

Impact of Single Use of Energy Drink on Blood Pressure and Heart Rate in Healthy Medical Students

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Abstract

Background: Globally, the popularity of energy drinks is steadily increasing. After being first introduced around 1960, they have been increasingly used all over the world for the promotion of mental concentration and vigilance. Although few of these claims have been partly demonstrated in a few athlete-targeted surveys, many more health concerns are increasingly unfolded about the excessive consumption of energy drinks. A number of investigations focused on the hemodynamic effects of the consumption of energy drinks on healthy individuals; some of which found a statistically significant effect on heart rate (HR) and blood pressure (BP)

Objective: To evaluate the acute effects of the consumption of energy drinks on blood pressure and heart rate in a group of healthy medical students.

Materials and Method: The study was conducted on 40 healthy MBBS students studying in Bangalore Medical College and Research Institute in the age group of 19 to 22 years. Blood pressure and pulse rate were recorded pre and 1 hour post consumption of energy drink in the subjects.

Results : Descriptive statistical analysis was carried out on the data obtained in the present study. The systolic and diastolic blood pressure increased 1 hour post consumption of energy drink but not statistically significant. Heart rate increased significantly 1 hour post consumption of energy drink.

Conclusion: A statistically significant increase in heart rate was observed in the subjects one hour after consumption of energy drink (pre=78.6±9.03, post=83.4±10.08, p value=0.05*). Though there was no statistically significant change in blood pressure, systolic BP increased by 3 mm of Hg (from 112.2±9.96 to 115.3±9.86) and diastolic BP increased by 2mm of Hg (from 71±7.32 to 72.2±6.75).

Keywords: energy drinks, blood pressure, heart rate, medical students

Introduction

Energy drinks (EDs) are gaining popularity every year with a broad consumer base including athletes, amateur competitors, and even those experiencing work-related fatigue. EDs represent a relatively new class of caffeinated beverages that are generally marketed to

improve energy, athletic performance, concentration, endurance, weight loss and to provide a short-term energy boost but they do not constitute suitable sources of rehydration or restoration of electrolytes in association with athletic activity. The main contents in these EDs are caffeine, water, sucrose, glucose, acidity regulators, acidulant (citric acid), glucuronolactone, taurine and vitamins.

In recent years the marketing of these energy drinks has increased drastically due to their easy availability. Adolescents and young adults are the most vulnerable group who fall prey to these energy drinks especially those in a transitional stage of physical and psychological development. Dependence on energy drinks could be

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a potential risk of substance abuse later in life ¹. The body develops a tolerance to the positive effect of these energy drinks and not to the negative effects. A number of studies have shown the high consumption rate of these energy drinks among college students and also medical students ^{2,4}. This shows the lack of awareness among college students and adolescence about the importance of good nutrition and the high caloric and caffeine content of energy drinks.

Numerous studies have associated EDs and their ingredients with acute hypertension ^{5,6}. This is consistent with known hemodynamic changes caused by caffeine consumption ^{7, 8}. Caffeine is a sympathomimetic. Acute caffeine consumption can increase plasma renin, catecholamines, and dopamine. These substances stimulate the central nervous system, thereby increasing blood pressure and heart rate ^{9,10}. A study on impact of acute consumption of EDs found that the systolic and diastolic blood pressures increased on an average by 4.44 mm of Hg and 2.73 mm of Hg respectively and the heart rate increased by 0.80 beats per minute ¹¹.

Medical students are exposed to various stressors ¹² that may precipitate a variety of health risk behaviours, such as smoking ^{13,14} and consumption of high levels of caffeinated beverages ¹⁵. Comparatively medical students' stress level is higher than non-medical students. Similarly stress level increases as one moves from junior to senior level at his/her college or university. There are also little researches done on energy drink consumption patterns among medical students.

Hence the present study was undertaken to assess the acute influence of energy drinks on blood pressure and pulse rate in medical students.

Materials and Method

Source of data:

The study was done on 40 healthy MBBS students studying in Bangalore Medical College and Research Institute in the age group of 19 to 22 years.

Method of collection of data (including sampling procedure):

Subjects were matched in for age & sex and selected based on inclusion and exclusion criteria after taking a written informed consent.

Study period: February 2017- April 2017

Study group: Healthy MBBS students studying in Bangalore Medical College and Research Institute

Sample size: 40 healthy medical students.

Inclusion Criteria:

1. 40 healthy medical students
2. Subjects who have given written informed consent.

Exclusion Criteria:

1. Those with a BMI greater than 30 kg m⁻²
2. Competition athletes
3. Individuals with a daily exercise workload exceeding 60 min per day.
4. Subjects having any diseases or taking any medication affecting cardiovascular or autonomic regulation.
5. Subjects whose caffeine intake in excess of 150 mg daily from food and beverages.
6. Subjects who reported to be on psychiatric treatment.
7. Subjects suffering from any chronic disorders.
8. Subjects with history of smoking or alcohol use.

Methodology

All experiments were conducted in a quiet, temperature-controlled (20–22 °C) laboratory and started between 08.00 and 09.00 a.m. Every subject would attend the experimental sessions at the lifestyle laboratory, centenary building, Victoria Hospital, BMCRI. On arrival at the laboratory, subjects were asked to empty their bladders if necessary and to sit in a comfortable armchair. All the subjects were asked to relax for a period of 30 minutes following which a baseline recording of BP using mercury sphygmomanometer and pulse rate were made. Then the test subjects would ingest 355 mL of a degassed energy drink containing caffeine (114 mg), taurine (1,420 mg), glucuronolactone (84.2 mg), sucrose and glucose (39.1 g) at room temperature. Subjects were asked to ingest their drink in a convenient pace over 4 min. After 1 hour of post-drink, BP and pulse

rate recording was repeated. Throughout the procedures, subjects were permitted to watch neutral documentaries on a flat TV screen set at eye level.

Results

The study was conducted on 40 healthy first and second year MBBS students.

Statistical Analysis

Descriptive statistical analysis has been carried out on the data obtained in the present study. Results on continuous measurements are presented on Mean \pm SD. Significance is assessed at 5 % level of significance. Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups. Significance was reckoned as: $0.01 < P \leq 0.05$ significant (*); $P \leq 0.01$ highly significant

Microsoft word and Excel have been used to generate tables.

Table 1: Mean \pm SD of different parameters pre and 1 hour post consumption of energy drink

Parameters	BEFORE	AFTER	P Value
SBP	112.2 \pm 9.96	115.3 \pm 9.86	0.23
DBP	71 \pm 7.32	72.2 \pm 6.75	0.52
HR	78.6 \pm 9.03	83.4 \pm 10.08	0.05*

Inference: The systolic and diastolic blood pressure increased 1 hour post consumption of energy drink but not statistically significant. Heart rate increased significantly 1 hour post energy consumption drink.

Table 2: Mean \pm SD of different parameters in females pre and 1 hour post consumption of energy drink

Parameters	BEFORE	AFTER	P Value
SBP	105.4 \pm 5.6	110.3 \pm 8.3	0.05*
DBP	70 \pm 8.1	72.5 \pm 6.45	0.34
HR	79.6 \pm 9.96	86.4 \pm 9.7	0.07

Inference: systolic blood pressure significantly increased in the female participants post 1 hour consumption of energy drink. Diastolic blood pressure and heart rate has increased but not statistically significant.

Table 3: Mean \pm SD of different parameters in males pre and 1 hour post consumption of energy drink

Parameters	BEFORE	AFTER	P Value
SBP	119.4 \pm 8.6	122.3 \pm 3.87	0.5
DBP	72 \pm 7.5	71.8 \pm 7.3	0.9
HR	77.4 \pm 8.2	86.4 \pm 9.7	0.07

Inference: Systolic blood pressure and heart rate increased in the male participants 1 hour post consumption of energy drink but not statistically significant. Diastolic blood pressure has decreased minimally but not statistically significant.

Discussion

There are currently more than 500 energy drink products available on the market purported to boost physical and mental alertness.¹⁶ In line with their increased popularity is a coinciding rise in energy drink-associated emergency department visits and deaths, which has led to questions about their true safety profile.^{17, 18, 19}

In this present interventional study we administered an energy drink containing caffeine (114 mg), taurine (1,420 mg), glucuronolactone (84.2 mg), sucrose and glucose (39.1 g) in 40 healthy first and second year medical students. We evaluated blood pressure and heart rate pre and 1 hour post consumption of energy drink in them. The results were tabulated and statistically analyzed.

Table 1 shows that the systolic and diastolic blood pressure increased 1 hour post consumption of energy drink but not statistically significant. Heart rate increased significantly 1 hour post energy drink consumption. These results are similar to the results quoted in the studies conducted by Emily A. Fletcher et al and G. Geethavani et al.²⁰

Caffeine increases systolic blood pressure to extent of 17% and mean arterial blood pressure by about 11%. Heart rate was also increased. The increase in systolic blood pressure was attributed more to the increased stiffness of the aorta and larger blood vessels rather than increased stroke volume. The increase of aortic stiffness is attributed to the increased production of angiotensin II and catecholamines potentially nor adrenaline. These changes are attributable to the inhibition of adenosine A_{2α} receptors activity in the smooth muscles of blood vessels. The concomitant increase in the release of renin from the kidneys because of the direct stimulation by caffeine and similar activity on sympathetic ganglions releasing noradrenaline contributes to the increased activity of vascular smooth muscles

Adenosine is a potent vasodilator but caffeine, an adenosine analogue competitively inhibits the adenosine receptors and brings out vasoconstriction. The psychoactive effects of caffeine are due to the blockade of adenosine receptors of brain. It can increase the systolic blood pressure by enhancing angiotensin II and epinephrine. It can also increase the heart rate by increasing the levels of catecholamines.²¹

Jonson w. daniels et al²² showed that angiotensin II levels were increased with caffeine. As we know that angiotensin II is a powerful vasoconstrictor, it causes increase in blood pressure. In the present study we noticed increase in values of blood pressure after caffeine intake which clearly substantiates the above statement.

Angiotensin II (ANG) potently enhances catecholamine release from the peripheral sympathetic system.²³ Catecholamines released by this mechanism contribute to the vasoconstricting and sodium-retaining properties of ANG6. In particular, the chronic effects of ANG at moderately elevated levels are promoted by adrenergic pathways that are significantly involved in the development of hypertension.^{24, 25}

Caffeine with its multiple effects is (1) an adenosine receptor blocker. (2) Increases levels of angiotensin II (3) increases the levels of catecholamines.

Table 2 systolic blood pressure significantly increased in the female participants post 1 hour consumption of energy drink. Diastolic blood pressure and heart rate has increased but not statistically significant.

This could be due to the varying levels of sex steroids during different phases of the menstrual cycle.²⁶

Energy drinks generally contain more than the recommended amount of potentially harmful chemicals. The Food and Drug Administration (FDA) regulates the amount of caffeine in sodas and other caffeinated drinks but not in energy drinks.

Students should be counseled regarding the consumption of energy drinks like Red Bull and Monster energy drinks which contain a high amount of caffeine and have poor nutritive value. This increased caffeine consumption serves as a gateway for drug abuse later in life.

One has to outweigh the benefits and hazards of consuming an energy drink before consuming it in high amounts which raises concerns about its safety. Energy drinks also contain taurine and glucuronolactone which do not directly affect reaction time but may alter it in combination. Therefore consuming these ingredients in excess also raises concern regarding their toxicity. An ideal energy drink should have the lowest amount of caffeine and sugar while still accomplishing the needed results without addiction. Further research needs to be done to evaluate the effects of the individual components of energy drinks like taurine and glucuronolactone. Well-designed randomized placebo controlled studies are needed to assess the benefits of an energy drink.

Implementation of educational awareness campaigns, especially in medical colleges, about healthy dietary habits, potential benefits, side effects and correction of wrong perceptions about energy drinks is urgently needed. Policies for energy drinks consumption and control programs are also recommended.

Conclusion

An interventional study was taken up to see the acute effect of energy drink commonly available in the market on blood pressure and heart rate in medical students. The data was tabulated, analyzed statistically and discussed.

The following conclusions were obtained from the study:

In all the 40 participants

Systolic and diastolic blood pressure increased 1 hour post consumption of energy drink but not statistically

significant and Heart rate increased significantly 1 hour post energy consumption drink in all the 40 subjects.

Systolic blood pressure significantly increased in the female participants post 1 hour consumption of energy drink. Heart rate increased but not statistically significant

Systolic blood pressure and heart rate increased in the male participants 1 hour post consumption of energy drink but not statistically significant.

Conflict of Interest – Nil

Source of Funding- Self

Ethical Clearance – was obtained from the institutional ethical committee.

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