

Caffeine, Strips, and Sports Performance.

by Pip Taylor, professional triathlete and sports nutritionist.



Caffeine is used widely by both athletes and non-athletes for its ability to boost performance and mental acuity. Here's what you need to know to get the most out of your caffeine, particularly when it comes to your results come competition day.

What is Caffeine?

Caffeine is a naturally occurring chemical found in certain plants (tea leaves, coffee beans, cocoa beans, cola nuts and fruit from particular plants). It is also an additive that can be manufactured and added to a range of foods, beverages and other supplements. Caffeine is chemically known as an alkaloid (meaning it is a plant derived substance) with the chemical name 1,3,7-trimethylxanthine.



Caffeine crystals under a scanning electron microscope.

Where is caffeine found?

Caffeine is widely used throughout the world and found in commonly consumed foods and drinks including tea, coffee, chocolate as well as energy foods and drinks, sports supplements. It is estimated that the average Australian consumes 250-300mg caffeine per day¹. Caffeine consumption is generally regarded as safe (except when very large amounts - over 600mg - are consumed regularly) and with a range with potential health benefits².

What effect does caffeine have in the body?

Caffeine is metabolized in the liver and has a half life of 3.5-5 hours (there is a large individual variation in how quickly we break down caffeine). This means that after 5 hours, half the original amount of caffeine consumed remains in the blood. There can still be traces of caffeine in the blood 24 hours

table 1: Caffeine Content of Common foods and Drinks		
Food or Drink	Serving size	Caffeine Content (mg)
Instant coffee	250 ml cup	60 (12-169)*
Brewed coffee	250 ml cup	80 (40-110)*
Short black coffee/espresso	1 standard serve	107 (25-300)*
Iced Coffee	500ml	99 (33-197)*
Tea	250 ml cup	27 (9-51)*
Hot chocolate	250 ml cup	5-10
Chocolate -milk	60 g	5-15
Chocolate - dark	60 g	10-50
Cola soft drink	375 ml can	49
Energy drink	250 ml can	80
Sports gels	40g	20-100

* There is a large range in caffeine content of these drinks due to a variety of factors (see more below)

Sources: Food Standards Australia and New Zealand; AIS Sports Nutrition Fact sheet.

after ingestion and a small amount 0.5-3% is excreted in the urine³.

Structurally caffeine is very similar to adenosine, a compound that is very biologically active in the human body, meaning that caffeine can reach all cells and systems and interact in various ways, including energy production, hormone release, mobilization of fatty acids, dilation of blood vessels. Caffeine can also alter fuel use in some people, breaking down adipose tissue and mobilizing fatty acids to be burnt as energy⁴. However the primary way in which caffeine influences sports performance is through its effect on the central nervous system (CNS) due to the ability of caffeine to cross the blood-brain barrier⁵.

Stimulation of the CNS leads to increased alertness, wakefulness and awareness as well as enhanced mood – all familiar feelings to anyone who regularly drinks coffee or any other caffeinated food or drink. Although the mechanisms are not totally understood, caffeine can also have a pain reducing effect, with the brain interpreting feedback from the muscles as less painful in relation to the workload⁶. It can also act indirectly on muscles to increase maximal force and contractile strength by simply improving the ability of the brain to activate the working muscles⁷.

Caffeine use is extremely common in very day life and is generally safe, even providing certain health benefits. However caffeine use has also been blamed for adverse events due to inappropriate use or over consumption. Greater education about caffeine, its role in sports performance and how, when and how much to consume will help eliminate any misuse and reduce risk of any adverse effects.

It must be pointed out that response to caffeine is individual – some athletes can respond positively or not respond at all, while others may even respond negatively to caffeine⁸. Use should be trialed in training to determine if it can be of benefit during competition.



Using caffeine to help boost performance:

While caffeine has been shown over many years to boost athletic performance, the mechanisms by which this occurs have been less well understood. The most likely explanation and one agreed upon by experts, is that caffeine reduces the perception of effort and fatigue, helping athletes push harder for longer and with a reduced feeling of pain⁹. Aside from this obviously being of benefit to endurance athletes, athletes in sports that demand high levels of skills and tactics benefit from the improved ability to concentrate and stay alert¹⁰.

How much is the right amount?

How much caffeine an athlete requires in order to maximally boost performance will be very individual and depends on sensitivity and tolerance levels. In general though small amounts are effective and are less likely to produce any negative effects such as gastrointestinal distress, anxiety, jitters. A number of studies show that caffeine can influence positive performance effects from doses of 1 – 3 mg / kg body weight and that ingesting more than 3 mg / kg body weight does not appear to provide further performance benefits¹¹. You can see that this is well within the range consumed by the average Australian and also well within any range recommended as part of a normal healthy diet¹².

What does the right amount look like? How and when an athlete takes caffeine is individual and may take some experimentation to figure out what works best for them – just like other nutritional strategies. Some athletes prefer to take their full caffeine dose before the race or competition starts. Others find it works better to wait until fatigue starts to set in and others plan smaller more frequent intakes throughout their event¹³. The following table gives a range of the total amount (including prior and during) of caffeine an athlete would want to take to give maximum performance boosts¹⁴. Keep in mind that this is a total so you need to be aware of all sources of caffeine – even in other drinks or sports foods that may be supplied at event aid or refueling stations.

Further to this, research shows that even very small amounts of caffeine can exert a large positive effect on performance as fatigue starts to set in. The amounts needed to have this effect are as little as 0.2 - 1mg/kg, suggesting that the brain is more sensitive to the effects of caffeine when it is tired¹⁵.

This information is critical for endurance athletes planning nutritional strategies for the latter parts of a race, or for those whose competition may span several bouts, rounds or even multiple events over several days. In other words small doses can have quick and powerful results. The Revvies Strips allow for this planning and also allow for these small amounts of caffeine to be taken easily at a time of competition where that boost is critical.

'Withdrawal' is not necessary: Despite popular perception – and coming as good news for regular caffeine consumers – research shows there is no need to withdraw from (or cease having) caffeine in the days preceding an event in order to experience the ergogenic (performance boosting) effects¹⁶. Withdrawal can for some people be accompanied by headaches, lethargy and a decline in mood and concentration¹⁷. These are clearly not optimal for preparing for an important competition or event, so it is recommended that regular caffeine users do not stop using the regular caffeine before an event.

Is caffeine dehydrating? This is a common belief, but is not supported by research. It is true that consuming a large dose of caffeine can initially increase urinary output, however it appears that this effect is diminished in habitual (frequent) caffeine consumers¹⁸. In other words the first time you ever had caffeine you may have had slightly greater urine loss, but by day three there is no effect.

Other benefits: Research shows promise that caffeine may also aid in the recovery process by improving blood flow and speeding uptake and delivery of nutrients¹⁹. This improved recovery process has been speculated to also assist in athletes immune function capacity – which is well known to be depressed immediately after a hard workout or competition²⁰. Of course it must be stated that recovery will not be improved if caffeine intake disturbs sleep patterns. Athletes need to be conscious of the timing and amount of caffeine consumed and make sure that it does not interfere with optimal sleep.



Disadvantages of coffee: Coffee and tea contain caffeine in such variable amounts. Differences can range from 15 to 300mg per single serve of coffee, making it difficult to regulate intake. This is not ideal for athletes attempting to carefully plan nutritional strategies as it increases the risk of over or under consumption of caffeine. Variability in these natural sources occurs due to plant species, growing conditions, storage and transport, extraction method, temperature, and even the technique of an individual barista.

Strips vs other delivery methods such as foods/drinks?

Caffeine consumed in the form of foods or drinks must be digested before being metabolized and absorbed. Generally it is metabolized fairly quickly - reaching the bloodstream in 15-20 minutes with peak blood levels occurring around 45-60 minutes after consumption. However for some people this can take as long as 2-3 hours²¹. But taken in the form of a strip means that you can experience the effects of caffeine much more instantaneously. Caffeine is absorbed extremely rapidly through the mucosal barrier of the mouth and into the blood for delivery to tissues throughout the body. Research shows that caffeine absorbed through the mouth reaches the blood stream in only 5 minutes making it quick and effective for performance boosts²².

It has been well documented that sports drinks can boost performance even without ingestion and during short events that are unlikely to be limited by delivery of fuel or hydration²³. This is explained by the presence of receptors in the mouth that detect the presence of glucose from a simple sports drink 'mouth wash', and send a signal to the brain, which in turn signals the muscles to 'keep pushing'. Exciting new research also suggests that there are similar receptors for caffeine in the mouth²⁴. Without even digesting or metabolizing the caffeine, performance benefits have been demonstrated in testing of athletes²⁵. This is good news for athletes as it means that performance benefits are possible through relatively small amounts of caffeine (as in a Revvies Strip pictured below) and that the effects are virtually immediate.

A major benefit of using a mouth-dissolving strip is that risk of caffeine induced gastrointestinal disturbances are eliminated.

Other benefits of using a strip as delivery include ease of use, accuracy of dosing, portability and the separation of other substrates to allow for better planning and execution of nutritional strategies.



Sport by sport:

Many sports supplements may provide caffeine but because they are tied in with either calories or fluids, how and when you get your caffeine boost may be reliant on other factors. For instance, for an athlete competing in an event which makes it impossible to carry fluids or food, their only previous choice was to have their caffeine prior to the start. Revvies Strips make it possible to have a caffeine boost when it suits you - they do not require fluid for ingestion and are sugar free. Plus they are portable making them convenient in many situations.

Endurance sports – lasting 1-3+ hours.

These sports have the greatest weight of evidence for the use of caffeine as an ergogenic (performance boosting) supplement²⁶. Caffeine can be taken either before the start or spread out during the event, especially as fatigue starts to set in. Different methods will work better for different people so this might need some experimentation to see what works best for you as well as what works best given other conditions and race scenarios.

Example of use in a triathlete or cyclist competing in a 4hour+ race:

- Option 1: Pre race consumption – Several strips taken in the 30 mins prior to race start (number will depend on weight of athlete as well as individual sensitivity).
- Option 2: Single strip taken pre race then additional single strips taken at planned intervals throughout event.
- Option 3: No strip pre race. Single strips taken at regular intervals throughout event.

Ultra-endurance races – lasting 10-48 hours.

As for endurance sports, ultra-endurance events have good evidence for the beneficial effects of caffeine²⁷. Best taken spread out throughout the event. It is also worth noting that for ultra-endurance (and endurance) athletes, gastrointestinal (GI) complaints are common. Traditionally caffeine has been pointed out as being a major contributor to the increased risk of these episodes of GI distress²⁸. Orally absorbed caffeine, such as that delivered by Revvies Strips may eliminate GI complaints due to caffeine use, while still providing the performance benefits.

High intensity sports – lasting 1-30 mins.

In these types of sports it is most practical to take caffeine before the race. Because Revvies strips are rapidly absorbed through the mouth, this can be immediately prior to the start of the event or in the 30 mins prior to take advantage of peak bloodstream levels. Because of the amount of caffeine in the strips, this can be safely repeated for sports where multiple rounds or heats and finals are competed in throughout the day.

Team and ball sports – stop and go sports:

These sports are most likely to be contested over a period of 30-90 minutes, with different players participating for varying amounts of time. Depending on limitations such as access to sidelines, breaks in play etc will also determine best practice for the timing of caffeine intake. In most cases intake would be in the 30 minutes prior to start of competition, with possible additional intake at break of play. It is also likely in these high intensity sports that ingestion of food, and to some extent fluid, is impractical, unnecessary and even detrimental to performance meaning that delivery of caffeine via strips is the most practical approach. Caffeine in these types of sports will provide boosts to endurance capacity as well as ability to concentrate on tactical play and skill maintenance as fatigue sets in.

Risks and adverse effects of caffeine:

For the healthy adult population* it is suggested that up to 400 mg / day of caffeine (classified as moderate intake) is not associated with adverse effects²⁹. Consumption above these ranges (or less for caffeine sensitive individuals) can increase risk of these effects:

- Nausea
- Muscle tremor

- Respiration rate increased
- Gastrointestinal upset
- Headache
- Nervousness
- Irritability
- Insomnia
- Sensory disturbances

These adverse effects highlight why it is so important. Not only for athletic performance. But also for general health to have an accurate understanding of how much caffeine you are consuming. Caffeine strips provide a known, guaranteed dose of caffeine in every strip so that you never consume more than you want or need to and also so that you can carefully strategize when and how you get your boost.

*** Caffeine use is not recommended for everyone. Certain medical conditions preclude the use of caffeine and caffeine is contraindicated with the use of some prescription medications.**

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