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Health effects of energy drinks on children, adolescents, and young adults

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Summary

Energy drinks are very popular nowadays. The number of people consuming this type of drink is growing every year, not only in the adult group but also in the population of adolescents and children. For many people, they are an alternative to stimulating coffee. In addition to the desired effects such as reducing fatigue, improving concentration and increasing physical and mental performance, energy drinks can also have adverse effects.

The substances they contain, such as caffeine, taurine and large amounts of carbohydrates, may contribute to an increased risk of cardiovascular complications, metabolic and gastroenterological diseases, and mental disorders. [1] The aim of the article is to present the negative effects of consuming energy drinks in the population of adolescents and children.

Key words: energy drinks; caffeine; taurine; diabetes

Introduction and purpose

Energy drinks i.e. stimulants began to gain popularity on the Polish market in the nineties of the 20th century. Since then, their consumption has continued to increase. They are high in caffeine, which is usually combined with plenty of vitamins, minerals, taurine, amino acids, ginseng and guarana, and carbohydrates in the form of glucose, sucrose, fructose or maltodextrin. [2]

The main means of stimulating the body is caffeine. The other ingredients are designed to enhance its action or eliminate the negative effects that may appear as a result of the forced "driving" of an exhausted organism. [3] The stimulating effect makes this type of drink especially popular among young people, students, working people and athletes, both amateurs and professionals. Intensive advertising campaigns using the images of famous people procure that younger and younger people reach for this beverage. According to one study, around 50% of consumers are children, adolescents and young adults (up to 25 years of age) [4]; according to another, close to $\frac{2}{3}$ of users are aged 13-35, of whom $\frac{2}{3}$ are boys and men. [5] There are no age restrictions on the sale and consumption of energy drinks, making them easily accessible to all social and age groups.

Consumers choose energy drinks because of the effect they have on their body - they increase or maintain high psychomotor activity, as well as improve concentration and combat symptoms of fatigue. [6]

The reasons why adolescents consume energy drinks vary by age group. Junior high school students more often explain their consumption with the desire to improve their sports performance and the popularity of drinks among peers; high school students to improve academic achievements and improving well-being, while adolescents practicing sports indicate the need to increase their ability to exercise as the reason for consuming energy drinks. [7]

The mechanism of action of energy drinks, in addition to providing large amounts of energy in the form of easily digestible carbohydrates, is based on the use of substances that stimulate mainly caffeine and taurine. In addition, they also contain inositol, B vitamins, sometimes ginseng root extract or guarana. [8,9] Some of the aforementioned compounds exhibit a synergistic effect in relation to caffeine, enhancing its effect. These substances have the ability to interfere with the biochemical processes taking place in our body, therefore the use of this type of beverages should be carried out with special care.

State of knowledge

Most energy drinks contain around 75-80 mg of caffeine in 250 ml, but the content may vary depending on the product. [10] This amount means that we feel a surge of energy quite quickly. Absorption of caffeine into the bloodstream usually does not exceed 45 minutes, while the maximum concentration is observed up to 2 hours after ingestion and the effect lasts an average of 6-8 hours. Individual susceptibility to its effects differs from person to person, depending on the differences in metabolism, body weight, muscle mass, age, gender and other factors. It is assumed that caffeine consumption by healthy adults should not exceed 400 mg a day, and according to other authors, incl. European Food Safety Authority (EFSA), 400-450 mg / day, while in children - no more than 2.5 mg per kilogram of body weight per day. [11] Canadian scientists have determined the daily recommended dose of caffeine for children 4-6 years of age no higher than 45 mg, 7-9 years - a maximum of 62 mg per day, and for 10-12 year olds a maximum of 85 mg per day. [12] Negative symptoms caused by children's consumption of caffeine occur when consumed above 3 mg / kg / day. [13] Exceeding this amount may cause side effects such as tremors, dizziness, sleep disturbances and palpitations. [14]

The effects of caffeine are multidirectional and still not fully understood. For years, this substance has raised much debate as to whether it has a positive or negative effect on

health, where children are a group of particular concerns. It is classified as a stimulant because it stimulates the central nervous system. It also affects the digestive and circulatory systems and respiratory, however, the greatest effect is seen on the nervous system and circulation. Here, most often side effects occur with excessive amounts. [15,16] The main effects of caffeine include: acceleration of the heart rate, increased cardiac output, vasoconstriction and, consequently, an increase in blood pressure. It should be borne in mind that high levels of caffeine can be dangerous for people with cardiovascular diseases or anxiety disorders, because after the initial period of increased brain activity, fatigue occurs and the nervous system is constantly being strongly stimulated. Some people feel quite anxious and nervous. [17] Children with diabetes, kidney and liver diseases or hyperthyroidism are also at risk.

Caffeine may affect the calcium and phosphate balance. It may interfere with the achievement of optimal bone density in children and adolescents, while building bone mass. This is especially noticeable with high caffeine intake and too little calcium intake. [18]

Another substance contained in energy drinks is taurine, which is formed as the final product of the breakdown of the amino acid – cysteine. It has anti-catabolic, anabolic and lipolytic properties. Through a series of changes, it helps to maintain a steady nitrogen balance, slows down catabolism and prevents some functional deficits in the muscles. It affects the metabolism of bile acids, stabilises cell membranes and has antioxidant properties, which makes it essential for the proper functioning of the cardiovascular system. It is an agonist of GABA receptors, it inhibits the sympathetic nervous system. Therefore, taurine may lower blood pressure and improve heart function and lower plasma glucose levels. It also works deep in the brain, the thalamic regulatory region, which is involved in the sleep-wake cycle pathways of the brain. [19] By inhibiting the production of serotonin, it reduces the feeling of fatigue, thus extending the body's ability to exercise. However, there are also indications that when used in large amounts, it may disrupt the function of the membranes of cells of the nervous system and disturb the oncotic pressure of the cerebral vessels. [20]

Some energy drinks contain guarana i.e. extract from the *Paulinia guarana* plant, which is famous for its high caffeine content. It is assumed that it contains about 40 mg of caffeine in 1g of the plant. In addition, it is also a source of similarly acting alkaloids - theobromine and theophylline. Guarana leads to an increase in the total caffeine content. In the case of guarana, the process of influencing the nervous system is more delicate, but longer - its effect lasts up to 6 hours after consumption.

Energy drinks contain a large amount of simple carbohydrates. This high supply is associated with the risk of overweight and obesity, especially in adolescents. [21] The adrenal hormones (mainly adrenaline) are stimulated, which results in an increase in blood glucose levels and a decrease in the sensitivity of cells to insulin. [22] Moreover, simple sugars may increase cardiac output, worsen the function of the arterial endothelium and modify peripheral resistance. They also increase blood pressure and aggregate platelets. [23]

Energy drinks affect the pH of the oral cavity by increasing its acidity, which promotes the demineralisation of plaque. Additively,, the sucrose contained in them is an ideal medium for bacteria living in the mouth. Caffeine increases the acidity of the stomach, which can irritate the stomach lining. Paradoxically, the food digestion processes may be impaired because the smooth muscles of the digestive tract are relaxed.

It should be remembered that the purpose of energy drinks is to improve the body's efficiency, but they do not have irrigation properties, so they should not be used to quench thirst. Consumers often confuse them with sports drinks, which are designed to rehydrate and provide the body with electrolytes lost through sweat, such as sodium, magnesium, calcium and potassium. Stimulant drinks also have a diuretic effect, mainly due to the caffeine content, which can additionally lead to dehydration.

A disturbing phenomenon is the fact that young people reach for energy drinks not only because of their stimulating or concentration-increasing effects, but also use them as an addition to alcohol or psychoactive substances. In combination with alcohol, they may increase the

side effects as well as the occurrence of side effects due to its combination with caffeine, taurine and other additives. [24] They also create a false sense of sobriety, leading to increased alcohol consumption and the risk of unsafe behaviour. [25]

Conclusion

Energy drinks enjoy unremitting demand on the market. Easy accessibility, their diversity and intensive advertising campaigns using the images of famous people make them popular not only among adults but also among the youth and children. Consumed in moderate amounts, caffeine removes fatigue, improves mood and concentration, increases the physical efficiency of the body, sharpens attention by increasing cognitive functions. Active substances consumed in large quantities can cause tremors, dizziness or sleep disturbances. Excessive consumption of energy drinks can also lead to the occurrence of metabolic diseases - insulin resistance, diabetes, overweight and cardiovascular diseases.

There is no data on the long-term side effects of consuming this type of stimulant drink, so it is worth educating the public, especially the younger generations, about the bioactive substances and the amount of sugars they contain. It is important to conduct extensive educational activities in this area, both among children and young people as well as their parents. It is also necessary to familiarise yourself with the composition of energy drinks and follow the recommendations for the maximum daily consumption of the substances contained in them. It seems necessary to intensify research on the long-term and the holistic influence of energy drink, which will allow to better estimate the risk associated with their consumption.

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