

KNOWLEDGE AND PRACTICES OF CAFFEINATED ENERGY DRINK CONSUMPTION AMONG UNDERGRADUATE MEDICAL STUDENTS IN KARACHI: A CROSS-SECTIONAL STUDY

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Abstract

Background: A significant increase in consumption of caffeinated energy drink (CED) despite its negative health risks has become a growing public health concern. The aggressive marketing of caffeinated energy drinks toward youth to enhance performance stems from a lack of regulatory oversight and surveillance.

Objective: This study aimed to assess the practices and knowledge regarding adverse health effects of caffeinated energy drink among undergraduate medical students.

Material and Methods A cross-sectional study was carried out at Fazaia Ruth Pfau Medical College (FRPMC) from Feb 2024 to August 2024. Systematic random sampling method was employed. The sample size was determined to be 366 estimated through OpenEpi software. Data were collected using a validated, structured questionnaire administered via online Google Forms platforms. Data were entered, processed and analyzed using SPSS version 25.0. A p-value of < 0.05 was considered statistically significant for analyses. Consumption, practices, level of knowledge, sources of information, and perceived adverse effects were assessed. Chi square test was applied to assess the significance among study variables. A multivariate logistic regression was applied to demonstrate the association between demographic characteristics and the practice of reading health warning labels on caffeinated energy drinks among participants.

Results: Among the 366 student, less than half of medical students 46.72% (n= 171/366) were ignorant about the adverse consequences of CED reported consumption of CED. Sixty one 61% (n= 226/366) of medical students do not read the health warning present on CED. A significant association was observed between ethnicity (p=0.022) and knowledge regarding the awareness of health warning on CED.

Conclusion: Since the knowledge regarding negative health consequences of CED among undergraduate medical students of Karachi during 2024 was found to be quite high. However the researcher wants to add that further longitudinal studies on this subject is needed to explore the practices regarding exact health consequences of CED. Further to this, there is still a need for implementation of policies at Federal, Provisional and local level to control the incorrect practices regarding excessive consumption of CED as the users do not need the health warning present on CED.

Keywords: Caffeinated energy drink, undergraduate medical students, cross sectional study

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Introduction:

A significant increase in consumption of caffeinated energy drink (CED) despite its adverse health consequences has become a growing public health concern among Generation Z and Millennial¹. A markedly increase consumption of ED was observed owing to the introduction of Red bull in Austria in 1987 and in the US in the year 1997². Globally the pooled prevalence of life-time consumption of CED was found

to be 54.7% .However higher prevalence rates of consumption of CED was observed in North America (62.1%) followed by Europe (55.5%), Asia (49%), Oceania (48.3%) and in Central and South America (39.1%)³. A study conducted in Pakistan stated that around 32(31%) out of 103 undergraduate students reported consuming CED⁴. Caffeine in energy drink is considered as a psychoactive substance

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capable of inducing tolerance and dependence. ED marketed through various social media platform contain novel ingredients i.e ginseng, guarana, taurine, glucuronolactone, L-carnitine, sugars ,illicit substances i.e amphetamine and high concentration of caffeine⁵.Caffeine intoxication leads to increase heart rate, seizures, cardiac arrhythmias, vomiting, seizures, obesity ,erosion of dental enamel and even death.^{1,6,7} However overconsumption of CED results in rhabdomyolysis and acute psychosis.⁸

The recommended intake of caffeine per day in children ranges from 2.5 mg/kg/day to 6mg/kg/day, 100 mg per day in adolescent and 400mg per day in adults¹. The content of caffeine in energy drink ranges between 50 and 505mg/ can⁹.Since health concerns related to caffeine intoxication are associated with adverse effects on cardiovascular, endocrine, kidney, liver lungs, reproductive system, and mental health issues such as depressive symptoms, sleep disorders, suicidal ideation³ .Although the health warning and content labeling varies across countries. The zealous marketing of CED targeting towards youths for enhancing performance is because of failure and absence of oversight and surveillance by regulatory authorities to regulate the sale, labeling and distribution of CED containing significant quantities of caffeine¹⁰.Whereas in European countries co ingestion of caffeine mixed with ethanol results in altered subjective states, pubertal delay and risk taking behavior¹.

Hypothesis:

Null hypothesis: There is no significant association between practices of CED and demographic characteristics

Research hypothesis: A statistically significant association was observed between practices of CED and demographic characteristics.

Material and Method:

Study Design and Setting:A descriptive, cross-sectional study was carried out at Fazaia Ruth Pfau Medical College (FRPMC) in Karachi, Pakistan. Data collection completed over a four-month period, from February 2024 to May 2024.

Study Participants and Sampling: The study population comprised of undergraduate medical students (MBBS 1st year through Final year) aged 18 to 25 years.

Ethical Considerations: Ethical approval was granted by the Ethical Review Committee (ERC) of FRPMC (Ref. No: FRPMC-IRB-2024-37). Data confidentiality and anonymity were strictly maintained throughout the study.

Sample Size: The sample size was calculated using OpenEpi software. Based on a 61.1% prevalence of Caffeinated Energy Drink (CED) consumption from a previous study¹¹, a 5% margin of error, and a 95%

Confidence Interval (CI), the required sample size was determined to be 366.

Sampling Technique: A simple random sampling technique was employed. From a total pool of 500 students, participants were selected using a random number generator by applying formula on Microsoft Excel =rand () times 1000 to ensure a fair selection of the 366 recruits to get the number below 1000 on Microsoft excel through simple random sampling technique.

Inclusion/Exclusion Criteria: Students willing to participate were included, while those who declined to provide online written informed consent were excluded.

Data Collection Tool: Data were collected using a validated, structured questionnaire administered via online Google Forms platforms. The tool was developed for this study and validated by experts in the medical field. The internal consistency of the questionnaire was assessed using Cronbach's alpha. The overall Cronbach's alpha value for the five-item scale was 0.587, indicating moderate internal consistency. The questionnaire consisted of two main sections:

Socio-demographic characteristics: Age, gender etc.

CED Assessment: Consumption, practices, level of knowledge, sources of information, and perceived adverse effects.

The questionnaire utilized dichotomous (Yes/No) and closed-ended multiple-choice questions to ensure standardized responses.

Statistical Analysis: Data were entered, processed and analyzed using SPSS version 25.0.

Descriptive Statistics: Frequencies and percentages were calculated for categorical variables, while means and standard deviations (SD) were used for continuous variables.

Inferential Statistics: The Chi-square test was applied to determine the association between socio-demographic characteristics and the level of knowledge regarding CEDs.

A multivariate logistic regression was applied to demonstrate the association between demographic characteristics and the practice of reading health warning labels on caffeinated energy drinks among participants.

A p-value of < 0.05 was considered statistically significant for all analyses.

Results:

Approximately fifty fivepercent.i.e 55.46 % (n= 203/366) of study participants were female. More than half of respondents 51.37% (n=188/366) were found to be Punjabi. Around thirty eight percent (n= 140/366) belonged to the age group of 20-21 years(Table1)

Table 1: Socio-Demographic characteristics Of Respondents (n=366)

Variables	n	Percentage (%)
Gender:		
Male	163	44.54%
Female	203	55.46%
Age:		
18 -19 years	67	18.31%
20-21 years	140	38.25%
22 -23 years	104	28.42%
24 -25 years	55	15.03%
Mean Age: 21.39±1.96		
Year of MBBS:		
1st year	89	24.32%
2nd year	84	23%
3rd Year	75	20.5%
4th year	67	18.3%
5th year	36	13.9%
Ethnicity:		
Balochi	3	0.82%
Muhajir	38	10.38%
Pakhtoon	22	6.01%
Punjabi	188	51.37%
Saraiki	68	18.58%
Sindhi	17	4.64%
Others	30	8.20%

Approximately 15.85% (n=58/366) undergraduate medical students received energy drink related information through mass media. Around 14.75% (n=54/366) knew tachycardia as the negative consequences of caffeine intoxication. Around 62.84% did not know that caffeine content in various ED is between 50 and 505mg per bottle/can (Table 2).

Table 2 : Knowledge of study participants (n=366) regarding consequences of CED (Contd)		
Variables	n	Percentage (%)
Awareness of the ingredients of energy drink e.g ginseng, guarana, ginkgo, taurine, glucoronolactone, inositol		34.43
Yes	126	65.57
No	240	
Do you know that caffeine content in various ED is between 50 and 505mg per bottle/can ?Awareness of Caffeine content		
Yes	136	37.16
No	230	62.84
Awareness of the adverse consequences of energy drink consumption?	195	
Yes		53.28%
No	171	46.72%
Sources of energy drink related information :		

Friends	97	26.50%
Internet	97	26.50%
Mass media	58	15.85%
School/Colleges/ Universities	53	14.48%
Others	61	16.67%
Awareness of the negative consequences of caffeine intoxication ?		
Cardiac arrhythmias	32	8.74%
Death	13	3.55%
Dental enamel erosion	23	6.28%
Obesity	36	9.84%
Palpitations	29	7.92%
Seizures	18	4.92%
Tachycardia	54	14.75%
Vomiting	27	7.38%
Don't know	134	36.61%
Reading health warning label present on CED ?		
Yes	140	38.25%
No	226	61.75%
Awareness that caffeine in energy drink enhance diuresis and sodium loss in urine affecting the plasma volume ?		
Yes	164	44.81%
No	202	55.19%
Do you know that energy drink consumption results in dental erosion ?		
Yes	193	52.73%
No	173	47.27%
Do you know that caffeine intoxication results in mental health problems and risk taking behavior ?		
Yes	190	51.91%
No	176	48.09%
Do you know that alcohol mixed energy drinks interfere with reproductive functions and development of puberty ?		
Yes	148	40.44%
No	86	23.50%
Don't Know	132	36.07%

Among 366 participants, 45.36% (n=166) of study participants were consuming energy drink. Approximately 39.62% consumed energy drink "Sting". Twenty one percent (21.58%) and twenty eight percent (28.42%) reported "energy boost" and "flavor" as the reason for consuming energy drink respectively. (Table 3).

Table 3 Practices of study participants (n=366) regarding the consequences of CED		
Variables	n	Percentage (%)
Do you consume energy drink ?		
Yes	166	45.36
No	200	54.64
If yes how often do you consume energy drink ?		
Less frequent (less than weekly)	74*	79.78
Frequent (weekly)	92*	20.22
How many times a week do you		

consume energy drink?		
2-4 days a week 1–2 times/week	52	14.21
5-6 days a week 3–5 times/week	8	2.19
Everyday more than once Daily	10	2.73
Less than once / week	96	26.23
Never	149	40.71
Once a day everyday (regularly)	7	1.91
Once a week	47	12.84
Several times a week	4	1.09
Energy drink brand consumed		
Red Bull	75	20.49
Sting	145	39.62
Gatorade White lightening drink	23	6.28
Gatorade Blue bolt	70	19.13
Others	16	4.37
None	37	10.11
Reasons of consuming energy drink :		
Before and after sports activity	19	5.19
Energy boost	79	21.58
Enhance academic performance	2	0.55
Flavor	104	28.42
Increase concentration	14	3.83
Reduce exhaustion	27	7.38
Reduce mental stress	26	7.10
Replenish lost body fluids	22	6.01
Stay awake for studies	42	11.48
Exam preparation	31	8.47

Table 4: Association between various factors and knowledge of CED in undergraduate medical students, Karachi, Pakistan						
Characteristics	Category	Yes	No	χ^2	df	p-value
Age group (years)	18–19	33	34	1.056	3	0.788
	20–21	64	76			
	22–23	47	57			
	24–25	22	33			
Total		166	200			
Year of Study	1st Year	47	42	9.832	4	0.043
	2nd Year	45	39			
	3rd Year	26	49			
	4th Year	30	37			
	5th Year	18	33			
Total		166	200			
Gender	Male	69	94	17.738	2	0.001
	Female	79	124			
Total		148	218			
Ethnicity	Balochi	3	0	13.142	6	0.041
	Muhajir	13	25			
	Pakhtoon	8	14			
	Punjabi	64	124			
	Saraiki	22	46			
	Sindhi	10	7			
Total	Other	6	24			
Total		126	240			

Table 5: demonstrates the association between demographic characteristics and the practice of reading health warning labels on caffeinated energy drinks among participants. Ethnicity revealed a statistically significant overall association with the practice of reading health warning labels ($p = 0.017$). However, none of the individual ethnic categories showed statistically significant association when compared with the reference category (Balochi).

Overall, the findings suggest that demographic variables are not significant predictors of reading health warning labels, except for ethnicity at the overall model level.

Table 5 : Association between Practices (Reading health warning label on Caffeinated Energy drink) and demographic characteristics

Variables	Unadjusted Odds Ratio	Confidence Interval	P value	Adjusted Odds Ratio	Confidence Interval	P value
Age group 18-19 yr (ref)	1	1	0.871	1	1	0.744
Age group 20-21yr	1.142	0.629-2.074	0.662	1.010	0.489-2.088	0.978
Age group 22-23 yr	0.996	0.533-1.863	0.991	1.002	0.406-2.474	0.966
Age group 24-25 yr	1.279	0.610-2.680	0.514	1.569	0.533-4.624	0.414
Gender (male) ref	1	1	1	1	1	1
Gender female	1.080	0.707-1.650	0.721	1.094	1.094-0.685	0.708
Ethnicity Balochi (ref cat)	1	1	0.025	1	1	0.017
Muhajir	1.800	0.150-21.569	0.643	1.282	0.102-16.087	0.847
Pakhtoon	4.286	0.330-55.585	0.266	3.566	0.267-47.712	0.337
Punjabi	4.065	0.362-45.692	0.256	3.382	0.293-39.084	0.329
Sarki	1.886	0.163-21.789	0.611	1.524	0.126-18.393	0.740

Sindhi		2.857	0.215-37.990	0.426	2.112	0.150-29.687	0.579
Other		6.571	0.516-83.757	.147	5.193	0.394-68.452	0.211
Year of MBBS (1st Year) (ref)	1			0.890		1	0.573
2nd Year	1.223	0.661-2.262		0.522	1.398	0.677-2.887	0.364
3rd Year	1.019	0.544-1.907		0.953	1.023	0.470-2.226	0.954
4th Year	1.299	0.673-2.510		0.436	1.449	0.587-3.578	0.422
5th Year	0.970	0.482-1.954		0.933	0.801	0.289-2.224	0.670

Multivariate logistic regression $p < 0.005$ = significant

Discussion:

The present study revealed that less than half i.e (45.36%) of participants were consuming CED. Around 26.50% respondents reported internet and friends as sources of energy drink related information. Approximately 21.58% participants reported energy boost whereas 28.42% replied flavor as reason for consuming CED. However 14.75% reported tachycardia as the negative consequences of caffeine intoxication. According to a study conducted in Islamabad stated that around 31% (n=32/103) respondents were consuming CED. Negligible percentage of participants' i.e 6.25% reported that they consume energy drink during sports and before exam¹². This finding is consistent with the present study which reported that 5.19% consume energy drink before and after sports activity.

Mutaza et al in his study reported that 25.7% of respondents consumed CED during exam. However 60% consumed it because of its pleasant taste. A huge majority of students (98.6%) consumed caffeine in soft drink owing to increased burden of academics¹³. In the present study 11.48% reported that consuming energy drink keeps them awake for studies. Another study conducted in Siberia reported that 27.7% of respondents consumed CED prior to exam or during studies¹⁴. A widespread consumption of CED was also reported among adolescent. This difference could be due to larger sample size in studies conducted

15,16,17,18,19

In a study conducted at Jordan, Qasem et al reported that half of respondents were consuming CED whereas 80.5% of students consumed CED during exams. 24.8% medical students consumed 5-10 can/ week whereas 30.6% of students occasionally consumed energy drink. Around 46% reported that they were influenced by their friends for the consumption of CED. Reasons for consuming energy drink was mood elevation and reduces fatigue reported by half of respondents whereas a large proportion of respondents (70%) were consuming energy drink for staying awake²⁰. A study in UAE revealed that 20% of students reported consuming CED. A vast majority of respondents (70%) reported that consumption of CED leads to heart disease, diabetes, raised blood sugar and blood pressure and obesity^{21,22}.

In the present study a negligible percentage (1.91%) of respondents consume energy drink regularly. According to a study conducted in Nowsera which reported that 73.3% of medical student consume "Sting" energy drink. Approximately 29.8% consumed energy drink for energy boost¹¹. This difference could be because of geographic location, variations in age groups and level of knowledge.

Asma Usman et al reported in her study that 43% of respondents reported consuming CED available with the brand name of "Red bull". 66% reported television and 48% reported friends as the main source of CED related information²³. However a study conducted in Oman also reported a higher (97%) CED consumption and more than half of respondents consuming it for energy boost²⁴. Another study in Pakistan reported a higher consumption of caffeine in drinks for enhancing academic performance²⁵. This difference could be due to lack of knowledge regarding the dreadful consequences of CED.

In the present study 20.49% and 39.62% reported consuming Red bull and Sting respectively. Around 15.85% and 26.50% of participants reported mass media and friends as a source of energy drink related information respectively. The findings of present study differ from previous study²³ in terms of sample size and individual preferences for the brand consumed for CED.

Limitation:

Since it is a snapshot study, temporal relationship cannot be established. Since the study focused solely on medical students, the results cannot be generalized to students of other disciplines (e.g., engineering or arts) who may have different health knowledge and study patterns. The chances of recall bias is more likely as the data is usually collected via self-administered questionnaires, students may not accurately remember the exact quantity of energy drinks or frequency consumed over the past weeks or months. The study design of this study does not support confounding variables that might influence the outcome e.g use of other stimulants i.e medications;

coffee etc may affect study findings. Important variables such as baseline stress levels, sleep quality, and the use of other stimulants (like tea, coffee, or nicotine) may not have been fully controlled for or analyzed in conjunction with energy drink use.

Conclusion:

Despite a high level of awareness regarding the potential health risks associated with Caffeinated Energy Drinks (CEDs), a significant gap remains between the consumption practices of undergraduate medical students and theoretical knowledge in Karachi. This discrepancy suggests that awareness alone is insufficient to deter use, particularly in high-stress academic environments. There is an immense need for longitudinal studies to move beyond self-reported data and establish the long-term, objective health consequences of CED consumption within this demographic. Our main concern and focus is to raise awareness regarding the dreadful consequences of CED and to promote a healthy lifestyle among Generation Z. Standardized policies must be implemented at the Federal, Provincial, and Local levels to mitigate the excessive consumption of these beverages and regulate marketing practices.

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