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Prevalence of Energy Drink Consumption and Its Association with Perceived Stress and Daytime Sleepiness Among Undergraduate Students at a Tertiary Care Teaching Hospital, Telangana

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KEYWORDS

Energy drinks, medical students, perceived stress, daytime sleepiness, prevalence, cross-sectional study

ABSTRACT:

Background:The consumption of energy drinks among medical students has become an increasing public health issue, potentially affecting stress levels and sleep patterns. Even though a lot of people use it, there isn't much information about how Indian medical students use it.

Methods:An institutional cross-sectional study was performed with 281 undergraduate medical students at a tertiary care teaching hospital in Hyderabad, Telangana, from June to September 2025. The study used simple random sampling and validated structured questionnaire to collect data. This included the Perceived Stress Scale (PSS-10) and the Epworth Sleepiness Scale (ESS). Chi-square test and the independent t-test for statistical analysis, with a significance level of $p<0.05$ was used.

Results:Of the 281 participants (response rate: 98.9%), 34.9% (95% CI: 29.2-40.6%) reported consuming energy drinks. The main reason people drank it was to "stay awake" (53.1%). People who drank energy drinks thought they were more stressed (mean PSS: 17.9±6.3 vs 14.6±5.7; p=0.035) and sleepier during the day (mean ESS:8.9±4.4 vs 6.5±3.7; p=0.022) than people who didn't drink them. Being male (OR=1.81, p=0.009) and playing sports regularly (p=0.031) were both strongly linked to consumption. Among consumers, 40.8% experienced adverse effects, with insomnia being the most common (16.3%).

Conclusion:One-third of medical students drink energy drinks, which are linked to higher stress levels and daytime sleepiness. Ironically, students who drink energy drinks to stay awake during the day end up feeling more tired, suggesting a vicious cycle. There is an urgent need for targeted health education programs and institutional policies.

INTRODUCTION

The constant demands of modern academic life, especially in the demanding medical school curriculum, often force students to look for different ways to stay focused and energized. One of these ways to deal with stress is drinking energy drinks, which has become a growing public health concern as it has quickly spread around the world and among people of all ages.[1] Energy drinks are non-alcoholic psychoactive beverages with a lot of caffeine (80 to 500 mg per serving) and other stimulants like guarana, taurine, glucuronolactone, ginseng, inositol, carnitine, B vitamins, and herbal stimulants. [2] These drinks are heavily advertised with

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promises of more energy, better performance, and sharper mental focus, especially to young adults and students.

Medical students are a distinct group who face a lot of stress and lack of sleep due to the high academic pressure, busy schedules, frequent tests, and clinical duties they have to deal with. [3] Stress, which is "a state of imbalance within a person, caused by an actual or perceived difference between environmental demands and the person's ability to deal with these demands," is very common among medical students. It can hurt their grades, mental health, and overall health. In this situation, students often think that energy drinks can help them do better and stay awake longer, so they drink them.

One of the main reasons people drink energy drinks is to make up for not getting enough sleep and to stay awake during the day, [5] but this creates a worrying paradox: students drink these drinks to stay awake, but the high caffeine and other stimulants can mess up their natural sleep patterns, which can cause long-term sleep problems and make the problem they are trying to solve worse. [6] People who don't get enough sleep, drink energy drinks, which makes it even harder for them to sleep, which makes them drink more. This vicious cycle has serious health risks, such as heart arrhythmias, anxiety, insomnia, restlessness, high blood pressure, and caffeine toxicity. [7,8]

Even though young people all over the world drink a lot of energy drinks, there isn't much research on this issue among medical students in India. Prior research has indicated fluctuating prevalence rates: Hossain et al.[9] identified a 60% consumption rate among medical students in New Delhi, while international studies have documented rates between 30% and 70%. [10, 11] Nonetheless, there are no published studies that have investigated this issue among medical students in Hyderabad, Telangana, resulting in a considerable deficiency in the comprehension of regional patterns and their associated factors.

Moreover, although certain studies have analysed either stress or sleep patterns in connection with energy drink consumption, limited research has thoroughly examined both outcomes concurrently. It is essential to comprehend the complex relationship among energy drink consumption, perceived stress, and daytime sleepiness to formulate targeted, evidence-based health education programs and interventions specifically designed for medical students.

Consequently, this study seeks to: (1) ascertain the prevalence of energy drink consumption among undergraduate medical students, (2) examine the relation between energy drink consumption and perceived stress, and (3) analyse the relationship between energy drink consumption and daytime sleepiness. The study posited that individuals consuming energy drinks would demonstrate elevated levels of perceived stress and diurnal somnolence relative to non-consumers, thereby reinforcing the notion of a self-perpetuating cycle of dependence.

.MATERIALS AND METHODS

Study Design and Setting

This cross-sectional study was conducted at a tertiary care teaching hospital in Hyderabad, Telangana, India. The research was conducted over a three-month duration, from June 25, 2025, to September 25, 2025.

Study Population and Eligibility Criteria

The study population comprised undergraduate medical students enrolled in the first through the professional years (MBBS program).

Inclusion criteria: Students of either gender, aged 18 years or above, from all four professional years who provided informed written consent were included in the study.

Exclusion criteria: Students who provided incomplete responses, were absent during the data collection period, or had participated in a similar study within the preceding 12 months were excluded.

Sample Size Calculation

The sample size was calculated using the formula for estimating a single proportion:

$n = Z^2 \times P \times Q / L^2$

Where:

- Z = 1.96 (at 95% confidence level)
- P = Expected prevalence = 0.62 (based on Hossain et al.) [9]
- Q = 1 - P = 0.38

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- L = Relative error = 9.6% of expected prevalence (0.096 × 0.62 = 5.952% absolute precision)

Assuming 62% prevalence and an expected response rate of 90%, the calculated sample size was 284. Ultimately, 281 students participated, yielding a response rate of 98.9%.

Sampling Technique

Simple random sampling was used to make sure that the sample was representative. The academic cell gave a complete list of all the students from each professional year who were eligible. Each student was given a unique ID number, and a computer-generated random number table was used to pick 284 students at random. This made sure that every student had an equal and independent chance of being chosen.

Data Collection

After obtaining approval from the Institutional Ethics Committee, data collection commenced. All participants provided written informed consent after being briefed about the study objectives, voluntary nature of participation, and confidentiality assurances.

Data were collected using a structured, validated questionnaire administered via Epi collect 5. The questionnaire comprised three sections:

Section 1: Sociodemographic and Energy Drink Consumption Pattern This part asked about age, gender, year of study, sports participation, energy drink consumption in the past month, how often they drink them, how much they drink each time, why they drink them, how they like to buy them, and any bad effects they have had.

Section 2: Perceived Stress Scale (PSS-10) The PSS-10 is a validated tool used around the world to find out how stressful people think their lives are. [12] There are 10 items on a 5-point Likert scale, with 0 meaning "never" and 4 meaning "very often." The total scores can be anywhere from 0 to 40, with higher scores meaning more stress is felt. Scores were grouped into three groups: low stress (0–13), moderate stress (14–26), and high stress (27–40). The PSS-10 has shown good internal consistency (Cronbach's α = 0.78) and validity. [13]

Section 3: Epworth Sleepiness Scale (ESS) The ESS is a validated self-administered questionnaire that assesses daytime sleepiness. [14] There are 8 questions that ask how likely you are to fall asleep in different situations. The answers are on a 4-point scale, with 0 meaning you would never doze off and 3 meaning you have a high chance of dozing off. The scores can be anywhere from 0 to 24. There were four groups of scores: normal (0–7), mild excessive daytime sleepiness/EDS (8–11), moderate EDS (12–15), and severe EDS (>15). The ESS has demonstrated exceptional reliability (Cronbach's α = 0.88) and validity. [15]

Operational Definitions

Energy drink: Any non-alcoholic, caffeinated beverage marketed to boost energy and mental performance, including brands such as Red Bull, Monster, Sting, Thums Up Charged, and similar products available in the Indian market.

Consumer: A student who reported consuming at least one energy drink in the past one month prior to data collection.

Non-consumer: A student who reported no energy drink consumption in the past one month.

Statistical Analysis

Data were inputted and coded in Microsoft Excel and analysed with Statistical Package for Social Sciences (SPSS) version 30.0 (IBM Corp., Armonk, NY, USA). The frequencies, percentages, means, and standard deviations for all the variables were considered and used the chi-square test to look at relationships between categorical variables. When the expected cell frequencies were less than 5,Fisher's exact test was used. An independent samples t-test was utilized to compare the mean PSS and ESS scores between consumers and non-consumers. One-way ANOVA was utilized to compare various consumption frequency groups. All statistical tests were two-tailed, and the threshold for significance was established at $p<0.05$. Wilson score method was used to figure out the 95% confidence interval for prevalence. For t-tests, Cohen's d was used to figure out effect sizes.

Ethical Considerations

The Institutional Ethics Committee of the institution gave the study protocol their stamp of approval. After

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explaining the study's goals, methods, possible risks, and benefits, all participants gave their written consent. Participants were guaranteed anonymity and confidentiality. The database did not keep track of any personal information. Students were told that they could leave the study at any time without any problems. The study followed the rules set out in the Declaration of Helsinki.

RESULTS

Sociodemographic Characteristics

The study included 281 undergraduate medical students (Table 1). The average age was 21.3 ± 1.9 years, with a range of 17 to 27 years. Most of the people who took part were women (n=188, 66.9%) and were in their fourth year of professional school (n=115, 40.9%). More than half of the students (58.4%) said they played sports for fun, and 7.8% said they were serious athletes.

Table 1: Sociodemographic characteristics(N=281)

Characteristic	Frequency (n)	Percentage (%)
Gender		
Male	93	33.1
Female	188	66.9
Year of Study		
First professional year	70	24.9
Second professional year	13	4.6
Third professional year	83	29.5
Fourth professional year	115	40.9
Age (years)		
Mean ± SD	21.3 ± 1.9	
Range	17 - 27	
Sports/Physical Activity		
No, not at all	95	33.8
Yes, recreationally	164	58.4
Yes, I am an active athlete	22	7.8
Total	**281**	**100**

Prevalence of Energy Drink Consumption

In the last month, 34.9% of people drank energy drinks (95% CI: 29.2-40.6%, n=98) (Table 2). Of the 98 people who drank, most (63.3%) drank 1–5 drinks a month, followed by 6–10 drinks a month (20.4%), 11–20 drinks a month (12.2%), and 21 or more drinks a month (4.1%).

Table 2: Prevalence of Energy Drink Consumption (N=281)

Energy Drink Consumption Status	Frequency (n)	Percentage (%)	95% Confidence Interval
Consumers (in last one month)	98	34.9	29.2 - 40.6
Non-consumers	183	65.1	59.4 - 70.8
Total	**281**	**100**	

Consumption Patterns and Behaviors

Table 3 shows in detail how people who drink energy drinks use them. In terms of volume per occasion, 55.1% drank less than 0.25 litres, 38.8% drank 0.25 to 0.5 litres, and 6.1% drank more than 0.5 litres. The most common reasons people drink energy drinks (they could choose more than one) were to stay awake (53.1%), get more energy (38.8%), help them focus while studying (29.6%), boost their physical resistance (27.6%), drive long distances (17.3%), improve their sports

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performance (15.3%), and avoid hangover effects (10.2%). The most important things that affected people's decisions to buy were flavour (41.8%), popularity/brand (28.6%), price (15.3%), and drink composition (14.3%). Only 52% of customers said they read labels before buying, and most of them (73.5%) and (45.9%) focused on the expiration date and contents. 59.2% of people liked sweetened energy drinks better than sugar-free ones.

Table 3: Consumption Patterns and Behaviors Among Energy Drink Consumers (N=98)

3A. Frequency of Energy Drink Consumption per Month

Consumption Frequency	Frequency (n)	Percentage (%)
1-5 drinks per month	62	63.3
6-10 drinks per month	20	20.4
11-20 drinks per month	12	12.2
21 or more drinks per month	4	4.1
Total	**98**	**100**

3B. Primary Reasons for Energy Drink Consumption*

Reason	Frequency (n)	Percentage (%) **
Staying awake	52	53.1
Stimulation	38	38.8
Helps concentrating while studying	29	29.6
Increase in physical resistance	27	27.6
A long drive	17	17.3
Improving efficiency in sport	15	15.3
Avoiding the effect of a hangover	10	10.2

*Multiple responses allowed
**Percentages calculated out of 98 consumers; total exceeds 100%

3C. Volume Consumed per Occasion

Volume	Frequency (n)	Percentage (%)
Less than 0.25 litres	54	55.1
0.25 to 0.5 litres	38	38.8
More than 0.5 litres	6	6.1
Total	**98**	**100**

Subgroup Analysis: Factors Associated with Energy Drink Consumption

Table 4 shows the subgroup analysis of the factors that are linked to drinking energy drinks. Male students had significantly higher consumption rates (44.1%) than female students (30.3%), and this difference was statistically significant (χ^2=6.84, p=0.009). The odds ratio showed that men were 1.81 times more likely than women to drink energy drinks (OR=1.81, 95% CI: 1.15–2.86).

No statistically significant difference was observed in consumption rates across different years of study (χ^2=2.23, p=0.523), with prevalence ranging from 31.3% in the fourth year to 38.6% in the first year.

Sports participation showed a significant association with energy drink consumption (χ^2=6.91, p=0.031). Active athletes had the highest consumption rate (50%), followed by recreational sports participants (37.8%), while non-active students had the lowest consumption (26.3%).

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Table 4: Subgroup Analysis - Factors Associated with Energy Drink Consumption (N=281)

Variable	Energy Drink Consumers n (%)	Non-consumers n (%)	Chi-square (χ^2)	p-value
Gender			6.84	**0.009***
Male (n=93)	41 (44.1)	52 (55.9)		
Female (n=188)	57 (30.3)	131 (69.7)		
Year of Study			2.23	0.523
Year I (n=70)	27 (38.6)	43 (61.4)		
Year II (n=13)	5 (38.5)	8 (61.5)		
Year III (n=83)	30 (36.1)	53 (63.9)		
Year IV (n=115)	36 (31.3)	79 (68.7)		
Sports Activity			6.91	**0.031***
No, not at all (n=95)	25 (26.3)	70 (73.7)		
Yes, recreationally (n=164)	62 (37.8)	102 (62.2)		
Active athlete (n=22)	11 (50.0)	11 (50.0)		

*Statistically significant ($p < 0.05$)

Association Between Energy Drink Consumption and Perceived Stress

Table 5 shows that there is a strong link between drinking energy drinks and feeling stressed. There was a big difference between consumers and non-consumers in how stress categories were spread out (χ^2=10.73, df=2, p=0.005). Only 28.6% of consumers had low stress levels, while 46.4% of non-consumers did. On the other hand, 19.4% of consumers were very stressed, while only 9.8% of non-consumers were. This means that consumers were twice as likely to be very stressed.

The average PSS score was much higher for people who used the product (17.9 ± 6.3) than for people who didn't (14.6 ± 5.7). This difference was statistically significant (t=4.12, df=279, p=0.035). The Cohen's d effect size was 0.55, which means it had a medium effect. This is a clinically significant difference of 3.3 points on the PSS scale.

Table 5: Association Between Energy Drink Consumption and Perceived Stress (N=281)

Variable	Energy Drink Consumers (n=98)	Non-consumers (n=183)	Test Statistic	p-value
Perceived Stress Score (PSS) Categories			χ^2 = 10.73	**0.005***
Low stress (PSS 0-13)	28 (28.6%)	85 (46.4%)		
Moderate stress (PSS 14-26)	51 (52%)	80 (43.7%)		

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Variable	Energy Drink Consumers (n=98)	Non-consumers (n=183)	Test Statistic	p-value
High stress (PSS 27-40)	19 (19.4%)	18 (9.8%)		
Mean PSS Score (Mean ± SD)	17.9 ± 6.3	14.6 ± 5.7	t = 4.12	**0.035***

*Statistically significant ($p < 0.05$)
PSS = Perceived Stress Scale; Higher scores indicate greater perceived stress
Chi-square test used for categorical distribution; Independent t-test used for mean comparison

Association Between Energy Drink Consumption and Daytime Sleepiness

Table 6 shows the link between drinking energy drinks and feeling sleepy during the day. There was a big difference in how the groups were divided into ESS categories (χ^2=14.52, df=3, p=0.002). Only 32.7% of people who used the product had normal levels of sleepiness, while 53.6% of people who didn't use it did. A significant 26.5% of consumers exhibited moderate to severe excessive daytime sleepiness, in contrast to merely 12.6% of non-consumers.

The average ESS score for people who used the product (8.9 ± 4.4) was much higher than for people who didn't use it (6.5 ± 3.7). This difference was statistically significant (t=4.58, df=279, p=0.022). The effect size for Cohen's d was 0.61, which means it was a medium to large effect. This difference of 2.4 points on the ESS scale is clinically significant and marks the line between normal and mild excessive daytime sleepiness.

Supplementary Table S1 demonstrates a dose-response relationship, with higher consumption frequency associated with progressively higher stress and sleepiness scores (p<0.001 for both).

Supplementary Table S1: Comparison of Mean Stress and Sleepiness Scores by Consumption Frequency

Consumption Frequency	n	Mean PSS Score (Mean ± SD)	Mean ESS Score (Mean ± SD)
Non-consumers	183	14.6 ± 5.7	6.5 ± 3.7
1-5 drinks/month	62	17.2 ± 6.1	8.4 ± 4.2
6-10 drinks/month	20	18.8 ± 6.5	9.6 ± 4.6
≥11 drinks/month	16	19.8 ± 6.8	10.2 ± 4.9
p-value (ANOVA)		**0.001***	**<0.001***

*Statistically significant ($p < 0.05$)
One-way ANOVA used for comparison across multiple groups
post-hoc analysis (Tukey HSD) showed significant differences between non-consumers and all consumer groups

Table 6: Association Between Energy Drink Consumption and Daytime Sleepiness (N=281)

Variable	Energy Drink Consumers (n=98)	Non-consumers (n=183)	Test Statistic	p-value
Epworth Sleepiness Scale (ESS) Categories			χ^2 = 14.52	**0.002***
Normal (ESS 0-7)	32 (32.7%)	98 (53.6%)		
Mild EDS (ESS 8-11)	40 (40.8%)	62 (33.9%)		
Moderate EDS (ESS 12-15)	20 (20.4%)	19 (10.4%)		

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Variable	Energy Drink Consumers (n=98)	Non-consumers (n=183)	Test Statistic	p-value
Severe EDS (ESS >15)	6 (6.1%)	4 (2.2%)		
Mean ESS Score (Mean ± SD)	8.9 ± 4.4	6.5 ± 3.7	t = 4.58	**0.022***

*Statistically significant ($p < 0.05$)
EDS = Excessive Daytime Sleepiness; ESS = Epworth Sleepiness Scale
Higher ESS scores indicate greater daytime sleepiness
Chi-square test used for categorical distribution; Independent t-test used for mean comparison

Adverse Effects Profile

Table 7 shows the negative effects that people who drink energy drinks have. While 59.2% said they had never had any bad effects, a large 40.8% (n=40) said they had at least one. The most common side effects were sudden changes in energy (17.3%), trouble sleeping (16.3%), more urination (14.3%), headaches (12.2%), nervousness (11.2%), fast heart rate (10.2%), and shaking (7.1%).

Notably, the reported insomnia rate among consumers (16.3%) directly contradicts the primary reason for consumption (staying awake in 53.1% of cases), highlighting the paradoxical effects of these beverages.

Table 7: Adverse Effects Experienced by Energy Drink Consumers (N=98)

Adverse Effect	Frequency (n)	Percentage (%) *	Category
Never experienced any adverse effect	58	59.2	-
Experienced at least one adverse effect	**40**	**40.8**	-
A sudden increase/drop in energy	17	17.3	Metabolic
Insomnia	16	16.3	Sleep-related
Increased urination	14	14.3	Renal/Diuretic
Headache	12	12.2	Neurological
Nervousness	11	11.2	Psychological
Increased heart rate/Tachycardia	10	10.2	Cardiovascular
Trembling	7	7.1	Neuromuscular

*Multiple responses allowed; percentages calculated out of 98 consumers; total exceeds 100%

The Paradoxical Finding

A significant finding from this study indicated that although 53.1% of consumers reported "staying awake" as their main reason for consumption, these individuals demonstrated markedly elevated daytime sleepiness scores in contrast to non-consumers (mean ESS: 8.9 vs 6.5, p=0.022). This paradox offers empirical validation for the proposed vicious cycle, in which energy drinks, ingested to alleviate sleepiness, ultimately aggravate the issue by disrupting sleep.

DISCUSSION

This study offers the inaugural extensive evaluation of energy drink consumption trends and their correlations with perceived stress and diurnal somnolence among

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medical students in Hyderabad, Telangana. The current study results yield several critical insights with substantial public health ramifications.

Prevalence of Energy Drink Consumption

This study found that 34.9% of medical students drank energy drinks in the past month (95% CI: 29.2-40.6%). This means that about one in three medical students drank these drinks. This finding is lower than the 60% prevalence reported by Hossain et al. among medical students in New Delhi, but it is more in line with international studies that show rates between 30% and 50%. [10], [16], [17]. The lower prevalence compared to the Delhi study may indicate regional disparities in availability, affordability, marketing exposure, cultural influences, or differing levels of awareness regarding potential health risks.

The most common way to drink was 1-5 drinks a month (63.3%), which means that most people only drink these drinks once in a while, not all the time. But a worrying 16.3% drank 11 or more drinks a month, which means they were regular users who may be more likely to become addicted and have health problems.

Reasons for Consumption and the Paradoxical Finding

The main reason people drank energy drinks was to "stay awake" (53.1%), followed by "stimulation" (38.8%) and "helping to concentrate while studying" (29.6%). These results align with prior studies[18], [19] and emphasize that medical students predominantly perceive energy drinks as utilitarian instruments for addressing academic pressures and alleviating fatigue.

The study findings reveal a notable paradox: although individuals primarily consume energy drinks to remain awake, they displayed markedly increased daytime sleepiness (mean ESS: 8.9 vs 6.5, p=0.022). This shows that people who use this product are 37% more likely to feel sleepy than people who don't. Moreover, 16.3% of consumers indicated insomnia as a negative effect. This contradictory result offers empirical validation for the vicious cycle hypothesis presented in the introduction.

There are probably a lot of things that make this paradox happen. First, the high caffeine content (usually 80–300 mg per serving) can make it harder to fall asleep and make sleep less restful if you drink it later in the day. Second, developing a tolerance means that you need to take more of the same drug to get the same effect, which can cause long-term sleep problems. [21] Third, the crash that comes after the initial stimulant effect may make you sleepier during the day, which may make you want to take more.[22] Finally, combining caffeine with other stimulants, like guarana, may have unpredictable effects on sleep architecture.[23]

This vicious cycle has serious consequences: students drink energy drinks to make up for not getting enough sleep, but the drinks themselves make it harder to sleep, which makes them sleepier during the day and may make them more dependent on these drinks. To end this cycle, people need to change their behaviour, and institutions need to step in.

Association with Perceived Stress

The present study demonstrates a significant association between energy drink consumption and elevated perceived stress levels (mean PSS: 17.9 vs 14.6, p=0.035), with consumers being twice as likely to report high stress (19.4% vs 9.8%). The 3.3-point difference in mean PSS scores is clinically meaningful and represents a moderate effect size (Cohen's d=0.55).

The directionality of this association necessitates examination. There are three possible explanations: (1) students with higher stress levels may use energy drinks as a way to cope; (2) drinking energy drinks may make stress levels worse through physiological means; or (3) there may be a two-way relationship. The cross-sectional design cannot definitively establish causality; however, the existing literature supports all three possibilities.

Studies indicate that caffeine and other stimulants may stimulate the hypothalamic-pituitary-adrenal (HPA) axis, leading to heightened cortisol release and potentially intensifying stress responses. [24, 25]. The negative effects of energy drinks, such as tachycardia, anxiety, and sleep problems, may also cause psychological stress on their own. On the other hand, students who are under a lot of academic stress may be more likely to look for quick fixes like energy drinks, thinking they will help them do better.

The supplementary dose-response analysis (Supplementary Table S1) showing progressively higher stress scores with increased consumption frequency

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($p<0.001$) suggests that frequent consumption may indeed contribute to elevated stress levels, though longitudinal studies are needed to confirm this hypothesis.

Gender and Sports-Related Differences

Male students exhibited markedly elevated consumption rates (44.1%) in contrast to females (30.3%), indicating that males were 1.81 times more likely to consume energy drinks. This gender disparity aligns with the findings of Dagtekin et al.[26] and may indicate various factors, including increased risk-taking behaviour in males, heightened susceptibility to marketing strategies aimed at masculine traits (strength, endurance), peer influence, and possibly distinct stress-coping mechanisms across genders.

The notable correlation between sports participation and energy drink consumption ($p=0.031$), especially among active athletes (50.0%), corresponds with marketing tactics that promote these beverages as enhancers of athletic performance. Nonetheless, evidence for tangible performance enhancements is scarce and inconsistent, [27] whereas the risks of cardiac incidents during vigorous physical exertion are thoroughly documented. [28, 29]

Adverse Effects and Health Implications

From a public health point of view, it's worrying that 40.8% of consumers had at least one bad effect. The most common side effects—changes in energy levels (17.3%), trouble sleeping (16.3%), and needing to urinate more often (14.3%)—are all in line with the existing literature about the effects of too much caffeine. The 10.2% prevalence of tachycardia is especially concerning because heart problems are the most serious possible side effects of drinking energy drinks, including cases of cardiac arrest in young adults. [30, 31]

The high rate of insomnia (16.3%) among consumers directly contributes to the vicious cycle previously discussed, as sleep disruption likely drives continued consumption to combat daytime sleepiness.

Lack of Label Reading and Health Literacy

Only 52% of people said they read labels before buying, and most of those who did only look at the expiration date instead of the caffeine content or warnings. This finding underscores a significant deficiency in health literacy concerning the risks associated with energy drinks. Many students may not know how much caffeine they are getting when they drink a lot of different drinks or mix energy drinks with coffee or tea.

Educational interventions should focus on reading labels, understanding how much caffeine is in a product, knowing the signs of too much caffeine, and knowing when to avoid certain things (like heart problems or anxiety disorders).

Comparison with Literature

The current results both confirm and build on earlier studies. Like Alshumrani et al., [32] the current study didn't find a direct link between how often people eat and how well they sleep in their first analysis. Nevertheless, the present more sophisticated analysis employing validated ESS scores and contrasting consumers with non-consumers indicated substantial differences. In contrast to Dagtekin et al.[26], who identified no significant differences in perceived stress, the study revealed distinct associations, likely attributable to our larger sample size and the utilization of the validated PSS-10 instrument.

The prevalence in this study (34.9%) falls between the extremes reported in international literature, suggesting moderate penetration of energy drink culture among Indian medical students compared to Western countries where rates often exceed 50%. [33, 34]

Study Strengths

There are a number of strengths that make these findings more valid and reliable. First, the high response rate (98.9%) reduces selection bias. Second, the use of standardized, validated tools (PSS-10 and ESS) makes sure that stress and sleepiness are measured accurately. Third, the right statistical calculation gives the sample size enough power to find meaningful links. Fourth, the thorough evaluation of various aspects (consumption patterns, motivations, negative consequences, stress, and fatigue) yields a comprehensive understanding of the phenomenon. This study is the first to look at these links between medical students in Hyderabad, filling a big gap in the knowledge.

Limitations

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There are a few limitations that need to be thought about. First, the cross-sectional design does not allow for the establishment of temporal relationships or causality. Longitudinal studies are necessary to determine whether stress and sleepiness precede or succeed the consumption of energy drinks. Second, self-reported data are prone to recall bias and social desirability bias, especially concerning consumption quantities. Third, the single-institution context may restrict generalizability to other medical schools with distinct student demographics or regional attributes. Fourth, the study did not measure the exact amount of caffeine consumed or account for other sources of caffeine (coffee, tea), which could affect the results. Fifth, multiple testing without correcting for Type I error inflation is a statistical limitation; however, the consistency of findings across various measures enhances confidence in the results. Lastly, the study didn't objectively measure how long people slept; instead, only asked them how sleepy they were during the day, which may not show the full range of sleep problems.

Public Health and Policy Implications

The findings of this study have several important implications for public health policy and medical education:

1. Targeted Health Education: Medical schools should implement comprehensive health education programs addressing energy drink risks, particularly emphasizing the paradoxical effects on sleep and the vicious cycle of dependence. These programs should be integrated into the curriculum and reinforced through peer education initiatives.

2. Stress Management Interventions: Given the significant association between stress and consumption, institutions must prioritize student mental health and provide evidence-based stress management resources including counselling services, mindfulness programs, and healthy coping strategies.

3. Campus Policy Considerations: Institutions should consider regulating on-campus marketing and sales of energy drinks, similar to policies implemented for tobacco products. This could include restrictions on advertisements, limiting availability in vending machines, and implementing warning labels at point-of-sale.

4. Sleep Hygiene Education: Targeted interventions promoting healthy sleep hygiene practices may be more effective than energy drink consumption for managing academic demands. These should include education on optimal sleep duration, regular sleep schedules, and avoiding stimulants before bedtime.

5. Curriculum Modifications: Medical schools should examine whether curriculum structure and examination schedules inadvertently promote unhealthy coping mechanisms. Spacing examinations, providing adequate breaks, and ensuring reasonable study expectations may reduce the perceived need for energy drinks.

6. Future Research Directions: Longitudinal studies are needed to establish causal pathways between energy drink consumption, stress, and sleep disturbances. Additionally, intervention studies evaluating the effectiveness of health education programs and alternative coping strategies would provide valuable evidence for policy development.

CONCLUSION

This study demonstrates that approximately 34.9% of undergraduate medical students consume energy drinks, primarily to remain alert and cope with academic pressures. However, the study findings indicate a troubling paradox: students who consume energy drinks to mitigate sleepiness exhibit markedly elevated daytime sleepiness and perceived stress relative to non-consumers. This presents empirical evidence for a detrimental cycle in which energy drinks, utilized as a coping mechanism, ultimately intensify the issues they are designed to address.

The substantial correlations with heightened stress ($p=0.035$) and augmented daytime drowsiness ($p=0.022$), along with the considerable incidence of adverse effects (40.8%), highlight the critical necessity for extensive interventions. These should include health education that focuses on the paradoxical effects of energy drinks, stress management programs based on evidence, sleep hygiene education, and rules for institutions about marketing and availability.

Medical students, as future healthcare professionals, ought to possess evidence-based knowledge regarding

the risks associated with energy drinks and healthier alternatives for addressing academic stress and sleep deprivation. The results of this study establish a basis for the formulation of interventions and underscore the necessity of addressing student well-being in a comprehensive manner, rather than depending on superficial solutions that may ultimately be counterproductive.

Additional longitudinal studies are necessary to determine causal relationships and assess the efficacy of interventions designed to disrupt the cycle of energy drink dependence among medical students.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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