Assessing Gait Variability in Adolescent Concussions: A Submaximal Aerobic Exercise Study

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Background

- Pediatric concussions are among the most prevalent childhood injuries in Canada[1].
- Concussion management is moving from a *rest-is-best* to *exercise-is-medicine* approach[2].
- Standardized graded, submaximal treadmill tests have been developed to assess symptom tolerance and prescribe exercise in concussion[2,3].
- Previous studies show concussion impacts balance and gait during steady-state walking[4].
- Gait has not been measured using accelerometry during a graded exercise test in concussion.

Objectives

- To determine if there are medio-lateral (ML) or anterior-posterior (AP) gait differences during graded treadmill exercise in children with concussion vs. controls

Methods

- ***Participants:*** Children (aged 12-18) diagnosed with a sport-related concussion. Age-matched healthy controls with no concussion history
- ***Protocols:*** All participants completed the validated Buffalo Concussion Treadmill Test, a graded aerobic exercise test developed for concussion[2,3] involving ~10 minutes of walking on a progressively inclining treadmill.
- ***Outcomes:*** Waist-worn tri-axial accelerometer (ActiGraph GT3x) recording movement at 30 Hz with data collected in 1-second epochs.
- ***Analysis:*** Cadence and gait variability (operationalized as the coefficient of variation; CV) were calculated for the ML and AP planes.

Results

- Eight participants have been analyzed to date (4 concussion, and 4 control; 25% female in each group)
- ***Cadence:*** Higher values (and more variability in this measure) are observed for healthy controls.
- ***CV:*** Early data visualizations show there may be a time-effect, wherein the CV increases in the AP and ML planes as test time (and test intensity) increases

As exercise becomes harder, children with concussion may have more variability in their gait.

Figure 1: Participant wearing an ActiGraph GT3x accelerometer, depicted with a display image pictograph, illustrating the three-axis visual representation.

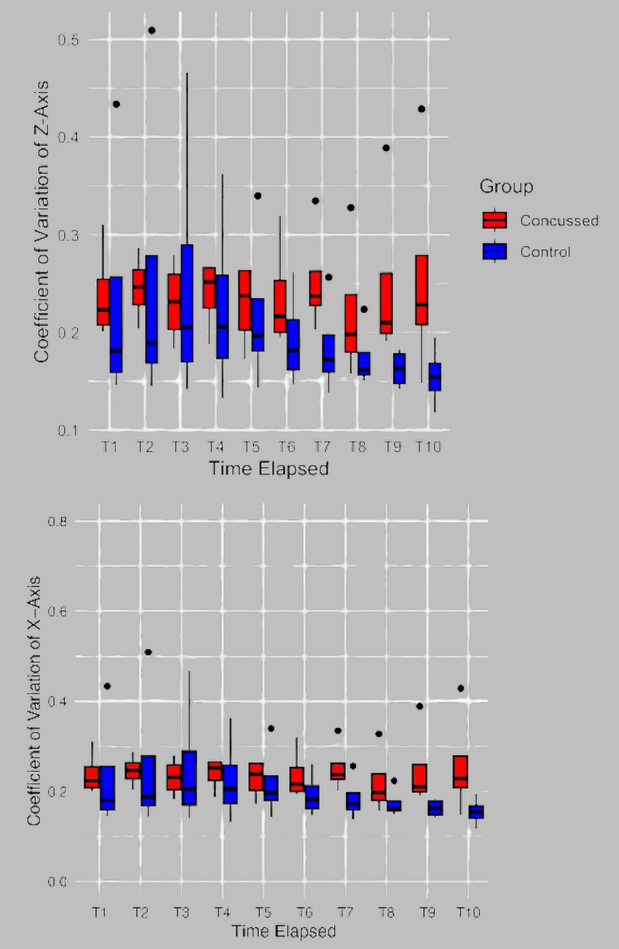

Figure 2. Comparison of categorical box plots depicting the analysis of coefficient of variation for the X-axis (Top) and Z-axis (Bottom) over time elapsed.

Discussion

- Preliminary data visualizations suggest a time-effect in the expected direction
- Additional participants need to be analyzed followed by formal statistical analysis

References

[1] Langer et al. (2020). Increasing Incidence of Concussion: True Epidemic or Better Recognition? *Journal of Head Trauma Rehabilitation*, *35*(1)
[2] Leddy, J., et al. (2018) "Exercise is medicine for concussion." *Current sports medicine reports* 17.8 (2018):
[3] Leddy, J et al. (2018). Safety and Prognostic Utility of Provocative Exercise Testing in Acutely Concussed Adolescents: A Randomized Trial. *Clinical Journal of Sport Medicine*, *28*(1)
[4] Howell, D. et el. (2015). "Monitoring recovery of gait balance control following concussion using an accelerometer." Journal of biomechanics 48.12

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