

# Consumption of Energy Drinks Among Lebanese Youth: A Pilot Study on the Prevalence and Side Effects

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**Background:** The new millennium has been together with a variety of synthetic and caffeinated high-energy drinks targeting the youth market. Energy drinks raise the level of energy and their consumption has been increased significantly worldwide.

**Objectives:** This research aimed to determine patterns of energy drink consumption and to assess the prevalence of adverse side effects among energy drink users.

**Patients and Methods:** A pilot cross-sectional study survey was undertaken on students aged between 13 and 30 years in private and public schools and universities in Lebanon over 5 months. A self-administered questionnaire was used inquiring about sociodemographic characteristics, consumption patterns, attitudes and beliefs about energy drinks. Bivariate and multivariate analyses were conducted. Data was analyzed using SPSS 17.

**Results:** We studied 1500 students (mean age:  $18.92 \pm 1.85$ ; 51.3% were males). The overall prevalence of energy drinks consumption was 63.6% (60.5% were males), among which 50.5% used alcoholic energy drinks. Respondents indicated that most consumed energy drinks were "Red Bull" and "Boom Boom" (70.9% and 51.5% respectively). In total, 64.5% of participants believed the effect of these drinks in energizing the body, and 72.7% believed that they can stimulate intellectual capacities. In addition, 29.6% of consumers experienced at least one adverse effect, where tachycardia was reported in 21.1% of cases. On the other hand, desired effects felt after consumption were mostly pleasure (33.8%). Males had a 3-time more risk of consuming such drinks compared to females (OR: 0.381,  $P < 0.001$ ; 95% CI: 0.300-0.484). Additionally, this analysis demonstrated a significant association between energy drinks consumption and regions outside Beirut (OR: 1.401,  $P: 0.006$ ; 95% CI: 1.103-1.781), medical field of work (OR: 0.376,  $P: 0.010$ ; 95% CI: 0.179-0.790) and higher personal income (OR: 1.317,  $P < 0.001$ ; 95% CI: 1.117-1.553).

**Conclusions:** This study showed a high prevalence of energy drinks consumption among youth. The current results highlight the importance of education to prevent the consumption of energy drinks in excessive quantities and modifying some wrong perceptions regarding the benefits of energy drinks in youth.

**Keywords:** Energy Drinks; Alcohol Drinking; Students

## 1. Background

The new millennium has been together with a variety of synthetic and caffeinated high-energy drinks targeting the youth market (1). The term "energy drink" (ED) designates any product in the form of a drink or concentrated liquid (2), which claims to contain a mixture of ingredients such as caffeine, taurine, Guarana, vitamins B, and some others able to raise the level of energy and mental performance (3). Over the past 10 years, consumption of energy caffeinated beverages has been increased significantly (1). In addition, energy drink industry has been developed exponentially with almost 500 brands launched internationally in 2006, which most are sold without age restrictions (4). However, energy drinks typically attract young people. Recent studies among college students documented the prevalence of energy drink use as 39% to 57% (5, 6). Approximately 66% of consumers were 13-35 years old. This attraction to energy drinks might be due

to effective product marketing, peer influence, and lack of knowledge about their potential harmful effects (5, 6).

Many harmful effects are attributed to these drinks and many cases of hospitalizations were reported by emergency physicians (7, 8). Adverse reactions and toxicity of high-energy drinks originate primarily from their caffeine content and the synergic effect of other ingredients (9). These effects might be due to the consumption of quantities of components that exceeds the maximum tolerated dosage per day (1, 3). Cardiovascular conditions following excessive energy drink consumption include heart palpitation, tachycardia, chest pain and dysrhythmias (10). Indeed, those beverages rich in exciting substances induce other side effects such as peripheral vasoconstriction, hypertensive effect (3), headache, anxiety, irritability, agitation, nausea, vomiting, abdominal pain, diarrhea, gastroesophageal reflux, heartburn and esophagitis (11).

The use of energy drinks seems to be increasing in Lebanon and their sale and use remain unregulated. In addition, there has been no research in Lebanon regarding the patterns of energy drink consumption and their side effects.

## 2. Objectives

In this pilot cross-sectional study, we aimed to determine the patterns of energy drink consumption and side effects in the youth Lebanese population.

## 3. Patients and Methods

### 3.1. Study Design and Data Collection

A pilot cross-sectional survey was conducted on students of three universities (1 public and 2 private universities) and eight schools (2 public and 6 private schools) in Lebanon. In Lebanon, the word “college” is equivalent to “school” (students stay at school until they obtain their baccalaureate (18 years old), while a university is a post-school institution (18 years and more). The study was performed over 5 months from February 2013 to June 2013. The final sample consisted of 1500 students. Inclusion criteria were being a full time university or school student, aged between 13 and 30 years, in a private or public institution, of both sexes. No exclusion criteria were considered.

### 3.2. Tools and Procedures

A self-administered, anonymous questionnaire in Arabic and French languages, developed by the investigators was distributed to students. It contained closed and open-ended questions. First, it was pilot-tested on 30 university students for further modifications of the questionnaire. The questionnaire contained items regarding current consumption, and knowledge and attitude about energy drinks. It consisted of 37 questions, divided into 3 parts. Ten questions were related to sociodemographic characteristics: age, gender, region and living status, field of study and work, and personal income. Fourteen general questions were related to energy drinks. Thirteen specific questions were about side effects of using energy drinks. Participants gave informed consent to participate in the study and were assured about the anonymity of questionnaires. Permissions were obtained from the schools administrations and the Ethics committee at universities prior to the initiation of study.

### 3.3. Statistical Analysis

Descriptive statistics, mainly mean values were used for continuous variables, and proportions were used for discrete variables. Chi-2 test was used to compare categorical variables. A Backward likelihood logistic regression was used whenever the dependent variable was dichotomous, and the independent variables are those showing association in the bivariate analysis at  $P < 0.2$ . In all logistic regressions, a non-significant Hosmer-Lemeshow

test was obtained ( $P > 0.05$ ) to ensure an adequacy of the model. A  $P < 0.05$  was considered significant. Data was analyzed using SPSS, version 17.

## 4. Results

### 4.1. Sociodemographic Characteristics

A total of 1500 participants (51.3% were males), aged  $18.92 \pm 1.85$  years (ranging from 13 to 30 years old) filled the questionnaire. The participants were divided in half between Beirut and other regions (Bekaa, South Lebanon, North Lebanon, and Mount Lebanon). They were distributed among schools (60.2%), and universities (28.7%). In total, 11.2% were graduated (23.7% from medical and 76.3% from nonmedical fields), and most had a monthly personal income around 100\$-300\$ (42%). Almost all were living with their families (93.3%); 97.3% did not have chronic diseases (Table 1).

### 4.2. Consumption Prevalence and Knowledge About Energy Drinks Effects

The prevalence of energy drink consumption among the surveyed participants was 63.6% ( $n = 956$ ). The mean age at first consumption was  $15 \pm 3$  years as shown in Table 2. Most participants (51.1%) consumed drinks lower than once per month. The mean number of cans consumed consecutively was  $1.4 \pm 0.8$  cans. The most common reason and situation to consume energy drinks was in nightclubs (29.2%). 70.9% of the respondents indicated that they usually drink “Red Bull®”. Others consumed brands of energy drinks as presented in Figure 1.

In total, 78.5% of participants considered this beverage as a drink that energizes and stimulates wakefulness, 15.7% as sports drink and 5.9% as a drink that stimulates the intellectual capacities. Regarding the knowledge about the side effects of these drinks, 53.4% believed that these drinks can affect the health, while 35.5% did not know the side effects and a minority (11.1%) considered them as safe drinks. Among the participants, 40.7% indicated possible side effects, most of them insisted on their potential cardiac effect. The two most mentioned adverse effects by the participants were tachycardia (34.2%) and cardiac disease (15.8%).

### 4.3. Adverse and Desired Effects Associated With the Consumption of Energy Drinks

In total, 29.6% of consumers experienced at least one adverse effect, while 70.4% did not. The adverse health effects occurred in consumers were tachycardia in 21.1%, insomnia in 14.4%, polyuria in 10.9%, tremor in 9.7%, headache in 8.7%, flushing in 8.4%, abdominal pain in 7.5%, nausea in 6.8%, vomiting in 4.2%, agitation in 3.5%, redness of the skin in 2.4% and pruritus in 0.5%. Other effects reported from consumers were dyspnea, hypotension, nervousness and dizziness. There was also a case of hospitalization, reported by a participant in the survey, due to tachycardia associated with consumption of energy drinks.

**Table 1.** Sociodemographic Characteristics of the Study Population <sup>a</sup>

	Results
<b>Age, y</b>	
13-18	872 ± 58.1
19-23	461 ± 30.7
23-30	167 ± 11.1
<b>Gender</b>	
Male	769 (51.3)
Female	731 (48.7)
<b>Region</b>	
Beirut	750 (50)
Other regions	750 (50)
<b>Living situation</b>	
With family	1399 (93.3)
Alone	35 (2.3)
With a roommate	33 (2.2)
Multiple dorm	33 (2.2)
<b>Number of people living together</b>	
1-5	1185 (79)
≥ 6	315 (21)
<b>Education</b>	
College	903 (60.2)
University	430 (28.7)
Graduated	167 (11.2)
<b>Field of study</b>	
Medical	102 (23.7)
Nonmedical	328 (76.3)
<b>Work</b>	
Full time	177 (62.5)
Part time	106 (37.5)
<b>Field of work</b>	
Medical	40 (14.1)
Nonmedical	243 (85.9)
<b>Personal income, \$</b>	
<100	493 (32.86)
100-300	630 (42)
300-500	181 (12)
> 500	196 (13.14)
<b>Chronic disease</b>	
No	1459 (97.3)
Yes	41 (2.7)

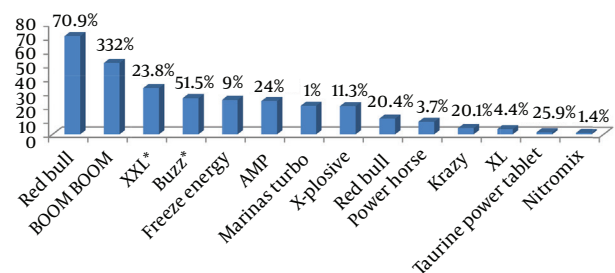
<sup>a</sup> Data are presented as Mean ± SD or No. (%).

**Table 2.** Characteristics of Energy Drink Consumers <sup>a</sup>

	Results
<b>Frequency of consumption</b>	
Rarely	487 (51.1)
Often	282 (29.6)
Regularly	128 (13.4)
Daily	57 (6)
<b>Monthly expenditure, LL</b>	
< 10.000	677 (71)
10.000-30.000	213 (22.3)
> 30.000	64 (6.7)
<b>Consumption by a relatives</b>	
Father	119 (12.5)
Mother	61 (6.4)
Siblings	354 (37.1)
Others	62 (6.4)
<b>Consumption places</b>	
Home	518 (27.5)
Restaurant/cafe/club	486 (25.8)
At friend's house	420 (22.3)
Public places/public garden	329 (17)
Beach	54 (2.8)
University	43 (2.2)
School	33 (1.7)
<b>Consumption occasions</b>	
In night clubs or evening	404 (29.2)
Before a sport activity	218 (15.7)
Long distance driving	175 (4.5)
Examination period	63 (12.6)
Thirsty	110 (7.9)
At anytime	413 (29.8)
<b>Age, y</b>	15 ± 3
<b>Number of cans consumed consecutive, cans</b>	1.4 ± 0.8

<sup>a</sup> Data are presented as Mean ± SD or No. (%).

**Figure 1.** Consumption Frequency of Each ED Available on the Lebanese Market



Available in nonalcoholic and alcoholic forms.

**Table 3.** Sociodemographic Characteristics of Consumer and Nonconsumers <sup>a, b</sup>

	Consumers	Non Consumers	P Value
<b>Age, y</b>			0.02
13-18	529 (60.7)	343 (39.3)	
19-23	313 (67.9)	148 (32.1)	
24-30	112 (67.1)	55 (32.9)	
<b>Gender</b>			0.000
Male	577 (75)	192 (25)	
Female	377 (51.6)	354 (48.4)	
<b>Region</b>			0.003
Beirut	449 (59.9)	301 (40.1)	
Other regions	505 (67.3)	245 (32.7)	
<b>Number of people living together</b>			0.006
1-5	775 (65.4)	410 (34.6)	
≥ 6	179 (56.8)	136 (43.2)	
<b>Field of study</b>			0.001
Medical	23 (57.5)	17 (42.5)	
Nonmedical	179 (74.3)	62 (25.7)	
<b>Personal income, \$</b>			0.000
< 100	272 (55.2)	221 (44.8)	
100-300	411 (65.2)	219 (34.8)	
300-500	89 (78.8)	24 (21.2)	
> 500	32 (64)	18 (36)	
<b>ED definition</b>			0.007
Drink that energizes and stimulates	759 (64.5)	418 (35.5)	
Wakefulness	131 (55.7)	104 (44.3)	
Sports drink that stimulates intellectual capacities	64 (72.7)	24 (27.3)	
<b>Knowledge of ED side effects</b>			0.001
No	128 (76.6)	39 (23.4)	
Yes	493 (61.5)	308 (38.5)	
<b>I do not know</b>	333 (62.6)	199 (37.4)	
<b>Total</b>	956 (63.6)	546 (36.4)	

<sup>a</sup> Abbreviation: ED, energy drinks.<sup>b</sup> Data are presented as No. (%).

Among participants consuming these beverages, 11.3% mentioned dependency to such drinks. A bivariate analysis reported the association between feeling of pleasure (87.7%) and dependency ( $P < 0.05$ ). Mainly the desired effects felt after energy drink consumption were mostly pleasure (33.8 %), gaining energy (33.8 %), wakefulness (17.6 %) and intellectual concentration (8.5 %).

#### 4.4. Combination of Energy Drinks With Alcohol

The prevalence regarding energy drink consumption with alcohol combination among the surveyed partici-

pants was 50.5% ( $N = 481$ ). The frequency of consuming energy drinks mixed with alcohol was as follow: always 24%, sometimes 42% and rarely 34%. The main type of used alcohol was vodka 77.5%, and 15.6% reported that this combination was associated with adverse health effects such as nausea (25.3%), tachycardia (20%) and vertigo (16%).

#### 4.5. Determinant Factors for the Use of Energy Drinks

As shown in table 3, consumption was significantly higher among 19-23 age group (67.9%) and males accounted

for the highest proportion (75%). On the other hand, the bivariate analysis showed less consumption among participants from Beirut (59.9%) compared to other regions (67.3%). Participants living with 1-5 persons consumed more ED compared to participants living with equal to or more than six persons (65.4% and 56.8% respectively). Moreover, consumption of energy drinks was significantly different across various fields of study, with the highest rate reported among participants of nonmedical field (74.3% and 57.3% respectively). Besides, a higher association was observed between personal incomes and drinking. Generally, consumers were people who did not know the health effects of energy drinks (76.6%) or considered them as safe ones (62.6%).

#### 4.6. Multivariate Analysis

##### 4.6.1. The Impact of Various Factors on the Consumption of Energy Drinks

Totally, 63.6% were found to be current consumers. Table 4 summarizes the predictive factors affecting the consumption of energy drinks in Lebanon. In multivariate analysis, gender was associated with energy drink consumption, females were less likely to consume energy drinks (ORa: 0.381,  $P < 0.001$ ; 95% CI: [0.3-0.484]).

Additionally, students majoring in medical fields were less likely to consume energy drinks compared to those of nonmedical fields (ORa: 0.376,  $P = 0.01$ ; 95% CI: [0.179-0.79]). Moreover, a significant association was found between energy drink consumption and region for participants who lived in other regions versus those living in Beirut (ORa: 1.401,  $P = 0.006$ ; 95% CI: [1.103-1.781]). Finally, increasing income was associated with higher odds of energy drink usage (ORa: 1.317,  $P = 0.001$ ; 95% CI: [1.117-1.553]).

##### 4.6.2. The Impact of Various Factors on ED Adverse Health Effects

In total, 29.6% of consumers declared that they had experienced an adverse effect from ED consumption. Multivariate analyses demonstrated significant higher risk of ED side effects and older age (ORa: 1.466,  $P < 0.001$ ; 95% CI: [1.187-1.811]). The same was found between the number of cans consumed consecutively and ED side effects (ORa: 1.223,  $P = 0.04$ ; 95% CI: [0.987-1.515]). Furthermore, incapability to stop drinking once the consumers started to drink was associated with greater odds of reporting ED side effects (ORa: 1.248,  $P = 0.02$ ; 95% CI: [1.03-1.511]). Another interesting finding was that consumption of other caffeine sources combined with ED was associated with increased risk of ED side effects (ORa: 2.297,  $P < 0.001$ ; 95% CI: [1.667-3.166]). Moreover, a greater association was found between the consumption during exam period and adverse effects (ORa: 2.241,  $P = 0.02$ ; 95% CI: [1.561-3.218]). Data of multivariate analysis is summarized in Table 5.

**Table 4.** Logistic Regression Analysis of Predictors of ED Consumption Among Participants

	P Value	Adjusted OR	95% CI
<b>Male</b>	< 0.001	0.381	0.300-0.484
<b>Regions outside Beirut</b>	0.006	1.401	1.103-1.781
<b>Nonmedical field of study</b>	0.010	0.376	0.179-0.790
<b>Higher personal income</b>	< 0.001	1.317	1.117-1.553

**Table 5.** Logistic Regression Analysis of Predictors of Adverse Health Effect Among ED Consumers

	P Value	Adjusted OR	95% CI
<b>Age</b>	< 0.001	1.466	1.187-1.811
<b>Number of cans consumed consecutively</b>	0.046	1.223	0.987-1.515
<b>During exam period</b>	< 0.001	2.241	1.561-3.218
<b>Incapable to stop once started drinking</b>	0.023	1.248	1.030-1.511
<b>Consumption with other caffeine sources</b>	< 0.001	2.297	1.667-3.166

## 5. Discussion

The current study indicated that energy drink consumption is popular among Lebanese youth. In our study, 956 of 1500 participants (63.6%) reported consuming energy drinks with a different frequency of consumption, which is higher compared to several investigations on college students reporting the prevalence of energy drinks use as 39% to 57% (5, 6, 12). On the other hand, this study was the first that estimated the prevalence and patterns of consumption among Lebanese youth. Our study is concordant with other studies who confirmed that young adults like to consume energy drinks. Oddy et al. found that 28% of 12-14 years old, 31% of 15-17 years old, and 34% of 18-24 years old participants reported regularly consumption of energy drinks (13).

A comparison between energy drink consumption habits of males and females in our study showed that a high percentage of the respondents were males (75%), where males consumed 3 times more ED compared to females (OR: 0.381,  $P < 0.001$ ; 95% CI: 0.3-0.48). This finding of the present study is in line with other investigations indicating higher consumption among males (5, 12, 14, 15). A probable reason for the higher intake of energy drinks among males is advertisements, which primarily target young males as asserted by Miller. In addition, we found no differences in the prevalence of side effects and attitude towards energy drinks between sexes.

The American College Health Association reported that 71% of college students under survey reported insufficient sleep (16). In our study, 78.5% of participants defined energy drinks as beverage that energizes and stimulates wakefulness supporting the premise that college students use energy drinks to treat sleep deprivation while studying or



partying. On the other hand, 15.7% considered this drink as sports drink and 5.9% as beverage that stimulates intellectual capacities. Such finding is not surprising, as Bonci (17) indicated that most people believed that consuming energy drinks is a fast means of obtaining 'extra energy' to undertake activities and speed up recovery from exercise. The findings of the present study corroborate with Malinauskas et al. findings (5), in which 65% of college students indicated consumption of energy drinks because they needed energy. Similarly, Oteri et al. (14) reported that energy drink consumption has become widespread among college students, particularly student athletes who meet both cognitive and physical performance demands.

Furthermore, drinking multiple energy drinks cans (37.7%) and combination with alcohol (50.5%) was a popular habit among energy drink users in our study. Our results showed that the favorite place for drinking was at home (27.5%) or restaurant/cafe/club (25.8%). This was in accordance with a survey conducted in the United States on a large cohort of students, which showed that consumption of energy drinks combined with alcohol was a common practice for 73% of regular users (14). These authors also showed that students, who regularly used these beverages, drank more than three cans each time. Another survey performed in Italy showed that 85% of participants used a mixture of alcohol and energy drinks and 36% of participants consumed more than three cans (18).

Health implications of excessive intake of energy drinks were numerous in our results as reported by 29.6% of users. In total, 21.1% experienced tachycardia, 14.4% reported insomnia, 10.9% had polyuria, 9.7% had tremor and 8.7% had headache. The results of our study are comparable to those found in other studies. Seifert et al. reported that energy drink consumption was associated with tachycardia, dyspnea, headache fatigue and anxiety (19). On the other hand, our results demonstrated an association between the occurrence of adverse health effects and the increasing number of cans consumed (OR: 1.22,  $P = 0.046$ ; 95% CI: 0.98-1.52). Participants who consumed ED combined with other caffeine sources had 2 times more risk to experience adverse effects compared to those who did not drink other caffeine drinks with ED (OR: 2.297,  $P < 0.001$ ; 95% CI: 1.67-3.17). Similar to our result, Strain et al. showed that the effects of caffeine are dose-related, with low to moderate doses of caffeine (20 to 200 mgs) producing increased happiness, energy, alertness, and sociability. Conversely, higher doses are more likely to produce undesirable effects, such as anxiety, nervousness, and upset stomach (20). Widely varying amounts of caffeine in energy drinks together with inadequate product labeling and marketing to youth increase the likelihood of caffeine overdose (i.e., caffeine intoxication), which can be medically problematic (9, 21-23).

Some possible biases could arise from the study methodology such as a selection bias. In this pilot cross sectional study, the sample was not taken randomly, because public university directors did not allow us to fill out

the questionnaires during classes; hence, it was not possible to select a random sample. Therefore, the questionnaires were empirically distributed to students during recess hours. Our results could be affected due to under or over estimation of the expected association because some faculties could be more represented than others. In addition, we did not take enough samples from private university and public schools. Indeed, based on the descriptive statistics regarding age, we primarily had undergraduate participants. Therefore, findings may not be broadly generalizable.

The possibility of nonresponders bias cannot be excluded in this study and some participants did not complete the entire questionnaire. It was not possible to get detailed information of nonresponders. However, nonresponder bias did not affect our results, because missing value was less than 10%. In addition, the delicateness of the subject increased the risk of false answers. The bias introduced by underreporting is possible, as the consumption behaviors such alcohol combination is a sensitive issue, and some students preferred not to reveal it especially females; this could cause an underestimation of the expected associations. While, males did not have a problem to indicate their consumption, because they liked to appear more mature and cool, which may lead to differential bias.

Another important limitation of this study was its cross-sectional nature, so causality or temporal relationships could not be inferred from the results, and future longitudinal researches would be necessary to investigate these issues. However, in the absence of other exhaustive studies in Lebanon and Arabic countries, these data provides a crucial starting point for such studies. To remove the confounding effect of several variables, we performed a multivariate analysis; however, we could not exclude the possibility of residual confounding due to variables that we did not evaluate. Our study also had some strong points; since we had a large sample size, we had no problem regarding the power of study. Furthermore, there was a significant dose-dependent association between energy drink consumption and related side effects. Moreover, since our results were much similar to those of recent studies, we have no reason to believe that this would have affected the validity of our results. Further studies are suggested to confirm our pilot findings.

Using energy drinks is a popular habit among students as we found that 63.6% of surveyed participants reported consumption of energy drinks. Alcohol-mixed energy drinks pose a particularly dangerous situation for young people, which needs more investigation. The current results of the study highlight the importance of health education to prevent the consumption of energy drinks in excessive quantities and modifying some wrong perceptions in young people regarding the benefits of energy drinks.

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## Authors' Contributions

All author contributed to the study design, data analysis and manuscript writing.

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