

Effect of acute caffeine intake on the fat oxidation rate during exercise: A systematic review and meta-analysis

Collado-Mateo, D.^aEmail Author,
Lavín-Pérez, A.M.
Merellano-Navarro, E.
Del Coso, J.

Abstract

A number of previous investigations have been designed to determine the effect of acute caffeine intake on the rate of fat oxidation during exercise. However, these investigations have shown contradictory results due to the differences in the exercise protocols used or the co-ingestion of caffeine with other substances. Hence, to date, there is no consensus about the effect of caffeine on fat oxidation during exercise. The purpose of this study was to conduct a systematic review followed by a meta-analysis to establish the effect of acute intake of caffeine (ranging from 2 to 7 mg/kg of body mass) on the rate of fat oxidation during exercise. A total of 19 studies published between 1978 and 2020 were included, all of which employed crossover experimental designs in which the ingestion of caffeine was compared to a placebo. Studies were selected if the exercise intensity was consistent in the caffeine and placebo trials and if these were preceded by a fasting protocol. A subsequent meta-analysis was performed using the random effects model to calculate the standardized mean difference (SMD). The meta-analysis revealed that caffeine significantly ($p = 0.008$) increased the fat oxidation rate (SMD = 0.73; 95% CI = 0.19 to 1.27). This increment was consistent with a significant ($p = 0.04$) reduction of the respiratory exchange ratio (SMD = -0.33; 95% CI = -0.65 to -0.01) and a significant ($p = 0.049$) increase in the oxygen uptake (SMD = 0.23; 95% CI = 0.01 to 0.44). The results also showed that there was a dose-response effect of caffeine on the fat oxidation rate, indicating that more than 3.0 mg/kg is necessary to obtain a statistically significant effect of this stimulant on fat oxidation during exercise. Additionally, the ability of caffeine to enhance fat oxidation during exercise was higher in sedentary or untrained individuals than in trained and recreational athletes. In conclusion, pre-exercise intake of a moderate dose of caffeine may effectively increase fat utilization during aerobic exercise of submaximal intensity performed after a fasting period. However, the fitness level of the participant may modulate the magnitude of the effect of caffeine on fat oxidation during exercise.

Author keywords

Carbohydrate
Endurance exercise
Performance
Stimulant
Thermogenic