



## Background

Energy drinks are used for their purported athletic-performance-enhancing effects, improved concentration, and weight loss. Most of these beverages contain caffeine in varying amounts, as well as small amounts of taurine, guarana, ginseng, sucrose, B vitamins, glucuronolactone, inositol, and/or other components.<sup>1</sup> Herbal sources of caffeine found in some energy drinks include guarana, yerba mate, kola nut, and green tea extract. The amount of caffeine ranges from 50–505 mg per can or bottle.<sup>2</sup> By comparison, a cup (eight ounces) of coffee contains approximately 100 mg of caffeine (and could be 300 mg or more per serving for some commercial coffee shops), and colas contain about half of that amount. The FDA has set the maximum allowable caffeine limit for cola-type beverages at 0.02% caffeine (71 mg per 12 oz serving; 21CFR §182.1180). However, many energy-drink manufacturers do not adhere to this limit since energy drinks are not regulated as cola beverages. Studies have reported high use among adolescent and college students, and a 2008 Air Force study reported that 61.0% of respondents used energy drinks and 30.5% consumed energy drinks once a week.<sup>3</sup> As of 2010, energy supplements were the most commonly reported supplement type used among a large military cohort.<sup>4</sup>

Most energy shots contain B vitamins—thiamin, riboflavin, niacin, vitamin B6, folic acid, vitamin B12, pantothenic acid—and varying amounts of caffeine and taurine.<sup>5</sup> Many also contain herbs and botanicals such as royal jelly, ginseng, gotu kola (cola/kola nut), green tea, guarana, and ginger.<sup>5</sup> There is no scientific literature specifically focused on energy shots. According to the *Nutrition Business Journal*, there are currently more than 70 brands of energy shots on the market.<sup>6</sup> Some energy shots available on the market are sugar-free.

It is important to note that some energy shots are marketed as energy drinks and, likewise, some energy drinks are marketed as energy shots. Energy drinks and shots have been categorized by their retail units; for example, those units of 250 ml or more can be categorized as energy drinks and units of 120 ml or less can be categorized as energy shots.<sup>7</sup>

## Dose Range and Upper Limit

### *Food and Nutrition Board DRI:*

*RDA/AI:* Not relevant due to variations and combinations of ingredients.

*Upper Limit:* Not relevant due to variations and combinations of ingredients. But intake should be limited due to excessive caffeine in many products (see toxicology below).

*Doses Used In Randomized Clinical Trials:* Commercial products vary, so there can be no consistency in doses of these products collectively.

*Toxicology Data:* The fatal acute oral dose of caffeine is estimated to be 150-200 mg/kg body weight (typically 10-14 grams).<sup>4</sup>

## Evaluation of Potential Benefits

Evidence as to the effect of energy drinks on athletic performance is inconsistent. A double-blind randomized crossover study of twelve cyclists who drank a commercial energy drink prior to a one-hour cycling workout showed improvement in endurance performance at 70% of maximum workload.<sup>8</sup> An Air Force study of only eight centrifuge riders who consumed a commercial caffeine-carbohydrate drink showed enhanced acceleration tolerance and improved cognitive reaction time.<sup>9</sup> A double-blind crossover study of fifteen subjects showed that consumption of a commercial energy drink increased upper body muscle endurance but had no significant effect on repeated Wingate cycling performance as a measure of anaerobic power.<sup>10</sup>

Research studies have demonstrated improvements in concentration and memory after consuming energy drinks, but it has not been established whether the beneficial effects may be attributed to the caffeine alone or, possibly, combinations of ingredients.<sup>11,12</sup>

Caffeine doses from two to six mg/kg of body weight have been associated with improved physical performance; a smaller dose typically exerts a longer-lasting and greater effect for individuals who do not normally consume caffeine.<sup>13</sup>

There is no scientific evidence to support the effectiveness of energy drinks or energy shots to promote weight loss.

### Potential Detrimental Effects on...

**Military Performance:** Adverse health effects such as nervousness, insomnia, and headache have been reported and attributed to the caffeine content of energy drinks and energy shots.<sup>14</sup> These adverse effects can occur with caffeine intake (in any form) as low 250-300 mg per day.<sup>4</sup> Adverse effects also can include restlessness and irritability.<sup>7</sup>

**Military Survivability:** A study enrolling healthy subjects reported increased platelet aggregation and decreased endothelial function (blood flow) one hour after consuming a 250-ml sugar-free energy drink (one can) containing caffeine (80 mg).<sup>12</sup> Other reported adverse effects include increased heart rate, cardiac arrest, and stroke, but limited scientific evidence is available on the cardiovascular effects of energy drinks and energy shots.<sup>15-17</sup>

### Other Health Risks

Energy drinks may have diuretic and natriuretic (i.e., excessive sodium in the urine) effects<sup>18</sup> and can cause dehydration during and after exercise.<sup>7</sup> Case studies have reported seizures after heavy consumption of energy drinks.<sup>19</sup> Several studies have noted the possibility of increased incidence of risky behavior and possible drug and alcohol misuse.<sup>1</sup>

### Interactions with Medications or Other Bioactive Substances

Some studies have found that combining an energy drink with alcohol can have detrimental effects on mood and cognitive performance and also can diminish the subjective signs of alcohol intoxication.<sup>20-22</sup> The FDA issued a warning to four companies that the caffeine added to malt alcoholic beverages was an “unsafe food additive.”<sup>23</sup> Several states have banned the sale of energy drinks. They should be avoided by anyone being treated for hypertension.<sup>7</sup> Caffeine-containing products should be taken with caution in combination with anticoagulant/antiplatelet drugs.<sup>5</sup>

For details of these and other potential interactions associated with the ingredients of energy drinks and shots, visit the Natural Medicines Comprehensive Database.<sup>5</sup>

### Withdrawal Effects

Research suggests that side-effect symptoms include headache; tiredness and fatigue; decreased energy, alertness, and attentiveness; and drowsiness, decreased contentedness, depressed mood, difficulty concentrating, irritability, and lack of clear-headedness, which are consistent with caffeine withdrawal after high intakes.<sup>5</sup>

### Concern and Benefit Estimate (see CHAMP Dietary Supplement Risk Matrix)

**Benefit potential:** Moderate (energy shots) and Moderate (energy drinks)

**Risk (safety concern):** High (energy shots) and Moderate (energy drinks)

**Classification score:** **10** (energy shots) and **8** (energy drinks)

The use of these commercial products, especially combined with additional caffeine consumption, has concern for adverse effects due to potentially high caffeine ingestion.<sup>2</sup> Energy drinks and energy shots vary based on their individual components, and limited scientific evidence exists on the use of these products.

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