

## Potential effects of excessive Energy drinks consumption in young people on long-term cardiovascular risks

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### ABSTRACT

Energy drinks have been recently associated with adverse outcomes. One of the prominent issues being considered is the link between the risk of developing cardiovascular diseases and energy drink consumption. The increasing concentration of caffeine accompanied by sugars, taurine, etc. are mainly responsible for these risks. In the long term, the children and the youth are vulnerable to the dangers of energy drink consumption. Attention needs to be given to the adverse cardiovascular effects in this population. Regulatory actions and future restrictions on the sale and consumption of these drinks can bring about positive attitudes in the minds of people and influence their patterns of energy drink consumption. This review gives a comprehensive picture of the various aspects related to energy drinks consumption, cardiovascular risks, risk in the younger population and regulatory actions to be implemented.

**Keywords:** Energy drinks, cardiovascular diseases, Risk, Youth

A literature review is a critical analysis of academic publications and scientific articles in order to comprehend theories and thoughts regarding a specific issue. The goal of the literature review is to explore different literature pertaining to a subject, collect and synthesise information, conduct a critical analysis of the obtained data to discover recent knowledge and gaps, and summarize the literature [1]. In this review of literature, the aim of the researcher is to collect and synthesize information from various secondary resources about the adverse effects of consuming large amounts of energy drinks among the young generations and shed light on its long-term cardiovascular risk potential.

Energy drinks appeared in Europe and Asia in the 1960s. The introduction of 'Red Bull' in Austria in 1987 and in the United States in 1997 resulted in a massive spike in the sale of high caffeine content energy drinks. As they have grown in popularity, their consumption has risen at an exponential rate. Energy drinks have risen in popularity as evidenced by their increased consumption patterns in the younger population. Young males primarily consume energy drinks for, psychoactive, stimulant and performance-enhancing drug effects [2, 3].

There are no specific restrictions or limitations on the sale and consumption of energy drinks making them accessible to all age groups. Though there are extensive studies suggesting a

positive association between consumption of energy drinks and improved athletic performance there are cardiovascular risks associated with it. Young, caffeine-deficient or caffeine-sensitive pregnant women, competitive athletes, and people with underlying cardiovascular disease are the most vulnerable to these risks [4].

### Energy Drinks

**Role of ingredients:** Caffeine and taurine are the two most common stimulant components in energy drinks. Caffeine has always been attributed to the majority of the adverse consequences associated with energy drink intake. Caffeine is found in energy drinks in quantities ranging from 70 to 200 mg per 500 mL can. It stimulates the sympathetic system indirectly by binding to the adenosine receptor/Gprotein on the surfaces of cardiac cells. This results in an increase in circulating noradrenaline and adrenaline levels. Noradrenaline raises blood pressure and heart rate, stimulates the release of glucose from energy stores and improves blood supply to skeletal muscle. The positive inotropic and chronotropic effects on the cardiovascular system are due to these related mechanisms. Caffeine in large quantities, especially in younger people, can disturb nervous system functioning, just as high sugar content makes an individual prone to overweight, obesity, dental erosion, and tooth decay. Caffeine's effects are highly dependent on the dose consumed, and individual responses are quite variable, a dose of

50-100 mg can be stimulating, while a dose of 500 mg can lead to serious health issues. Furthermore, athletes consuming energy drinks prior to extended physical activity should be warned about caffeine's diuretic effect that can exacerbate dehydration caused by sweat [5].

Taurine is a sulfur-containing amino acid that influences a variety of biological and physiological processes in the human body, including important cardiovascular effects, platelet aggregation, and central nervous system neuromodulation. Animal studies have suggested that taurine can lengthen the QT interval in a dose-dependent manner. Sugars in energy drinks can also affect the cardiovascular system as consuming dietary calories is known to cause an increase in heart rate, cardiac output, and pulmonary ventilation rate. Sucrose, glucose and high fructose corn syrup are easily absorbed sugars that are available in large quantities in energy drinks, which are the sources of 'rapid boosters'. Ginkgo biloba, guarana, ginseng, theophylline vitamins, L-carnitine, etc. are also among the other constituents present in variable concentrations in energy drinks [6, 7].

### Cardiovascular Effects of Energy Drinks

Myocardial infarction, aortic dissection, arrhythmias, QT prolongation, and sudden death are the cardiovascular adverse events linked to caffeinated energy drink use and the most common adverse being arrhythmias. Hypertensive patients and hypertension-risk groups, such as patients with kidney failure, morbidly obese individuals, patients with valvular heart disease, pregnant women, and patients with hypertension-related complications or congenital or acquired vascular abnormalities, can face cardiovascular risk from energy drink consumption [8].

**Risk of supraventricular and ventricular arrhythmias:** Caffeine promotes cardiac adenosine, which inhibits cardiac fibroblast formation in vitro and hence hinders remodelling after myocardial infarction, which may be a contributing factor in the development of atrial fibrillation. Caffeine is pro arrhythmic at very high doses because it increases intracellular calcium, which facilitates atrial automaticity and post depolarization-induced triggered activity. Energy drinks have also been linked to ventricular arrhythmias and sudden cardiac death in some cases [9–11]. It is recommended that healthy people restrict their energy drink use to one per day. Mixing energy drinks with alcohol is also a potential source of threat as it can lead to synergistic proarrhythmic effects [12]. Thus, amplifying the arrhythmic activity and increasing the risk of adverse cardiovascular events.

**Risk of prolonged QT interval:** Ingestion of caffeine poses a risk of QT interval prolongation. Other energy drink constituents, like ginseng, have been associated with QT prolongation in a young patients, leading to torsades de pointes

[13]. Ephedra, have been linked to a variety of cardiovascular issues, prompting its removal from the market [14].

**Risk of myocardial ischaemia or infarction:** Evidence suggests a risk of myocardial infarction in energy drink consumers [15]. The plausible explanation for this adverse event is the increase in mean arterial blood pressure, increase in platelet aggregation and impairment in endothelial function after consumption of energy drinks [16]. They all contribute to the development of long-term hypertension, increased coagulability, sudden cardiac death, cumulative vascular load, dyslipidemia, atherosclerosis and other life-threatening conditions.

**Other risks:** The other uncommon cardiovascular risks associated with energy drink consumption are aortic dissection and dilated cardiomyopathy. Caffeine-induced elevated blood pressure is one likely explanation for energy drinks-related aortic dissection. Future studies linking energy drinks consumption and aortic dissection are needed [17].

### Energy Drinks and the Younger

**Population:** Higher occurrence of energy drinks associated with adverse events in children and adolescents is attributed to their relative caffeine naivety and elevated levels of caffeine in their system. As per the recommendation of the American Academy of Pediatrics and the National Federation of State High School Associations, consumption of energy drinks is prohibited in children and adolescents, its consumption should be restricted before, after or during physical activity. The 2015 Dietary Guidelines Advisory Committee has also addressed the threats pertaining to energy drinks consumption, highlighting the sensitivity of children and adolescents to the negative health effects of caffeine, as well as the scarcity of data on caffeine use in this vulnerable cohort [18].

**Table 1: Possible cardiovascular manifestations of energy drink abuse in adolescents**

| Possible cardiovascular manifestations of energy drink abuse in adolescents |
|---|
| Tachycardia   |
| Atrial fibrillation or flutter  |
| Ventricular arrhythmias   |
| QT prolongation   |
| ST-segment elevation  |
| Myocardial infarction   |
| Hemodynamic failure   |
| Sudden cardiac death  |
| Cumulative cardiovascular load  |

Effective commercial marketing, peer influence, and a lack of knowledge of the possible hazards associated with energy drinks consumptions are the few reasons for its increased popularity among young adults and adolescents. The propensity

among young people to use alcohol-mixed energy drinks, particularly during social events, is a major public health concern. Energy drink consumption can also precipitate the onset of substance use disorder in people who are predisposed to such tendencies [19]. Also, there are concerns being raised about consuming energy drinks with illicit substances like marijuana and amphetamines [20].

It is proven that caffeine administration raises blood pressure and lowers heart rate. Similar findings have been reported in both pre- and post-pubertal boys and girls. There are gender differences in cardiovascular responses to caffeine which usually emerge after puberty. The metabolism of caffeine is altered by fluctuating steroid hormones that are present during the pubertal phase of boys and girls leading to varied cardiovascular responses. According to studies, estradiol decreases cytochrome P450 function, resulting in an increased concentration of caffeine in the systemic circulation. Another possible explanation is that these gender differences are linked to variations in caffeine consumption patterns as the younger population ages. Studies have also documented evidence of changes in caffeine metabolism with changes in the phases of the menstrual cycle in post-pubertal girls [21]. Caffeine if consumed in large quantities can also lead to exacerbation of underlying cardiac conditions [22, 23].

**Prevention of Cardiovascular Diseases:** Cardiovascular diseases are one of the leading causes of mortality globally. Diet is a combination of carbohydrates, fats and protein that have an impact on human health. The link between nutrition and health is complicated, and attempts to delay or prevent chronic diseases like cardiovascular diseases are of particular importance because chronic diseases, and specifically cardiovascular diseases, remain the largest cause of death and disability globally [24].

Cardiovascular prevention should include a multimodal behavioural intervention focused on health education, physical activity, and psychological risk factors. This critical stage in cardiovascular prevention begins with changing one's smoking habits. Half of all preventable deaths in smokers are attributable to cardiovascular diseases, which are caused by smoking. Smoking cessation has been shown to have immediate and long-term benefits. To achieve the goal of quitting smoking, health care practitioners must provide an intensive programme that includes professional assistance for improving patients' motivation and, in certain cases, pharmacological aids. Regular physical activity and aerobic exercise training have also been linked to a lower incidence of cardiovascular diseases and nonfatal coronary events in both healthy people and those with coronary risk factors and cardiac patients.

A heart-healthy diet plays a crucial role in preventing cardiovascular disease. Observational studies provide the majority of evidence supporting the impact of healthy eating

habits on cardiovascular risk. Saturated fatty acids should account for 10% of total energy intake, with polyunsaturated fatty acids replacing them as much as possible; transunsaturated fatty acids should account for 1% of total energy intake; 200 g fruit/day; 200 g vegetables/day; fish at least twice a week; alcohol consumption should be limited to two glasses (20 g/day alcohol) for men and one glass (20 g/day alcohol) for women. The amount of energy consumed should correspond to the amount of energy required to achieve a healthy weight.

Weight loss in overweight (BMI 25–29.9 kg/m<sup>2</sup>) and obese (BMI.30 kg/m<sup>2</sup>) patients is significant for cardiovascular protection since it is linked to improvements in cardiovascular risk variables such as blood pressure, dyslipidemia, and insulin resistance. Prevention is critical in diabetic patients to lower the risk of microvascular and cardiovascular problems. Another important goal in the prevention of cardiovascular diseases is reducing lipid levels. Increased plasma cholesterol and LDL cholesterol, as well as hypertriglyceridemia and low HDL cholesterol, are major risk factors for cardiovascular diseases [25]. Integration of these preventive methods in conjunction with decreased consumption of energy drinks can be a valuable strategy. Therefore, practising good cardiovascular risk prevention practices can yield better life outcomes, reduce economic burden and also decrease the burden on the expanding healthcare system.

### Regulatory Requirements

The Food and Drug Administration (FDA) has primary jurisdiction over energy drink safety, labelling, and ingredients. State and local governments can exercise jurisdiction over public health and safety to control the sale of these products and safeguard consumers through their legislatures and agencies [26]. Regulatory actions on the manufacturing and sale of high-energy drinks by the FDA and the Consumer Product Safety Commission are needed, considering the serious health issues it imposes. In addition to this, medical vigilance can also be implemented and health education can be imparted to parents and young children about the inherent risks associated with the consumption of energy drinks [27]. The rapid introduction of caffeine in non-traditional food, beverages and energy drinks makes it necessary to implement dietary assessment tools to account for evolving caffeine sources and novel components in the food supply chain. Energy drinks consumption is associated with adverse events, poison centre visits, emergency visits and hospitalisations, a systematic collection of these data along with an understanding of the various risk factors can be a useful source for determining the risk of toxicity among the youth and other populations [28].

### Literature Gap

After a thorough literature review, it can be understood that there is a lack of large epidemiological studies that correlate the

direct association between cardiovascular events and energy drink consumption. Evaluation of energy drinks over a long period of time and in a systematic manner and reducing overall caffeine consumption, particularly among children, should be a priority. Future studies exploring the adverse outcomes of energy drink consumption, and its interaction with various food products other than alcohol and illicit substances are recommended. Future studies should reflect on the association of other ingredients in energy drinks and their contribution to cardiovascular risk. Research should also be extended to identify the exact reason that leads to adverse events – rapid intake, the volume of intake or intake with other ingredients. Individual case reports can be a valuable source to stage a platform for formulating a hypothesis, and testing of hypothesis on a larger target population can yield valuable scientific results.

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