Title: Effects of Acute Stress on Measures of Heart Rate and Heart Rate Variability

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Introduction: Heart rate (HR) and heart rate variability (HRV) provide reliable noninvasive measures of the state of the autonomic nervous system (ANS). Variance from the resting baseline of HR and HRV as measured by wearable device technology provides an indication of acute physiological stress. Stimuli such as the cold pressor can induce stress and be utilized to observe drastic changes in HR and HRV over a short period of time (Peng et al., 2015). Given that HR and HRV provide reliable and noninvasive measures of physiological stress response, the study at hand intends to observe changes in these measures in response to the cold pressor as a physiological stressor.

Hypothesis: We expected to observe an increase in HR and a decrease in HRV at the introduction of the cold pressor stimulus

Methods:

- **Participants**: Four healthy individuals (2M, 2F; Age 19.2 ± 1.1 years) participated in this study.
- **Procedures:** An ambulatory 3-lead ECG (Figure 1) was used to measure participants' HRV. Electrodes were placed below the left and right clavicle as well as in a left intercostal space. A Polar H10 heart rate monitoring chest strap was used to measure participants' heart rate. The cold pressor (Figure 2), a cooler of water set at a temperature of 3 degrees Celsius, was used to induce acute stress. Participants endured a 5-minute rest period (PRE) to establish a baseline followed by a 5-minute period in which their left hand was placed in the cold pressor (up to the wrist) (CP) and a 5-minute rest period to return to baseline (POST)

Figure 1 & 2: Ambulatory 3-lead ECG and Cold-pressor device

Results:

- Figure 3 displays the change in HR during the three phases of data collection (Pre, CP, and Post). The results indicate an increase in HR during the cold pressor task, as well as an increased resting HR after the stimulus is removed.
- Figure 4 displays the change in HRV during the phases of the study (Pre, CP, and Post). There was a significant decrease in HRV during the acute stress response, and HRV was significantly higher after the stimulus was removed.

Figure 3: Average HR Graph Pre, CP, and Post

Figure 4: Average HRV Graph Pre, CP, and Post

Discussion: The results of the study supported the hypothesis which predicts that during acute stress, physiological symptoms of HR will increase and HRV will decrease. This is consistent with previous research findings which indicate that acute stress is correlated with decreased HRV (Kim, et. al., 2018).

Limitations: The generalizability of this study is greatly decreased by the small sample size as well as the lack of demographic diversity in the participants.

Conclusion: Acute stress response is correlated with an observable increase in HR and decrease

in HRV. This is consistent with the expected changes of physiological symptoms during the cold pressor task which is used to induce an acute stress response.

References:

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