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Adverse and Beneficial Health Effects of Energy Drinks Consumption

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ABSTRACT

Energy drinks consumption in the world today is spiking at a rate that calls for public health attention to educate and present facts on how these products may potentially affect human health negatively or positively. Since the rate of promotion of many of these products is increasing with exaggerated benefits, it is important to enhance public knowledge about these products and regulate their promotion by manufacturers in order to protect the health of many ignorant consumers who consume them out of believe of what has been suggested during promotion adverts and those who consume them because they consider them as unharmful to human health.

Introduction

Popularly marketed as effective products that increase energy, enhance mental alertness and physical performance (National Center for Complementary and Integrative Health, 2022), the targeted consumers of energy drinks initially were athletes, but the marketing companies have now shifted their target consumers to not only athletes but to the general population of which only children are excluded (Alsunni, 2015). It has however been indicated by Visram, et al., (2016) that energy drink consumption among children is alarming considering the range of health risks that energy drinks have on the health of children. Nuss, et al., (2021), espoused that the promotion of energy drinks is often directed to adolescents, and no person, irrespective of age, is restricted from buying energy drinks in Australia. According to John, et al., (2018), People from diverse social and economic backgrounds including students, office workers, athletes, weekend warriors, and service members have become frequent consumers of energy drinks.

Wondering how energy drink consumption is popular among teenagers and young adults is the result of the aggressive marketing culture in areas where these groups of the population live (Alsunni 2015). Evidence to this claim is what was reported by the Mintel Energy Drink Report of 2012 (as cited in Alsunni, 2015), where it was reported that approximately two thirds of energy drink consumers are within the age range of 13–35 years old, where boys constitute two thirds of those who patronise these products.

According to Ibrahim and Iftikhar (2014), considering the increasing demand for energy drinks, reported evidence by studies regarding the safety, efficacy, and performance benefits of these products are unsystematic and often contradictory. This complex situation of drawing a firm conclusion has been enhanced by differing protocols as well as the types of products consumed.

The United States Food and Drug Administration (2018), has indicated that 400 milligrams of caffeine per day is the recommended amount for a healthy adult. This constitutes about four or five cups of coffee. This amount is considered the safest daily amount that can prevent the dangers associated with high doses of caffeine use. There is however a wide variation in both how sensitive people are to the effects of caffeine and how fast they metabolize it (Olson, 2020).

Being classified as a dietary supplement by the United States Food and Drugs Administration, regulations do not require manufacturers to prove that energy drinks are safe before they can be marketed (United States Food and Drug Administration, 2015). The mandate of the administration is to monitor mandatory serious reporting of adverse effects by energy drink manufacturers and voluntary adverse effects reporting by healthcare professionals and consumers (United States Food and Drug Administration, 2015).

According to the United States Food and Drug Administration (2018), as the concentration of caffeine in any dietary supplement (including energy drink) increases, so does the risk of caffeine overdose increase, a single teaspoon of pure powdered caffeine can contain the same quantity of caffeine as 28 cups of coffee, and a 1/2 cup of a liquid highly concentrated caffeine product can contain an equal measure of more than 20 cups of coffee. These are toxic measures of caffeine that can have lethal health consequences, including death.

The scientific community, media, governments, athletic departments, and the general public have expressed safety concerns over energy drinks, due to adverse events to include trouble sleeping, anxiety, cardiovascular events, seizures, and even death (Breda et. al., as cited in John, et al., 2018). These safety concerns regarding these products as they increasingly continue to flock the market has become a subject of keen interest to public health due to their consumption by certain vulnerable populations, including those younger than 18 years, pregnant and breastfeeding women, caffeine naïve or sensitive

individuals, individuals taking stimulant or other caffeine-based medications, those with certain cardiovascular or medical conditions, and/or heavy consumption patterns (Institute of Medicine, 2014).

Studies have indicated reported symptoms among energy drinks consumers to include palpitations, agitation, tremor, gastrointestinal upset, serious cardiac toxicities such as arrhythmias or cardiac ischaemia, and serious neurological toxicities such as hallucinations and seizures (Gunja, & Brown, 2012). Excessive use of caffeine enriched energy drinks is averred to have a significant capacity to cause an increased blood pressure, promote sleep deprivation, exacerbate mental health disorders, encourage physiologic dependence and addiction (Itany et al., 2014). A study by Huhtinen, Lindfors & Rimpelä (2013), posits that the daily use of energy drinks is strongly associated with four major health symptoms: headache, sleeping problems, irritation and tiredness/fatigue. As cited in Seifert, et al., (2011), self-reported surveys have shown that energy drinks are consumed by 30% to 50% of adolescents and young adults. Many adolescents have reported a feeling of tachycardia after consuming energy drinks that are either free of alcohol or mixed with alcohol (Itany et al., 2014). The presence of above recommended amount of caffeine in some energy drinks may predispose susceptible individuals to acute intoxication effects (Sankararaman et al., 2018). Acute energy drink intoxication characterized by cardiac arrhythmias, vomiting, seizures, tachycardia or death presents when caffeine rich energy drinks are consumed beyond the recommended daily dose (Wolk, Ganetsky & Babu, 2012). Insomnia, restlessness, tremors, depressive mood, stress and gastrointestinal upset are largely presented among people of differing ages who consume energy drinks (Nadeem, et al., 2020). With a frequency of high and unregulated concentration of caffeine, these drinks have been reported to produce serious adverse effects, especially in children, adolescents, and young adults with seizures, diabetes, cardiac abnormalities, or mood and behavioural disorders or those who take certain medications (Seifert, et al., 2011).

Adverse Effects of Energy Drinks Consumption

Cardiovascular Effects

Numerous studies have evidenced that there is a sudden increase in heart rate, cardiac output and arterial blood pressure following energy drink consumption. These findings, according to Alsunni (2015), have been linked to the ergogenic effects of the caffeine content of the energy drink. There is preponderance of evidence that cardiac malfunctions such as ventricular arrhythmias, ST segment elevation and QT prolongation have been linked to excessive energy drink consumption (Goldfarb, Tellier, & Thanassoulis, 2014). Scientific findings have also indicated that consuming energy drinks reduces endothelial function and stimulates platelet activity through arachidonic acid-induced platelet aggregation in healthy young adults (Pommerening, et al., 2015). This has been associated with the diagnosis of myocardial infarction in healthy 17-and 19-year-old boys in the studies by Wilson, et al., (2012); and Scott, El-Hassan, Khan, (2011). A randomised crossover study by Grasser, et al., (2014), revealed that energy drinks cause elevation in systolic and diastolic blood pressure levels and also lowers cerebral blood flow velocity. A 2016 meta-analysis study by Shah, et al., supported the evidence available about the effects of energy drinks in causing an increase in systolic and diastolic pressure as well as increased heart rate and cardiac output. An analysis of self-reported cases of adverse symptoms experienced following the consumption of energy drinks to the United States National Poison Data System spanning between October 1, 2010 and September 30, 2011, revealed incidences of moderate to major adverse effects such as seizure, non-ventricular dysrhythmia, ventricular dysrhythmia, and tachypnea (Seifert, et al., 2013). Palpitations, agitation, tremor and gastrointestinal upset were the most commonly reported symptoms from callers to the Australian Poisons Centre in the year 2010 (Gunja & Brown, 2012). Recent studies have also shown that the principal ingredients available in energy drinks cause vascular dilatation, aneurysm formation, dissection and ruptures of large blood vessels (González, et al., 2015).

Neurological and Psychological Effects

Studies have indicated reported health problems such as sleep disturbance, tiredness, fatigue, insomnia and headaches (Al-Shaar, et al., 2017). Even though energy drinks have been suggested to enhance memory and promote work performance attention (Scholey, & Kennedy, 2004), people develop symptoms of energy drink intoxication at doses equal to or higher than 200mg (Alsunni, 2015). Excessive consumption of energy drinks has been associated with mild, moderate and severe daily headaches by stimulating a pro-nociceptive state of cortical hyperexcitability (Espinosa, & Sobrino, 2015; Ariffin, et al., 2022). Even though the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) does not recognise a diagnosis of substance dependence on caffeine, the World Health Organization's International Classification of Diseases - 10th Revision (ICD-10), have indicated that caffeine intoxication, caffeine-induced anxiety, caffeine-induced sleep disorder and caffeine related disorder as the four-caffeine induced mental health disorders (World Health Organisation, 1992). There is a strong correlation between caffeine rich beverage consumption and violent behaviours and conduct disorders among young adolescents between the ages of 15 and 16 years (Kristjansson, et al., 2013). There is a high risk of ischemic stroke, epileptic seizures and hyperintense signal changes in the brain when people over-consume energy drinks (Dikici, et al., 2013). Studies have indicated that blood cortisol level increases after energy drink intake as it is a very important biological chemical that enhances the physiological effects of stress resulting in a greater tendency for energy drink consumers to hallucinate (Crowe, et al., 2011).

Renal Effects

According to Williams (2021); and Alsunni (2015), energy drinks that contain caffeine have the affinity to increase urine output because caffeine is a diuretic that prevents the renal tubules from selectively reabsorbing water and sodium, and also irritates the bladder walls. This suggests that energy drinks can result in dehydration. This is why it has been advised that people should avoid energy drinks intake when the environmental temperature is high and when engaging in rigorous prolonged exercise. When the body attains a dehydration level of 1.5% during prolonged exercise, an increase in body temperature, heart rate and perceived rate of exertion ensues (Montain, & Coyle, 1992). Studies have also noted an increase in serum creatinine

levels following daily consumption of energy drinks for about 2 - 3 weeks (Greene, Oman, & Lefler, 2014). This suggests that a prolonged culture of energy drinks can predispose to renal failure.

Dental Effects

There are increasing studies that are reporting a strong association of dental erosion and decay to the consumption of sugary drinks, of which energy drinks is not an exception. In a study conducted among a Swedish population, the prevalence of dental erosion was significantly associated with the consumption of soft drinks that are enriched with sugar (Hasselkvist, Johansson, & Johansson, 2010). The low pH and high sugar levels of energy drinks makes them a good fit for increasing the prevalence of dental erosion by 2.4 folds (Alsunni, 2015). Plaque microorganisms that are found in the mouth metabolise the sugars in energy drinks to produce organic acids that weaken the well mineralised enamel (Li, Zou, & Ding, 2012).

Gastrointestinal Effects

In a reported case by Vivekanandarajah, Ni, & Waked, (2011), they inferred that a patient who excessively consumed energy drinks reported to the hospital facility with clinical manifestations of jaundice, abdominal pain, and markedly increased liver transaminases, all of which were strongly noted to be associated with the habitual consumption of an energy drinks. Another report by Huang, et al., (2014), indicated that a 36 years old man who consumed 3 sugar-free energy drinks daily for the past year with binge alcohol use presented to the hospital facility with a history of one week of right upper quadrant abdominal pain, jaundice, and fatigue.

Metabolic Effects

Most energy drinks contain large amounts of sugars of about 21g to about 34g per ounce. These sugar contents are added to the drinks in the forms of sucrose, glucose or high fructose corn syrup. In view of this, people who consume energy drinks are at increasing risk of obesity and Type II diabetes (Bedi, Dewan and Gupta, 2014 as cited in Alsunni, 2015). The risk of obesity and metabolic syndrome is increased when an individual consume energy drinks because the high sugar contents in energy drinks can reduce the activity, diversity and gene expression of intestinal bacteria (Greenblum, Turnbaugh, & Borenstein, 2012). Olas & Brys (2019), suggests that energy drinks are capable of modifying the physiological processes of platelet reactivity via altering the actions of signaling enzymes, and by altering cAMP and reactive oxygen species levels. A randomised controlled study by Basrai, et al., 2019), revealed that energy drinks caused a reduction in serum glucose levels and an elevation in insulin concentrations after one hour of consumption. Energy drinks decrease significantly, serum levels of glucose and lactate (Soon-Mi, et al., 2017). However, acute energy drink ingestion has been suggested to reduce insulin sensitivity (Lee, et al., 2005), this may account for the substantive elevation in blood glucose after energy drink consumption (Lee, et al., 2005; Ragsdale, et al., 2010).

Effects on Pregnancy and Female Reproductive Health

Numerous scientific sources have evidenced that consuming artificially sweetened drinks containing aspartame during pregnancy is directly associated with an increased risk of premature birth in both normal-weight and overweight women (Arifin et al., 2022). This suggests that aspartame intake and use, especially during pregnancy, may have detrimental consequences on both the mother and fetus (Halldorsson, et al., 2010). This has been espoused in various reports that pregnant mothers who consume aspartame give birth to children with autism (Czarnecka, et al., 2021; Halldorsson, et al., 2010; Martins, et al., 2007). Scientific studies have also shown that aspartame promotes early commencement of menstruation in females aged 9 - 10 years (Martins, et al., 2007; Halldorsson, et al., 2010).

Perceived Benefits of Energy Drinks Consumption

The famous study by Alford, Cox, & Wescott (2001), evidenced the role that energy drinks play on psychomotor performance (memory, reaction time and concentration), subjective alertness and physical endurance. Using 36 volunteers in a controlled trial study, they discovered that energy drinks increased aerobic endurance (i.e., maintaining 65-75% maximum heart rate) and anaerobic activity (i.e., maintaining maximum speed) on cycle ergometers. The study further showed that energy drinks enhance intellectual performance including choice reaction time, concentration (number cancellation) and memory (immediate recall), which are indicative of increased subjective alertness. The study by Warburton, Bersellini, & Sweeney (2001), also revealed that drinks containing caffeine and taurine improve attention, information processing and verbal reasoning. Caffeine, taurine and glucuronolactone, which are very key ingredients in energy drinks, have beneficial effects on human mental performance and mood (Seidl, et al., 2000). These effects may be instigated by the effects of caffeine on purinergic (adenosinergic) receptors and taurine mediation of receptors (Seidl, et al., 2000).

According to Jeffers, Vatalaro Hill, & Benotsch, (2014), reasons for energy drink consumption among a cohort of 856 undergraduate students included desire to lose weight, a perception of poor body image, and losing weight without engaging in unhealthy weight loss behaviours such as bulimia and anorexia nervosa. A meta-analysis of randomised control trial studies on weight loss using caffeine rich beverages by Tabrizi, et al., (2019), concluded that caffeine consumption may improve weight loss, and may also decrease Body Mass Index (BMI) and overall body. Collado-Mateo, et al., (2020), have suggested that pre-exercise drinking of a moderate dose of caffeinated drink may increase optimally fat utilisation during aerobic exercise of submaximal intensity that is undertaken after a fasting period. As ginger is one of the ingredients available in some energy drinks, studies have demonstrated that ginger contributes significantly in reducing Body Mass Index (BMI), Waist-to-Hip Ratio, Hip-Ratio, Fasting Glucose Levels, and Insulin Resistance Index, and also promotes an increase in High Density Lipoproteins (HDL) cholesterol levels (Maharlouei, et al., 2019).

Even though energy drinks have been noted to improve performance during exercises of various forms and intensities, their detrimental effects on health cannot be underestimated, as they have been documented to cause serious health problems in children, adolescents and adults. Often constituted with B-

group vitamins in values that are usually higher than the daily recommended doses for healthy people, energy drinks may provide the many benefits that these vitamins provide to the body. Studies have shown that higher nutritional intake of folate and Vitamin B6 reduces the risk of stroke related deaths, coronary heart disorders and cardiac failure (Rhenze, 2010).

Conclusion

It is clearly evident that the consumption of energy drinks is increasingly alarming. Consumers to a large extent are not in tune with what is considered safe consumption. Even though energy drinks present some beneficial effects that may be alluring, the long-term damage they have on the human body needs to be given the necessary attention to safeguard the health of the public. With the increasing popularity of many of these products in the market, it is important for regulatory bodies to take keen interest in how these products are promoted to avert exaggerated and unscientific claims that are being propounded by manufacturers.

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