European Journal of Nutrition (2024) 63:3025–3035
https://doi.org/10.1007/s00394-024-03486-9

ORIGINAL CONTRIBUTION

Effects of different doses of caffeine on cognitive performance in healthy physically active individuals

María Ramírez-delaCruz[1] · Paula Esteban-García[1] · Pablo Abián[2] · Alfredo Bravo-Sánchez[3] · Inés Piñas-Bonilla[4] · Javier Abián-Vicén[1]

Received: 16 October 2023 / Accepted: 23 August 2024 / Published online: 4 September 2024

Abstract

Purpose Caffeine is a potent central nervous system stimulant that increases the activity of the prefrontal cortex and can improve various cognitive skills. An improvement in these cognitive skills can lead to further benefits in athletic performance. Therefore, it is necessary to clarify the dose-response of caffeine on cognitive performance. This study aimed to determine the effects of different doses of caffeine on sport-related cognitive aspects.

Methods Twenty-nine healthy physically active young adults were recruited. All participants completed three trials under the following conditions: (a) placebo, (b) 3 mg/kg, or (c) 6 mg/kg body mass of caffeine. In each trial, different cognitive abilities were evaluated with the following battery of tests: reaction time (Dynavision™ D2), anticipation (Bassin Anticipation Timer), sustained attention (Go/No-Go and Eriksen Flanker Test) and memory tests. Moreover, the side effects and the perceived sensation index were recorded 24 h after each test.

Results Reaction time only improved following 6 mg/kg of caffeine intake (Physical reaction time: -0.04 s, 95% CI -0.08 to -0.01 s, $P = 0.036$, d = 0.5; Motor reaction time: -0.04 s, 95% CI -0.07 to -0.01 s, $P = 0.008$, d = 0.6) compared to the placebo condition. Anticipation, sustained attention, and memory were not affected after either caffeine dose intake (all $P > 0.05$). In addition, the 6 mg/kg dose of caffeine augmented the occurrence of the side effects of increased activeness ($P = 0.046$) and nervousness ($P = 0.001$).

Conclusion Acute intake of 6 mg/kg caffeine is effective in improving reaction time despite increasing the occurrence of side effects in healthy physically active young adults.

Study registration This study has been registered in ClinicalTrials whose ID is: NCT05995314 (2023-08-08).

Highlights

- Although caffeine is considered ergogenic at doses of 3 to 6 mg/kg body mass, we have only found significant differences with the 6 mg/kg dose.
- The acute intake of 6 mg/kg body mass of caffeine is effective in improving reaction time.
- The 6 mg/kg dose of caffeine augmented the occurrence of side effects, mainly increased activeness and nervousness.
- Caffeine can be a potent ergogenic aid to improve sports performance (i.e., motor and physical reaction time), however, at the cognitive level no improvements have been found with the doses used (3 and 6 mg/kg).
- Further research with higher doses of caffeine (i.e., 9 mg/kg) and with different protocols for measuring cognitive abilities is needed to test whether the trends shown in our study could be converted into real improvements in cognitive performance.

Keywords Ergogenic aid · Sports performance · Reaction time · Anticipation · Attention · Memory

Extended author information available on the last page of the article