

LUCOZADE SPORT SCIENCE:

CAFFEINE USE IN SPORT

KEY POINTS

- ‡ Caffeine can improve performance in both short and long term endurance events as well as short term high intensity intermittent exercise.
- ‡ Caffeine can improve many of the cognitive (mental processing) attributes important to sport such as alertness, concentration, reaction time and focus.
- ‡ The mechanism(s) behind the performance benefits of caffeine remain unclear, although it is likely that caffeine stimulates the central nervous system reducing the perception of effort.
- ‡ The performance benefits of caffeine have been shown with doses ranging between 1-13 mg/kgBM, although it appears that there is no dose response above 3 mg/kgBM.
- ‡ It appears that caffeine does not promote dehydration when taken before or during exercise and caffeine is NOT on the WADA list of prohibited substances.

INTRODUCTION

Caffeine is a naturally occurring compound found in the leaves, nuts and seeds of various plants and enjoys widespread use around the world. It is commonly consumed in various forms including coffee, tea and soft drinks, providing ~ 30-100 milligrams (mg) of caffeine per serve. Caffeine is one of the most widely researched ergogenic (enhances athlete performance) aids with proven performance benefits potentially applicable across a range of different sports.

MECHANISMS OF ACTION

Caffeine can affect the body in a number of ways, principally through the inhibition (competitive blockade) of adenosine receptors. Due to the complex biochemistry and interacting responses, the underlying mechanisms behind the ergogenic effect of caffeine remain unclear. One early suggestion was that caffeine may increase the utilisation of fat during endurance exercise, thus sparing muscle glycogen for the later stages. Currently, this is not well supported and furthermore, caffeine has been known to be ergogenic during exercise where the use of fat is not important. The most likely reason is that caffeine stimulates the central nervous system reducing the perception of effort so that athletes feel better and increase their self selected pace.

CAFFEINE INGESTION ON PHYSIOLOGICAL PERFORMANCE

Short and Long Term Endurance

Endurance is best described as the ability of an athlete to sustain a set or chosen intensity for as long as possible and can be measured in two ways: time trial (performance test) or exercise to exhaustion (capacity test). Caffeine can improve performance in both methods with exercise durations ranging between 3-120 min. The level of performance benefit will vary between individuals. Although, it seems that the effects of caffeine are independent of individual fitness level, caffeine dose, habituation and caffeine withdrawal, caffeine should be trialled in training first before competition.

Short Term High Intensity Intermittent Exercise

Football, rugby, hockey and netball are just some of the team sports that are characterised as high intensity intermittent sports. Typically, successful performance in team sports is associated with an increased ability to maintain work rate during repeated sprints towards the latter stages of a match. Caffeine has been shown to improve the ability of athletes to maintain performance during repeated bouts of high intensity activity, principally by delaying the onset of fatigue. Currently, the impact of caffeine on single sprint bouts < 60 s needs further clarification.

Caffeine taken in combination with Carbohydrate

Caffeine has traditionally been consumed by athletes in isolation (powder or commercially available pill) or in the form of coffee. More recently, caffeine has been consumed in combination with carbohydrate, typically in the form of an isotonic sports drink. When consumed in this format caffeine is still shown to improve performance. Therefore individual choice/preference can dictate the format of the caffeine intake.

CAFFEINE INGESTION ON COGNITIVE PERFORMANCE

Caffeine can improve many of the cognitive (mental processing) attributes important to sport such as alertness, concentration, reaction time and focus. Improvements are more consistent under situations of fatigue/physical stress, and typically seen at doses ranging between 1-2 milligrams per kilogram of body mass (mg/kgBM).

The most consistently reported outcome of caffeine ingestion during exercise, regardless of the mode, intensity or duration is a reduction in an individual's perceptual response, i.e. exercise feels easier as measured by 'rating of perceived exertion' (RPE). In addition to increasing self selected pace, it may explain improvements in alertness, concentration, reaction times and focus. Again this appears to be independent of subject withdrawal, caffeine dose and interval time between ingestion and exercise.

PRACTICAL CONSIDERATIONS OF CAFFEINE INGESTION

Dose

The ingestion of 3-13 mg/kgBM caffeine (210 – 910 mg caffeine for a 70 kg individual) can improve endurance performance. However, it would appear that a caffeine intake > 3 mg/kgBM does not provide any greater effect, except potentially in those individuals who consume large quantities of caffeine in their normal diet. There may also be a performance benefit of consuming caffeine at even lower doses in the region of 1 mg/kgBM, but as yet the minimal amount necessary is not fully understood. The dose of caffeine should be consumed 60-minutes prior to exercise to allow the caffeine to peak in the blood stream.

Diuretic (dehydration) effect of caffeine

Caffeine under sedentary conditions may have a diuretic action, and athletes are often advised to avoid drinks containing caffeine in situations where fluid balance may be compromised, such as exercise. However, when caffeine is consumed either before and/or during exercise there does not appear to be any impact on typical markers of hydration. Thus, whilst caffeine is a mild diuretic at rest, assuming appropriate fluid intake, there is no reason to refrain from caffeine in preparation for and/or during exercise.

World Anti-Doping Agency (WADA)

Caffeine is mainly excreted from the body in the urine with the time to clear half of the ingested caffeine between 3-5 hours. This is, however, subject to individual variation with factors including genetics, prior ingestion of caffeine, gender and exercise affecting its metabolism. This is one primary reason why caffeine currently remains off the list of prohibited substances as defined by the World Anti-Doping Agency (WADA).

Possible Adverse Effects

Caffeine use can have side effects, particularly when ingesting high doses (> 500 mg per day) or when taken by those individuals not consuming caffeine on a regular basis. Side effects may include gastrointestinal distress, headaches, tachycardia, restlessness and irritability. These symptoms are, however, individual in nature and therefore caffeine ingestion should be trialled in training prior to use in competition. If side effects occur an athlete should consult their doctor.

RECOMMENDED READING

- ▶ Doherty, M. and Smith, P.M. (2004). Effects of caffeine ingestion on exercise testing: A Meta-analysis. *International Journal of Sport Nutrition and Exercise Metabolism*, 14, 626-646.
- ▶ Doherty, M. and Smith, P.M. (2005). Effects of caffeine ingestion on rating of perceived exertion during and after exercise: a meta-analysis. *Scandinavian Journal of Medicine and Science in Sports*, 15, 69-78.
- ▶ Graham, T.E. (2001). Caffeine and Exercise: Metabolism, Endurance and Performance. *Sports Medicine*, 31, 785-807.
- ▶ Armstrong, L.E. (2002). Caffeine, body fluid-electrolyte balance, and exercise performance. *International Journal of Sport Nutrition and Exercise Metabolism*, 12, 189-206