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Mikayla K. Locke

University of Nebraska - Lincoln, mlocke2@huskers.unl.edu

Karsten Koehler

University of Nebraska - Lincoln, kkoehler3@unl.edu

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# Relationship Between Body Composition, Fitness, and Eating Behaviors and Markers of Metabolic Suppression in Exercising Men

Mikayla Locke; Advisor: Karsten Koehler PhD

Department of Nutrition and Health Sciences

## Study Purpose

- Chronic dieting can result in characteristic metabolic adaptations such as a suppression of resting metabolic rate (RMR).
- Previous research has focused on health outcomes related to metabolic suppression in female athletes, which include impaired menstrual and bone health. However, metabolic adaptations may differ between men and women.
- The study purpose was:
  - To assess the relationship between metabolic suppression and body composition, fitness, and eating behavior traits in exercising men and
  - To understand whether metabolic suppression is linked to health-related outcomes in this population.

## Methods

- Cross-sectional study comparing exercising men who display evidence of metabolic suppression (MS) and a control group (Con)
- Inclusion criteria: 19-40 years old, BMI: 18.5-30 kg/m<sup>2</sup>, and overall good health
- Groups for analysis:
  - RMR was used as a surrogate marker of metabolic suppression:
    - MS:** low RMR (<90% of predicted RMR)
    - Con:** RMR >90% of predicted RMR
- Assessments:
  - Body Composition (skinfolds, bioimpedance)
  - Resting Metabolic Rate Test (RMR)
  - Exercise Performance Test (Bicycle)
  - Exercise Performance Test (Treadmill)
  - Blood Draw
  - 7-day Diet and Exercise Logs
  - 7-day Accelerometer
- Statistical Analyses:
  - Non-paired, 1-tailed T-test
  - Fisher Exact Test for categorical variables

## Results

### Anthropometrics

Table 1. Comparison of anthropometric characteristics

	MS	Con	p-value
<b>Body Composition</b>	n=8	n=7	
Height (cm)	180 ± 5	180 ± 8	0.50
Weight (kg)	85.2 ± 11.4	77.4 ± 9.3	<b>0.09</b>
BMI (kg/m <sup>2</sup> )	26.2 ± 3.1	23.8 ± 2.5	<b>0.07</b>
Age (years)	23.8 ± 4.43	23.0 ± 5.6	0.39
Exercise (min/week)	304 ± 160	299 ± 256	0.48

### Exercise Performance

Table 2. Comparison of exercise performance results

	MS	Con	p-value
<b>Bicycling</b>	n=8	n=7	
VO <sub>2</sub> max (mL/kg/min)	40.6 ± 4.28	42.0 ± 3.79	0.25
Maximal Fat Oxidation (g/min)	0.44 ± 0.22	0.38 ± 0.22	0.29
<b>Running</b>	n=3	n=6	
VO <sub>2</sub> max (mL/kg/min)	47.4 ± 3.06	50.1 ± 4.06	0.17
Maximal Fat Oxidation (g/min)	0.57 ± 0.16	0.55 ± 0.17	0.42

### Lab Parameters

Table 3. Comparison lab parameters

	Normal Range	MS	Con	p-value
		n=8	n=7	
Glucose (mg/dL)	74-106	84.8 ± 6.7	85.7 ± 9.3	0.41
Cholesterol (mg/dL)	0-200	176 ± 24	155 ± 34	<b>0.10</b>
Triglycerides (mg/dL)	0-150	91.1 ± 35.9	96.3 ± 74.1	0.43
Direct HDL (mg/dL)	40-60	60.4 ± 27.7	53.3 ± 8.9	0.26
Hematocrit (%)	40-54	46.8 ± 2.8	47.0 ± 2.6	0.45
Hemoglobin (g/dL)	14-18	14.1 ± 5.7	15.9 ± 0.7	0.21
Lymphocytes + Monocytes (10X/L)	1.7-4.9	2.56 ± 1.24	2.64 ± 1.51	0.46

### Dietary Intake

Table 4. Comparison of dietary intake

	MS	Con	p-value
	n=7	n=7	
Energy (kcal/day)	3015 ± 396	2427 ± 678	<b>0.04</b>
Fat (g/day)	117 ± 28.7	93 ± 30	<b>0.08</b>
Fat (g/kg/day)	1.38 ± 0.44	1.20 ± 0.36	0.22
Carbohydrate (g/day)	312 ± 69.0	270 ± 117	0.22
Carbohydrate (g/kg/day)	3.62 ± 0.91	3.54 ± 1.58	0.45
Protein (g/day)	155 ± 42	128 ± 19	<b>0.07</b>
Protein (g/kg/day)	1.81 ± 0.59	1.67 ± 0.31	0.29
Cholesterol (mg/day)	595 ± 323	400 ± 128	<b>0.08</b>
Calcium (mg/day)	1579 ± 382	959 ± 343	<b>0.00</b>

### Body Composition

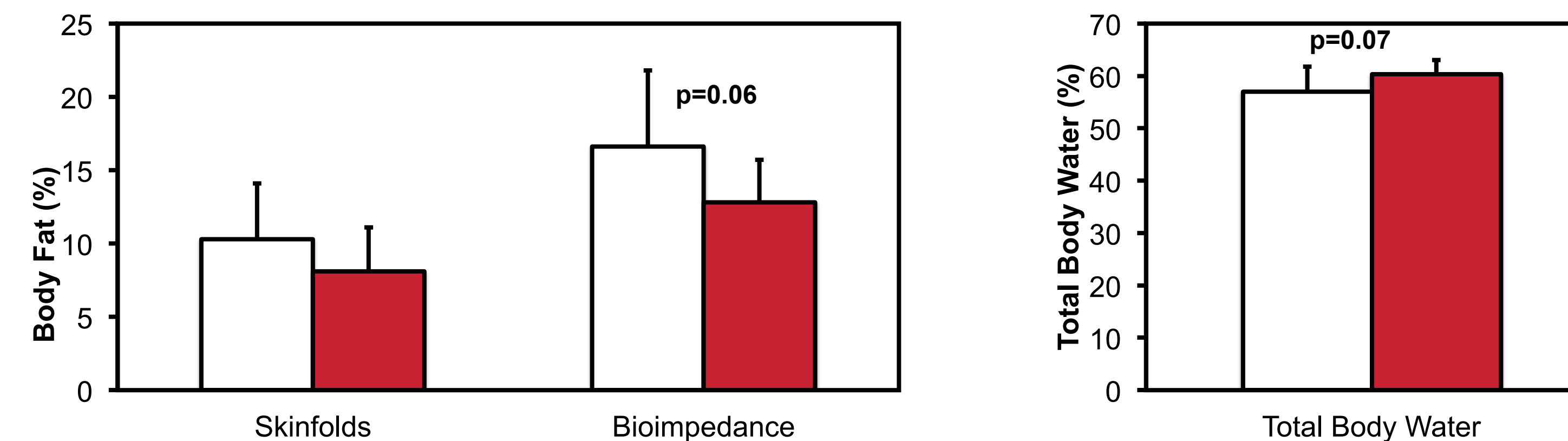


Figure 1. Comparison of body fat percentage measured by skinfolds (left) and bioimpedance (middle) and total body water between MS (n=8) and Con (n=7).

### Energy Balance

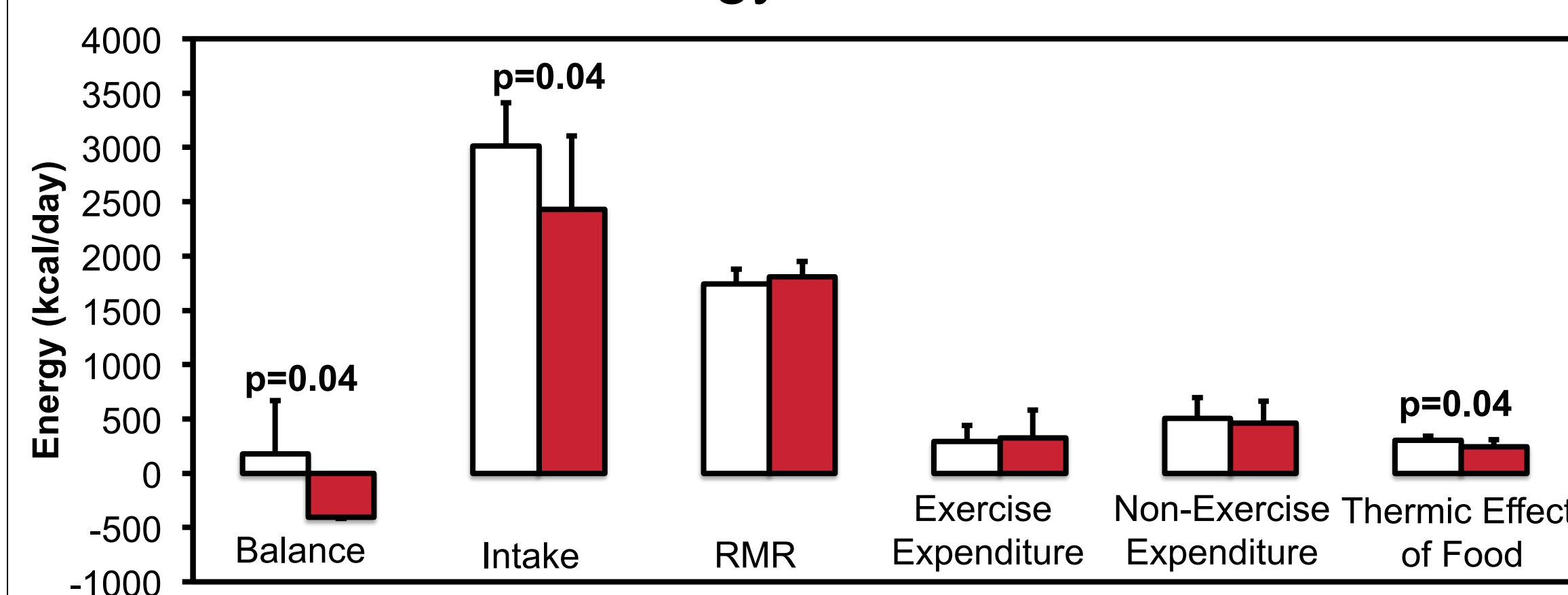


Figure 2. 7-day energy balance and its components (intake, resting metabolic rate, exercise expenditure, non-exercise expenditure, and thermic effect of food) between MS (n=7) and Con (n=7).

Legend: MS □ Con ■

### Eating Behaviors

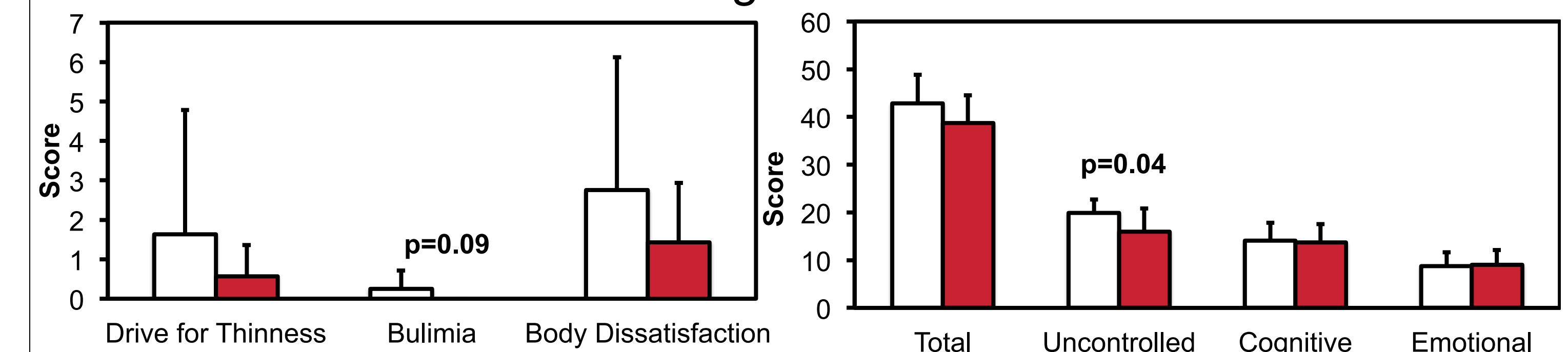


Figure 3. Scores for the Eating Disorder Inventory (left) and 3-Factor Eating Questionnaire (right) between MS (n=8) and Con (n=7).

MS reported significantly **more injuries** than Con (p=0.03).

There were no significant differences for other self-reported data, such as weight fluctuation (p=0.31), desire to gain or lose weight (p=0.31), and incidence of stress fractures (p=0.47).

## Discussion and Conclusion

- Despite conducting the same amount of exercise and having the same aerobic fitness, participants with indicators of metabolic suppression (MS) had a higher body fat percentage, consumed more calories and were in a positive energy balance, scored higher on eating behavior scales related to overeating, and had a higher incidence of injuries.
- Additional analyses of biological markers of metabolic suppression (e.g. testosterone, leptin, IGF-1) are needed to confirm metabolic suppression.
- Future long-term studies are needed to determine a) the underlying factors and b) the long-term risks associated with metabolic suppression.