Consumption of energy drinks and their effects on sleep quality among medical students

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ABSTRACT

Background and Objectives: Energy drinks contain caffeine, which causes genuine concern among health professionals and authorities about their negative health effects. Their effect on sleep quality specifically was not well studied. In our study, we aim to assess the prevalence of energy drink consumption and its effect on the quality of sleep among Saudi medical students. **Materials and Methods:** A cross-sectional study was done on 260 medical students who were in their first till the sixth academic year at King Abdulaziz University Jeddah, Saudi Arabia. An online questionnaire was distributed as a Google form including demographics, the beverage questionnaire (BEVQ-15), and the Pittsburgh sleep quality index (PSQI). **Results:** Coffee was found to be the most favorite (56.5%) caffeinated beverage among medical students, 46.2% reported a sleep duration of 5 h, and 15% reported a sleep latency of more than 30 min. Also, 19.3% were found to have reduced sleep efficiency (less than 74%) and 82.6% used sleep medication once a week. Male students had a significantly higher mean frequency of drinking Energy & Sports drinks (Red Bull, code red, Gatorade, etc.) compared to females. Moreover, 74.6% of the medical students studied had poor sleep quality, with no relationship found between sleep quality and participant demographics, favorite caffeinated beverages, BEVQ-15 scale scores, or the frequency of energy drink consumption. In contrast, the PSQI and BEVQ-15 scores showed a significant positive correlation. **Conclusion:** Students at the university level should be educated on the causes of poor sleep quality and the effect of energy drinks on sleep quality. More research on a larger sample of Saudi university students is needed to determine the scope of the problem.

Keywords: Drinks, energy, medical, quality, Saudi, sleep

Introduction

Beverages marketed as "energy drinks" contain stimulants, particularly caffeine, and are marketed as both mental and physical stimulants. They entice the average user by promising increased energy, alertness, and athletic results.[1] However, there is genuine concern among health professionals and authorities about their negative health effects. There are some safety concerns about energy drink consumption, as well as claims of physiological and behavioral benefits. High levels of caffeine in energy drinks have been shown to have negative effects on the cardiovascular system. Caffeine consumption is known to have negative consequences. High consumption of caffeine is known to have adverse effects, including increased blood pressure in susceptible individuals and sleep problems in adolescents.[1]

During their academic years, medical students experience high levels of subjectivity stress. Academic overload, a lack of leisure time and facilities, fatigue, and increased psychological toxicity are all factors to consider. Caffeinated beverages, such as coffee, tea, soft drinks, and energy drinks, are used to increase alertness

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and help people cope with stress, but they have a negative impact on their sleep quality.[2]

A previous study conducted in 2016 confirmed that college students consumed energy drinks primarily to compensate for insufficient sleep, have more energy, drink with alcohol while partying, and primarily while studying.[3]

Another study conducted in the USA in 2011 discovered that participants' reported stress and their usage of energy drinks had a positive association. However, academic achievement was found to be inversely correlated with this. According to a previous study, freshmen and sophomores had fewer energy drinks in the previous 30 days than junior students. Male students were found to consume more than female students.[4] Moreover, in 2019, in Saudi, the frequency of energy drink users was higher in male nonmedical students (both senior and junior) compared to medical students. The most significant determinant identified was male gender.[1]

Few studies were done in Saudi Arabia to assess the degree of caffeinated beverage/energy drink consumption among college students, but none studied the association between energy drinks specifically and their effects on sleep quality in medical students. This study aimed to assess the prevalence of energy drink consumption and its effect on the quality of sleep among Saudi medical students.

Materials and Methods

Study design and setting

This was a cross-sectional study conducted at King Abdulaziz University Hospital, Jeddah, Saudi Arabia. The study duration was from July to September 2021.

Sample size and sampling

With a margin of error of 5% and a confidence interval of 95%, a sample size of 260 students was obtained. The inclusion criteria were medical students of both genders studying from the first till the sixth academic year in King Abdulaziz University. The exclusion criterion was medical students with chronic/mental illnesses.

Data collection

An online questionnaire was distributed as a Google form that included opening questions about participants' demographics. The second section of the questionnaire included the beverage questionnaire Beverage Intake Questionnaire (BEVQ-15) and the Pittsburgh sleep quality index (PSQI).

The BEVQ-15 was used to assess energy drink beverage consumption ("How much per week"), and total beverage consumption was calculated by adding all beverages together.[5,6] The average weekly total intake of energy drinks was calculated by multiplying the number of bottles per week by the amount

per bottle of each beverage.[5,6] The average weekly total intake of energy drinks was calculated by multiplying the number of bottles per week by the amount per bottle of each beverage. Total beverage consumption was calculated by adding all beverages together.[5,6]

The PSQI is a 19-item self-reported questionnaire that evaluates sleep quality over the preceding month. The PSQI has identified seven sleep components: sleep duration, sleep disruption, sleep latency, habitual sleep efficiency, use of sleeping medicine, daytime dysfunction, and overall sleep quality.[7-9] The sleep components were scored on a scale of 0–3, with 3 indicating the most severe dysfunction. The overall score ranged from 0 to 21, with higher total scores (also known as global scores) indicating poorer sleep quality. Participants who received a global score of more than 5 were categorized as poor sleepers, while those who received a score of less than 5 were categorized as good sleepers.[7-9]

Data analysis

Data were statistically analyzed using the Statistical Package for the Social Sciences (SPSS) application version 26. To investigate the association between the variables, the Chi-squared test (χ^2) was applied to qualitative data that was expressed as numbers and percentages. The association between the quantitative nonparametric variables that were expressed as mean and standard deviation (Mean ± SD) was examined using the Mann–Whitney test and the Spearman's correlation analysis. Multivariate logistic regression analysis was done to determine risk factors of poor sleep quality, where the odds ratio was determined at a confidence interval of 95%. Statistical significance was defined as a *P* value of less than 0.05.

Ethical considerations

The research ethics committee at the King Abdulaziz University Hospital in Jeddah, Saudi Arabia, approved the study. An online consent was obtained from all students before they completed the online questionnaire.

Results

Study population

Of the study participants, majority were females, younger than 25 years of age, and currently at their clerkship years of medical school. Most of the participants reported that coffee is their favorite caffeinated beverage. The mean PSQI and BEVQ-15 scores indicated poor sleep quality and high consumption of energy drinks, respectively [Table 1].

Sleep disorders among participants

About less than half of the participants reported a sleep duration of <5 h. A few of them reported prolonged sleep latency of more than 30 min, and most of them had no day dysfunction due to sleep loss. Half of them had normal sleep efficiency; however, the majority reported using sleep aid medication less than once a week [Table 2].

Risk factors for poor sleep quality

The study showed that majority of studied medical students had a poor sleep quality based on the PSQI score [Figure 1].

A nonsignificant relationship was found between sleep quality and participants' demographics, favorite caffeinated beverages, scores of BEVQ-15 scales, and frequency of consumption of energy drinks ($P < 0.05$) [Table 3].

Effect of gender on PSQI/BEVQ-15 scales

A nonsignificant relationship was found between participants' gender and all components of the PSQI scale ($P > 0.05$). Male students had a significantly higher mean frequency of drinking Energy & Sports drinks (Red Bull, code red, Gatorade, etc.) compared to females ($P < 0.05$) [Table 4].
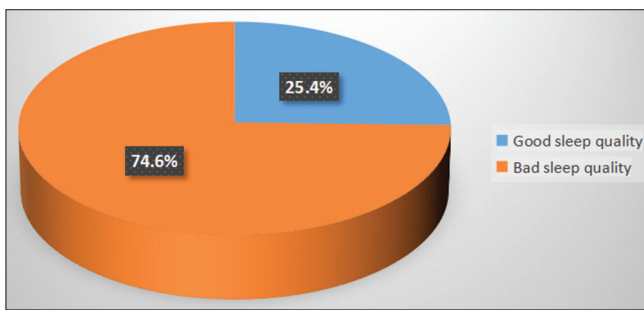

Figure 1: Percentage distribution of sleep quality of the participants

Table 1: Distribution of studied participants according to their demographics, favorite caffeinated beverages, and scores of the PSQI and BEVQ-15 scales (*n*=260)

Variable	*n* (%)
Gender	
Female	186 (71.5)
Male	74 (28.5)
Age	
<18	1 (0.4)
18–24	251 (96.5)
25–30	8 (3.1)
Education level	
Second year	19 (7.3)
Third year	57 (21.9)
Fourth year	122 (46.9)
Fifth year	45 (17.3)
Sixth year	17 (6.5)
What are your favorite caffeinated beverages?	
Carbonated beverages	16 (6.2
Chocolate	35 (13.5)
Coffee	147 (56.5)
Tea	62 (23.8)
Frequency of drinking tea or coffee with cream and\or sugar (includes nondairy creamer)	3.12±2.59
Frequency of drinking tea or coffee, black with\without artificial sweetener (no cream or sugar)	2.37±2.63
Frequency of drinking Energy & Sports drinks (Red Bull, code red, Gatorade, etc.)	0.57±1.38
PSQI score, mean±SD	9.49±4.62
Total beverage consumption based of the BEVQ-15 questionnaire, mean±SD	54.89±43.02

PSQI: Pittsburgh sleep quality index; SD: Standard deviation

Multivariate linear regression analysis was done to assess the risk factors (independent predictors) of poor sleep quality based on the PSQI total score among the studied participants. It was found that having a high total beverage consumption based on the BEVQ-15 score was a risk factor (independent predictor) of poor sleep quality [Table 5].

Discussion

Prevalence of consumption of energy drinks among medical students

Coffee was found to be the most consumed drink in this study, which agrees with the findings of another study conducted on 823 Patagonian Chilean college students.[10]

In a previous study, 56.5% of the participants reported that coffee is their favorite caffeinated beverage. In contrast, data from another study on University of Sharjah (UOS) students revealed that the majority of students did not consume energy drinks.[11] The current study found that medical students aged 18–24 years had the highest energy drinks (ED) consumption. A study conducted on Italian students reported similar results.[12]

The current study discovered that 74.6% of the participants had poor sleep quality [Figure 1], which is consistent with

Table 2: Distribution of studied participants according to sleep disorders

Variable	*n* (%)
Sleep duration (h)	
<5	120 (46.2)
5–6	69 (26.5)
6.1–7	35 (13.5)
≥7	36 (13.8)
Sleep latency (min)	
≤15	173 (66.5)
16–30	48 (18.5)
31–60	39 (15)
Day dysfunction due to sleep loss	46 (17.7)
Less than once a week	173 (66.5)
Not during the past month	28 (10.8)
One or two times per week≥3 times per week	13 (5)
Sleep efficiency (%)	
≥85	132 (50.8)
75–84	28 (10.8)
65–74	37 (14.2)
<65	63 (5.1)
Sleep medicine use	
Never	10 (4.1)
Less than once a week	215 (82.6)
One or two times per week	20 (7.6)
≥3 times per week	15 (5.7)
Sleep quality	
Very good	40 (15.3)
Fairly good	135 (51.9)
Fairly bad	60 (23)
Very bad	25 (9.8)

Table 3: Risk factors of poor sleep quality and the relationship between sleep quality and participants' demographics, favorite caffeinated beverages, scores of BEVQ-15 scales, and frequency of consumption of energy drinks

Variable	Good sleep quality n (%)	Bad sleep quality n (%)	χ^2 (P)
Gender			0.06 (0.804)
Female	48 (25.8)	138 (74.2)	
Male	18 (24.3)	56 (75.7)	
Age			5.69 (0.058)
<18	1 (100)	0 (0.0)	
18–24	65 (25.9)	186 (74.1)	
25–30	0 (0.0)	1 (100)	
Education level			4.99 (0.288)
Second year	3 (15.8)	16 (84.2)	
Third year	12 (21.1)	45 (78.9)	
Fourth year	29 (23.8)	93 (76.2)	
Fifth year	16 (35.6)	29 (64.4)	
Sixth year	6 (35.3)	11 (64.7)	
What is your favorite caffeinated beverage?			2.03 (0.565)
Carbonated beverages	3 (18.8)	13 (81.3)	
Chocolate	12 (34.3)	23 (65.7)	
Coffee	35 (23.8)	112 (76.2)	
Tea	16 (25.8)	46 (74.2)	
Total beverage consumption based on the BEVQ-15 questionnaire, mean±SD	3.13±8.11	5.79±15.16	0.46 (0.646)
Frequency of drinking tea or coffee with cream and\or sugar (includes nondairy creamer)	2.8±2.56	3.23±2.6	1.07 (0.284)
Frequency of drinking tea or coffee, black with\without artificial sweetener (no cream or sugar)	2.2±2.54	2.42±2.64	0.4 (0.687)
Frequency of drinking Energy & Sports drinks (Red Bull, code red, Gatorade, etc.)	0.38±0.89	0.63±1.51	0.51 (0.604)

SD: Standard deviation

different studies that found poor sleep quality among college students.[13,14] That could be explained by the need of medical students to study for longer duration at the expense of sleep time.

Risk factors for poor sleep quality among medical students

In our study, we found a nonsignificant relationship between sleep quality and participant demographics, favorite caffeinated beverages, BEVQ-15 scale scores, and frequency of energy drink consumption. The results are similar to those of a study conducted in Western Nepal, where the demographic characteristics were not shown to be significantly linked with sleep quality.[15]

Our results could be attributed to the use of a subjective method to evaluate the sleep quality, that is, by using a self-reporting questionnaire, instead of an objective method by using sleep study that could vary from time to time based on different contributing factors other than energy drink consumption. In contrast, a study done among Ethiopian College students found that more than three-fourths of students used caffeinated beverages, with poor sleepers reporting higher consumption than those with good sleep quality.[14] This could be explained by the known effect of caffeine on the sleep cycle and biological clock.

Relation between sleep quality and energy drink consumption

The PSQI and BEVQ-15 scores showed a significant positive correlation. This finding appears to be similar to the findings of another cross-sectional study conducted at the New York College of Podiatric Medicine, which found a link between poor sleep quality and coffee and energy drink consumption.[16] This is not surprising, given the negative effect of caffeine on sleep structure and circadian rhythm.

In addition, a study done in Zambia's Copperbelt University School of Medicine to assess the consumption of energy drinks among students discovered a significant relationship between sleep quality and energy drink intake.[17]

Another study conducted at the UOS discovered a link between energy drink consumption and students' sleep quality and patterns. In this study, 41% of students consumed energy drinks on a regular basis. Almost 50% of the participants slept normally, while the other half had difficulty sleeping.[11]

Effect of gender as an independent factor on sleep quality

According to the current study, the percentage of female students who slept less than 5 h was 50.54%, whereas the percentage of female students who slept more than 7 h was

Table 4: Relationship between participants' gender and components of the PSQI scale and frequency of consumption of energy drinks

Variable	Female n (%)	Male n (%)	χ²	P
Sleep duration (h)				
<5	94 (78.3)	26 (21.7)	6.19	0.103
5–6	43 (62.3)	26 (37.7)		
6.1–7	23 (65.7)	12 (34.3)		
≥7	26 (72.2)	10 (27.8)		
Sleep latency (min)				
≤15	118 (68.2)	55 (31.8)	2.87	0.238
16–30	38 (69.2)	10 (20.8)		
31–60	30 (76.9)	9 (23.1)		
Day dysfunction due to sleep loss				
Less than once a week	34 (73.9)	12 (26.1)	1.43	0.697
Never	121 (69.9)	52 (30.1)		
One or two times per week	20 (71.4)	8 (28.6)		
≥3 times per week	11 (84.6)	2 (15.4)		
Sleep efficiency (%)				
≥85	51 (81)	12 (19)	6.3	0.098
75–84	29 (78.4)	8 (21.6)		
65–74	17 (60.7)	11 (39.3)		
<65	89 (67.4)	43 (32.6)		
Sleep medicine use				
Never	0 (0.0)	0 (0.0)	0.29	0.863
Less than once a week	152 (70.7)	63 (29.3)		
One or two times per week	15 (75)	5 (25)		
≥3 times per week	10 (66.7)	5 (33.3)		
Sleep quality				
Very good	31 (77.5)	9 (22.5)	0.93	0.817
Fairly good	96 (71.1)	39 (28.9)		
Fairly bad	42 (70)	18 (30)		
Very bad	17 (68)	8 (32)		
Frequency of drinking tea or coffee with cream and\or sugar (includes nondairy creamer)	3.03±2.56	3.34±2.67	0.71[a]	0.473
Frequency of drinking tea or coffee, black with\without artificial sweetener (no cream or sugar)	2.44±2.65	2.18±2.6	0.76[a]	0.447
Frequency of drinking Energy & Sports drinks (Red Bull, code red, Gatorade, etc.)	0.42±1.26	0.93±1.59	3.74[a]	**<0.001**

[a]Mann–Whitney test, PSQI: Pittsburgh sleep quality index. BOLD mean statistically significant ($p<0.05$)

Table 5: Multivariate linear regression analysis of risk factors of poor sleep quality based on the PSQI total score

Variable	B	Wald	P	Odds ratio (95% CI)
Gender	0.24	0.12	0.728	0.43 (0.19–1.01)
Age	0.03	0.22	0.638	0.32 (0.16–1.14)
Education level	0.09	0.32	0.566	0.86 (0.78–1.68)
What is your favorite caffeinated beverage?	0.12	0.15	0.216	0.87 (0.63–1.08)
Total beverage consumption based of the BEVQ-15 questionnaire	0.05	5.44	**0.02**	0.93 (0.99–1.79)
Frequency of drinking tea or coffee with cream and\or sugar (includes nondairy creamer)	0.25	0.56	0.452	0.41 (0.67–1.06)
Frequency of drinking tea or coffee, black with\without artificial sweetener (no cream or sugar)	0.87	1.35	0.244	0.06 (0.03–0.34)
Frequency of drinking Energy & Sports drinks (Red Bull, code red, Gatorade, etc.)	0.05	0.27	0.07	0.31 (0.65–1.91)

CI: Confidence interval; PSQI: Pittsburgh sleep quality index; SD: Standard deviation. BOLD mean statistically significant ($p<0.05$)

13.98%. In a study of Peruvian college students, these values were 39.6% and 15.1% for females and 38.7% and 9% for males, respectively.[7] The majority of the participants in the current study (66.5%) had a sleep latency of 15 min or less. Furthermore, female students had longer sleep latency, but there was no significant gender difference. In a study of Thai college students, most female students had a sleep latency of 15–30 min.[13] Hormonal changes and differences between males and females could play a role in these observed differences in sleep structure and quality.

Limitations

This study was done on medical students at the King Abdulaziz University (KAU) only, which limits the contribution of other universities in Saudi Arabia. Moreover, because it is a self-administered questionnaire filled out by the students, there is a possibility for reporting bias in cross-sectional studies.

Conclusion

In this study, most of the studied students (74.6%) had poor sleep quality, with a nonsignificant relationship between sleep quality and participant demographics, favorite caffeinated beverages, BEVQ-15 scale scores, and frequency of energy drink consumption. The PSQI and BEVQ-15 scores, on the other hand, showed a significant positive correlation. Male students had a significantly higher mean frequency of drinking Energy & Sports drinks (Red Bull, code red, Gatorade, etc.) compared to females.

Recommendation

University students should be educated on the causes of poor sleep quality as well as the effects of energy drinks on sleep quality during their primary care visits. Further research on a larger sample of Saudi university students is required to assess the magnitude of the problem.

Ethical approval

The research ethics committee at the King Abdulaziz University Hospital in Jeddah, Saudi Arabia, approved the study.

Author contribution

RA, BS, AS, LW, SA, AS: Conception of the work. BS, AS, LW, SA, AS: Collected and organized data. RA: Interpretation of data for the work. RA, BS, AS, LA, SA, AS: Drafting the manuscript.

All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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Conflicts of interest

There are no conflicts of interest.

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