Sex Differences in Heart Rate Variability During Physical Exertion and Its Association to Symptom Severity Following Adolescent Concussion

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SUMMARY

1. Adolescents with a recent concussion completed an HRV assessment during rest, handgrip and deep breathing, and a clinical concussion assessment battery.
2. Female adolescents displayed lower HRV than males during handgrip contraction, but not at rest or during deep breathing.
3. Handgrip HRV was correlated with reaction time on a one-back task in both males and females, but was only correlated with VOMS outcomes and emotional symptom severity in males.

BACKGROUND

- Cardiac autonomic nervous system (C-ANS) function is altered after concussion in a situationally dependent manner, such that it is consistently altered during exertion but not always at rest
- C-ANS dysfunction may be related to symptom severity following concussion
- Despite sex differences in C-ANS function in healthy populations, the influence of sex on C-ANS activity during exertion following concussion remains unclear

OBJECTIVE: To investigate sex differences in C-ANS function during conditions of varying physiological exertion following concussion and its association with symptomology

METHODS

- Participants consisted of female and male adolescents presenting to a pediatric specialty clinic with a recent concussion
- Analysis included group*time ANCOVAs and partial correlations controlling for age, BMI, and days between evaluations

ASSESSMENTS:

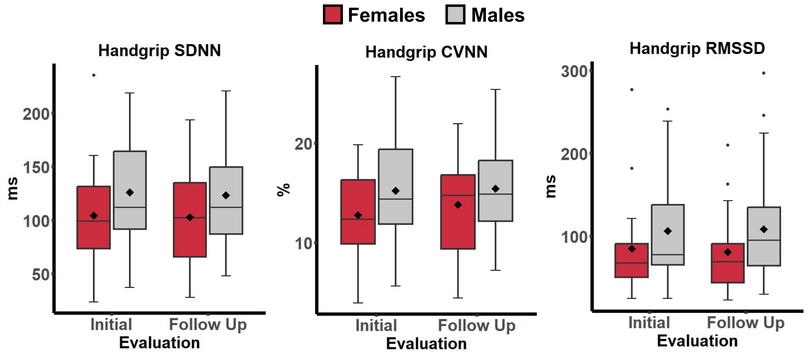
1. Heart rate variability
   a) Rest, isometric handgrip contraction, deep breathing
2. Vestibular Ocular Motor Screening (VOMS)
   a) Smooth pursuits, saccades, vestibular ocular reflex (VOR), visual motion sensitivity (VMS), convergence
3. Rivermead Post Concussion Symptoms Questionnaire (RPQ)
4. Computerized cognitive assessment
   a) 1- and 2-back tasks, maze learning and recall tasks

RESULTS

PARTICIPANTS

	Females	Males	*p*-value
N	26	48	
Age	15 ± 1	15 ± 2	.84
BMI	**25 ± 7**	**23 ± 5**	**.05**
Race/Ethnicity			.48
Black	15 (58%)	22 (46%)	
White	9 (35%)	24 (50%)	
Other	2 (8%)	2 (4%)	

HEART RATE VARIABILITY



Sex: $p = .04$, $\eta_p^2 = .06$
Sex*Eval: $p = .63$, $\eta_p^2 = .003$

Sex: $p = .04$, $\eta_p^2 = .06$
Sex*Eval: $p = .22$, $\eta_p^2 = .02$

Sex: $p = .05$, $\eta_p^2 = .06$
Sex*Eval: $p = .85$, $\eta_p^2 = .001$

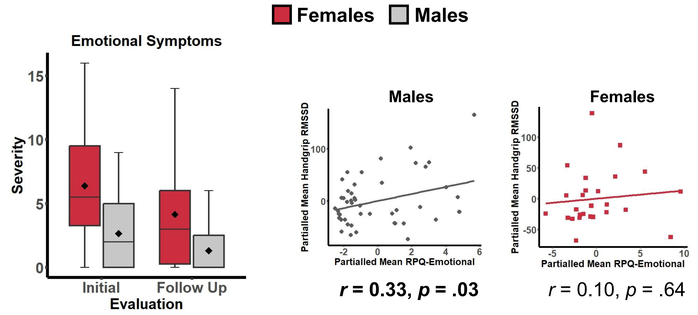
- Groups did not differ on HRV during rest or deep breathing ($ps \geq .08$, $\eta p^2 s \leq 0.08$)

ASSOCIATION BETWEEN HRV & VOMS OUTCOMES

	Females	Males
Handgrip SDNN	No significant correlations: $rs \leq 0.26$, $ps \geq .23$	Vertical VOR: $r = 0.43$, $p = .01$
Handgrip CVNN		Vertical VOR: $r = 0.40$, $p = .01$ Horizontal VOR: $r = 0.32$, $p = .04$ VMS: $r = 0.34$, $p = .03$ Convergence: $r = 0.36$, $p = .02$
Handgrip RMSSD		Vertical VOR: $r = 0.47$, $p = .002$ Horizontal VOR: $r = 0.41$, $p = .01$ VMS: $r = 0.38$, $p = .02$ Convergence: $r = 0.38$, $p = .02$

RESULTS CONT'D

ASSOCIATION BETWEEN HRV & SYMPTOM SEVERITY

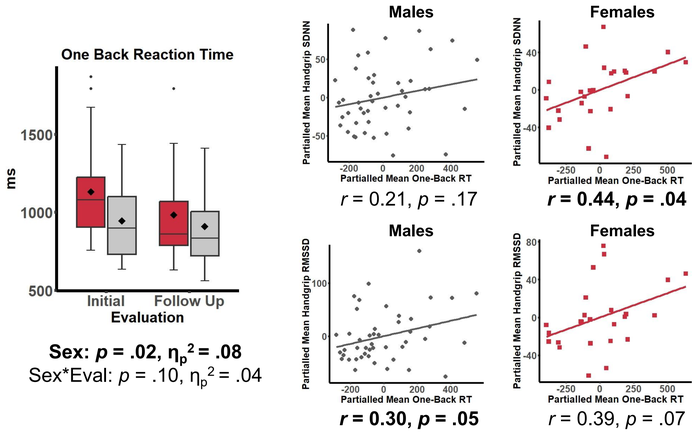


Sex: $p < .001$, $\eta_p^2 = .17$
Sex*Eval: $p = .14$, $\eta_p^2 = .03$

$r = 0.33$, $p = .03$

$r = 0.10$, $p = .64$

ASSOCIATION BETWEEN HRV & COGNITIVE FUNCTION



Sex: $p = .02$, $\eta_p^2 = .08$
Sex*Eval: $p = .10$, $\eta_p^2 = .04$

$r = 0.21$, $p = .17$

$r = 0.44$, $p = .04$

$r = 0.30$, $p = .05$

$r = 0.39$, $p = .07$

CONCLUSION

- Sex should be considered as a potential moderating variable for interventions that are based on cardiac autonomic function, such as aerobic exercise or HRV biofeedback
- Future research should investigate the potential influence of menstrual cycle phase on such effects