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EFFECT OF CAFFEINE INGESTION ON ASPECTS OF ENDURANCE PERFORMANCE AND COGNITION IN CYP1A2 HETROZYGOUS A/C MALE RECREATIONAL ATHLETES

By

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ABSTRACT

Background: Globally, caffeine is the most widely accessible psychoactive drug and has been shown to improve endurance performance as well as aspects of cognition, mood and perceptual responses during exercise. However, the ergogenic effects of caffeine between individuals are variable, and the cause of this variability is unknown. The CYP1A2 gene is known to mediate caffeine metabolism and has been suggested as a contributor to the variability of the ergogenic effects of caffeine.

Purpose: To investigate the effects of CYP1A2 genotype on exercise performance (10 km time trial), sleep, mood, cognition and perceptual responses following caffeine ingestion in adult male recreational athletes.

Methods: 16 recreationally trained athletes (age = 26.9 ± 7.93 y; weight = 77.00 ± 9.04 kg) volunteered for this study. Participants completed a familiarisation session at least one week before the first trial and a saliva sample was collected for testing of the participants' CYP1A2 genotype. Participants completed two trials one week apart in a randomised double-blind placebo-controlled cross-over design. Participants were asked to abstain from caffeine ingestion and keep a food diary for 24 h prior to the trial. Participants wore an actigraph, and completed a sleep diary and Leeds Sleep Evaluation Questionnaire (LSEQ) every day for the two week duration of the trials starting 3 days before the first trial and ending 3 days after the second trial. The main trial consisted of a set of pre- and post-ingestion measures which included leg power by vertical jump height (squat jump – SJ; countermovement jump – CMJ), leg strength by maximal voluntary concentric and eccentric contraction of the knee extensors (isokinetic dynamometer), perceptual (feeling scale – FS; felt arousal scale – FAS), mood (profile of mood states – POMS), cognition (digit vigilance – DV; Corsi blocks – CB; rapid visual information processing – RVIP) and heart rate. Pre- and post-ingestion urine, saliva and blood samples were also collected for analysis of caffeine metabolism and genotype. Following completion of pre-ingestion measures, participants consumed a capsule containing either anhydrous caffeine (6 $mg \cdot kg^{-1}$) or placebo (maltodextrin) and were instructed to rest quietly for 50 min. Following post-ingestion measures, participants completed a 10-km time trial run. Perceptual

measures (FS and FAS) including ratings of perceived exertion (RPE) were recorded every 2.5 km and heart rate was recorded every 1 km. A venous blood sample and saliva sample was collected at 5 km and 10 km. At completion of the 10-km time trial all post-ingestion measures were repeated, followed by another 50 min rest period. After the second 50 min rest period the participants completed the perceptual, mood and cognitive measures and further blood, urine and saliva samples were collected. Participants returned 24 and 48 h post-ingestion to repeat all post-ingestion measures and another blood, urine and saliva sample was collected. This protocol was then repeated 1 week later for the alternate treatment (placebo or caffeine). The effect of treatment (caffeine, placebo) and the interaction effect of treatment x time were assessed using a repeated measures ANOVA. A student's t-test was used to measure differences between Leeds sleep evaluation questionnaire (LSEQ) and actigraph data.

Results: Fourteen of sixteen participants were heterozygous A/C CYP1A2 for the CYP1A2 genotype and therefore results based on genotypes could not be compared as originally intended. Plasma caffeine, paraxanthine and theophylline concentrations were all elevated following caffeine ingestion ($P < 0.05$) peaking at 10-km, 1 hour after the 10-km run and 24 hours post caffeine ingestion respectively. Caffeine did not significantly improve 10-km run times. Eccentric leg strength but not concentric leg strength was improved following caffeine ingestion ($P < 0.05$). Squat jump height but not countermovement jump height was improved following caffeine ingestion ($P < 0.05$). Digit vigilance reaction times were decreased significantly following caffeine ingestion ($P < 0.05$) and a trend of decreased rapid visual information processing (RVIP) reaction times were seen ($P < 0.1$), however, no improvements in the accuracy during cognitive tests were seen following caffeine ingestion. A trend of increased heart rate ($P < 0.1$) during exercise was observed following caffeine ingestion, but no significant differences in heart rate before and after exercise were observed.

Conclusions: While no overall, significant improvements in run time occurred following caffeine ingestion, 11 of 14 participants had a faster run time following caffeine ingestion compared to placebo. Caffeine, rather than the metabolites of caffeine, is likely the main cause of any observed ergogenic effects following caffeine ingestion as the improvements in reaction times, mood and

endurance performance occurred when plasma caffeine concentration was elevated but plasma caffeine metabolite concentrations were low. It was found that caffeine ingestion improves endurance performance and reaction times during cognitive tasks. Taken together, the pharmacokinetics of the caffeine and caffeine metabolite peaks suggest that for athletes with the A/C CYP1A2 genotype ingestion of caffeine 1.5 – 2 h prior to an event may be more beneficial for endurance performance compared to the usual recommendations of taking caffeine 1 h prior to exercise.

Keywords: caffeine, endurance exercise, CYP1A2, performance, genetics

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