



## Effects of Too Much Caffeine on Athletic Performance

As a central nervous system stimulant, caffeine consumed in moderate amounts of 200-300mg per day in the form of food or beverages, is considered socially acceptable and safe.<sup>1</sup> Consuming amounts in excess of 500mg per day can lead to adverse side effects<sup>1</sup>, and at very high levels of consumption (600-800mg) an athlete can test positive for caffeine as a banned substance by the NCAA.<sup>2</sup> Research does exist to support caffeine's performance enhancing benefits; however, it must be examined critically. With caffeine easily accessible to college athletes in food, beverages, and supplements, the potential risks of excessive caffeine should be considered.

### Caffeine and Athletic Performance

Testing positive for caffeine as a banned substance by the NCAA requires an athlete to reach a urinary caffeine threshold level of 15 mcg/mL. This equates to consuming approximately six to eight cups of brewed coffee (80-100 mg/8 oz) two to three hours prior to competition.<sup>1</sup> This amount of coffee would most likely impair performance due to gastrointestinal issues, nausea, or shaking.<sup>1</sup> The exact mechanism by which caffeine works to enhance performance is an area of continued research. Caffeine reduces pain and perception of fatigue by antagonizing adenosine receptors in the brain, allowing athletes to work at higher intensities.<sup>3</sup> There is some evidence to suggest caffeine increases fatty acid mobilization for energy metabolism; however, this concept has not been consistently supported in the literature.<sup>1</sup>

In laboratory settings, caffeine consumption at levels recognized as safe (2-6 mg/kg) one hour prior to and during sub-maximal endurance training and high intensity cardiovascular exercise up to twenty minutes, has shown improved performance.<sup>3,4</sup> In addition, caffeine may potentially enhance submaximal contractions during strength training.<sup>3</sup> Combined with decreasing an athlete's perceived exertion, caffeine may allow athletes to engage in longer strength training sessions.<sup>3</sup> Caffeine consumption exceeding recommended levels has not been associated with similar increases in performance.<sup>3</sup> Enhanced athletic performance is highly dependent on the athlete and form of caffeine consumed, which influences metabolism and excretion.<sup>1</sup>

With the current research on caffeine and athletic performance limited to primarily endurance trained athletes, these recommendations cannot be generalized to all sports.<sup>3</sup> Caffeine's effects on performance are also difficult to study given the multitude of products which contain it.<sup>1</sup> Further, most of the research supporting caffeine's ergogenic effects is performed in lab based settings, making it hard to extrapolate to the competitive arena.

## **Health and Eligibility Risks**

Despite the potential benefits, caffeine consumed at very high levels can put an athlete at risk for being “overstimulated”, therefore negatively impacting training, sleep, and ultimately performance.<sup>1</sup> Caffeine is also an addictive substance when consumed regularly in amounts as low as a 100mg a day, or one cup of brewed coffee. Side effects of withdrawal include headache, fatigue, depression, irritability, insomnia, increased heart rate, increased blood pressure, and premature left ventricular contractions.<sup>1,5</sup> While there is little evidence to support the diuretic effects of caffeine contributing to dehydration and electrolyte imbalances, caffeine consumed without adequate fluids can negatively impact thermal regulation in athletes training in a hot environments.<sup>1</sup>

Athletes may consume caffeine from multiple sources making total intake a challenge to assess.<sup>3</sup> Consuming very high levels of caffeine can increase risk of seizures, acid-base disorders, acute hepatitis, and cardiovascular events.<sup>5</sup> If a food, beverage, or medication contains caffeine, it must say so; however, the specific amount of caffeine is not required to be listed.<sup>1</sup> The amount of caffeine in energy bars, gels, and medications tends to be standardized, while the amount in coffee and tea can vary considerably.<sup>1</sup> Non-food sources of caffeine including energy drinks, pills, and “sports performance enhancers” may contain unlabeled banned substances like ephedrine, in addition to unknown amounts of caffeine which can result in serious health consequences, including death.<sup>3</sup> Approximately 10g, or one hundred 8 oz cups of coffee, is considered the lethal dose of caffeine.<sup>5</sup>

Energy drinks contain a combination of caffeine and sugar among other potentially unknown ingredients. These drinks can increase energy levels and mask fatigue for 60-90 minutes due to the stimulating effect of the caffeine combined with the immediate increase in blood sugar.<sup>1</sup> Caffeine mixed with alcohol creates a potentially lethal combination, as well. The depressive effects of alcohol are masked by caffeine potentially increasing binge drinking, impairing judgment, decreasing reaction time, or more serious consequences of heavy drinking.<sup>5</sup>

### **Food First**

The perception of having increased energy from caffeine will not replace the actual energy provided from food. Caffeine alone will not provide a competitive advantage if athletes are not optimizing their nutrition through whole foods. Successful athletic performance is dependent on a nutrition plan which meets the athlete’s energy and nutrient needs through food first.

### **Author**

Written by SCAN Registered Dietitians (RDs). For advice on customizing a nutrition plan, consult a RD who specializes in sports, particularly a Board Certified Specialist in Sports Dietetics (CSSD). Find a SCAN RD at [www.scandpg.org](http://www.scandpg.org).

**Table 1: Caffeine Containing Products<sup>1</sup>**

<b>Caffeine Containing Food Product</b>	<b>Amount of Caffeine (mg)</b>
8 oz. home-brewed coffee	80-100
8 oz. instant coffee	65-100
2 oz. espresso	100
8 oz. decaf coffee	5
8 oz. brewed tea	50
12 oz. soft drink	35-55
8 oz. energy drink	80
Energy bar with caffeine	50 or 100
1.5 oz. dark chocolate	30
2 Caplets Excedrin	130
1 Tablet NoDoz	200

*Note: exact amounts may vary between product brand and types.*

## **References**

- 1) Dunford Marie and Doyle J. Andrew. *Nutrition for Sport and Exercise 2<sup>nd</sup> ed.* Belmont: Wadsworth, 2012.
- 2) "NCAA Banned Drug List." *National Collegiate Athletic Association*. 2013. Web. 23 June 2013.
- 3) Rosenbloom Christine A and Coleman Ellen J. *Sports Nutrition A Practice Manual for Professionals 5<sup>th</sup> ed.* Academy of Nutrition and Dietetics, 2012.
- 4) Hodgson Adrian B, Randell Rebecca K, and Jeukendrup Asker E (2013). The Metabolic and Performance Effects of Caffeine Compared to Coffee during Endurance Exercise. *PLoS ONE* 8(4): e59561.
- 5) McArdle Willaim D, Katch Frank I, and Katch Victor L. *Sports Nutrition and Exercise Nutrition 4<sup>th</sup> ed.* Philadelphia: Lippincott Williams & Wilkins, 2013.