

The Effect of Caffeine on Anaerobic Performance: A Preliminary Study

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Abstract

The ergogenic effects of caffeine on endurance exercise have been well documented; however, the effects of caffeine on maximal anaerobic exercise are not as well researched. **PURPOSE:** To determine the effects of caffeine ingestion on anaerobic run test performance in college aged male and female club-sport athletes. **METHODS:** A randomized, double-blind study was conducted on 4 healthy, active women and 4 healthy, active men ($n=8$). Subjects performed a maximal anaerobic run test (treadmill set at 7 mph at a 20% grade) 60 minutes after ingestion of 6 oz. sugar-free lemonade (placebo) or 6 oz. sugar-free lemonade with caffeine (5 mg/kg body mass). Heart rate, run time, and rating of perceived exertion (RPE) were recorded immediately at the end of the test. A series of 2x2 repeated measures ANOVAs were used to identify the influence of treatment and gender on time, work, power, and RPE. **RESULTS:** No significant interaction was found between gender and treatment for run time with caffeine (Females (F): 40.25 ± 6.4 s, Males (M): 57.3 ± 6.4 s $p > .05$) and without caffeine (F: 34.0 ± 5.8 s, M: 61.8 ± 5.8 s, $p > .05$). Three of the four females increased performance during the caffeine trial by an average of 8.7 ± 8.96 s, while three of the four males decreased performance during the caffeine trial by an average of 7.3 ± 5.13 s. No significant differences ($p > .05$) were found for RPE, power, or work between trial and gender. **CONCLUSIONS:** Ingestion of 5 mg/kg body mass of caffeine 60 min prior to exercise may narrow the gender differences in time to exhaustion (TTE) during maximal anaerobic exercise.

Introduction

- Caffeine's effect on aerobic performance has been well documented and supplementation results in significant improvements in performance¹
- Less research has been done documenting caffeine's effect on anaerobic performance
 - Performance improvements in anaerobic tests are evident if the dosage is at least 4 mg/kg^{2,3}
 - Smaller doses may not improve performance, but may reduce RPE during exercise^{2,3}
- Caffeine is metabolized in the liver into xanthines^{4,5,6}
 - Xanthines stimulate catecholamine release causing increases sympathetic stimulation^{6,7}
- Caffeine increases release of catecholamines causing increased calcium permeability and ultimately increased muscle contractility⁶
 - Increased myofilament sensitivity allows for increased muscle contraction force⁵
- Caffeine increases muscle fiber recruitment by lowering motor neuron excitation threshold⁵
- Caffeine causes a skeletal muscle efflux of potassium allowing for greater force production per motor unit and/or increased motor unit activation⁸
- Caffeine blocks adenosine receptors and increases dopamine levels creating a decreased perception of effort⁵

Purpose

- To determine the effects of caffeine ingestion on anaerobic run test performance in college aged male and female club sport athletes

Methods

- A randomized, double-blind study was conducted on 4 healthy, active women and 4 healthy, active men ($n=8$)
 - Subjects were habitual caffeine users
- Subjects performed a maximal anaerobic run test (treadmill set at 7 mph at a 20% grade) 60 minutes after ingestion of one of 2 treatments
 - 6 oz. sugar-free lemonade (placebo)
 - 6 oz. sugar-free lemonade with caffeine (5 mg/kg body mass)
- During 60 min rest period, HR and BP were measured every 10 min
- A complete and dynamic warm-up was performed at the end of the 60 min rest period and before the test
- Heart rate, TTE, and RPE were recorded immediately at the end of the test
- 2x2 repeated measures ANOVAs were used to identify the influence of treatment and gender on time, work, power, and RPE

Table 1. Descriptive Characteristics of Subjects

	Males	Females
N	4	4
Age (Years)	20.5 (20-21)	20.75 (19-22)
Height (cm)	183.8 (177.8 - 188.0)	164.0 (157.5 - 177.8)
Weight (kg)	86.9 (77.1 - 106.6)	64.2 (56.3 - 75.2)
% Body Fat	13.99%	22.10%

Results

- No significant differences ($p > .05$) were found between treatment or gender for TTE, work, power, or RPE.
- 3 of the 4 females increased TTE with caffeine
 - Average increase = 8.7 ± 8.96 s
- 3 of the 4 males decreased TTE with caffeine
 - Average decrease = 7.3 ± 5.13 s
- Although not statistically significant:
 - Females reported lower RPE with caffeine
 - Relatively no RPE change in males

TTE Differences Between Genders With and Without Caffeine Treatment

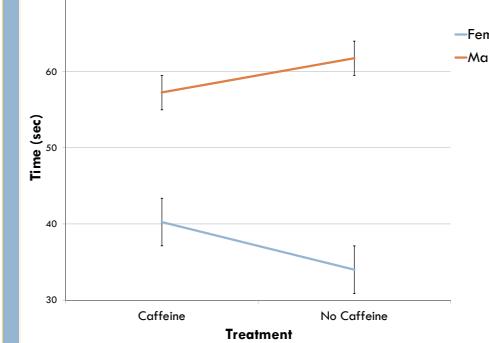


Figure 1. Differences in time to exhaustion between genders with and without caffeine treatment 60 minutes prior to maximal anaerobic run test

RPE Differences Between Genders With and Without Caffeine

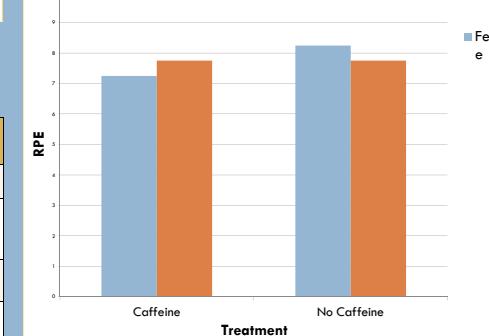


Figure 2. RPE differences between genders with and without caffeine treatment 60 minutes prior to maximal anaerobic run test

Discussion

- Women experienced a longer TTE with caffeine compared to without caffeine than men did with caffeine compared to without caffeine
- Mechanism for this action might be due to:
 - Increase in stroke volume with caffeine
 - 3.3 mg/kg caffeine significantly increased stroke volume in women and not in men⁹
 - Women may have slower systemic caffeine clearance during the luteal phase of the menstrual cycle resulting in greater exposure time to caffeine¹⁰
- Although not significantly different, the lower RPE in women might have attributed to the increase in time to exhaustion¹¹

Conclusions

- Caffeine narrows the gender differences in time to exhaustion during maximal anaerobic exercise
- Future research should be related to gender differences with caffeine and anaerobic performance

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