Comparing Heart Rate Variability Metrics Between Nasal and Oral Breathing

Jens Cuba, Allison Bowerfind, Savannah Boutwell, Jessica Cassette, Isabela Fernandez, Allyson May, Katherine Kirk, Justine Moss, Joseph Watso

BACKGROUND

- Around 80 million Americans regularly participate in some type of cardiovascular exercise[1]
- It is known that the cardiovascular system is affected by breathing patterns based on input from the para/sympathetic nervous systems.
- Heart rate variability (HRV) measures the changes in time intervals between each heartbeat (i.e., R-R interval) from an electrocardiogram **(Figure 1)**.
- A previous study found that nose compared with mouth breathing increased heart rate during exercise, but the effects of mouth and nose breathing on HRV is unknown[2].

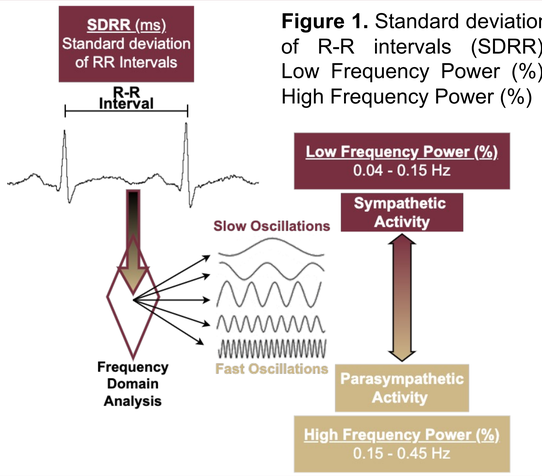

Figure 1. Standard deviation of R-R intervals (SDRR), Low Frequency Power (%), High Frequency Power (%)

PURPOSE

- We hypothesized that nasal breathing would have a superior HRV profile (e.g., lower sympathetic input) when compared to mouth breathing.

EXPERIMENTAL DESIGN

- **Recruitment**: Eleven healthy participants (18 ±1 years; males: N = 5, females: N = 6).
- **Randomization**: Participants were asked to free breathe, then only through the nose or mouth in random order. A standard laboratory nose clip used during only mouth breathing.
- **Maintenance of Respiratory Rate**: A metronome was used to maintain breathing rate as determined from the free breathing period. Respiratory rate was not different between conditions at rest (nasal: 17 ± 4 vs. oral: 16 ± 4 bpm, p=0.18) or during exercise (nasal: 26 ± 5 vs. oral: 24 ± 4 bpm, p=0.19).
- **Statistical Analysis**: We performed Shapiro-Wilk Normality tests and two-tailed, paired t-tests or Wilcoxon non-parametric tests to compare heart rate (beats per minute), Low-Frequency (LF) Power (%), High-Frequency (HF) Power (%), and the standard deviation of R-R intervals (SDRR; ms) between conditions during rest and exercise.

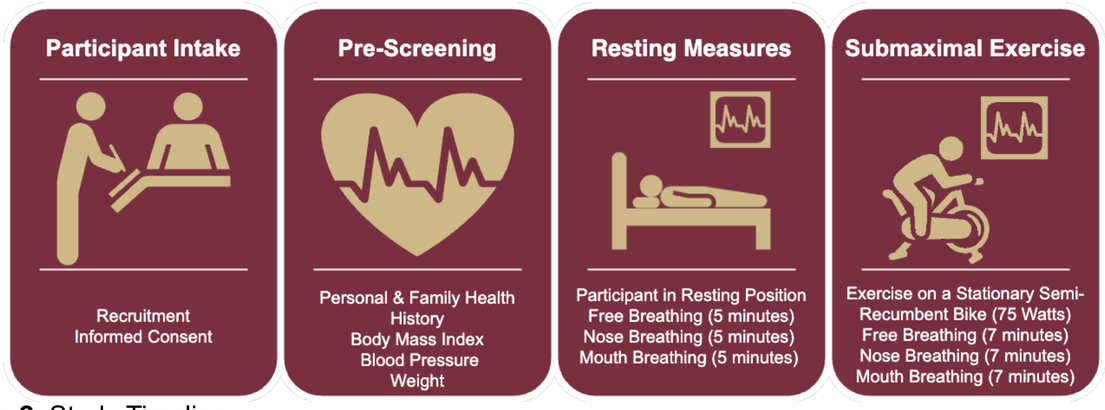

Figure 2. Study Timeline.

ACKNOWLEDGMENTS

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RESULTS

Table 1: Average HR during Rest & Exercise.

	Nose	Mouth	p-value
Rest	74 ± 11	76 ± 11	0.2969
Exercise	131 ± 20	130 ± 19	0.5187

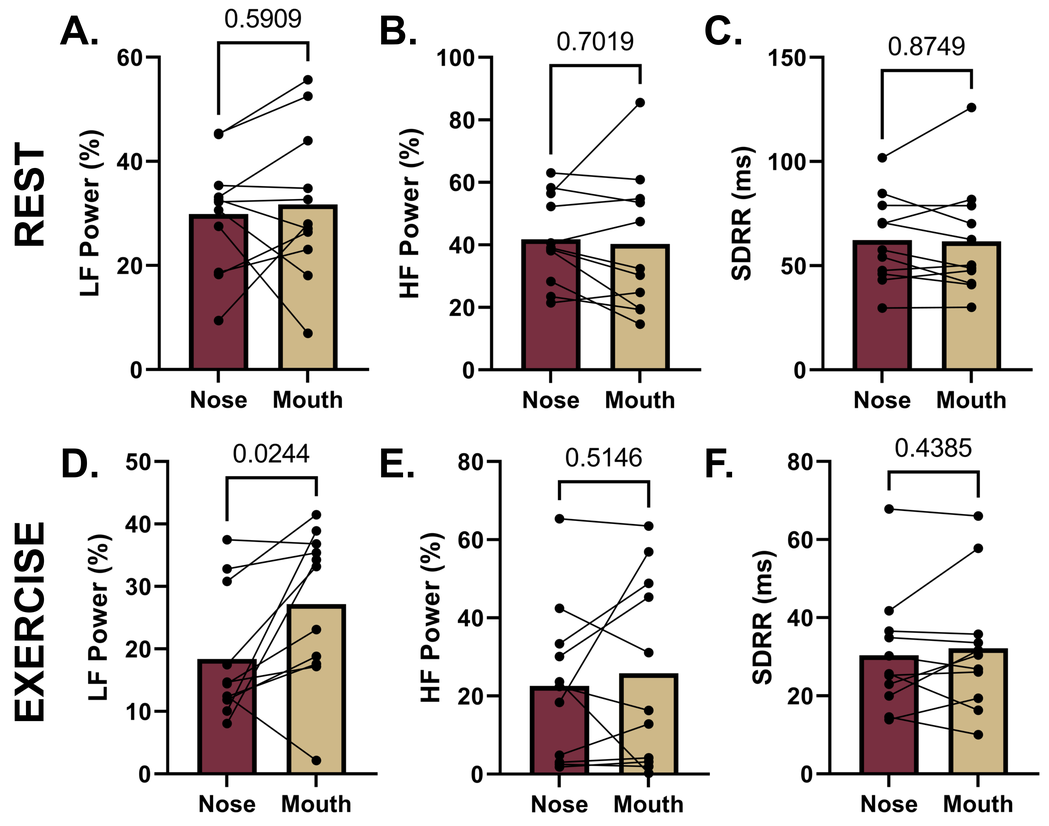

Figure 3. Heart Rate Variability. LF Power was significantly higher during Exercise **(D)** during mouth breathing, but no differences were seen during rest **(A)**. No significant differences were observed between nose and mouth breathing during rest or exercise for HF Power **(B/E)** or SDRR **(C/F)**. *P* values are included in each figure panel.

CONCLUSIONS

The higher LF Power during mouth breathing indicates greater sympathetic input and cardiac stress[3] during exercise when compared with nasal breathing.

REFERENCES

1. Elgaddal N, Kramarow EA, Reuben C. Physical activity among adults aged 18 and over: United States, 2020. NCHS Data Brief, no 443. Hyattsville, MD: National Center for Health Statistics. 2022.
2. Recinto, C., Efthemeou, T., Boffelli, P. T., & Navalta, J. W. (2017). Effects of Nasal or Oral Breathing on Anaerobic Power Output and Metabolic Responses. International journal of exercise science, 10(4), 506–514.
3. Shaffer, F., & Ginsberg, J. P. (2017). An Overview of Heart Rate Variability Metrics and Norms. Frontiers in public health, 5, 258. https://doi.org/10.3389/fpubh.2017.00258