

HEART RATE
VARIABILITY AS A
MEASURE OF
CARDIOVASCULAR
HEALTH IN
INDIVIDUALS WITH
SPINAL CORD
INJURY

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SMS – Honors Track

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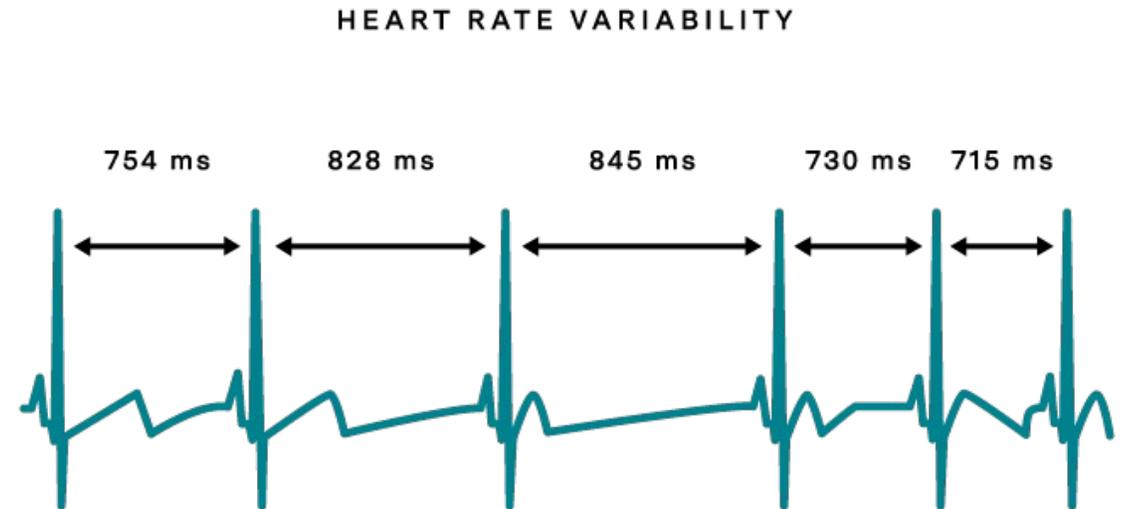


BACKGROUND

- ❑ People who have suffered Spinal cord injury (SCI): Impaired or absent cardiovascular sympathetic control
- ❑ Results: autonomic dysfunction
 - ❑ lower heart rate variability (HRV)
 - ❑ impaired blood pressure control
 - ❑ 40% risk of death from cardiovascular disease
 - ❑ Not participating in whole-body exercise (Abreu 2016)

HEART RATE VARIABILITY (HRV)

- *HRV as a measure of autonomic function*
- Above T6 – loss of sympathetic supraspinal control of the heart (Buker 2018)
- HRV – a measure of the variation in time between each heartbeat by assessing the cardiac autonomic nervous system and positive adaptations after exercise

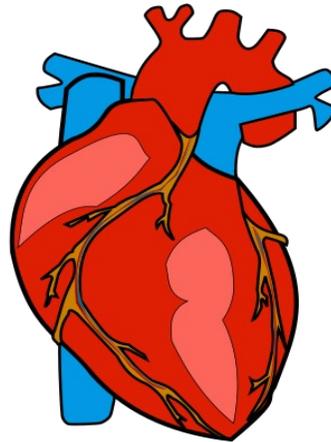


AUTONOMIC FUNCTION AND HRV

HR, HRV, and blood pressure controlled by a balance of sympathetic (fight or flight, stress response) and parasympathetic nervous system (rest & digest) activity

Parasympathetic

- ↓ Heart rate
- ↑ HR variability
- ↓ Blood pressure



Sympathetic

- ↑ Heart rate
- ↓ HR variability
- ↑ Blood pressure



HRV IN SPINAL CORD INJURY

- Patients with SCI – lower HRV and a higher risk of cardiovascular disease
- Low Frequency (LF): frequency activity in the 0.04 – 0.15 Hz range
- High Frequency (HF): frequency activity in the 0.15 – 0.40 Hz range
- SCI individuals: lower HRV values in the LF compared to able-bodied subjects
- Regular exercise: better HRV in SCI subjects (Baker 2018)
- Fully reviewed 29 articles to research the effects of spinal cord injury in heart rate variability after exercise

HRV WITH EXERCISE TRAINING



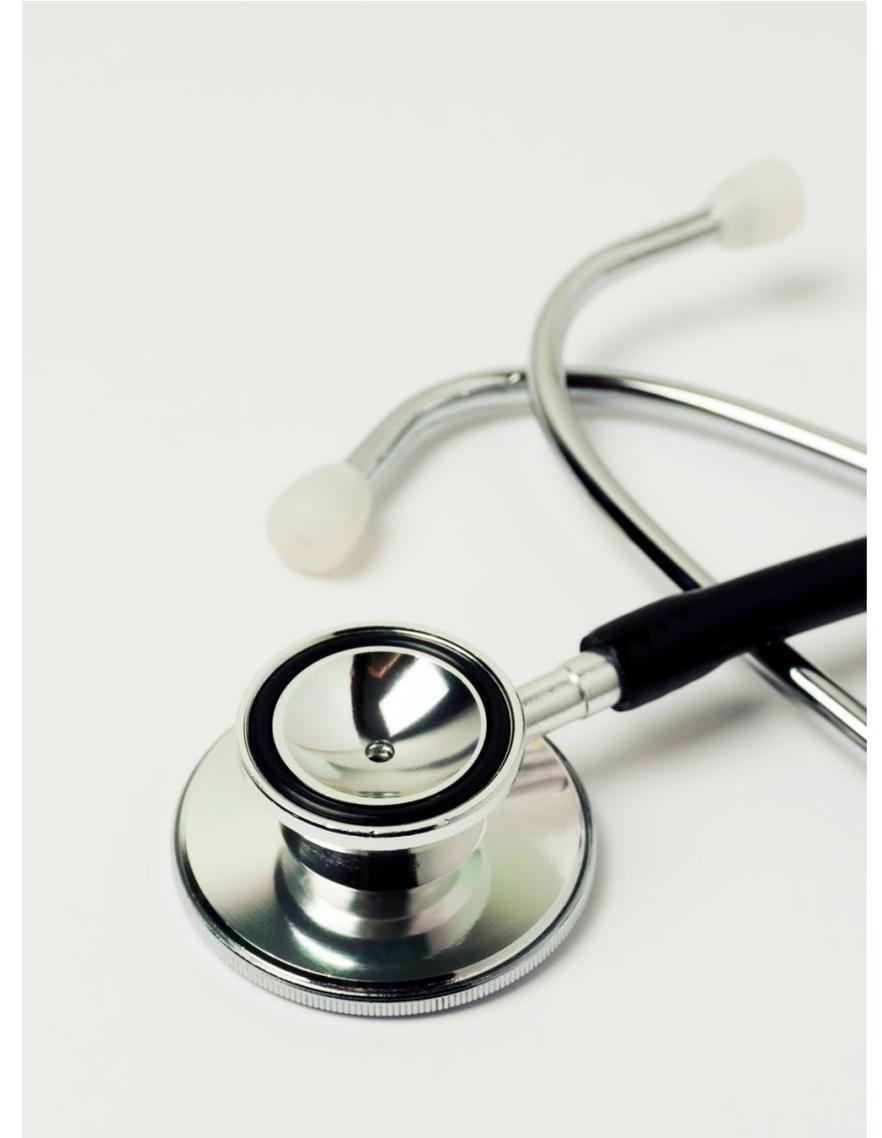
- 32 SCI patients: 6 months of exercise training or control group
- HRV and Blood pressure variabilities (BPV) measured
- Supine position
- Low Frequency (LF) and High Frequency (HF) HRV and BPV were significantly lower in patients with SCI ($p = 0.008-0.002$) (Solinsky 2021)
- Impact of exercise: better HRV and lower risk of CV disease

AUTONOMIC FUNCTION AND HEAT

- Recent studies have shown that passive heat exposure can improve cardiovascular health and autonomic function in able-bodied populations (Ely et al., 2019)
- Due to their inability to gain the full cardiovascular benefits of exercise, people with SCI may benefit from passive heat exposure (heat therapy)
- The impact of heat therapy, alone or in combination with exercise in people with SCI, has not previously been studied.

SUMMARY

- **HRV is an essential variable for measuring the balance between sympathetic and parasympathetic systems.**
- **Pointer for predicting cardiovascular health outcomes.**
- **Overnight HRV is highly correlated with risk of stroke (Binici 2011)**
- **Individuals with SCI have lower (impaired) HRV -> loss of innervation and their inability to perform whole-body exercises.**
- **This project examines the impact of exercise (rowing machine) and heat therapy as interventions for individuals with spinal cord injury to result in better HRV data and CV health.**



PURPOSE / PROPOSAL



- The purpose of this project is to examine the impact of exercise, hot water immersion, or combined therapies on overnight HRV in individuals with SCI
- This project will explore the impact of spinal cord injury on autonomic function, and whether exercise and/or passive heating interventions can improve heart rate variability and restore cardiovascular health.

Subjects with Spinal Cord Injury (SCI)

Exercise alone (Ex): 20 minutes on an adaptive rowing machine at a moderate intensity

Exercise + Heat (Ex + HT): 20 minutes on an adaptive rowing machine at a moderate intensity + Lower – leg hot water baths for a period of 45 minutes

Heat alone (HT): Lower – leg hot water baths for a period of 45 minutes

Monitoring during heating:
Heart rate (HR), Blood pressure (BP), temperature, & overnight Heart rate variability (HRV)

PROPOSED METHODOLOGY



- Bio strap: counts steps, monitors your sleep, HRV, resting HR, oxygen saturation, & respiratory rate
- Hypothesis: HRV will be lower in subjects who are part of the exercise alone/ heat alone trial, and combined exercise and hot water immersion will result in higher HRV during overnight and first-morning monitoring

WORKS CITED

Abreu, Elizângela Márcia de Carvalho et al. "Autonomic cardiovascular control recovery in quadriplegics after handcycle training." *Journal of physical therapy science* vol. 28,7 (2016): 2063-8. doi:10.1589/jpts.28.2063

Binici, Zeynep, et al. "Decreased Nighttime Heart Rate Variability Is Associated With Increased Stroke Risk." *Stroke*, 15 Sept. 2011.

Buker, Daniel Bueno et al. "Effects of Spinal Cord Injury in Heart Rate Variability After Acute and Chronic Exercise: A Systematic Review." *Topics in spinal cord injury rehabilitation* vol. 24,2 (2018): 167-176. doi:10.1310/sci17-00028

Solinsky, R., Vivodtzev, I., Hamner, J.W. et al. The effect of heart rate variability on blood pressure is augmented in spinal cord injury and is unaltered by exercise training. *Clin Auton Res* **31**, 293–301 (2021). <https://doi.org/10.1007/s10286-020-00677-2>



