Energy Drinks, Caffeine, and Athletes

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Sales of caffeinated energy drinks and shots saw double-digit growth in the past few years. Whereas the number of athletes who use energy drinks is unknown, the number of college athletes who report using energy drinks is about 45%. Caffeine in small doses (2–3 mg/kg per body weight) is an effective ergogenic aid, acting on the central nervous system to delay fatigue and increase alertness. Energy drinks claim to have other functional ingredients that enhance athletic performance, but research on energy drinks in athletes is scant and results equivocal. If there is a positive effect, it is the caffeine in energy drinks that provides a performance boost. This article reviews use and safety concerns of energy drinks, the role of caffeine on sports performance, and guidelines for use in athletes. Nutr Today. 2014;49(2):49–54

A 20-year-old college football player was dizzy and lightheaded during preseason workouts. The athletic trainer noted he had a rapid pulse, and the team physician described tachycardia, with the initial impression that the athlete was dehydrated. He sat out in practice, drank plenty of fluids, and was referred to the sports dietitian for hydration evaluation. During the assessment, his diet history revealed that he used a "preworkout intensifier" formula (he doubled the recommended dose), drank 3 to 4 energy drinks throughout the day, and downed an energy shot instead of eating breakfast. Estimated caffeine intake was 1070 mg in a 24-hour period. This 100-kg athlete (220 lb) was consuming 10 mg of caffeine per kg of body weight, far in excess of the 2 to 3 mg/kg per body weight that is effective as an ergogenic aid.[1] At moderate to high doses of 5 to 9 mg/kg, caffeine can increase epinephrine concentrations 50% to 100% leading to rapid pulse and heart rate.[2]

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Caffeinated energy drinks, and their little cousins, energy shots, are a big business. The Chicago-based market research firm, SymphonyIRI Group, reported that energy drink sales netted more than $6.9 billion from April 2012 to April 2013, a 19.4% increase from the previous 12 months.[3] The energy shot category reported $1.1 billion in sales with an 8.5% increase over the same period. These figures do not include sales at one of the biggest retailers, Wal-Mart.[3]

Athletes have used caffeine to enhance sports performance long before scientists understood the physiological effects of caffeine on muscle and brain that could contribute to improved performance. While sports researchers have uncovered the mechanism behind the ergogenic effect of caffeine, there is growing concern that products such as energy drinks and shots can lead to excess caffeine consumption. This article reviews the use of energy drinks and shots by athletes and the effects of caffeine on performance and offers guidelines for caffeine use by athletes.

ENERGY DRINK USE BY ATHLETES AND REASONS FOR USE

There is not much research on the prevalence of energy drink consumption by athletes, but there are data on college athletes. The National Collegiate Athletic Association (NCAA) released a report in 2012 on substance use among college athletes, and the survey included 1 question on energy drink use.[4] The survey was distributed to all active member NCAA institutions, and 20 474 student-athletes completed the survey across 23 championship team sports. In response to the question, "I have taken energy drinks while in college," 44.5% of athletes reported that they had consumed energy drinks in college. Table 1 shows the percentage of male and female athletes in various sports who reported using energy drinks.

In an online survey, Hoyte and colleagues[5] reported on energy drink, dietary supplements, and prescription drugs in college students. Data were taken from the larger College Survey Program, and 1960 college students responded to the survey. Twenty-three percent of those surveyed participated in sports, and of those (n = 397), 80.1% said they used energy drinks to enhance sports performance.

The reasons for using energy drinks by college students and athletes include obtaining an extra boost in energy, promoting wakefulness and aiding sleep deprivation, maintaining alertness, and providing cognitive and mood enhancement.[6] There is also evidence that energy drinks are used by athletes to enhance the effects of alcohol, using the central

TABLE 1 Energy Drink use by College Student-Athletes

Sport	Males, %	Females, %
Baseball	52.9	—
Basketball	36.6	—
Football	44.3	—
Field hockey	—	40.5
Golf	52.6	49.4
Ice hockey	53.7	—
Lacrosse	55.2	46.2
Soccer	48.0	43.3
Softball	—	46.1
Swimming	51.7	41.2
Tennis	52.5	38.5
Track	38.2	30.5
Volleyball	—	48.9
Wrestling	61.3	—

Source: NCAA.[4]

nervous stimulation of energy drinks to counteract the depressant effects of alcohol.[7]

GROWTH OF ENERGY DRINKS AND CAFFEINATED PRODUCTS

Energy drink consumption became popularized when Red Bull (Red Bull, Santa Monica, California) was introduced in Austria in 1987.[8] In 2012, 5.2 billion cans were consumed, and it is sold in 165 countries.[8] The success of Red Bull encouraged the entry of competitors into the marketplace, and although there are dozens of energy drinks on the market, Red Bull still leads market share with 42%.[9] This is followed by Monster Energy Drink (Monster Energy Drink Co, Corona, California) (37%), Rockstar Energy Drink (Rockstar Energy, Buena Park, California) (11%), Amp (PepsiCo, Purchase, New York) (4%), NOS Energy Drink (The Coca Cola Co) (4%), and Full Throttle (The Coca Cola Co, Atlanta, Georgia) (2%). The main ingredients in most energy drinks are sugar and caffeine, with some containing other functional ingredients such as taurine, carnitine, glucuronolactone, ginseng, B vitamins, and other stimulants such as guarana, yerba mate, and kola nut. Table 2 shows the top selling energy drinks and their nutrient profiles. Because most energy drinks are sold as dietary supplements, and caffeine is not a nutrient (therefore not required to be listed on the supplement facts or nutrition facts label), getting accurate information about the composition of energy drinks is challenging.

Energy drinks are widely marketed to teens, college students, and athletes through sponsorships with extreme sports, such as BMX racing, wakeboarding, mountain biking, surfing, snowboarding, and downhill skiing, as well as partnerships with NASCAR, monster truck rallies, and music concerts. Promotion of these events has created demand for energy drink–labeled clothing lines, and almost every energy drink Web site has a shop where logoed apparel can be purchased. Woolsey[7] believes that energy drinks have tapped into the youth market by pairing the drinks with risk-taking behaviors associated with athletes and identification with a "jock identity." Energy drink samples are frequently given out at college sporting events on campuses around the country to encourage consumption. Today, the energy drink market is becoming more segmented with products targeting special audiences. For example, VPX Redline Princess is marketed to women as having "the same level of energy as original Redline, but with the added bonus of appetite suppression and mood enhancement, which is nothing short of euphoric."[10] GungHo,[11] with "ninja-like focus," markets to video gamers, students, and athletes alike with claims of a "patent-pending formula that offers smoother, more balanced energy without rush-induced jitters that reduce mental and physical goal-oriented effort. Yet it contains a full complement of energy-enhancing caffeine." GungHo and several other newcomers are marketing their drinks as "natural" sources of caffeine, containing guarana and/or kola nut. Guarana seeds contain more caffeine (1 g of guarana contains about 40 mg of caffeine) than other plants, but that does not make these sources of caffeine any healthier than plain old caffeine.[12] And, indeed it is the caffeine and/or caffeine-containing botanicals that give energy drinks their central nervous–stimulating properties.

Want the stimulation of caffeinated energy drinks without the volume? Enter energy shots. The market is dominated by 5-hour ENERGY, a 1.93-fl oz shot containing B vitamins (30 mg niacin or 150% of daily value [DV], 40 mg vitamin B_6 or 2000% of DV, 400 µg folic acid or 100% of DV, and 500 µg vitamin B_{12} or 8333% of DV) and 1870-mg energy blend of taurine, glucoronic acid, malic acid, *N*-Acetyl l-tyrosine, l-phenylalanine, caffeine, and citicoline. The Web site says that the caffeine content is similar to a premium cup of coffee, but the actual amount of caffeine is not listed. Five-hour ENERGY reported $1114 million in sales in 2013, with the next best-selling energy shot (Stacker 6-hour power) coming in with $47 million in sales.[9] Energy shots appear to be expanding their market to athletes recruiting an older athlete, Jim Furyk, a 43-year-old professional golfer as a spokesperson for the brand. Not to be outdone by energy shots, newer caffeine delivery systems

TABLE 2 Nutrient Composition of Popular Energy Drinks per 8 oz[a]

Product	Calories	Caffeine, mg	Sugar, g	Vitamin B_6, %DV	Vitamin B_{12}, %DV	Taurine, mg	Other Herbal Ingredients
Amp (PepsiCo, Purchase, New York)	110	71	29	100	100	ND	Guarana, ginseng
Full Throttle (The Coca Cola Co, Atlanta, Georgia)	107	72	29	100	100	ND	Guarana, ginseng, carnitine
Monster Energy (Monster Energy Drink Co, Corona, California)	110	86	27	100	100	1000	Guarana. ginseng
NOS Energy Drink (The Coca Cola Co)	105	80	27	100	100	ND	None
Red Bull (Red Bull, Santa Monica, California)	110	80	27	250	250	1000	None
Rockstar Energy (Rockstar Energy, Buena Park, California)	144	82	31	ND	ND	1000	Guarana, ginseng, carnitine, ginkgo biloba, milk thistle

Abbreviation: ND, not disclosed.

[a]Nutrient values and caffeine content derived from company Web sites, www.caffeineinformer.com, and USDA National Nutrient Database for Standard Reference, Release 26.

have been introduced. Inhalable caffeine (AeroShot by AeroLife) has 100 mg caffeine per "puff." The latest entry is Sprayable Energy claiming that 4 sprays contain about 100 mg caffeine that can be absorbed through the skin.

Caffeine seems to be everywhere and easily accessible to athletes as evidenced by the range of products containing caffeine. Some of these products, shown below, are not usually thought of as caffeine-containing foods or beverages.

- ARMA Energy Snx (ARMA Energy, Inc, Carlsbad, California)
  - Snacks include potato chips, trail mix, granola, fruit mix, and tortilla mix containing about 70 mg caffeine per 2-oz serving
- Cracker Jack'D (PepsiCo, Purchase, New York)
  - Variety of flavored snacks containing about 70 mg caffeine per 2-oz serving
- MiO Energy (Kraft Foods Group, Northfield, Illinois)
  - A "liquid water enhancer" in a variety of flavors containing about 60 mg caffeine per "squeeze" or one-half teaspoon
- Crackheads[2] (Osmanium Candy Co, Milwaukee, Wisconsin)
  - Candy in a variety of flavors containing 600 mg caffeine per box (40 g)
- Wired Waffles (Wired Waffles, LLC, Iowa)
  - Variety of flavors containing 200 mg caffeine per waffle (there is also a caffeinated maple-flavored syrup, but the amount of caffeine is not listed on the Web site)
- Bang!! Caffeinated Ice Cream (Bing! Bang! Boom! Ice Cream Co, Madison, Wisconsin)
  - Variety of flavors containing 125 mg caffeine per 4-oz serving

Concern about energy drink consumption and caffeine intake was triggered in the fall of 2012 when a 14-year-old girl died after consuming Monster Energy Drink. Her parents filed a wrongful death suit against the energy drink maker. As of November 2012, the FDA reported that there have been 40 illnesses and 5 deaths linked to Monster Energy, 13 illnesses and 2 lasting disabilities linked to Rockstar Energy, and 92 illnesses and 13 deaths linked to 5-hour ENERGY.[13,14] Emergency room visits involving energy drinks doubled from 10 068 visits in 2007 to 20 783 visits in 2011, and more patients are aged 18 to 39 years than in any other age group.[15]

All these adverse events linked to energy drinks led Congress to hold hearings on July 31, 2013, expressing concern over safety and marketing of energy drinks to young consumers. As of this time, there has been no policy change regarding energy drink labeling, marketing, or sales, but Michael R. Taylor, FDA Deputy Commissioner for Foods and Veterinary Medicine, expressed concern that caffeinated products are breaking outside the traditional boundaries of caffeine in the food supply and that they pose challenging public health and regulatory questions. He

noted that new products are marketed explicitly for stimulant properties, in new forms, under new conditions, which are attractive and accessible to children and adolescents. The FDA has the authority to place limits on the amount of caffeine in foods and beverages, but "the science should come first, and there are no simple answers to questions raised about caffeine.[16] (Currently, the FDA limits caffeine content only in cola-type beverages to 00.2% or 71 mg/12 oz; they considered banning caffeine from soft drinks but accepted the soft drinks maker argument that caffeine was a flavor enhancer.)[17]

ENERGY DRINKS AND SPORTS PERFORMANCE

Does consumption of energy drinks lead to improved sports performance? There is no doubt that caffeine is an effective ergogenic aid. Athletes have been using caffeine to enhance sports performance since the advent of modern sports. Burke et al[2] report that in the early 1900s caffeine was added to "cocktails" designed for athletes that also contained drugs such as cocaine and heroin. Later in the 20th century, researchers sought to understand the mechanism and the most effective dose of caffeine to improve athletic performance. Caffeine has been shown to delay fatigue in training, enhance skeletal muscle contractile force, and increase the pain threshold.[18] Early research suggested that it was the fat-burning effects of caffeine that improved performance. It was thought that caffeine, by increasing fat oxidation during exercise, could spare muscle glycogen, allowing an athlete to have more glycogen at the end of competition for the kick to the finish. However, subsequent research shows that caffeine's main ergogenic effect is on the central nervous system. Caffeine is adenosine receptor antagonist. Adenosine induces sleep and fatigue, so blocking the effects of adenosine with caffeine promotes a more alert state. Davis and colleagues,[19] using animal models, showed that when caffeine was injected into the brains of rodents, performance in treadmill running improved by more than 50%. An athlete's response to caffeine is highly variable, and early research studies used high doses of caffeine (5–6 mg/kg per body weight), but more recent observations show that a smaller dose of 2 to 3 mg/kg per body weight is effective. For a 70-kg athlete (154 lb), a caffeine dose of 140 to 210 mg caffeine, the amount found is small to medium cup of coffee, is an effective dose.[1]

While caffeine has been shown to be an effective ergogenic aid, what about energy drinks? For every study that supports an increase in endurance, speed, or strength when an energy drink is consumed, there is another study that shows no effect on performance. What is clear is that any effect that energy drinks have on performance comes from the caffeine. Because energy drinks also contain components that claim to improve mental and physical performance (primarily taurine, glucuronolactone, and B vitamins), McLellan and Lieberman[20] conducted a comprehensive review and found 32 research articles on the effects of energy drinks alone and/or in combination with caffeine on mental or physical performance. They found some weak evidence of increased sports performance for glucose and guarana extract but state there is an "overwhelming lack of evidence to substantiate claims that components of energy drinks, other than the caffeine, contribute to the enhancement of physical or cognitive performance."[20]

Heneghan and colleagues[21] at the Center for Evidence-Based Medicine at the University of Oxford, United Kingdom, reviewed studies on the effects of energy drinks on sports performance. The researchers noted that it was difficult to compare studies because they all used different subjects (some were exercise trained, whereas others were not), used different types of energy drinks in differing amounts, and did not always make the treatments isocaloric, and outcome measures differed. They did not find any research comparing the effectiveness of energy drinks versus caffeine alone on sports performance. They concluded that if there is any positive effect on sports performance with energy drinks, it is the caffeine that produces the effect. They also found some negative effects of consuming energy drinks for sports performance enhancement, including insomnia, headache, nausea, vomiting, tachycardia, tremors, and seizures.[21]

VOLUNTARY LABELING OF ENERGY DRINKS

Currently, the FDA has not proposed changes to labeling of energy drinks to include caffeine or make energy drink ingredients more transparent, but 2 groups have developed guidelines for energy drink labeling. The American Beverage Association (ABA) developed voluntary guidelines for its members.[22] Whereas most energy drinks are marketed as dietary supplements, Rockstar Energy and most recently Monster Energy have repositioned their drinks as beverages. (Beverages do not have to report adverse effects, whereas dietary supplements do.) The ABA guidelines include the following:

- Labels of energy drinks should follow a voluntary format for the labeling of caffeine and identify the quantity of caffeine from all sources contained in the beverage.
- Labels of energy drinks should not promote the mixing with alcohol or make any claims that the consumption of alcohol together with energy drinks counteracts the effects of alcohol.
- Labels of energy drinks should include an advisory statement that they are not intended or recommended for children, pregnant or nursing women, and those sensitive to caffeine.

- Energy drinks should neither be sold nor marketed in schools.
- Energy drinks should not be marketed to children.

In April 2013, the Council for Responsible Nutrition (CRN), the supplement industry trade association, issued voluntary guidelines for caffeine-containing dietary supplements, including energy drinks.[23] The association guidelines are similar to the ABA guidelines for beverages and include the following:

- There should be disclosure of total caffeine content from both added caffeine and naturally occurring caffeine combined and should be declared in mg per serving (however, this would not apply to supplements that contain no added caffeine and >25 mg per serving of naturally occurring caffeine).
- Any supplement with total caffeine content of more than 100 mg per serving should provide a statement that the product is not intended/recommended for children and those sensitive to caffeine.
- Pregnant or nursing women, those with a medical condition, and those taking medication should consult a healthcare professional before use.
- The CRN members should not advertise, market, or otherwise promote the use of caffeine-containing dietary supplements in combination with alcohol or to counter the acute or immediate effects of alcohol.

As of this time, there is no information if any members of either ABA or CRN have adopted these voluntary guidelines.

WHAT IS MODERATION OF CAFFEINE INTAKE FOR ATHLETES?

The word *moderation* is frequently used to describe a "safe" intake of caffeine, but what is moderation? The Academy of Nutrition and Dietetics cites 200 to 300 mg/d as a moderate and safe dose of caffeine,[24] and that amount appears consistent with other health organizations definition of moderation.[25]

For collegiate athletes, caffeine is a restricted substance, and a positive drug test could result if an athlete has a urine concentration exceeding 15 µg/mL.[26] To achieve that level, an athlete would have to consume about 17 caffeine-containing soft drinks.[18] The equivalent in energy drinks would range from 12 to 15 servings (8-oz servings). Energy drinks often come in larger servings (16 oz), so the actual number of cans of energy drinks to achieve a urine concentration that could result in a positive drug test could be lower.

Higgins and colleagues[27] make the following recommendations on energy drink consumption and athletes.

- For the athlete participating in exercise lasting less than 1 hour, do not use energy drinks because of the possibility of dehydration, elevation of blood pressure, and lack of equivocal benefits versus water or sports drinks.
- For the athlete participating in exercise lasting longer than 1 hour, do not use energy drinks. Sports drinks containing carbohydrates and electrolytes help prevent dehydration and restore important minerals lost through perspiration, and they produce better hydration than water.

Getting back to our football player whose case study was introduced in the introduction, he modified some of his habits by replacing energy shots with eating breakfast, but he continued to consume a preworkout formula, as in his words, he was "psychologically addicted" to taking some supplement before practice. The NCAA has concerns about not only energy drink consumption but also caffeine consumption in college athletes and developed a poster for member schools in 2013. The Figure shows the poster that is displayed for the athletes to encourage them to seek energy from real foods.

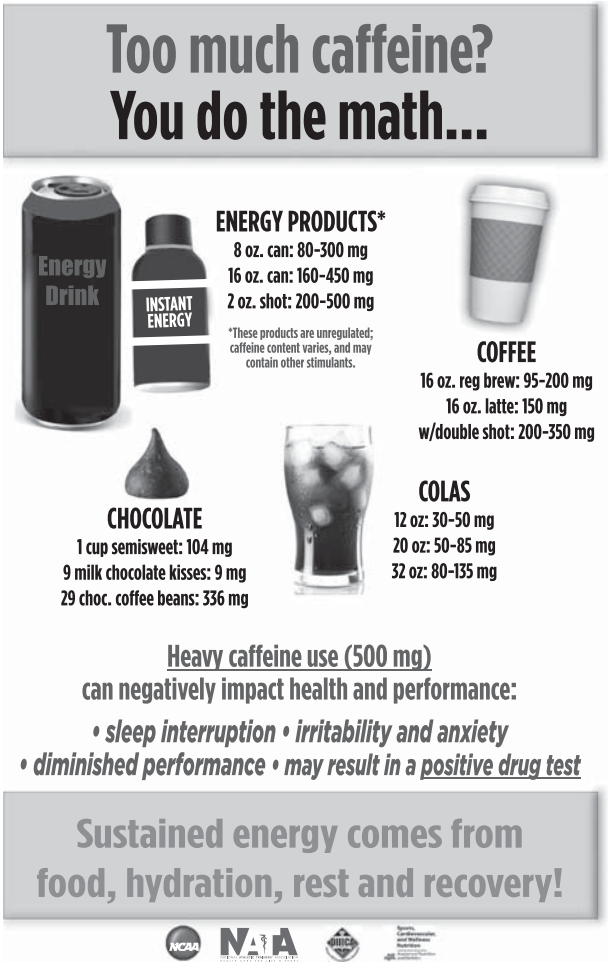

FIGURE. Caffeine poster of the National Collegiate Athletic Association. Reprinted with permission NCAA.

Caffeine is safe and legal for use by athletes when used in moderate amounts. Athletes should be educated about the effective dose of caffeine to enhance performance and the dangers to health as well as detrimental effects on performance when large amounts are consumed.

REFERENCES

1. Burke LM. Caffeine and sports performance. *Appl Physiol Nutr Metab*. 2008;33:1319–1334.
2. Burke L, Desbrow B, Spriet L. *Caffeine for Sports Performance*. Champaign, IL: Human Kinetics; 2013.
3. State of the Industry: Energy Drinks. http://www.bevindustry.com/articles/85655-consumers-seek-out-energy-boosts. Accessed December 3, 2012.
4. *Substance Use. National Study of Substance Use Trends Among NCAA College-Student Athletes*. Indianapolis, IN: NCAA; 2012. https://www.ncaapublications.com/p-4266-research-substance-use-national-study-of-substance-use-trends-among-ncaa-college-student-athletes.aspx. Accessed December 4, 2013.
5. Hoyte CO, Albert D, Heard KJ. The use of energy drinks, dietary supplements and prescription medications by United States college students to enhance athletic performance. *J Community Health*. 2013;38:574–580.
6. Ishak WW, Ugochukwu C, Bagot K, Khalili D, Zaky C. Energy drinks: psychological effects and impact on well-being and quality of life. *Innov Clin Neurosci*. 2012;9:25–34.
7. Woolsey C. Energy drink cocktails: a dangerous combination for athletes and beyond. *J Alcohol Drug Educ*. 2010;54:41–68.
8. Always diving in headfirst. http://energydrink-us.redbull.com/. Accessed December 9, 2013.
9. The top 15 energy drink brands. http://www.caffeineinformer.com/the-15-top-energy-drink-brands. Accessed December 9, 2013.
10. Redline Princess Energy Drink. http://www.vpxsports.com/fat-loss-energy-supplements/redline-princess. Accessed December 9, 2013.
11. GungHo. http://www.gogungho.com/the-science. Accessed December 9, 2013.
12. Scott GN. Which plants contain caffeine? Medscape, May 13, 2013. http://www.medscape.com/viewarticle/780334. Accessed December 9, 2013.
13. Food and Drug Administration. Energy "drinks" and supplements: investigation of adverse event reports. http://www.fda.gov/Food/NewsEvents/ucm328536.htm. Accessed December 10, 2013.
14. WebMD. More deaths, illness linked to energy drinks. http://www.webmd.com/diet/news/20121116/more-deaths-illness-energy-drinks. Accessed December 10, 2013.
15. Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality. The DAWN Report: Update on Emergency Department Visits Involving Energy Drinks: A Continuing Public Health Concern. Rockville, MD. January 10, 2013.
16. Taylor MR. Defining boundaries for caffeine in today's marketplace. FDA Voice. August 26, 2013. http://blogs.fda.gov/fdavoice/index.php/2013/08/defining-boundaries-for-caffeine-in-todays-marketplace/. Accessed December 10, 2013.
17. Reissig CJ, Strain EC, Griffiths RR. Caffeinated energy drinks—a growing problem. *Drug Alcohol Depend*. 2009;127:511–528.
18. Dunford M, Coleman EJ. Ergogenic aids, dietary supplements, and exercise. In: Rosenbloom CA, Coleman EJ, eds. *Sports Nutrition: A Practice Manual for Professionals*, 5th ed. Chicago, IL: Academy of Nutrition and Dietetics; 2012:128–161.
19. Davis JM, Zhao Z, Stock HS, Mehl KA, Buggy J, Hand GA. Central nervous system effects of caffeine and adenosine on fatigue. *Am J Physiol*. 2003;284:R399–R404.
20. McLellan TM, Lieberman HR. Do energy drinks contain active components other than caffeine? *Nutr Rev*. 2012;70:730–744.
21. Heneghan C, Gill P, O'Neill B, et al. Mythbusting sports and exercise products. *BMJ*. 2012;345:1–7.
22. American Beverage Association. ABA Guidance for the Responsible Marketing and Labelling of Energy Drinks. http://www.ameribev.org/nutrition-science/energy-drink-guidance/. Accessed December 13, 2013.
23. Council for Responsible Nutrition. CRN Recommended Guidelines for Caffeine-Containing Dietary Supplements. http://www.crnusa.org/caffeine/guidelines.html. Accessed December 13, 2013.
24. Academy of Nutrition and Dietetics. The buzz on caffeine. http://www.eatright.org/Public/content.aspx?id=6442452080&terms=caffeine%20moderate. Accessed December 13, 2013.
25. Medline Plus. Caffeine in the diet. http://www.nlm.nih.gov/medlineplus/ency/article/002445.htm. Accessed December 13, 2013.
26. NCAA Banned Drug List. http://www.ncaa.org/wps/wcm/connect/public/ncaa/health+and+safety/drug+testing/resources/ncaa+banned+drugs+list. Accessed December 13, 2013.
27. Higgins JP, Tuttle TD, Higgins CL. Energy beverages: content and safety. *Mayo Clin Proc*. 2010;85:1033–1041.