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The Rising Trend of Energy Drink Consumption among University Students: A Hidden Health Risk

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ABSTRACT

Energy drinks, highly caffeinated beverages marketed to combat fatigue, are a global public health concern due to their association with adverse effects like insomnia and cardiovascular symptoms, particularly among young adults. **Objective:** To determine the prevalence, predictors, and self-reported health effects of energy drink consumption among university students in Pakistan. **Methods:** A cross-sectional online survey was conducted among 460 students at the University of the Punjab, Lahore. Data on consumption patterns, knowledge, and health effects were collected. First, bivariate analyses were performed to identify factors associated with frequent energy drink use. Subsequently, multivariable logistic regression was used to identify predictors of frequent energy drink use (≥3 times/week). The AOR from this test quantifies the strength of association between a predictor and the outcome, after controlling for the influence of other variables in the model. **Results:** The prevalence of current energy drink use was 175 (38.0%), with 22.9% of users classified as frequent consumers. Common consumption triggers were exam preparation (65.1%) and late-night studying (52.0%). Notably, 44.6% of users reported adverse effects, primarily insomnia (29.7%) and anxiety/jitters (18.2%). Knowledge about safe caffeine limits was low (28.5%). Significant predictors of frequent use included male gender (AOR=1.9; 95% CI: 1.1–3.3), residing in a university hostel (AOR=2.4; 95% CI: 1.4–4.2), and part-time employment (AOR=1.7; 95% CI: 1.0–2.9). **Conclusions:** The findings highlight an urgent need for targeted university-level health promotion interventions to educate students, particularly those in high-risk groups, about the potential dangers of energy drinks and to promote healthier alternatives for managing academic stress.

INTRODUCTION

The consumption of energy drinks has become increasingly popular among young adults, particularly university students, over the past two decades. Marketed as beverages that enhance alertness, concentration, and physical performance, these products are widely accessible and heavily promoted through targeted advertising campaigns. Their use is often linked to coping with academic stress, late-night study routines, and social pressures that characterize student life [1]. Globally, research has raised concerns about the health risks of frequent energy drink consumption. Studies have shown that the high caffeine and sugar content in these beverages is associated with adverse effects, including insomnia, elevated blood pressure, obesity, dental caries, and an increased risk of cardiovascular complications [2, 3]. Furthermore, mixing energy drinks with alcohol, a common practice among students, has been linked to impaired judgment and engagement in risky behaviors [4]. Despite these documented risks, awareness about safe consumption limits remains low among young populations

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[1]. In South Asian countries, including Pakistan, energy drink consumption among university students is an emerging trend, yet the body of scientific literature remains limited. Existing studies highlight that students often use these beverages to combat academic fatigue and enhance performance, but few investigations have explored the extent of this habit, its determinants, and its potential health implications in local contexts [5].

Despite the growing popularity of energy drinks among university students, there is limited evidence from Pakistan quantifying consumption patterns, identifying key predictors, and assessing associated health effects. Most existing studies focus on Western populations, leaving a critical gap in understanding the local sociocultural and academic factors influencing use. Additionally, students' awareness of safe caffeine limits and potential health risks remains underexplored, highlighting the need for context-specific research to inform public health interventions. This study aimed to assess the prevalence of energy drink consumption among university students in Pakistan, identify the sociodemographic and academic factors that influence their use, and examine students' knowledge and perceptions regarding the associated potential health risks.

METHODS

This cross-sectional study utilized a web-based survey conducted at the University of the Punjab, Lahore, from October 2023 to January 2024. A convenience sampling method was employed, with eligibility restricted to students aged 18 years or older enrolled in undergraduate or postgraduate programs. The minimum sample size was calculated to be 384, but a target of 500 was set to account for subgroup analyses. Participation was voluntary and confidential, and no personal identifiers were collected. The questionnaire, which was available in both English and Urdu after a rigorous translation process, was piloted with 30 students. The data from this pilot phase were used solely to refine the instrument and were not included in the final analysis. Frequent consumption was defined as an intake of four or more standard servings per week. This threshold was selected to identify the upper tier of consumers and was consistent with cut-offs used in prior public health research to classify high or habitual caffeine intake, which was associated with increased risk of adverse effects. It covered sociodemographic characteristics, consumption behaviors, knowledge, and self-reported health outcomes. Data collection involved measuring both the frequency and volume of energy drink consumption. "Frequent consumption" was defined as an intake of four or more standard servings per week, a threshold derived by multiplying the average volume per occasion by a habitual frequency cut-off. The minimum sample size was calculated using Cochran's formula for cross-sectional studies: $n = Z^2P(1-P)/d^2$. The assumptions were a 95% confidence level (Z = 1.96), an expected prevalence (P) of 50% (0.5) to maximize the sample size due to the lack of prior precise estimates in the local population, and a margin of error (d) of 5% (0.05). This calculation yielded a minimum sample size of 384. A target sample size of 500 was set to account for potential incomplete responses and to ensure sufficient power for subgroup analyses. Written informed consent was taken. The original English questionnaire underwent a rigorous process of forward and back translation to ensure conceptual equivalence in Urdu. First, two independent bilingual translators produced two Urdu versions (T1 and T2), which were synthesized into a single version. This version was then back-translated into English by two other translators, who were blinded to the original instrument. The research committee compared the back-translated versions with the original to identify and resolve any discrepancies in meaning. For cultural adaptation, a panel of experts (including a nutritionist, a public health specialist, and a linguist) assessed the content validity of the Urdu version, evaluating the relevance and clarity of each item. The Content Validity Index (CVI) was calculated, and items with a CVI below 0.78 were revised. Finally, the pre-final Urdu version was pilot-tested on 30 students to assess face validity, comprehensibility, and contextual appropriateness (e.g., ensuring local names for energy drinks were used). Minor adjustments to wording were made based on pilot feedback. The data from this pilot phase were used solely to refine the instrument and were not included in the final analysis. Data analysis was performed using IBM SPSS Statistics version 27. Descriptive statistics summarized the data, and bivariate analyses (Chi-square and t-tests) identified factors associated with frequent use. For the continuous variable (age), the use of parametric tests (t-test) was deemed appropriate given the large sample size (n=460) and the robustness of the t-test to minor deviations from normality, as supported by the Central Limit Theorem. Variables with a p-value<0.10 were included in a final multivariable logistic regression model to identify independent predictors, with a p-value<0.05 considered significant. Measures to mitigate bias included emphasizing anonymity and using validated survey items.

RESULTS

The study cohort comprised 460 university students with a mean age of 21.4 years, reflecting a typical undergraduate population. The sample was predominantly composed of undergraduates (84.8%) and was nearly evenly split by sex,

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with a slight majority of females (52.6%). A key characteristic of the sample is that nearly half of the participants (47.0%) resided in university hostels, a factor often associated with independent lifestyle choices and increased exposure to peer influences (Table 1).

Table 1: Sociodemographic Characteristics of the Study Participants (n=460)

Characteristic	Category	Mean ± SD, n (%)
Age	Years	21.4 ± 2.1
Sex	Male	218 (47.4%)
	Female	242 (52.6%)
	–	460 (100.0%)
Academic Level	Undergraduate	390 (84.8%)
	Postgraduate	70 (15.2%)
	–	460 (100.0%)
Residential Status	Hostel	216 (47.0%)
	With Family	205 (44.6%)
	Other	39 (8.4%
	–	460 (100.0%
Part-Time Employment	Yes	98 (21.3%)
	No	362 (78.7%)
	-	460 (100.0%)

The bivariate analysis revealed that male students and those residing in university hostels had significantly higher odds of being frequent energy drink users, with crude odds ratios of 2.83 and 2.26, respectively. A positive, though not statistically significant, association was observed for part-time employment. No significant associations were found for age or academic level (Table 2).

Table 2: Bivariate Associations Between Sociodemographic Factors and Frequent Energy Drink Use (≥4 Servings/Week)

Variables	Category	Frequent Users (n=40)	Non-Frequent Users (n=420)	Crude Odds Ratio (COR)	95% CI	p-Value
Categorical, n (%)						
Sex	Male	28 (70.0%)	190 (45.2)	2.83	1.40 – 5.73	0.003
	Female	12 (30.0%)	230 (54.8%)			
Residential Status	Hostel	26 (65.0%)	190 (45.2%)	2.26	1.18 – 4.35	0.014
	With Family/Other	14 (35.0%)	230 (54.8%)			
Part-time Employment	Yes	12 (30.0%)	86 (20.5%)	1.67	0.83 – 3.36	0.152
	No	28 (70.0%)	334 (79.5%)			
Academic Level	Undergraduate	32 (80.0%)	358 (85.2%)	0.69	0.31 – 1.56	0.377
	Postgraduate	8 (20.0%)	62 (14.8%)			
Continuous (Mean ± SD)						
Age	Years	21.6 ± 2.2	21.4 ± 2.1	1.05*	–	–

The multivariable analysis, adjusting for all other factors, confirmed that male sex, hostel residence, and part-time employment were significant independent predictors of frequent energy drink consumption. Notably, students living in hostels had 2.4 times higher adjusted odds of being frequent consumers compared to those living with family or elsewhere. Age and academic level were not significant predictors in the adjusted model (Table 3).

Table 3: Multivariable Logistic Regression Analysis of Predictors of Frequent Energy Drink Use (≥4 Servings/Week)

Variables	Category/ Comparison	Adjusted Odds Ratio (AOR)	95% CI	p-Value
Sex	Male vs. Female	1.9	1.1 – 3.3	0.020
Residential Status	Hostel vs. Family/ Other	2.4	1.4 – 4.2	<0.001
Part-time Employment	Yes vs. No	1.7	1.0 – 2.9	0.040
Age	Per One-Year Increase	1.1	0.9 – 1.3	0.280
Academic Level	Postgraduate vs. Undergraduate	1.3	0.7 – 2.6	0.400

AOR: Adjusted Odds Ratio; CI: Confidence Interval.

DISCUSSION

This study contributes to the growing body of international literature confirming energy drink (ED) consumption as a significant public health concern among university students. The observed prevalence of 38.0% among Pakistani students is consistent with rates reported in recent studies from the UAE (35%), Italy (48.7%), and Saudi Arabia (up to 60%), underscoring the global nature of this trend [6-8]. This convergence suggests that common drivers, such as escalating academic pressure, the need for cognitive enhancement, and aggressive marketing targeting young adults, are influential across diverse cultural contexts [9, 10]. A central finding of this study is the robust association between ED consumption and self-reported adverse health effects, with insomnia being the most common (29.7%). This aligns perfectly with physiological evidence on high-dose caffeine's disruption of sleep architecture by antagonizing adenosine receptors [11]. Recent large-scale studies have further solidified this link; for instance, the Norwegian SHOT2022 study, which included over 50,000 students, found a strong, dose-dependent relationship between ED consumption and poor

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sleep quality, including longer sleep latency and reduced sleep duration [6]. Similarly, the reported anxiety and jitters(18.2%)are consistent with known sympathomimetic effects of caffeine and taurine, which can induce physiological arousal and heighten stress responses, as demonstrated in controlled laboratory studies [11, 12]. A 2023 systematic review further affirmed that these subjective reports are often correlated with measurable physiological changes, including transient elevations in blood pressure and heart rate variability, highlighting a tangible cardiovascular strain even in young, presumably healthy individuals [13]. A critical and concerning finding is the significant gap between consumption and knowledge. Only 28.5% of respondents were aware of safe caffeine intake guidelines. This "knowledge-practice" dissonance is a recurring theme in contemporary literature. A 2022 study among Malaysian medical students found that despite high awareness of general ED risks, detailed knowledge of caffeine content and safe limits was poor, and this knowledge was not a significant deterrent to consumption [14]. This pattern is echoed in studies from Jordan and the US, where perceived functional benefits like improved concentration and fatigue reduction often override factual knowledge, leading to continued use [15, 16]. The primary motivations identified in our sample, coping with academic stress and enhancing concentration for late-night studying, are echoed globally. This often creates a vicious cycle of dependency, where ED use leads to poor sleep, which in turn increases daytime fatigue and perpetuates the need for stimulants [9, 10]. The multivariable analysis identified key sociodemographic predictors of frequent use. The association with male gender (AOR=1.9) is well-documented and often attributed to higher risk-taking propensity and greater engagement in sensation-seeking behaviors among young men [17]. The strong independent predictor of hostel residence (AOR=2.4) is particularly insightful. It suggests that the environment itself—characterized by independence from parental supervision, irregular routines, peer influence, and heightened academic stress in a confined setting is a powerful driver of consumption. It is important to note, however, that some predictors, notably part-time employment (AOR=1.7; 95% CI: 1.0–2.9), had wide confidence intervals that crossed the null value of 1. This suggests a degree of statistical imprecision and indicates that the study may have had limited power to detect a more precise effect size for this variable, potentially due to the smaller subgroup of students engaged in employment. A 2023 study from the Philippines specifically highlighted that university dormitory residents had significantly higher odds of ED consumption compared to their family-dwelling peers, reinforcing the role of the residential environment in facilitating this health behavior [18]. The attenuation of the crude odds ratios for these variables in the multivariable model indicates shared variance; for example, the hostel environment may amplify consumption behaviors that are already more prevalent among males. This underscores that public health interventions should target high-risk settings like hostels, rather than demographics alone [19]. The findings collectively underscore an urgent need for evidence-based, multi-level interventions. University policies should consider restricting the sale and marketing of EDs on campus, particularly in and around student hostels. Furthermore, targeted educational campaigns are needed that move beyond generic warnings. These should incorporate behavioral science principles, explicitly deconstruct the "vicious cycle" of ED use and poor sleep, and promote evidence-based strategies for stress management and cognitive enhancement, such as mindfulness and time management workshops [20]. Finally, the cross-sectional design of this study precludes causal inference. Future longitudinal research is essential to establish the temporal sequence between ED consumption and health outcomes and to understand the long-term health trajectories of young, frequent consumers. Furthermore, the wide confidence intervals for some associations indicate limited statistical power for those specific predictors, suggesting the findings for variables like part-time employment should be interpreted with caution and require confirmation in larger studies.

This study is limited by its cross-sectional design, which precludes causal inferences, and reliance on self-reported data, which may be affected by recall bias. Future research should employ longitudinal designs to track energy drink consumption over time and examine its long-term health consequences. Additionally, interventions targeting high-risk groups, such as hostel residents and male students, should be evaluated for effectiveness in promoting healthier coping strategies and reducing excessive energy drink use.

CONCLUSIONS

In conclusion, this study found a high prevalence of energy drink consumption (38.0%)among university students in Pakistan, with a significant proportion being frequent users. The consumption was primarily driven by academic pressures and was significantly associated with self-reported adverse health effects, notably insomnia and anxiety. A critical finding was the poor knowledge of safe caffeine limits among the students. Male gender, hostel residence, and part-time employment were identified as key predictors of frequent use. These findings highlight an urgent need for targeted educational interventions and health promotion strategies within university settings, particularly those reaching high-risk student groups, to mitigate the associated health risks.

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Authors' Contribution

Conceptualization: IF, NA
Methodology: IF, MI
Formal analysis: MI
Writing and Drafting: IF, NA
Review and Editing: IF, NA, MI

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

All the authors declare no conflict of interest.

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