Changes in Neurocognitive Outcomes among Youth Football Teams Participating in an Intervention

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Introduction:
Youth football inherently involves repetitive athlete-to-athlete contact and subsequently exposure to head impacts and head acceleration events (HAEs).[1] There is increasing evidence that exposure to head impacts and HAEs over multiple seasons can result in long-term neurological deficits.[2,3] It is unknown if reducing exposure to HAEs mitigates short-term or long-term deficits in neurocognitive outcomes. The objective of this study was to evaluate changes in neurocognitive outcomes among participants involved in an evidence-based intervention aimed to reduce exposure to HAEs in youth football practices.

Methods:
Forty-six athletes (ages 11-13) on four teams wore instrumented mouthpieces throughout their football seasons.[4] Two teams (n=25; football control) followed coach-prescribed practices and two teams followed the practice intervention (n=21; 12U-I, 13U-I). Film was collected at sessions, and used to visually verify and characterize recorded events via a custom MATLAB program. Each athlete completed neurocognitive assessments before and after the football season, including the Conners' Continuous Performance Test Third Edition (CPT-3), NIH Toolbox (Version 2), and Immediate Post-concussion Assessment and Cognitive Test (ImPACT). Summary statistics were calculated for biomechanical and neurocognitive data.

Results:
The 13U-I team followed the practice intervention throughout their entire season. The 12U-I team followed the practice intervention for the first five weeks of practice; in week 6, a head coaching change occurred and the 12U-I team stopped following the intervention. For the football control teams, median (95th percentile) peak resultant linear acceleration, rotational acceleration, and rotational velocity were 9.5 g (27.0 g), 666.4 rad/s^2 (1863.3 rad/s^2), and 8.5 rad/s (17.4 rad/s), respectively.[5] The 12U-I team had median (95th percentile) peak resultant linear acceleration, rotational acceleration, and rotational velocity values of 12.9 g (32.2 g), 1042.8 rad/s^2 (2873.8 rad/s^2), and 10.1 rad/s (21.1 rad/s), respectively. For the 13U-I team, median (95th percentile) peak resultant linear acceleration, rotational acceleration, and rotational velocity were 12.7 g (35.2 g), 814.7 rad/s^2 (2428.3 rad/s^2), and 8.8 rad/s (19.2 rad/s), respectively. The percentage of athletes that declined on neurocognitive assessments are provided in Table 1.

Table 1. Percentage of athletes that declined on neurocognitive assessments from pre- to post-season.

Assessment	Score Metric	Football Control	12U-I	13U-I
CPT-3	Detectability	40%	25%	58%
	Hit Reaction Time	48%	75%	50%
NIH Toolbox	Flanker Inhibitory Control and Attention	44%	44%	25%
	List Sorting Working Memory	12%	67%	67%
	Pattern Comparison Processing Speed	20%	33%	42%
	Picture Vocabulary	76%	89%	75%
ImPACT	Verbal Memory Composite	28%	33%	42%
	Visual Memory Composite	36%	44%	67%
	Visual Motor Composite	36%	33%	17%
	Reaction Time Composite	36%	56%	50%
	Impulse Control Composite	56%	78%	67%

Conclusions:

Youth football athletes wore instrumented mouthpieces to capture head kinematics data and completed neurocognitive assessments pre- and post-season. Preliminary results indicate the intervention was effective in reducing the frequency of HAEs but the percentage of individuals with declining neurocognitive measures varied across intervention and control teams. Future work will relate biomechanical measures of HIE to pre-to-post-season changes in cognitive measures. This project was supported by the National Institutes of Health (NICHD 5K25HD101686-03, 1F31HD110224-01A1) and the Wake Forest University School of Medicine's Dean's Award.

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