Effects of caffeine on anaerobic exercise

Crowe, Melissa J[1], Leicht, Anthony S[1] & Spinks, Warwick L[1]
[1] *Institute of Sport and Exercise Science, James Cook University, Townsville, Australia.*

Correspondence: Melissa.Crowe@jcu.edu.au

Introduction

The effects of caffeine on endurance exercise have been well researched with the majority of studies reporting positive effects[1]. However, few studies exist examining the potential ergogenic effects of caffeine on short-burst, anaerobic exercise. Caffeine may enhance anaerobic exercise by increasing the release of adrenaline thereby enhancing anaerobic metabolism[1] and/or by a direct effect on the skeletal muscle such as causing the release of calcium from the sarcoplasmic reticulum[2]. Given the lack of research in this area, this study investigates the effects of a single dose of caffeine on repeated, anaerobic exercise. The authors hypothesise that caffeine will enhance exercise performance with a corresponding increase in blood lactate levels compared to the control and placebo. Additional hypotheses include increases in resting heart rate (HR) and blood pressure (BP), plasma triglycerides and glucose, decreases in plasma potassium and increases in alertness in response to caffeine compared to the control and placebo interventions.

Methods

Seventeen healthy students (12 male, 5 female; mean ± SE age 21.1 ± 0.7 yr, height 177.5 ± 2.2 cm, weight 73.3 ± 2.5 kg) provided written informed consent to participate in the study. Ethics approval to undertake the study was provided by the James Cook University Human Ethics Committee. All subjects completed three randomized, double-blind testing sessions consuming either caffeine (6 mg/kg in caffeine-free cola), placebo (caffeine-free cola) or control (no intervention) 90 min prior to exercise. Parameters were measured at baseline (before consumption of fluids), 80-90 min post-intervention, and, for blood parameters, at post-exercise. Parameters measured included resting HR and BP, reaction time and concentration (via number recall), plasma potassium and triglycerides, blood lactate and glucose, peak power, time to peak power, total work, maximal exercise HR and rating of perceived exertion (RPE). The exercise test consisted of two 60 s maximal cycling bouts separated by 3 min seated rest. The participants were requested to abstain from caffeine for 48 hours prior to testing. Data were analysed by two-way, repeated measures ANOVA with alpha set to 0.05.

Results

Caffeine had no effect on resting HR or BP, reaction time, concentration, plasma triglycerides or blood glucose compared to baseline and to placebo and control conditions. Plasma potassium levels significantly decreased at rest after caffeine compared to control and placebo with this effect lost after exercise ($p=0.001$; Fig. 1). Overall, potassium was significantly lower after caffeine compared to control ($p=0.025$). Exercise caused a significant increase in blood lactate for all conditions ($p<0.001$) with a higher overall lactate with caffeine compared to control ($p=0.014$; Fig. 2). Caffeine had no significant effect on peak power, total work, HR_{max} or RPE compared to control and placebo. Time to peak power was significantly slower in the second exercise bout after caffeine compared to control and placebo ($p=0.008$).

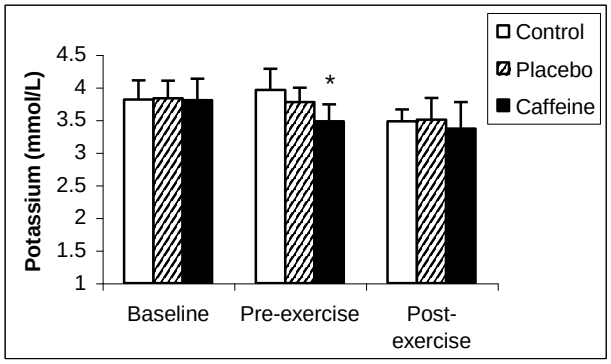

Fig. 1: Plasma potassium levels (mmol/L) for control, placebo and caffeine interventions at baseline, pre- and post-exercise. * $p<0.01$ caffeine significantly lower than pre-exercise control and placebo.

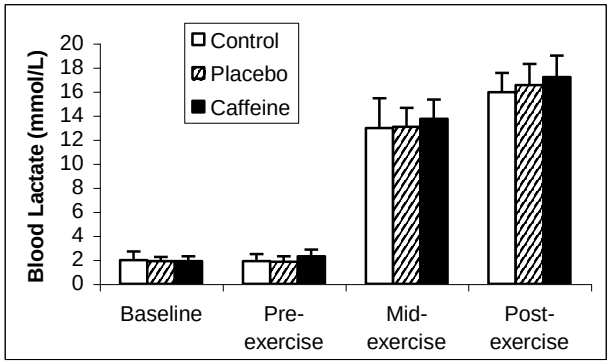

Fig. 2: Blood lactate levels (mmol/L) for control, placebo and caffeine interventions at baseline, pre-, mid- and post-exercise.

Discussion/Conclusion

In conclusion, caffeine had no ergogenic effect on repeated maximal cycling bouts and may be detrimental to performance with a significant decrease in time to peak power on the second exercise bout and higher blood lactate levels. However, caffeine decreased resting plasma potassium levels and may therefore limit exercise-induced hyperkalemia.

References

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2. Lopes, J., Aubier, M. et al. (1983) *Journal of Applied Physiology*. 54:1303-1305.