Sports and Energy Drinks
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Objectives

- Identify groups at risk for dental caries.
- List the ingredients in soda pop and energy and sports drinks responsible for dental caries.
- Understand the pH scale and the importance of its relationship to the caries process.
- Compare and contrast different types of beverages available to the young adult.
- Discuss how frequency and duration play an important role in the caries process.
- Understand food sequencing and the benefits to the oral cavity.
- Explain the relationship between calorie dense beverages and childhood obesity, heart disease, high blood pressure and type 2 diabetes.
- Understand the relationship between the diet and dental caries.
- Discuss the caries process and factors that can decrease caries risk.
Introduction

The consumption of sports and energy drinks are on the rise, although many patients remain unaware of their health consequences; oral disease, obesity, heart disease, and type 2 diabetes. Many of these beverages contain a large amount of refined carbohydrates and caffeine, coupled with a low pH due to the citric acid content, which can lead to a variety of health problems.

Children and adolescents have significantly increased their consumption of sugar-sweetened beverages, supplying approximately 10% to 15% of their daily caloric intake. With approximately 18.4% of American teenagers participating in sports, the average teenager does not engage in enough physical activity to warrant consumption of caloric sports drinks. More than 100 different beverage brands in the United States have been associated with poor oral health, displaced nutrition, and childhood obesity and type 2 diabetes.

As the consumption of sports and energy drinks is increasing and drink manufactures are marketing toward children and adolescents, the dental professional needs to be aware of the systemic and oral effects caused by the consumption of these sweetened beverages. Patients must be aware of the health consequences associated with soda pop, sports and energy drinks and consider alternative and healthier beverage choices. As part of a comprehensive dental evaluation, healthcare professionals should include an individualized patient education component as part of the routine dental exam.

This course will provide information so health care professional may educate patients and promote healthy behaviors and beverage choice alternatives.

Understanding Soda Pop, Energy and Sport Drinks

In 1965, sports drinks were made available in the United States as a dietary supplement for endurance athletes to help eliminate sports related physiological and nutritional issues. These beverages were designed to replenish not only water, but carbohydrates and electrolytes lost during vigorous and prolonged physical activities in hot and humid temperatures.

The production and sales of sports, energy, and soda pop has become an extremely lucrative and competitive business, with the market capturing over 1.5 billion dollars a year. In the past, the term sweetened beverage was often associated with soda pop. However, today the category also includes: sports drinks, energy drinks, tea, juice, and punch, most which contain large amounts of carbohydrates and artificially flavored ingredients. Depending on the beverage choice, some contain as much as 19 grams of added sugar, 200 milligrams of sodium, and 400 calories per serving.
According to the 2010 National Youth Physical Activity and Nutrition Study, 16% of high school students drank one or more servings of sports drinks per day, and are likely to be male, black or Hispanic, eat fast food often, and be physically inactive. These results indicate that these beverages are being consumed by non-athletes who simply like the taste and looking for an alternative to soda pop. Marketing companies are successful in their recent approach to promote sports drinks to younger consumers as a healthy alternative to soda pop with Gatorade having over 3 million followers on social networks, and Mountain Dew ranking the most advertised product seen by adolescents.

Nutritional related claims that state “contains vitamins and electrolytes” sends a confusing message to both young consumers and parents. Twenty seven percent of parents believe that sports drinks, such as Gatorade, are a healthy drink choice for children. The American Academy of Pediatrics has recently issued a public service announcement stating that most children should not consume sports drinks, and recommends water as the best hydrating source. The benefits of sports drinks are appropriate only for athletes or individuals engaging in prolonged physical activity such as marathon training and races, football training during the summer, competitive soccer, and long cycling races, just to name a few.

The 2010 Dietary Guidelines for Americans recommends consuming water and other fluids with few or no calories for proper hydrations. Many carbohydrates and electrolytes lost during exercise can also be easily replaced from the fruit and vegetable food group in the food guide pyramid. Young athletes should be taught to drink water before, during, and after physical activities. It is well documented that fluids before and during exercise minimizes the dehydration effects on the cardiovascular system, helps regulate body temperature, and enhance athletic performance.

Both soda pop and sport and energy drinks are a source of empty calories and a poor calorie choice for young adults requiring a nutrient dense diet during this period of rapid growth and accelerated nutritional demands of the body. The dangers of calorie drinks extend beyond the increase of calories. Studies show calories consumed in liquid form do not satisfy hunger, will cause a spike in blood glucose and insulin levels, which in turn leads to inflammation and insulin resistance.

In addition, a significant amount of research indicates a positive association between added sugars from beverages and increased risk of cardiovascular disease, type 2 diabetes, oral disease, and childhood obesity.

Young adults have been known to use energy drinks as mixers with alcohol. This combination of caffeine and alcohol carries a number of potential dangers. Since energy drinks are a stimulant, and alcohol is a depressant, the caffeine in the energy drink can mask the intoxication feeling, causing overindulgence. Fatigue is a normal body response to reducing alcohol intake. Individuals can also misperceive their ability to perform complex tasks, such a driving. Both
energy drinks and alcohol are very dehydrating. Dehydration can hinder the body’s ability to metabolize alcohol and will increase toxicity and increase the likelihood of alcohol poisoning.

In a survey of college students, 51% said they had consumed at least one energy drink during the past month. Adverse reactions have been reported to the U.S. poison control centers which include: nausea, vomiting, high blood pressure, tremors, dizziness, and numbness. Professionals fear that energy drinks will be the “gateway” to use of other recreational substances.

Studies do indicate there is one benefit of sports drinks to exercising individuals, they do generally increase voluntary fluid consumption. It is well documented that athletes exercising over one hour in hot and humid conditions do require additional carbohydrates, minerals and electrolytes due to the risk of hypo-hydration. The volume and frequency of voluntary fluid consumption is affected by a beverages taste, aroma, and appearance, and are more likely to be consumed than plain water. Sports drinks should be considered when a child is participating in prolonged sessions of exercise (more than 60 minutes).

If sports drinks are used with youth athletes, consider lower-sugar options and smaller portion sizes. A few drinks on the market that contain reduced high fructose corn syrup, artificial sweeteners, and lower citric acid levels include Vita Coco Coconut Water, E-Boost Natural Orange, and SoBe Lean Life Water, sweetened with Stevia and also contain added antioxidants and electrolytes.

**PH of Popular Drinks**

Both soda pop and sports and energy drinks contain added sugar and have varying levels of a low pH, which creates an acidic environment in the oral cavity. The pH scale is logarithmic. This means, one unit of change in pH is associated with a 10 fold change of acidity.

For example, Coke Classic has a pH of 2.53 and is 100 times more acidic as Barqs Root beer with a pH of 4.6. Water has a neutral pH of 7 and is great for replenishing fluids and has the added benefit of fluoride (when present in the water supply at beneficial levels), which is good for remineralization of enamel. Milk, which has a pH of 6.8, is a good source of calcium and vitamin D, which is important for bone health. Even coffee, (see chart below), has a pH of 5.5 and is a better choice for caffeine with the added bonus of antioxidants.

The biggest misconception with consumers is that energy and sports drinks are better for you than soda pop. However, studies show they can cause as much damage due to the high levels of citric acid, a preservative used to increase its shelf life and enhance the flavor of the beverage.

When naturally occurring bacteria in the oral cavity comes into contact with a fermentable carbohydrate (sugar) from a beverage, it produces an acid, lowering the pH of the mouth and initiating the caries process. Even sugar free beverages like Vitamin Water Zero, which has a pH of 3.15 because of its citric acid content, is detrimental to the oral cavity. Whether the beverage
is sugar free or has a sugar listed as an ingredient, individuals are bathing their teeth in an acid environment, causing enamel destruction.

In the chart below is a comparison of frequently consumed beverages with varying pH levels, carbohydrates, caffeine, and calories per serving. Any beverage having a pH of 5.5 or lower has the potential to initiate the caries process in the oral cavity and is considered cariogenic.

<table>
<thead>
<tr>
<th>Brand</th>
<th>pH</th>
<th>Carbohydrates per serving (g)</th>
<th>Caffeine per serving (mg)</th>
<th>Calories per serving</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMP Energy Drink (8 oz)</td>
<td>2.7</td>
<td>30</td>
<td>75</td>
<td>110</td>
</tr>
<tr>
<td>Coca-Cola Soft Drink (8 oz)</td>
<td>2.5</td>
<td>27</td>
<td>34</td>
<td>97</td>
</tr>
<tr>
<td>Coffee (8 oz)</td>
<td>5.5</td>
<td>0</td>
<td>139</td>
<td>0</td>
</tr>
<tr>
<td>Full Throttle Energy Drink (8 oz)</td>
<td>1.45</td>
<td>14.5</td>
<td>36</td>
<td>110</td>
</tr>
<tr>
<td>Gatorade Sports Drink (12 oz)</td>
<td>3.4</td>
<td>14</td>
<td>0</td>
<td>310</td>
</tr>
<tr>
<td>Jolt Energy Drink (8 oz)</td>
<td>Not available</td>
<td>27</td>
<td>140</td>
<td>100</td>
</tr>
<tr>
<td>Monster Energy Drink (8 oz)</td>
<td>2.7</td>
<td>27</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td>Mountain Dew Soft Drink (8 oz)</td>
<td>3.2</td>
<td>46</td>
<td>36</td>
<td>110</td>
</tr>
<tr>
<td>NOS Energy Drink (8 oz)</td>
<td>Not available</td>
<td>27</td>
<td>130</td>
<td>110</td>
</tr>
<tr>
<td>Powerade Sports Drink (12 oz)</td>
<td>2.6</td>
<td>29</td>
<td>0</td>
<td>117</td>
</tr>
<tr>
<td>Red Bull Energy Drink (8.3 oz)</td>
<td>3.3</td>
<td>28</td>
<td>80</td>
<td>110</td>
</tr>
<tr>
<td>Rock Star Energy Drink (8 oz)</td>
<td>1.5</td>
<td>15.5</td>
<td>80</td>
<td>140</td>
</tr>
</tbody>
</table>

**The Oral Cavity**

As dental health professionals, we are well aware of how the oral cavity is sometimes ignored when discussions turn to the topic of overall health. Athletes are dedicated to training, eating well, and improving performance, and may place a lesser priority on dental health.

Tooth enamel is a thin, hard, translucent substance protecting the dentin, mainly made up of hydroxyapatite, which is a crystalline calcium phosphate. It is the most highly mineralized and toughest substance in the human body. Thickness of enamel varies among gender, age, and the location of the tooth.

The caries process begins when the oral bacteria, streptococcus mutans and lactobacillus (plaque) comes into contact with a fermentable carbohydrate (sugar). The two together form
acids which in turn lower the pH of the oral cavity, and the enamel loss process begins. When considering diet soda pop and energy and sports drinks, they already contain citric acid and subsequently skip the conversion step and jumps straight to enamel loss. In one study, researchers immersed enamel samples in both energy and sports drinks. Enamel loss of between 1.5% and 3.0% was evident after five days of exposure at fifteen minute intervals.

The frequency and duration of exposure to acidic beverages plays an important role in the vulnerability of the enamel. Frequent sipping of soda pop, sports and energy drinks leaves the teeth bathing in an acidic environment at frequent intervals, causing the pH of the oral cavity to remain below 5.5, and therefore at risk of enamel destruction.

Signs of dental erosion include: hollow defects on cusp tips, loss of surface detail on chewing surfaces, chipping of incisal edges of anterior teeth, underlying grey brown appearance of the tooth, and tooth sensitivity to hot or cold.

Along with the drinking habits of a patient, research also suggest salivary function plays a vital role in protecting the tooth surface. Saliva serves as a natural buffering agent containing sodium bicarbonate, calcium, and phosphorus to neutralize acids and remineralize the tooth surface. Saliva also acts as natural cleansing factor, with antibacterial, antiviral, and antifungal properties to kill microorganisms. In addition, when fluoride is introduced into the saliva, it remains elevated for up to three hours, protecting the enamel further.

Dehydrating of the body experienced by endurance athletes, the very young, and the elderly, may cause xerostomia, which will increase the time the acid comes into contact with the tooth and exposes the tooth surface to an acid attack.

Dental caries is due to a combination of factors, including: colonization of microorganisms, type and frequency of exposure of fermentable carbohydrate, susceptible tooth surface, oral hygiene care, salivary function, and fluoride exposure.

**Heart Disease, High Blood Pressure, Diabetes and Obesity**

Americans consume roughly 400 calories worth of refined sugars per day, half coming from soda pop, juice and sports and energy drinks. A numbers of studies have confirmed a correlation between consumption caloric beverages and obesity, high levels of triglycerides, low-density lipoproteins and insulin resistance, all which are precursors of heart disease.

The American Heart Association (AHA) recommends that women consume no more than six teaspoons of added sugars a day and that men consume no more than nine teaspoons of added sugars a day. To make a comparison, a 20 oz. bottle of Gatorade contains eight teaspoons of added sugars, a can of Coke contains nine teaspoons of added sugars, and a 16 oz. can of Rock Star contains fifteen teaspoons of added sugars.
Combined with a typical American adolescent diet, which is already high in sodium, soda pop and sport and energy drinks also contribute to excessive sodium, putting individuals at risk for high blood pressure. Gatorade and Powerade contain between 35 and 200 milligrams of sodium per 8 ounces. Data reveals that sodium intake among children and adolescent exceeds the recommended level. Childhood obesity and type 2 diabetes is rising at an alarming rate in the United States.

Today, about one in three youth are overweight or obese. It is currently the number one health concern among parents, topping drug and alcohol abuse. There are also psychological effects; low self-esteem, negative body image, and depression. The most alarming statement from the former Surgeon General states;

“Because of the increasing rates of obesity, unhealthy eating habits and physical inactivity, we may see the first generation that will be less healthy and have a shorter life expectancy than their parents.”

There is no one single cause of childhood obesity, but rather a combination of factors that have contributed to this American health concern. Portions sizes are growing as individuals are eating outside the home more frequently. Adolescents are moving less, spending entertainment hours in front of the TV, computer, and video games on average four to five hours per day.

The typical American diet contains added sugars and supply calories with essentially few nutrients or dietary fiber. The consumption of high calorie beverages also displaces more nutritional sound calories, such as milk containing calcium, vitamin D, and fruits and vegetables, essential sources of folic acid and iron, all which are necessary nutrients for periods of rapid growth among children and adolescents.

**The Dental Professionals Role**

The dental professionals role should include a comprehensive evaluation, targeting adolescent boys between the age of 14 and 15, the largest consumers of both sports and energy drinks. When counseling dental patients about the dangers of calorie dense, sugary beverages, it is important to offer options in order to reach an obtainable goal. It is unrealistic to think a patient consuming multiply sodas, or energy and sports drinks per day will eliminate them all together. Reducing their consumption or offering alternative choices is the best approach to achieve compliance and reduce risk of oral disease.

When comparing the pH of popular beverages, water is the obvious best choice for hydration and the oral cavity, with its neutral pH of 7.0. It also carries the added benefit of fluoride (when present in the water supply at beneficial levels). Low-fat milk also has a safe pH of 6.8, and is an excellent source of calcium and vitamin D, good for remineralization of enamel and bone building.

*Dynamic Dental Educators – Sports and Energy Drinks*
For students needing a caffeine boost, black coffee has a pH of 5.5, and has the added benefit of antioxidants. Once the pH is below 5.5, the caries process is initiated. Comparing various juices, tomato ranks the best with a pH of 4.1. Barqs Root Beer has the highest pH of all sodas with a pH of 4.6. Most energy and sports drinks have a pH range from 3.7 to 2.5. To place that in perspective, battery acid has a pH of 0.

If giving up soda pop and energy and sports drinks proves challenging for patients, there are several options to lessen the effects of enamel destruction.

Food sequencing proves to be an effective dietary measure to raise the pH of the oral cavity after a fermentable carbohydrate has been introduced. A patient is instructed to finish the meal with a protein or a fat, such as cheese, yogurt or nuts, to raise the pH of the oral cavity and neutralize the acid. Chewing sugar free gum with xylitol reduces the number of streptococcus mutans, the bacteria responsible for the caries process, and helps promote salivary flow, both proven to reduce caries risk. If ending a meal in a fat or protein, or chewing gum is not available, rinsing the mouth with water can be beneficial, but to a lesser extent, to clear the acidic beverage from the mouth and aid in salivary flow through rehydration.

Reducing the frequency of the fermentable carbohydrate, drinking the beverage with a meal, using a straw, and drinking it in one sitting verse sipping it throughout the day can eliminate the exposure time of the acid with the tooth surface. Also, instruct patients not to use sports drinks as a quick mouth rinse, or rinse the mouth guard with the beverage before inserting it.

As we all know, a patient’s oral hygiene can play a large role in the caries process, but brushing immediately following the consumption of an acidic beverage has shown to be harmful to the enamel surface. While the pH of the oral cavity is below 5.5, the enamel is considered vulnerable to further damage. It is advised to wait 30 minutes for the pH to reach neutral, and then proceed with a regular oral hygiene routine. To try and decrease this wait time, it is tempting to want to use water to rinse the mouth and try to elevate pH levels quicker. But, rinsing may only remove some of the solution, spread around the acid and not alter pH levels at all depending on how much sodium bicarbonate, calcium, and/or phosphorus is found in the source water being used as a rinse. Neutralizing products, fluoride varnishes, gels or rinses can remineralizes the enamel surface in order to reduce the erosive potential. Placement of dental sealants should be discussed with the patient as part of their regular oral hygiene regimen and professional dental care.
Conclusion

The research provides evidence that sports and energy drinks are recommended only for individuals engaged in prolonged vigorous physical activity for more than one hour. For most children and adolescents, consuming water before, during, and after physical activity provides the necessary hydration for the body. Parents, coaches, and children and adolescents need to understand that calorie beverages are not recommended for the vast majority of youth engaged in normal physical activity.

Sports drinks, along with soda pop, energy drinks, juice, and fruit flavored drinks account for 46 percent of added sugars in the diets of American children.

Given the already elevated levels of added sugars in processed foods, the American diet is quickly having a detrimental impact on health. Public health advocates and health care professionals are increasing efforts to educate parents and consumers as to the health risk involved.

Soda pop and sport and energy drinks contribute to increased sugar consumption, excessive calories, unnecessary sodium intake, and displaced nutrients. These dietary pitfalls are leading to an alarming increase in dental decay, childhood obesity, type 2 diabetes, and risk factors associated with heart disease, such as high blood pressure and elevated cholesterol levels.

Health care professionals are the first line of defense to educate children, adolescents, parents, teachers, and coaches as to the potential health risk of consuming products of this nature. A discussion regarding superior beverage choices, including type, frequency, amount, and food sequencing should be reviewed in detail as part of the comprehensive dental exam.
Glossary

- Cariogenic: producing or promoting the development of tooth decay.

- Citric acid: a main ingredient in diet soda and energy drinks that contribute to loss of bone mass, kidney stones, and enamel erosion.

- Electrolytes: sodium, potassium, and chloride used to maintain fluid balance.

- Enamel erosion: a microscope loss of dental enamel due to an acid environment in the oral cavity.

- Fermentable carbohydrate: a sugar which has the ability to drop the pH of the oral cavity to 5.5 or below and initial the caries process.

- Hypo-hydration: excessive loss of body fluid.

- PH: a logarithmic measurement of acid and base balance of an aqueous solution. Enamel demineralization begins at a pH of 5.5.

- Refined sugars: added sugars which include cane, beet, glucose, sucrose, maltose high fructose corn syrup, and dextrose to make drinks more palatable.

- Titratable acidity: a measurement of how long it takes for saliva to neutralize acid in the oral cavity.

- Xerostomia: dryness of the mouth due to salivary gland dysfunction.
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