and cumulative linear acceleration (CT: 181.7 + 184.3 and Control: 284.3 + 185.5 g's, P=0.050), but there were no differences in cumulative rotational acceleration (CT: 24.7 + 20.9 and Control 34.7 + 22.4 krad/s2, p=0.198). **CONCLUSION**: These results provide preliminary evidence supporting a primary prevention strategy to reduce the number and cumulative linear accelerations of head impacts in youth ice hockey; however, these preliminary results need to be confirmed in larger studies.

METHODS

Participants

20 Youth Ice Hockey players from 2 teams (U16: N=14 and U18: N=6) enrolled in the study. All active team members were invited to participate in the study and all participants provided informed assent and parents/guardians provided informed consent

	Age (Years)	Height (cm)	Weight (kg)	Concussion History
Intelligym	15.5 ± 0.6	172.7 ± 6.2	67.8 ± 25.8	0.0 ± 0.0
Control	16.1 ± 0.9	177.8 ± 9.9	73.7 ± 9.2	0.6 ± 0.8

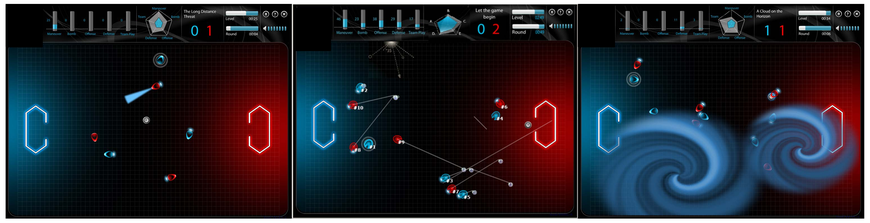
Instruments

All participants wore accelerometers (SIM-G, Triax Inc, Norwalk, CT) during all practices and home games. The SIM contains a high-g and low-g tri-axial accelerometer (1,000 hz) to measure linear acceleration levels within a 3-150g range and a tri-axial gyro to measure angular head motion. A 10-g threshold was set and when an impact above the threshold occurred, information regarding 10ms before and 52ms after the impact was transmitted to a laptop.

METHODS

Procedures

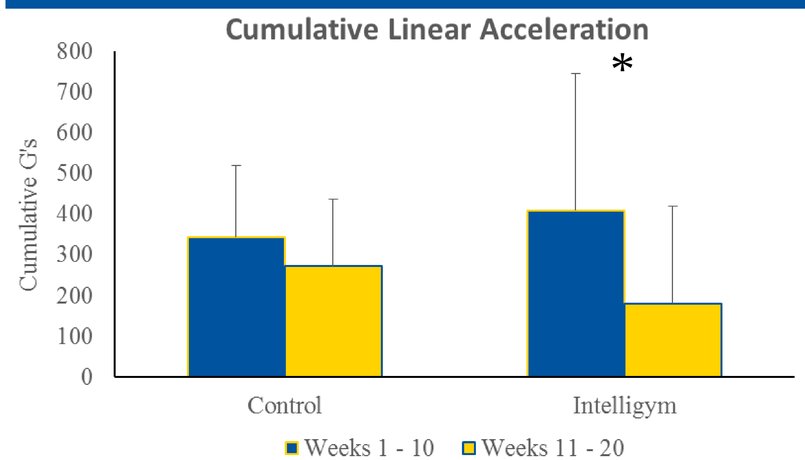
The participants were randomly divided into two groups: 1) Cognitive Training group using the "Intelligym" (Applied Cognitive Engineering, Pine Brook, NJ, USA) and 2) a control group that watched ice hockey videos and reported on come game performance statistics (e.g., number of passes attempted by a specific player). Both groups performed two sessions per week with each session designed to last 20 – 30 minutes. The Intelligym program was developed to train cognitive awareness through a computer based video game style platform.



Statistical Analysis

There were three primary outcome measures associated with this study; 1) Number of Head Impacts per Week, 2) Cumulative Linear Acceleration (g), and 3) Cumulative Rotational Acceleration (krad/s^2). As the manufacturer recommends 15 – 20 training sessions to see improvements, the season was divided into two 10-week blocks (Weeks 1 – 10 and Weeks 11 – 20). A 2 (group) x 2 (time) repeated measures ANOVA compared performance.

RESULTS



There was a significant interaction (F: 4.556, P=0.050) between group and time. The effect size was medium to large (η^2=0.233). There as no difference between groups at weeks 1 – 10 (p=0.334) and the control group was unchanged (Week 1 – 10: 344.0 ± 175.1g and Week 11 – 20: 272.9 ± 165.4g; P=0.95). The Intelligym group improved over time (Weeks 1 – 10: 409.6 ± 336.7 and Weeks 11 – 20: 181.7 ± 239.1, P<0.001, *d*=0.78)

RESULTS

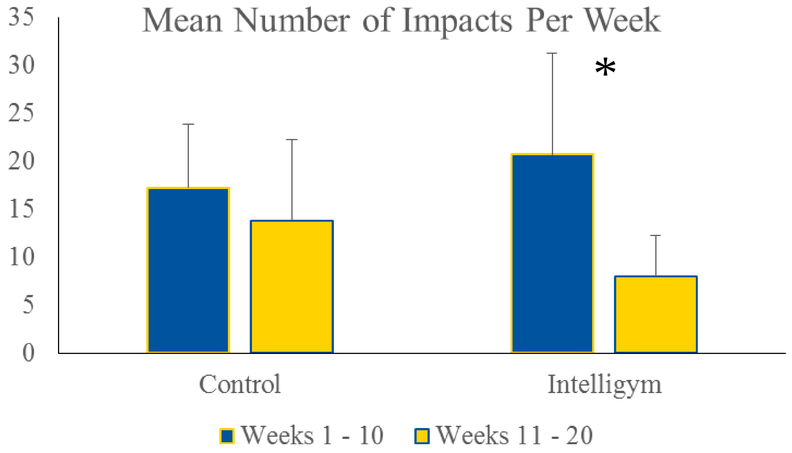


Figure 2. There was a significant interaction (F: 7.554, P=0.015) between group and time with a large effect size (η^2=0.335). There was no significant differences between groups during Weeks 1 – 10 (P=0.183). The control group was unchanged over time (Weeks 1 – 10: 17.2 ± 6.6 impacts and Weeks 11 – 20: 13.8 ± 8.4 impacts; P=0.861). The Intelligym group improved over time (Weeks 1 – 10: 20.7 ± 10.5 impacts and Weeks 11 – 20: 8.0 ± 4.2 impacts; P<0.001, *d*=1.6).

There was no significant interaction in **Rotational Acceleration** (F: 1.445, P=0.248).

	Weeks 1 – 10	Weeks 11 – 20
Intelligym	57.0 ± 59.8 krad/s^2	24.7 ± 20.9 krad/s^2
Control	42.6 ± 27.1 krad/s^2	34.7 ± 22.4 krad/s^2

DISCUSSION

The main finding of this preliminary study was **a reduction in the number of head impacts per week and cumulative linear accelerations** following a cognitive training program. While these results represent a small sample size and require confirmation in larger studies, the results potentially suggest head impacts kinematics can be reduced through cognitive training. Given the growing concern of repeated head impacts/subconcussive blows, primary prevention mechanisms are needed to reduce the risk of potential later life neuropathologies.

REFERENCES

1. Emery CA, Black AM, Kolstad A, et al. What Strategies Can Be Used to Effectively Reduce the Risk of Concussion in Sport? *British Journal of Sports Medicine*. 51(12): 978 – 984. 2017.
2. Bailes JE, Petraglia AL, Omalu BI, et al. Role of Subconcussion in Repetitive Mild Traumatic Brain Injury. *Journal of Neurosurgery*. 119: 1235 – 1245. 2013.

DISCLOSURE/COI

This study was funded by *Applied Cognitive Engineering*, the parent company of Intelligym. The study was designed by the research team and the company had no access to any head impact kinematics data associated with the study. The decision to submit to AAN Sports Concussion was the sole decision of the research team and the abstract & poster were designed without input from the company.