

Article

Consumption of Energy Drinks among University Students in Eastern Croatia

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Abstract: The modern lifestyle today creates a certain pressure on people who are forced to adapt to such a way of living. Energy drinks (EDs), beverages containing certain stimulating ingredients, are increasingly being offered on the market. Given the unclear impact of EDs consumption on the health of the individual, the focus of this study was to determine the prevalence of EDs consumption among the student population at the University of Osijek (Eastern Croatia). The cross-sectional study via an anonymous questionnaire included 424 students, with an average age of 22.8 years. It was discovered that 52.4% of participants consume EDs. Males were significantly more likely to drink EDs than females (χ^2 -test; $p = 0.006$). They more frequently consume EDs six or more times per month (χ^2 -test; $p = 0.045$) as well as consume more EDs on one occasion (χ^2 -test; $p < 0.001$). University students who were engaged in sports or physical activity were significantly more likely to consume EDs (χ^2 -test; $p = 0.024$) as well as smokers in comparison to non-smokers (χ^2 -test; $p = 0.034$). In conclusion, the study proved the frequent consumption of EDs among Croatian university students consequently highlighting the need to raise awareness of the possible adverse effects of EDs consumption.

Keywords: energy drinks; university students; adverse effects; health promotion; Croatia

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1. Introduction

Modernized and stressful way of life today has led people to seek new solutions for overcoming fatigue just to be more productive. Therefore, they turn to various products offered on the market such as energy drinks (EDs) [1]. The ingredients of EDs have different biochemical, ergogenic, and possible additive or synergic properties which are not yet been fully clarified [1,2]. The concentration of caffeine, which is the main ingredient of EDs, sometimes varies significantly in those drinks [3–5]. Along with highlighted beneficial effects of EDs such as an energy boost, and improvement of physical and cognitive performance, there are some adverse health effects related to the consumption of EDs such as arrhythmia, increase in blood pressure, anxiety, sleep disorders, gastrointestinal and metabolic effects, agitation, migraines [3,6] and cardiovascular complications [3,6,7]. U.S. Poison Control Centers as well as U.S. Food and Drug Administration (USFDA) linked the consumption of EDs even to possibly fatal outcomes [8,9]. Ehlers et al. [10] noticed how moderate EDs consumption did not reveal clinically relevant cardiovascular changes in young adults while high intake (≥ 1 L) could cause some adverse effects. A large study conducted on more than 52,000 participants from 16 different EU Member States revealed that 68% of adolescents, 30% of adults, and 18% of children consumed EDs at least once during the last year with the average volumes consumed being 2.1, 2.0, and 2.0 L/month. A particularly worrying fact is that around 12% of adolescent consumers were identified as so-called “high chronic” consumers, i.e., consuming EDs 4–5 times/week or more, with an average consumed EDs volume of 7 L/month [2]. Galimov et al. [11] investigated the patterns of EDs use among German adolescents and discovered that 61.7% of the respondents reported using EDs during their lifetime while 21.4% reported using EDs in

the last month. They also discovered that consumption of EDs was related to the male sex, older age, drug use, poor nutrition, higher BMI, excitement seeking, poor school achievement, and more frequent commercial exposure. Studies have also shown more frequent consumption of EDs among people who engage in physical activity as well as among people who smoke [12]. Numerous studies highlighted the growing trend of EDs consumption worldwide [13–15]. Scalese et al. [13] discovered a significant increase in EDs consumption over the past 12 years (from 2008 to 2019) among high school students. Vercammen et al. [15] reported a significant increase in EDs consumption from 2003 to 2016 for three population groups in the U.S. The consumption increased in adolescents (0.2% to 1.4%, $p = 0.028$), young adults (0.5% to 5.5%, $p < 0.001$), and middle-aged adults (0.0–1.2%, $p = 0.006$), indicating the largest increase among young adults. A higher total caffeine intake was also noticed for all observed groups in comparison to EDs non-consumers which also indicates EDs as a major source of caffeine.

Moreover, consumers often do not read the labels provided on EDs which is why they are probably not even aware of the harmful effects of EDs consumption [16]. Except for labeling caffeine concentration and highlighting warnings such as “High caffeine content” and “Not recommended for children, pregnant and breastfeeding women”, EDs remain globally under-regulated [11,17,18]. The European Cardiac Arrhythmia Society recently issued recommendations regarding the consumption of these drinks, to prevent possible adverse effects. The consumption of EDs is not recommended for children under 14 years of age, as well as for populations at higher risk of heart disease. The daily limit of caffeine intake is emphasized to be 400 mg, while in children over 14 years the total intake should not exceed 2.5 mg/kg of body weight. Consumption of EDs before or during sports activities or mixing EDs and alcohol or illicit drugs is also not recommended [17].

Until now in Croatia, there has been no comprehensive study focused on the features of EDs consumption in the university student population. However, there was one study on a limited number of subjects from the University of Rijeka which showed that 30.9% of university students from Rijeka drink EDs, and one smaller study on Osijek university students which showed that 48.5% of university students’ sometimes drink EDs while 6.2% drink them often. These studies revealed that EDs consumption is an important issue in the Croatian university student population that should be better examined to develop and imply appropriate preventative measures [19,20].

Another important reason which contributes to the significance of investigating the EDs consumption in adolescence lies in the fact that some studies are reporting how the consumption of EDs can lead to addiction [21,22]. Research on the connection between the consumption of EDs and substance use in adolescents revealed that this connection is stronger in students from middle schools compared to high school students, which in turn suggests that the younger population is more vulnerable and susceptible to negative effects [23]. Many studies highlight the possible addiction to caffeine if consumed over an extended time [24,25]. Although the average consumption of caffeine among young people has decreased over the past two decades, the consumption of EDs among adolescents has increased significantly over the past 10 years, which is worrying. It has also been proven that adolescents who consume EDs use tobacco, alcohol, and illicit drugs more often [26]. A study conducted on animals proved how the consumption of well-known, most commonly consumed EDs in the world, can lead to the development of alcoholism, given that it enhances the consumption of higher concentrations of alcohol [27].

Considering the above-stated facts and the current situation related to the popularity of these drinks, this study aimed to investigate the prevalence of EDs consumption among the student population at the University of Osijek in Eastern Croatia and to evaluate the association of EDs consumption with the participant’s lifestyle as well as the possible occurrence of the adverse effects that can be contributed to the consumption of EDs.

2. Materials and Methods

2.1. Study Population

The cross-sectional study was conducted among the student population at the Josip Juraj Strossmayer University of Osijek in Eastern Croatia via an anonymous questionnaire (Supplementary Materials) between March and May of 2018. The survey was voluntary and included 424 students who filled out the online questionnaire, 313 (73.8%) females and 111 (26.2%) males. The participants were aged between 19 and 53 years, with an average age of 22.8 years. Study participants in this cross-sectional study were enrolled using snowball sampling—a non-probability, convenience sample gathered among university students from the University of Osijek. The initial sample of students was formed through the students' representatives at each faculty of the University of Osijek and then these participants were asked to enroll more participants in the study and share the survey's internet link with their friends, and colleagues—potential participants from undergraduate, graduate, integrated and postgraduate studies at the University of Osijek. According to Agency for science and higher education, the Josip Juraj Strossmayer University of Osijek, the largest university in Eastern Croatia had 15,996 students in the academic year 2018/2019. The sample size of 424 students presented 2.7% of all students attending this University. The study was approved by the Ethics Committee of the Faculty of Medicine Osijek, Croatia (Ethical Approval Code: 2158-61-07-17-189).

2.2. Questionnaire

The online validated questionnaire on the frequency of EDs consumption was self-administered to all university students through an open link. The questionnaire consisted of 27 questions: 8 socio-demographic and socio-economic questions (questions regarding gender, year of birth, faculty subject area i.e., field of science, level of study, current year of study, repetition of the year of study, student status, and the main source of income during the study); 4 questions regarding certain life habits (questions regarding playing sports, cigarette smoking, coffee drinking, and alcohol beverages drinking), 11 questions regarding EDs consumption (questions regarding the frequency of EDs consumption, the number of EDs drunk monthly, the main reason for consuming EDs, the type of most often consumed EDs, level of EDs consumption on one occasion, factors that affect ones choice while buying EDs, reading the product label while buying EDs, information on label that one is most interested in while buying EDs, EDs preferences regarding the sugar, consumption of EDs with alcohol, and the frequency of such consumption); 1 question regarding other ways of substance intake for increasing energy levels or staying awake; and 3 questions regarding possible side effects and negative consequences of EDs consumption (a question regarding adverse health effects due to the EDs consumption; a question regarding the ones injury due to the EDs; a question regarding the someone else's injury due to the EDs consumption). It took 10 min for participants to complete the questionnaire (Supplementary Materials). The whole questionnaire is available as an appendix of the manuscript. This questionnaire was constructed by using some questions from similar questionnaires that were used by Casuccio et al. and Reid et al. in their studies where the questions are formulated following the Croatian language expression [28,29].

2.3. Statistical Analysis

Interpretation of the data results included IBM SPSS Statistical Package, version 22.0 (SPSS Inc., Chicago, IL, USA). All categorical variables were expressed in absolute and relative frequencies, while the numerical variables were expressed as median and interquartile ranges. The Kolmogorov–Smirnov test verified the normality of the data distribution. For the comparison of categorical variables between the groups, the χ^2 -test and Fisher exact test were used. Spearman's correlation coefficient was calculated to test the correlation between reasons for EDs consumption and the quantity of EDs consumed on one occasion and monthly, as well as to test the correlations between the monthly frequency of EDs consumption and socio-demographic characteristics of study participants such as the

repetition of the year of study, mixing EDs with alcohol, participants gender, the existence of the participants' nutrition education at the faculty, playing sports, drinking coffee and smoking. In all statistical analyses, two-sided p -values of 0.05 were considered significant.

3. Results

3.1. Participant's Profile

The main characteristics of all study participants included in this study are presented in Table 1. The median age was 22 years, with an interquartile range from 21.0 to 24.0 years.

Table 1. Characteristics of all study participants.

Study Participants Characteristics	N	%
Sex		
Male	111	26.2
Female	313	73.8
The faculty subject area (field of science)		
The field of humanities and arts field	66	15.6
The social field of science	164	38.7
The technical field of science	17	4.0
The biotechnical field of science	90	21.2
The field of biomedicine and the natural field of science	87	20.5
Level of study		
Undergraduate study	226	53.3
Graduate study	83	19.6
Integrated study	110	25.9
Postgraduate study	5	1.2
The year of study		
1st	122	28.8
2nd	127	30.0
3rd	60	14.2
4th	50	11.8
5th	53	12.5
6th	12	2.8
The repetition of the year of study		
No	309	72.9
Yes	115	27.1
Learning about nutrition on faculty		
No	247	58.3
Yes	177	41.7
Student status		
Full-time student—costs are covered by the Ministry of Science and Education	268	63.2
Full-time student—the costs are partially covered by the student	78	18.4
Part-time student—the costs are covered by the student	78	18.4
Source of income for studying		
Parents	298	70.3
Scholarship	39	9.2
Independent work	74	17.5
Others	13	3.1

N-number of participants.

Table 2 presents study participants' habits divided into two categories.

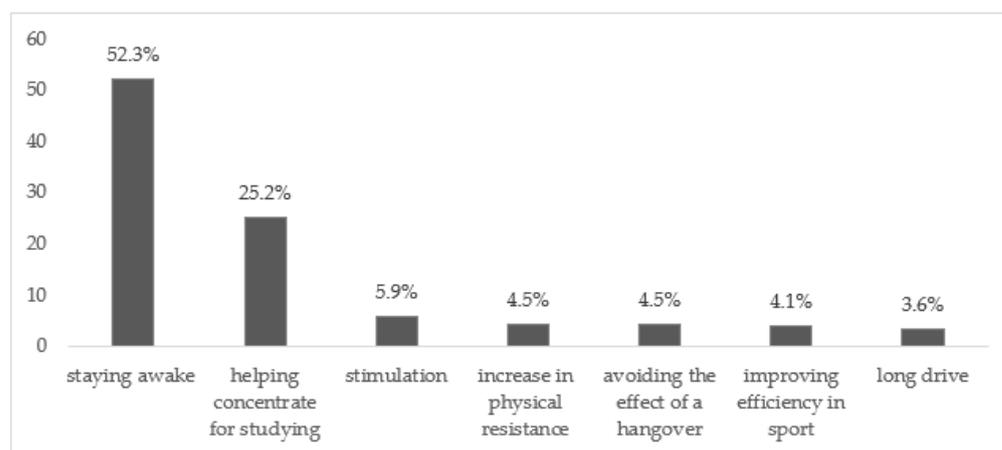
Table 2. Study participants' habits.

Study Participants' Habits	N	%
Playing sports		
No	189	44.6
Yes	235	55.4
Cigarette smoking		
No	295	69.6
Yes	129	30.5
Coffee intake		
No	130	30.7
Yes	294	69.4
Alcohol intake		
No	46	10.8
Yes	378	89.1
Energy drink intake		
No	202	47.6
Yes	222	52.4

N-number of participants.

3.2. Consumption of EDs

Of all the participants, there were 222 (52.4%) of those who consumed EDs. By observing only consumers, there were 132 (59.5%) of those who prefer it 1 time per month or less, followed by 66 (29.7%) of those who consume it 2–4 times per month, 15 (6.8%) of those who prefer consumption of EDs 2–3 times per week and 9 (4.1%) of them who consume it 4 or more times per week. By observing the frequency of consumption on a monthly basis, 180 (81.1%) of them consume 1–5 EDs, 21 (9.5%) consume 6–10 beverages, 14 (6.3%) consume 11–20 beverages, and 7 (3.2%) consume 21 and more EDs per month. Figure 1 presents the most common reasons for the consumption of EDs among the study population.

**Figure 1.** The main reasons for EDs consumption among the student population in Eastern Croatia.

In total, 108 (48.6%) consumers reported taste as the most common reason for purchasing EDs, while 59 (26.6%) specified the price as the most important factor, among others. Although most consumers, 133 (59.9%) of them, stated that they were not interested in product labels, 89 (40.1%) still read them. Of those who are interested in labels, 26 (11.7%) stated caffeine as the most important information of interest, as well as sugars, 25 (11.3%). Still, 125 (56.3%) of the consumers prefer sweetened drinks instead of no-sugar drinks. By observing the health impact of EDs, students were asked if they experienced any specific symptoms after consumption. It turned out that 55 (24.8%) of the consumers reported an increased heart rate, 27 (12.2%) of them had a sudden increase and a decrease in energy, 25

(11.3%) experienced insomnia and 14 (6.3%) noticed nervousness, among other symptoms that were listed in the questionnaire (Supplementary Materials).

Table 3 presents participants divided into consumers and non-consumers according to their characteristics and habits.

Table 3. Participants' consumption of EDs according to their sociodemographic characteristics and habits.

Participants' Sociodemographic Characteristics and Habits	N (%)			<i>p</i> *
	Do Not Drink	Drink	Overall	
Sex				
Male	40 (36.0)	71 (64.0)	111 (100.0)	0.006
Female	162 (51.8)	151 (48.2)	313 (100.0)	
The faculty subject area (field of science)				
The field of humanities and arts field	40 (60.6)	26 (39.4)	66 (100.0)	0.085
The social field of science	71 (43.3)	93 (56.7)	164 (100.0)	
The technical field of science	8 (47.1)	9 (52.9)	17 (100.0)	
The biomedicine and natural science	46 (52.9)	41 (47.1)	87 (100.0)	
The biotechnical field of science	37 (41.1)	53 (58.9)	90 (100.0)	
The repetition of the year of the study				
No	139 (45.0)	170 (55.0)	309 (100.0)	0.081
Yes	63 (54.8)	52 (45.2)	115 (100.0)	
Playing sports				
No	102 (54.0)	87 (46.0)	189 (100.0)	0.024
Yes	100 (42.6)	135 (57.4)	235 (100.0)	
Learning on nutrition				
No	119 (48.2)	128 (51.8)	247 (100.0)	0.844
Yes	83 (46.9)	94 (53.1)	177 (100.0)	
Cigarette smoking				
No	151 (51.2)	144 (48.8)	295 (100.0)	0.034
Yes	51 (39.5)	78 (60.5)	129 (100.0)	
Coffee intake				
No	68 (52.3)	62 (47.7)	130 (100.0)	0.208
Yes	134 (45.6)	160 (54.4)	294 (100.0)	

* χ^2 -test; N-number of participants.

According to the results shown in Table 3, men were significantly more likely to drink EDs than women (χ^2 -test; $p = 0.006$). The study revealed how males also more frequently consume EDs six or more times per month (χ^2 -test; $p = 0.045$). By observing the male population only, it can be seen that there are more of them who consume EDs than those who do not. Furthermore, by observing only the female population, it can be seen that most women in this study do not consume EDs, although the difference between those who do not consume and those who consume EDs is smaller than in the male population. Furthermore, there were no statistically significant differences in the consumption of EDs according to the field of science of the participants (χ^2 -test; $p = 0.085$). Despite that, it can be observed that there were visible differences among students considering the frequency of EDs consumption, where among those studying the biotechnical field of sciences the consumption was the most frequent (58.9%), while the least common consumption was among those studying in the field of humanities and arts field (39.4%). There were also no

statistically significant differences in the consumption of EDs according to the repetition of the year of the study (χ^2 -test; $p = 0.081$). According to their sports habits, students who play sports either recreationally or professionally were significantly more likely to consume EDs than students who do not play sports (χ^2 -test; $p = 0.024$). Additionally, there were no statistically significant differences in the consumption of EDs concerning nutrition education at the faculty (χ^2 -test; $p = 0.844$). Yet, smokers were significantly more likely to consume EDs than non-smokers (χ^2 -test; $p = 0.034$), while there were no statistically significant differences regarding their routine of coffee consumption (χ^2 -test; $p = 0.208$).

When looking at those who consume EDs and the amount of consumed EDs on one occasion, there were 69 (31.1%) of those consuming less than one can and 144 (64.9%) of those consuming one can while there were only 9 (4.1%) of those consuming more than one can of EDs on one occasion. It is visible from Table 4 that men consume a higher amount of EDs significantly more often during one occasion in comparison to females (Fisher’s exact test; $p < 0.001$). The study did not reveal differences in the amount of EDs consumed on one occasion between students who repeated the year of study and those who did not repeat it (Fisher’s exact test; $p = 0.134$). There were also no differences in the amount of EDs consumed on one occasion between students who played sports and those who did not play sports (Fisher’s exact test; $p = 0.068$). Finally, the study did not discover differences in the amount of EDs consumed on one occasion between students who had nutrition education at the faculty and those who did not have such education (Fisher’s exact test; $p = 0.940$).

Table 4. The amount of consumed EDs on one occasion according to gender.

Consumption on One Occasion	N (%)				p *
	Do Not Drink	Drink			
		Less Than 0.25 L	0.25–0.5 L	More Than 0.5 L	
Sex					
Male	40 (36.0)	10 (9.0)	54 (48.6)	7 (6.3)	111 (100.0)
Female	162 (51.8)	59 (18.8)	90 (28.8)	2 (0.6)	313 (100.0)
Overall	202 (47.6)	69 (16.3)	144 (34.0)	9 (2.1)	424 (100.0)

* Fisher exact test.

The study further revealed that among those students who consume EDs there were 167 (75.2%) students who mixed EDs with alcohol. The results presented in Table 5 show that there were no statistically significant differences in the consumption of EDs in combination with alcohol according to the gender of the participants (χ^2 -test; $p = 0.870$). However, the habit of mixing EDs and alcohol was more frequent in students who smoke (χ^2 -test; $p = 0.017$), and students who consume alcoholic beverages (Fisher’s exact test; $p < 0.001$).

Table 5. The amount of EDs consumed in combination with alcohol according to gender.

Participants Mixing EDs and Alcohol	N (%)			p *
	No Mixing	Mixing EDs and Alcohol	Overall	
Sex				
Male	17 (23.9)	54 (76.1)	71 (100.0)	
Female	38 (25.2)	113 (74.8)	151 (100.0)	0.870
Overall	55 (24.8)	167 (75.2)	222 (100.0)	

* χ^2 -test.

The EDs consumers declared that 143 (64.4%) of them do not use any other substances to increase alertness or energy level, while 79 (35.6%) of them do. Finally, 214 (96.4%) of the participants declared that they had never experienced an injury due to the consumption of EDs, while 8 (3.6%) of them had experienced an injury. When asked whether someone

else suffered an injury due to their consumption of EDs and under what circumstances, 215 (96.8%) of them answered negative, while 7 (3.2%) of them were to blame for someone else's injury.

The study revealed that there was no correlation between reasons for consuming EDs and the monthly frequency of EDs consumption ($r_s = 0.011$; $p = 0.868$) as well as no correlation between reasons for consuming EDs and the quantity of EDs consumed on one occasion ($r_s = -0.086$; $p = 0.199$). Regarding the correlations between the socio-demographic profile of EDs consumers and the monthly frequency of EDs consumption, this study revealed that there was a weak negative correlation between the repetition of the year of study and the monthly frequency of EDs consumption ($r_s = -0.140$; $p = 0.037$) and weak positive correlation between mixing EDs with alcohol and the monthly frequency of EDs consumption ($r_s = 0.144$; $p = 0.032$). Furthermore, correlation analysis revealed that the monthly frequency of EDs consumption was higher in males in comparison to females ($r_s = 0.137$; $p = 0.041$). Finally, the study showed that there were no significant correlations between the monthly frequency of EDs consumption and some other socio-demographic characteristics of the study participants such as the existence of nutrition education at the faculty ($r_s = 0.028$; $p = 0.675$), playing sports ($r_s = 0.011$; $p = 0.873$), drinking coffee ($r_s = -0.058$; $p = 0.388$) and smoking ($r_s = 0.030$; $p = 0.657$).

4. Discussion

This study showed how more than half of our participants (52.4%) consume EDs which is consistent with the results of some studies [11,16,30–33] but higher than reported in some other studies [12,24,34–41]. In opposition to that, higher EDs consumption was discovered among medical and dental students in Nigeria where 80.1% declared themselves as current consumers while 87.8% of them revealed using EDs at least once in their lifetime [31]. Italian university students were also found to consume EDs more than our students (65.0%) [42]. Some studies prove how more than half of the participants have tried EDs at least once [5,12,24,25,31,39] as well as studies that confirm how less than half of them have ever consumed this type of drink [43]. In general, this widespread consumption of EDs gives us alarming data considering how the young population is in an extremely sensitive phase of life of physical and psychological development, probably unaware of the possible harmful effects that this consumption can cause.

According to our study, those who consume EDs, drink them mainly once a month (59.5%). Most of them declared that they consume 1–5 drinks (81.1%) on monthly basis, similar to some previous findings [29], while some studies have shown a lower frequency of EDs consumption [24,25]. In addition, our work showed a small prevalence of heavy consumers which is consistent with some other studies [30,34]. Costa et al. [44] investigated EDs consumption among Australian adolescents and found that more than a third of EDs consumers (36%) had exceeded the recommended daily limit for adults at least once.

Given the difference in EDs consumption by gender and the fact that the male population consumes more of these beverages than females, our study is consistent with numerous studies from different countries [11,12,16,24,25,30,31,35,38,39,45–47]. Degirmenci et al. [30] investigated the consumption of EDs among Norwegian high school students and reported that there were twice as many consumers of EDs among males than females, which is a greater gender difference in comparison to EDs consumption found in this study. Oppose to those findings, Malinauskas et al. [33] found a greater prevalence of EDs consumption among female college students, while Fields et al. [48] found no significant differences in consumption between male and female high school athletes. This study also showed gender differences in the amount of EDs consumed on one occasion. It was found that males drink significantly more EDs during one consumption than females. Although various research has proven how long-term consumption of EDs can cause adverse effects on human health [49], its excessive consumption on one occasion can be just as harmful [50], if not fatal [6]. If we look at the facts that our students do not consume EDs often, but when

they do, they usually drink one can, which is amount to up to 0.5 L, this data should not be ignored.

By observing the reasons for the consumption of these products, participants in this study indicated that they consume EDs mostly to stay awake. Some other studies also stated this as the most common reason [12,25,33,51,52], while others specified taste [24], studying and socializing [35], as well as sport or physical performance [30,36] as the main motivation for EDs consumption. Nadeem et al. [53] specified in their meta-analysis increase in energy and relief fatigue, to stay awake or to counter insufficient sleep as well as for concentration during studies as the most common reasons for EDs consumption. These reasons suggest a possible tendency of overconsumption on one occasion just to satisfy those needs.

This study revealed that our participants mostly do not read the labels on the EDs (59.9%), which is more significant than found by Chang et al. [16]. Those authors found that 50.7% of undergraduates in Taiwan never read the nutrition labels while 48.7% were unaware of EDs effects. It can be assumed that consumers cannot be aware of the dangers of these drinks if they do not read product labels. However, Scuri et al. [36] discovered that 93.0% of Italian high school consumers are familiar with EDs composition, and Douglas and Nkporbu [31] found that 51.7% of the respondents among medical and dental students in Nigeria had a positive attitude toward EDs consumption, while 26.5% have good knowledge about those drinks. Stacey et al. [47] highlighted the association between advertising and consumption of these products, emphasizing the importance of possible restrictions through stronger regulation and clearer labeling of such products. This study revealed that 41.7% of all participants have prior nutrition knowledge which is similar to Hardy et al. [34]. They found that approximately half of the participants from two U.S. universities had learned about nutrition during high school or college (46%). This study found no significant difference in EDs consumption between students who studied nutrition and those who did not and also showed that there was no significant correlation between the monthly frequency of EDs consumption and the existence of nutrition education at the faculty. Despite that, a possible connection between EDs intake and more frequent consumption of junk food and bad dietary habits was previously mentioned in a few studies [54,55].

A survey from Saudi University identified male gender, being a single and non-medical field of study as the main determinant for EDs consumption among students [46]. This is similar to our study because the consumption of EDs was more frequent in males and among students in the field of biotechnical sciences although the latter determinant was not statistically significant in this study. Šljivo et al. [25] pointed out students of the higher year as an independent predictor for EDs consumption among university students in Sarajevo. By observing the consumption of EDs among students according to the repetition of the study year, no statistically significant difference was found in this research although there was a weak negative correlation between the repetition of the year of study and the monthly frequency of EDs consumption meaning that students who repeated the year of study had the higher monthly frequency of EDs consumption.

As for mixing EDs with alcohol, 75.2% of our consumers declared that they mixed these two types of drinks which is more than found among participants in some other studies [5,12,16,24,25,28,35,38,39,41,43]. Doggett et al. [56] emphasized the association between regular EDs consumption and AmED (mixing EDs with alcohol) consumption among the young population by demonstrating that young EDs consumers were 3.38 times more likely to consume AmED than non-consumers of EDs. This finding was supported by this study that showed a weak positive correlation between mixing EDs with alcohol and the monthly frequency of EDs consumption. Borlu et al. [12] highlighted how EDs consumption is more frequent in alcohol consumers, smokers, males, and those performing physical activity. The fact that AmED consumers drink significantly more alcohol was also found by some previous studies [53,57,58]. This study also proved that mixing EDs with alcohol was more frequent in those students who drink alcoholic beverages that put this subgroup of students at risk of engaging in other forms of risky behaviors such as

increased odds of driving a car under AmED influence, being hurt or injured, experiencing unwanted sexual contact, having unprotected sex, and using drugs [59]. On the contrary, a study that included Australian, Dutch, and UK students, did not find this association [60]. Furthermore, regarding the consumption of EDs and alcohol, a statistically significant difference by gender in this study was not found, which means that both men and women mix these types of drinks equally. Nevertheless, some other studies found that males mix EDs with alcohol more likely than females [36,60], while Spangler et al. [61] was the only one reporting more prevalent AmED consumption among females supporting their results with those obtained in-vivo, the increased use of alcohol among the female population in the last few years, and marketing that targets women. Mansour et al. [32] found no correlation between alcohol and EDs consumption with reasonable explanation due to the Muslim study population and the fact that drinking alcohol is generally forbidden. Our study shows that only 24.8% of participants who consume EDs at the University of Osijek do not mix these drinks with alcohol, which is very disturbing because AmED consumers are more likely to engage in binge drinking. Further, the consumption of AmED may lead to alcohol addiction, liver diseases, and obesity or diabetes related to the high-caloric content of these drinks. The caffeine content of EDs increases the need for more alcohol consumption, leading frequently to alcohol intoxication, not to mention all other previously mentioned caffeine adverse effects [6,59]. A cross-sectional study from the 2019 European School Survey Project on Alcohol and other drugs reported that 33.9% of 16-year-old students in Europe consumed AmED with the global prevalence greater among males. They stated significantly higher odds of AmED users with risk behaviors which also has been proven in this study [62]. The present study also showed that mixing EDs with alcohol is more frequent among smokers which were shown in the study by Bonar et al. which confirmed that besides smoking, alcohol use, as well as drug use, and depression symptoms were also positively associated with AmED use [63].

We also found that those who play sports or are engaged in regular physical activity were more likely to consume EDs. This finding is consistent with some other research [39], while some studies did not confirm this association [64]. However, when analyzing sports engagement in correlation to the monthly frequency of EDs consumption this study did not confirm the existence of a such connection. Goodhew et al. [65] revealed that a large proportion of extreme sports enthusiasts consume EDs regularly, younger adults above all. Šljivo et al. [25] stated how being a man and living in an urban environment were independent predictors for the consumption of EDs in association with sports or physical activity among university students in Sarajevo in Bosnia and Herzegovina. A review by Jiménez et al. [66] concluded that caffeinated drinks effectively increase several aspects of sports performance. The authors highlighted how the ergogenic role is connected to at least 3 mg of caffeine per kg of body mass. Fields et al. [48] found that 37.3% of high school athletes in the U.S. consume EDs. The alarming fact is also that they start this consumption very early, around 11–12 years of age, or even younger, mostly to gain energy.

The market is full of caffeinated beverages such as EDs that are widely used today by professional and recreational athletes to improve their performance. This could be a very significant problem because of the possible occurrence of serious cardiovascular events [66].

Students who smoke were found to consume more EDs than non-smokers. A Similar was found by some other authors [16,38,67]. However, some studies did not find a connection between the consumption of EDs and smoking habit [28,68], although according to gender differences among EDs users, male smokers were found to consume EDs more frequently than females [28]. Our study showed no statistical differences in EDs consumption according to coffee drinking habits which is consistent with the results of another similar study [39]. However, some studies found a connection between those two consumptions [25,28]. Finally, this research showed that there were more of those who prefer sweetened energy drinks (56.3%), which is in line with some other research [33]. Additionally, females were more prone to sugar-free versions [33]. According to research, the male population is a risk population group regarding the consumption of EDs. We can

clarify how given the more frequent consumption and excessive consumption of EDs, as well as their choice of sugary drinks, males are more likely to be faced with harmful effects, unlike females.

More than half of the consumers (65.4%) experienced certain symptoms after consuming EDs, which is in line with several other studies [39,69], while some studies confirmed side effects in less than half of the consumers [28,40]. Our study revealed an increased heart rate as the most common symptom after the consumption of EDs which is consistent with some other research [14,39,40,53]. Various studies have also reported insomnia [34,53,70], palpitations [12,71], jitteriness [48,70], and headache [72] as the main symptoms. A systematic review and meta-analysis on adverse effects of EDs consumption specified insomnia as the most frequent effect in children and adult populations [53]. In this study, insomnia was the third symptom experienced by our consumers. Tóth et al. [39] found that various adverse effects experienced by high school and college students in Hungary were directly proportional to the frequency of EDs consumption alongside alcohol or stimulants.

Given the harmful impact associated with the consumption of EDs, which are insufficiently regulated, the high prevalence of their consumption in the student population of the University of Osijek is a concerning fact and a possible problem.

This research has several limitations and should be interpreted with caution. First of all, it should be noted that the sample of students is quite small given the number of university students in Osijek. In addition, apart from the fact that only students from the University of Osijek in Eastern Croatia were included in the survey, it cannot be claimed with certainty that the results are applicable at the national level. Furthermore, students filled out the questionnaire according to their self-assessment, which does not necessarily mean that the answers were objective. As strengths of this study are concerned, it should be mentioned that this is the first study on the consumption of EDs in Eastern Croatia as well as the only comprehensive study on the consumption of EDs among university students in Croatia which is a solid ground for more detailed future studies on larger students' samples.

5. Conclusions

This study on EDs consumption among students from the University of Osijek in Eastern Croatia proved that the consumption of EDs is quite prevalent in the university student population. Additionally, males were more likely to consume EDs and also showed to be more prone to excessive consumption. Furthermore, by observing students' behavioral habits, there were also significant differences noticed. According to sports practice, students who perform sports or some physical performance consumed EDs more often, unlike those who do not perform any kind of exercise. Additionally, students who smoke were more likely to consume EDs as opposed to non-smokers. Study participants stated that in most cases they did not experience an injury due to the consumption of EDs but what is really concerning is that they reported experiencing certain negative symptoms after the consumption. These symptoms can interfere with their daily activities as well as their work. The real question then is, from the consumer's perspective, do the benefits of EDs consumption outweigh its drawbacks? If so, what are the consequences? Discussion and research on this topic should be encouraged considering that most people are not aware of the dangers that EDs consumption can cause.

This research contributes to the current literature and confirms the previous global pattern of EDs consumption as well as its possible harmful effects on human health. Due to the high content of caffeine and poorly regulated laws related to EDs, targeted action programs are needed to raise awareness of their harmful effects, and to change the consumption patterns among the student population.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/app13021124/s1>. Questionnaire on consumption of energy drinks among the students of the University of Osijek.

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