Effects of Exercise on Neurocardiac Responses to a Sad Mood Induction in MDD

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Significance & Rationale

- Depression is one of the most common mental health disorders in the United States with a lifetime prevalence rate of 17% (Kessler et al., 2005). By the end of the 21st century, depression is predicted to be one of the most economically burdensome diseases (Greenberg et al., 2015).
- Individuals with depression exhibit inflexible autonomic nervous system (ANS) functioning (Bylsma et al., 2014), although it is unclear whether ANS dysregulation is responsible for the increased morbidity and mortality associated with depression in CVD patient populations (Carney et al., 2005).
- Aerobic exercise has been shown to enhance mood as well as prevent and treat various mental health disorders. Mata and colleagues (2013) examined the effects of a moderate-intensity bout of aerobic exercise on negative affect following repeated sad mood inductions in formerly depressed individuals and found that exercise helps to maximize positive affective states (Reed & Ones, 2006)
- In the present study, cardiac autonomic measures were collected in conjunction with psychological measures to examine physiological mechanisms implicated in affect regulation in depression.
- **Purpose: To investigate the efficacy of an acute bout of exercise to buffer negative reactivity to a sad mood induction in individuals with variable symptoms of depression.**

Methods & Design

Fitness Assessment
Cardiovascular fitness test (VO_2 peak)

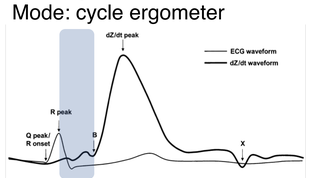
Cardiovascular Autonomic Measures
Electrocardiogram (ECG) and impedance cardiogram (ICG) signals were collected to derive estimates of cardiac sympathetic (SNS) and parasympathetic (PNS) control.

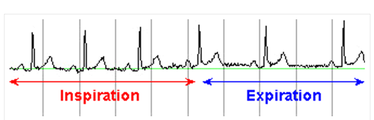
Pre-ejection period (PEP)
time interval from the start of ventricular depolarization to the opening of the aortic valve and simultaneous onset of left ventricular ejection

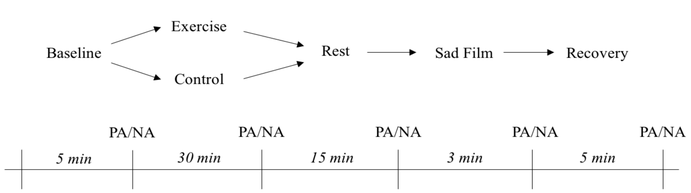
Respiratory Sinus Arrhythmia (RSA)
natural log spectral value in the high-frequency bandwidth (0.15 - 0.40 Hz)

Questionnaires
Depressive symptoms (BDI-II)
Positive and negative affect (PANAS)

Aerobic Exercise
Duration: 30 minutes
Intensity: moderate (14 ± 1 RPE)
Mode: cycle ergometer







Statistical Analysis
Repeated measures analysis of variance (RM-ANOVA) with condition (exercise vs sedentary control) as the within-subjects factor and depressive severity (BDI < 17 vs BDI ≥ 17) as the between subjects factor. All analyses controlled for baseline CV responses captured during a plain vanilla task prior to each experimental condition.

Measure	BDI < 17	BDI ≥ 17
Depressive Symptoms (BDI-II) *	8.1 ± 5.4	26.4 ± 9.1
n (male)	21 (5)	22 (6)
Age (yrs)	20.1 ± 1.5	19.9 ± 1.3
BMI (kg/m^2)	22.6 ± 2.8	24.5 ± 4.7
VO_2 peak (mL·kg^{-1}·min^{-1})	38.9 ± 6.1	38.6 ± 9.0
Heart Rate (bpm)	78.8 ± 10.5	81.6 ± 10.0
Pre-ejection Period (ms)	123.2 ± 11.5	120.0 ± 12.1
Respiratory Sinus Arrhythmia (ms^2)	5.9 ± 1.6	6.0 ± 1.1

Table 1. Participant demographics presented as M ± SD. *$p < 0.05$

Mood Induction Movies

The Champ

Return to Me

Figure 1. The film clips used in the present protocol are the current gold-standard used to elicit negative emotion according to the *Handbook of Emotion Elicitation and Assessment* (Rottenberg et al., 2007).

Results

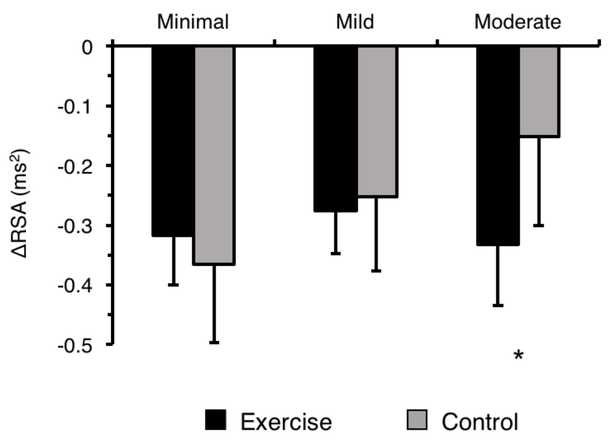


Figure 2. Cardiovascular activity by exercise and control presented by depressive symptoms; Minimal (left), Mild (Center), and Moderate (Right) following the sad mood induction.
*significant group x condition interaction, $p < .05$

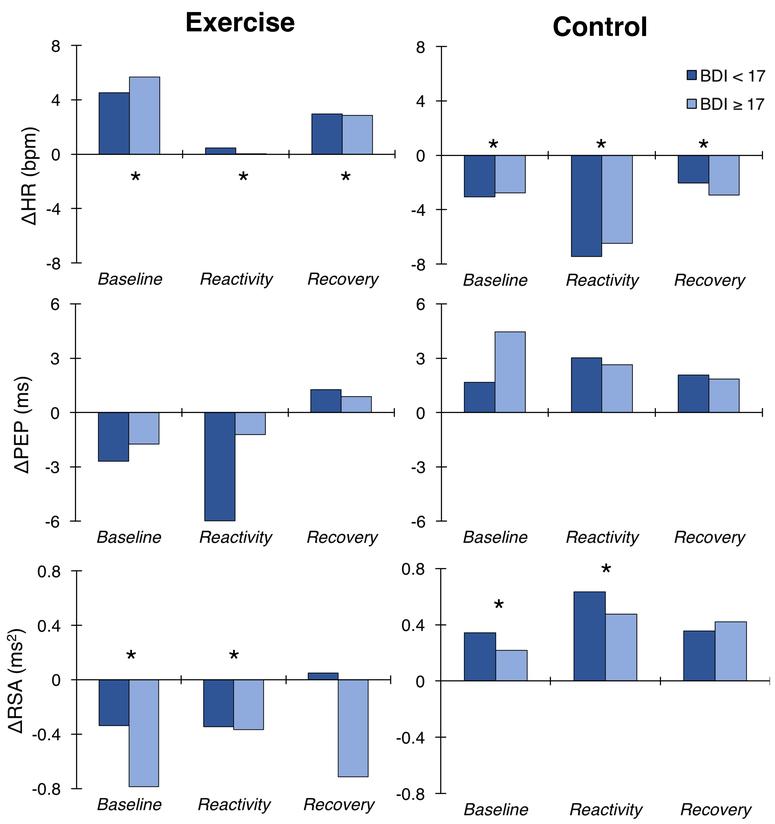


Figure 3. Cardiovascular activity preceding (Baseline), during (Reactivity), and following (Recovery) the sad film presented following exercise (left) or control (right). Change scores were calculated by subtracting individual baseline values. *significant condition main effect, $p < .05$; significant group x condition interaction, $p < .05$

Conclusion

- No significant changes in PEP reactivity following exercise, however, there were significant changes in RSA reactivity at baseline and following exercise.
- HR remained elevated following exercise and throughout the sad mood induction.
- The high depressive symptom group displayed a significant decrease in RSA (i.e., vagal withdrawal) while recovering from the sad film after exercising, compared to the control condition.

Limitations

- Cardiorespiratory fitness is known to influence CV reactivity to emotional stressors and was not included as a covariate in the analyses.

Future Directions

- These findings suggest that RSA reactivity and recovery are modifiable risk factors of depression and may present evidence for the role of RSA flexibility in the antidepressant effect of exercise.

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