



Orthostatic vital signs after sport related concussion: a cohort study

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NEUROSPORT
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BACKGROUND

- Evidence suggests sport-related concussion (SRC) is associated with autonomic nervous system (ANS) dysfunction.^{1, 2}
- Measures of ANS function may therefore represent potential biomarkers for SRC, yet there is limited evidence to guide ANS evaluation following SRC.
- Orthostatic vital signs (VS) represent a clinically-accessible measure of ANS function that may be of value for SRC assessment.
- Objective: To compare orthostatic changes in heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) in athletes with acute SRC vs. control athletes.

METHODS

Design:

- Observational cohort study.

Participants:

- 133 athletes (ages 8-32 years old; 45.9% female) with acute SRC, seen within 30 days of injury, were compared to 100 similarly-aged orthopedic injury and healthy control athletes (54.0% female).

Outcome measures:

- Participants completed standard orthostatic VS evaluation including HR, SBP, and DBP in the supine position and immediately as well as 2 minutes after standing.

Statistical analysis:

Primary:

- Linear regression compared supine-to-standing changes in HR, SBP, and DBP at 2 minutes (Δ HR, Δ SBP, Δ DBP) as a continuous variable, accounting for age and sex as covariates.
- Logistic regression compared patients with positive orthostatic VS changes (defined as HR increase ≥ 30 beats per minute (bpm), SBP decrease ≥ 20 mmHg, DBP decrease ≥ 10 mmHg), also accounting for age and sex as covariates.
- A Bonferroni correction was applied across the 6 primary analyses.

Secondary:

- Sub-group analyses were performed in children (<13 yo), adolescents (13-17 yo), and adults (>17 yo) accounting for sex as a covariate.

RESULTS & DISCUSSION

Demographics:

Characteristic	Concussion Group	Control Group
Number of athletes	133	100
Age (years)	15.3 \pm 3.9	15.7 \pm 2.5
Age Group:		
Children (<13 yo)	28 (21.1%)	12 (12.0%)
Adolescents (13-17 yo)	82 (61.7%)	63 (63.0%)
Adults (>17 yo)	23 (17.3%)	24 (24.0%)
Biological Sex:		
Male	72 (54.8%)	46 (46.0%)
Female	61 (45.9%)	54 (54.0%)
Race:		
White	111 (84.1%)	58 (58.0%)
Black/African American	16 (12.1%)	23 (23.0%)
Asian/Pacific Islander	2 (1.6%)	5 (5.0%)
Other	3 (2.3%)	14 (14.0%)
Sport Contact Classification:		
Non-contact	4 (4.3%)	33 (38.8%)
Contact	49 (52.7%)	47 (55.3%)
Collision	40 (43.0%)	5 (5.9%)

Primary Results:

- Significant between-group differences were present for Δ HR ($p=0.002$) and Δ SBP ($p=0.001$).
- Positive orthostatic HR changes present more frequently in athletes with SRC compared to control athletes ($p=0.027$).

Measure	Δ Value	+ Orthostatic Findings
Heart Rate:		
Concussion Group	18.4 \pm 12.7 bpm *	24 (18.0%) *
Control Group	13.2 \pm 11.0 bpm *	7 (7.0%) *
Systolic BP:		
Concussion Group	-3.1 \pm 6.6 mmHg*	2 (1.5%)
Control Group	-0.4 \pm 6.5 mmHg*	0 (0.0%)
Diastolic BP:		
Concussion Group	6.5 \pm 8.8 mmHg	8 (6.0%)
Control Group	3.8 \pm 8.1 mmHg	3 (3.0%)

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Secondary Results:

- Odds of positive orthostatic HR findings were greatest for children and adolescents (25% vs. 0%, child; 20.1% vs. 9.5%, adolescent, OR=2.48).

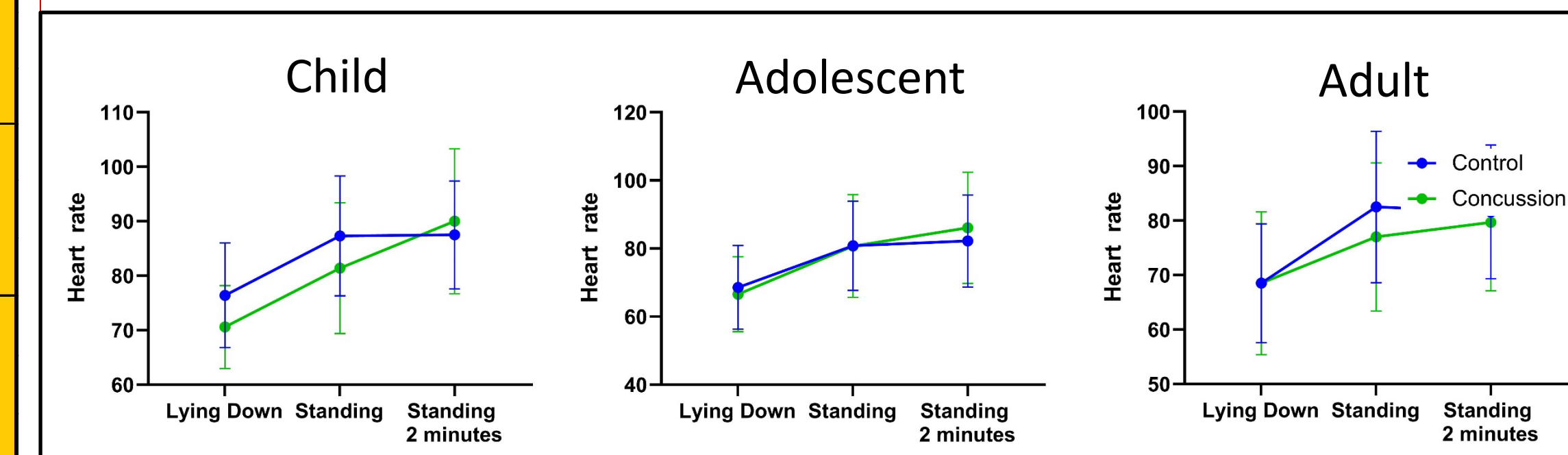


Fig. 1. Orthostatic HR by age sub-group

Discussion:

- Patients with acute SRC had greater orthostatic VS changes than controls, with sustained HR elevations being more prominent than changes in SBP or DBP.
- Orthostatic HR changes were greater in children and adolescents, compared to adults.
- Limitations:**
 - Single data collection timepoint without longitudinal follow up.
 - No correlation of Orthostatic VS with other clinical features, nor with recovery outcomes.

Conclusion and future directions:

- Clinical evaluation of autonomic change after SRC through standard orthostatic VS assessment may be a helpful clinical biomarker in the assessment of SRC, especially in children and adolescents.
- Future research should prospectively investigate the diagnostic and prognostic value of orthostatic VS as a component of the multifaceted concussion evaluation.

REFERENCES

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