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Guidance for the Clinician in Rendering Pediatric Care

Clinical Report—Sports Drinks and Energy Drinks for Children and Adolescents: Are They Appropriate?

abstract

FREE

Sports and energy drinks are being marketed to children and adolescents for a wide variety of inappropriate uses. Sports drinks and energy drinks are significantly different products, and the terms should not be used interchangeably. The primary objectives of this clinical report are to define the ingredients of sports and energy drinks, categorize the similarities and differences between the products, and discuss misuses and abuses. Secondary objectives are to encourage screening during annual physical examinations for sports and energy drink use, to understand the reasons why youth consumption is widespread, and to improve education aimed at decreasing or eliminating the inappropriate use of these beverages by children and adolescents. Rigorous review and analysis of the literature reveal that caffeine and other stimulant substances contained in energy drinks have no place in the diet of children and adolescents. Furthermore, frequent or excessive intake of caloric sports drinks can substantially increase the risk for overweight or obesity in children and adolescents. Discussion regarding the appropriate use of sports drinks in the youth athlete who participates regularly in endurance or high-intensity sports and vigorous physical activity is beyond the scope of this report. *Pediatrics* 2011;127:1182–1189

Sports and energy drinks are a large and growing beverage industry now marketed to children and adolescents for a variety of uses. Marketing strategies for sports drinks suggest optimization of athletic performance and replacement of fluid and electrolytes lost in sweat during and after exercise, and marketing strategies for energy drinks purport a boost in energy, decreased fatigue, enhanced concentration, and mental alertness. Sports drinks are different products than energy drinks; therefore, the terms should not be used interchangeably. Sports drinks are flavored beverages that often contain carbohydrates, minerals, electrolytes (eg, sodium, potassium, calcium, magnesium), and sometimes vitamins or other nutrients. Although the term "energy" can be perceived to imply calories, energy drinks typically contain stimulants, such as caffeine and guarana, with varying amounts of carbohydrate, protein, amino acids, vitamins, sodium, and other minerals.

With children and adolescents, careful consideration is necessary when selecting a beverage to hydrate before, during, or after exercise and outside of physical activity to prevent excessive sugar and caloric intake that may encourage dental erosion, overweight, and obesity.[1]

COMMITTEE ON NUTRITION AND THE COUNCIL ON SPORTS MEDICINE AND FITNESS

KEY WORDS

sport drinks, energy drinks, obesity, caffeine

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Pediatric athletes can benefit from using sports drinks that contain carbohydrates, protein, or electrolytes[2]; however, for the average child engaged in routine physical activity, the use of sports drinks in place of water on the sports field or in the school lunchroom is generally unnecessary. Stimulant-containing energy drinks have no place in the diets of children or adolescents.[3] Excessive regular consumption of carbohydrate-containing beverages increases overall daily caloric intake without significant additional nutritional value. Therefore, frequent consumption adversely affects the appropriate balance of carbohydrate, fat, and protein intakes needed for optimal growth, development, body composition, and health. This report defines and categorizes selected popular sports and energy drinks, reviews their contents, and examines the evidence for and against the use of sports and energy drinks in children and adolescents. Recommendations are provided for counseling patients, parents, government policy-makers, and administrators who run both school programs and youth sports organizations with regard to appropriate use of sports drinks. It is not intended to be a guide for the use or effectiveness of these drinks in children and adolescents involved in competitive endurance, repeated-bout sports (such as tournaments in which the athlete may have prolonged exposure to a hot, humid environment or be subjected to prolonged, repetitive exercise, often without adequate recovery time in between competitions), or other prolonged vigorous physical activities, because these uses have been reviewed elsewhere.[4]

DEVELOPMENT OF THIS REPORT

The American Academy of Pediatrics Committee on Nutrition (CON) and Council on Sports Medicine and Fitness (COSMF) conducted a thorough review of the literature from 2000 to 2009. Various approaches were used, including numerous PubMed searches. Reference lists from related studies, reviews, editorials, and position statements from other professional organizations were used. Search terms included sports drinks, energy drinks, children, and adolescents. The recent Institute of Medicine report on school health[3] and position statements on this subject from the American Dietetic Association and American College of Sports Medicine[2] were reviewed for this report. Comments were solicited from committees, sections, and councils of the American Academy of Pediatrics; 7 entities responded. For recommendations for which high levels of evidence are absent, the expert opinions and suggestions of the CON, the COSMF, and other groups/authorities consulted were taken into consideration in development of this clinical report.

DEFINITION AND CATEGORIZATION OF SPORTS DRINKS VERSUS ENERGY DRINKS

Sports drinks are beverages that may contain carbohydrates, minerals, electrolytes, and flavoring and are intended to replenish water and electrolytes lost through sweating during exercise. In contrast, the term "energy drink" refers to a very different type of beverage. Today's energy drinks also contain substances that act as nonnutritive stimulants, such as caffeine, guarana, taurine, ginseng, L-carnitine, creatine, and/or glucuronolactone, with purported ergogenic or performance-enhancing effects. Tables 1 and 2 list some popular commercially available sports drinks and energy drinks and their respective contents.

COMPONENTS OF SPORTS AND ENERGY DRINKS AND THEIR INDICATIONS

Water

Water is an essential part of the daily diet. Adequate hydration is necessary for maintaining normal cardiovascular, thermoregulatory, and many other physiologic functions during exercise and routine daily activity. In children, maturation and body size are the primary determinants of the necessary daily water intake. The quantity of water needed to maintain a euvolemic state is influenced by a number of fac-

TABLE 1 Contents of a Sampling of Sports Drinks per Serving (240 mL [8 oz])

Product	Manufacturer	Calories	Carbohydrate, g	Sodium, mg	Potassium, mg	Vitamins	Other
All Sport Body Quencher	All Sport, Inc	60	16	55	60	C	—
All Sport Naturally Zero	All Sport, Inc	0	0	55	60	B_3, B_5, B_6, B_{12}	—
Gatorade	PepsiCo Inc	50	14	110	30	—	—
Gatorade Propel	PepsiCo Inc	10	3	35	—	B_3, B_5, B_6, B_{12}, C, E	—
Gatorade Endurance	PepsiCo Inc	50	14	200	90	—	Calcium, magnesium
Gatorade G2	PepsiCo Inc	20	5	110	30	—	—
Powerade Zero	Coca-Cola Company	0	0	100	25	B_3, B_6, B_{12}	—
Powerade	Coca- Cola Company	78	19	54	—	—	Iron
Powerade Ion4	Coca-Cola Company	50	14	100	25	B_3, B_6, B_{12}	—
Accelerade	Pacific Health Laboratories, Inc	80	15	120	15	E	Calcium, protein

Selection of the specific sports drinks listed was based on the most commonly available products at the time this report was under development.

TABLE 2 Contents of a Sampling of Energy Drinks per Serving (240 mL [8 oz])

Product	Manufacturer	Calories	Carbohydrate, g	Sodium, mg	Potassium, mg	Caffeine, mg	Calcium, mg	Vitamins	Taurine, mg	Guarana, mg	Other
Java Monster	Hansen Natural Corporation	100	17	340	240	[a]	180	A, B_2, B_3, B_6, B_{12}, C, D	1000	[a]	Inositol, ginseng, L-carnitine, glucuronolactone, phosphorus
Java Monster Lo-Ball	Hansen Natural Corporation	50	6	230	60	[a]	90	B_2, B_3, B_6, B_{12}, C, D	—	—	Inositol, ginseng, L-carnitine, glucuronolactone, phosphorus
Monster Energy	Hansen Natural Corporation	100	27	180	—	[a]	—	B_2, B_3, B_6, B_{12}, C	1000	[a]	Inositol, L-carnitine, ginseng, glucuronolactone
Monster Low Carb	Hansen Natural Corporation	10	3	180	—	[a]	—	B_2, B_3, B_6, B_{12}	1000	[a]	Inositol, L-carnitine, ginseng, glucuronolactone
Red Bull	Red Bull GmbH	106	27	193	—	77	—	B_3, B_5, B_6, B_{12}	[a]	—	Inositol, glucuronolactone
Red Bull Sugar Free	Red Bull GmbH	9.6	3	193	—	77	—	B_3, B_5, B_6, B_{12}	[a]	—	Inositol, glucuronolactone
Power Trip Original Blue	Power Trip Beverages, Inc	100	26	190	—	105	—	B_3, B_5, B_6, B_{12} , C	1000	23	Inositol, glucuronolactone
Power Trip "0"	Power Trip Beverages, Inc	5	0	190	—	105	—	B_3, B_5, B_6, B_{12}, C	1000	23	Inositol, glucuronolactone
Power Trip the Extreme	Power Trip Beverages, Inc	110	30	130	—	110	—	B_2, B_3, B_5, B_6, B_{12}, C	1300	30	Inositol, glucuronolactone
Rockstar Original	Rockstar, Inc	140	31	40	—	80	—	B_2, B_3, B_5, B_6, B_{12}	1000	25	Ginseng, inositol, ginkgo, L-carnitine
Rockstar Sugar Free	Rockstar, Inc	10	0	125	—	80	—	B_2, B_3, B_5, B_6, B_{12}	1000	25	Ginseng, inositol, ginkgo, L-carnitine
Full Throttle	Coca-Cola Company	110	28	85	—	[a]	—	B_3, B_5, B_6, B_{12}	—	—	—

Selection of the specific energy drinks listed was based on the most commonly available products at the time this report was under development.

[a] The amount was not specified on the nutritional content label.

tors such as diet, medications, illnesses, and chronic health conditions. With exercise, daily water needs can increase quickly and dramatically on the basis of environmental conditions (eg, heat, humidity, sun exposure), exercise time and intensity, heat-acclimatization state, and individual sweat rates. Therefore, a deliberate increase in water intake is frequently required during exercise to avoid significant dehydration and related health consequences such as heat illness.[5]

Dehydration is caused by a mismatch between body water loss (through sweating, respiration, urine production, and fecal loss), and water intake. Significant dehydration can be associated with premature fatigue, impaired sports performance, cognitive changes, possible electrolyte abnormalities (sodium deficit), and increased risk of heat illness.[6,7] Effective management of hydration, which optimizes performance and minimizes risk of heat illness in the setting of prolonged vigorous sports participation, is complex and beyond the scope of this report. Children and adolescents should be taught to drink water routinely as an initial beverage of choice as long as daily dietary caloric and other nutrient (eg, calcium, vitamins) needs are being met. Water is also generally the appropriate first choice for hydration before, during, and after most exercise regimens. Children should have free access to water, particularly during school hours.[1,2]

Carbohydrates

Carbohydrates are the most important source of energy for an active child or adolescent. However, daily carbohydrate intake must be balanced with adequate intake of protein, fat, and other nutrients. In general, there is little need for carbohydrate-containing beverages other than the recommended daily intake of fruit juice and low-fat

milk. However, for youth who exercise with prolonged vigorous intensity, blood glucose becomes an increasingly important energy source as muscle glycogen stores decrease and the use of circulating (blood) carbohydrates rises, which results in a need to supply an ongoing carbohydrate energy substrate to avert fatigue and maintain performance. The use of a carbohydrate-containing beverage by a child or adolescent in this situation is the most appropriate use of a commercial sports drink. The carbohydrate content of sports and energy drinks varies widely. Sports drinks contain 2 to 19 g of carbohydrates (glucose and fructose forms) per serving (240 mL [8 oz]), and the carbohydrate content of energy drinks ranges from 0 to 67 g per serving. The caloric content of sports drinks is 10 to 70 calories per serving, and the caloric content of energy drinks ranges from 10 to 270 calories per serving (Tables 1 and 2). Excessive intake of carbohydrate-containing beverages beyond what is needed to replenish the body during or after prolonged vigorous exercise is unnecessary and should be discouraged.[8] Sports and energy drinks are not indicated for use during meals or snacks as a replacement for low-fat milk or water. Excessive caloric intake can result from routine dietary intake of carbohydrate-containing beverages such as sports drinks, energy drinks, or soft drinks. This excessive caloric intake can substantially increase the risk for overweight and obesity in children and adolescents and should be avoided.[1,2]

Caffeine and Other Stimulants

Many children and adolescents perceive the need to increase or boost energy levels. The body's need for energy in the form of carbohydrate and other dietary fuel sources is best provided through balanced nutrition. Energy drinks often provide carbohydrate, but the primary source of energy in these drinks is caffeine—one of the most popular stimulants taken today. It is unfortunate that many young people knowingly ingest large amounts of caffeine in a variety of forms despite the fact that regular intake has many noted negative health effects.

Caffeine has been shown to enhance physical performance in adults by increasing aerobic endurance and strength, improving reaction time, and delaying fatigue.[9–11] However, these effects are extremely variable, dose dependent, and, most importantly, have not been studied in children and adolescents. Ergogenic effects have been reported with doses of 3 to 6 mg/kg. Some athletes who desire to achieve performance enhancement may voluntarily reach daily caffeine intakes of up to 13 mg/kg of body weight.

Caffeine is absorbed by all body tissues. It is structurally similar to adenosine and, thus, can bind in its place to cell membrane receptors, which results in a subsequent block of adenosine's actions. The effects of caffeine on various organ systems include increases in heart rate, blood pressure, speech rate, motor activity, attentiveness, gastric secretion, diuresis, and temperature. Sleep disturbances or improved moods are considered variable and individualized effects.[12–17] Caffeine can increase anxiety in those with anxiety disorders,[17] and it is known also to play a role in triggering arrhythmias.[18]

There is heightened awareness of the risks of caffeine use, abuse, and even toxicity in children and adolescents.[19,20] In 2005, the American Association of Poison Control Centers reported more than 4600 calls received for questions regarding caffeine. Of these calls, 2600 involved patients younger than 19 years, and 2345 patients required treatment, although the number of pediatric patients who required treatment was not defined.[21,22] Energy drinks contain large and varied amounts of caffeine, often much more per serving than cola. Parents and children should be cautioned about the difficulties in being aware of how much caffeine is ingested depending on the product and the serving size, as differentiated from the product size. The actual caffeine content for many energy drinks is not easily identified on product packaging or via the Internet. The total amount of caffeine contained in some cans or bottles of energy drinks can exceed 500 mg (equivalent to 14 cans of common caffeinated soft drinks) and is clearly high enough to result in caffeine toxicity.[23] A lethal dose of caffeine is considered to be 200 to 400 mg/kg.[24]

Additional concerns regarding the use of caffeine in children include its effects on the developing neurologic and cardiovascular systems[14] and the risk of physical dependence and addiction. Because of the potentially harmful adverse effects and developmental effects of caffeine, dietary intake should be discouraged for all children.[14,20] Avoidance of caffeine in young people poses a great societal challenge because of the widespread availability of caffeine-containing substances and a lack of awareness of potential risks. The primary dietary source of caffeine for children is soft drinks, which contain approximately 24 mg per serving (240 mL [8 oz]).[25] Ellison et al[26] reported that children 6 to 10 years old ingested caffeine on an average of 8 of 10 days. Other authors have reported variable caffeine intakes of up to 16 mg/day by 7- to 8-year-olds, 24 mg/day by 9- to 10-year-olds, and 37.4 mg/day by 5- to 18-year-olds.[27] Symptoms of caffeine withdrawal include headache, fatigue, decreased alertness, drowsiness, difficulty concentrating, decreased desire to socialize, flulike symptoms, irritability, depressed

mood, muscle pain or stiffness, and nausea or vomiting.[28]

Guarana

Guarana is a plant extract that contains caffeine.[29] It is marketed to increase energy, enhance physical performance, and promote weight loss. One gram of guarana is equal to approximately 40 mg of caffeine.[30] Thus, the presence of guarana in an energy drink is a cause for concern, because it increases the total caffeine level in the beverage.[31]

Electrolytes

Electrolytes (primarily sodium and potassium) are often found in sports and energy drinks (Tables 1 and 2). Sodium content varies from approximately 25 to 200 mg, and potassium content generally ranges from 30 to 90 mg per serving (240 mL [8 oz]). For most children and adolescents, daily electrolyte requirements are met sufficiently by a healthy balanced diet; therefore, sports drinks offer little to no advantage over plain water.[32] During or after participation in short training or competition sessions, athletes generally do not need supplemental electrolyte replacement. However, caution should be taken with athletes who are inappropriately restricting their dietary sodium or who drink excessive amounts of water, because they may be more susceptible to serious electrolyte abnormalities. Electrolyte-replacement requirements in the setting of prolonged vigorous exercise or in excessively hot or humid conditions vary widely because of large variations in sweat rates. Severe electrolyte abnormalities that occur in each of these settings are serious and potentially life-threatening situations and are discussed in detail elsewhere.[5,32]

Amino Acids/Protein

Specific amino acids are added to some sports and energy drinks (Table 2). Protein has been shown to enhance muscle recovery when ingested promptly after exercise; accordingly, a small subset of sports drinks that contain protein or amino acids are often marketed as "muscle-recovery drinks." The ingestion of protein (the major source of amino acids) should occur throughout the day as part of a normal diet to allow the body free access to necessary amino acids. Most children and adolescents who eat a well-balanced diet easily get their recommended daily allowance of protein (1.2–2.0 g of protein per kg), even those who are engaged in regular sports activities.[33] If a food source of protein is unavailable, an amino acid–containing sports drink can be used immediately after prolonged vigorous exercise for muscle recovery. Low-fat milk is a good option for use as a postexercise protein-recovery drink. The optimal ratio of carbohydrate/protein intake is likely individual and is affected by personal tolerance, dietary practices, metabolism, and exercise type and duration.

Additional, heavily marketed effects of specific amino acids in sports and energy drinks have not been supported by appropriate clinical trials. Enhanced immune function (glutamine), vasodilatation (arginine), enhanced lipolysis (L-carnitine, which is not technically an amino acid), and caffeine-potentiating effects (taurine) are among the most commonly described.[34–36] Taurine does have an inotropic effect on cardiac muscle similar to that of caffeine.[24] Like caffeine, taurine has physiologic effects on the intracellular calcium concentration in smooth muscles that may cause coronary vasospasm.[37] In general, the use of amino acids in energy drinks in place of traditional dietary sources is not supported by the scientific literature and, therefore, is discouraged for children and adolescents. Use of stimulant-containing energy drinks with or without amino acid supplementation is always discouraged.

Vitamins and Minerals

Many sports and energy drinks contain several B vitamins, vitamin C, calcium, and magnesium. There is no advantage to consuming these vitamins and minerals in drinks, because they can be easily obtained from a well-balanced diet. For further details, see the *Pediatric Nutrition Handbook*.[1]

HARMFUL DENTAL EFFECTS OF SPORTS AND ENERGY DRINKS

Dental Erosion

Dental erosions from sports and energy drinks are of concern in children and adolescents. Bartlett et al[38] found enamel erosion in 57% of 11- to 14-year-olds in a cluster sample of adolescents. Most sports and energy drinks have a pH in the acidic range (pH 3–4). A pH this low is associated with enamel demineralization.[39] Citric acid is frequently included in sports and energy drinks and has been found to be highly erosive, because its demineralizing effect on the enamel continues even after the pH has been neutralized.[40]

Extent of Use and Misuse

Sports and energy drink consumption by children and adolescents is widespread and continues to grow. O'Dea[41] studied 78 adolescents and found that 56.4% used sports drinks and 42.3% consumed energy drinks during the 2 weeks before the survey. Adolescents consumed these products for various reasons including good taste, quenched thirst, and extra energy needed to improve sports performance. Most notably, the adolescents did not differentiate between sports and energy drinks and cited the same benefits for both beverages. None of the adolescents surveyed mentioned potential problems referable to the

consumption of these beverages, and they did not distinguish use on the basis of the degree of athletic participation.[41]

Physically active children and adolescents and their parents are often unaware of the additional nutrient and fluid needs relative to exercise. Sports drinks have an important, specific role in the diet of young athletes who are engaged in prolonged vigorous sports activity—primarily to rehydrate and replenish carbohydrate, electrolytes, and water lost during exercise.[2] However, confusion about energy by young people can lead to unintentional ingestion of energy drinks when their goal is simply to rehydrate and replenish carbohydrate, electrolytes, and water with sports drinks. Using energy drinks instead of sports drinks for rehydration can result in ingestion of potentially large amounts of caffeine or other stimulant substances and the adverse effects previously described. Of additional concern is the intentional use of energy drinks by adolescents who desire stimulant effects to combat fatigue and increase energy during sports and school activities. Advertisements that target young people are contributing to the confusion rather than effectively distinguishing between sports and energy drinks. Furthermore, marketing fails to identify appropriate sources and amounts of energy substrate that should be consumed by children and adolescents.[42]

ASSESSMENT OF USE/MISUSE IN THE OFFICE

As part of each yearly checkup, it is important for pediatric health care providers to review a patient's nutritional status (food and fluid intake) and quantify physical activity. Routine questions that specifically address the use of sports and energy drinks are recommended. Parents may be unaware of their use, or they may, in fact, promote their use, which opens the door to provide education about these drinks for both patients and their parents. Frequent consumption of energy drinks may identify students at risk of substance use and/or other health-compromising behavior.[43] Education on proper dietary and sleep habits may help combat fatigue in adolescents and may decrease the common "stimulant-seeking behaviors."

Stimulant toxicity should be reported to local poison control centers. The ability to use tracking methods for sources of stimulant substances, such as energy drinks, will improve our understanding of dietary habits and facilitate the development of appropriate public health measures to prevent misuse and abuse.[19]

Given the current epidemic of childhood overweight and obesity, we recommend the elimination of calorie-containing beverages from a well-balanced diet, with the exception of low-fat or fat-free milk, because it contains calcium and vitamin D, which are particularly important for young people.

SPORTS AND ENERGY DRINKS ARE NOT INDICATED AS NORMAL FLUID CONSUMPTION IN SCHOOLS

Sales of sports and energy drinks in schools are increasing. Having agreed voluntarily to phase out full-calorie sodas from schools by the 2009–2010 school year, beverage manufacturers are heavily promoting sports drinks as a healthier alternative. In 2006, sports drinks were the third-fastest growing beverage category in the United States, after energy drinks and bottled water, according to the trade journal *Beverage Digest*.[44] The trade group representing beverage manufacturers reported that sports drinks increased their market share in schools from 14.6% in 2004 to 20% in the 2006–2007 school year. During the same period, the market share for full-calorie sodas decreased from 39.9% to 29.8%.[44]

A few school districts have already fought policy battles over sports drinks, and Connecticut became the first, and so far only, state to have passed legislation barring sports drinks and enhanced waters in schools.[45] Bills have been introduced in the US Congress to set new nutritional standards for the foods and drinks that schools sell to students outside cafeterias.[45]

In April 2007, the Institute of Medicine published a report titled *Nutrition Standards for Foods in Schools*,[3] in which it recommended a healthier eating environment for children and adolescents in this country. Relevant to sports and energy drinks, its recommendations for schools included:

- limit sugars in food and drink;
- have water available at no cost;
- restrict carbonated, fortified, or flavored waters;
- restrict sports drinks to use by athletes only during prolonged, vigorous sports activities;
- prohibit energy drink use, even for athletes; and
- prohibit the sale of caffeinated products in school.

CLINICAL IMPLICATIONS: GUIDANCE FOR THE PEDIATRICIAN

Regarding consumption of sports and energy drinks by children and adolescents, the pediatrician is encouraged to:

- Improve the education of children and adolescents and their parents in the area of sports and energy drinks. This education must highlight the difference between sports drinks and energy drinks and their associated potential health risks.

- Understand that energy drinks pose potential health risks primarily because of stimulant content; therefore, they are not appropriate for children and adolescents and should never be consumed.
- Counsel that routine ingestion of carbohydrate-containing sports drinks by children and adolescents should be avoided or restricted. Intake can lead to excessive caloric consumption and an increased risk of overweight and obesity as well as dental erosion.
- Educate patients and families that sports drinks have a specific limited function for child and adolescent athletes. These drinks should be ingested when there is a need for more rapid replenishment of carbohydrates and/or electrolytes in combination with water during periods of prolonged, vigorous sports participation or other intense physical activity.
- Promote water, not sports or energy drinks, as the principal source of hydration for children and adolescents.

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