

## Potential Health Problems with the Use of Energy Drinks

L Hurlock, MG Lee

The use of energy drinks has significantly increased in the Caribbean and worldwide as aggressive marketing campaigns target adolescents and young adults. More than 30% of adolescents reported using energy drinks and surveys have revealed that energy drinks are consumed by 30% to 50% of adolescents and young adults (1, 2). In a study in college students, 51% of participants reported consuming greater than one energy drink each month (3).

More than 500 new energy drinks were launched worldwide in 2006 and currently, there are more than 300 varieties of energy drinks representing more than 200 brands, and beverage companies are reaping huge financial rewards. These energy drinks are designed to give the consumer a “jolt” of energy provided by the combination of stimulants and “energy boosters” that they contain (3, 4). In addition, the intake of energy drinks are utilized to enhance cognitive performance and to improve mood and physical vigor. Most energy drinks contain caffeine and a combination of other components, including plant-based stimulants (guarana, yerba mate), simple sugars (glucose, fructose), glucuronolactone (a naturally occurring glucose metabolite), amino acids (taurine, carnitine, creatine), herbs (ginkgo biloba, ginseng), and vitamins (niacin, pyridoxine, cyanocobalamin). The effects of these ingredients are incompletely understood (5).

Reports published regarding the effects of these drinks have not identified negative health effects associated with taurine, ginseng and guarana used in the amounts found in most energy drinks. Guarana contains caffeine (4–8%), theobromine, theophylline and a high concentration of tannins (1). The amount of guarana, taurine and ginseng found in many popular energy drinks is usually below the amount expected to deliver either therapeutic benefits or adverse events.

However, caffeine and sugar are present in amounts known to cause a variety of adverse health effects. The caffeine content of these products is presently unregulated (1). Commonly reported adverse effects seen with caffeine in the quantities present (80 to 141 mg caffeine per 8 ounces) in most energy drinks are insomnia, nervousness, headache and tachycardia. In addition, caffeine consumption reduces insulin sen-

sitivity and increases mean arterial blood pressure (6, 7). High caffeine consumption is associated with chronic daily headaches, particularly among young women (8). After accidental or intentional overdose, one of the initial symptoms is often profound emesis and caffeine-induced vomiting may be refractory to treatment with traditional antiemetics. Patients may also experience gastro-esophageal reflux symptoms and abdominal pain. Multiple vital sign abnormalities have been described in the setting of caffeine toxicity, including hyperthermia, tachypnoea, tachycardia and blood pressure lability (1). In a three-year analysis at a single hospital, 34 patients were hospitalized for medical complications from caffeine taken in association with concomitant recreational abuse of other pharmaceuticals (9).

In a survey of 496 college students, 51% reported consuming at least one energy drink during the last month (3). Of these energy drink users, 29% reported “weekly jolt and crash episodes”, 22% reported headaches, and 19% reported heart palpitations from consuming energy drinks. There was a significant dose effect only for jolt and crash episodes (3). In a study in students in New York, the frequency of energy drink consumption was positively associated with marijuana use, sexual risk-taking, fighting, seatbelt omission and taking risks on a dare. In addition, energy drinks consumption was associated with smoking, drinking, alcohol problems, and illicit prescription drug use (10).

The main concern with these energy drinks is the effect of adverse cardiac events in individuals with either known or unsuspected heart disease. Patients with pre-existing cardiac pathology or a history of seizures may be at greater risk (1). The role of caffeine in triggering arrhythmia is well established. In the setting of caffeine toxicity, sinus tachycardia is almost always present, and supraventricular tachycardia has been commonly described. Several tachyarrhythmias, including atrial and ventricular ectopy, atrial fibrillation, ventricular tachycardia, and ventricular fibrillation, have been described in caffeine-poisoned patients (1). There have been a number of case reports of hospitalizations or deaths due to caffeine toxicity, although the mechanism usually seems to be tachyarrhythmia and involves high doses (11). Underlying structural disease may increase the risk of dysrhythmia. Those with diagnosed heart disorders such as ischaemic heart disease and heart failure would be at increased risk. This could lead to decompensated cardiac failure and, in extreme cases, death. Undiagnosed cardiac conditions such as supraventric-

From: Department of Medicine, The University of the West Indies, Kingston 7, Jamaica.

Correspondence: Professor MG Lee, Department of Medicine, The University of the West Indies, Kingston 7, Jamaica. E-mail: michael.lee@uwimona.edu.jm

ular tachycardias and ion channel disorders may be unmasked with the use of these stimulants and this could subsequently lead to an increased risk of malignant arrhythmias and sudden cardiac death. This is especially true in the young athlete who uses these drinks to enhance workouts and performance. Dehydration from these workouts would be added stress on the heart.

It is popularly suggested that the effects of energy drinks decrease the depressant effects of alcohol, such as fatigue, sleepiness and impairment of motor coordination, and increases physical performance (12). The associated ingestion of alcohol and energy drinks has recently been observed to be becoming more widespread (13). Almost one-quarter of current college student drinkers reported mixing alcohol with energy drinks. These students were at increased risk for alcohol-related consequences (5). In another study, in college students using three or more energy drinks, it was common practice to drink these with alcohol while partying (3). Considering the pharmacological properties of caffeine and taurine, a reduction of some symptoms of alcoholic intoxication could be expected. In fact, the combination of energy drinks and alcoholic drinks can reduce adverse symptoms of alcohol intoxication including the depressant effects. As a consequence, users of the combination might not experience the signs of alcohol intoxication, thus increasing the probability of accidents and/or increasing the possibility of the development of alcohol dependence (13). When compared with the ingestion of alcohol alone, the ingestion of alcohol plus energy drinks significantly reduced subjects' perception of headache, weakness, dry mouth and impairment of motor coordination. However, the ingestion of the energy drink did not significantly reduce the deficits caused by alcohol on objective motor coordination and visual reaction time (14). The mixing of these drinks with alcohol is increasing in night clubs and these young individuals may present with symptoms and, in severe cases, may actually die. Reports of caffeine-associated deaths have been documented as well as separate cases of seizures associated with the consumption of energy drinks (11, 15–17).

Although the full impact of the rise in popularity of energy drinks has yet to be realized, concern about their safety and potential for adverse health consequences should be considered (18). Sales restrictions of caffeine containing products may decrease mortality from overdose (17). The following recommendations should be considered by all health authorities:

- \* There should be a safety warning on the use of energy drinks.
- \* Recommended use should be limited to no more than 1–2 drinks per day in adults.
- \* Children under 16 years of age should not be allowed to purchase and consume these drinks (the effects on the developing brain are unknown).

- \* Adults should be warned on the risk of mixing these drinks with alcohol.
- \* Patients with known cardiac conditions should be warned not to consume these energy drinks.

## REFERENCES

1. Babu KM, Church RJ, Lewander W. Energy drinks: The new eye-opener for adolescents. *Clin Ped Emerg Med* 2008; **9**: 35–42.
2. Seifert SM, Schaechter JL, Hershorn ER, Lipshultz SE. Health effects of energy drinks on children, adolescents, and young adults. *Pediatrics* 2011; **127**: 511–28.
3. Malinauskas BM, Aeby VG, Overton RF, Carpenter-Aeby T, Barber-Heidal K. A survey of energy drinks consumption patterns among college students. *Nutrition Journal* 2007; **6**: 35. Doi: 10.1186/1475-2891-6-35
4. Heckman MA, Sherry K, Gonzalez de Mejia E. Energy drinks: An assessment of their market size, consumer demographics, ingredient profile, functionality, and regulations in the United States. *Compr Rev Food Sci Food Saf* 2010; **9**: 303–17.
5. O'Brien MC, McCoy TP, Rhodes SD, Wagoner A, Wolfson M. Caffeinated cocktails: Energy drink consumption, high-risk drinking, and alcohol-related consequences among college students. *Academic Emerg Med* 2008; **15**: 453–60.
6. Lee SJ, Hudson R, Kilpatrick K, Graham TE, Ross R. Caffeine ingestion is associated with reductions in glucose uptake independent of obesity and Type 2 diabetes before and after exercise training. *Diabetes Care* 2005; **28**: 566–72.
7. Bichler A, Swenson A, Harris MA. A combination of caffeine and taurine has no effect on short term memory but induces changes in heart rate and mean arterial blood pressure. *Amino Acids* 2006; **31**: 471–6.
8. Scher AI, Stewart WF, Lipton RB. Caffeine as a risk factor for chronic daily headache: A population-based study. *Neurology* 2004; **63**: 2022–7.
9. McCarthy DM, Mycyck MB, DesLauriers CA. Hospitalization for caffeine abuse is associated with concomitant abuse of other pharmaceutical products. *Am J Emerg Med* 2008; **26**: 799–802.
10. Miller KE. Energy drinks, race, and problem behaviors among college students. *J Adolesc Health* 2008; **43**: 490–7.
11. Berger AJ, Alford K. Cardiac arrest in a young man following excess consumption of caffeinated “energy drinks”. *Med J Austr* 2009; **190**: 41–3.
12. Ferreira SE, de Mello MT, Rossi MV, Souza-Formigoni ML. Does an energy drink modify the effects of alcohol in a maximal effort test? *Alcohol Clin Exp Res* 2004; **28**: 1408–12.
13. Oteri A, Salvo F, Caputi AP, Calapai G. Intake of energy drinks in association with alcoholic beverages in a cohort of students of the School of Medicine of the University of Messina. *Alcohol Clin Exp Res* 2007; **31**: 1677–80.
14. Ferreira SE, de Mello MT, Pompeia S, de Souza-Formigoni ML. Effects of energy drink ingestion on alcohol intoxication. *Alcohol Clin Exp Res* 2006; **30**: 598–605.
15. Holmgren P, Nordén-Pettersson L, Ahlner J. Caffeine fatalities – four case reports. *Forensic Sci Int* 2004; **139**: 71–3.
16. Kerrigan S, Lindsey T. Fatal caffeine overdose: two case reports. *Forensic Sci Int* 2005; **153**: 67–9.
17. Thelander G, Jönsson AK, Personne M, Forsberg GS, Lundqvist KM, Ahlner J. Caffeine fatalities – do sales restrictions prevent intentional intoxications? *Clin Toxicol* 2010; **48**: 354–8.
18. Reissig CJ, Strain EC, Griffiths RR. Caffeinated energy drinks – A growing problem. *Drug Alcohol Depend* 2009; **99**: 1–10.