Caffeine and Athletic Performance

Caffeine is the kick in your coffee. It gets you up and going in the morning, and helps keep you going when you start dragging. The benefit of a caffeine lift is not lost on athletes. In fact, among some of the world’s best endurance athletes — Ironman triathlon competitors — almost three-fourths reported using caffeine to improve athletic performance. And yet many of these same top athletes confess to being unsure about how much caffeine they need for a performance boost, not to mention the caffeine content of common foods and beverages. Are you up to date on the latest research on caffeine as a performance booster, and do you have a caffeine usage strategy to effectively improve your athletic performance?

Caffeine 101

1,3,7-trimethylxanthine, aka caffeine, is the world’s most consumed natural pharmacologic agent. Found in coffee beans, tea leaves, cacao beans (and therefore chocolate), and kola nuts, caffeine consumption is almost unavoidable. Roughly 9 out of every 10 adults in the US consume caffeine, averaging 238 mg every day — the equivalent of 2–3 cups of coffee. Upwards of 20–30% of US consumers down a whopping 600 mg of caffeine daily. About 71% of that caffeine comes from coffee, 16% from tea, and 12% from soft drinks and energy drinks. And the US is not alone. Coffee, which is chock-full of caffeine, is the beverage of choice around the globe.

Why all the fuss about caffeine? It’s all about the buzz. Caffeine functions as a mild stimulant: It helps wake us up, and it keeps us going when we might otherwise throw in the towel. No surprise — athletes are very interested in using those qualities to their advantage.

Effects vary by sport

The data are pretty convincing that caffeine is effective at improving athletic performance across a number of different sports. It’s been shown to improve endurance and time trial performance in cyclists, increase endurance in runners, and improve performance times and boost power in rowers. It’s also been shown to improve performance in cycling and running events lasting approximately 5 minutes, and to increase peak power output, speed, and isokinetic strength in sprint and power events lasting less than 10 seconds. Researchers studying tennis players found that caffeine increased hitting accuracy, speed and agility, and overall playing success on the court. And players reported feeling more energy late in their matches. While the evidence supports a performance-boosting effect of caffeine for a number of sports and events, it doesn't help in all cases. Specifically, caffeine has been shown to have no effect, and may even be a negative factor, in sprint and power events lasting anywhere from 15 seconds to 3 minutes.

How it works

Caffeine has a wide range of effects on the human body; it affects hormonal, metabolic, muscular, cardiovascular, kidney, and respiratory functions. It also influences the central nervous system, where it acts as a stimulant by interfering with the binding of the brain chemical adenosine to its receptors. Adenosine affects nerve cell activity, and it works opposite to caffeine. Where adenosine has a calming effect because it slows the activity of nerve
cells, caffeine speeds up the activity of these cells. Thus, caffeine reduces tiredness, increases alertness, improves mood, confers a sense of being energized, enhances concentration, and helps to speed reaction time. Exactly how the hormonal, metabolic, physiologic, and central nervous system effects of caffeine work together to improve athletic performance remains a matter of study. However, one performance benefit in particular stands out: For many athletes, caffeine lowers the perception of the intensity or difficulty of exercise. So, you’re able to compete or train at a higher intensity for longer, without actually feeling like you are working harder.

But is it legal?
Because of its ergogenic effects, caffeine at high doses used to be on the list of banned substances for Olympic athletes. But because caffeine confers performance benefits in relatively small amounts and its use is so widespread, the ban was lifted in 2004.

Caffeine sensitivity
That same stimulant effect that helps propel you through the last few miles of a marathon may actually impair performance for someone who is sensitive to caffeine. For example, in some individuals, almost any amount of caffeine seems to interfere with sleep patterns. This can spell disaster before an important competition, and can also undermine training. Also, if you’re caffeine-sensitive, the accompanying jitteriness and anxiety may compound the pre-game jitters you already feel. Headaches, dizziness, and stomachaches are other possible caffeine-related side effects for those who are sensitive to it. So, if you fall into this camp, take a pass on caffeine.

How much caffeine is effective?
Athletes interested in the potential performance-boosting benefits of caffeine are often uncertain about how much caffeine to consume and when to consume it in relation to exercise. A moderate dose of caffeine is all that’s needed. Higher doses are more likely to cause unwanted side effects, and there’s no evidence that more caffeine provides greater performance benefits. The recommended amount of caffeine for performance improvement is in the range of 0.45–1.36 mg caffeine per lb body weight (1–3 mg per kg). For a 150-lb (68-kg) athlete, that equates to a dose of 68–204 mg of caffeine. It’s a good idea to use the lowest amount that’s effective for you, because, again, more does not mean better. When caffeine intake gets too high, there is an increase in side effects like jitteriness, nervousness, insomnia, headache, dizziness, and gastrointestinal distress, all of which can impair your athletic performance.

Timing of intake in relation to exercise
Caffeine is readily absorbed by your digestive tract. In fact, caffeine concentration in the bloodstream peaks 30–60 minutes after ingestion and stays high for 3–4 hours. On average, about half of it is gone within 4–6 hours, and 75% is cleared within 6–7 hours. So, as a general rule, consuming caffeine about an hour before your event will help to ensure that blood levels are high when you begin competing; your window of opportunity for obtaining a performance benefit from caffeine is probably about 4 hours from the time you consume it. That being said, you don’t need to consume all your caffeine before exercise, especially for longer endurance events. Studies have compared taking a full dose of caffeine an hour before exercise to taking half the dose an hour before and the other half 45 minutes into exercise. Both regimens improved performance times similarly in comparison to a control group. Another study compared taking the full amount of caffeine an hour before exercise to taking the caffeine in divided doses every half hour during exercise. Here again, both regimens improved performance times similarly. Putting this into practice, if you weigh 150 lbs (68 kg) and require 0.90 mg caffeine per lb body weight (2 mg per kg) for a 3-hour event, the 136 mg of caffeine can be taken all at once about an hour before competing, or it can be taken in divided doses prior to and during the competition.

Tolerance, withdrawal, and your caffeine usage strategy
There’s more to the caffeine story than dosage and timing. Caffeine tolerance and withdrawal symptoms need to be considered. If you’re new to caffeine, you’ll probably experience a noticeable buzz or jolt the first time you consume a moderate dose. But if you consume that same amount of caffeine every day, after about 5 or 6 days, the stimulant effects are much less obvious. This is because you develop a
tolerance or diminished response to caffeine with repeated doses. The other side of the tolerance coin is withdrawal. Once you grow used to a certain daily intake of caffeine, stopping abruptly can lead to withdrawal symptoms, most commonly, a bad headache. Withdrawal also can have a less obvious, but detrimental, impact on athletic performance. Withdrawal symptoms peak in a day or two, and are usually completely gone within 4–7 days. If you resume caffeine intake in the midst of withdrawal, the symptoms, including headache, usually disappear pretty quickly.

Take caffeine tolerance and withdrawal into consideration when you formulate your caffeine usage strategy:

- If you are a caffeine novice, you can use caffeine to get you through 3 or 4 days of intense workouts, as you gear up for a competition. Do this by starting with a low dose of 0.45–0.9 mg caffeine per lb (1–2 mg per kg) body weight, and then increase the dosage a bit each day to achieve the same effect.
- If you've got a well-established caffeine habit, beware of the unintended withdrawal. For example, this can occur when you're on your way to a competition, stuck in a remote airport with absolutely no coffee to be had anywhere. Unintended withdrawal can also occur when training in hot weather. You'll probably notice the telltale pounding headache. Caffeine withdrawal symptoms can impair your ability to perform during a competition, so be sure to plan ahead and have a caffeine source handy if your usual fix is in short supply.
- If you're a regular caffeine user and you want to optimize the benefits of caffeine ingestion for an important competition, first wean yourself off caffeine gradually over 3–4 days to avoid withdrawal symptoms. Do this about a week before the competition, so you're completely free of any withdrawal effects. Then, once you're off caffeine, resume a moderate intake of 0.45–1.36 mg caffeine per lb (1–3 mg per kg) body weight on the day of your competition. You'll get the desired stimulant effects again, just like a caffeine novice would experience.
- Finally, if the mere thought of tapering your caffeine intake before a competition leaves you dysfunctional, stick with your current regimen, but consume some extra caffeine before and during your event to get an extra kick.

Caffeine sources

Although coffee is the most widely consumed caffeine source, it may not be the best source for improving athletic performance. One reason is that you can never quite be sure what amount of caffeine you're getting in that fresh-brewed cup of java, because of the inherent variability in coffee sources and differences in preparation methods. Another reason is that there may be other factors in coffee that antagonize or impair the performance-boosting effects of caffeine. In a study of treadmill runners, endurance times were improved when athletes were given a standardized dose of caffeine, but not when given that same dose in the form of coffee. An advantage of the caffeinated energy gels and cola drinks that are often available at aid stations during running events and triathlons is that their caffeine dosages are more uniform and dependable. This can be helpful in ensuring that you get the caffeine dose you know from training to be effective. The table below provides some idea of the caffeine amounts in typical caffeine sources that athletes rely upon. Beverages are often the most concentrated caffeine sources, but levels can vary considerably from one beverage to the next.

Complicating matters is the fact that manufacturers are not required to list on the label the quantity of caffeine in their products. So, if you have a favorite caffeine fix, but aren't too sure how much it's packing, do some searching on the Internet to try to nail down the dosage you are getting. Energy gels and energy chews are available with or without caffeine. These energy gels and energy chews can be used to help meet your caffeine load in the hour before exercise, or during an event, when you need that extra kick to push you through to the finish.
Practical application
If you’d like to know if caffeine might help to boost your athletic performance, follow these guidelines:

- Don’t begin experimenting with caffeine at an important event or competition. Test the impact of caffeine on your performance during a few race-pace training sessions.
- Use the lowest possible amount that is effective for you. More is not necessarily better.
- Keep in mind that you will develop a tolerance to your usual caffeine intake, and there are symptoms associated with sudden caffeine withdrawal. Both of these issues need to be factored into your caffeine usage strategy.
- Remember that caffeine can produce side effects. If you feel uncomfortably jittery, anxious, hyper, or if your heart is racing, dial back your dosage. And if you can’t seem to find a caffeine level that leaves you feeling comfortable, skip it entirely. Caffeine doesn’t work for everyone.

References:

Website resource: http://wilstar.com/caffeine.htm