

Knowledge and Consumption Practice of Energy Drinks among Medical University Students in Mosul, Iraq

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ABSTRACT

Objective: Energy drinks are gaining popularity, and their consumption is associated with adverse effects. This study aims to explore the level of knowledge regarding energy drinks among medical students and the practices of those students who consume these products.

Methods: A cross-sectional, questionnaire-based study design was adopted for this work. The survey was distributed among students of medical colleges at the University of Mosul to assess their knowledge and practices regarding energy drinks.

Results: A total of 1298 students participated in the study, with 60% being females. Most of the students (89%) knew what energy drinks are, but only 42% knew their ingredients. Almost all the students (95%) were aware that energy drinks have adverse effects, but only a few knew about any beneficial effects these products might have. Only 30% of the participants admitted to consuming energy drinks, with more than half of those students drinking less than five cans monthly. Sugar-containing products were more favored than sugar-free ones, and Tiger™ was the most preferred brand of energy drinks among students. Forty-one percent of the energy drink-consuming students reported experiencing side effects. The knowledge of the side effects of energy drinks was the most commonly reported reason for not consuming these beverages. Older male students in their last two years of study and those living within the city were found to be more knowledgeable about energy drinks.

Conclusions: The level of knowledge regarding energy drinks was low, which should be a cause for concern, especially given the increasing popularity of energy drinks and the marketing campaigns targeting youth.

Keywords: Energy drinks, Tiger™, Knowledge, EDs consumption, Practice.

INTRODUCTION

"Energy drinks" (EDs) is the term given to beverages that are sold with the claim of boosting consumers' "energy" through their containment of caffeine in conjunction with a variety of other ingredients [1]. Despite the fact that the term "energy drinks" is not officially recognized by the American Food and Drug Administration (FDA) or the United States Department of Agriculture (USDA), these beverages

represent a multibillion-dollar market and have gained increasing popularity in recent years, thus making them the fastest-growing sector in beverage sales [1-3]. A wide variety of brands and flavors of EDs are available in the market [4], all reputedly able to increase consumer energy through their content of stimulants and energy enhancers such as caffeine, guarana (a plant rich in caffeine), taurine, vitamins, sugar, ginseng, ginkgo biloba, among others [5].

Energy drinks are specifically marketed towards certain demographic segments such as truck drivers, university students, athletes, and other sectors of society that require an "energy boost" [6]. Some of the benefits attributed to

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consumption of EDs in these populations include improved mental and physical capabilities, increased athletic endurance and energy, enhanced learning ability, ability to maintain wakefulness for longer periods, faster reaction times, improved emotional health, and better driving skills [7]. However, the use of EDs also carries associated risks. Documented adverse effects of EDs include impacts on the cardiovascular system like palpitations and increased blood pressure [8], effects on the central nervous system such as restlessness, sleeping disturbances, and acute psychosis [5,9-11], the renal system (e.g., metabolic acidosis) [11,12], the endocrine system (e.g., obesity, hyperinsulinemia, decreased insulin sensitivity) [5,13,14], along with gastrointestinal upset, peptic ulcer [15,16], and increased dental erosion [17].

Despite the harmful effects of EDs, many individuals consume them excessively, leading to suggestions that warning labels should be placed on packaging [10, 18]. This is particularly common among university students, who often ingest high quantities of EDs to manage the stress associated with studying, assignments, examinations, and extended periods of separation from their families. Furthermore, many of these students are uninformed about the detrimental consequences these beverages can provoke—instead, they remain captivated by their stimulating effects [18-22].

Aligning with logical expectations, pursuing a degree in a medicine-related field should theoretically reduce the consumption of EDs since such students would learn about these beverages' harmful impacts—a proposition supported by existing literature [23]. Accordingly, this study strives to evaluate the level of knowledge regarding EDs among medical university students and to understand the practices these students adopt concerning these beverages in the city of Mosul, Iraq.

METHODS

A survey was conducted among medical college students at the University of Mosul to assess the knowledge and consumption practices related to EDs. Google Forms was

utilized to create and disseminate the questionnaire. The survey was composed of three sections: the first comprised seven questions that collected sociodemographic data (age, gender, year of study, residence, sleep duration, sleep regularity, and students' weekly income).

The second part assessed the participants' knowledge about EDs, their constituents, and their effects on the body, using 18 questions. Participant knowledge was assessed by assigning a score of "1" for each correct answer and "0" for each incorrect answer, yielding a potential knowledge score range of 0 to 18. The median-split method [24] was employed to categorize students based on their scores into groups with either adequate or inadequate knowledge. The median was identified as 8, and thus, students with a knowledge score less than 8 were deemed to have inadequate knowledge, while those with a score of 8 or higher were categorized as having adequate knowledge.

The third section of the questionnaire comprised 11 practice questions, addressing aspects such as ED consumption, frequency and timing of ED consumption, preferred drinks and ED brands, reasons for selecting a specific brand, whether they experienced side effects (SE), the types of SE experienced, and the reasons for consuming EDs. Finally, a question asked participants who refrained from drinking EDs about their motivations for non-consumption.

The survey link was randomly distributed to students from October 13th to 20th, 2022, by sharing the link with different class representatives. These representatives then forwarded the survey link to their classmates via various social media groups, in which most students were members. Eligibility for this study was restricted to students in pharmacy, dentistry, or medical schools, excluding students from other schools and colleges within the university. Based on data procured from the Registration Offices at the Colleges of Pharmacy, Dentistry, and Medicine, the approximate total number of undergraduate students during data collection was 6,000. The Raosoft sample size calculator (<http://www.raosoft.com/samplesize.html>) was utilized to determine the sample size, identifying a minimum of 362 students as the desired size to achieve a 95% confidence level.

The survey was conducted in Arabic to encourage student participation and to provide ease in survey completion. The reliability of the survey items was tested through the calculation of the Cronbach's alpha value. The survey's content validity was verified using the opinions of three experts.

The study's aim was detailed in the first page of the Google Form. It was clearly indicated that participation was voluntary, with a mandatory tick box present on the first page to record students' informed consent to participate and complete the survey. Furthermore, prior to the beginning of data collection, the study received ethical approval from the Scientific Committee at the Department of Clinical Pharmacy, College of Pharmacy, University of Mosul.

Statistical analysis, which includes both descriptive and inferential statistics, was performed using SPSS version 28 software. A statistical significance level of P-value ≤ 0.05 was applied to all results.

RESULTS

A total of 1,298 medical students completed the questionnaire, constituting the final study sample. The Cronbach's alpha value was 0.769, indicating acceptable internal consistency. In terms of validity, the experts determined that the survey questions sufficiently reflected the topics needed to fulfill the study's objectives. The majority of the students (84.6%) were aged between 21 and 23 years old. Approximately 60% of the participants were female, and the percentages of students studying in the second, third, and fourth classes were 20%, 22%, and 21%, respectively. About 80% of the participants resided in urban areas, and approximately 57.9% reported irregular sleep patterns. The regular sleep duration for 64.8% of the students was between 6 and 8 hours. The weekly allowance from their families was less than \$20 for approximately two-thirds of the students (60.9%). Table 1 provides a summary of the students' socio-demographic characteristics.

Table 1: Demographic characteristics of the students

Variables (N= 1298)	Frequency (%)
Age	
18 – 20 years	126 (9.7)
21 – 23 years	1098 (84.6)
> 23 years	74 (5.7)
Gender	
Male	516 (39.8)
Female	782 (60.2)
Year of study	
1 st year	221 (17.0)
2 nd year	262 (20.2)
3 rd year	289 (22.3)
4 th year	277 (21.3)
5 th year	213 (16.4)
6 th year	36 (2.8)
Residence	
Urban	1074 (82.7)
Rural	224 (17.3)
Sleeping regularly	
Yes	547 (42.1)
No	751 (57.9)
Sleeping hours	
< 6 hours	0 (0)
6 – 8 hours	841 (64.8)
> 8 hours	457 (35.2)
Weekly income	
< 20 \$	791 (60.9)
20 – 35 \$	382 (29.4)
> 35 \$	125 (9.6)

Upon questioning students about the constituents of EDs, a mere 6.7% identified ginkgo biloba as an ingredient, while 18.2% and 19.0% mentioned taurine and vitamins, respectively. The majority of respondents (95.4%) were aware that EDs could have various negative

health impacts and understood that EDs can affect both blood sugar levels (90.5%) and heart rate (89.7%). The response percentages to other knowledge-based questions, along with their correct answers, are presented in Table 2.

Table 2: Responses of the students to knowledge questions

	Knowledge Questions (N= 1298)	Answers	
		Yes n (%)	No n (%)
Q1	Do you know what energy drinks are?	1154 (88.9) *	144 (11.1)
Q2	Do you know what the ingredients of EDs are?	541 (41.7) *	757 (58.3)
Q3	EDs contain caffeine	798 (61.5) *	500 (38.3)
Q4	EDs contain taurine	236 (18.2) *	1062 (81.8)
Q5	EDs contain sugars	747 (57.6) *	551 (42.4)
Q6	EDs contain ginkgo biloba	87 (6.7) *	1211 (93.3)
Q7	EDs contain vitamins	247 (19.0) *	1051 (81.0)
Q8	EDs enhance physical performance	494 (38.1) *	804 (61.9)
Q9	EDs improve concentration/ability to study	415 (32.0) *	883 (68.0)
Q10	EDs help to stay awake	770 (59.3) *	528 (40.7)
Q11	EDs cause weight gain	316 (24.3) *	982 (75.7)
Q12	EDs enhance metabolism	84 (6.5) *	1214 (93.5)
Q13	EDs improve mood	201 (15.5)	1097 (84.5) *
Q14	EDs have other effects	233 (18.0) *	1065 (82.0)
Q15	Do EDs have negative effects?	1238 (95.4) *	60 (4.6)
Q16	EDs raise blood pressure	960 (74.0) *	338 (26.0)
Q17	EDs affect blood sugar	1175 (90.5) *	123 (9.5)
Q18	EDs affect heart rate	1164 (89.7) *	134 (10.3)

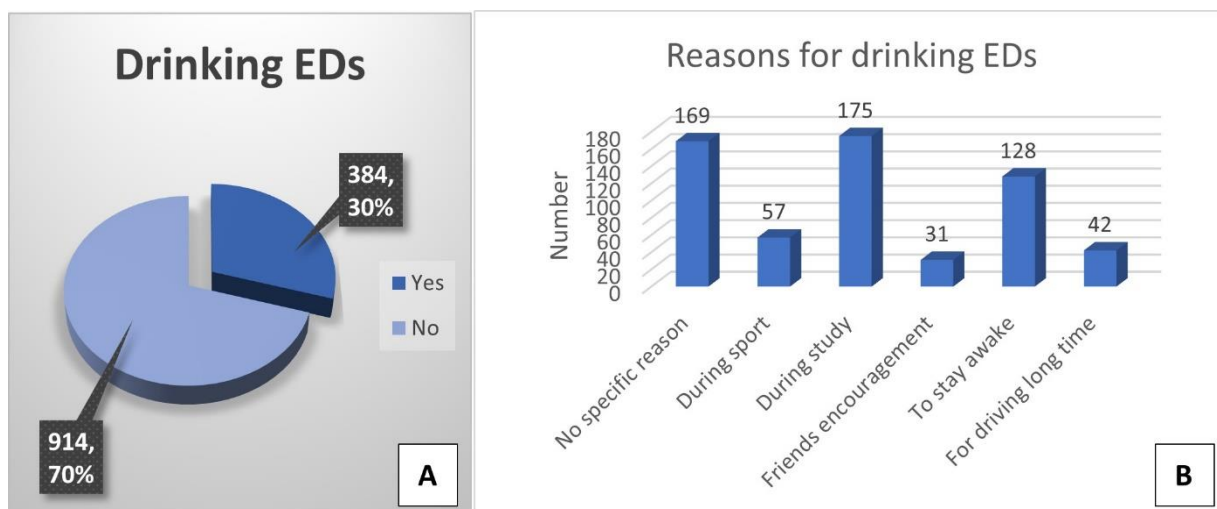
* Correct answer

Thirty percent of the medical students reported consuming EDs (Figure 1A). When queried about their reasons for consuming these beverages, the most common response was for study purposes (175 students), followed by no specific reason (169 students). Meanwhile, 128 students reported drinking EDs to stay awake longer. Drinking EDs for sports, driving long distances, and friends' encouragement were less commonly reported

reasons with 57, 42, and 31 responses respectively (Figure 1B). Table 3 features the students' responses to practice questions. A third of the respondents (35.2%) claimed to consume EDs one to three times a week, more than half (58.6%) reported drinking less than five cans a month, and 47.7% stated that they would consume EDs at any time during the day.

Table 3: Responses of the students to the practice questions

Variables (N=384)	Frequency (%)
Frequency of drinking EDs	
Daily	59 (15.4)
More than once weekly	108 (28.1)
Once weekly	82 (21.4)
1 – 3 times monthly	135 (35.2)
Number of cans drunk monthly	
Less than 5 cans	225 (58.6)
5 – 10 cans	87 (22.7)
10 – 20 cans	44 (11.5)
More than 20 cans	28 (7.3)
Time to drink EDs	
At morning	51 (13.3)
With meals	12 (3.1)
At night	138 (35.9)
Anytime	183 (47.7)



**Figure 1: A: Frequency of students who drink EDs
B: Reasons behind drinking EDs (more than one answer per student)**

When inquired about the students' preferred types of drinks, 77% indicated a preference for beverages containing sugar (Figure 2A). With regard to their preferred brand of EDs, Tiger™ was the most popular,

selected by 48.7% of respondents, followed by Red Bull (24.0%), Monster Energy (15.4%), and Smart (7.8%) (Figure 2B). The primary reasons for choosing a specific brand of EDs were taste and the drink's effect (Figure 2C).

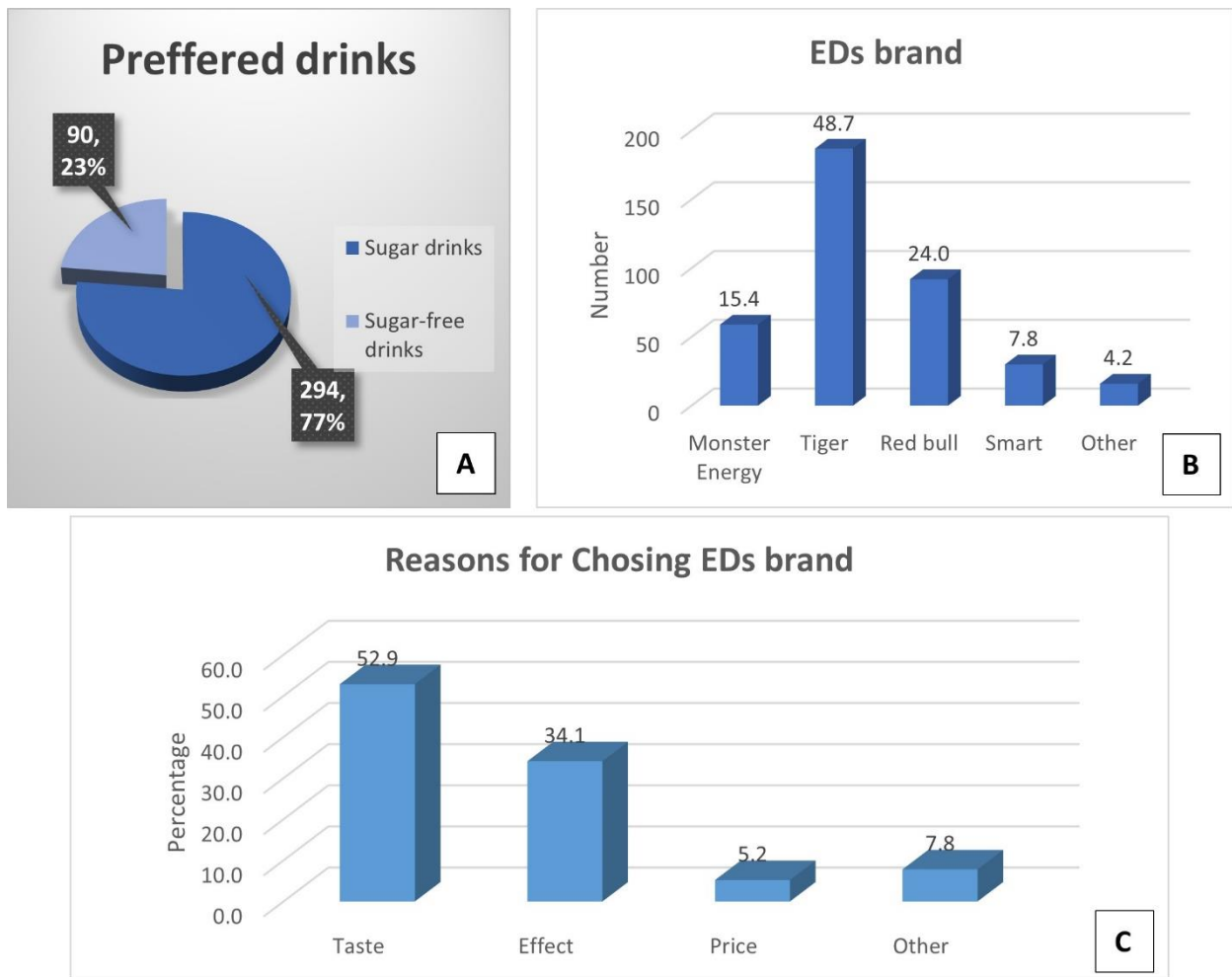


Figure 2: A: Preferred EDs in terms of sugar content

B: Preferred EDs brand

C: Reasons for preferring ED brands

Approximately 71% of students reported that EDs met their expectations. As shown in Figure 3A, 226 respondents (59%) had experienced some side effects

following consumption of EDs. The most frequently reported effects were insomnia and palpitations, followed by fatigue, nervousness, and anxiety (Figure 3B).

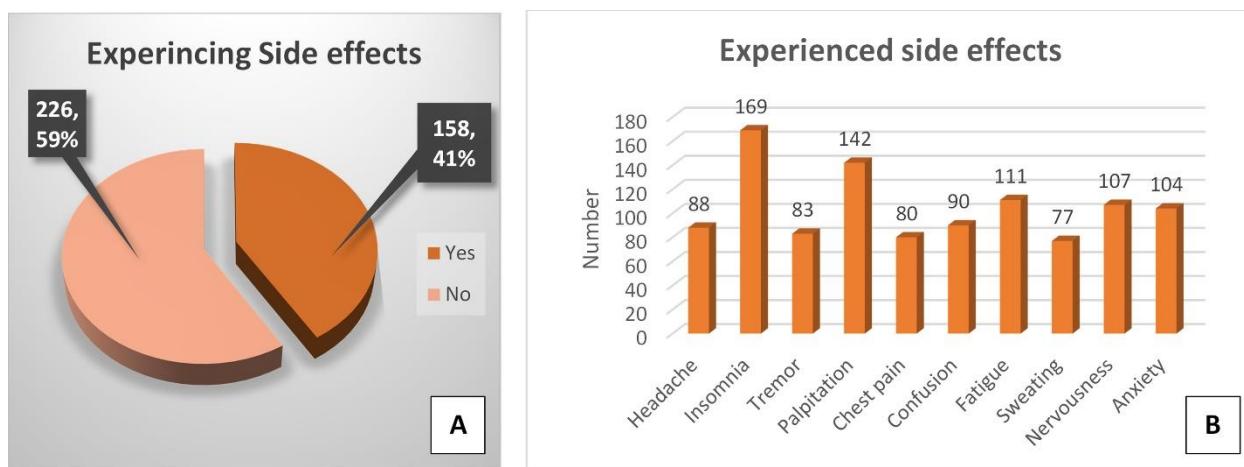


Figure 3: A: Experiencing side effects from EDs

B: Frequency of different side effects experienced by students (more than one answer per student)

Upon questioning the medical students who refrained from consuming EDs about their reasoning, the majority

indicated that knowledge of EDs' side effects or a general dislike for EDs were the primary reasons (Figure 4).

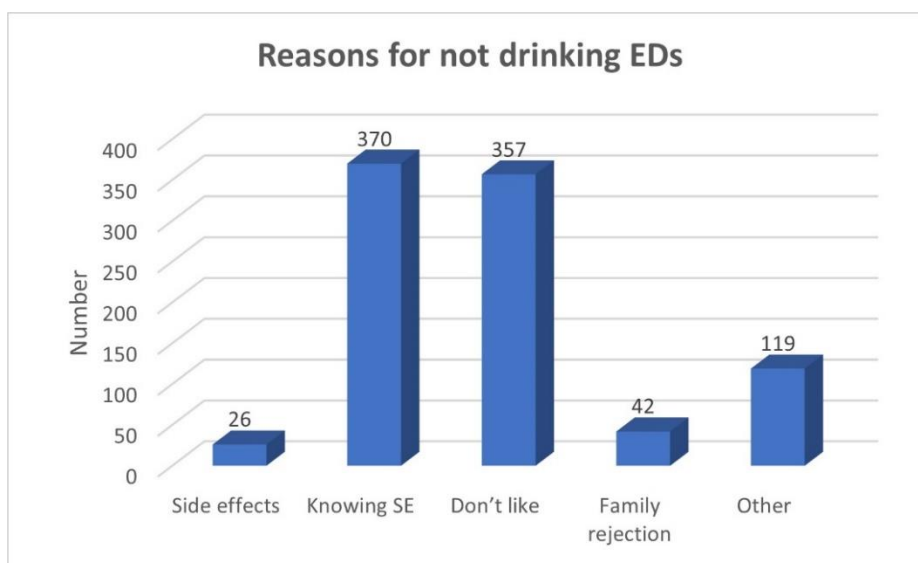


Figure 4: Reasons behind not drinking EDs.

The total knowledge score for participating students ranged from 1 to 17, with a mean \pm SD (standard deviation) of 8.37 ± 2.76 and a median of 8. The median score was used to divide the data into two groups: students with a knowledge score less than 8 were classified as having inadequate knowledge, and those with scores equal to or

greater than 8 were considered to have adequate knowledge. Hence, the inadequate knowledge group consisted of 693 students (53.4%) while the adequate knowledge group comprised 605 students (46.6%).

Statistically significant differences were found in the total knowledge score across various categories: age,

gender, year of study, residence, weekly income, and ED consumption habits. Higher scores were noted among students older than 23 years of age, males, fifth-year students, those living in urban areas, those receiving a weekly income exceeding \$35, and among students who

reported using EDs. Among students who indicated not drinking EDs, the group that previously experienced side effects exhibited the highest knowledge scores; the difference between these and other groups was statistically significant. These results are summarized in Table 4.

Table 4: Differences in knowledge scores among different variables

Variable N= 1298	Total knowledge score	
	Mean ± SD	P-value
Age*		0.006[§]
18 – 20 years	7.99 ± 2.51	
21 – 23 years	8.35 ± 2.76	
> 23 years	9.27 ± 2.99	
Gender**		<0.001[§]
Male	8.82 ± 2.75	
Female	8.07 ± 2.73	
Year of study*		<0.001[§]
1 st year	7.37 ± 2.47	
2 nd year	7.99 ± 2.56	
3 rd year	8.22 ± 2.60	
4 th year	8.69 ± 2.79	
5 th year	9.51 ± 2.83	
6 th year	9.08 ± 3.60	
Residence**		<0.001[§]
Urban	8.49 ± 2.76	
Rural	7.80 ± 2.73	
Sleeping regularly**		0.990
Yes	8.37 ± 2.79	
No	8.37 ± 2.74	
Sleeping hours**		0.196
6 – 8 hours	8.44 ± 2.71	
> 8 hours	8.23 ± 2.86	
Weekly income*		<0.001[§]
< 20 \$	8.13 ± 2.70	
20 – 35 \$	8.55 ± 2.72	
> 35 \$	9.32 ± 3.03	
Drink EDs		<0.001[§]
Yes	9.29 ± 2.67	
No	7.98 ± 2.71	
N = 384		
Frequency of drinking EDs*		0.180
Daily	8.95 ± 2.46	
More than once weekly	9.76 ± 2.68	
Once weekly	9.20 ± 2.65	
1 – 3 times monthly	9.13 ± 2.74	
N = 914		
Reasons not to drink*		<0.001[§]
Experiencing side effects	9.81 ± 2.95	
Knowing the side effects	8.46 ± 2.52	
Disliking EDs	7.53 ± 2.70	
Family disapproval	8.26 ± 2.67	
Others	7.32 ± 2.85	

*One-Way ANOVA, **Independent-Samples T test, [§]Significant results

DISCUSSION

A review of the literature reveals numerous studies suggesting that EDs can lead to various side effects [7, 25, 26], and in some cases, sudden deaths have been reported [27]. To the best of our knowledge, this study is the first to evaluate the prevalence of ED consumption among medical university students at the University of Mosul. This age group was selected for the study because university students are at high risk for ED consumption, and commercial advertisements for EDs notably target this sector of society. For example, the slogan “Red Bull gives you wings” has become popular among the public [28, 29].

The sample size in the current study was 1,298, compared to 783 in a Saudi study [7], 570 in a Kuwaiti study [29], and 131 in a Polish study [30]. The large sample size in our study may add strength to the generalizability of our results, potentially extending to society in general or specifically to the youth demographic. Similar to our study, a Saudi Arabian study [23] also observed higher participation from female students. This higher rate of female participation reflects the predominance of females opting for careers related to medicine in Arab countries.

The results of the knowledge section displayed some inconsistencies. While the majority of participating students acknowledged knowing what EDs are, fewer could accurately answer specific questions concerning the constituents and effects of EDs. This discrepancy could stem from the characteristic youthful tendency to know about different aspects of life but with a lesser focus on the specific details related to those aspects.

When inquired about their knowledge of ED ingredients, 41.7% of the medical students answered affirmatively, a percentage lower than the reported findings of Cencek et al. [30]. Almost all participants (95.4%) in the present study asserted that EDs could negatively impact health, whereas in Jordan [31] slightly more than 70%, and in Poland [30], only 61.83% of study participants acknowledged these negative effects.

In this study, 30% of participants confirmed they consume EDs. This figure is considerably lower than the 61.8% found in a Polish study conducted by Cencek et al. [30]. This discrepancy could be attributed to differences in sample size. In our research, the sample size was 1,298 students, with 384 reporting ED consumption. In contrast, the Polish study had only 131 participants, with 81 confirmed consumers. Regardless, our results align with other studies conducted among the Marmara University Medical School in Turkey [32] and medical students in South Africa [33]. An Italian study [28] reported that, contrastingly, 22% of participating medical students regularly consumed EDs, and other studies in both Italy [34] and Pakistan [35] found roughly half of the participants were consumers of EDs.

The most common reason cited for ED consumption in our study was the need to increase concentration and improve memory during study and examination periods. This contrasts with a Kuwaiti survey [29] where taste and the need to stay awake were the primary reasons for consuming EDs. Approximately one-third of the participants in our study (35.2%) claimed to consume EDs one to three times monthly, less than the percentage from a study among Saudi students (50.7%) [7]. Most of our study's participants had no preferred time of day for consuming EDs, a finding concurrent with that of Subaiea et al. [7]. These data also align with those reported in the study by Casuccio et al. [28].

In this study, only 23% of students indicated a preference for sugar-free drinks. This proportion mirrors the results obtained by Al-Waalan & Al-Khamees [29], suggesting that sugar-free EDs are not very popular. The inclusion of sugar in these beverages can potentially lead to health issues such as weight gain, which exacerbates the health risks associated with EDs [36]. Almost half of the students (48.7%) preferred the Tiger™ ED brand, followed by Red Bull (24%), mirroring the results of Subaiea et al. [7] in Saudi Arabia regarding Red Bull preferences. In both our study and the Saudi one, taste

emerged as the primary motive for choosing a specific ED brand [7].

Forty-one percent of students in our study reported experiencing side effects after consuming EDs, a figure that aligns with Cencek et al.'s findings [30]. A slightly higher proportion (48%) was noted in a survey by Chuda and Lelonek [37] among medical students in Poland. Insomnia and palpitations were the most commonly reported symptoms in our study, with the latter finding aligning with studies conducted among Polish medical students by Chuda and Lelonek [37] and Semeniuk [38].

Older students and those in their final two years of study exhibited higher knowledge scores than others. This trend may be linked to increased awareness and the curriculum content in medical colleges. Higher knowledge scores were also observed among students who were consumers of EDs. This could be attributed to these individuals handling these beverages more frequently and possibly reading the labels. This is contrary to the results obtained by Subaiea et al. [7], who found an inverse association between knowledge and ED consumption. Our study also found that daily ED consumers showed lower knowledge, a finding consistent with a Saudi survey [7].

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Limitations of the study

Since the study design is cross-sectional, it precludes causal interpretation. Additionally, as the results are primarily based on participants' survey responses, there is potential for social desirability bias. These factors represent limitations of this study.

Conclusions

Energy drinks are gaining increasing popularity in recent years, necessitating closer monitoring of their use. Although this study determined that consumption of EDs is relatively low among students at medical colleges, their level of knowledge was also observed to be low. Other concerning findings included a preference for sugar-containing EDs and reports of side effects among consumers. These observations suggest the need for increased governmental oversight of EDs, their targeted advertising campaigns, and their labeling practices. Approaches may include awareness campaigns, promoting healthier alternatives, supporting further research in this area, and working collaboratively with manufacturers to provide beverages with lower sugar content and fewer stimulants.

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المعرفة وممارسة استهلاك مشروبات الطاقة بين طلاب الجامعات الطبية في مدينة الموصل، العراق

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ملخص

الهدف: تحظى مشروبات الطاقة بشعبية كبيرة ويرتبط استهلاكها بآثار ضارة. تهدف هذه الدراسة إلى استكشاف مستوى المعرفة فيما يتعلق بمشروبات الطاقة بين طلاب الطب وممارسات هؤلاء الطلاب الذين يستهلكون هذه المنتجات. **الطرق:** تم اعتماد تصميم دراسة مقطعية مستعرضة مبنية على الاستبيان في هذا العمل. تم توزيع المسح على طلاب الكليات الطبية في جامعة الموصل لتقييم معرفة وممارسة هؤلاء الطلاب فيما يتعلق بمشروبات الطاقة. **النتائج:** شارك في الدراسة ما مجموعه 1298 طالباً، 60% منهم إناث. يعرف معظم الطلاب (89%) ماهية مشروبات الطاقة، ولكن 42% فقط يعرفون مكوناتها. عرف جميع الطلاب تقريباً (95%) أن مشروبات الطاقة لها آثار ضارة، لكن القليل منهم فقط يعرفون الآثار المفيدة لهذه المنتجات. اعترف 30% فقط من المشاركين بتناول مشروبات الطاقة، لكن أكثر من نصف هؤلاء الطلاب يشربون أقل من 5 علب شهرياً. كانت المنتجات المحتوية على السكر أكثر تفضيلاً من المنتجات الخالية من السكر وكانت تاكر هي العلامة التجارية الأكثر تفضيلاً لمشروبات الطاقة بين الطلاب. أفاد 41 بالمائة من الطلاب الذين يستهلكون مشروبات الطاقة أنهم يعانون من آثار جانبية. كانت معرفة الآثار الجانبية لمشروبات الطاقة هي أكثر الأسباب التي تم الإبلاغ عنها كسبب لعدم شرب هذه المشروبات. تم العثور على الطلاب الأكبر سناً في السنين الأخيرتين من الدراسة والطلاب الذين يعيشون داخل المدينة على دراية أكبر بمشروبات الطاقة. **الاستنتاجات:** كان مستوى المعرفة بمشروبات الطاقة متدنياً، وهو أمر يندرج بالخطر، خاصة مع تزايد الإقبال على مشروبات الطاقة والحملات الإعلانية الموجهة للشباب.

الكلمات الدالة: مشروبات الطاقة، تاكر، معرفة، استهلاك مشروبات الطاقة، ممارسة.

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