

## Original Research Article

# Energy drink consumption patterns and perceived benefits and health risks among MBBS students: a cross-sectional study

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## ABSTRACT

**Background:** Energy drink consumption has increased among young adults, particularly medical students, due to academic stress, prolonged study hours, and the perceived need for enhanced alertness. This study assessed the prevalence, consumption patterns, associated factors, and perceived benefits and health risks of energy drink use among MBBS students.

**Methods:** A cross-sectional analytical study was conducted among 120 MBBS students at a private medical college in Kanpur, Uttar Pradesh, using a structured, self-administered questionnaire. Data regarding socio-demographic characteristics, consumption patterns, motivations, awareness of health risks, and self-reported adverse effects were collected. Associations were assessed using the Chi-square test, with  $p < 0.05$  considered statistically significant.

**Results:** Overall, 47.5% of students reported consuming energy drinks, with 69.2% of consumers reporting rare use. The commonest motivations were boosting energy and improving concentration, while Red Bull and Sting were the preferred brands. Although 75.0% were aware of potential health risks and 85.0% considered long-term consumption harmful, awareness was not significantly associated with consumption ( $p = 0.2986$ ). Palpitations (16.7%) and gastrointestinal symptoms (9.2%) were the most frequently reported adverse effects. Consumption was significantly associated with male gender ( $p < 0.0001$ ) and year of study ( $p = 0.0417$ ).

**Conclusion:** Energy drink consumption was common despite substantial awareness of health risks. Targeted health education, stress management, and promotion of healthier alternatives may help reduce consumption among medical students.

**Keywords:** Energy drinks, Medical students, Caffeine, Consumption patterns, Health risks

## INTRODUCTION

Energy drinks are pre-packaged, ready-to-consume beverages that contain caffeine along with calories and other purported energy-boosting ingredients such as taurine, guarana, L-carnitine herbal extracts, and B vitamins.<sup>1</sup> First introduced in the United States during the late 1990s, they have rapidly evolved into one of the highest-selling categories within the functional beverage

industry, with annual global sales projected to exceed 21 billion US dollars by 2026.<sup>2</sup>

Energy drinks are aggressively marketed toward adolescents and young adults, who constitute the primary consumer population. A large European survey conducted across 16 countries reported a lifetime prevalence of energy drink consumption of nearly 68% among adolescents, compared to 30% among adults. Among

regular consumers, around 12% were identified as high chronic users, consuming an average of seven litres per month.<sup>3</sup> Similar prevalence rates among adolescents have also been documented in Canada (62%) and Germany (61%).<sup>4,5</sup> Furthermore, studies from the United States have demonstrated a steady rise in energy drink consumption between 2003 and 2016 across adolescent, young adult, and middle-aged populations, highlighting the increasing global popularity of these beverages among younger age groups.<sup>6</sup>

Medical students represent a particularly vulnerable group for excessive energy drink (ED) consumption because of the unique academic and psychological pressures associated with medical training. The underlying motivators in this cohort include irregular sleep patterns including the need to stay awake till late at night, managing long shifts and clinical duties. Similar findings have been reported in previous studies, where prolonged wakefulness and improved cognitive or academic performance were identified as major drivers of ED use among medical students.<sup>7</sup> Additionally, evidence suggests that individuals consuming alcohol mixed with energy drinks (AmED) tend to consume alcohol more frequently and in greater quantities compared to non-users, thereby increasing the risk of severe dehydration, alcohol poisoning, and other high-risk behaviours.<sup>8</sup>

Although the individual ingredients present in energy drinks are generally considered safe when consumed within recommended limits, increasing consumption—particularly among young adults and students—has raised concerns regarding their potential health effects. Excessive intake of energy drinks has been associated with a range of adverse outcomes, most notably affecting the cardiovascular and neurological systems. Caffeine, the principal active ingredient in most energy drinks, is largely responsible for their stimulant effects. A typical 250 ml serving contains approximately 50–150 mg of caffeine, and excessive consumption may result in caffeine intake approaching or exceeding recommended safety thresholds.<sup>9</sup> Additionally, numerous ingredients in energy drinks have been linked to adverse effects such as arrhythmias, anxiety, insomnia, restlessness, caffeine toxicity, gastrointestinal disturbances, obesity, and type 2 diabetes, highlighting the need to create awareness among the younger generations about the same.<sup>10</sup>

Despite the increasing popularity of EDs among young adults, there remains limited evidence regarding their consumption patterns, motivations for use, and awareness of potential health risks among MBBS students, particularly in the Indian context. Understanding both the perceived benefits and perceived risks of ED consumption is essential for developing targeted educational interventions and promoting informed consumption practices. The present study was thus undertaken to assess the prevalence and patterns of energy drink consumption, identify factors associated with its use, and explore the perceived benefits and health risks among MBBS students.

## METHODS

### *Study design and setting*

This cross-sectional analytical study was conducted among MBBS students enrolled at a private medical college in Kanpur, Uttar Pradesh, India. Data were collected over a six-month period from October 2025 to March 2026 using a structured, self-administered questionnaire designed to assess energy drink consumption patterns and perceptions regarding their benefits and risks.

### *Study population and sampling strategy*

The study population comprised undergraduate MBBS students from all professional years who were enrolled in the institution during the study period. A non-probability convenience sampling method was used. The questionnaire was disseminated electronically through official MBBS student WhatsApp groups, and students from all professional years were invited to participate voluntarily to ensure representation across different academic years. Students were encouraged to share the survey among their classmates to maximize participation. Only fully completed questionnaires were included in the final analysis.

### *Sample size estimation*

The sample size was determined using the standard formula for cross-sectional studies:

$$n = \frac{Z^2 P(1 - P)}{d^2}$$

Based on a previously reported prevalence of 62% for energy drink consumption among medical students in New Delhi, India, a 95% confidence level ( $Z=1.96$ ), and an absolute precision of 9%, the minimum required sample size was calculated to be approximately 112 participants.<sup>10</sup> To improve representation across different professional years and to account for potential incomplete or non-response questionnaires, the target sample size was increased to 120 students.

### *Data collection tool*

Data were collected using a semi-structured, self-administered questionnaire. The tool addressed socio-demographics, consumption frequency, motivations, awareness of harmful effects and experienced side effects.

### *Variables under study*

The primary outcome variable was energy drink consumption, assessed as a dichotomous variable (consumer/non-consumer). Independent variables included socio-demographic characteristics (age, gender,

and year of study), frequency of energy drink consumption, preferred brand, reasons for consumption, awareness regarding potential health risks, and self-reported adverse effects following energy drink intake. Consumption frequency was operationally categorized as rarely (less than once a month), a few times a month (1–3 times per month), once a week, several times a week (2–6 times per week), and daily.

### Statistical analysis

Data were entered into Microsoft Excel and analysed using SPSS version 25 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized using mean and standard deviation, whereas categorical variables were expressed as frequencies and percentages. Associations between categorical variables were assessed using the Chi-square test. A *p* value <0.05 was considered statistically significant.

### Ethical considerations

Ethical approval for the study was obtained from the Institutional Ethics Committee of Rama Medical College, Hospital and Research Centre prior to commencement of the study (Approval No. RMCHRC/IEC/Acad-2025/5111-B). Participation was voluntary, and electronic informed consent was obtained from all participants before questionnaire administration. Confidentiality and anonymity of participants were maintained throughout the study, and no personally identifiable information was collected.

## RESULTS

### Socio-demographic profile

The mean age of the 120 MBBS respondents was 21.46±1.33 years. The study saw a higher participation rate from female students (66.7%) and students in their 1<sup>st</sup> (35.0%) and 3<sup>rd</sup> (35.0%) professional years (Table 1).

**Table 1: Socio-demographic profile of MBBS respondents (n=120).**

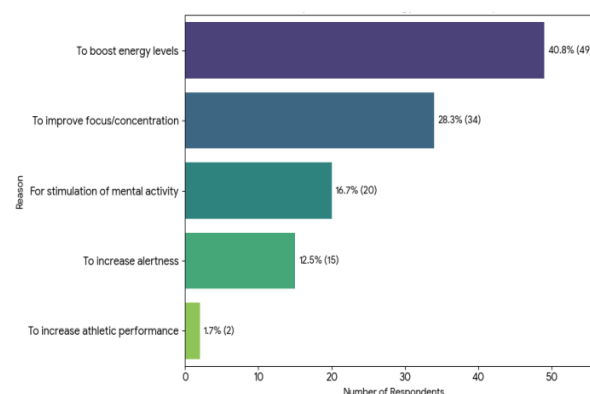
| Variables            | Category   | Frequency (N) | Percentage (%) |
|----------------------|------------|---------------|----------------|
| <b>Gender</b>        | Female     | 80            | 66.7           |
|                      | Male       | 40            | 33.3           |
| <b>Year of study</b> | 1st Year   | 42            | 35.0           |
|                      | 2nd Year   | 27            | 22.5           |
|                      | 3rd Year   | 42            | 35.0           |
|                      | Final Year | 9             | 7.5            |
| <b>Age (years)</b>   | Mean±SD    | 21.46±1.33    | Range: 18–25   |

### Consumption habits and brand preferences

Red Bull (34.5%) and Sting (28.4%) were the most frequently cited brands. While 69.2% of students consumed EDs "Rarely," a significant subset of the medical student population used them multiple times per week (Table 2).

**Table 2: Patterns of energy drink consumption among students.**

| Parameters                   | Category             | N  | %    |
|------------------------------|----------------------|----|------|
| <b>Frequency</b>             | Rarely               | 83 | 69.2 |
|                              | Several times a week | 13 | 10.8 |
|                              | A few times a month  | 12 | 10.0 |
|                              | Once a week          | 10 | 8.3  |
|                              | Daily                | 2  | 1.7  |
| <b>Most preferred brands</b> | Red Bull             | 40 | 34.5 |
|                              | Sting                | 33 | 28.4 |
|                              | Monster              | 17 | 14.7 |



**Figure 1: Primary reasons for energy drink consumption.**

The leading driver for ED consumption was "To boost energy levels" (40.8%), followed by "To improve focus/concentration" (28.3%) highlighting the relatively high academic pressures, medical students face (Figure 1).

### Health impacts and perceptions

A high percentage of students (75%) were aware of the harmful effects. However, 40.8% of students still reported experiencing adverse physiological effects (Table 3).

Energy drink consumption was found to be highly significantly associated with gender ( $\chi^2$  (1)=19.887, *p*<0.0001), with male participants reporting a

significantly higher prevalence of consumption (77.5%) compared to females (32.5%). The year of study also demonstrated a statistically significant relationship ( $\chi^2$  (3)=8.218,  $p=0.0417$ ), with consumption peaking noticeably during the final year (77.8%) and second year

(63.0%). Conversely, awareness of potential risks did not significantly influence habits ( $\chi^2$  (2)=2.417,  $p=0.2986$ ), indicating that understanding the health risks of excessive consumption does not reliably deter usage in this cohort (Table 4).

**Table 3: Perceived risks and experienced adverse effects.**

| Parameter          | Category                        | N  | %    |
|--------------------|---------------------------------|----|------|
| Awareness of risks | Yes                             | 90 | 75.0 |
|                    | Somewhat                        | 20 | 16.7 |
|                    | No                              | 10 | 8.3  |
| Negative effects   | None                            | 71 | 59.2 |
|                    | Palpitations                    | 20 | 16.7 |
|                    | GIT Side Effects                | 11 | 9.2  |
|                    | Insomnia                        | 10 | 8.3  |
|                    | Others (Headache, Irritability) | 8  | 6.6  |

**Table 4: Association of sociodemographic and awareness factors with energy drink consumption.**

| Variables          | Category   | Do you consume energy drinks? (No) | Do you consume energy drinks? (Yes) | Total (N) | Chi-Square (df) | P value | Significance              |
|--------------------|------------|------------------------------------|-------------------------------------|-----------|-----------------|---------|---------------------------|
| Gender             | Female     | 54 (67.5%)                         | 26 (32.5%)                          | 80        | 19.887 (1)      | <0.0001 | Highly Significant        |
|                    | Male       | 9 (22.5%)                          | 31 (77.5%)                          | 40        |                 |         |                           |
| Year of study      | 1st year   | 25 (59.5%)                         | 17 (40.5%)                          | 42        | 8.218 (3)       | 0.0417  | Statistically Significant |
|                    | 2nd year   | 10 (37.0%)                         | 17 (63.0%)                          | 27        |                 |         |                           |
|                    | 3rd year   | 26 (61.9%)                         | 16 (38.1%)                          | 42        |                 |         |                           |
|                    | Final year | 2 (22.2%)                          | 7 (77.8%)                           | 9         |                 |         |                           |
| Awareness of risks | No         | 3 (30.0%)                          | 7 (70.0%)                           | 10        | 2.417 (2)       | 0.2986  | Not Significant           |
|                    | Somewhat   | 10 (50.0%)                         | 10 (50.0%)                          | 20        |                 |         |                           |
|                    | Yes        | 50 (55.6%)                         | 40 (44.4%)                          | 90        |                 |         |                           |

## DISCUSSION

Energy drinks are primarily carbohydrate-rich beverages that are designed to enhance energy levels temporarily through the provision of high amounts of caffeine, which promotes wakefulness by antagonizing adenosine receptors and delaying the onset of sleep.<sup>11</sup> Altered sleep cycles often contribute to a perceived dependence on energy drinks, as individuals increasingly use them to counteract fatigue and maintain alertness.<sup>12</sup> Past studies have established that medical students are more likely to indulge in their regular or occasional use compared to students coming from other specialities.<sup>13</sup>

The present study highlights a complex relationship between medical knowledge and lifestyle practices among MBBS students where despite significant awareness of the adverse effects of these drinks, their use was largely prevalent in them. Notably, while the prevalence of "Daily" consumption was reported to be low (1.7%), the intermittent use of energy drinks (EDs) as a functional tool was found to be widespread.

Our findings indicate that the primary motivations for energy drink consumption among medical students were boosting energy levels (45.8%) and improving focus (26.7%). Mularczyk-Tomczewska et al in their study, noted that the most common motivations for energy drink (ED) consumption were increased energy (63.1%), improved concentration while studying (37.3%), and taste (37.4%), followed by the use of EDs as a substitute for coffee (32.0%).<sup>14</sup>

Red Bull (34.5%) and Sting (28.4%) emerged as the leading brands. The popularity of Red Bull is consistent with international trends where it remains a market leader. Similar trends were noted by Edrees et al, in their study who found that Code Red was the most preferred energy drink brand among their participants, followed by Red Bull, indicating the strong popularity of these brands among young consumers.<sup>13</sup> However, the high preference for Sting in our local context likely reflects its affordability and aggressive marketing in the Indian market. The finding is consistent with recent market trends in India. According to a 2023 industry report, Sting has gained considerable popularity among adolescents and young adults, particularly students, owing to its

affordability and accessibility. The report further notes that the brand has achieved substantial penetration among price-sensitive consumers, including students, and has expanded the accessibility of energy drinks beyond their traditional premium market segment.<sup>15</sup>

Previous studies have demonstrated that energy drink consumption is associated with increased heart rate and arterial blood pressure, primarily due to the stimulatory effects of caffeine.<sup>16</sup> Consistent with these observations, 16.7% of participants in our study reported experiencing palpitations, suggesting a notable cardiovascular response following energy drink intake. Further, energy drink consumption has been associated with symptoms such as anxiety, insomnia, gastrointestinal disturbances, muscle twitching, restlessness, and episodes of heightened energy.<sup>17</sup> Consistent with these reported stimulant-related effects, 16.7% of students in our study experienced palpitations and 8.3 per cent suffered from insomnia.

While only a small fraction of our respondents reported mixing EDs with other substances, the literature suggests this is a critical area for vigilance. Pérez-Mañá et al. (2021) noted that mixing energy drinks with alcohol can mask the effects of intoxication, leading to "wide-awake drunkenness" and increased risk-taking behaviour.<sup>18</sup> Previous studies have also identified energy drink consumption as a potential risk factor for accidents and various adverse health outcomes among young individuals.<sup>19</sup> Although prevalence in our specific MBBS cohort was low for alcohol mixing (6.7% reported mixing), the potential for dependency and withdrawal, as cited by Rogers et al. (2010), remains a concern for students seeking to maintain constant energy levels.

Male students have been found to be significantly more likely to consume energy drinks compared to females.<sup>20,21</sup> On similar lines, the present study demonstrated a highly significant association between gender and energy drink consumption, with male students reporting a substantially higher prevalence of consumption than females (77.5% vs. 32.5%;  $\chi^2(1)=19.887$ ,  $p<0.0001$ ). In addition, a statistically significant association was observed between the year of study and energy drink consumption ( $\chi^2(3)=8.218$ ,  $p=0.0417$ ), with the highest prevalence among final-year students, followed by second-year students. Similar trends have been observed in past studies where most ED users were in their fourth academic year, followed by second and fifth years.<sup>8</sup> This trend may reflect the increasing academic demands, prolonged study hours, examination stress, and greater reliance on stimulants to combat fatigue as students advance through medical training.

A significant finding of this study is the "Knowledge-Behaviour Paradox." Although a substantial proportion of participants were aware of the potential health risks associated with energy drink consumption, awareness of these risks did not significantly influence their consumption habits ( $\chi^2(2)=2.417$ ,  $p=0.2986$ ). Similar

observations were reported by Hossain et al in a study among medical college students in New Delhi, where 62% of participants reported consuming energy drinks despite 60.4% being aware of their harmful effects and 59.7% possessing knowledge regarding their ingredients.<sup>10</sup> These findings suggest that knowledge alone may be insufficient to deter energy drink use among medical students. Factors such as academic pressure, sleep deprivation, the perceived need for enhanced alertness and concentration, and social influences may override health-related knowledge, leading students to continue consuming energy drinks despite being aware of their potential adverse effects.

### Limitations of the study

The present study has certain limitations that should be considered while interpreting its findings. First, the cross-sectional design precludes establishing causal relationships between energy drink consumption and the associated factors identified. Second, the study was conducted among MBBS students from a single medical college using a non-probability sampling approach, which may limit the generalizability of the findings to other student populations or geographical settings. Third, information on energy drink consumption, motivations, awareness, and adverse effects was self-reported and may therefore be subject to recall bias and social desirability bias. Furthermore, the study did not quantify the exact amount of caffeine consumed from energy drinks or other dietary sources such as coffee, tea, or soft drinks, which may have influenced the reported adverse effects. Despite these limitations, the study provides valuable insights into the consumption patterns, perceptions, and associated factors of energy drink use among Indian medical students and may serve as a basis for larger multicentric studies in the future.

### CONCLUSION

Energy drink consumption was common among MBBS students, with most participants consuming these beverages intermittently to enhance energy levels and improve concentration. Male students and those in senior academic years demonstrated significantly higher consumption. Despite a high level of awareness regarding the potential health risks associated with energy drinks, such knowledge did not significantly influence consumption behaviour, highlighting a persistent knowledge-behaviour gap. These findings underscore the need for targeted educational interventions, stress management programmes, and institutional initiatives promoting healthier strategies for managing academic demands and fatigue among medical students.

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