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## ABSTRACT

**PURPOSE**: Dietary guidelines for sodium intake is less than 2,300 mg/day, yet 90% of Americans exceed this value. This study examined individuals resistant to salt-induced changes in blood pressure to determine the impact of a high sodium diet on blood flow regulation at rest and during upper and lower limb exercise. **METHODS**: Ten young (24 ± 2 years) individuals followed recommended dietary sodium intake guidelines for two weeks, with one-week supplemented with salt (HS: 6,900 mg/day sodium) and the other week supplemented with placebo (LS: 2,300 mg/day sodium). On day 7 of each diet, central hemodynamic, brachial artery (BA) flow mediated dilation (FMD), peripheral hemodynamic to upper and lower body exercise were measured. Blood flow (BF), shear rate (SR), and flow mediated dilation (FMD)/SR of the brachial and superficial femoral artery were taken during rhythmic (1 Hz), progressive handgrip (HG) and plantar flexion (PF) exercise, respectively. Exercise workloads increased by increments of 8 kilograms until exhaustion, with a work to rest ratio of three : two minutes for each workload . **RESULTS**: There was no difference in mean arterial blood pressure from HS to LS (84 ± 7 v 85 ± 5 mmHg; p = 0.4). Resting BAFMD was impaired from a LS to HS diet (8.6 ±4.9 v 5.9 ±4.5; p = 0.02), but all parameters for peripheral vascular function during HG and PF were not impacted between diets ($p < 0.05$ for all). **CONCLUSION**: In agreement with previous evidence reporting a HS diet impairs resting vascular function, this study revealed that peripheral vascular function and blood flow regulation during exercise of the upper and lower limbs were not impacted by a HS diet in salt resistant individuals.

## METHODS

**Subjects**

Nine males and one female (24 ± 2 years) with no history of cardiovascular disease participated in this study.

**Study Protocol**

Randomization between high sodium (HS: 6,900 mg/day) and low sodium (LS: 2,300 mg/day) diets for one week. Resting measurements and brachial artery flow mediated dilation preceded exercising measurements on the last day of each diet.

**Exercise Protocol**

Subjects performed progressive handgrip and plantar flexion exercise with workloads increasing by 8 kilograms until exhaustion. Subjects contracted once per second with a work to rest ratio of three : two minutes for each workload.

**Vascular Function Measures**

Brachial and superficial femoral artery diameter were measured using with LogiqE ultrasound (General Electric Medical Systems, Milwaukee, WI). Central and peripheral hemodynamics were measured at rest and the end of each workload using a Tango M2 (Suntech Medical, Morrisville, NC).

**Statistical analysis**

Paired t-test and two-way repeated measures ANOVA were used to identify significant changes between condition (HS v LS), across workload (8 kg, 16 kg, 24 kg, etc), and interactions (Bonferroni) were performed when appropriate.

## RESULTS

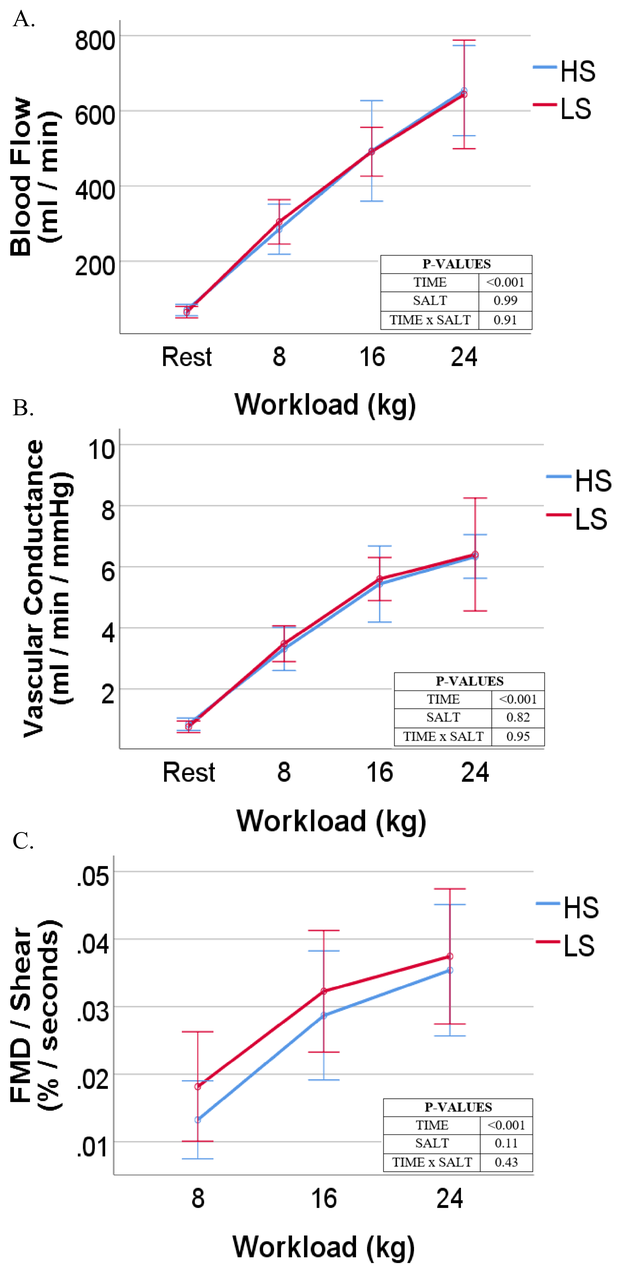


Figure 1. Brachial artery (BA) blood flow (Panel A), arm vascular conductance (Panel B), and BA dilation (normalized for the shear stimulus) (Panel C) during progressive handgrip exercise after a week of high or low sodium diet.

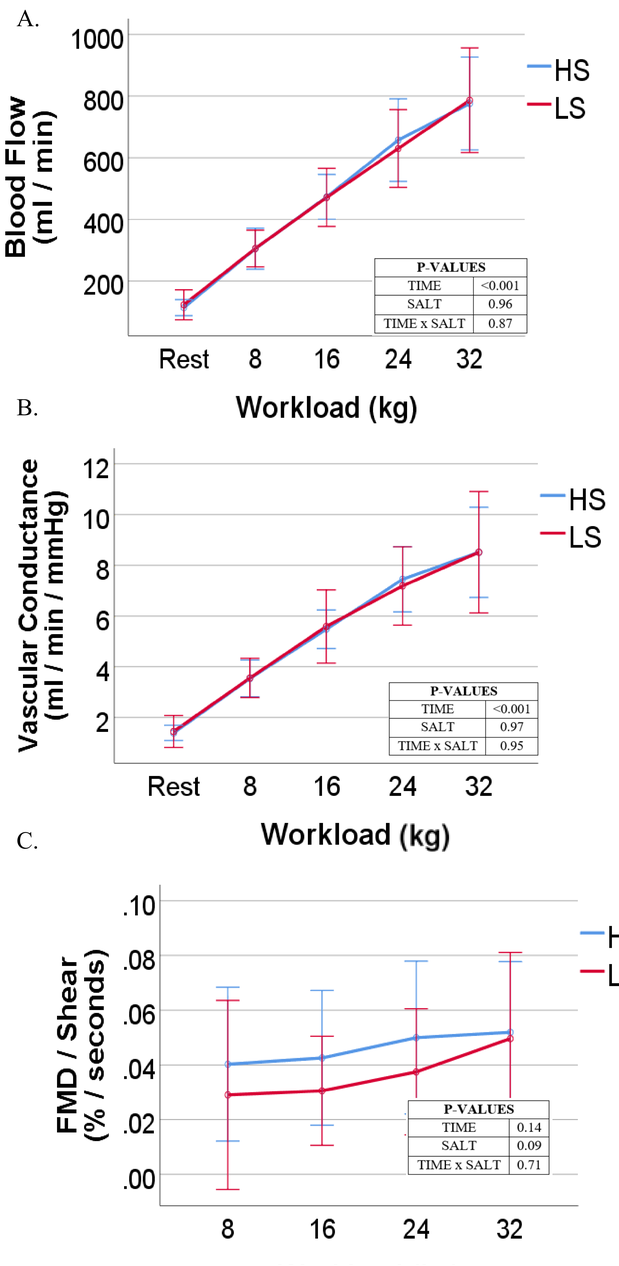


Figure 2. Superficial femoral artery (SFA) blood flow (Panel A), leg vascular conductance (Panel B), and SFA dilation (normalized for the shear stimulus) (Panel C) during progressive plantar flexion exercise after a week of high or low sodium diet.

Table 1. Subject Characteristics n = 10 (9 males and 1 females

| Age (years) | Height (cm) | Weight (kg) | BMI kg/m$^2$ | BF (%) |
|---|---|---|---|---|
| 24 ± 2 | 172.7 ± 6.1 | 72.6 ± 8.9 | 24.3 ± 2.4 | 13.7 ± 5.0 |

Mean ± Standard Deviation. Body Mass Index (BMI), Body Fat (BF), centimeters (cm), kilograms (kg), kilograms per meter squared (kg/m$^2$),

Table 2. Central hemodynamic measurements and brachial artery flow mediated dilation responses to a 7-day diet of high sodium and low sodium.

| Condition | High Sodium | Low Sodium | P-Value |
|---|---|---|---|
| SBP (mmHg) | 116 ± 9 | 118 ± 7 | 0.3 |
| DBP (mmHg) | 68 ± 7 | 68 ± 6 | 0.8 |
| MAP (mmHg) | 84 ± 7 | 85 ± 5 | 0.4 |
| Heart Rate (bpm) | 63 ± 9 | 62 ± 10 | 0.6 |
| Baseline BA Diameter (mm) | 4.29 ± 0.34 | 4.31 ± 0.37 | 0.57 |
| Peak BA Diameter (mm) | 4.53 ± 0.23 | 4.67 ± 0.33 | 0.12 |
| BAFMD (mm) | 0.24 ± 0.16 | 0.36 ± 0.18 | 0.03 |
| BAFMD (%) | 5.9 ± 4.5 | 8.6 ± 4.9 | 0.02 |
| BA Shear at Peak (seconds$^{-1}$) | 50535 ± 15123 | 47206 ± 16641 | 0.59 |
| BAFMD / Shear (%.seconds$^{-1}$) | 0.11 ± 0.05 | 0.19 ± 0.10 | 0.06 |
| BA Blood Flow (ml.min$^{-1}$) | 31860 ± 13864 | 39970 ± 8876 | 0.22 |
| BA Shear (seconds$^{-1}$) | 74571 ± 16674 | 75461 ± 26560 | 0.93 |

Mean ± Standard Deviation. Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Blood Pressure (MAP), beats per minute (bpm), Brachial Artery (BA), millimeters (mm), Flow Mediated Dilation (FMD).

## CONCLUSIONS

- Salt resistant individuals, evident by the lack of significant changes in blood pressure between a HS and LS diet, reported a significant reduction in resting brachial artery flow mediated dilation after 7 days of the HS diet (vs LS diet) (Table 2).
- During upper and lower limb exercise, no difference in arterial dilation, limb blood flow, and limb vascular conductance of the upper (Figure 1) or lower limb (Figure 2) were revealed following the HS and LS diet.
- Therefore, a HS diet may negatively affect resting, but not exercising vascular function. Furthermore, upper and lower limb blood flow regulation during exercise was unaltered by the HS diet.

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