

**Title** – Effects of Caffeine on Heart Rate Variability (HRV) at High Altitude.

**Program of Study** – M.S. Biomedical Science.

**Presentation Type** – Power Point

**Mentor Email** – Ben Kalu, M.D. Director of Biomedical Sciences Assistant Professor of Biology ([bnkalu@liberty.edu](mailto:bnkalu@liberty.edu))

**Student name(s) and email(s)** – Vhuthuhawe Tintswalo Madzinge ([vmadzinge@liberty.edu](mailto:vmadzinge@liberty.edu))

**Category** – Applied Science

**Abstract:** The heart is innervated by the sympathetic nervous system via the cardiac plexus to increase heart rate and force of contraction and parasympathetic via the vagus nerve to slow the heart rate and force of contraction. These can be influenced by hypoxia (inadequate oxygen supply to tissues which induces sympathetic response) and caffeine which is a sympathomimetic. The goal of this study is to evaluate the pattern of cardiac autonomic regulation with sympathetic hyperstimulation using HRV.

HRV (the standard deviation of normal RR intervals - SDRR), evaluates the balance between the parasympathetic (the root mean square of RR intervals - RMSSD, high-frequency -HF, and the percentage of normal RR intervals that differ by 50ms - pRRx%) and sympathetic (low-frequency - LF) nervous system control of the heart.

A cross over trial of 13 healthy subjects was conducted with a goal of measuring HRV at an altitude of 4000m before and after the consumption of 200mg of caffeine. This study was conducted using Liberty University's CAT Altitude chamber. The hypothesis was that caffeine consumption at 4000m will increase HRV. The data was analyzed using a two tailed t test.

The results showed that compared to baseline caffeine consumption at 4000m decreased HR ( $t(13) = 1.252, p=0.234$ ) but increased SDRR ( $t(13) = -0.496, p=0.629$ ). RMSSD ( $t(13) = -1.353, p=0.201$ ) and pRRx% ( $t(13) = -1.1339, p=0.279$ ) decreased at 4000m and increased with caffeine consumption at 4000m compared to baseline. Also LF/HF ( $t(13)=0.721, p=0.485$ ) increased at 4000m, but decreased with caffeine consumption at 4000m compared to baseline.

Although these findings were not statistically significant, they showed consistent trends which indicate an increased sympathetic stimulation of the heart at 4000m, but an overriding parasympathetic stimulation with added caffeine consumption compared to baseline. However, the study would benefit from an increased sample size.