



## Original article

## Prevalence of energy drink consumption and association with dietary habits among governmental university students in Riyadh

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## ABSTRACT

To determine the prevalence of Energy Drinks (ED) consumption, and the adverse effects experienced by consumers among governmental university students in Riyadh, and to assess the relationship between ED consumption and dietary habits. This is a cross-sectional study carried out in 2020 in a random sample of students at government universities in Riyadh (King Saud University (KSU) and Imam Muhammad Ibn Saud Islamic University (IMSIU)). The study was conducted within a time frame of 3 months which included a total of 546 students. The data collection tool was an online self-administered questionnaire that included three sections. The first section addressed the characteristics of the students, the second section addressed ED consumption, and the third section addressed the dietary habits of ED consumers. A SPSS software-based analysis revealed that the percentage of ED consumers in our cohort was 29.3%. Moreover, we found a significant association between ED consumption and consumption of fewer than three meals, skipping breakfast, and fast food intake ( $\chi^2 = 0.002$ ,  $P = 0.364$ ;  $\chi^2 = 0.028$ ,  $P = 0.341$ ; and  $\chi^2 = 0.010$ ,  $P = 0.369$ , respectively), with moderate correlation. No association was found between the consumption of EDs and that of fruits, vegetables, and snacks. Moreover, 36% of the consumers experienced jolt-and-crash symptoms and signs after ED consumption, with 84.5% of them exhibiting increased consumption of salty snacks, sweets, and fast food during the episodes. Our findings showed that ED consumption is not a common practice among governmental university students in Riyadh. Furthermore, the consumption of EDs was correlated with unhealthy dietary habits. Creating educational programs for school going students and providing healthy alternative options to the students is highly recommend. Future research should be conducted using a larger sample and including universities from the private sector, to compare the results.

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## 1. Introduction

Energy drinks (EDs) are a group of beverages that are highly consumed among youth. The key ingredient of EDs is caffeine, as demonstrated in most studies of these beverages. Caffeine is a well-known stimulant with many side effects (Subaiea et al., 2019). In addition to caffeine, EDs contain guarana, taurine, ginseng, inositol, carnitine, glucuronolactone, B vitamins, and carbo-

hydrates (Subaiea et al., 2019; Park et al., 2016; Alsunni and Badar, 2011; Poulos and Pasch, 2015; Richards and Smith, 2016). ED consumption became popular among university students because of their desired effects, such as increased attention and improved performance in exams, which are attributed to caffeine.

The prevalence of ED consumption has been assessed and it was found that a significant proportion of students consume these beverages (Alsunni and Badar, 2011; Rahamathulla, 2017; Reid et al., 2015; Cabezas-Bou et al., 2016; Ballistreri and Corradi-Webster, 2008; Hasan et al., 2019). Moreover, ED consumption was increased in this population during studying and social activities (Cabezas-Bou et al., 2016). The initiation of ED consumption among the students was as follows: they consumed EDs for the first time before age 20, and males began consuming EDs influenced by advertisements, while females were influenced by friends' recommendations (Reid et al., 2015). The reasons for consumption were to increase energy, improve academic performance, participate in social events, and to stay awake (Alsunni and Badar,

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2011; Rahamathulla, 2017; Reid et al., 2015; Cabezas-Bou et al., 2016; Ballistreri and Corradi-Webster, 2008). A survey of 50 randomly selected Midwest universities was conducted to assess the prevalence of ED consumption and its effects on students. The incidence of ED consumption was 25.8%. Energy enhancement, anxiety/negative physical effects, withdrawal, and appetite suppression were significantly correlated with ED consumption (Luneke et al., 2020).

Dietary habits are the habitual decisions of individuals or groups of people regarding the foods they eat. University students do not meet the dietary recommendations for fruits, vegetables, and milk, and show higher consumption of sweetened beverages, salty snacks, and fast food (Poulos and Pasch, 2015). The results of two studies performed in Saudi Arabia and Korea are consistent regarding the poor dietary habits of university students. The Saudi study showed that the majority of the students consumed more junk food and fewer fruits and vegetables, as well as more than one soft drink or ED per day; moreover, overweight and obesity were common in this group of individuals (Khabaz et al., 2017). Williams et al. (2017) reported that regular consumption of EDs can trigger the consumption of other high-sugar drinks.

We aimed to determine the prevalence of ED consumption, the major reasons for their use, and the adverse effects experienced, and to assess the dietary habits of ED consumers regarding skipping breakfast, fruit and vegetable consumption, and fast food and snack consumption among governmental university students in Riyadh.

## 2. Patients and methods

### 2.1. Study design and duration

This was a cross-sectional study carried out in 2020 that assessed the prevalence of ED consumption and its association with dietary habits among undergraduate students at the KSU and IMSIU public universities. The universities were selected based on the following criteria: governmental universities located in Riyadh that included male and female students with scientific, humanitarian, medical, and administrative colleges, i.e., King Saud University (KSU) and Imam Muhammad Ibn Saud Islamic University (IMSIU).

### 2.2. Measures and participants

An online self-administered questionnaire was used to obtain data. It was formulated in English and Arabic to include 31 closed-ended questions developed based on previous studies. The questionnaire consisted of three sections. The first section included ten questions to assess the student's characteristics. Moreover, this section included a question about whether the participants consumed EDs or not. The survey of participants who answered (no) at this point ended automatically. The second section was composed of 12 questions to assess ED consumption. Finally, the third section consisted of ten questions to assess dietary habits. A pilot study was conducted to enhance study validity. The inclusion criteria were male or female undergraduate students in the Riyadh region (at KSU or IMSIU) who consumed EDs. Students who did not meet the criteria or did not complete the questionnaire were excluded from the study. Ethical approval for conducting this research was granted by the College of Medicine Institutional Review Board of KSU.

### 2.3. Data collection

The survey was conducted in two phases. In the first phase, the questionnaire was distributed randomly online to reach the

required number of participants in the study. The second phase was conducted because of the small number of participants from IMSIU (38%). A total of 480 participants from KSU (54.6%) and IMSIU (45.5%) filled out the questionnaire.

### 2.4. Statistical analysis

The data were analyzed using the SPSS software. However, descriptive statistics were used to interpret and present the results accurately. A chi-squared test was used to investigate the association between ED consumption and the dietary habits of the participants. Descriptive statistics were used to calculate the frequencies of the responses regarding student characteristics and ED consumption (Khan et al., 2019).

## 3. Results

### 3.1. Sociodemographic data

The sample was predominantly female (68.7%). Most of the participants were in the age group of 18–21 years (58.4%), followed by the age group of 22–25 years (37.7%) and the age group of 26–28 years (3.8%). Most students were from KSU (54.4%). Moreover, most of them were enrolled in a bachelor's degree (96%), while 4% were pursuing a diploma degree. Most of the participants were in the 3rd or 4th year of study (40.2%), followed by the 1st or 2nd year, then the 5th or 6th year of study (30.2% and 29.4%, respectively). In addition, most of the subjects were in the humanities and administrative track (64.49%), while 35.53% were in the sciences and medical track students. Among the sample of 546 students, 160 individuals were identified as ED consumers, as shown in Table 1. The body mass index (BMI) of the participants was different between the ED consumers and the non-ED consumers. The ED consumers had a slightly higher BMI than did the non-consumers (Table 1).

**Table 1**  
Characteristics of respondents (n = 546).

Characteristic	Categories	N (%)
<b>Gender</b>	Female	375 (68.7)
	Male	171 (31.3)
<b>Age group (years)</b>	18–21 years	319 (58.4)
	22–25 years	206 (37.7)
	26–28 years	21 (3.8)
<b>University</b>	King Saud University	297 (54.4)
	Imam Mohammed Ibn Saud Islamic University	249 (45.6)
<b>Type of degree</b>	Bachelor	524 (96)
	Diploma	22 (4)
<b>Year of study</b>	1st or 2nd year	165 (30.2)
	3rd or 4th year	220 (40.2)
	5th or 6th year	161 (29.4)
<b>Academic track</b>	Humanities and Administrative track	352 (64.5)
	Science and Medical track	194 (35.5)
<b>Energy drink consumption</b>	Non-energy drink consumer	386 (70.7)
	Energy drink consumer	160 (29.3)

### 3.2. Consumption pattern

The first event of ED consumption occurred in middle school (36.88%), followed by secondary school (31.88%). Among seven brands of EDs, Code Red was the brand that was consumed most by the participants (50%), as shown in Table 2. The general reason for consumption was a “nice taste” (53.6%), followed by “no reasons” (16.7%). Most of the participants consumed EDs 1–2 times/week (73.17%), and most of them did not consume EDs with meals (70.6%).

### 3.3. Adverse effects

Table 3 lists the different adverse effects experienced by the study participants after ED consumption: 66.3% of the participants never experienced adverse effects, while 33.8% noticed side effects after consumption. The commonest side effect was an elevated heartbeat (38.5%), followed by frequent urination (19.2%).

### 3.4. Knowledge about Eds

Most of the participants were aware of the presence of caffeine in EDs (88.1%), but a large number of them did not know about the presence of Taurine (82.5%), glucuronolactone (77.5%), and guarana (95.5%), as reflected in Table 4.

**Table 2**  
Preferred energy drink brand.

Brands Name	Frequency	Percent	Sugar content 100 ml/cans
<b>Code Red</b>	27	50.0	15.4 g
<b>Bison</b>	4	7.4	13 g
<b>Red Bull</b>	11	20.4	11 g
<b>Red Bull (sugar free)</b>	3	5.6	0
<b>Powerhouse</b>	3	5.6	10.7 g
<b>Gfuel Energy</b>	1	1.9	0

**Table 3**  
Adverse effect experienced with energy drink consumption.

Respond	Frequency	Percent
<b>Yes</b>	54	33.8
<b>No</b>	106	66.3
<b>Increased urination</b>	5	19.2
<b>Elevated heartbeat</b>	10	38.5
<b>Insomnia</b>	3	11.5
<b>Stomach pain</b>	3	11.5
<b>Jolt and crash episode</b>	3	11.5
<b>Dehydration</b>	1	3.8
<b>Kidney pain</b>	1	3.8

**Table 4**  
knowledge about ingredients of energy drinks.

Do you know that Caffeine is an ingredient in energy drink?		
Respond	Frequency	Percent
<b>Yes</b>	141	88.1
<b>No</b>	19	11.9
Do you know that Taurine is an ingredient in energy drink?		
Respond	Frequency	Percent
<b>Yes</b>	28	17.5
<b>No</b>	132	82.5
Do you know that Glucuronolactone is an ingredient in energy drink?		
Respond	Frequency	Percent
<b>Yes</b>	36	22.5
<b>No</b>	124	77.5
Do you know that Guarana is an ingredient in energy drink?		
Respond	Frequency	Percent
<b>Yes</b>	8	5.0
<b>No</b>	152	95.0

### 3.5. ED consumption and dietary habits

An analysis performed using the SPSS software showed that most ED consumers (117 out of 160 participants) consumed these beverages 1–2 times/week. A chi-squared test was used to investigate the association between ED consumption and the dietary habits of the participants.

### 3.6. Consumption of main meals, breakfast, fruits, and vegetables

The statistical analysis showed a significant association between ED consumption and the consumption of less than three meals per day and skipping breakfast ( $\chi^2 = 0.002$ ,  $P = 0.364$ ; ( $\chi^2 = 0.028$ ,  $P = 0.341$ , respectively), with moderate correlation, but no significant association was found between the consumption of EDs and fruit and vegetable consumption ( $\chi^2 = 0.249$ ,  $P = 11.399$ ;  $\chi^2 = 0.743$ ,  $P = 3.507$ , respectively) (Table 5).

### 3.7. Consumption of fast food and snacks

A statistically significant association was detected between ED consumption and fast-food intake ( $\chi^2 = 0.010$ ,  $P = 0.369$ ), but no significant association was observed between ED consumption and snack consumption ( $\chi^2 = 0.441$ ) (Table 6).

### 3.8. Jolt-and-crash episodes

A jolt is the experience or feeling an increase in the energy level, accompanied by an increase in alertness and circulation. A crash is the feeling that is experienced after a jolt, in which there is a significant and sudden decrease in energy level. Forty-nine participants experienced jolt-and-crash symptoms and signs after ED consumption, with 43 of them reporting an increase in their consumption of salty snacks, sweets, and fast food during the episodes (Table 7).

## 4. Discussion

The frequency of ED consumption in our sample was 29.3%, which was considered a low value compared with previous studies performed in Saudi Arabia. The study that recruited students from Prince Sattam bin Abdulaziz University in 2017 reported a frequency of ED consumption of 81.3%, while 45.63% of the participants in another study performed at the University of Dammam drank EDs (Alsunni and Badar, 2011; Rahamathulla, 2017). These lower values are suggested to be the result of new regulations from the SFDA and the General Authority of Zakat, as well as a tax (GAZT) regarding EDs. In 2017, the SFDA published the requirements for handling Eds, which include obligating the manufacturers and importers of these products to be registered in the authority of the EDs before the initiation of their marketing, and to adhere to the limits of the components of these products and to the following warning phrases written in a clear and prominent manner in the front of the package: “It should not be taken by pregnant, breastfeeding women, children under six years of age, and people who are sensitive to caffeine, who have heart problems, and athletes while watering Flashing” (<https://www.sfda.gov.sa/en/Pages/default.aspx> SfadaToomaioedtraattlotiRf).

In 2019, the (GAZT) (<https://gazit.gov.sa/en/RulesRegulations/Taxes/Pages/excise-tax.aspx> GAoZaTcstetRf) imposed a 100% tax for the EDs that have marketable and salable stimulant compounds. Moreover, the first-time consumption of EDs among the study sample occurred in middle school. A study of students of the Sattam University reported that 81% of the students started consuming EDs between the ages of 10 and 12 years

**Table 5**  
Consumption of main meals, breakfast, fruits, and vegetables.

How many meals do you consume daily				
On average, how many energy drinks do you consume per week?	1–2 time/week	3 meals	Less than 3 meals	2 meals
	3–4 time/week	54	12	51
	5–6 time/week	6	4	19
	More than 6 time/week	4	1	2
Do you consume breakfast daily	1–2 time/week	always	often	rarely
	3–4 time/week	25	60	27
	5–6 time/week	2	11	12
	More than 6 time/week	2	2	3
How many fruits do you consume weekly?	1–2 time/week	never	1–2 time/week	3–4 time/week
	3–4 time/week	31	65	13
	5–6 time/week	14	12	1
	More than 6 time/week	3	1	2
How many vegetables do you consume weekly?	1–2 time/week	never	1–2 time/week	More than 4 time/week
	3–4 time/week	21	81	15
	5–6 time/week	6	19	4
	More than 6 time/week	1	4	2
Total	1–2 time/week	2	3	2
	3–4 time/week	2	3	2
	5–6 time/week	2	3	2
	More than 6 time/week	2	3	2
<b>160</b>				

**Table 6**  
Consumption of fast food, and snacks.

How many fast foods do you consume weekly?				
On average, how many energy drinks do you consume per week?	1–2 time/week	never	1–2 time/week	3–4 time/week
	3–4 time/week	13	54	29
	5–6 time/week	1	9	14
	More than 6 time/week	0	3	1
How many snacks do you consume weekly?	1–2 time/week	10	44	29
	3–4 time/week	0	13	6
	5–6 time/week	0	4	0
	More than 6 time/week	1	4	0
Total	1–2 time/week	0	1	1
	3–4 time/week	0	1	1
	5–6 time/week	0	1	1
	More than 6 time/week	0	1	1
<b>160</b>				

**Table 7**  
Jolt and crash episodes.

		If yes, which kind of food do you prefer during jolt and crash episodes? (you can choose more than one answer)				Total
		Fast food (French fries, burger, shawarma, pizza, other)	Salty snack (biscuits, chips, cracker, other)	Sweet food	Fruit and vegetable	
Do you experience symptoms of jolt and crash episodes after consuming energy drinks?	Yes	17	17	9	6	49
	No	4	2	0	3	9
Total		21	19	9	9	58

(Rahamathulla, 2017). Hence, it is crucial to increase awareness about ED use by children in middle school.

The general reason for the consumption of EDs among the participants in the present study was a “Nice taste,” followed by “for no reason,” while a small fraction of the sample consumed EDs during learning processes. This was in accordance with the results of a study conducted in Argentina (Ballistreri and Corradi-Webster, 2008).

We reported several adverse effects experienced by this study’s participants, as well as their frequency. Overall, most of the participants reported an elevated heartbeat, followed by frequent urination, as shown in Table 3. Moreover, the dietary habits assessed in our study were skipping breakfast, fruit and vegetable consump-

tion, fast food consumption, and snack consumption. The results regarding the dietary habits highlighted the fact that most of the participants did not consume EDs with meals (70.6%). Most of the ED consumers (117 out of 160 participants) drank these beverages 1–2 times/week. Furthermore, 96% of the participants reported that they consumed less than three meals/day, and that most likely they skipped the breakfast, accompanied by a significantly increased level of consumption of fast food (more than two times/week), as shown in Table 5. Although a low consumption of fruits and vegetables was observed among ED consumers, the differences were not statistically significant (148 of the participants consumed fruits less than four times/week and 137 participants consumed vegetables less than four times/week), as shown

in **Tables 5**. A significant association was observed between ED consumption and fast-food intake while not significantly associated with snack consumption showed in **Tables 6**. However, among the 160 ED consumers, 49 individuals experienced a jolt-and-crash episode after the consumption of these beverages and reported that they consumed salty and sweet foods, as well as fast food, during the episodes, as shown in **Table 7**.

This study had several potential limitations, with the main one being related to the short study duration, as one semester is not sufficient to guarantee the appropriate sample and accurate results: the number of responses was limited because of the tight time frame of the study. Similarly, because of time constraints, we included more female than male respondents in the study.

## 5. Conclusion

The findings of our study showed that ED consumption is not a common practice among the students of both IMSIU and KSU, as its prevalence was 29.3%. Furthermore, a relationship was observed between the consumption of EDs and unhealthy dietary habits regarding skipping breakfast and fast-food intake.

## 6. Recommendations

Increasing community awareness, specifically among young children and teenagers, about the side effects of EDs on health. Creating educational programs for school students and providing healthy alternative options to the students. Additional studies should be conducted in the private sector and include more male participants.

## Ethics approval and consent to participate

Ethical approval for conducting this research was granted by the College of Medicine Institutional Review Board of KSU (20/0297/IRB).

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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