Sex-specific Effects of Early Physical Activity on Concussion Outcomes

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BACKGROUND

- Physical activity is an effective method to improve post-concussion outcomes.[1]
- Many factors, including biological sex, may affect concussion recovery.[2] While many studies prioritize equal representation of males and females, they fail to include comparisons between sexes.
- Exploring the sex-specific effects of physical activity on concussion outcomes is important to provide personalized care to adolescents with a concussion.

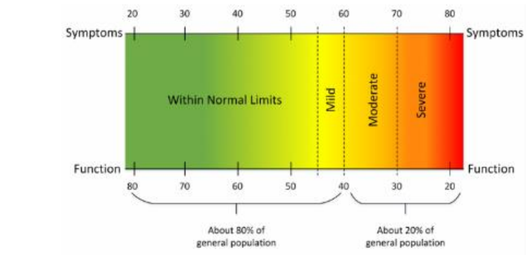
Purpose: To identify associations in early physical activity engagement (prior to initial evaluation) and concussion outcomes in between female and male adolescents.

METHODS

Participants: adolescents, 13-18 years old, with recent concussion were assessed ≤21 days post-concussion

Assessment Tools:

- Post-Concussion Symptom Inventory (PCSI)
- Dizziness Handicap Inventory (DHI)
- PROMIS Pediatric Global v.1.1. anxiety, depressive symptoms, fatigue, pain interference subscales



Grouping Variables:

- Biological Sex: Female/Male
- Physical activity within 21 days of concussion: yes/no

Statistical Analysis:

- We assessed interactions and main effects between sex and early physical activity status using two-way ANOVA.
- Post-hoc tests evaluated with an adjusted value of p<0.0125.

RESULTS

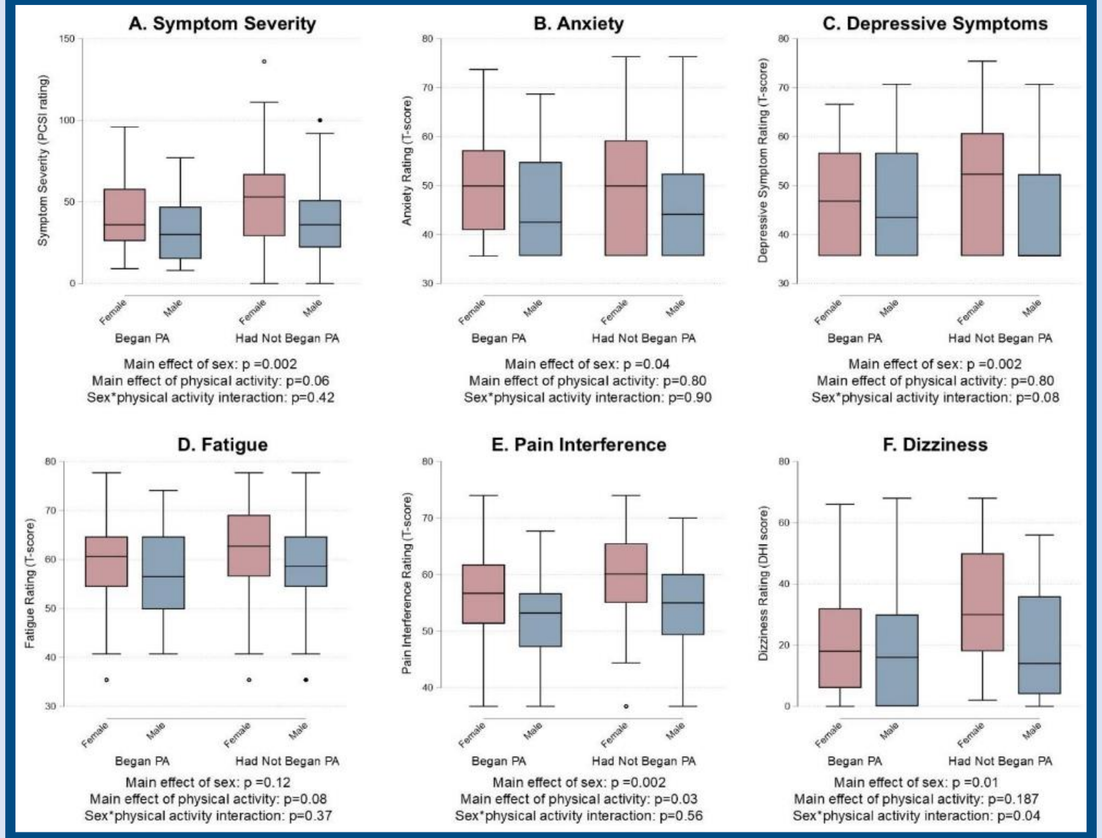


Figure 1. Box plots describing the interaction between sex and early physical activity on post-concussion outcomes - (A) symptom severity (PCSI), (B) anxiety symptoms (PROMIS), (C) depressive symptoms (PROMIS), (D) fatigue (PROMIS), (E) pain interference (PROMIS), and (F) dizziness (DHI).

Table 1. Descriptive characteristics of study participants

Variable	Female participants (N=98)	Male participants (N=90)	*p*
Early Physical Activity (yes/no)	41 (42%)	25 (39%)	0.68
Age (years)	15.6 (1.4)	15.4 (1.88)	0.50
Time of evaluation (days post-concussion)	11.0 (4.8)	10.8 (4.8)	0.79
Height (cm)	160.1 (22.9)	171.5 (12.7)	0.001
Weight (kg)	58.2 (11.3)	66.0 (17.8)	0.001
Concussion history	47 (48%)	44 (49%)	0.90
Anxiety history	17 (17%)	11 (12%)	0.32
Depression history	16 (16%)	9 (10%)	0.22
History of MSK injury	58 (59%)	63 (70%)	0.17
LOC at time of concussion	15 (15%)	22 (24%)	0.12
Amnesia at time of concussion	14 (14%)	25 (28%)	0.03
Sport-related concussion	80 (82%)	74 (82%)	0.92

CONCLUSIONS

- Early physical activity following concussion is associated with less pain interference (E) and dizziness (F) in both female and male adolescents.
- Sex differences were observed in multiple domains including concussion symptom severity (A), depression (C), and anxiety (B).
- Early physical activity was not associated with sex differences in depression (C), anxiety (B), or concussion symptom severity (A) at initial evaluation.
- Dizziness severity (F) may be associated with exercise tolerance or response to exercise in adolescents, especially for female adolescents with concussion.

SIGNIFICANCE

Understanding and addressing barriers to early physical activity post-concussion, and accounting for potential sex-biases, are crucial steps in providing individualized and multidimensional care.

ACKNOWLEDGMENTS

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REFERENCES

1. Wilson, J. C. et al. (2020), *Journal of Clinical and Translational Research* 5(4)
2. Koerte, I. K. et al. (2020), *American Society of Neuroimaging* 30(4)