



ENERGY DRINKS ON CARDIOVASCULAR SYSTEM;

SHORT TERM EFFECTS OF ENERGY DRINKS ON CARDIOVASCULAR SYSTEM AND PHYSICAL PERFORMANCE OF MALE MEDICAL STUDENTS

Muhammad Usman Bashir¹, Muhammad Imran², Amjad Ali³

1. MBBS, FCPS
Associate Professor
Department of Physiology
CMH Multan Institute of Medical Sciences Multan.
2. MBBS, M.Phil
Associate Professor
Department of Physiology
Continental Medical College Lahore.
3. MBBS, FRCS, FCPS
Assistant Professor
Department of Anatomy
CMH Multan Institute of Medical Sciences Multan.

Correspondence Address:

Dr. Muhammad Usman Bashir
Department of Physiology
CMH Multan Institute of Medical Sciences,
Multan.
mubpgg@yahoo.com

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ABSTRACT... Objectives: The objective of this study was to determine the short term effects of energy drinks on the cardiovascular system and physical performance of healthy adult male medical students. **Study Design:** Experimental study. **Place and Duration of Study:** This study was conducted at the Physiology departments of CMH Multan Institute of Medical Sciences, Multan and Continental Medical College, Lahore from February 2017 to April 2017. **Subjects and Methods:** Sixty eight healthy, adult, male medical students participated in this study. Each day, heart rates and blood pressures of 3 to 4 students were measured and then the tests of physical performance (hand grip test and 300 meter run test) were performed ("pre-test" measurements). After that, each student drank 250 mL of a standard energy drink and then rested for about 30 minutes, after which post-test measurements were recorded in the same way. Changes in various parameters, before and after the consumption of energy drink were compared using the student's t-test. **Results:** The cardiac parameters (heart rate & blood pressure) of the students increased significantly after using the energy drink (p-value < 0.05). Mean±SD hand grip of the students increased from 44.97±3.96 Kg to 45.14±3.99 Kg after consuming the energy drink, but this increase was not significant (p-value = 0.667). Similarly, the mean±SD time of "300 meter run test" decreased from 68.28±3.40 seconds to 67.93±4.47 seconds after the consumption of the energy drink, but this was also non-significant (p-value = 0.448). **Conclusion:** We observed significant increase in heart rate and blood pressure of the study subjects, while no significant enhancement was seen in the physical performance of healthy adult male medical students, 30 minutes after consuming the energy drinks.

Key words: Energy Drinks, Heart Rate, Blood Pressure, Physical Activity.

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INTRODUCTION

The use and popularity of energy drinks is increasing day by day especially among the youth. The major ingredients of these drinks include caffeine, taurine, some herbal ingredients, vitamin B and glucose.¹ The first energy drink was marketed in the U.S. in 1949, and in the Europe in 1987, but their sale increased dramatically throughout the world after the aggressive marketing of the popular energy drink "Red Bull" in 1997.² The popularity of EDs is increasingly not only in the young athletes but also in non-athletes, students and children.³ In Pakistan, the situation is almost the same, although the government has recently banned the sale of energy and cola drinks near the premises of educational institutions. Inspired by various attractive

marketing tactics and media commercials, these are being consumed on regular basis by athletes and students.⁴

It is claimed that the energy drinks provide "energy" to the customer instantly.⁵ Some of the manufacturers also say that their product has also additional beneficial effects on health and well being of the customers.⁶ Although some of these claims have been partly proved in some studies⁶, most of their advertised claims remain yet to be tested and proved by the competent authorities. The main constituent of the energy drinks i.e. caffeine is known to enhance the physical performance in several studies.⁷⁻¹⁰ Various energy drinks have variable amounts of caffeine in them; the minimum being 80mg/

drink. Energy drinks also contain some other components like guarana, ginseng, ginkgo biloba, glucuronolactone, taurine, methylxanthines, vitamin B and green tea extract. The use of ergogenic ingredients on regular basis has been questioned in past because if these are taken in excessive quantities, these can lead to adverse effects like loss of sleep, heart rate disturbances, headaches, dehydration and anxiety. Indeed, a lot of studies have shown their dangerous effects on health.⁷⁻¹³

Taurine is found in high amounts in the muscle and heart. It has beneficial effects at both sites regarding the control of contractility of both muscles and various studies in animal a have shown that deficiency of taurine can lead to various types of cardiomyopathies.¹⁴ It has also been claimed that if taurine is used in combination with caffeine then the possible adverse effects of caffeine are reduced.¹⁵ Caffeine is said to have variable acute and long term effects on the cardiovascular system. The most prominent short term effects of caffeine on the cardiovascular system include increase in the arterial blood pressure, a change in vasodilatation response and a rise in the concentration of circulating norepinephrine levels.¹⁶

Regarding the short term effects of energy drinks on the cardiovascular system, the international data is still scanty, and to our knowledge, no previous Pakistani study has been done on this topic yet. The aim of this study was to investigate the short term effects of an energy drink on the cardiovascular system and physical performance of healthy adult male medical students.

MATERIALS & METHODS

One hundred healthy male medical students of first and second year MBBS belonging to CIMS, Multan and Continental medical college (CMC), Lahore wished to participate in this study. Out of these, 50 students were from CIMS, Multan and 50 were from CMC, Lahore. Written consent was given by all students for their participation. The study was approved by the Research Ethics Committee of both the medical colleges. Out of 100 students, 32 had to be excluded from the

study due to exclusion criteria (chronic smoking, excessive use of tea/coffee/energy drinks/cola drinks or of any other substance with ergogenic properties, history of cardiovascular disease, alcohol abuse etc.), so the final sample size came to be 68.

Each day, 3 to 4 students were tested for the effects of energy drink in the Physiology department of each medical college. The students were advised not to consume tea, coffee, cola, chocolates, energy drinks or any caffeine containing substance 48 hours prior to testing to allow wash down of caffeine, taurine etc.⁶ On the test day, they used to arrive about one hour before the commencement of their classes in the physiology lab. The students were made to rest for about 10 minutes and then their heart rate and blood pressure was measured using stop watch and mercury sphygmomanometer (Certeza CR-2002L). Then the students warmed up for five minutes and then the tests of physical performance (hand grip test and 300 meter run test) were performed. Strength of upper body muscles was tested with "hand grip test" using a standard hand held digital dynamometer (Qingfeng, China). Each medical student was given three chances to show maximum grip of his dominant hand (usually the right hand) and then, out of these three measurements, the one with the maximum value was recorded. Strength of lower limb muscles was tested with "300 meter run test".¹⁷ These measurements were labeled as "pre-test" measurements.

After that, each student drank 250 mL of a standard energy drink containing caffeine (80 mg), glucuronolactone, taurine and some vitamins. Caffeine, the major constituent of energy drinks, takes about 15-30 minutes for complete absorption.¹⁷ So, the students rested for about 30 minutes after energy drink consumption and then post-test measurements were recorded in the same way; i.e. first, checking the heart rate and blood pressure and then subjecting the students to the physical performance tests (hand grip and 300 m run test), to see the effects of energy drink.

Statistical analysis was performed using SPSS

version 17.0 (IBM Corporation, USA). Values were presented as mean and standard deviation. Descriptive statistics were calculated for age, height, weight and BMI. Changes in the heart rate, blood pressure, hand grip strength and 300 meter run test, before and after the consumption of energy drink were compared using the student's t-test. A P-value <0.05 was considered significant.

RESULTS

Sixty eight medical students participated in this study. The major physical characteristics of the students are given in Table-I. The mean±S.D age of the students was 20.38±1.12 years and the mean±S.D body mass index was 24.76±2.10 Kg/m².

The mean±SD data of the students, before and after the consumption of energy drink has been compared using the student's "t" test and shown in Table-II. The pre-test values show the measurements taken before the consumption of the energy drink, while the post test measurements are taken after the energy drink consumption. The table shows that the heart rate,

systolic blood pressure and the diastolic blood pressure of the students was less before the energy drink consumption and all these cardiac parameters increased significantly after using the energy drink (p-value < 0.05).

The table also shows that the mean±SD right hand grip of the students was 44.97±3.96 Kg before the consumption of energy drink and it increased to 45.14±3.99 Kg after the consumption of the energy drink, but this increase was not significant (p-value = 0.667). Similarly, the mean±SD time of "300 meter run test" was 68.28±3.40 seconds before the consumption of energy drink and this time was less (67.93±4.47 seconds) after the consumption of the energy drink, but this decrease in the run time was again not statistically significant (p-value = 0.448).

Characteristics	Mean±S.D value
Age (years)	20.38±1.12
Height (meters)	1.74±0.04
Weight (Kg)	75.06±5.07
Body Mass Index (BMI) (Kg/m ²)	24.76±2.10

Table-I. Physical characteristics of the participants (n = 68)

Variables	Pre-test value**	Post-test value#	p-value
Heart Rate (beats/minute)	76.84±5.63	77.82±5.48	0.007*
Systolic Blood Pressure (SBP) (mmHg)	118.49±6.87	119.93±6.74	0.001*
Diastolic Blood Pressure (DBP) (mmHg)	74.29±4.91	75.81±4.88	0.000*
Right Hand Grip (Kg)	44.97±3.96	45.14±3.99	0.677
300 meter Run Time (seconds)	68.28±3.40	67.93±4.47	0.448

Table-II. Comparison of Mean±SD data of the students, before and after energy drink consumption (n = 68)

**= before consumption of energy drink. # = after consumption of energy drink.

* = statistically significant (p-value < 0.05)

DISCUSSION

This study was conducted to observe the short term effects of an energy drink on the cardiovascular system and physical performance of healthy adult male medical students. Total sixty eight medical students successfully completed this experimental study.

The physical characteristics of the study

participants (Table-I) revealed that mean±SD body mass index of students was 24.76±2.10 Kg/m². Most of the students who took part in this study were neither obese, nor overweight according to the WHO criteria.¹⁸

Various cardiovascular parameters of the medical students before and after the consumption of the energy drink have been compared in Table-II. It

shows that mean \pm SD heart rate, systolic blood pressure and the diastolic blood pressure of the students increased significantly after consumption of the energy drink than it was before (p-value < 0.05). Similar results were reported by Menci et al¹⁹ who reported increase in mean \pm SD values of heart rate, systolic blood pressure and the diastolic blood pressure of the study participants after the consumption of energy drinks; but, in their study, this increase in the values of these parameters was non-significant (p-value > 0.05). They proposed that this could be the result of various inotropic ingredients (e.g taurine) included in the energy drinks. Taurine is known to affect the myocardial contractility by changing the release of calcium ions from sarcoplasmic reticulum.¹⁴

On the other hand, Hajsadeghi et al²⁰, who also conducted an experimental study on healthy young adults to see the effects of energy drinks on various cardiovascular parameters, claimed that consumption of energy drinks caused a significant acute decline in heart rates of the study participants. They proposed that this decrease in heart rate may be caused by an increase in the stroke volume and force of myocardial contraction after taking energy drink. They also mentioned that high quantities of catecholamines are released in bloodstream after energy drink consumption and this phenomenon might be the basis of ST-T changes reported in their study. Catecholamines are known to increase heart rate. This conflict about the underlying mechanisms of their results might be related to the quantity of the energy drinks consumed and the duration of follow-up. Hajsadeghi et al. also reported non-significant effects on systolic and diastolic blood pressure after energy drink consumption.²⁰

A review of literature shows that various investigators reported different effects of energy drinks regarding their impact on blood pressure. Some claimed that energy drink consumption does not cause significant changes on blood pressure on short term basis^{21,22}, while most of the investigators reported a significant rise in blood pressure of the study participants after the consumption of energy drinks.²³⁻²⁵

Regarding the short term effects of energy drinks on the physical performance of the healthy, male medical students, we found no significant improvement in physical abilities after energy drink consumption (Table-II). The strength of the upper and lower body muscles was tested with hand grip test and 300 meter run test, respectively. The mean \pm SD hand grip increased and the mean \pm SD time for 300 meter run test decreased after the energy drink consumption, but these changes were non-significant (p-value > 0.05).

Again, the literature review gives us conflicting results about short term effects of energy drinks on the physical performance of study participants. Some believe that use of energy drinks can acutely enhance the performance of athletes and other healthy subjects²⁶⁻²⁸, while other report no significant improvement in the physical performance after the consumption of energy drinks.^{17,29,30} Those who report positive short term effects of energy drinks on physical performance propose that caffeine might be the main ingredient of the energy drinks responsible for such effects. Different mechanisms have been proposed by various researchers to explain the ergogenic effects of caffeine. Goldstein proposed that caffeine directly competes with adenosine for receptor binding and also cause release of endorphins.²⁷ Azdad et al claimed that caffeine alters the fatigue perception on central nervous system level.³¹ While, Higgins et al proposed a metabolic change from use of glycogen to that of free fatty acids under influence of caffeine.³² Further experimental studies, on larger scales and involving more resources are required to establish the effects of caffeine and energy drinks on physical performance.

CONCLUSION:

In conclusion, we observed significant increase in heart rate and blood pressure of the study subjects 30 minutes after consuming the energy drinks, while no significant enhancement was seen in the physical performance of healthy adult male medical students.

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REFERENCES

1. Alsunni AA, Badar A. **Energy drinks consumption pattern, perceived benefits and associated adverse effects among students of University of Dammam, Saudi Arabia.** J Ayub Med Coll Abbottabad 2011; 23: 3-9.
2. Rotstein J, Barber J, Strowbridge C, Hayward S, Huang R, Godefroy SB. **Energy drinks: An assessment of the potential health risks in the Canadian context.** Int Food Risk Anal J, 2013; 3-5.
3. Ishak WW, Ugochukwu C, Bagot K, Khalili D, Zaky C. **Energy drinks: Psychological effects and impact on well-being and quality of life—a literature review.** Innov Clin Neurosci 2012; 9: 25-34.
4. Khan AA, Ali T, Imran M, Ali SA, Khan M. **Understanding of health risks by the use of energy drinks among millennial generation of Karachi, Pakistan.** Curr Res Nutr Food Sci 2017;5:3
5. Abian-Vicen J, Puente C, Salinero JJ, González-Millán C, Areces F, Muñoz G, et al. **A caffeinated energy drink improves jump performance in adolescent basketball players.** Amino Acids 2014; 46: 1333-41.
6. Lara B, Gonzalez-Millán C, Salinero JJ, Abian-Vicen J, Areces F, Barbero-Alvarez JC, et al. **Caffeine-containing energy drink improves physical performance in female soccer players.** Amino Acids 2014; 46: 1385-92.
7. Clauson KA, Shields KM, McQueen CE, Persad N. **Safety issues associated with commercially available energy drinks.** J Am Pharm Assoc (Wash) 2008; 48: e55-e63.
8. Garriott JC, Simmons LM, Poklis A, Mackell MA. **Five cases of fatal overdose from caffeine-containing “look-alike” drugs.** J Anal Toxicol 1985; 9: 141-3.
9. Goldfarb M, Tellier C, Thanassoulis G. **Review of published cases of adverse cardiovascular events after ingestion of energy drinks.** The American journal of cardiology. 2014; 113(1):168-172.
10. Di Rocco JR, During A, Morelli PJ, Heyden M, Biancaniello TA. **Atrial fibrillation in healthy adolescents after highly caffeinated beverage consumption: two case reports.** J Med Case Reports. 2011;5(1):18.
11. Scott MJ, El-Hassan M, Khan AA. **Myocardial infarction in a young adult following the consumption of a caffeinated energy drink.** BMJ case reports. 2011; 2011:bcr0220113854.
12. Wilson RE, Kado HS, Samson R, Miller AB. **A case of caffeine-induced coronary artery vasospasm of a 17-year-old male.** Cardiovascular toxicology. 2012; 12(2):175- 179.
13. Pommerening MJ, Cardenas JC, Radwan ZA, Wade CE, Holcomb JB, Cotton BA. **Hypercoagulability after energy drink consumption.** J Surg Res 2015; 199(2):635-40.
14. Schaffer SW, Jong CJ, Ramila KC, Azuma J. **Physiological roles of taurine in heart and muscle.** J Biomed Sci 2010 Aug 24;17 Suppl 1:S2. doi: 10.1186/1423-0127-17-S1-S2.
15. Bichler A, Swenson A, Harris MA. **A combination of caffeine and taurine has no effect on short term memory but induces changes in heart rate and mean arterial blood pressure.** Amino Acids 2006; 31(4):471-6.
16. Doherty M, Smith PM. **Effects of caffeine ingestion on rating of perceived exertion during and after exercise: A meta-analysis.** Scand J Med Sci Sports 2005 Apr;15(2):69-78.
17. Fernández-Campos C, Dengo AL, Moncada-Jiménez J. **Acute consumption of an energy drink does not improve physical performance of female volleyball players.** Int J Sport Nutr Exerc Metab 2015 Jun; 25(3):271-7.
18. World Health Organization. **Factsheet No. 311 - Obesity and Overweight.** September 2006. Geneva. Available at: <http://www.who.int/mediacentre/factsheets/fs311/en/index.html>.
19. Menci D, Righini FM, Cameli M, Lisi M, Benincasa S, Focardi M et al., **“Acute Effects of an Energy Drink on Myocardial Function Assessed by Conventional Echo-Doppler Analysis and by Speckle Tracking Echocardiography on Young Healthy Subjects,”** J Amino Acids 2013; 2013: 646703. doi:10.1155/2013/646703.
20. Hajsadeghi S, Mohammadpour F, Manteghi MJ, Kordshakeri K, Tokazebani M, Rahmani E, et al. **Effects of energy drinks on blood pressure, heart rate, and electrocardiographic parameters: An experimental study on healthy young adults.** Anatol J Cardiol. 2016; 16:94–9.
21. Ragsdale FR, Gronli TD, Batool N, Haight N, Mehaffey A, McMahon EC, et al. **Effect of Red Bull energy drink on cardiovascular and renal function.** Amino Acids 2010; 38: 1193-200.
22. Alford C, Cox H, Wescott R. **The effects of red bull energy drink on human performance and mood.** Amino Acids 2001; 21: 139-50.
23. Worthley MI, Prabhu A, De Sciscio P, Schultz C, Sanders P, Willoughby SR. **Detrimental effects of energy drink**

- consumption on platelet and endothelial function. Am J Med 2010; 123: 184-7.
24. Franks AM, Schmidt JM, McCain KR, Fraer M. **Comparison of the effects of energy drink versus caffeine supplementation on indices of 24-hour ambulatory blood pressure.** Ann Pharmacother 2012; 46: 192-9.
 25. Steinke L, Lanfear DE, Dhanapal V, Klaus JS. **Effect of “energy drink” consumption on hemodynamic and electrocardiographic parameters in healthy young adults.** Ann Pharmacother 2009; 43: 596-602
 26. Ganio MS, Klau JF, Lee EC, Yeargin SW, McDermott BP, Buyckx M et al. **Effect of various carbohydrate-electrolyte fluids on cycling performance and maximal voluntary contraction.** Int J Sport Nutr Exerc Metab 2010; 20(2):104-14.
 27. Goldstein E, Jacobs PL, Whitehurst M, Penhollow T, Antonio J. **Caffeine enhances upper body strength in resistance-trained women.** J Int Soc Sports Nutr 2010; 7:18.
 28. IvyJL, Kammer L, Ding Z, Wang B, Bernard JR, Liao YH, Hwang J. **Improved cycling time-trial performance after ingestion of a caffeine energy drink.** Int J Sport Nutr Exerc Metab 2009; 19(1):61-78.
 29. Astorino TA, Matera AJ, Basinger J, Evans M, Schurman T, Marquez R. **Effects of red bull energy drink on repeated sprint performance in women athletes.** Amino Acids 2012; 42(5):1803-8. PubMed doi:10.1007/s00726-011-0900-8.
 30. Umaña-Alvarado M, Moncada-Jiménez J. **Consumption of an ‘Energy Drink’ does not improve aerobic performance in male athletes.** Intl J Appl Sport Sci 2005; 17(2):26-34.
 31. Azdad K, Gall D, Woods AS, Ledent C, Ferré S, Schiffmann SN. **Dopamine D2 and adenosine A2A receptors regulate NMDA-mediated excitation in accumbens neurons through A2A-D2 receptor heteromerization.** Neuropsychopharmacology 2009; 34(4):972-86.
 32. Higgins JP, Tuttle TD, Higgins CL. **Energy beverages: Content and safety.** Mayo Clin Proc 2010; 85(11):1033-41.



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The price of greatness is responsibility.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
1	M. Usman Bashir	Study planning & designing, Data collection, Manuscript writing.	
2	Muhammad Imran	Data collection, Manuscript writing.	
3	Amjad Ali	Data analysis, Proof reading.	