ANALYZING THE COMPOSITION OF ENERGY DRINKS AND THE EFFECT THAT THEY CAN HAVE ON STUDENTS

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Consumption of energy drinks by young people has been increased due to various reasons. The drinks have potentially harmful effects. The purpose was to examine the frequency of and reasons for energy drink consumption by medical students, subjectively assess health effects related to energy drinks, and analyze composition of energy drinks. 150 students of the Voronezh State Medical University named after N. N. Burdenko were interviewed to find out the effect produced by energy drinks on their performance, health and attitude to energy drinks using Google Forms. Methods of statistical analysis were utilized during the assessment. Four energy drink labels were selected and analyzed with their composition being described. Students' health and adverse effects after consumption of the drinks underwent subjective assessment. 35% of those interviewed believe that energy drinks are effective. 70% of the students report increased performance after consumption of the drinks. However, 55% of them develop adverse effects such as tremor of the extremities (11.3%), increased excitability (20%), increased blood pressure (23.3%), heart arrhythmia (26%), allergic reactions (4%), and loss of consciousness (2%). A safe amount to be consumed (250 ml) is recommended after the analysis, whereas 60% of the respondents consume 450 ml. Every year energy drinks are gaining more and more popularity among young people. The found adverse effects of energy drinks require subsequent and a more elaborated examination.

Keywords: students, energy drinks, health, prevention

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АНАЛИЗ СОСТАВА ЭНЕРГЕТИЧЕСКИХ НАПИТКОВ И ИХ ВЛИЯНИЕ НА ЗДОРОВЬЕ СТУДЕНЧЕСКОЙ МОЛОДЕЖИ

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В молодежной среде по разным причинам увеличивается употребление энергетических напитков. Они потенциально вредны для здоровья. Цель работы — изучение частоты и причин употребления энергетических напитков среди студентов-медиков, субъективной оценки состояния здоровья и побочных эффектов после употребления напитков, проведение анализа состава энергетиков. При помощи Google-Формы мы опросили 150 студентов ВГМУ им. Н. Н. Бурденко относительно влияния энергетических напитков на их работоспособность и здоровье, а также отношение к употреблению энергетических напитков. В ходе оценки результатов применялись методы статистического анализа. Были выбраны четыре торговых марки энергетических напитков и был проанализирован и описан их состав. Проведена субъективная оценка состояния здоровья студентов и побочных эффектов после употребления напитков. 35% респондентов считают энергетические напитки эффективными. После употребления энергетиков 70% студентов отмечают у себя повышение работоспособности, однако у 55% отмечены нежелательные побочные явления: тремор конечностей (11,3%), повышенная возбудимость (20%), повышение артериального давления (23,3%), нарушение сердечного ритма (26%), аллергические реакции (4%), потеря сознания (2%). В результате проведенного анализа состава напитков рекомендован безопасный объем употребления (250 мл), в то время как 60% опрошенных употребляют 450 мл. Энергетические напитки с каждым годом становятся все популярнее среди молодежи. Выявленные побочные эффекты энергетиков требуют дальнейшего более детального изучения.

Ключевые слова: студенты, энергетические напитки, здоровье, профилактика

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Supply of energy drinks in Russia is increasing every year. On a percentage basis, supply of energy drinks in the Russian market was annually increased by 14.9–30.0% [1].

The issue of energy drink consumption is essential due to a possible negative effect of this product on various organs, systems of organs and entire body [2–5]. According to a number of researchers, caffein contained in energy drinks can induce drug dependence (withdrawal syndrome), when consumed on a long-term basis, and produce a psychostimulant effect. In her work devoted to the experimental study of a possible withdrawal syndrome in laboratory animals following 30 days of caffeine-containing energy drink consumption, Zemskova EA concluded that their motor activity was reduced, anxiety level was increased and that a number of signs available didn't exclude the withdrawal syndrome in tested animals as compared with the control group. A negative trend in weight of white rats was observed as well [6]. A number of data of foreign researchers [7, 8] demonstrated a negative effect of energy drinks on the cardiovascular system [9, 10]. In the experiment of scientists headed by Sachin A. Shah, various parameters

(QT, PR, QRS complex, HR, SBP, DBP, cSBP, cDBP) were compared. It was found out that the systolic and diastolic pressure values were increased by 5 mm Hg and 4 mm Hg following consumption of energy drinks [11]. A stable rise in BP by 2 mm Hg increases the risk for coronary heart disease by 7% and risk of stroke by 10% [11]. Based on the World Health Organization (WHO), 17.3 million people die of cardiovascular diseases annually, making 30% of all lethal cases [12]. There currently exists a trend towards an increased consumption of various energy drinks, especially among students.

The purpose was to examine the reasons for and frequency of energy drink consumption among medical students, subjectively assess health and adverse effects following consumption of the drinks, and analyze the quantitative and qualitative composition of popular drinks presented during questioning.

PATIENTS AND METHODS

First, a literature review was surveyed. Then, year 1 to year 6 students of therapeutic, pediatric and dental departments of the Voronezh State Medical University named after N. N. Burdenkohad to complete 30 question surveys using Google Forms [13]. Their responses were analyzed with IBM SPSS statistical data processing program, student opinion ratios were analyzed. The sampling included 150 students; its size wasn't preliminary determined. Then qualitative and quantitative composition of four different energy drinks was assessed.

We surveyed 150 volunteers from the Voronezh State Medical University named after N. N. Burdenko. 80% (120) of them were female, 20% (30) were male. The majority of those interviewed (93.3%) were 18–25 years old. Students from the departments of general medicine (43.3%), pediatric department (29.3%), dental department (17.3%) and that of preventive medicine (4.7%) along with year 1 to year 6 students from the Institute of International Education of the Global Institution of Medical Education and Cooperation (5.3%) participated in the study.

RESEARCH RESULTS

The survey consisted of four sections: what the students knew about energy drinks; the frequency of and reasons for consuming energy drinks by medical students; effect produced by energy drinks on students' health; and their personal attitude to these products. The students had to answer some questions regarding what an energy drink is, what labels they are aware of, what opinion they have about the price and quality relation. According to subsequent statistical processing, 93.3% of students are aware or have ever heard of the product. Adrenaline Rush (96%) and Red Bull (94.7%) were the most popular drinks among the students of the Voronezh State Medical University named after N. N. Burdenko. 59.3% of those interviewed noted that quality doesn't depend on price; whereas 40% believe that the greater the cost is, the safer and more qualitative the energy drink is.

It has been established during the analysis that 80% of the students consume energy drinks. The vast majority (85%) reported that the drinks help regenerate energy during the examination period. Many prefer consuming energy drinks while resting (15.3%). The main reasons for it included shortage of energy (56%), nice taste (46%) and proper price (9.3%).

When asked about the purpose of the consumption, the majority of students mentioned a chance to cheer up (65%), improved performance (40%), better mood and positive emotions (32%). During the questioning it has been found out that students mainly have energy drinks in the evening. The frequency of use was as follows: once or twice a month for 23.3%, once or twice half a year for 22.7%, once or twice a year for 15% and more frequently than once or twice a year for 14.9% only. Students prefer having a large 450 ml can (60%) or a small 180 ml can (40%) per day.

There was also a question about a possible combination of energy drinks and other caffeine-containing products on the same day. About 74% of respondents mentioned that it was undesirable to combine energy drinks and caffeine-containing products, whereas 26% admitted that they could combine them, though it was very bad for health. Based on subjective health assessment after consumption of energy drinks, it was found out that 35% of students believed energy drinks to be effective. The effect was almost immediate or occurred within 30 minutes and within one hour after the consumption in 14.7%, 37.3% and 16.7% students, respectively. Improved performance was noted in 70% of those interviewed. A half of respondents (54.7%) reported that adverse events developed after consumption of different energy drinks. Thus, they mentioned tremor of the extremities (11.3%), headaches (5.3%), loss of consciousness (2%), allergic reactions (4%), increased excitability (20%), high blood pressure (23.3%), and disturbed cardiac rhythm (26%).

Having analyzed quantitative and qualitative composition of such energy drinks as Adrenaline rush, Flash energy, Burn (zero sugar) and Red Bull, we have calculated the energy value per 100 ml of these products. It amounted to 230 kJ/54 kcal, 210 kJ/50 kcal, 10 kJ/2 kcal and 195 kJ/46 kcal. Thus, the least energy value was calculated for sugar-free Burn, with the difference being not over 20 kJ for other drinks. As far as the qualitative composition goes, all the presented energy drinks contained water, acidity regulators, taurine (synthetic analogue of caffeine) (Adrenaline rush — 240 mg/100 ml, Flash energy — 120 mg/100 ml, Burn (zero sugar) — 240 mg/100 ml, Red Bull — 400 mg/100 ml), flavoring agents, *caffeine* (Adrenaline rush — 30 mg/100 mg, Flash energy — 27 mg, Burn (zero sugar) — 32 mg, Red Bull — 32 mg), vitamin B6 (Adrenaline rush — 0.8 mg, Flash energy — 0.6 mg, Burn (zero sugar) — 0.4 mg, Red Bull — 2 mg), colorants, and sugar (with exception of Burn, zero sugar). Other components varied depending on the manufacturer. Adrenaline rush also contained L-carnitine, stabilizing agents, inositol, guarana seed extract, ginseng root extract, and vitamin B12. Flash energy composition was supplemented with antioxidant, niacin, pantothenic acid, potassium sorbate and sodium benzoate, sweetening agents and maltodextrin. Red Bull also included niacin and pantothenic acid.

Special attention should be paid to the content of caffeine and taurine in the presented samples, as they are responsible for the main 'refreshing' effect. The combination can be harmful for people with cardiovascular or nervous disorders. Ginseng and guarana (extracts) ensure rapid removal of lactic acid from skeletal muscles, facilitating functioning of muscles and producing an analgesic effect. Vitamins of group B are essential participants of many biochemical reactions, though their excess can't improve mental activity, as many manufacturers promise. However, they produce not only a positive effect. Long-term consumption that exceeds the daily requirement can result in disturbance of water-salt balance, anxiety, irritation, chronic headache, increased spinal reflex excitability, stimulation of the respiratory center and decreased resistance of cellular membrane receptors to insulin. Taurine is a 'synthetic caffeine

analogue'. It can accumulate in the muscular tissue and has anticonvulsant properties [14]. In large amounts, it can result in over-excitation and even exhaustion of the nervous system, increase the risk of dangerous cardiac arrythmias and peripheral circulation disturbances [14, 15].

To avoid adverse effects, it is necessary to remember about the acceptable values of energy drink components and not exceed the dosage. Energy drinks are marketed in different volumes: 250 ml (small can) and 450 ml (large can). As cited in literature, a safe daily amount of caffeine is 150 mg. This amount comes in two small cans (or one large 0.45 l can). The maximum daily dose of taurine is 300 mg. The 450 ml can, which is most frequently used by the majority of young people (60%), has 540–1800 mg of taurine, which significantly exceeds the daily allowance. So, it is safer to use a small can of energy drink (180 ml) per day.

DISCUSSION OF RESULTS

It has been found out that 80% of medical students consume medical drinks, mainly, to replenish the shortage of own energy (56%) and improve performance (40%). A medical student digests enormous data within a short period of time, has frequent emotional overload, high energy expenditure and improper daily regimen. These can be the reasons for the increased consumption of different energy drinks by medical students. However, the students are poorly aware of the effect produced by energy drinks on the body (26% of those interviewed combine energy drinks and caffeine-containing products), which can lead to serious health problems in the future. We also concluded that a safer amount of an energy drink is 250 ml, though 60% prefer 450 ml. There exist various negative adverse events that require special attention and subsequent examination, because bad mental and physical condition can produce a negative effect on the educational process and, as a consequence, work of future healthcare professionals [5].

CONCLUSIONS

Energy drinks are becoming increasingly popular among young people. They produce various effects on the body, and it is commonly justifiable when they are used to improve performance. However, in our opinion, their adverse effects require a subsequent detailed examination. A person who consumes energy drinks is loaded with imaginary well-being and cheerfulness, as the body actually uses its own reserves, which are depleted over time. Energy shortage can be replenished with normal sleep and rest and good nutrition. Any student who follows the simple recommendations will feel fresh and energetic.

References

1. Analiz rynka pishchevykh produktov v Rossii v 2016–2020 gg, otsenka obsledovaniya i prognoz na 2021–2025.). Available from URL: https://businesstat.ru/images/demo/energetic_drinks_russia_demo_businesstat.pdf
2. Tarasov AV, Rakhmanov RS, Bogomolova ES, Skoblina NA, Ievleva OV. Modern factors that determine the state of health of student youth. Russian Bulletin of Hygiene. 2022; (1):4–9. DOI: 10.24075/rbh.2022.034. Russian.
3. Koroleva AA, Yanushanets OI, Petrova NA, Bezzubenkova EF. The influence of the degree of adaptation and lifestyle on the quality of life of medical university students. Russian Bulletin of Hygiene. 2021; (2): 29–34. DOI: 10.24075/rbh.2021.011. Russian.
4. Mikhailov AD. Influence of alkaloids in the composition of tea, coffee and energy drinks on stress reactions of the body. Forcipe. 2020; 3 (S1): 441–442. Russian.
5. Karepanova II, Savchuk OO, Chetverikova DA, Dryutskaya SM. The effect of energy drinks on the body. Topical issues of modern medicine: materials of the 72nd final scientific conference of young scientists and students of the Far Eastern State Medical University with international participation, Khabarovsk, April 20–24, 2015. Far Eastern State Medical University. Khabarovsk, 2015: 18–20. Russian.
6. Zenkova EA. Experimental study of the possible development of withdrawal syndrome after prolonged use of energy drinks. Perm Medical Journal. 2019; 36 (2): 102–107. Russian.
7. Mudrakova TA, Protsenko AA, Khachatryan MK. Changes in behavioral reactions in rats when using an energy drink for one month. Bulletin of medical Internet conferences. 2020; 10 (11): 297. Russian.
8. Alimov NV, Ilyina MN, Mikulyak NI. Influence of consumption of a large amount of energy drinks on electrocardiogram and blood pressure parameters. Academic journalism. 2021; 7: 213–219. Russian.
9. Trofimov NS, Kutya SA, Kriventsov MA, et al. The influence of energy drinks on human health. Crimean Journal of Experimental and Clinical Medicine. 2019; 9(3): 75–82. EDN FRNWLD. Russian.
10. Tulunay Kaya C, Gerede DM, Akhundova Ja. Acute effects of energy drink consumption on left and right ventricular function — a 2-dimensional speckle tracking echocardiographic study. Cardiology. 2022; 62 (2): 28–35. DOI:10.18087/cardio.2022.2.n1899.
11. Shah SA. Impact of high volume energy drink consumption on electrocardiographic and blood pressure parameters: a randomized trial. Journal of the American heart association. 2019; 8: 11.
12. Cardiovascular diseases. World Health Organization: Available from URL: https://www.who.int/cardiovascular_diseases/about_cvd/ru/ (дата обращения 27.12.2021). Russian.
13. Poll "Energy drinks — evil or salvation? The impact of EN on health». Available from URL: https://docs.google.com/forms/d/1jQm0oRtQPc3eOKv4fy9lYg1Ss4RVosRzqDoGJ1CvUUA/edit. Russian.
14. Lapteva YuV, Kharisova SF, Tolmachev DA. Influence of energy drinks on students' health. Modern Science. 2020; 5–3: 446–450. Russian.
15. Trubitsyna IE, Varvanina GG, Mikhalev IV, et al. Metabolic changes after drinking energy and low-alcohol drinks. Doctor.Ru. 2015; 2–2 (103): 6. Russian.

Литература

1. Анализ рынка энергетических напитков в России в 2016–2020 гг, оценка влияния коронавируса и прогноз на 2021–2025 гг. Режим доступа: [Электронный ресурс]. URL: https://businesstat.ru/images/demo/energetic_drinks_russia_demo_businesstat.pdf
2. Тарасов А. В., Рахманов Р. С., Богомолова Е. С., Скоблина Н. А., Иевлева О. В. Современные факторы, определяющие состояние здоровья студенческой молодежи. Российский вестник гигиены. 2022; (1): 4–9. DOI: 10.24075/rbh.2022.034
3. Королева А. А., Янушанец О. И., Петрова Н. А., Беззубенкова Е. Ф. Влияние степени адаптированности и образа жизни на качество жизни студентов медицинского университета. Российский вестник гигиены. 2021; (2): 29–34. DOI: 10.24075/rbh.2021.011

4. Михайлов А. Д. Влияние алкалоидов в составе чайных, кофейных и энергетических напитков на стресс-реакции организма. Forcipe. 2020; 3(S1): 441–442.
5. Карепанова И. И., Савчук О. О., Четверикова Д. А., Дрюцкая С. М. Влияние энергетических напитков на организм. Актуальные вопросы современной медицины: материалы 72-й итоговой научной конференции молодых ученых и студентов Дальневосточного государственного медицинского университета с международным участием, Хабаровск, 20–24 апреля 2015 года. Дальневосточный государственный медицинский университет. Хабаровск, 2015:18–20 с.
6. Зенкова Е. А. Экспериментальное изучение возможного развития абстинентного синдрома после длительного применения энергетических напитков. Пермский медицинский журнал. 2019; 36 (2): 102–107. DOI 10.17816/pmj362102–107.
7. Мудракова Т. А., Проценко А. А., Хачатрян М. К. Изменение поведенческих реакций у крыс при употреблении энергетического напитка в течение одного месяца. Бюллетень медицинских интернет-конференций. 2020; 10 (11): 297.
8. Алимов Н. В., Ильина М Н., Микуляк Н. И. Влияние употребления большого количества энергетических напитков на параметры электрокардиограммы и кровяного давления. Академическая публицистика. 2021; 7: 213–219.
9. Влияние энергетических напитков на здоровье человека. Трофимов Н. С., Кутя С. А., Кривенцов М. А. и др. Крымский журнал экспериментальной и клинической медицины. 2019; 9(3): 75–82 с. EDN FRNWLD.
10. Tulunay Kaya C, Gerede DM, Akhundova Ja. Acute effects of energy drink consumption on left and right ventricular function — a 2-dimensional speckle tracking echocardiographic study. Кардиология. 2022; 62 (2): 28–35. DOI:10.18087/cardio.2022.2.n1899.
11. Shah SA. Impact of high volume energy drink consumption on electrocardiographic and blood pressure parameters: a randomized trial. Journal of the American heart association. 2019; 8: 11
12. Сердечно-сосудистые заболевания. Всемирная организация здравоохранения. Режим доступа [Электронный ресурс] URL: https://www.who.int/cardiovascular_diseases/about_cvd/ru/ (дата обращения 27.12.2021)
13. Опрос « Энергетические напитки-зло или спасение? Влияние ЭН на здоровье» Режим доступа: [Электронный ресурс]. URL: https://docs.google.com/forms/d/1jQm0oRtQPc3eOKv4fy9lYg1Ss4RVosRzqDoGJ1CvUUA/edit
14. Лаптева Ю. В., Харисова С. Ф., Толмачев Д. А. Влияние энергетических напитков на здоровье студентов. Modern Science. 2020; 5–3: 446–450.
15. Трубицына И. Е., Варванина Г. Г., Михалев И. В. и др. Метаболические изменения после употребления энергетических и слабоалкогольных напитков. Доктор.Ру. 2015; 2–2 (103): 6.