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): 40.23 ± 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/kg1,2
• Smaller doses may not improve performance, but may reduce RPE during exercise1,2,3
• Caffeine is metabolized in the liver into xanthines4,5,6
• Xanthines stimulate catecholamine release causing increased sympathetic stimulation5,7
• Caffeine increases release of catecholamines causing increased calcium permeability and ultimately increased muscle contractility8
• Increased myocardial sensitivity allows for increased muscle contraction force9
• Caffeine increases muscle fiber recruitment by lowering motor neuron excitation threshold2
• Caffeine causes a skeletal muscle efflux of potassium allowing for greater force production per motor unit and/or increased motor unit activation2
• Caffeine blocks adenosine receptors and increases dopamine levels creating a decreased perception of effort9

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

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

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 men
• 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

Table 1. Descriptive Characteristics of Subjects

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<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
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</thead>
<tbody>
<tr>
<td>Age (Years)</td>
<td>20.5 (20-21)</td>
<td>20.75 (19-22)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>183.8 (177.8 - 188.0)</td>
<td>164.0 (157.5 - 177.8)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>86.9 (77.1 - 106.6)</td>
<td>64.2 (56.3 - 75.2)</td>
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<td>% Body Fat</td>
<td>13.99%</td>
<td>22.10%</td>
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Literature cited

Acknowledgments
• Special thanks to Dr. Amy Olson, Dr. Mary Stenson, and all participants.