

A Survey of Energy Drink Consumption Patterns among College Students: An Article Review

Michel V Mutabazi^{1*}, Brian Miyanda¹, Monique M Ndahayo² and Sophonie Ndahayo³

¹*School of Health Sciences, Department of Nursing, Rusangu University, Monze, Zambia*

²*School of Science and Technology, Department of Natural Sciences, Rusangu University, Monze, Zambia*

³*Independent Researcher, Zambia*

***Corresponding Author:** Michel V Mutabazi, School of Health Sciences, Department of Nursing, Rusangu University, Monze, Zambia.

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Abstract

Malinauskas BM, Aeby VG, Overton RF, Carpenter-Aeby T and Barber K [1] published an article entitled "A survey of energy drink consumption patterns among college students" in *Nutrition Journal* 6 (35), doi:10.1186/1475-2891-6-35. The study had three purposes: 1. to determine energy drink consumption patterns among college students, prevalence and frequency of energy drink consumption under the following variables: insufficient sleep, to increase energy in general, while studying, driving long periods of time, drinking with alcohol while partying, and to treat a hangover, 2. to establish the prevalence of adverse side effects and 3. to identify the energy drink use-dose-effects among college energy drink users. Data was collected using focus groups, field trip as well as a questionnaire from 496 respondents randomly selected at a university. Of the total respondents (n = 496), 51% reported consuming greater than one energy drink each month. Furthermore, 67%, 65% and 54% used energy drinks for insufficient sleep, increase energy in general, and with alcohol respectively. Forty nine percent consumed three drinks to treat various situations. Weekly jolt and crash episodes were experienced by 29% of users, while 22% reported ever having headaches, and 19% heart palpitations. It was concluded that using energy drinks is a popular practice among college students for a variety of situations and side effects were fairly common. Recommendations included finding out whether college students recognize the amounts of caffeine in consumed drinks.

Keywords: Energy Drinks; College Students; Side Effects; Caffeine; Carnitine; Taurine; Ginseng; Guarana

Introduction

Adolescents' energy needs vary depending on current growth rate, gender, body composition and physical activity [2]. Energy comes from foods and drinks. Adolescents who consume soft drinks regularly are more likely to be overweight [3,4]. Soft drinks containing caffeine present a different problem if caffeine intake becomes excessive (200 mg). In greater amounts, caffeine may cause symptoms associated with anxiety, such as sweating, tenseness, and inability to concentrate ([5], p. 526).

Harris and Munsell [6] found that the marketing of energy drinks is often youth-oriented and the energy drink market has grown rapidly in recent years with global consumption nearly doubling between 2006 and 2012 (Meier, 2012). However, there is a concern about the risks and potentially harmful effects of energy drinks consumption on consumers' health, especially young people, due to the high content of caffeine, sugar, and other ingredients such as taurine, guarana, vitamins, and herbal ingredients [6,7]. Some studies have found associations between energy drinks use and other risk-taking behaviors such as alcohol and drug use, smoking, sexual risk-

taking, and violence among adolescents and young adults [8,9]. Energy drinks, which include Red Bull, Amp, Monster, Rock Star, Rip It, Full Throttle, and Cocaine, are designed to give the consumer a “surge” of energy provided by the combination of stimulants and “energy boosters” that they provide, including caffeine, herbal extracts such as guarana, ginseng, and ginkgo biloba, B vitamins, amino acids such as taurine, amino acid derivatives such as carnitine, and sugar derivatives, including glucuronalactone and ribose [10]. Having noted with concern the influx of energy drinks in the local market, the authors purposed to review the above-named article to enlighten the reader on the energy drinks’ health effects besides the boost of energy. This is in line with Al-Shaar, *et al.* [11] who observed that as energy drinks consumption continues to grow worldwide and within the United States. They added that it is important to critically examine the nutritional content and effects on population health of these beverages. The researchers went on to say that emerging evidence has linked energy drinks consumption with a number of negative health consequence such as risk-seeking behaviors, poor mental health, adverse cardiovascular effects, and metabolic, renal or dental conditions.

Review of related literature and studies

Red Bull became the first energy drink on the market when it was released in 1987. Studies [1,6,12] found that energy drink consumption has continued to gain popularity since the 1987 debut of Red Bull, the then leader in the energy drink market. Most of energy drinks contain high doses of caffeine and free-sugars or sweeteners. Smit, *et al.* [13] found that energy drinks, as compared to placebo, had energizing effects among 18 to 55-year-old participants, with effects being strongest 30 to 60 minutes after consumption and sustained at least 90 minutes. A major cause of concern has been increased risk associated with energy drinks’ consumption, excess caffeine ingestion, which can lead to adverse health effects. Jones and Fernyhough [14] reported that hallucinations might be observed in individuals that consume more than 300 mg of caffeine per day. It is noteworthy that some countries like Canada regulate relatively high caffeine quantities: Health Canada allows a caffeine content of 200 - 400 ppm (mg/liter) and a maximum of 180 mg per serving/container [15].

Side effects of energy drinks

Consumption of energy drinks is currently regarded as a health-risk practice that is on an exponential rise globally [16,17]. Of great concern, especially to public health nutritionists, is the lack of regulation for energy drinks, as well as the ingredients used in their manufacture. Evidence is emerging on the harmful physiological and psychological effects of energy drinks. Rationally this would imply that prolonged consumption of these beverages may adversely affect ones physical and mental well-being [18].

Physical effects

In children and youth, regular energy drink consumption can cause dependence, even in moderate amounts [19]. The risks noted from use of sugar sweetened beverages on individuals include diabetes and metabolic syndrome [20]. Furthermore, chronic health implications associated with the high sugar contents of the energy drinks include dental erosion, type 2 diabetes and obesity. Upon consumption, experience of surge of energy followed by a rigid decrease in energy levels is experienced, this causes customers to turn to foods that are calorically dense predisposing them to weight gain and obesity [21]. Furthermore, an association with unhealthy dietary behaviors and food choices has been noted [9]. Some trials reported acute cardiovascular effects of energy drinks, especially among high-risk individuals for such events [22].

Similarly, case reports have shown an association between health effects such as: stroke, seizures, cardiac effects and energy drink consumption [23,24]. Associations between energy drinks consumption and high-risk behaviors such as alcohol consumption, sexual risk-taking practices, excitement of the desire and intention to drive under the influence of alcohol, as well as marijuana use have also been reported [9,25].

The United States Food and Drug Administration (USFDA) has identified more than 30 deaths linked to energy drinks based on adverse events reports between 2004 and 2012 [26]. In a study conducted in Finland, increased odds of headaches were noted. Also, in another

Australian study among 12 to 18-year-olds, more than half of participants reported experiencing at least one symptom after consuming energy drinks including tachycardia, upset stomach, anxiety, tremors and heart palpitations.

Psychological effects

An Italian survey revealed that 45% of medical students reported insomnia and irritability following energy drink consumption. Population-based studies are believed to offer clearer and more realistic reports, because contacts are more proactive. In one school-based study, sleeping problems and irritation were notable among energy drink users [27].

Side effects as per constituents of energy drinks

Caffeine

Among energy drink constituents, caffeine comes first. Moderate caffeine intake (up to 400 mg/day) is generally considered safe [28], though other authorities [29] disputed the fact. As for free sugar, the amount of sugar contained in one can (500 ml) of an energy drink is typically about 54 grams, while the recommendations of the World Health Organization are 25 grams (six teaspoons) per day, which would provide additional health benefits (www.who.int).

In America, though the amount of caffeine in sodas has been restricted to 18 mg/100 ml by the Food and Drug Administration, energy drinks have been exempted from such legislature. As a result, common energy drinks on the market were found to have between 14 - 31 mg of caffeine per 100 mls, leading to higher levels of caffeine intake [30].

Among the documented side effects of caffeine, hyperglycemia is common in cases of caffeine toxicity secondary to increased lipolysis, glycogenolysis and gluconeogenesis [31]. Furthermore, leukocytosis, mild metabolic acidosis, ketonuria, hypophosphatemia and hypocalcemia have been described as well [32]. It has been proposed that as a result of adrenergic B2-receptor agonism and diuresis profound hypokalemia has been observed [33]. In addition, rhabdomyolysis, sinus tachycardia and tachyarrhythmias have also been reported in cases of caffeine toxicity, similarly irritability that progresses to lethargy and coma were observed in cases of central nervous system toxicity. Also, myoclonic jerks, clonus, hallucinations and opisthotonos are commonly associated with caffeine toxicity [33]. It has been noted that patients with pre-existing heart pathology, or a history of seizures are at a greater risk.

Carnitine

Carnitine is an amino acid commonly found in energy drinks. It is commonly useful in vitamin B-oxidation of fatty acids. Supplementation of the active isomer (levocarnitine) is a common practice reported in dementia and end stage renal disease. Adverse effects of its supplementation include nausea, vomiting, abdominal pain, diarrhea as well increased seizure frequency in known patients. Ignoring all these adverse effects, energy drink manufacturers promote carnitine consumption as a means to burn fat and increase stamina [34].

Taurine

Taurine is an amino acid produced by the metabolism of methionine and cysteine that plays a vital role in metabolism including osmoregulation, antioxidation and glycolysis. Very little is known about taurine, especially regarding dosage effects and long-term use by youths, this implies that its use is questionable [35].

Ginseng (*Panax ginseng*)

This is a very common ingredient in energy drinks, originally used as a herb in East Asia for improved stamina and memory. Only very few medical literatures assert these uses. On the contrary reports of serious complications include cases of diarrhea, vaginal bleeding, severe headache as well as Steven-Johnsons Syndrome [36]. A ginseng abuse syndrome has been frequently reported characterized by hypertension, morning diarrhea, rashes, insomnia and irritability. Similarly, herb-drug interactions in its use include a decreased blood pressure when used with warfarin, it may also cause hypoglycemia when used with antidiabetic agents [37].

Guarana

A South American plant known for stimulant properties, derived from *Paullinia cupana* seeds. It has similar adverse effects to caffeine, containing 4 - 8% caffeine, as well as theobromine, theophylline and a high concentration of tannins. However, its duration of action is longer because of the presence of saponins and tannins [38].

Other caffeine containing ingredients found in energy drinks include kola nut, tea, yerba mate and cocoa. The inclusion of such ingredients does not necessitate caffeine labelling and their presence may not be included in calculations of caffeine content, when in reality they actually contribute to caffeine content of energy drinks [38,39].

Reasons for consumption

Just like any product on the market, the reasons for purchase and consumption of energy drinks are diverse. Globally there has been expressively an exponential increase in consumption of energy drinks [40]. From the pool of reasons of consumption, the following are the notable reasons why people take energy drinks: sweet taste compounded by a need for energy, to enhance sports performance, association to a particular brand (trademark) due to vigorous advertising, having some time out with friends and various social predicaments, encouraging or prohibiting behaviour by parents and caregivers, to boost energy levels, compensate for insufficient sleep, driving long distances, improve concentration while studying, to improve the taste of alcoholic drinks during parties, to treat hangovers, perceived benefits on health, prevention of illness, improved immunity and to rectify poor diet [41]. Costa, Hayley and Miller [42] added that energy drink consumption provides social acceptance, hence perceived necessity to meet busy lifestyle demands. In addition, energy drinks were found to suppress or delay the depressing effects of alcohol. Other reasons may include availability of energy drinks in stores, school tuck shops and non-restrictions on their purchase and consumption. According to Friis, Lyng, Lasgaard and Larsen [43], lower levels of education also contributes to energy drinks' consumption. Earlier on, Wilmer and Levant [44] had reported masculinity ideology and risk-taking as factors contributing to more men consuming energy drinks.

Recent advances on the topic

The contemporary world places various burdens on youths and adult alike; therefore, they find themselves overwhelmed with the hustle and baffle of life. In a quest to accomplish more and yet more, which also demands more energy, individuals find themselves in need of some external drives and source of energy. Attracted by the claims of energy drink manufacturers and advertisements, which seem to meet their present energy need, a sizeable number of individuals fall prey to energy drink consumption. Bottle after bottle, with increasing frequency and amount on subsequent occasions. Such a predicament comes as no surprise because a boost of one's energy levels, increased physical endurance, as well as a shorter reaction rate and increased mental concentration are every individual's desires. Having identified these needs, energy drink manufacturers market their products as the solution to the desperate individuals' need [45]. Energy drinks have been defined as beverages containing concentrated amounts of caffeine as well as stimulants in the form of herbal supplements, sugars, sweeteners and amino acids such as taurine and vitamins [46].

The widespread trend of an exponential increase in the consumption of energy drinks leaves African countries as no exception. In this regard there has been consistency in evolving evidence, which is revealing diverse links between energy drink consumption and a broad spectrum of negative health results ranging from dental conditions, metabolic imbalances, negative cardiovascular effects, risk seeking behaviors and mental illness. This unacceptable predicament is worsened by a regulatory oversight, as well as an aggressive marketing by the industry towards the youths [47]. There is great need for critical evaluation of the nutritional content of energy drinks, even more of their effects on the human body, especially that the consumer target group for the energy drink industry are adolescents and young adults [48].

In a cross-sectional survey conducted in Taiwan among undergraduate students, it was reported that the major reasons for consuming energy drinks included: keeping alert at work, being curious about the products, enjoying the flavor, preparing for school exams and to

increase energy during before sexual intercourse. Half of the participants had never read the nutritional label, and it was also appreciated that the practice of mixing energy drinks with alcohol was common. Being male, living away from the parent's home, tobacco use, alcohol use and positive perceptions of energy drinks effects, impulsivity, and risk-taking behaviors significantly predicted energy drink consumption. Correlations between energy drink consumption, alcohol and tobacco use were appreciated. These results revealed how critical this subject is, especially in vulnerable groups such as children and adolescents [49].

Though energy drinks are available under various brand names, most of them contain similar ingredients, which include water, sugar, caffeine, non-nutritive stimulants (such as guarana, ginseng, yerba mate, taurine, L-carnitine, D-glucuronolactone and inositol) and certain vitamins and minerals [48]. The content has been found to range widely from 47 to 80 mg per 8oz to as high as 207 mg per 2oz and this is derived from a number of ingredient sources [50]. A large pool of literature on energy drinks has proposed that the health disadvantages of both short and long-term energy drink consumption are attributable to high levels of caffeine and sugar. However, considering the significant caffeine content of other ingredients, more research on the effects of other energy drink constituents is a necessity [11].

In a recent study [51] on the effects of acute consumption of energy drinks on blood pressure, heart rate and blood glucose in a group of healthy young adults, having consumed 3 portions of energy drinks (240 mg of caffeine), a significant increase in diastolic blood pressure and blood glucose was appreciated, in addition some participants reported various discomforts, which escalated after 2-3 portions of energy drinks. Though these findings may not suffice to be a baseline on which to draw conclusions, however they do indicate the vast demand for further research on the effect of these beverages on larger populations, in order to provide conclusive evidence [51].

In a review by Richards and Smith [52] that sought to address the associations between energy drink use and mental health outcomes, positive associations between energy drink consumption and symptoms of mental illness were reported. Most literature available follows a cross-sectional design, hence it is limited in determining the cause, for this reason longitudinal and intervention studies are required to increase the understanding of the correlations observed.

In a nationally representative study conducted in New Zealand on the associations of energy drink consumption, mental health as well as health risk behaviors and body size, it was found that energy drink consumption was significantly associated with greater depressive symptoms, greater emotional difficulties and lower general subjective wellbeing. Moreover, frequent energy drink consumption was associated with binge drinking, smoking, engagement in unsafe sex, violent behaviors, risky motor vehicle use and disordered eating behaviors. However, no association was found between consumption energy drink consumption and body size. The acute surge of energy experienced after consumption seems to be of a positive effect, however long-term associations are not positive [52]. It is high time that health professionals should consider that energy drink consumption may be a marker for many other health risk behaviors and emotional distress among young people. Given their high sugar and caffeine content, public health strategies to limit consumption among young people are necessary [17].

Methodology

The study followed a descriptive research methodology. Data was collected through a systematic process: focus groups were formed, and then a registered dietitian and a health educator designed a questionnaire to assess among others demographic information, type of energy drink consumed, monthly consumption and side effects from using energy drinks. A pilot study was carried out on students randomly chosen. The study was conducted in line with the Helsinki declaration. Participants were informed about the research process and those will to take part filled-in the questionnaire. The research purpose was scrutinized by the University's Institutional review board for research on human subjects: University Medical Centre Institutional Review Board number 06-0718.

The population of the study was made of the fall 2006 enrolment: undergraduate enrolment of approximately 18,000 undergraduate and 6,000 graduate students. Statistical analysis was performed using JMP IN software. A 0.05% level of acceptance was adopted for all statistical tests. A sample of 496 respondents that were randomly selected participated in this research.

Results

Results showed that energy drink consumption patterns among college students were as follows: 51% of participants reported drinking greater than one energy drink each month in an average month during the semester of the study, with significantly more female (53%) than male (42%) energy drink users, $\chi^2 (1, n = 496) = 6.46, p = .01$. Seventy-four percent users drank sugar-containing versions with significantly more females (35%) than males (12%) drinking sugar-free versions, $\chi^2 (1, n = 247) = 16.56, p < .01$. Energy drink consumption patterns of college energy drink users for the six situations assessed were in the table that follows on page 13 of the article.

Situation	% females	% males	χ^2	p
Insufficient sleep	67	68	.17	.68
Need of energy in general	62	69	1.27	.26
Studying/major projects	46	56	2.22	.14
Driving long distances	40	51	3.01	.08
Mixing with alcohol while partying	57	50	1.33	.25
Treating hangover	16	18	.18	.67

Table 1: Distribution of reasons for use of energy drinks per gender.

Insufficient sleep was the most common reason to drink energy drinks, as indicated by 67% of energy drink users. The majority of users consumed energy drinks to increase their energy (65%) and to drink with alcohol while partying (54%). Fifty percent drank while studying or completing a major course project, 45% while driving a car for a long period of time, and 17% to treat a hangover. There were no significant differences in use of energy drinks for the six situations assessed by sex.

Discussion

Consumption of energy drinks was observed to be high (more than one per month) among college students ($n = 253$) to treat various situations that included 67% for insufficient sleep, increase energy in general 65%, partying (49%) among others. These findings were consistent with those of Pomeranz, *et al.* [7], Reid, *et al.* [12]. Pertaining to health effects, 22% reported headache while 19% experienced heart palpitations. These adverse effects were similar with the findings of the National Institute of Health [53]: more than 500 milligrams a day of caffeine is considered unhealthy and causes insomnia, nervousness, restlessness, irritability, stomach upset, muscle tremors, and increased blood pressure, as well as heart rate. Similarly, Hammond, Reid, and Zukowski [54] found adverse effects of caffeinated energy drinks among youth (12 - 17) and young adults (18 - 24) in Canada to include fast heart rate (24.7%), difficult in sleeping (24.1%), headache (18.3%), nausea/vomiting/diarrhea (5.1%) and chest pain (3.6%) ($n = 2055$).

Conclusion

The consumption of energy drinks is very popular among adolescents. Though energy drinks benefit performance, detrimental health problems have been documented especially among children and adolescents in the reviewed article and many others [12,55,56]. Alsunni [56] recommended that overambitious marketing and non-scientific claims should be regulated by governments. It is necessary for each individual, especially adolescents and young adults to be responsible enough in matters of disease prevention through a healthy lifestyle that includes food and drink intake [57-66].

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