

# ENERGY DRINKS

## *The Good, the Bad, and the Jittery*

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## Introduction

Energy drinks have become the new “go-to” source of caffeine in our 24/7 society, particularly for young people. Available nearly everywhere, affordable and conveniently packaged, energy drinks represent an apparently simple solution to the worldwide exhaustion epidemic. Yet despite their widespread consumption and popularity - sales in the United States reached over \$10 billion in 2012 - many questions still remain about their safety and efficacy (Meier, January 2013). To start with, most energy drinks contain ingredients that consumers are not familiar with, and that haven’t been studied for safe consumption in a laboratory environment.

The goal of this whitepaper is to provide background information on what makes energy drinks different from other common sources of caffeine, examine the ingredients that give energy drinks their “boost”, and identify best consumption practices and potential safety issues.\*

## I. What Are Energy Drinks Anyway?

You might say that energy drinks are the older, stronger, jock brother of caffeinated soft drinks. They share some similarities – both are typically carbonated, contain caffeine and sugar, and are available everywhere. However, the biggest difference between energy drinks and sodas is how they are classified by the United States Food & Drug Administration (FDA).

### **Beverage or Dietary Supplement?**

Sodas like Coca-Cola, Pepsi, Mountain Dew, Sprite, etc. are considered to be beverages (conventional foods), and their ingredients and caffeine contents are tightly regulated. These drinks are sub-classified as “functional foods,” since they provide a non-nutritious benefit (alertness). The precise amount of caffeine in a functional beverage has to be listed in the ingredients, and cannot exceed 71mg of caffeine in 12 ounces – for reference, Coca-Cola has about 35mg of caffeine in a 12 ounce can (Table 1).

Other sources of caffeine, including over-the-counter drugs such as Midol and NoDoz, are also strictly regulated – they are limited to 100-200mg of caffeine per dose, and include dosing instructions (once every 3-4hrs) and the standard cautionary warning that, “too much caffeine may cause nervousness, irritability, sleeplessness, and, occasionally, rapid heart beat.” They also state that they are not to be used by children under 12 (Burdock Group, 2010).

Energy drinks on the other hand are classified as dietary supplements, and are not regulated by the FDA. Dietary supplements are anything that “supplements a regular diet” including vitamins, minerals, amino acids, metabolites, and herbal remedies. If an energy drink claims to “increase

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\* The information in this whitepaper was compiled from industry reports, news stories, and academic research papers, and is appropriate for all readers.

energy” or “improve health,” those assertions don’t have to be proven scientifically. Furthermore, while the ingredients in a dietary supplement must be listed, there’s no requirement for the specific amount of each ingredient to be disclosed. Instead, this information is only provided at the discretion of the manufacturer.

Energy drinks have avoided extra regulation by a loophole that was created by the Jolt Cola beverage company. To avoid the requirement of affixing a caffeine warning statement, Jolt argued that the nature of the packaging of its product (name, yellow can color, lightning bolt) made it “obvious” that Jolt Cola was not a regular soft-drink, but contained stimulant properties. The FDA agreed, and since then other beverages with caffeine contents that exceed the maximum amount for a functional beverage have entered the market as dietary supplement energy drinks (Burdock Group, 2010).

However, this decision may well be revisited. The FDA is now reconsidering the “dietary supplement” label of energy drinks, wondering instead whether the packaging of energy drinks in bottles (similar to soft drinks, juice, and tea) give consumers the impression that they are regulated as conventional foods. The FDA is also concerned with the addition of ingredients in many energy drinks that have not been tested for use in food/beverages, or are added in amounts far exceeding their normal-use level, potentially even beyond safe levels (US FDA, 2009).

## II. Energy Drinks: Just How Popular Are They?

The popularity of energy drinks can best be measured in terms of sales. As the fastest-growing segment of the beverage industry, energy drink sales in the United States reached more than \$10 billion in 2012. Now, energy drinks are more popular than sports beverages (like Gatorade) or even iced tea (Meier, January 2013). Red Bull alone reports annual sales of approximately 4 billion cans in more than 160 countries (Red Bull Company Figures).

Since the introduction of Red Bull to the United States in 1997, the energy drink market has grown tremendously. For example, from 1998 to 2003 energy drink sales in the US increased by 465% (Clausen et al, 2008). Even through the worst years of the recession, energy drink sales continued to climb. In both 2010 and 2011, energy drinks showed the strongest growth in the top 10 “consumable packaged goods” grocery item category, with sales increasing by 13.3% in 2010 over 2009, and by 16.7% over 2010 – besting staples such as wine/beer, cheese, and milk. In 2010, Red Bull Energy Shot and Monster Nitrous drove the most growth in the energy drinks market, with 5-Hour Energy Extra Strength driving sales higher in 2011. The “innovation” in product development within the energy drink market is touted as the key factor in their exceptional sales (Symphony IRI Group, 2011 and 2012).

### III. What is it about energy drinks that make them so popular?

There are several factors/theories that help explain the tremendous growth and popularity of energy drinks.

1. **Energy Boost** – Just as advertised, energy drinks do provide a noticeable “energy boost.” For the millions of sleep-deprived people out there looking for a pick-me-up, the promise of some extra energy to get through the day is an extremely appealing one.
2. **Speed / Convenience / Availability** – Unlike coffee, there’s no brewing involved with energy drinks – you simply pop-open the top, start drinking, and get a quick jolt of energy. Additionally, energy drinks are available in nearly every grocery and convenience store and are often sold in vending machines, and you can either buy one can at a time or buy a 6-pack or larger.
3. **Taste** – Many people, especially teenagers and young adults, prefer the taste of energy drinks over coffee, which they complain tastes too bitter.
4. **Marketing** - Energy drinks have a “cool factor” that coffee doesn’t, especially with a younger crowd. They are marketed to young people who often have hectic lives, between overwhelming schoolwork, sports activities, and busy social schedules.

Energy drink companies have worked hard to cultivate an image associated with extreme sports like snowboarding, and racecar driving. Red Bull, for example, sponsors many sporting events and individual extreme athletes, as well as soccer and ice hockey teams (including the New York Red Bulls soccer team) and NASCAR and Formula One racing teams. Interestingly, some analysts believe that the “bad boy” image of energy drinks, caused by a bevy of negative press surrounding the health consequences of drinking energy drinks (more on that to come), has actually increased their popularity (Bouckley, 2011).

5. **Alcohol / Socializing** – Combining energy drinks with alcohol is becoming increasingly popular. In fact, if you poll college students on why they drink energy drinks, 67% say it is to make up for lost sleep, 65% drink them to increase energy, and a full 54% of energy drink users drink energy drinks in combination with alcohol while socializing (Malinauskas et al., 2007).

### IV. What gives an energy drink its “boost?”

The energy “boost” in energy drinks is primarily due to caffeine and sugar, but many drinks include additional ingredients like taurine, B-vitamins, and guarana (although how these ingredients increase energy is less understood). To better illustrate the ingredients in energy drinks, we have listed below in Table 1 the amount of caffeine, sugar, and additional ingredients in seven of the top selling energy drink brands (the original version of each brand), in the 5-Hour Energy shot, in both a standard brew drip coffee and a Starbucks Espresso, and in six of the most popular sodas. Each of the most popular ingredients in energy drinks is described in more detail below.

**ENERGY DRINKS**
**Table 1 – Beverage Ingredients.**

	Size (oz)	Caffeine (mg)	Caffeine (mg/oz)	Caffeine (mg/oz) - Consumer Reports	Calories	Sugar (g)	Taurine (mg)	B12 (% recom.)	B6 (% recom.)	Niacin (B3)	Guarana	Ginseng	Carnitine
<b>FULL SIZED ENERGY DRINKS</b>													
Red Bull	8.3	80	9.6	9.9	110	27	1,000	80	250	*	*	*	*
Monster	24	240	10	11.5	300	81	3,000	300	300	*	*	*	*
Rockstar	16	160	10	na	280	62	2,000	200	200	*	*	*	*
NOS	16	260	16.3	14.0	220	56	1,000	200	200	*	*	*	*
Starbucks Doubleshot	6.5	130	20	5.9	150	17	0	0	0	*	*	*	*
AMP	16	142	8.9	8.9	220	58	14	20	20	*	*	*	*
Full Throttle	16	144	9	26.3	220	58	*	200	200	*	*	*	*
<b>ENERGY SHOT</b>													
5-Hour Energy	2	138	69	113.2	4	0	*	8,333	2,000	*	*	*	*
<b>COFFEE</b>													
Drip Coffee (standard)	6	144	24	na	0	0	0	0	0	0	0	0	0
Starbucks Espresso	1	60	60	na	0	0	0	0	0	0	0	0	0
<b>SODA</b>													
Coca-Cola	12	34	2.8	na	140	39	0	0	0	0	0	0	0
Diet Coke	12	45	3.8	na	0	0	0	0	0	0	0	0	0
Pepsi	12	38	3.2	na	150	41	0	0	0	0	0	0	0
Mountain Dew	12	54	4.5	na	170	46	0	0	0	0	0	0	0
Dr. Pepper	12	41	3.4	na	150	40	0	0	0	0	0	0	0
Sprite	12	0	0	na	140	38	0	0	0	0	0	0	0

\* Published information was not found

The values in this table were compiled from product websites where available, from other industry sources, and from the website "energyfiend.com". However, the products' actual caffeine contents may be as much as 20% more than listed (see 'Popular Ingredient #1 – Caffeine' section below).

**Popular Ingredient #1 – Caffeine:**

The most common ingredient in energy drinks is caffeine. This is not surprising given that caffeine works quickly (within 15 minutes) and increases alertness, improves reaction time and improves performance.

Consumer Reports independently measured caffeine content in the 27 bestselling energy drinks and found that 41% of the drinks did not list caffeine content at all on their labels. Of those that did, almost a third of them contained 20% more caffeine than listed on the label.

Asked why Monster Energy did not publish caffeine amounts on their labels, a representative of Monster said, "because there is no legal or commercial business requirement to do so, and also because our products are completely safe, and the actual numbers are not meaningful to most consumers" (Consumer Reports Magazine, 2012). Whether the company believes it meaningful or not, many consumers believe that they should have access to accurate information regarding anything that could affect their health.

### *Absorbance and half-life:*

Just because energy drinks have less caffeine per ounce than coffee doesn't mean that they are safe to consume, especially in large amounts. The human body absorbs 99% of caffeine, reaching peak levels within 30-75 minutes (Carrillo and Benitez, 2000; Mandel, 2002). The **half-life** of caffeine in the body (the time when half of the caffeine you have ingested has been metabolized) can vary between 2.5-10 hours (Kaplan et al., 1997; Magkos and Kavouras, 2005), with an average of about 4 hours (Kaplan et al., 1997). Factors that influence half-life include impaired liver function (which increases half life), cigarette smoking (which decreases half life) (Mandel, 2002), high levels of caffeine consumption (increases half life) (Kaplan et al., 1997; Magkos and Kavouras, 2005), weight, age, medication, health status, and even gender (men are more sensitive to caffeine) (Mayo Clinic).

What does this mean for the typical energy drink consumer? Well, unlike hot coffee, which is often sipped slowly, energy drinks tend to be “gulped,” and are finished quickly. Therefore, the peak caffeine level of an energy drink will be reached quickly. With a long half-life, energy drink users can quickly find themselves in danger of reaching very high levels of caffeine in the body, especially after consuming several drinks in a short amount of time.

### *How much caffeine is too much?*

There are no hard and fast rules on how much caffeine is safe. As mentioned above, caffeine sensitivity can vary widely depending on the individual.

However, several major medical organizations have published guidelines. For example, the Mayo Clinic recommends that people consume no more than 200-300mg of caffeine per day, which is in line with the average amount of caffeine a typical person drinks (256mg) (Mandel, 2002).

There should also be a distinction made between “immediate” and “long-term” risks of caffeine consumption. For example, people given a shot of 300mg of caffeine experienced the following symptoms (in order of prevalence) (Carrillo and Benitez, 1996):

- restlessness or muscle tremor
- palpitation
- dizziness
- headache
- diarrhea
- wakefulness
- polyuria
- increased sweating

- abdominal pain
- ear/eye problems
- vomiting or nausea
- delirium

These short term side-effects can be troubling, and can be exacerbated in caffeine-sensitive people. For most healthy people, ingesting 400mg of caffeine is not associated with some of the reported long-term effects of caffeine such as cardiovascular problems, calcium balance (caffeine can remove calcium from the body), behavioral problems, or cancer rates (Nawrot et al., 2003).

However, according to the Mayo Clinic, anyone who drinks 500-600mg of caffeine a day (or the equivalent of about 5 cups of coffee) or more is considered to be a “heavy” user. This level of caffeine intake can begin to be considered a health risk (Nawrot et al., 2003). Doses of caffeine around 1000mg (and many people consume this amount of caffeine in a day) can lead to insomnia, restlessness, and agitation (IOM, 2004). Doses over 1000mg of caffeine can even cause convulsions and vomiting (Dreisbach, 1974). The long-term effects of high amounts of caffeine ingestion can be quite dangerous.

***Other factors to consider:***

Some common medications and herbal supplements can negatively interact with caffeine. The Mayo Clinic website ([www.mayoclinic.com](http://www.mayoclinic.com)) offers a few examples to consider before drinking a caffeinated beverage such as an energy drink:

- a) Antibiotics such as Cipro (ciprofloxacin) and Noroxin (norfloxacin) can slow the breakdown of caffeine and increase its half life in the body.
- b) The bronchodilator Theophylline can mimic the effects of caffeine, and its breakdown is inhibited by caffeine, which can cause side-effects of theophylline such as nausea, heart palpitation, and vomiting to occur.
- c) The commonly used herbal supplement Echinacea can also increase the amount of caffeine in your blood.

**Popular Ingredient #2 – Sugar:**

Sugar is an essential part of our diet, since it fuels the brain, red blood cells, muscles, and is needed for function of the central nervous system (Clausen et al, 2008). It can also give us a “sugar rush,” which is essentially a rush of energy. Some sugar-free energy drinks are on the market, but the majority available have a large amount of added sugar.

The sugar in an energy drink can range from 17 grams to 81 grams (Table 1) – equivalent to ~ 1.5 to 7 tablespoons of sugar per can. An official U.S. dietary guidelines publication finds that

added sugars comprise 16% of the calories in an average American diet – with energy drinks, soda, and sports drinks responsible for 36% of this added sugar! (USDA and USHHS, 2010)

Sugar is responsible for the quick energy boost you get from an energy drink, and also the crash that follows. Caffeine takes about 45min to reach peak levels in the bloodstream (Mandel, 2002), so the added sugar gets your body moving until the caffeine takes over. Interestingly, 5-Hour Energy stands out in the crowd by not containing any sugar. However, it does pack a whopping caffeine punch of about 70mg/oz. It's also worth noting that the marketing claims by 5-Hour Energy that consumers will experience “no crash” seems to be based entirely on the fact that the energy drink contains no sugar.

### **Popular Ingredient #3 – Taurine:**

Taurine is the most abundant amino acid found inside of our cells, and is essential – either we need to create it from other amino acids, or we need to take it as a supplement (for review, see Higgins et al., 2010). It's added to some of the energy drinks we examined in a range of ~1000-3000mg (Table 1).

As might be expected, taurine is involved in many biological processes. Of interest to energy drink manufacturers is the potential ability to increase athletic performance by regulating skeletal muscle contraction (Ballard et al., 2010). Taurine is used clinically to treat conditions ranging from alcohol withdrawal, diabetes, heart palpitations, and congestive heart failure in the dose level found within a typical energy drink (Table 4, Clausen et al, 2008). Is that good or bad? Well, that's up for debate! The use of taurine in energy drinks hasn't been widely studied. However, few known side effects have been reported from using taurine (Clausen et al, 2008).

### **Popular Ingredient #4 – B Vitamins: B12, B6, B3**

The energy drinks that we examined include massive amounts of B-vitamins (particularly 5-Hour Energy) because of the ability of B-vitamins to convert sugar to energy within the cell. Of all the B-vitamins, B12 (cyanocobalamin), B6 (pyridoxine hydrochloride), and B3 (niacin) are most commonly added to energy drinks. All three participate in many functions within the cell including cellular energy production, nerve cell function and production of nerve cell chemical messengers (to relay signals to the brain and body), red blood cell function, and DNA/RNA production (Higgins et al., 2010).

### **Popular Ingredient #5 – Guarana:**

Guarana is a vine that has been cultivated in the Amazon for its fruits. The active ingredient in guarana that gives it energetic properties is caffeine – in fact, guarana seeds contain a higher concentration of caffeine (from 2-8%) than any other plant, and also contains stimulants theophylline and theobromine (For review, see Higgins et al., 2010).



The amount of guarana added to energy drinks is probably not enough to cause either an adverse or a positive benefit (Clausen et al., 2008). However, it's important to note that the additional amount of caffeine contributed by guarana is not included in the total caffeine amounts (when reported), so be aware when reading labels that one gram of guarana is equivalent to about 40mg of caffeine (Finnegan, 2003).

**Popular Ingredient #6 – Ginseng:**

Ginseng is one of the most widely used herbal medicines in the world. It is said to stimulate the immune system, increase stamina, and increase resistance to stress, anxiety, and fatigue (For review, see Higgins et al., 2010 and Clausen et al., 2008). It is likely added to energy drinks to enhance physical performance. However, this effect has not been clinically proven (Bahrke et al., 2009). Regardless, the amount of ginseng added to energy drinks is not enough to provide any real benefit, or produce side-effects (of which there are many for ginseng), including insomnia (Clausen et al., 2008).

**Popular Ingredient #7– L-Carnitine:**

L-carnitine is an amino acid added to energy drinks for its ability to increase metabolism and aid in recovery after exercise (Higgins et al., 2010). Unlike many of the other additives to energy drinks, supplementation of L-carnitine has actually been shown to be beneficial to athletes in training, competition, and recovery (For review, see Karlic and Lohninger, 2004). However, as with many of the energy drink additives, the amount of L-carnitine is probably not enough to see an obvious benefit. A 154lb person would need 2 grams of L-carnitine supplementation a day to see a benefit on recovery from exercise (For review, see Karlic and Lohninger, 2004), but a 16 oz bottle of Rockstar contains only 50mg of L-carnitine.

## V. Dangers of energy drinks

Energy drinks have come under fire lately because of their potential dangers, particularly for younger consumers. In fact, some countries have gone so far as to ban energy drinks completely (such as Denmark, Turkey, Uruguay, Germany [Red Bull only]) and other countries have imposed restrictions on their use, including banning drinks over a certain caffeine content (Australia), requiring warning labels (Canada, European Food Safety Authority, Sweden), or limiting sales to pharmacies (Norway) (Seifert et al., 2011).

As covered already, some of the potential dangers arise from properties of the drinks themselves (i.e. drug interactions, potential for caffeine overdose). However, the majority of the dangers of energy drinks appear to be caused by the way they are used. It's important to educate the public about these dangers, since once they are identified, behavior can be changed, and we can reduce the risks.

**Potential Danger: “Gateway” to other risky behaviors?**

Studies by Miller (2008 a,b) have investigated the idea that energy drinks contribute to an overall unhealthy lifestyle. While this might be a classic case of “the chicken or the egg,” there is evidence that risky behaviors and energy drink consumption go together.

Many people are, of course, capable of drinking energy drinks in moderation, and not becoming a risk to themselves or others. However, taken to the extreme, Miller (2008b) describes a “toxic jock” syndrome whereby people of both genders who strongly identify themselves as jocks consume more energy drinks than non-jocks, drink alcohol heavily, take sexual risks, are delinquent, and are more violent (Miller 2008b).

In an earlier study, Miller (2008a) found a relationship between energy drink consumption and negative behaviors in college-aged students. Students who drank more energy drinks were also more likely to smoke marijuana, take sexual risks, fight, not wear a seatbelt, and have problems with smoking, drinking, and prescription drug abuse. Interestingly, white students were more likely to engage in these behaviors (in association with energy drinks) than black students (Miller, 2008a).

Many studies have examined the relationship between mixing alcohol and energy drinks together, which has become an increasingly popular version of a mixed drink (e.g. Red Bull and Vodka; Four Loko, a Jagermeister shot and a Red Bull, etc.). People enjoy the combination of a depressant (alcohol) and a stimulant (energy drink/caffeine) because they believe that it reduces the depressant side-effects of alcohol, and allows them to drink more and stay out longer.

In reality however, while their perception of drunkenness (loss of motor control, dry mouth, headache, etc.) is reduced, people drinking alcohol + energy drinks, versus alcohol alone are just as impaired in motor coordination and reaction time (Ferreira et al., 2006). Even more troubling is that people who have drunk alcohol + energy drinks are 3 times more likely to be intoxicated above the legal limit, and are 4 times more likely to plan on driving home (Thombs et al., 2010).

**Potential Danger: Heart problems?**

The jury appears to still be out regarding whether energy drinks specifically (versus ingesting caffeine alone) can cause cardiac arrhythmias and other heart problems. Several case reports have been published linking energy drinks to heart problems, but few controlled studies have been conducted.

In one study, Steinke et al. (2009) examined blood pressure and heart rate in healthy subjects who drank two cans of an energy drink per day over a 7-day period. They found that both systolic and diastolic blood pressure increased each day, and increased slightly over the length of the study. Similarly, heart rates increased each day, and increased slightly over the length of the study.

These results should be taken with a grain of salt – the authors didn’t compare energy drink consumption to ingesting caffeine alone, nor did they have a control group that didn’t drink any

caffeinated beverage – however the authors caution that anyone with a pre-existing heart condition should avoid energy drinks, since they did observe an increase in blood pressure and heart rate (Steinke et al., 2009).

Unfortunately in the real world, few consumers distinguish between caffeine in coffee from caffeine in energy drinks. Unfortunately, populations who are at the highest risk for caffeine toxicity (young people, those with heart problems) are often unable to make informed decisions on whether to consume energy drinks, because in many cases caffeine content is not listed on the label.

### *Energy Drinks in the News:*

In 2012, Monster Energy received a lot of attention, when the FDA published a report listing Monster Energy drinks as a possible contributing factor to the deaths of five people over three years. One of those people was a 14-year-old Maryland girl, whose death certificate stated that she died of “cardiac arrhythmicity due to caffeine toxicity” that exacerbated a pre-existing heart condition. She drank two 24-ounce cans of Monster in 24hrs – the equivalent of ~480-740 mg of caffeine (Table 1) before she died. The family of the girl is now suing Monster Energy for failing to provide adequate warnings about the risks of consuming their drinks (Meier, October 2012).

5-Hour Energy has been listed as a factor in 13 fatalities since 2009 by the FDA. Interestingly, companies that market their products as “dietary supplements” such as Living Essentials (the parent company of 5-Hour Energy) are now required to submit “adverse event reports” to the FDA when they think their product may have contributed to the death of a consumer. Red Bull, NOS, and AMP are marketed as beverages, and are NOT required to submit adverse event reports (Meier, November 15, 2012, and Meier, November 16, 2012).

The flurry of news reports covering the fatalities linked to Monster and 5-Hour Energy prompted the FDA to release a special report listing ALL adverse events linked to 5-Hour Energy, Monster, and Rockstar between January 2004 and October 2012 (US FDA, 2012). The FDA is not required to release adverse event reports for products listed as dietary supplements, but did so “in an effort to be transparent” (Meier, November 16, 2012). (Note: the report emphasizes that the FDA did not assign a cause to the death, and that important medical information may be missing that would be meaningful towards understanding the cause of death).

In the period from 2004 to 2012, 5-Hour Energy amassed 92 incident reports with 13 fatalities, Monster had 40 reports with 5 fatalities, and Rockstar had 13 reports with no fatalities. Over 50 of the incidents for all three energy drinks list heart problems (chest pain, arrhythmia, cardiac arrest, etc) in the events (US FDA, 2012).

### **Potential Danger: Sleep disturbances**

This may be another “chicken or the egg” scenario – does drinking energy drinks cause sleeplessness, or does sleeplessness cause people to drink energy drinks to stay awake?

71% of college students (generally a chronically sleep deprived population) report that they either didn't get enough sleep or didn't feel fully rested for 5 of the last 7 days (ACHA, 2007). 29% of energy drink users reported a weekly "jolt and crash" event, presumably to get them through a particularly tough period of sleep deprivation (Malinauskas et al., 2007).

At least one study suggests that energy drink use causes sleeplessness – students who consumed energy drinks the night before were found to have increased daytime sleepiness the following day (Calamaro et al., 2009). This can lead to a vicious cycle of energy drink dependency to get through the day.

A recent study involving deployed U.S. military service members in Afghanistan also showed that sleepiness and increased energy drink consumption are linked (although it did not assign a cause-and-effect relationship) (MMWR, 2012). Interestingly, the prevalence of energy drink use was much higher in the U.S. military population than in the U.S. civilian population - 45% of service members of all ages and ranks drank at least one energy drink daily, versus 6% of young civilian males (MMWR, 2011). Those service members who drank more than 3 energy drinks a day (13.9%) were more likely to sleep less than 4 hrs a night, experience daytime sleepiness (fall asleep during briefings or guard duty), and experience sleep disturbances due to stress or sickness (MMWR, 2012).

### **Potential Danger: Athletic performance and dehydration**

An analysis of over 20,000 urine samples showed that 75% of elite athletes drink caffeine (in some form) before competing (Del Coso et al., 2011). It is likely that most of the caffeine in the urine samples came from energy drink consumption – 73% of American college athletes, 75% of Canadian college athletes, and 42% of British elite athletes drink energy drinks to get their caffeine (Del Coso et al., 2012). Energy drinks are popular with athletes, and not just due to marketing campaigns – at least some measures of athletic performance are improved by caffeine consumption (Del Coso et al., 2012).

The danger arises from the diuretic/dehydrating effects of caffeine – 1mg of caffeine can cause a water loss of 1.17ml (Stookey, 1999). Imagine drinking seven and a half 12oz cans of Coca-Cola during a football game (as a player or observer) – that's the caffeine equivalent of a single 16oz NOS energy drink. If an athlete drinks NOS to stay energized while playing football, they could lose over 300ml of water just from the caffeine – not to mention what they lose from sweating from the exertion and/or a hot day. Since many athletes don't limit themselves to a single energy drink, drinking 3-4 NOS drinks during a day (750-1000mg) would put them at serious risk for caffeine overdose.

### **Potential Danger: Overdose / Emergency Room visits**

Drinking energy drinks can cause people to go to the emergency room based on the side-effects of the energy drinks alone. As of 2010, the American Association of Poison Control Centers began

tracking “energy drinks” as a separate hazard class. The 28th Annual Report found that of the 308 single-exposure reported cases (people consumed energy drinks only), 82 of the cases required medical treatment to address, as opposed to leading to an outcome not requiring any treatment (Bronstein et al, 2011). The Australian NSW Poisons Information Centre (NSWPIC) reported similar findings (Gunja and Brown, 2012).

Of note, the US and Australian Poison Control numbers are much lower than those reported by the Drug Abuse Warning Network. Their report showed that emergency room visits due to energy drink consumption increased significantly between 2005 and 2009, with a peak in 2008 of more than 16,000 visits (DAWN Report, 2011). Importantly, the majority of the visits (56%) were by people who only drank energy drinks – they did not mix them with drugs, alcohol or any other substance.

### **It can't be all bad...**

While the majority of studies published on energy drinks focus on the negative effects, not everyone agrees with their assessments. For example, energy drinks do appear to enhance physical performance, as we mentioned above. Drinking energy drinks also improves driving performance in sleepy subjects – including reducing driving mistakes, swerving, and self-reported sleepiness and alertness (Reyner and Horne, 2002).

Clausen et al. (2008) mention in a review on energy drinks that despite being consumed by people covering a wide range of age and health status, few published reports of adverse effects exist. They suggest that this speaks to the safety of these products, and mention that the attention that has been focused on the additives in energy drinks may be misguided, since most of the doses contained in an energy drink are not within a therapeutic range (Clausen et al, 2008). A particularly outspoken review by Verster et al. (2012) disputes the validity of the current research on perception of drunkenness in those who mix energy drinks and alcohol; cardiovascular effects; or the association between energy drinks and drug/alcohol abuse. Instead they argue the other side of the chicken/egg debate – that drinking energy drinks is just one facet of a personality drawn to other risky behaviors.

### **Conclusion:**

Over the past two decades, the energy drink industry has experienced tremendous growth. And it is easy to see why: energy drinks offer a quick, easy and affordable energy boost to our 24/7, sleep-deprived society. As a result, they have carved out their own niche in the world of caffeinated beverages, right next to coffee and soda, for people trying to operate on less sleep and who need that jolt of caffeine to keep them safe and alert.

However, as we've explored in this whitepaper, there are several potential dangers associated with energy drink use. The high levels of caffeine and sugar can lead to jitteriness, gastrointestinal

problems and potentially even more serious cardiovascular side effects. Furthermore, the lack of regulatory oversight on the energy drink market means that customers are neither informed on exactly what they are consuming, nor adequately warned about potential risks.

In light of the public interest in this topic, don't be surprised if the packaging on your favorite energy drink changes in the near future. Facing increasing pressure, the FDA and other regulatory bodies will likely seek to tighten the dietary supplement loophole that allows these beverages to not disclose the specific amount of each ingredient they contain.

### **So is it safe to have an energy drink?**

Bottom line: Yes, but use energy drinks in moderation. If you can't get going in the morning or are dragging during the middle of your night shift, an energy drink now and then is fine. But remember, whether you get your caffeine from energy drinks, soda or coffee, read the labels (or do some research) and be aware of the levels of caffeine and other ingredients you're putting in your body. As long as you use caution and keep track of what you're consuming, feel free to enjoy the benefits of energy drinks – without ignoring the risks.

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