The effects of caffeine ingestion on the hemostatic response to simulated firefighting
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Abstract
The leading cause of death among firefighters is sudden cardiac event, and it is acknowledged that most ischemic events are due to an occlusive thrombus formation. In addition, due to the demanding job requirements and shift work, firefighters are commonly known to overuse caffeine as an ergogenic aid. PURPOSE: The purpose of this study was to examine the potential effects of caffeine on the hemostatic response to simulated firefighting activity.

METHODS: Twelve healthy male firefighters (age, 31.3 ± 5.4 yrs; weight, 94.2 ± 13.1 kg; BMI, 28.7 ± 2.9 kg·m⁻²) participated in this study, wearing full personal protective equipment (PPE) and self-contained breathing apparatus (SCBA). Subjects completed two trials of a simulated firefighting activities course after consuming either 6mg/kg body weight of caffeine or placebo one hour prior to exercise. Blood samples and air levels from the SCBA were obtained pre-exercise and post-exercise, and time to completion was recorded.

RESULTS: Factor VIII and tissue plasminogen activator (tPA) activity significantly increased post-exercise and platelet activating factor (PAI-1) activity significantly decreased post-exercise in both conditions. There was a significant treatment x exercise interaction as Factor VIII levels increased more in the caffeine trial versus the placebo trial, resulting in an increased coagulation potential and fibrinolytic response. The leading cause of death among firefighters is sudden cardiac event, and it is acknowledged that most ischemic events are due to an occlusive thrombus formation. In addition, due to the demanding job requirements and shift work, firefighters are commonly known to overuse caffeine as an ergogenic aid. PURPOSE: The purpose of this study was to examine the potential effects of caffeine on the hemostatic response to simulated firefighting activity.

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CONCLUSION: Results from the present study suggest that caffeine elicits a higher coagulation response without concomitant increases in fibrinolysis during simulated firefighting.

Blood Draws and Assays
Venous blood was obtained from an antecubital vein immediately prior to and following firefighting activity.
Subjects assumed a seated position for 15 minutes prior to the blood draw to avoid postural changes in hemostatic variables.
Blood samples were collected in tubes containing an acidified citrate solution for tPA and PAI-1 activity measurement and in normal citrate tubes for the analysis of Factor VIII.
Blood samples were centrifuged at 4500 g/min at 4 °C for 20 min to obtain platelet-poor plasma, which was stored in an ultrafreezer (-80 °C) until assayed.
Plasma samples were analyzed using an enzyme-linked immunosorbency assay (ELISA) for Factor VIII, tPA activity and PAI-1 activity.

Simulated Firefighting Activity
All subjects performed two laps of the simulated firefighting course one hour after ingestion of either 500mL placebo or 6 mg/kg body weight of anhydrous caffeine administered in double-blind fashion.
Performed in the morning following a 10-hour fast.
24 hour abstinence from caffeine, tobacco or alcohol.
Time to completion and air consumption were recorded.

Statistical Analysis
Changes in each hemostatic variable were analyzed using repeated-measure analysis of variance (RMANOVA), with exercise (pre- and post-exercise) and treatment (caffeine, placebo) as within-subjects factors.
Post-hoc tests were done using paired t-tests to assess testing condition (caffeine, placebo).
Paired t-tests were also used to compare time to completion of the course and air consumed (change in PSI) during the course.
A priori significance set at P < 0.05.

Subjects
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>31.3 ± 5.4</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>180.9 ± 5.1</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>94.2 ± 13.1</td>
</tr>
<tr>
<td>BMI (kg·m⁻²)</td>
<td>28.7 ± 2.9</td>
</tr>
<tr>
<td>Average Daily Caffeine Consumption (mg)</td>
<td>332.4 ± 215.7</td>
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</tbody>
</table>

Conclusions
• There is a greater increase in Factor VIII antigen during simulated firefighting activities in the caffeinated condition, despite similar fibrinolytic responses in both conditions.
• While there was no observed ergogenic effect of caffeine, there was a trend for increased air consumption in the caffeinated condition, which is of particular interest in the firefighting profession as work is limited by the air supplied by the SCBA.