

Patterns of energy drinks consumption in leisure, sports and academic activities among a group of students attending University of Sarajevo, Bosnia and Herzegovina

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Abstract

Background. Energy drinks (EDs) are non-alcoholic beverages that contain caffeine and other ingredients, marketed for their actual or perceived effects as stimulants, energizers and performance enhancers. The aim of this pilot study was to evaluate patterns of EDs consumption in leisure, sports, and academic activities over the last year among a group of pregraduate students of the University of Sarajevo, Bosnia and Herzegovina.

Study design. A cross-sectional study conducted by an online questionnaire-based survey.

Methods. An anonymous questionnaire was mainly based on a Consortium Nomisma-Areté questionnaire [background information and consumer profile, general EDs consumption practices and reasons; alcohol mixed with EDs (AmEDs) consumption, EDs consumption in sports, consumption of other caffeinated beverages], and an additional part to evaluate EDs consumption during academic activities.

Results. Out of 812 respondents from 22 faculties (participation rate of 23%), mean age 21.37 ± 1.98 years, 498 (61.7%) reported EDs consumption over the last year. Three main reasons for EDs consumption were to stay awake (58.2%), to enjoy the taste (46.8%), and to boost energy (38.0%). Energy drinks were mainly consumed less than once a month (70.5%), most frequently during academic activity (50.4%), less frequently mixed with alcohol for relaxation (21.5%), and only rarely in association with sports or other physical activity (10%). Drinking coffee (OR = 2.022; 95% CI 1.416–2.830; $p < 0.001$) and being a higher year student (OR = 0.723; 95% CI 0.639–0.819; $p < 0.001$) were independent predictors for EDs consumption; being single and living with parents (OR = 17.138; 95% CI 1.328–221.528; $p = 0.030$) for consumption of AmEDs; and being a man (OR = 2.251; 95% CI 1.493–3.392; $p < 0.001$) and living in urban environment (OR = 1.193; 95% CI 1.125–3.251; $p = 0.017$) for consuming EDs in association with sports or other physical activity.

Conclusions. Based on these preliminary data and taking low participation rate into account, EDs consumption seems not to be alarming among university students in our region. EDs are most frequently consumed

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during academic activity, less frequently mixed with alcohol for relaxation, and only rarely in association with sports or other physical activity. However, as EDs are increasingly aggressively promoted and easily accessible, the larger study is warranted to provide more reliable and up to date conclusions, and if necessary, to inform measures preventing health risks associated with EDs consumption.

Introduction

Energy drinks (EDs) are non-alcoholic beverages that contain caffeine and other ingredients such as taurine, D-glucurono-y-lactone, beta-complex vitamins, guarana, maltodextrin, ginseng, L-carnitine, creatinine, ginkgo biloba, acai, yerba mate, inositol, artificial and natural sweeteners, marketed for their actual or perceived effects as stimulants, energizers, and performance enhancers (1, 2). Although the first ED appeared in Japan in 1960, their popularity started rising from the appearance of Red Bull™ in 1987 in Europe, and from 1997 in the USA (1).

As the main ingredient, in concentration range from a modest 70–400 mg/L to an estimated astonishing 1600 mg/L or even 13300 mg/L (1), caffeine leads to improvements in mental performances, concentration, memory, alertness (3), but also in reaction performances during physical exercise (4), and in endurance performance (5). The estimated contribution of EDs to total caffeine exposure in adults measured in EFSA (European Food Safety Authority) study, conducted in 2012 in 16 European Member States, was 8% (from 5% in Sweden to 11.3% in Austria) (1). In the USA, a review of national quantitative studies conducted from 1999 to 2011 showed caffeine intake in mg to positively correlate with age in a population of adolescents and young adults up to 24 years of age (6).

Regarding other EDs ingredients, taurine and D-glucurono-y-lactone are natural human body products. Taurine is essential for the function of the cardiovascular system, skeletal muscle, the retina and the central nervous

system (1). It might have a positive inotropic effect and may potentiate caffeine effects on the sarcoplasmic reticulum of cardiac myocytes (7). Its acute supplementation was recently shown to enhance thermoregulation and endurance cycling performance in the heat (8), while the long-term usage caused weight loss (9). D-glucurono-y-lactone is the structural component of connective tissues, and although it is considered unlikely to have any interaction with caffeine, taurine, alcohol or the effects of exercise (1, 10), other authors reported that it may contribute to cardiovascular changes including endothelial dysfunction, increased platelet aggregation, and an increase in blood pressure (7). Guarana extract was also shown to potentiate the effect of caffeine (7). Most of the EDs brands contain large amounts of glucose (usually 9 or 10%), but next to sweetened versions, sugar-free versions are also available (2).

Despite the lack of causal evidence of ED-associated adverse effects, there is a number of case reports indicating their potential to cause cardiac arrest (11–13), adult-onset seizures (14, 15), transient ischemic attack (16), ischemic stroke (15), etc. Based on a cross-sectional survey, one third of EDs consumers experience some type of ED-related adverse event (17), while of the emergency room visits for ED-related causes, 45% occurred in young adults (18–25 years), and 32% in adults old 26–39 years (18).

The health risks associated with EDs consumption are primarily related to their caffeine content (1). As reported in a systematic review from 2015 (7), in doses

usually > 200 mg (19, 20), contained in two cups of coffee or one to two cans of any commonly available ED (20), caffeine was shown to adversely affects the major organ systems, most frequently including the cardiovascular system [arrhythmias, myocardial ischemia, aneurysm dissection, cardiac arrest, vasospasm, coronary thrombosis, cardiomyopathies, hypertension (7)], neuro-psychiatric system [seizures, cerebrovascular accident, suicidal ideation, psychosis (7), but also impaired motor skills, hallucinatory experiences, insomnia, increased anxiety and tension (19, 21)], and less often the hematological system with perioperative excessive bleeding and thrombocytopenia, anaphylactic reactions, the renal and electrolyte system, hepatic injury (7), as well as type 2 diabetes (18), reduced insulin sensitivity (22), rhabdomyolysis (23), etc.

As caffeine increases the tendency for addiction (24), and EDs consumption increases the risk for alcohol dependence (25), the increase in the popularity of „alcohol mixed with energy drinks” (AmEDs) is not surprising. Although some authors consider AmEDs to be unique alcoholic beverages used with no intention to achieve the extra effects (26), other authors showed those to be mainly used to suppress sedation and to get drunk faster (27), but also to carry a significant risk for a variety of health and safety risks (11, 27-29). Of 4854 ED-related calls (0.2% of total calls) to US poison information centers recorded over the year 2010–2011, 39.3% of the severe adverse effects related calls involved AmEDs (30).

Besides the combination of EDs and alcohol, the combined effect of intense physical effort and the stimulant action of EDs was also shown to pose health risks for some subjects (1).

In addition to adverse effects caused by caffeine, excessive sugar intake can cause obesity (19), dental cavities and other teeth abnormalities (31, 32).

Despite the health threat, the combination of enormous growth and promotion of EDs market on one side, and scarce regulations on the other side (33), the consumption of EDs is becoming more and more widespread, especially in young people (1). However, as the data regarding EDs consumption among young people in Western Balkans are scarce, in this pilot study we aimed to evaluate patterns of EDs consumption in leisure, sports and academic activities over the last year among a group of pregraduate students of the University of Sarajevo.

Methods

Subjects

During academic year 2017/18, a pilot cross-sectional study was conducted by an online questionnaire-based survey among students of the University of Sarajevo, Bosnia and Herzegovina. The questionnaire was mainly based on a Consortium Nomisma-Areté questionnaire issued by EFSA (1), and an additional part to evaluate EDs consumption during academic activities was added. The questionnaire was translated into the local language and tailored to national characteristics concerning the main ED brands [Red Bull™ (Red Bull GmbH, Austria), Burn™ (Monster Beverage Corporation, US), Fast Energy™ (Park sistem d.o.o. Serbia), Monster™ (Monster Beverage Corporation, US), Guarana™ (Knjaz Miloš, Serbia), B52™ (Beer Brewer Bavaria, Netherlands), Hell™ (Hell Energy Magyarország Kft, Hungary)] and other common beverages containing caffeine. The study was approved by the University Bioethical Committee (0101/206/18).

Study instrument and data collection

The questionnaire consisted of questions divided into six sections, as follows: 1. background information (gender, age, faculty, year of study, living environment)

and consumer profile (body weight, body height, regular smoking, characteristics of the family unit); 2. EDs consumption practices and reasons; 3. AmEDs consumption; 4. EDs consumption in sports or other physical activities; 5. EDs consumption during academic activities; 6. consumption of other caffeinated beverages (cola, coffee, tea, hot chocolate). “High chronic” consumers were defined as consuming EDs 4–5 times/week or more, and “high acute” consumers as consuming at least 1 L/single session.

Students representatives were asked to advertise and distribute the questionnaire to students of respective study years of faculties of the University of Sarajevo via Facebook students groups. The questionnaire was open for 15 days, in the period December 7 to 22nd 2017. It took approximately 5 minutes to complete the questionnaire. To ensure compliance and allay any kind of anxiety, the introduction of the questionnaire informed students that the questionnaire is anonymous and the data are collected solely for research purposes.

Statistical analysis

Collected data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 20.0. Descriptive statistics were run to summarize the data and, for categorical variables the results were presented in frequencies and percentages, while for numerical variables by the arithmetic mean \pm standard deviation for normally distributed data, or by median (25th; 75th quartile) for not normally distributed data. Inferential statistics were conducted by the Mann-Whitney U test to test differences in numerical variables between different groups of students, and Chi-square test (X^2) to test associations between different categorical variables. Binary logistic regression analysis was performed to assess independent predictors of different patterns of EDs consumption over the last year (i.e. EDs consumption, AmEDs, EDs consumption in association with sports or other physical activities, EDs consumption during academic activities). The variables tested as covariates were:

Table 1 - Gender, year of study, living environment and smoking habits of students consuming and students not consuming energy drinks (EDs) (5 students did not answer all or any of these questions)

Variables		EDs non-users, N = 309	EDs users, N = 498	p-value
Gender	female	238 (40.3%)	352 (59.7%)	0.05 ^a
	male	71 (32.7%)	146 (67.3%)	
Year of study	1st year	38 (28.0%)	97 (72.0%)	< 0.001 ^b
	2nd year	56 (28.0%)	144 (72.0%)	
	3rd year	99 (42.7%)	133 (57.3%)	
	4th year	76 (43.4%)	99 (56.6%)	
	5th year	33 (61.0%)	21 (39.0%)	
	6th year	4 (50.0%)	4 (50.0%)	
Living environment	urban	273 (39.4%)	420 (60.6%)	0.112 ^c
	rural	34 (31.2%)	75 (68.8%)	
Regular smoking	yes	55 (33.7%)	108 (66.3%)	0.207 ^d
	no	254 (39.4%)	390 (60.6%)	

a: $X^2 = 3.899$, $df = 1$; b: $X^2 = 31.100$, $df = 5$; c: $X^2 = 2.681$, $df = 1$; d: $X^2 = 1.788$, $df = 1$

gender, age, faculty, year of study, urban/rural area of living, AmEDs, EDs consumption during sports or other physical activity, EDs consumption during midterms/finals, regular smoking, body mass index, coffee consumption, cola consumption, tea consumption, characteristics of family units. To assess their predictive ability, all predictor variables were tested in one block by Forced Entry Method. To calculate the sample size, formula $N > 50 + 8m$ (where m = number of independent variables) was used. For odds ratio (OR), the formula $OR = \text{odds after a unit change in the predictor} / \text{original odds}$ was used.

Results

In total, the questionnaire was distributed to around 3700 students from 22 faculties of the University of Sarajevo. However, only 812 students, with an estimated participation rate of around 22%, participated in the study (Table 1).

Background information

Respondents were mainly women 590 (73.1%). The age range was 18–38 years, with a mean age of 21.37 ± 1.98 years. Students attended different years of study, i.e. 135 (16.6%) students of the 1st year,

Table 2 - Number (percentage) of students consuming and students not consuming energy drinks (EDs) per faculties of the University of Sarajevo (31 students did not answer this question)

Faculty	EDs non-user, N = 295	EDs user, N = 486
Faculty of Medicine	78 (41.1%)	112 (58.9%)
Faculty of Mechanical engineering	18 (18.6%)	79 (81.4%)
Faculty of Pharmacy	34 (40.5%)	50 (59.5%)
Faculty of Natural Sciences and Mathematics	19 (31.7%)	41 (68.3%)
Faculty of Philosophy	27 (54.0%)	23 (46.0%)
Faculty of Electrical engineering	19 (40.4%)	28 (59.6%)
Faculty of Architecture	14 (31.1%)	31 (68.9%)
Faculty of Economics	17 (39.5%)	26 (60.5%)
Faculty of Civil engineering	8 (24.2%)	25 (75.8%)
Faculty for Dentistry	13 (44.8%)	16 (55.2%)
Faculty of Law	15 (51.7%)	14 (48.8%)
Music Academy	15 (60.0%)	10 (40.0%)
Faculty of Traffic and Communication	6 (33.3%)	13 (66.7%)
Faculty of Agriculture and Food Sciences	2 (22.2%)	7 (77.8%)
Faculty of Veterinary Medicine	3 (42.9%)	4 (57.1%)
Faculty of Political Science	3 (50.0%)	3 (50.0%)
Faculty of Health Studies	1 (33.3%)	2 (66.7%)
Catholic Faculty of Theology	1 (100.0%)	0 (0.0%)
Academy of Arts	1 (100.0%)	0 (0.0%)
Faculty of Pedagogy	0 (0.0%)	1 (100.0%)
Faculty for Sports	1 (100.0%)	0 (0.0%)
Faculty for Criministics	0 (0.0%)	1 (100.0%)

Table 3 - Reasons for energy drinks (EDs) consumption (more than one answer possible), and frequency of EDs consumption per average month

Variables		EDs users, N = 498
Reasons for EDs consumption	to stay awake	290 (58.2%)
	I like the taste	233 (46.8%)
	I need energy	189 (38.0%)
	because it improves my concentration while I study	178 (35.7%)
	to drive for long periods	38 (7.6%)
	to cure hangovers	12 (2.4%)
	to improve my sport performances	9 (1.8%)
	to stimulate my metabolism	25 (5.0%)
Frequency of EDs consumption	rarely	351 (70.5%)
	once or twice a month	52 (10.4%)
	once a week	34 (6.8%)
	2–3 days per week	44 (8.8%)
	4–5 days per week	14 (2.8%)
	every day	2 (0.4%)

200 (24.6%) of the 2nd year, 232 (28.5%) of the 3rd year, 175 (21.5%) of the 4th year, 54 (6.6%) of the 5th year, 8 (1.0%) of the 6th year. Most of the students, 693 (86.2%) were living in an urban environment.

Energy drinks consumption

Out of 812 respondents, 498 (61.7%) students consumed EDs at last once over the last year. Of EDs consumers, 70.7% were women, and 84.3% were from the

Table 4 - Binary logistic regression analysis of independent predictors for energy drinks (EDs) consumption, alcohol mixed with EDs consumption (AmEDs) and EDs consumption in association with sports or other physical activities over the last year

Independent predictors	Odds ratio	95% CI	p-value
EDs consumption over the last year			
Coffee consumption	2.022	1.416–2.830	< 0.001
Year of study	0.723	0.639–0.819	< 0.001
<i>The model was not statistically significant $X^2 = 9.632$, $p = 0.292$; it explained 7.9% (Nagelkerke R²) of the variance and correctly classified 62.0% of cases.</i>			
AmEDs consumption over the last year			
Single and living with parents	17.138	1.326–221.528	0.030
<i>The model was not statistically significant $X^2 = 1.480$, $p = 0.993$; it explained 46.5% (Nagelkerke R²) of the variance and correctly classified 93.9% of cases.</i>			
EDs consumption in association with sports or other physical activities over the last year			
Men	2.251	1.493–3.392	< 0.001
Urban environment	1.193	1.125–3.251	0.017
<i>The model was not statistically significant $X^2 = 3.129$, $p = 0.926$; it explained 6.7% (Nagelkerke R²) of the variance and correctly classified 59.3% of cases.</i>			

Table 5 - Pattern and frequency of consumption of alcohol mixed with energy drinks (AmEDs), and number of AmEDs consumed in a single session over the last year

Variables		AmEDs users, N = 107
Pattern of AmEDs consumption	mixing them in the same cup	87 (81.3%)
	consuming alcohol and energy drinks together but in different moment	15 (14.0%)
	consuming drinks that already contain alcohol and energy drinks	5 (4.7%)
Frequency of AmEDs consumption	rarely	72 (67.3%)
	once or twice a month	17 (15.9%)
	once a week	12 (11.2%)
	2 to 3 days a week	5 (4.7%)
Number of AmEDs consumed in a single session	1–2 energy drinks	78 (72.9%)
	3–4 energy drinks	15 (14.0%)
	5–6 energy drinks	3 (2.8%)
	7–8 energy drinks	3 (2.8%)
	9–10 energy drinks	5 (4.7%)

urban living environment. Those students were mainly attending the 2nd (28.9%) and the 3rd study year (26.7%). Associations of gender, year of study, living environment and smoking habits with EDs consumption are presented in Table 1. Numbers of students consuming and students not consuming EDs per faculty are presented in Table 2.

Out of all EDs consumers, 342 (68.7%) reported to usually drink an ED can of 250 mL. The average volume consumed was approximately 0.5 L/month. The most popular ED was Red Bull™, being the first choice for 27.8% of EDs consumers, followed by Fast Energy™ (25.3%) and Hell™ (16.1%). Reasons for EDs consumption and EDs consumption frequency per average month are presented in Table 3. Only 3.2% of students were identified as “high chronic” consumers, and only 0.9% as “high acute” consumers.

Independent predictors of EDs consumption over the last year are identified by binary logistic regression analysis and showed in Table 4.

Alcohol mixed with energy drinks (AmEDs) consumption

Out of 498 EDs consumers, 107 (21.5%) reported AmEDs consumption. Pattern and frequency of AmEDs consumption and number of AmEDs consumed in a single session over the last year are presented in Table 5.

Independent predictor of the AmEDs consumption over the last year is identified by binary logistic regression analysis and showed in Table 4.

Energy drinks and sports or other physical activities

Out of 498 EDs consumers, 39 never practice sports or other physical activities. The frequency of sports or other physical activities among the rest of 459 (92.1%) EDs consumers, the frequency of EDs consumption in sports or other physical activities and number of EDs consumed in a single sport session are presented in Table 6. Out of 242 EDs consumers who practice sports or other physical activities once a

Table 6 - Frequency of sports or other physical activities among energy drinks (EDs) consumers, frequency of EDs consumption in association with sports or other physical activities, and number of EDs consumed in a single sport session (15 students did not answer all or any of these questions)

<i>Variables</i>		<i>EDs and sports users, N = 459</i>
Frequency of sports or other physical activities	rarely	217 (47.2%)
	once a week	60 (13.0%)
	twice a week	80 (17.4%)
	3 to 4 time a week	78 (17.0%)
	every day	24 (5.2%)
<i>Variables</i>		<i>EDs users in association with sports, N = 24</i>
Frequency of EDs consumption in association with sports or other physical activities	sometimes (1 of 4 sport sessions)	20 (83.3%)
	often (1 of 2 sport sessions)	2 (0.1%)
	every time	2 (0.1%)
Number of EDs consumed in a single sport session	2 energy drinks	16 (76.2%)
	3 energy drinks	5 (23.8%)

week or more frequently (Table 4), only 24 (9.9%) consumed EDs in association with i.e. before/during/after sports or other physical activities, of whom the majority (83.3%)

consumed it only sometimes (approximately at one out of four sports sessions). The most frequently stated first choice reason for EDs consumption in association with sports or

Table 7 - Reasons and frequency of energy drinks (EDs) consumption during midterms/finals, the main reasons for the consumption the night before the exam, and the number of EDs consumed during the night before the exam

<i>Variables</i>		<i>EDs users during midterms/finals, N = 251</i>
Reasons for EDs consumption during midterms/finals	I concentrate easier on the exam	132 (52.6%)
	I achieve better scores	39 (15.5%)
	I remember things I learned easier	27 (10.7%)
	I feel less stage fright	24 (9.6%)
Frequency of EDs consumption during midterms/finals	once a week during the exams	102 (40.6%)
	2 or 3 days a week	79 (31.4%)
	4 or 5 days a week	30 (12.0%)
	every day	38 (15.2%)
Main reasons for EDs consumption the night before the exam	to concentrate easier	103 (50.7%)
	to achieve better scores	49 (24.1%)
	remember things easier	32 (15.8%)
	to feel less stage fright	19 (9.4%)
Number of EDs consumed the night before the exam	1 energy drink	126 (46.0%)
	2 energy drinks	45 (16.4%)
	3 and more energy drinks	13 (4.7%)
	do not drink	90 (32.8%)

other physical activities was “concentration” (26.3%), and “strength” (30.0%) was the most frequently reported reason among all i.e. the first, second and third choice reasons.

Independent predictors of EDs consumption in association with sports or other physical activities over the last year are identified by binary logistic regression analysis and shown in Table 4.

Energy drinks and academic activities

Out of 498 EDs consumers, 251 (50.4%) reported consuming EDs during midterms/finals. Reasons and frequency of EDs consumption during midterms/finals, number of EDs consumed during the night before the exam, the main reasons for the consumption of EDs the night before the exam and the number of EDs consumed during the night before the exam are presented in Table 7.

Table 8 - Frequency of cola, coffee, tea and hot chocolate drinking, and of chocolate bars consumption over the last year among energy drinks (EDs) consumers

Variables		EDs consumers, N = 498
Frequency of cola drinking	never	218 (43.8%)
	rarely	23 (4.6%)
	once a week	105 (21.1%)
	2 or 3 days a week	71 (14.3%)
	4 or 5 days a week	25 (5.0%)
	every day	56 (11.2%)
Frequency of coffee drinking	never	38 (7.6%)
	rarely	51 (10.2%)
	once a week	25 (5.0%)
	2 or 3 days a week	60 (12.0%)
	4 or 5 days a week	49 (9.8%)
	every day	275 (55.2%)
Frequency of tea drinking	never	14 (2.8%)
	rarely	94 (18.9%)
	once a week	86 (17.3%)
	2 or 3 days a week	136 (27.3%)
	4 or 5 days a week	71 (14.3%)
	every day	97 (19.5%)
Frequency of hot chocolate drinking	never	161 (32.3%)
	rarely	274 (55.0%)
	once a week	34 (6.8%)
	2 or 3 days a week	22 (4.4%)
	4 or 5 days a week	5 (1.0%)
	every day	1 (0.2%)
Number of chocolate bars consumed in a week	none	81 (16.3%)
	1–2 chocolates	238 (47.8%)
	3–4 chocolates	123 (24.7%)
	5–6 chocolates	16 (3.2%)
	7–8 chocolates	14 (2.8%)
	10 chocolates	4 (0.8%)

Compared to students who did not consume EDs during midterms\finals, students who did consume it were younger [21 (20; 22) vs 21 (20; 22) years; $U = 26872.0$; $p = 0.019$], and at lower year of study [3rd (2nd; 4th) vs 2nd (2nd; 3rd) year; $U = 27233.5$; $p = 0.032$]. Binary logistic regression analysis did not confirm those variables as independent predictors.

Other consumer habits

The frequency of cola, coffee, tea, hot chocolate, and chocolate bars consumption over the last year among 498 EDs consumers is presented in Table 8.

The majority of students who consumed EDs (43.8%) never consumed cola or consumed it once a week (21.1%) or 2–3 days a week (14.3%); consumed coffee every day (55.2%); consumed tea 2–3 days a week (27.3%); and consumed hot chocolate rarely (55.0%). Distribution of students who consume EDs and one or more of other caffeinated beverages (cola, coffee, tea, and

hot chocolate) is presented in Figure 1.

Regarding consumption of caffeinated vs non-caffeinated cola, coffee and tea, most students consumed those products with caffeine, i.e. cola 375 (75.3%) vs 47 (9.4%), coffee 432 (86.7%) vs 11 (2.2%), and tea 457 (91.8%) vs 18 (3.6%).

When age, year of study, body weight, and body mass index were compared between EDs consumers who consumed either cola or coffee or alcohol or practice sports, with EDs consumers who do not consume/practice any of those, only the difference in body weight, lower in EDs and tea consumers compared to EDs consumers who do not consume tea were found [median 65.0 (58.0; 75.0) vs 70.0 (60.0; 80.0) kg; $U = 17426.5$; $p = 0.007$].

Discussion and conclusion

To our knowledge, this is the first study regarding the different patterns of EDs

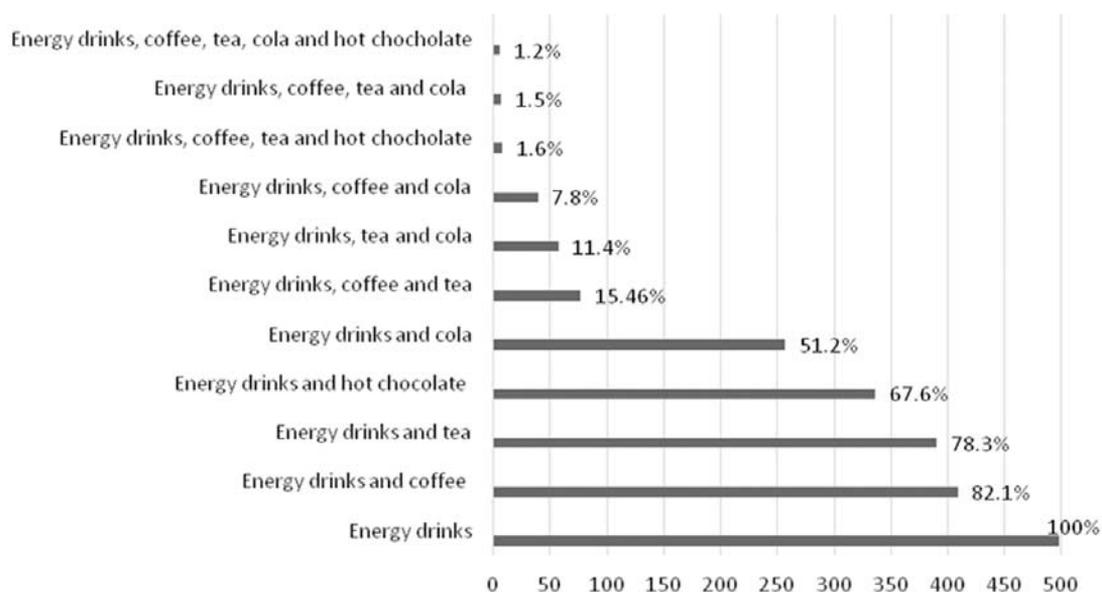


Figure 1 - Distribution of students who consume EDs and one or more of other caffeinated beverages (cola, coffee, tea and hot chocolate)

consumption in Bosnia and Herzegovina, and in even wider Western Balkan region.

The majority of students included in our study reported EDs consumption in the last year, but generally in small amounts and rarely, in order to stay awake, to gain pleasure from good taste, and to boost energy. Energy drinks consumers were most likely students at lower years of study and were also coffee consumers. Most students used EDs in academic activities during midterms/finals and were younger and at lower years of study. Fewer students consumed AmEDs for relaxation and were most likely single and lived with parents, and the majority of them mixed it rarely and consumed only 1–2 AmEDs in a single session. Only a minority of students who consumed EDs practiced it in association with sports or other physical activities and were most likely men and lived in an urban environment.

Regarding EDs consumption during the last year, compared to the majority (61.7%) of our students who consumed it, in EFSA study only 30% of adult reported EDs consumption, of whom mainly young adults (53%, 18–29 years), with prevalence varying from 14% in Cyprus to 50% in Austria (1). However, our students consumed EDs mostly rarely i.e. 70.5% consumed it less than once a month while only 0.4% consumed it every day, and unlike 13.3% of young adult EDs consumers in EFSA study (1), only 3.2% of our students were identified as “high chronic” consumers. Also, although a 250 mL can was the favourite consumed size of EDs in both studies, the average volume consumed per month was 4 times higher in EFSA study (2.0 vs 0.5 L/month). Moreover, unlike 13.4% of young adult EDs consumers in EFSA study (1), only 0.9% of our students were identified as “high acute” consumers. Likewise, higher EDs consumption than reported among our students was documented among 65.0% of Italian university students, with 15.8% of students who consumed it 3–4 times/week (34), and in the USA where daily

consumption was reported by even 25% of EDs consumers (35). On the contrary, less frequent EDs consumption (every 2–3 months) compared to our study was reported among the majority of 21% of Puerto Rico university students who consumed EDs (36).

Although Red Bull™ was reported as the most popular ED in both our and EFSA study (1), the portion of our consumers who indicated it as the first choice was much lower (27.8 vs 89%). The second and the third choice were different between these two studies (Fast Energy™ and Hell™ vs Monster™ and Burn™, respectively).

Likewise, the same two main reasons for EDs consumption was reported in our and EFSA study (1), but with the different portions of consumers, i.e. to stay awake 58.2 vs 18%, and to enjoy the taste 46.8 vs 16%, respectively. The main reasons for EDs consumption were also in keeping with the reasons documented in other studies (37, 38).

In line with our results, several studies confirmed coffee consumption to be an independent predictor of EDs consumption, but unlike in our study, smoking and alcohol consumption (39, 40), as well as being single and a man (34, 36, 41) were also documented as EDs consumption independent predictors. Likewise in our study, the place of residence was not shown to play a significant role in EDs consumption among Polish adolescent EDs consumers (42).

Regarding AmEDs consumption, it was reported by 21.5% of all our EDs consumers and was lower compared to either 71% of young adults in EFSA study (varying from 24% in Cyprus to 67% in Germany) (1), or to 56.9% of Italian medical students (26), or to 34.7% of US university students (43), or to more than one-third of college students at a Mostly Hispanic University (36), or to 25% among Italian high school students (44). Also, unlike 38% of adults in EFSA study (1), only 4.7% of AmEDs consumers in our

study declared the habitual consumption of more than once a week, and also unlike 57% of adults in EFSA study, far less of our AmEDs consumers (24.3%) declared to drink more than two AmEDs in a single session. Furthermore, the portion of AmEDs consumers who consume it more than three times in a month were more than two times lower among our students compared to Italian medical students (15.9 vs 35.8%) (25). In addition and interestingly, among the reasons for EDs consumption, 2.4% of EDs consumers in our study and 1.0% of adult EDs consumers in EFSA study stated “to treat hangover”, while in earlier studies the reason “to escape hangover” was also reported (45, 46). However, this is of safety relevance as the consumption of AmEDs was shown to reduce the adverse signs of alcohol intoxication increasing the probability of accidents (25).

Although almost all (92.1%) of our EDs consumers practiced sports or other physical activity compared to 74.2% of adults in EFSA study (ranging from 26% in Poland or Cyprus to 62% in Spain) (1), the portion of EDs consumers who consumed EDs in association with sports or other physical activity was lower in our study (9.9 vs 25.0%). Also, compared to EFSA study, in our study it was practiced only sometimes among the greatest portion of EDs consumers (39 vs 83%). The number of consumed EDs cans per single sport session was similar between these two studies. In addition, in our study, men were more than two times more likely to consume EDs in association with sports or other physical activities. Likewise, a higher prevalence of EDs consumption during sports among adolescent men compared with adolescent women, regardless of their socioeconomic or educational status was shown in another study (47). Some authors suggest that the main reason for such the finding is aggressive marketing targeted primarily toward young men (33), or the fact that men, compared to women, have

an urge to achieve success in sports (42, 48). In addition, this could be linked to a fact that men believe that consumption of EDs could prolong their training, give them an energy boost required for physical activities, and also a better mental focus needed in some sports (42). This last reason, i.e. “concentration” is in line with the most frequently reported first choice reason for EDs consumption during sports in our study (26.3%), while the EFSA study reported the main reasons to be “endurance time at the maximum intensity” (40%) (1). Although living environment didn’t play a role in general EDs consumption pattern in our study, students living in the urban environment were shown to be 19.3% more likely to consume EDs in association with sports or other physical activities.

Of our students who consume EDs, 82.1% also consumed coffee, 78.3% tea, 67.6% hot chocolate, and 51.2% cola (Figure 1). “Every day” coffee consumption was reported by 55.2% of EDs consumers, far more compared to cola, tea, and hot chocolate consumption. Regarding the consumption habits of cola, coffee, and tea, students preferred caffeinated over non-caffeinated products. Moreover, as EDs consumers may concomitantly consume EDs and sweetened caffeinated or non-caffeinated beverages or chocolate bars (Table 7), one should be aware of the potentially excessive caffeine or sugar intake that can cause adverse effects.

The traditional, long term and widespread consumption of coffee, in which caffeine is a natural constituent, may be the major explanation for EDs being less popular, less frequently consumed and consumed in lower volumes among our students compared to young adults in EU Member States. However, only during extensive academic activities such as during midterms/finals and during the night before the exam, when students need better concentration for studying or need to stay awake, the greater portion of our students (50.4%)

seem to consume EDs. However, as in other evaluated patterns, mainly the low volume of EDs is consumed, i.e. mainly only one can the night before the exam (46.0%).

Our study had several limitations. Firstly, its cross-sectional design makes it difficult to infer causality. Secondly, students representatives distributed the questionnaire to about 3700 students from 22 faculties, which is a limited fraction (around one third) of the total number of pregraduate students of the University of Sarajevo (around 11000 students). It was distributed to all students of the Faculty of Medicine (N = 620) and the Faculty of Electrical engineering (N = 730), to students of usually only one study year of the other faculties, i.e. to around 120 students per faculty, with exception of Academies where in total around 50 students are enrolled. The questionnaire was not distributed to students of four faculties (The Faculty of Administration, The Faculty of Islamic Studies, The Faculty of Forestry, The Academy of Performing Arts). Thirdly, the low participation rate of 22% could be linked to the lack of students' motivation to participate as the survey was unintentionally conducted during the partial exams period when students are busy with their academic activities, as well as because the second call for non-respondents was not made. In addition, recall bias was possible as students were asked about their consumption habits over the previous year.

For regulation of EDs consumption, several policies could be of public health benefit, such as i. health promotion and education about health risks associated with EDs consumption; ii. the social networking site usage optimization as it was recognized risk factor for risk-related behavior in young people (1), early adolescence (49), and university undergraduates (50); iii. the price increase as it was already shown to substantially contribute to the reduction of sugar-sweetened beverages including high caffeine EDs consumption (51, 52).

In conclusion, based on these preliminary data and taking low participation rate into account, EDs consumption seems not to be alarming among university students in our region. Energy drinks are most frequently consumed during academic activities, less frequently mixed with alcohol for relaxation, and only rarely in association with sports or other physical activity. However, as EDs are increasingly aggressively promoted and easily accessible further increase in their consumption may be expected making the larger study warranted to provide more reliable and up to date conclusions.

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Riassunto

Profili di consumo delle "energy drinks" nel tempo libero, nelle attività sportive e nelle attività accademiche da parte di un gruppo di studenti iscritti all'università di Sarajevo, Bosnia-Erzegovina

Contesto. Le bevande energetiche sono bevande analcoliche che contengono caffeina e altri ingredienti, commercializzate come stimolanti, energizzanti o potenziatori delle prestazioni per via dei loro effetti reali o percepiti. Lo scopo di questo studio pilota è stato di valutare nell'ultimo anno i modelli di consumo di bevande energetiche in attività ricreative, sportive e accademiche in un gruppo di studenti dell'Università di Sarajevo, Bosnia Erzegovina.

Schema dello studio. Trattasi di uno studio trasversale condotto da un sondaggio online basato su questionari.

Metodi. Il questionario anonimo si basava principalmente su un questionario del Consorzio Nomisma-Areté [informazioni di base e profilo del consumatore, pratiche e motivi generali del consumo di bevande energetiche; consumo di alcool mescolato a bevande energetiche, consumo di bevande energetiche negli sport, consumo di altre bevande contenenti caffeina] e su una parte aggiuntiva intesa a valutare il consumo di bevande energetiche durante le attività accademiche.

Risultati. su 812 risposte provenienti da 22 facoltà (tasso di partecipazione del 23%), età media di 21,37 ± 1,98 anni, 498 (61,7%) hanno riferito un consumo di bevande energetiche nel corso dell'ultimo anno. Tre sono

risultati i motivi principali per il consumo di bevande energetiche: rimanere svegli (58,2%), apprezzarne il gusto (46,8%) ed aumentare l'energia (38,0%). Le bevande energetiche venivano consumate in prevalenza meno di una volta al mese (70,5%), più frequentemente durante le attività accademiche (50,4%), meno frequentemente mescolate con alcol per il relax (21,5%) e solo raramente in associazione con lo sport o altre attività fisiche (10%). Essere bevitori di caffè (OR = 2,022; IC 95% 1,416-2,830; $p < 0,001$) ed essere uno studente anziano (OR = 0,723; IC 95% 0,639-0,819; $p < 0,001$) sono risultati predittori indipendenti per il consumo di bevande energetiche; essere single e convivere con i genitori (OR = 17,138; IC 95% 1,332-221,528; $p = 0,030$) è risultato predittore per il consumo di alcol mescolato con bevande energetiche; ed essere di sesso maschile (OR = 2.251; IC 95% 1.493-3.392; $p < 0,001$) e vivere in ambiente urbano (OR = 1.193; IC 95% 1.125-3.251; $p = 0,017$) sono risultati predittori per il consumo di bevande energetiche in associazione con sport o altra attività fisica.

Conclusioni. Sulla base di questi dati preliminari e tenendo conto del basso tasso di partecipazione, il consumo di bevande energetiche non sembra essere un fenomeno allarmante tra gli studenti universitari della nostra regione. Le bevande energetiche vengono consumate più frequentemente durante l'attività accademica, meno frequentemente mescolate con alcol per il relax e solo raramente in associazione con sport o altre attività fisiche. Tuttavia, poiché le bevande energetiche sono facilmente accessibili e promosse in modo sempre più aggressivo, è previsto uno studio più ampio per fornire conclusioni maggiormente affidabili e aggiornate e, se necessario, proporre nuove misure per prevenire i rischi per la salute associati al loro consumo.

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