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Evaluating the Effects of Energy Drink Consumption on Liver Function among Students and Staff at Cihan University, Duhok, Iraq

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Abstract

Energy drinks (ED) have been related to many health issues, including elevated pressure, cardiovascular difficulties, head pain, rest disruptions, drug overuse, tension and excitement. The purpose of the current research is the estimate of the association between individuals with energy drinks and without them and to estimate the impact of energy drinks on liver metabolic. The current cross-sectional study included 50 individuals, aged 18 to 40, who were divided into two groups: (1) a healthy group (n=25) consisting of individuals who did not consume energy drinks, and (2) a case group (n=25) comprising individuals who regularly consumed energy drinks. Aspartate aminotransferase (AST) and alanine transaminase (ALT) liver enzymes were estimated by using spectrophotometry, while vitamin B12 levels were assessed using the VIDAS® apparatus. Anthropometric measurements were also recorded for all participants. The findings revealed a significant elevation in AST, ALT value and vitamin B12 in the drinkers of energy group in contrast to the healthy subjects (p<0.001). Additionally, males showed more pronounced increases in these markers than females p levels were lower than 0.001. In conclusion, the investigation discovered that energy drink consumption significantly elevates hepatocyte function markers (ALT and AST) and anthropometric parameters. It also highlighted that extreme energy drink intake may contribute to cases of severe liver damage.

Keywords: *Drinkers, GOT, GPT, Hepatocyte, Vitamin B12*

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I. INTRODUCTION

A drinker of energy drinks has been associated with a variety of undesirable health implications involving hypertension, cardiovascular disorders, headaches, sleep disturbances, substance dependency, stress, and hyperactivity (Higgins *et al*., 2018). The global energy drink market is projected to grow considerably, achieving an approximate value of $61 billion by 2021 (Piccioni *et al*., 2021). Energy drinks are carbonated beverages designed to enhance energy, indorse sleeplessness, sustain alertness, and improve mood and cognitive performance (Gunja and Brown, 2012). These beverages typically contain a blend of components Comprising caffeine, carbohydrate, sodium benzoic, citrate, sodium citric acid, B-group vitamins, vitamin E, amino acids, herbal stimulants, and artificial couloring substance (Kanter *et al*., 2012).

Caffeine is the most prevalent ingredient, often combined with B vitamins to amplify its effects (Temple *et al*., 2017).

Excessive intake of energy drinks was recently connected to cases of clinically apparent to acute liver injury, which might be severe enough to impose urgent medical intervention or even liver transplantation (Tobias *et al*., 2019). The liver has a critical role in sustaining blood glucose homeostasis. Given that energy drinks are high-sugar containing, prolonged consumption may disrupt metabolic processes, including cholesterol regulation, blood sugar levels, and body weight (Goldfarb *et al*., 2014). The liver, which is an important organ in the stores glucose as glycogen and this led to maintaining the regulation of blood glucose. In addition, the patients of chronic liver disease don't have the ability to maintenance the

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hemostasis of proteins and this is can lead to hyper or hypo albumin (Reddy *et al*., 2018; Al-Habib *et al*., 2016).

Several kinds of events and processes, such as modifications of the metabolism of the lipids and waste products that happen during the digestion of ED components, might be a cause of many impaired functions in the liver, and this contributes to liver disease (Krentz *et al*., 2013). Imbalances in the hepatocyte metabolism of the liver are also a component in the progression of chronic liver disease (Zucconi *et al*., 2013). The significant incidences of being treated with liver damage as a consequence of high ED intake is an important awareness for the global health issue (Cabrera *et al*., 2016). Acute kidney injury also has been related to excessive ED use as reported by past case studies (Alsunni, 2015), In addition to that the drinking of the energy drinks would be a cause of kidney stones because of presenting advanced levels of sodium (Nowak *et al*., 2018). Furthermore, energy drinks are frequently linked to cardiovascular issues, such as heart attacks and strokes, and may raise the chance for diabetes (Seifert *et al*, 2011). This awareness should be taken carefully, certainly for the people that are more likely to get elevated blood pressure as well as cardiovascular disease (Ferdinand *et al*., 2019).

One of the principal organs that is impacted by ED is the liver since it is accountable for metabolizing extremely large quantities of drugs that are stimulated including caffein in this beverage and these constituents have the ability to elevate heart rate and hypertension and also cause liver damage (Higgins *et al*., 2015; Gunja and Brown, 2012). Liver disease encompasses a wide range of illnesses that impair liver function, such as hepatic steatosis, pancreatitis, and irritable stomach. Despite being not treated, liver disease can progress to malignancy or liver failure (Nowak *et al*., 2018; Zucconi *et al*., 2013). Vitamin D, A, and E deficiencies have been associated with liver disease (Goldfarb *et al*., 2014). Defects in vitamin B12 are also caused by liver disease (Kanter *et al*., 2012). Among the more frequent B-complex vitamins influenced by liver illness are thiamine (B1), pyridoxine (B6), and cobalamin (B12). Energy drinks tend to contain extra B vitamins, including niacin (B3), pyridoxine (B6), and cobalamin (B12), with certain brands additionally containing riboflavin (B2) and pantothenic acid (B5) (Seifert *et al*., 2011).

The current study aimed to examine how energy drinks affect the enzymes of the liver, in addition to the relation of the ED consumption with alanine transaminase (ALT), aspartate transaminase (AST) and vitamin B12.

II. Materials And Methods

A. Research method and selection of participants

A cross-sectional study was evaluated for 50 participants and divided to two group 25 healthy individuals as a control group and 25 energy drink consumers. The research was done within 5 months from September 2024 until January at Medical Laboratory Department, College of Health Sciences, University of Cihan in Duhok, Iraq. Participants included students, medical professionals, university staff, and acquaintances who were either healthy or exhibited health concerns but had no history of chronic diseases, diabetes mellitus, or alcoholism. These individuals were categorized into negative control (healthy) and positive control (energy drink consumer) groups.

Participants were allocated into two groups: a healthy group (n=25) with no energy drink consumption and a case group (n=25) consisting of regular energy drink consumers. Guidelines for appropriate daily intake served as the basis for the energy drink days. Mild = one to three energy drinks within seven days. Three to five energy drinks within seven days are considered as a moderate. Severe = more than five times Weekly usage of energy drinks (Markon *et al*., 2023).

Before sample collection, participants were interviewed to gather demographic and health-related data, including age, anthropometric measurements (blood pressure, heart rate, Oxygen saturation (SPO2) levels, weight, height, and body mass index BMI), smoking status, alcohol consumption, exercise habits, sleep duration, family and medical history, and current medication use. Blood samples were collected from male and female students aged 18–40 years at a university in the Dohuk Governorate, Kurdistan Region of Iraq (KRI). The study procedure was consulted and accepted via the College of Health Sciences, Cihan University at Duhok.

All the participants were informed for overnight fasting for blood collection three milliliters were obtained from the study participants and collected in a Gel vacutainer of a five ml tube and centrifuged for 10 minutes at 5000 round per minute for separating the serum.

B. Measurements

Serum Alanine Aminotransferase (ALT) along with Aspartate Aminotransferase (AST) values were determined using a BioLabo kit and analyzed with (KENZA 240tx, France) spectrophotometer. Serum Vitamin B12 Concentration: determined using the Roche/Hitachi cobas 6000 systems (Germany).

Blood pressure (BP) was measured using an automated sphygmomanometer after the participant had rested for at least 5 minutes in a seated position. Measurements were taken twice, 5 minutes apart, and the average reading has been recorded (Theodorakopoulou *et al*., 2024).

C. Statistical analysis

Data were investigated via Statistical Package for the Social Sciences (SPSS) software (v26). Descriptive statistics were

presented as mean ± standard deviation (SD) and Number percentage (N%). An independent sample t-test compared ED consumers and controls. One-way ANOVA analyzed gender differences, showing significant variations in ALT, AST, and B12 levels. Further analysis of ED consumption duration (mild, moderate, severe) indicated significant differences in BMI, BP, and biochemical parameters. At the levels of p value with less than 0.05, statistical significance was established.

III. RESULTS

The current study included a 50-student sample of controls and ED consumers consisting of male and female of age ranged between 18 to 40 years. Medical employees, college staff, and acquaintances without a history of diabetes mellitus provided blood samples, which were then examined for the necessary criteria. Table 1. shows the findings on the effects of energy drinks on blood pressure (B.p), BMI, and different markers. According to the findings, the diastolic pressure increased from 77.60± 12.08 in the control group to 84.22±9.45 compared to control group, though this difference was not statistically significant. Nevertheless, the systolic B.p increased significantly (P<0.001) from 101.72± 19.37 (in the control group) to 117.91±12.10, the ALT level increased from 34.68± 4.56 (in the control group) to 178.13± 11.24, the AST level increased from 39.02± 8.277 (in the control group) to 96.31± 8.43 with significance (P<0.000). In addition to, the B12 value increased from 313.41± 8.89 (in the control group) to 932.18 ± 9.02 students who drank energy drinks.

Table 1. General characteristics and biochemical markers of the contributors.

Characteristics	EDs No (25) Mean± StD	Controls No (25) Mean± StD	P value
Age(years)	25.17 ± 7.17	24.14± 8.28	0.007
Gender N % Males Females	(15) 60% (10) 40%	(19) 76% (6) 24%	NS
Systolic B.P (mmHg)	117.91±12.10	101.72± 19.37	<0.001
Diastolic B.P mmHg)	84.25±9.45	77.12± 12.08	0.040
BMI (kg/m2)	25.34±6.73	23.86± 3.61	0.034
Vitamin B12 (ng/L)	932.18 ± 9.02	313.41± 8.89	<0.001
ALT (IU/L)	178.13± 11.24	34.68± 4.56	<0.001
AST (IU/L)	96.31±8.43	39.02± 8.277	<0.001
T-test tests had been executed for statistical analyses. NS=non-significant			

Male participants had significantly higher mean values of serum ALT, AST, and vitamin B12 than the females of the ED (179.51±10.27 IU/L, 102.34±10.421 IU/L, and 989±9.543 ng/L, respectively), with <0.001 of p values for ALT, p less than 0.001 for AST, and p had a value of 0.041 for B12, as shown in Table 2.

Table 2: Association of biomarkers with gender of ED.

Biomarkers	Energy drinkers		
	Male No. (15) Mean ±StD	Female No. (10) Mean ±StD	p value
Vitamin B12 (ng/L)	975.22±9.56	845.63±7.46	0.041
ALT (IU/L)	179.51±10.27	164.32±13.51	<0.001
AST (IU/L)	107.35±10.39	92.43±8.211	<0.001
T-test tests were examined for utilizing statistical analyses.			

Table 3 displays the effects of energy drink use over time, categorized as mild, moderate, and severe. This covers how energy drinks consuming affects blood pressure, BMI, and biochemical indicators. According to the findings, students' diastolic blood pressure increased considerably when they drank energy drinks, it went from 80.31±6.54 in the mild to 84.17±7.96 in the moderate to 87.13±8.74 in the severs. In mild group (110.81±17.16), moderate group (114.12±10.15), and severe group (119.89±13.62), the systolic B.p was significantly higher (P=0.041). The mild ED had ALT levels of 172.46 ±10.33, the moderate group had ALT levels of 174.62 ± 16.57, and the severe group had ALT values of 180.32± 21.64. The B12 levels in the mild, moderate, and severe groups were 934.51 ±7.02, 941.3 ± 9.62, and 956.1, respectively (P 0.001), while the AST levels were 91.7 ± 8.57, 95.8 ±7.92, and 99.8 ±8.91.

Table 3. Number of ED groups and their percentage range of duration according to biochemical markers and other characters.

Characters	Duration of ED groups			
	Mild Mean ±SD	Moderate Mean ±SD	Severe Mean ±SD	P value
No%	5(20%)	8(32%)	12(48%)	
Age(years)	24.87 ± 3.22	23.14 ± 2.45	21.63 ± 3.53	0.031
Gender Males Females	(1) 20% (4) 80%	(2) 25% (6)75%	(9) 75% (3)25%	NS
BMI (kg/m2)	23.15±3.47	24.15±3.83	27.45±5.92	0.041
Systolic B. P (mmHg)	110.81±17.16	114.12±10.15	119.89±13.62	0.043
Diastolic B. P (mmHg)	80.31±6.54	84.17±7.96	87.13±8.743	<0.001
Vitamin B12 (ng/L)	934.51 ± 7.02	941.3 ± 9.62	956.1 ± 8.78	<0.001
ALT level (IU/L)	172.46± 10.33	174.62± 16.57	180.32± 21.64	<0.001
AST level (IU/L)	91.7±8.57	95.8±7.92	99.8±8.9	<0.001
One-way ANOVA was computed for statistical analysis, and the Tukey test was used to make the pairwise comparisons.				

As demonstrated in Table 4. ALT, AST and B12 presented with a positive and valuable relationship with drinking ED, ALT (r was 891, p was less than0.001), AST (r was 0.718, p

of less than0.001) and Vitamin B12 (r=0.653, p<0.001), in addition to positive and significant correlation of Systolic B.P (r=0.827, p<0.001). However, there was in significant correlation of Age, BMI and diastolic blood pressure.

Table 4. Correlation between biochemical markers and other pertinent variables in groups with ED.

parameters	Pearson Correlation (r)	Sig. (2-tailed) (p)
Age(years)	0.043	0.764
Systolic(mmHg)	0.827	< .001
Diastolic(mmHg)	0.048	0.749
BMI (kg/m2)	0.175	0.225
B12 (ng/L)	0.653	< .001
ALT(IU/L)	0.891	< .001
AST(IU/L)	0.718	< .001
Bivariate correlation was performed for statistical analysis.		

IV. Discussion

Recent research has focused on the effects of ED consumption on hepatic tissue, particularly markers such as ALT, AST and vitamin B12 levels. The liver and biological parameters are among the most significantly impacted areas, especially in young individuals who frequently consume these beverages. This was consistent with a prior study that showed that energy drinks are carbonated beverages designed to enhance energy, promote alertness, improve attitude, and boost mental activity (Al-Habib *et al*., 2014). They typically contain a mix of ingredients, including caffeine, carbohydrate, sodium benzoic acid, citrate, sodium citric acids, B vitamins, vitamin E, amino acids, herbal boosters, and artificial coloring substance (Palliser *et al*., 2020; McCusker *et al*., 2015).

The current study observed the influence of energy drinks on numerous physiological factors, including BP (diastolic and systolic) and BMI. The research findings revealed that energy drink consumption did not significantly affect diastolic blood pressure. However, systolic blood pressure was notably higher in energy drink consumers ($p < 0.001$), indicating a potential cardiovascular risk associated with these beverages (Nawrot *et al*., 2022). Nawrot *et al*., 2022, resulted that increased diastolic blood pressure, in addition to the rate of heart is caused by consuming energy (Nawrot *et al*., 2022). Caffeine had a significant impact on increasing the systolic blood pressure as well as the heart rate. Caffeine is a constituent of the ED as the levels of it are elevated during the digestion of the ED (McCusker *et al*., 2015).

The metabolism of molecules and detoxifications is a responsibility of liver as well as the presence of high contents of macromolecules and other chemical in the ED can cause severe stress on this critical organ (Keller *et al*., 2020; DiNicolantonio *et al*., 2018).

The research results revealed that the values of ALT and AST are significantly improved in the group that are ED consumer compared to controls. Previous studies have demonstrated significant changes in liver enzyme levels (ALT and AST) among energy drink consumers, although this was consistent with a prior study showed that the ED led to elevate liver enzymes such as AST and ALT (Keller *et al*., 2020).

The constituent parts of the vitamin B complex include pyridoxin, thiamine, riboflavin, pantothenic acid, niacin, hydrochloride, biotin, inositol, and cyanocobalamin. are a constituent of the ED. The conversion of energy drinks' excessive sugar levels into useful energy depends on these vitamins. The results of the current study demonstrated that the values of vitamin B12 are significantly elevated in energy drinkers in comparisons with non-drinkers as this was agreed with research done by Palliser and his classmates in 2020 (Palliser *et al*., 2020). Although higher B12 levels could seem advantageous, consuming too much of them through energy drinks may have unexpected metabolic effects. According to earlier research, consuming too much vitamin B12 from fortified drinks may change how the body uses glucose and secrete insulin. (Babu *et al*., 2018; Zha *et al*., 2021).

V. Conclusion

The main component in energy drinks, caffeine, together with taurine, guarana, and B vitamins, has considerable effects on a lot of different physiological and metabolic aspects. The results of this study show that, although there was no gender-specific variances, consuming energy drinks considerably raises systolic blood pressure and causes noticeable alterations in body mass index (BMI). Significant elevations in liver enzyme levels (ALT and AST) indicate that energy drinks negatively affect liver function. Further evidence of a possible impact on metabolic processes came from the association between energy drink use and higher vitamin B12 levels. These findings highlight the importance of exercising caution while using energy drinks, especially by those who are susceptible to liver or cardiovascular problems

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