

Article

Infographic. Wake up and smell the coffee

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1 **Infographic. Wake up and smell the coffee**

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19 Caffeine has been used as a performance-enhancing aid by athletes for many years. The first
20 known study to explore the effects of caffeine ingestion on exercise performance dates back
21 to 1907.¹ Until recently, however, findings on this topic remained equivocal, despite a large
22 number of published studies over the last 30 to 40 years.² There are many possible reasons for
23 the discrepant results between these studies, but one likely issue could be a common use of
24 relatively small samples. To reconcile the equivocal evidence on this topic and overcome the
25 low statistical power of individual studies, researchers have started to use meta-analytical
26 methods. Meta-analysis is a statistical method that allows pooling of results from studies that
27 address a similar research question.³

28

29 Given that meta-analytical findings may yield more conclusive statements than individual
30 studies, the recent International Olympic Committee consensus statement placed meta-
31 analyses at top of the hierarchy of evidence pyramid.³ However, even meta-analyses may
32 produce misleading conclusions. Methods used in a given review, such as the
33 comprehensiveness of the search strategy (*eg*, number of databases searched) and how the
34 data was analysed may impact the overall robustness of these findings. Umbrella reviews (*ie*,
35 reviews that include the synthesis of available meta-analyses) allow better recognition of the
36 uncertainties, biases, and knowledge gaps and therefore may provide a better understanding of
37 the credibility of results from different meta-analyses.⁴

38

39 In our recent umbrella review, published in the *British Journal of Sports Medicine*, we
40 synthesised results of the current meta-analyses that explored the effects of caffeine ingestion
41 on exercise performance.² We included 11 reviews with a total of 21 meta-analyses. As
42 assessed using Assessing the Methodological Quality of Systematic Reviews 2 checklist, all
43 of the included reviews were categorised as being of moderate or high methodological

44 quality. The included meta-analyses explored the effects of caffeine vs placebo on different
45 exercise tasks, including aerobic endurance, muscle strength, muscle endurance, anaerobic
46 power, jumping performance, and exercise speed. Moderate-to-high quality systematic
47 reviews that provided a moderate quality of evidence (assessed using the Grading of
48 Recommendations Assessment, Development and Evaluation [GRADE] criteria) support the
49 ergogenic effects of caffeine on muscle endurance, muscle strength, anaerobic power, and
50 aerobic endurance.⁵⁻⁸ For other outcomes, namely, jumping performance, and exercise speed,
51 we found moderate quality reviews that provided evidence categorised as of low or very low
52 quality on the GRADE assessment. The majority of primary studies were conducted in young
53 men, which highlights the need for future studies in women and older age groups.

54
55 Across the primary studies, caffeine was most often provided as caffeine anhydrous
56 (concentrated caffeine powder). However, ingestion of caffeine through coffee also has the
57 potential to be ergogenic.⁹ For a 70-kg individual, approximately two cups of coffee should
58 generally be ergogenic as this dose would provide around 3 mg of caffeine per kg of body
59 mass—which seems to be sufficient for acute improvements in exercise performance.
60 However, the content of caffeine in coffee may vary depending on the coffee bean type,
61 preparation method, as well as coffee brands and flavours, which needs to be taken into
62 account when prescribing caffeine supplementation.¹⁰⁻¹²

63
64 In summary, this umbrella review highlights that the effects of caffeine on exercise
65 performance are well-established and well-replicated, appearing consistent across a broad
66 range of exercise modalities. Therefore, individuals interested in acute performance-
67 enhancement may consider the use of caffeine.

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73 **Patient consent for publication** Not required.

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