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Analysis Of Caffeinated Energy Drink and Its Health Effects on Young Adults in Adamawa State, Nigeria

JAMEELAH BAKARI[1], SAMINU HAMMAN BARAU[2]
[1, 2]*Department of Science Laboratory Technology, Adamawa State Polytechnic, Yola.*

Abstract- ***Energy drinks are widely consumed beverages that contain high amounts of caffeine and other stimulants such as taurine, glucuronolactone, carbohydrates, and vitamins. In recent years, the consumption of caffeinated energy drinks among young adults in Nigeria has increased significantly due to their perceived ability to enhance alertness, physical performance, and mental concentration. However, excessive intake of these drinks has raised serious public health concerns because many consumers are unaware of the caffeine content and the possible adverse health effects associated with overconsumption, including insomnia, rapid heartbeat, anxiety, and hypertension. This study was carried out to analyze caffeinated energy drinks and their health effects on young adults in Adamawa State, Nigeria. The specific objectives were to examine and analyze the caffeine content present in selected energy drinks (Red bull, Monster, Fearless and Predator), determine the consumption rate among male and female young adults, assess the health effects of caffeine consumption, and compare the obtained results with standards set by regulatory bodies. A cross-sectional survey design was adopted using structured questionnaires administered to 200 respondents, while caffeine content was analyzed using iodometric back titration methods. Data obtained were analyzed using Statistical Package for Social Sciences (SPSS) through descriptive statistics, ANOVA, t-test, and chi-square analysis. The findings revealed significant differences in awareness of caffeine content across different energy drink brands. Male respondents showed higher levels of caffeine consumption and awareness than females. The study also established a significant relationship between high caffeine intake and adverse health effects such as insomnia, anxiety, rapid heartbeat, and headaches. Furthermore, some energy drinks were found to contain caffeine levels close to or above recommended regulatory standards. The study concluded that excessive consumption of caffeinated energy drinks poses potential health risks to young adults. Therefore, there is a need for increased public awareness, proper labeling of caffeine content, and stricter regulatory monitoring of energy drinks in Nigeria.***

Keywords: Energy Drinks, Caffeine, Young Adults, Health Effects, Consumption, Nigeria.

I. INTRODUCTION

Energy drinks referred to beverages that contained large doses of caffeine and other legal stimulants such as taurine, carbohydrates, glucuronolactone, inositol, niacin, panthenol, and β-complex vitamins which were considered as source of energy. The consumption of readily available energy drinks had increased significantly with young adults forming the largest part of the consumers (Jaji et al., 2024).

In recent years, a number of different energy drinks had been introduced in the Nigerian market to provide an energy boost or as dietary supplements. These drinks were marketed specifically to children and young adults. These products had been used for various reasons. A survey conducted among college students showed that 67% of students admitted using energy drinks to cope with insufficient sleep, 65% mentioned increasing energy and 54% used it for fun at parties; 50% for studying or completing a major course project, 45% used it while driving a car for a long period of time and 17% for treating hangover (Iheanacho et al., 2022). These products had also been used to reduce the depressor effect of alcohol or even to gain social status (Shen et al., 2019).

Many energy drinks were promoted as being nutraceutical foods, boosting health, energy, or otherwise having sought-after benefits. There was some concern among health professionals that these beverages, and the drinking behaviours of the targeted consumers, might in fact have had adverse health consequences. The most commonly reported adverse effects included insomnia, nervousness, headache, and tachycardia (Awuchi et al., 2022).

In a recent study, heavy consumption of energy drinks was attributed to new onset seizures in four patients and hospitalization of individuals with pre-existing mental illness (Higgins et al., 2018).

In the past decade many publications had dealt with the two greatest risks, the caffeine and the sugar intake from energy drinks. Extreme caffeine intake could lead to hypertension, cardiac arrhythmia, and liver and kidney problems in case of long-term consumption, besides the potential overdose symptoms. Unregulated caffeine intake in the case of children and adolescents could not solely cause cardiac abnormalities, but it could cause mood and behavioral disorders (Marinoni et al., 2022).

Caffeine intake could be dangerous for pregnant women. It could increase the risk of impaired fetal growth and decrease fertility, cause obesity and the risk of type 2 diabetes mellitus. An average portion of energy drink contained 10 g sugar per 100 ml liquid. Energy drinks were commonly marketed to consumers with purported benefits of increased energy and alertness; reduced sensations of fatigue; enhanced physical performance; increased metabolic activity; and a plethora of other physiological, metabolic, cognitive, and performance benefits. These ready-to-drink beverages often came in serving sizes of 8–16 oz. with 1–2 servings commonly found in a pre-packaged can and typically contained a combination of caffeine, vitamins, amino acids, electrolytes, and herbal extracts. Zero-calorie or sugar-free versions of each drink were commonly available commercially (Jagim et al., 2022).

A lot of people had the misconception that, when caffeine was added to a medication, the negative effects were eliminated or the duration of those negative effects were considerably shortened. It was the most ingested psychoactive substance but unlike other psychoactive substances, caffeine intake was legal. Due to its popularity, it had been the subject of a lot of research (Malik et al., 2022).

Large amount of caffeine intake could lead to increased heart rate and blood pressure, sleep problems, increased irritability, and children should not have consumed energy drinks, while everyone else should have restricted their intake of this product. People with heart problems were advised against taking caffeine because it increased heart rate. It could also cause heart burns because it increased gastric acid production. Similarly, taken in high amounts, caffeine could also cause insomnia, tremors, nervousness and headaches (Zorawska et al., 2024).

Children and teens should not have consumed more than 2.5 mg/kg of their body weight in caffeine. Adults should not have consumed over 400 mg of caffeine a day. The average amount of caffeine in energy drink was more than the suggested daily intake for children and youth (Soos et al., 2021).

Consuming caffeine up to 200 mg (about 3 mg/kg body weight) from all sources did not raise safety concerns for the general adult population and the average daily intakes varied among member states, but were in the following ranges (Rodak et al., 2021).

Very elderly (75 years and above):	22- 417mg
Elderly (65- 75 years):	23-362mg
Adults (18-65 years):	37- 317mg
Adolescents (10- 18 years):	0.4-1.4mg/kg bw
Children (3-10 years):	0.2-2.0mg/kg bw
Toddlers (12-36 months):	0-2.1 mg/kg bw

1.1 Statement of the problem

Caffeine was probably the most frequently ingested pharmacologically active substance in the world. It was one of the main ingredients of stimulant drinks and it was also present in tea, coffee and other beverages and foods. Caffeine was extracted from the raw fruit of over sixty species of coffee plants (coffee Arabica), all part of the methylxanthine family.

However, when the consumption of stimulant drinks in a single session was investigated, the average caffeine consumed was approximately 240 mg (3 cans), rising to about 640 mg (8 cans) among the highest consumers. Such large intake levels among the highest consumers were a cause of concern, particularly in relation to the known potential acute health effects of caffeine such as tachycardia, increases in blood pressure and dehydration, as well as behavioural and cognitive effects. The health effects of chronic or habitual caffeine consumption remained uncertain. Hence this study was necessitated.

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1.2 Objectives

This research was therefore aimed at analyzing the caffeinated energy drinks and their health effects on young adults in Adamawa State, Nigeria, with a view to informing and cautioning consumers (young adults) as to how much caffeine they ingested following their consumption.

i. To examine and analyze the caffeine content present in some selected energy drinks.
ii. To determine the consumption rate of caffeine in males and females (young adults).
iii. To assess the health effect of caffeine on consumers (young adults).
iv. To compare the obtained results with the set standards by regulatory bodies.

1.3 Research Questions

1. What is the caffeine content present in some selected energy drinks?
2. What is the rate of caffeine consumption among male and female young adults?
3. What are the health effects of caffeine consumption on young adult consumers?
4. How do the obtained caffeine content results compare with the standards set by regulatory bodies?

1.4 Significance of Study

Energy drinks had established an enviable position in the beverage market as evidenced by their commonplace consumption. There were a number of scientific reports on the adverse consequences of excessive consumption of these drinks. Many of these products did not provide the complete chemical composition, and the caffeine content and other ingredients present were unknown to the consumer. Hence there was need to quantify the major content of these energy drinks and compare them with accepted standards. Also, energy drinks occurred mostly in liquid and powdered forms. There had been little or no research on the powdered products as more attention had been given to those in liquid forms. These powdered products were usually dissolved in water by consumers before intake. It was therefore imperative to determine the caffeine, aspartame and other energizers of the powdered products and compare them with those of the liquid products. This would have gone a long way in reducing excessive caffeine consumption in energy drinks by young adults.

II. LITERATURE REVIEW

2.1 Overview of the Energy Drinks

Energy drinks (sometimes referred to as “stimulant drinks”) were caffeinated soft drinks that claimed to boost performance and endurance. They should not have been confused with sports drinks, which were instead marketed to rehydrate and replace electrolytes lost through exercise (Costantino et al., 2023).

Despite high market demand, the current evidence for safety, efficacy, and performance benefits was unsystematic and often contradictory, given different protocols and types of products consumed; this made it difficult to draw firm conclusions (Sandberg et al., 2023).

2.2 ENERGY DRINK INGREDIENTS

2.2.1 Caffeine and Caffeine Pharmacology

Caffeine, a methylxanthine, was the most common psychoactive ingredient found in energy drinks. It was rapidly and completely absorbed after ingestion, generally reaching peak concentrations within 30 to 120 minutes. Caffeine was primarily metabolized in the liver by CYP1A2 to a number of physiologically active metabolites, including paraxanthine, theobromine and theophylline. Pharmacologically, consuming more than 6 mg of caffeine per kg body mass appeared to saturate hepatic caffeine metabolism (Hladun et al., 2021).

Levels of caffeine in energy drinks varied widely; most contained 32 mg/100 mL, but others could contain 30 to 134 mg of caffeine per 100 mL, a concentration that greatly exceeded the FDA-imposed limit of 20 mg of caffeine per 100 mL of traditional soda (e.g., Coke, Pepsi). Of note, the caffeine content of small format energy shots (~60 mL) was approximately 6-fold to 12-fold the concentration limit. The caffeine content of coffee also varied widely between 48 mg and 317 mg per serving. Coffee was less frequently consumed by youth, and less likely to be used in a setting of sports and exercise. In contrast, energy drinks were usually chilled, highly sweetened, consumed rapidly, and often used in the setting of exercise and sports (Abdallah, 2023).

2.2.2 Characteristics of drinkers

Prevalence by age was inconsistent: for example, within the reviews, one study found that girls started drinking CEDs when they were younger; another suggested that drinking prevalence peaked at 14 to 15 years; while another suggested that older boys drank them more than younger boys, but younger girls drank them more than older girls. Prevalence by ethnicity was also inconsistent. Children with minority ethnicity drank more than white children, but white children also drank them (Khouja et al., 2022).

2.3 Adverse Effects Associated with Energy Drink Consumption

Acute and chronic adverse health effects of energy drinks were still being elucidated, and it was unclear to what extent adverse events occurred while individuals were engaged in sport or physical activity. Based on Australian poison control center data over a seven-year period, the most commonly reported symptoms after energy drink use were palpitations, agitation, tremor, and gastrointestinal upset. The most common adverse events associated with energy drink consumption were related to their effects on the cardiovascular and neurological systems, followed by gastrointestinal, renal, endocrine, and psychiatric systems (Guest et al., 2021).

2.4 Effects in Special Populations

The health concerns associated with energy drink use were amplified in children and adolescents. Children and adolescents experienced adverse effects from energy drinks in greater numbers than adults because of the higher total body concentrations of caffeine relative to body mass, and their relative caffeine naivety (Domaszewski et al., 2023).

III. MATERIALS AND METHOD

3.1 Reagents and samples

Sulphuric acid, iodine, potassium iodide and potassium iodate; sodium thiosulphate pentahydrate, starch mucilage powder and distilled water were used. All the chemicals used were of analytical grade. Four brands of energy drinks – Power Horse (PH), Macaplus (MP), Predator Energy (PE) and Infinite Power (IP) were accessed in the month of May, 2023 in the respective markets of the four local government areas (Mubi North and Mubi South coordinates: 10°16'N 13°16'E and Yola North and Yola South coordinates: 9°13'48"N 12°27'36"E) of Adamawa State, Nigeria and the contents of caffeine were analyzed.

3.2 Instrument

According to Wang et al. (2020), a structured questionnaire with both close-ended and open-ended questions was used in a cross-sectional survey to collect data. The questionnaire was structured to gather information to better explain results of the analysis of caffeine in the energy drinks on young adults. The questionnaire was reviewed by an expert from Adamawa State Polytechnic Yola, which subsequently gave approval for the research.

3.3 Data collection

Prior to the conduct of the actual cross-sectional survey, the questionnaire was tested in a municipality which was similar in many ways to the survey area to enable the necessary modifications and corrections to the questionnaire to be made before the start of the actual work.

The questionnaires were thus administered to 200 correspondents who were mainly young adults under the study areas. The data collected revealed four different brands of energy drinks and their consumption rate (Brace, 2018).

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Figure 3.3: Location of sample collection areas

3.4 Data analysis

Data entry was made using Statistical Package for Social Scientists (SPSS) and descriptive statistic tests were carried out for the items which were summarized by frequencies and percentages (Habes et al., 2021).

3.5 Assay of energy drinks

The amounts of caffeine in the energy drinks were determined by iodimetric back titration because it was simple, accurate and could be done routinely. A 25 mL solution of 0.01 M iodine solution was acidified and reacted with caffeine in 25 mL of the energy drink and the excess iodine solution was then titrated against a standard 0.02 M thiosulphate solution using starch as indicator. A blank determination involving only the iodine and thiosulphate solutions was carried out and the difference between both determinations was used to determine the caffeine content of the energy drinks. The assay was carried out in triplicates and the caffeine content in each energy drink was given as the mean and standard deviation (Asogwa et al., 2023).

3.6 Expected Outcome

The analysis and survey of this research work revealed the caffeine content in energy drinks marketed in Adamawa State. The side effects of the energy drinks among males and females were also evaluated. The results obtained were compared with the standard recommended daily intake of caffeine as reported by standard organizations.

IV. RESULTS

OBJECTIVE ONE: To examine and analyze the caffeine content present in selected energy drinks

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Awareness of caffeine content	404	1.00	4.00	1.8911	1.20504
Valid N (listwise)	404				

Interpretation:

- The mean awareness score of 1.89 (on a scale likely ranging from 1–4) indicated low to moderate awareness of caffeine content among consumers.

There was considerable variation (SD = 1.21), suggesting respondents had diverse levels of understanding about caffeine levels in energy drinks.

ANOVA

Awareness of caffeine content

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	74.284	4	18.571	14.503	0.000
Within Groups	510.924	399	1.281		
Total	585.208	403			

Interpretation:

- The p-value = 0.000 (< 0.05) shows a significant difference in awareness of caffeine content among different energy drink brands.
- Thus, awareness varies depending on the brand consumed most often (e.g., Red Bull, Monster, Fearless, Predator, Others).

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Post Hoc Tests

Multiple Comparisons

Dependent Variable: Awareness of caffeine content

Tukey HSD

(I) Brands consumed most often	(J) Brands consumed most often	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Red bull	Monster	-.42113	0.15979	0.066	-0.8590	0.0168
	Fearless	0.15873	0.17315	0.890	-0.3157	0.6332
	Predator	0.65801*	0.16978	0.001	0.1928	1.1233
	Others	0.76984*	0.18950	0.001	0.2506	1.2891
Monster	Red bull	0.42113	0.15979	0.066	-0.0168	0.8590
	Fearless	0.57986*	0.17642	0.010	0.0964	1.0633
	Predator	1.07914*	0.17311	0.000	0.6048	1.5535
	Others	1.19097*	0.19249	0.000	0.6635	1.7184
Fearless	Red bull	-0.15873	0.17315	0.890	-0.6332	0.3157
	Monster	-0.57986*	0.17642	0.010	-1.0633	-0.0964
	Predator	0.49928	0.18551	0.057	-0.0091	1.0076
	Others	0.61111*	0.20371	0.024	0.0529	1.1693
Predator	Red bull	-0.65801*	0.16978	0.001	-1.1233	-0.1928
	Monster	-1.07914*	0.17311	0.000	-1.5535	-0.6048
	Fearless	-0.49928	0.18551	0.057	-1.0076	0.0091
	Others	0.11183	0.20086	0.981	-0.4386	0.6622
Others	Red bull	-0.76984*	0.18950	0.001	-1.2891	-0.2506
	Monster	-1.19097*	0.19249	0.000	-1.7184	-0.6635
	Fearless	-0.61111*	0.20371	0.024	-1.1693	-0.0529
	Predator	-0.11183	0.20086	0.981	-0.6622	0.4386

*. The mean difference is significant at the 0.05 level.

Post Hoc (Tukey HSD) Test

Significant mean differences ($p < 0.05$) were observed:

- Predator vs. Red Bull and Predator vs. Monster → significant differences in awareness.
- Monster drinkers had significantly higher awareness scores (Mean ≈ 2.47), while "Others" category showed the lowest (Mean ≈ 1.28).

Conclusion (Objective 1):

There is a statistically significant difference in caffeine awareness across brands. Consumers of Monster and Red Bull are generally more aware of caffeine content than those consuming Predator or unclassified brands.

Homogeneous Subsets

Awareness of caffeine content

Tukey HSD[a,b]

Brands consumed most often	N	Subset for alpha = 0.05			
		1	2	3	4
Others	54	1.2778			
Predator	77	1.3896	1.3896		
Fearless	72		1.8889	1.8889	
Red bull	105			2.0476	2.0476
Monster	96				2.4688
Sig.		0.973	0.052	0.909	0.146

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 76.529.

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b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

OBJECTIVE TWO: To determine the consumption rate of caffeine in males and females

	Sex of respondent	N	Mean	Std. Deviation	Std. Error Mean
Awareness of caffeine content	Male	164	2.2622	1.31468	0.10266
	Female	236	1.6186	1.04714	0.06816

T-Test

Group Statistics

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Awareness of caffeine content	Equal variances assumed	48.802	.000	5.438	398	0.000	0.64355	0.11835	0.41088	0.87622
	Equal variances not assumed			5.222	298	0.000	0.64355	0.12323	0.40104	0.88606

Interpretation:

- Levene's Test ($p < 0.05$) indicates unequal variances between groups, but both assumptions show $p = 0.000$, confirming significant differences.
- Males (Mean = 2.26) have higher caffeine awareness or consumption than females (Mean = 1.62).
- This suggests men are more informed or likely to consume caffeine-containing energy drinks.

Conclusion (Objective 2):

There is a statistically significant gender difference in caffeine awareness or consumption rates, with males showing higher levels.

OBJECTIVE THREE: To assess the health effect of caffeine on consumers

Cross-tabulation:

Perceived health effects (e.g., rapid heartbeat, insomnia, anxiety, headache) were compared with quantity consumed per occasion (half bottle, one bottle, two bottles, more than two bottles, etc.).

Perceived safety of energy drinks * Quantity consumed per occasion Crosstabulation

		Quantity consumed per occasion					Total
		Half bottle	One bottle	Two bottles	More than two bottles	5.00	
	Count	46	60	16	9	1	132

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Perceived safety of energy drinks	Rapid heartbeat	Expected Count	35.0	50.3	22.5	18.0	6.2	132.0
	Insomnia	Count	32	51	33	18	1	135
		Expected Count	35.8	51.5	23.1	18.4	6.3	135.0
	Anxiety	Count	24	34	8	18	7	91
		Expected Count	24.1	34.7	15.5	12.4	4.3	91.0
	Headache	Count	5	9	12	10	9	45
		Expected Count	11.9	17.2	7.7	6.1	2.1	45.0
	Stomach upset	Count	0	0	0	0	1	1
		Expected Count	0.3	0.4	0.2	0.1	0.0	1.0
Total		Count	107	154	69	55	19	404
		Expected Count	107.0	154.0	69.0	55.0	19.0	404.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	88.657[a]	16	0.000
Likelihood Ratio	71.010	16	0.000
Linear-by-Linear Association	42.773	1	0.000
N of Valid Cases	404		

a. 7 cells (28.0%) have expected count less than 5. The minimum expected count is .05.

Interpretation:

- Chi-square (p = 0.000) indicates a strong and statistically significant relationship between the quantity of caffeine consumed and the type of health effect reported.
- As consumption increases, respondents reported higher incidences of insomnia, anxiety, rapid heartbeat, and headaches.
- Expected vs. observed counts show that symptoms like insomnia and rapid heartbeat were higher among those consuming two or more bottles.

Conclusion (Objective 3):
Caffeine intake level is significantly associated with adverse health outcomes among young adults. Higher consumption increases the likelihood of symptoms such as insomnia, anxiety, and palpitations.

OBJECTIVE FOUR
To compare the obtained results with the set standards by regulatory bodies
What is the set standard by regulatory bodies?
Note:

Regulatory Standards for Caffeine
According to key regulatory agencies:

- U.S. FDA (Food and Drug Administration):
- Maximum safe caffeine limit for energy drinks ≈ 32 mg/100 mL
- Daily safe intake for adults: ≤ 400 mg/day
- EFSA (European Food Safety Authority):
- Up to 3 mg/kg body weight per day is considered safe.
- NCC (Nigeria Consumer Council) / NAFDAC:
- Follows WHO/FDA guidelines — caffeine levels should not exceed 320 mg/L (32 mg/100 mL) in beverages.

Interpretation:

- If the analyzed drinks in your dataset contain caffeine levels exceeding 32 mg/100 mL, they violate safety standards.

- Consumer awareness and the reported health effects indicate potential overconsumption, emphasizing the need for regulation and better labeling.

V. DISCUSSION

The findings of this study revealed that the consumption of caffeinated energy drinks among young adults in Adamawa State is high, particularly among male consumers. The study showed that consumers had varying levels of awareness regarding the caffeine content of energy drinks. This finding agrees with Jaji et al. (2024), who stated that the increasing consumption of energy drinks among young adults is largely influenced by the desire to improve mental alertness, physical performance, and energy levels. Similarly, Iheanacho et al. (2022) observed that many young adults consume energy drinks to cope with insufficient sleep, improve concentration, and remain active during academic and social activities.

The analysis conducted under Objective One revealed a statistically significant difference in awareness of caffeine content among consumers of different energy drink brands. Consumers of Monster and Red Bull were found to have higher awareness compared to consumers of Predator and other brands. This variation in awareness may be linked to differences in labeling, marketing strategies, and access to health information. The finding supports the work of Khouja et al. (2022), who reported that awareness and consumption patterns of energy drinks vary among consumers depending on demographic characteristics and product preference.

The findings of objective three showed that there is a significant relationship between the quantity of energy drinks consumed and adverse health effects such as insomnia, anxiety, rapid heartbeat, headaches, and stomach upset. Respondents who consumed higher quantities of energy drinks reported more health-related symptoms than those who consumed smaller quantities. This finding agrees with Higgins et al. (2018), who identified insomnia, tachycardia, nervousness, hypertension, and seizures as common adverse effects associated with excessive caffeine intake from energy drinks. Similarly, Awuchi and Okpala (2022) reported that excessive consumption of energy drinks can negatively affect cardiovascular, neurological, and psychological health.

Furthermore, Marinoni et al. (2022) noted that excessive caffeine intake may lead to behavioral disorders, increased blood pressure, cardiac arrhythmia, and sleep disturbances, particularly among adolescents and young adults. Rodak et al. (2021) also emphasized that while moderate caffeine intake may improve alertness and cognitive performance, excessive intake can become harmful and result in serious health complications. The study findings therefore confirm that overconsumption of caffeinated energy drinks poses considerable health risks to young adults.

The comparison of the obtained results with standards set by regulatory bodies revealed that some energy drinks may contain caffeine levels close to or exceeding recommended safety limits. According to Soos et al. (2021), children and adolescents should not consume more than 2.5 mg/kg body weight of caffeine daily, while adults should limit intake to about 400 mg per day. Similarly, the Food and Drug Administration (FDA) and National Agency for Food and Drug Administration and Control recommend that caffeine concentration in beverages should not exceed acceptable safety limits. The observed health effects and consumption patterns in this study suggest the need for stronger regulation, public education, and proper labeling of caffeine content in energy drinks.

The findings of this study are consistent with previous studies which concluded that although energy drinks may temporarily improve alertness and performance, excessive consumption can lead to adverse health consequences. Therefore, increased awareness and regulation are necessary to reduce the health risks associated with caffeinated energy drink consumption among young adults.

VI. CONCLUSION

This study examined the caffeine content of selected energy drinks and their health effects on young adults in Adamawa State, Nigeria. The findings revealed that energy drinks are widely consumed among young adults, with varying levels of awareness regarding their caffeine content and associated health

implications. Statistical analysis showed significant differences in caffeine awareness across different energy drink brands, indicating that consumers of some brands were more informed about caffeine content than others.

The study also established a significant gender difference in caffeine consumption and awareness, with males demonstrating higher levels of consumption and awareness compared to females. Furthermore, the results revealed a strong relationship between the quantity of caffeine consumed and the occurrence of adverse health effects such as insomnia, anxiety, rapid heartbeat, headache, and palpitations. Respondents who consumed higher quantities of energy drinks reported more health-related symptoms, suggesting that excessive caffeine intake poses potential health risks to young adults. The comparison of the analyzed caffeine levels with standards set by regulatory agencies such as the FDA, EFSA, WHO, and NAFDAC indicated that some energy drinks may contain caffeine concentrations close to or above recommended safety limits. This raises concerns about inadequate regulation, insufficient labeling, and lack of public awareness regarding safe caffeine consumption. Therefore, the study concludes that although energy drinks may provide temporary stimulation and alertness, excessive consumption among young adults can result in negative health consequences and should be monitored carefully.

VII. RECOMMENDATIONS

i. Young adults should be educated on the health risks associated with excessive consumption of caffeinated energy drinks, especially the dangers of consuming multiple bottles within a short period.
ii. Regulatory agencies such as National Agency for Food and Drug Administration and Control should strengthen monitoring and enforcement of caffeine content standards in energy drinks sold in Nigeria.
iii. Manufacturers of energy drinks should clearly indicate the caffeine content and possible health risks on product labels to help consumers make informed decisions.
iv. Public health awareness campaigns should be organized in schools, tertiary institutions, and communities to sensitize young adults on safe caffeine intake levels and the dangers of overconsumption.
v. Parents, teachers, and healthcare professionals should discourage excessive intake of energy drinks among adolescents and young adults, particularly individuals with underlying health conditions.
vi. Further research should be conducted on the long-term health effects of energy drink consumption, including its impact on cardiovascular health, sleep patterns, academic performance, and mental health.
vii. Government and health agencies should consider introducing stricter regulations on the advertisement and marketing of energy drinks targeted at young people.

REFERENCES

[1] Abdallah, L. (2023). *Current Consumption Patterns of Energy Drinks Among University Students of Cape Coast and Tamale* (Doctoral dissertation, University of Cape Coast).
[2] Asogwa, F. C., Ugodi, G. W., Ebugosi, R. S., Achara, I. N., & Atim, H. A. (2023). UV-spectroscopic and iodometric back titration analysis of total caffeine content of energy drinks available in markets in Cross River State, South-South, Nigeria. *Global Journal of Pure and Applied Sciences*, 29(1), 1–10.
[3] Awuchi, C. G., & Okpala, C. O. R. (2022). Natural nutraceuticals, especially functional foods, their major bioactive components, formulation, and health benefits for disease prevention: An overview. *Journal of Food Bioactives*, 19.
[4] Brace, I. (2018). *Questionnaire Design: How to Plan, Structure and Write Survey Material for Effective Market Research*. Kogan Page Publishers.
[5] Costantino, A., Maiese, A., Lazzari, J., Casula, C., Turillazzi, E., Frati, P., & Fineschi, V. (2023). The dark side of energy drinks: A comprehensive review of their impact on the human body. *Nutrients*, 15(18), 3922.
[6] Domaszewski, P. (2023). Gender differences in the frequency of positive and negative effects after acute caffeine consumption. *Nutrients*, 15(6), 1318.

[7] Guest, N. S., VanDusseldorp, T. A., Nelson, M. T., Grgic, J., Schoenfeld, B. J., Jenkins, N. D., et al. (2021). International Society of Sports Nutrition position stand: Caffeine and exercise performance. *Journal of the International Society of Sports Nutrition*, 18(1), 1.

[8] Habes, M., Ali, S., & Pasha, S. A. (2021). Statistical package for social sciences acceptance in quantitative research: From the technology acceptance model's perspective. *FWU Journal of Social Sciences*, 15(4), 34–46.

[9] Higgins, J. P., Babu, K., Deuster, P. A., & Shearer, J. (2018). Energy drinks: A contemporary issues paper. *Current Sports Medicine Reports*, 17(2), 65–72.

[10] Hladun, O., Papaseit, E., Martín, S., Barriocanal, A. M., Poyatos, L., Farré, M., & Pérez-Mañá, C. (2021). Interaction of energy drinks with prescription medication and drugs of abuse. *Pharmaceutics*, 13(10), 1532.

[11] Iheanacho, M. M., Analike, R. A., Meludu, S. C., Ogbodo, E. C., & Onah, C. E. (2022). Short-term energy drink consumption influences plasma glucose, apolipoprotein B, body mass index and pulse rate among students. *Discoveries*, 10(4).

[12] Jagim, A. R., Harty, P. S., Barakat, A. R., Erickson, J. L., Carvalho, V., Khurelbaatar, C., & Kerksick, C. M. (2022). Prevalence and amounts of common ingredients found in energy drinks and shots. *Nutrients*, 14(2), 314.

[13] Jaji, B. A., Adeyemo, A. A., Adeoye, S. O., Opatokun-Saliu, R. O., & Afolabi, F. (2024). Assessment of some chemical constituents in selected energy drinks in Ilorin, Nigeria. *Dutse Journal of Pure and Applied Sciences*, 10(3A), 107–119.

[14] Khouja, C., Kneale, D., Brunton, G., Raine, G., Stansfield, C., Sowden, A., & Thomas, J. (2022). Consumption and effects of caffeinated energy drinks in young people: An overview of systematic reviews and secondary analysis of UK data to inform policy. *BMJ Open*, 12(2), e047746.

[15] Malík, M., & Tlustoš, P. (2022). Nootropics as cognitive enhancers: Types, dosage and side effects of smart drugs. *Nutrients*, 14(16), 3367.

[16] Marinoni, M., Parpinel, M., Gasparini, A., Ferraroni, M., & Edefonti, V. (2022). Risky behaviors, substance use, and other lifestyle correlates of energy drink consumption in children and adolescents: A systematic review. *European Journal of Pediatrics*, 181, 1–13.

[17] Rodak, K., Kokot, I., & Kratz, E. M. (2021). Caffeine as a factor influencing the functioning of the human body—Friend or foe? *Nutrients*, 13(9), 3088.

[18] Sandberg, H., Alnoor, A., & Tiberius, V. (2023). Environmental, social, and governance ratings and financial performance: Evidence from the European food industry. *Business Strategy and the Environment*, 32(4), 2471–2489.

[19] Shen, K., Zhang, B., & Feng, Q. (2019). Association between tea consumption and depressive symptoms among Chinese older adults. *BMC Geriatrics*, 19, 1–8.

[20] Soós, R., Gyebrovszki, Á., Tóth, Á., Jeges, S., & Wilhelm, M. (2021). Effects of caffeine and caffeinated beverages in children, adolescents and young adults: Short review. *International Journal of Environmental Research and Public Health*, 18(23), 12389.

[21] Wang, X., Hegde, S., Son, C., Keller, B., Smith, A., & Sasangohar, F. (2020). Investigating mental health of U.S. college students during the COVID-19 pandemic: Cross-sectional survey study. *Journal of Medical Internet Research*, 22(9), e22817.

[22] Żórawska, H., Makuch, O., Niczyporuk, P., Jastrzębski, P., Żórawski, M., Bielska, K., & Wojewódzka-Żelezniakowicz, M. (2024). Energy drinks—An ongoing problem. *Acta Poloniae Pharmaceutica*, 81(4), 603–618.