Background

Caffeine is the most widely used stimulant in the world and is present in a variety of products including beverages such as coffee, tea, colas, energy drinks, food products containing chocolate, some energy bars, and over-the-counter medications sold to increase alertness. Dietary supplements may contain herbal sources of caffeine such as guarana, kola nut, Yerba mate, green or black tea, and cacao pods used to make chocolate products. A cup (eight ounces) of coffee contains approximately 100 mg of caffeine, while colas contain about half of that amount. Following consumption, caffeine concentrations peak after about one hour, although this can be shortened if caffeine is ingested by chewing gum, since it will be absorbed in the mouth. Caffeine can affect multiple biological processes but most notable are its effects on alertness, vigilance, and physical performance. Caffeine blocks receptors in areas of the brain that control arousal and motivation.

Dose Range and Upper Limit

Nutrition Board DRI:

RDA/AI: Not relevant.

Upper Limit: Not relevant.

Doses Used In Randomized Clinical Trials: Multiple 200 mg doses during the late evening, overnight, and early morning periods totaling 800 mg per day have been administered during trials involving three days of sleep loss. Typical single acute doses to improve cognitive function approximate 200 mg, whereas two to six mg/kg body weight doses are used to enhance physical performance.

Toxicology Data: The acute lethal dose in adult humans has been estimated to be 10 grams; however there has been at least one report of death following intake of lesser amounts (i.e., 6.5 g) of caffeine.

Evaluation of Potential Benefits

Moderate daily consumption of 400 mg has been deemed safe for healthy adults and non-pregnant/non-lactating women. Caffeine in moderate doses up to 200 mg has improved cognitive performance in rested, sleep-deprived, and fatigued individuals. Doses from two to six mg/kg of body weight are associated with improved physical performance; a smaller dose typically will exert a longer-lasting and larger effect for individuals who do not normally consume caffeine. Smaller doses can also exert a positive effect on physical performance when consumed during exercise and/or for re-dosing prior to a subsequent physical challenge. Also, caffeine may help maintain a positive subjective experience and lower perceived exertion during extended exercise.

Potential Detrimental Effects on...

Military Performance: Higher doses of caffeine may induce mild tremor that could negatively impact marksmanship. Caffeine consumption has a mild increased diuretic effect but no long-term impact on hydration or work performance in the heat. A large caffeine dose of nine mg/kg given to non-heat-acclimated and non-habitual caffeine users during exercise in a hot, dry environment resulted in only minor shifts in heat balance.

Doses of caffeine over 600 mg/day can cause significant side effects including tachycardia, tremors, insomnia, nervousness, GI upset, chest pain, and arrhythmias.
Higher doses may also produce gastrointestinal distress. However, no negative effects have been reported in sleep-deprived and fatigued individuals following moderate caffeine consumption; rather, improved speed of target acquisition has been noted.\textsuperscript{16,17}

**Military Survivability:** No data found.

**Other Health Risks**

High caffeine intake is not recommended during pregnancy or periods of lactation, and it may interfere with calcium absorption. Caffeine can also increase resting heart rates and blood pressure, which might impact long-term cardiovascular health.

**Interactions with Medications or Other Bioactive Substances**

Some studies have found that combining caffeine with alcohol can have detrimental effects on mood and cognitive performance and also can diminish the subjective signs of alcohol intoxication.\textsuperscript{18-20} The FDA has issued a warning that the caffeine added to malt alcoholic beverages was an “unsafe food additive.”\textsuperscript{21} Several states have banned the sale of energy drinks. Caffeine is often found in energy drinks containing other products such as taurine (see monograph on energy drinks in this series) and in some multi-ingredient weight-loss supplements. Caution is advised since the impact of these other ingredients on the effects of caffeine has not been systematically studied.

**Withdrawal Effects**

Headache, irritability, and mood swings can accompany sudden withdrawal from regular caffeine use in about half of the population. These effects usually subside in a couple of days and may be alleviated if caffeine use is reduced gradually rather than abruptly.\textsuperscript{3}

**Concern and Benefit Estimate (see Dietary Supplement Risk Matrix)**

- **Benefit potential:** Moderate
- **Safety concern:** Low
- **Numeric score:** 4

Moderate daily consumption of up to 400 mg of caffeine has been deemed safe for healthy adults and non-pregnant/non-lactating women.\textsuperscript{8} Caffeine in moderate doses up to 300 mg can improve cognitive performance in rested, sleep-deprived, and fatigued individuals.\textsuperscript{3} As caffeine is present in a variety of foods and supplements, military personnel may want to monitor their daily intakes.

**References**