

Position Statement

Energy and sports drinks in children and adolescents

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Abstract

Sports drinks and caffeinated energy drinks (CEDs) are commonly consumed by youth. Both sports drinks and CEDs pose potential risks for the health of children and adolescents and may contribute to obesity. Sports drinks are generally unnecessary for children engaged in routine or play-based physical activity. CEDs may affect children and adolescents more than adults because they weigh less and thus experience greater exposure to stimulant ingredients per kilogram of body weight. Paediatricians need to recognize and educate patients and families on the differences between sport drinks and CEDs. Screening for the consumption of CEDs, especially when mixed with alcohol, should be done routinely. The combination of CEDs and alcohol may be a marker for higher risk of substance use or abuse and for other health-compromising behaviours.

Keywords: Alcohol; Caffeine; CEDs; Energy drinks; Sports drinks

BACKGROUND

Sports drinks and caffeinated energy drinks (CEDs) are commonly encountered in the Canadian marketplace. Sports drinks and CEDs are different beverages. Sports drinks are marketed as beverages that: replenish electrolytes lost during exercise, supply carbohydrates, prevent dehydration and sustain endurance capacity (1–3). In 2009, the sports drinks market in Canada was valued at \$423 million (4), and sports drinks accounted for 1.2% of all nonalcoholic beverages sold in Canada (5). CEDs, in contrast, are advertised to increase energy and/or alertness. They contain caffeine and other stimulant substances that sports drinks typically do not contain. With caffeine as their primary ‘energy’ component, CEDs entered the American market as a separate beverage category in 1997, with the introduction of Red Bull (6). Data from the USA show that energy drink consumption and sales have increased rapidly over the decade since, with over US\$3.2 billion in sales in 2006, a greater than 500 per cent inflation-adjusted increase since 2001 (7).

Because these commercial beverages are increasingly ubiquitous, paediatricians may encounter questions from parents about possible benefits and harms related to their consumption. This position statement provides guidance on sports drink consumption for the average child or youth in the general population, who are engaged in daily, play-based physical activity. For children engaged in competitive endurance sports or in repeated bouts of prolonged, vigorous physical activities, or who exercise in situations of extreme heat, refer to the Canadian Paediatric Society’s 2013 practice point: Sport nutrition for young athletes at: www.cps.ca/documents/position/sport-nutrition-for-young-athletes.

WHAT ARE SPORTS DRINKS?

Sports drinks are flavoured beverages that typically contain a mixture of sugars and electrolytes, such as sodium, potassium and magnesium (3). They may also contain added vitamins, typically vitamin C or B vitamins (1). Sports drinks typically contain carbohydrates from sugar sources such as glucose-fructose (high-fructose corn syrup), sucrose or maltodextrin. Carbohydrate content in the range of 5 g to 14 g per 240 mL/8 oz serving is reported (8). Sports drinks may also contain low-calorie sweeteners, citric acid and natural and artificial fruit flavours (9).

Sports drinks with more than 8% carbohydrate content (8 g per 100 mL) may slow gastric emptying and intestinal absorption during exercise compared with beverages having lower concentrations of carbohydrate. There appears to be no difference in rates of gastric emptying or fluid absorption between water and sports drinks when carbohydrate concentration falls between 4% and 8% (4 g to 8 g per 100 mL) (10–12). Sports drinks are designed to replace fluids and electrolytes lost in sweat and to rapidly deliver both carbohydrates and fluid to the body (4).

Although sports drinks are marketed to optimize athletic performance, studies investigating positive benefits for children are sparse. Most research has been conducted using adult athletes. Sweat rates during exercise are variable within and among children (13), making it difficult to establish the specific exercise duration after which sports drinks are warranted. When sports drinks are used judiciously in children who are exercising vigorously for prolonged periods of time, dehydration rates rarely exceed 1% (13). Therefore, while sports drinks may have a specific role in supporting adequate hydration in young athletes during prolonged and vigorous activities (14), their use is generally unnecessary for the average child engaged in routine or daily play-based physical

activity. For the average child, water should be the first choice for hydration before, during and after routine physical activity (1).

Sports drinks typically contain simple sugars and are often included in studies examining the overall impact of sugar-sweetened beverages on health outcomes. There is a small positive association between sugar-sweetened beverage consumption and obesity, with one systematic review reporting a 0.06 increase in BMI units per serving consumed (15). Because of their carbohydrate content, sports drinks may contribute to the risk of dental caries (16). In general, adequate carbohydrates to support routine physical activity in children can be obtained by following Health Canada recommendations in Eating Well with Canada's Food Guide (www.hc-sc.gc.ca/fn-an/food-guide-aliment/index-eng.php). Children and adolescents should be reminded to drink water routinely as the beverage of first choice, always providing that daily dietary caloric and nutrient needs are being met (1).

WHAT ARE CEDs?

CEDs claim to boost energy, decrease fatigue and enhance concentration (1). CEDs sold in Canada contain caffeine (9) from either pure or synthetic caffeine or herbal ingredients, such as guarana or yerba mate. CEDs may be sweetened with various types of sugar, such as glucose–fructose and/or sucrose (17,18). They may also be artificially sweetened. Sugar is widely used in CEDs because it is considered a source of rapid 'energy'. Also, the sweet taste of sugar is thought to encourage consumption (19). The quantity of sugar in CEDs ranges between 1 g and 43 g per 237 mL/8oz serving (8) (up to 10 teaspoons), typically much more than in the average sports drink, and comparable to sugar quantities in soft drinks. Other common ingredients in CEDs include taurine, ginkgo biloba, ginseng, tryptophan, tyrosine, B vitamins, L-carnitine and alanine (1,2).

The consumption of CEDs by adolescents is common, with more than one-half (61% to 66%) of high school students surveyed in 2008 in one Quebec study reporting usage (20). In New Brunswick, 57% of all students surveyed reported consuming at least one energy drink in the past 12 months. Also, 15% of male adolescent students and 8% of female students reported consuming CEDs at least once per month (21). In an Ontario sample, one-half of adolescents reported consuming at least one energy drink in the past 12 months, 19% indicated consumption in the past seven days and 1.5% of the sample reported consuming one or more CEDs per day (22). Another study that recruited students in Ontario found 18% of respondents consumed one energy drink in a typical week (23). According to a recent Canadian Paediatric Surveillance Program survey, the three reasons cited most frequently for consuming CEDs were to: increase alertness, conform to peer pressure and improve sports performance (24).

In Canada, CEDs available in ≥ 125 mL volumes are regulated as a 'food' and therefore must follow the requirements of Health Canada's CED guidance. The maximum amount of caffeine allowed in CEDs is 180 mg/per single serve container or serving, or a concentration of 400 mg/L (see Table 1 for the caffeine content of commonly consumed products to put this amount into perspective). For complete regulatory information, consult: www.hc-sc.gc.ca/fn-an/legislation/guide-ld/guidance-caf-drink-boiss-tma-amt-eng.php. Energy 'shots', defined as single-dose containers, are regulated under the Natural Health Product legislation, which requires that they have a Natural Health Product number (NPN). For information about safety and efficacy of natural health products, consult: www.hc-sc.gc.ca/dhp/mps/prodnatur/legislation/docs/modern-eng.php.

Health Canada also requires that energy drink containers carry cautionary statements specifying a maximum daily consumption limit for containers or servings (25). Other cautions are required, including: "Do not mix with alcohol" and "Not recommended for children, pregnant or breastfeeding women and individuals sensitive to caffeine". The total amount of caffeine from all sources (synthetic and natural) must be stated on the product label (25). Based on available evidence, Health Canada states there are no immediate safety concerns

related to the consumption of CEDs, but they also acknowledge that more research is needed. Moreover, children and adolescents may be more susceptible than adults to the adverse effects of CEDs, because weighing less leads to higher exposure to active ingredients, such as caffeine, on a per kilogram of body weight basis (18).

Health Canada prohibits advertising, marketing or promoting CEDs to children ≤ 12 years of age. Industry also has a voluntary marketing code for CEDs, which stipulates that companies should not advertise to children over traditional media (notably television, radio and in print). This marketing code was agreed on by the Canadian Beverage Association and its implementation is encouraged by industry (26). However, despite these regulatory mechanisms and voluntary marketing codes, energy drink companies are known to target youth sporting events, 'extreme' athlete sporting sponsorships, and social media. To target teenagers, marketers use dramatic product names and edgy graphics (7).

CAFFEINE

Caffeine is the most common stimulant ingredient used in CEDs. Caffeine is extracted from the fruit of over 60 species of coffee plant; caffeine is also found in guarana, tea, cocoa and yerba mate (2). The pharmacological effects of caffeine include central nervous system and cardiac stimulation. Caffeine relaxes smooth muscle and stimulates skeletal muscle (27,28). The clinical effects of caffeine include increased heart rate, blood pressure, speech rate, motor activity, attentiveness, gastric secretion, diuresis and temperature (1). Caffeine can also increase anxiety in susceptible individuals (1,29), and may induce arrhythmias (1,27). Additional adverse effects with very high doses or overdoses may include altered level of consciousness, rigidity, seizures, supraventricular and ventricular tachyarrhythmias and death (30).

Caffeine has traditionally been considered a weak diuretic (31,32). However, one recent meta-analysis of adults found only a small effect of caffeine on overall fluid loss. Subanalysis revealed that caffeine had no effect on fluid loss in individuals engaged in exercise, compared with individuals at rest (33).

Caffeine is known to increase aerobic endurance, improve reaction time and delay time to exhaustion in adults (34,35). Caffeine generally increases alertness, affects complex cognitive processes, and can alleviate some of the effects of sleep deprivation (e.g., slowed reaction time and decreased attentiveness). However, other decrements in performance, such as impairments in more complex cognitive functions and working memory, may only be improved by sufficient sleep, not by ingesting caffeine (36).

As per the Canada Vigilance Adverse Reaction Database, adverse events associated with the consumption of CEDs have been reported in children as young as 8 years of age (37). Adverse events include tachycardia, increases in

Table 1. Caffeine content of various commonly consumed products

Product	Serving size		Caffeine content in mg (approximate value)
	oz	mL	
Energy drinks	8	237	95*
Instant coffee	8	237	76–106
Roasted and ground brewed coffee	8	237	118–179
Black tea	8	237	43
Green tea	8	237	30
Regular cola beverage	12	355	36–46
Chocolate milk	8	237	8
Hot chocolate	8	237	5

Data taken from ref. (42). *Based on the maximum regulatory limit of 400 mg/L of caffeine added to CEDs in Canada

blood pressure, electrocardiogram (ECG) changes, vomiting, diarrhea, impulsive behaviour, agitation, delusions, circulatory collapse and death. In one 2011 Canadian Paediatric Surveillance Program survey, 9% of the 741 respondents reported caffeine-related complications (24).

Children with cardiovascular, renal and liver diseases, seizures, diabetes, mood and behavioural disorders and hyperthyroidism, may be at higher risk for adverse events from energy drink consumption (31). In children with attention deficit hyperactivity disorder, the caffeine in CEDs may potentiate the cardiovascular side effects of attention deficit hyperactivity disorder-stimulant medications (31).

Studies have suggested that children are more likely than adults to develop caffeine dependence or to develop dependence at lower doses or frequencies of caffeine use (38). Consumption of caffeine in childhood and adolescence may be linked to a higher likelihood of developing dependence (31). Caffeine withdrawal is usually experienced as headaches. Other symptoms may include fatigue, decreased energy, decreased alertness, drowsiness, dysphoric mood, difficulty concentrating, irritability, flu-like symptoms, nausea and vomiting and muscle aches (39).

Some authors have suggested that children and adolescents who are not habitual caffeine users may be more vulnerable to caffeine intoxication, due to lack of pharmacological tolerance (40). Also, one review conducted by Health Canada found that children and adolescents were at higher risk than adults for exceeding Health Canada's Recommended Maximum Daily Intakes for caffeine (Box 1), due to the volume of energy drinks that can be consumed easily and the lower recommended maximum daily intakes established for youth under 18 years of age (41).

In Canada, the caffeine concentrations in CEDs are limited to 400 mg/L or a maximum of 180 mg per single-serve container (single-serving containers are defined as containers that cannot be resealed and contain less than 750 mL) (41). In comparison, a 237 mL cup of brewed coffee provides an average of 135 mg of caffeine (Table 1) (42). For more information on foods containing caffeine, see: www.dietitians.ca/Your-Health/Nutrition-A-Z/Caffeine/Food-Sources-of-Caffeine.aspx.

The permitted caffeine concentrations in energy drinks differ widely worldwide, with some energy drinks in the USA containing as much as 344 mg of caffeine per 473-mL can (40), or more than seven times the amount of caffeine found in the same quantity of Coca-Cola (43). It is important for paediatricians to be aware that regulations differ in neighbouring countries and that teenagers can purchase highly concentrated beverages outside of Canada.

MIXING CEDs WITH ALCOHOL

The purpose of mixing energy drinks with alcohol is to counteract the sedative effect of alcohol with the stimulatory effect of caffeine. Mixing alcohol with CEDs may exert a dual effect, increasing stimulation and decreasing sedation (44). The mixing of energy drinks with alcohol was found to have little impact on the total volume of alcohol consumed on a single drinking occasion. However, individuals who mix energy drinks with alcohol tend to drink more alcohol in general, compared with other drinkers (45,46). Overall, the consumption of CEDs mixed with alcohol has been associated with an increase in risk-taking behaviours and harmful incidents (46,47).

Certain subpopulations appear to be more likely to mix energy drinks with alcohol and may be particularly vulnerable to adverse outcomes. Studies have shown that the mixing of CEDs and alcohol is common among college students (47,48), and students who reported this practice were also found to be at higher risk of experiencing alcohol-related consequences, including being sexually assaulted or sexually assaulting others, driving with an intoxicated driver, being physically hurt or injured, and requiring medical treatment (47). A survey of university students in Canada also found a significant association between the mixing of CEDs with alcohol and risk-taking behaviours, including the use of cocaine, crack-cocaine, amphetamines or crystal meth within the previous 12 months. Students were also likely to drink more heavily when mixing alcohol with CEDs (46). A recent Ontario study showed an association between

adolescent traumatic brain injury and CEDs consumption, which increased further when CEDs were mixed with alcohol (49).

One Ontario survey of over 20,000 grades 9 to 12 students showed that almost one in five reported consuming CEDs in a typical week, while 17% of respondents had mixed CEDs with alcohol within the previous 12 months (23). In the Canadian Paediatric Surveillance Program survey cited above, 28% of respondents who presented with complications associated with CEDs had also consumed alcohol, and 26% had taken other drugs, such as psychostimulants, cannabis or amphetamines (24).

Due to concerns with the combination of CEDs and alcohol, Health Canada prohibits the use of CEDs as an ingredient in premixed alcoholic beverages (50). Furthermore, Health Canada's Food and Drug Regulations do not permit the sale of CEDs containing alcohol or the sale of any alcoholic beverage with additional caffeine. However, naturally occurring sources of caffeine, such as guarana and coffee, are permitted as a flavouring ingredient in alcoholic beverages (50). Health Canada advises consumers not to mix CEDs with alcohol and requires all CEDs to display the statement "Do not mix with alcohol" on their labels (50).

Given the multiple health concerns related to the consumption of CEDs by children and adolescents, the Canadian Medical Association (CMA) has recommended that the Canadian Pharmacists Association, National Association of Pharmacy Regulatory Authorities and Canadian Association of Chain Drug Stores introduce a voluntary ban on the sale of CEDs to minors (51). The CMA also supports a ban on the sale of CEDs to Canadians younger than the legal drinking age in their jurisdiction (52).

CONCLUSION

Given the widespread use of sports drinks and CEDs in children and adolescents, it is imperative that physicians discuss the risks of using these beverages with patients and families. The dietary role of sports drinks should be individualized, based on the child's or youth's activity levels. Providing education regarding the differences between sports drinks and CEDs, and the potential health risks and side effects associated with CED consumption, is essential. Frequent consumption of CEDs, especially when mixed with alcohol, may be a marker for increased risk of substance use and abuse and other health-compromising behaviours.

RECOMMENDATIONS FOR CLINICIANS:

- Paediatricians should ask children and adolescents about their sports and energy drink consumption, their reasons for consuming these beverages, and whether they mix alcohol with CEDs.
- Paediatricians need to educate children, adolescents and families concerning the potential health risks posed by CEDs, highlighting the differences between sport drinks and CEDs.
- Paediatricians should counsel children, adolescents and parents that water is the most appropriate replacement fluid for routine physical activity. Consuming sports beverages during sporting activities should be reserved for young athletes involved in prolonged and vigorous activities.

Box 1. Health Canada Recommended Maximum Daily Intakes for caffeine

Children aged

- 4–6 years: 45 mg/day
- 7–9 years: 62.5 mg/day
- 10–12 years: 85 mg/day

Adolescents aged

- 13 years and older: 2.5 mg/kg of body weight/day

Data taken from ref. (42).

- Paediatricians should advocate for expanding legislation to prevent marketing of CEDs to children and adolescents.

Acknowledgements

This position statement was reviewed by the Community Paediatrics, Healthy Active Living and Sports Medicine, and Adolescent Health Committees of the Canadian Paediatric Society. It has also been reviewed and endorsed by Dietitians of Canada. A special thank you to Heather Petrie, MSc RD for contributing her content expertise.

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