



Survey of Energy Drink Consumption and Adverse Health Effects: A Sample of University Students in the United Arab Emirates

Dr. Matthew A. Robby^{1*} and Sarah Sanad¹

¹*Department of Health Sciences, Sharjah Women's College, Higher Colleges of Technology, United Arab Emirates.*

Authors' contributions

This work was carried out in collaboration between both authors. Author MAR designed the study, managed the literature review, wrote the protocol, performed the statistical analysis, and wrote the first draft of the manuscript. Author SS contributed to the literature review and assisted with the analysis of the study and the final write up. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JSRR/2017/34978

Editor(s):

(1) Shunpu Zhang, Department of Statistics, University of Nebraska – Lincoln, USA.

Reviewers:

(1) Oguzhan Gorler, Cumhuriyet University, Turkey.

(2) Heloisa Bettiol, University of Sao Paulo, Brazil.

Complete Peer review History: <http://www.sciencedomain.org/review-history/20798>

Original Research Article

Received 22nd June 2017
Accepted 29th August 2017
Published 2nd September 2017

ABSTRACT

Aims: The study examined energy drink consumption patterns, reasons for use, and the brand preferences of university students. Based on participant characteristics, the variation in use was determined including the impact on university performance in terms of grades and quality of health. The study also determined whether high frequency of consumption was correlated with negative physical health symptoms.

Study Design: A cross sectional study design was implemented.

Place and Duration of Study: At a higher education institution in the United Arab Emirates (UAE), the survey study was conducted between November 2016 and January 2017.

Methodology: Among four campuses, a 30% random sample of 1,100 Emirati students were surveyed and 522 completed the Energy Drink Questionnaire. Data were analyzed using IBM-SPSS and frequency tables, cross-tabulations, and graphs; including chi-square and phi statistics, t-tests, hedge's g, and spearman correlations.

Results: Two-thirds of participants were 18 to 20 years of age, in year 2 of university, in good

*Corresponding author: E-mail: drmattie777@gmail.com;

health, and from Dubai or Abu Dhabi. Energy drinks were consumed by 85.1%. Thus, 54.9% drank 1 to 8 cans a month, 13.2% drank 3 to 4 a week, and 16.7% drank 1 or more a day. Daily users were more likely males. The most consumed brands were identified and the reasons for consumption varied. Those consuming 1 to 3+ a day had a "slight to moderately" lower Grade Point Average (GPA). Statistically significant correlations were found between drinking 1 to 3+ a day and experiencing headaches, blurred vision, nervousness, excessive thirst, and difficulties sleeping.

Conclusion: Young adults should not consume energy drinks daily and excessively because of the likelihood of negative side effects. Students need to exercise caution when considering using energy drinks and strive to make healthier lifestyle choices to maximize their health. Public health information plays a vital role in raising awareness, altering behavior, and reducing risks. Student support services in higher education are important for at risk students with excessive daily energy drink usage and potential dependency. Stronger future research is recommended to help quantify the risk of disease from specific substances found in energy drinks and their long-term impact on health.

Keywords: Energy drinks; health effects; consumption; students; risk factors.

1. INTRODUCTION

Consumption of energy drinks is a global phenomenon, has spread to 140 countries, and sales and market share of the beverage industry has been increasing exponentially since the late 1990s [1]. It is a multibillion dollar industry with many different brands. The marketing uses themes of an active lifestyle and increased energy and performance targeted at teenagers and young adults [2]. Peer associations and norms have been found to have a strong influence on decisions to use energy drinks [3]. Energy drink consumption has become popular and is occurring in large proportions of minors and young adults [4,5].

For example, a university study in the USA found at least half of the students consumed energy drinks monthly [4]. Relying on a European Food Safety study in 2011, research found that 70% of minors and 30% of adults consumed energy drinks in 16 European countries examined [6]. In Western Saudi Arabia, 55% of secondary school girls drank energy drinks [7]. Similarly, research found that 54% of college males in Eastern Saudi Arabia regularly consumed energy drinks [8]. A study in the University of Sharjah in the United Arab Emirates (UAE) found that 41% of university students regularly drank energy drinks [9]. Another study of 125 medical students in Ajman, UAE found that 92% recently drank energy drinks [10].

A review of the literature finds limited research published in peer-reviewed sources globally about energy drink use and impacts on the health of young adults [4,11]. A review of 410 studies across the globe (mostly in Europe and

the USA) found only 11% had designs and methods scientific enough to be included for meta-analysis [6]. It appears that most studies are cross-sectional examining knowledge, consumption, and self-reported information; that is, rather than quasi-experimental or longitudinal to test hypotheses about energy drink ingredients, dosages, and impact on health and safety. Eleven studies in the Middle East were identified [12]. Most research occurred in Saudi Arabia as 8 studies were identified [5,7,8,13-16]. One study was in the Sultanate of Oman [17]. Two studies were published about energy drink consumption in the United Arab Emirates (UAE) among university students with mixed backgrounds [9,10]. *Nevertheless, no published studies have been identified that have focused only on Emirati young adults in higher education to understand their energy drink consumption behaviors and self-reported impacts on health.*

1.1 Public Health and Safety

Public information about the potential harmful effects of energy drinks appeared in about three-dozen newspapers in the Middle East over the course of the last 5 years. Public health information campaigns have been performed in the UAE out of concern for the health and safety of the public and at-risk populations. Emirates Authority for Standardization Metrology and the Ministry of Health requires important standards for product display and labelling requirements for energy drinks for the protection of consumers. *In fact, because of health concerns, energy drink warnings have been issued and posted for minors, pregnant women, people with allergies, persons with heart disease, and athletes.* Markets and convenience stores found selling

energy drinks to any minors will be fined [18]. To protect the public, the mixing of energy drinks with other drinks in restaurants has been banned in the Sharjah Emirate [19]. As energy drinks are viewed as part of an unhealthy lifestyle and poses risks to health, the UAE will impose a 100% excise tax on harmful products such as energy drinks [20]. This could have a positive impact on enhancing knowledge, encouraging better lifestyle choices, and reducing potential harm to health.

1.2 Energy Drink Contents

Energy drinks contain potentially large doses of caffeine, herbs, and other substances. Nevertheless, there is lack of consumer and scientific knowledge about the risks to health from the mixture of ingredients, the doses, and frequency of consumption [21]. Key substances found in typical energy drinks include: (a) large levels of caffeine; (b) herbal ingredients like ginseng, guarana, cordy ceps (fungi), ginkgo biloba, milk thistle, and Echinacea; (c) amino acids consisting of taurine, glutamine, and carnitine; (d) vitamins b3, b6, and b8; (d) artificial sweeteners or unhealthy sugar derived from corn syrup and salt [22,23,24]. Many of these substances have other uses in medicine as part of treatments for certain conditions. Many ingredients found in energy drinks have warnings associated with them with respect to known and unknown toxicity and physical symptoms (e.g., potential hypersensitivity and allergic reactions, impact on blood sugar and insulin insensitivity, digestive disorders, blood pressure and cardiovascular risks, nervous system effects, and influence on behavior) and many of these substances have medically proven contraindications with certain prescription medications [25].

With regards to caffeine, the concentration will vary by brand. The amount of caffeine in a typical energy drink ranges from an 8-ounce cup of brewed coffee or a 1 once espresso drink up to a concentrated mega dose of 500 mgs of caffeine per drink [11]. Nevertheless, some plant extracts are stimulants and may not be part of the estimates of the caffeine dosage on the product label [22]. For example, the herbal stimulant known as "Guarana" and others were reported as being a source of caffeine not always included in the count on labels resulting in higher dosages of caffeine than reported [23]. Energy drinks with high doses of caffeine and other stimulants pose a risk to health. Caffeine is a diuretic and

stimulant and in large concentrations can place a person engaged in moderate activity at risk for experiencing dehydration [26]. Research in Saudi Arabia found high caffeine and herbal stimulant consumption associated with increased blood pressure, dehydration, type 2 diabetes symptoms, nervousness, and abdominal pain [14].

1.3 Symptoms Reported

From meta-analysis, there is a growing body of evidence that excessive energy drink consumption is associated with headaches, digestive issues, unhealthy behaviors, and lack of sleep [6]. Research has connected ingestion of energy drinks and experiencing negative symptoms in the nervous system, digestive system, and circulatory system [23]. Energy drink consumption was reported to disrupt sleep, elevate blood sugar and blood pressure, and produce digestive disorders [26]. A survey of 1,298 patients visiting emergency rooms in San Diego, California found negative health symptoms associated with use of energy drinks. For those experiencing symptoms due to energy drink consumption, 65.2% reported nervousness, 34.9% heart palpitations, 31.7% insomnia, 19.1% stomach pain, and 14.4% experienced headaches [27]. A Mayo Clinic study found that energy drinks abnormally increase blood pressure and heart rhythm worse than caffeine alone [28]. Frequent use of energy drinks has also been correlated with substance abuse and risky behaviors among young adult populations [29].

Heavy consumption as well as prolonged use of energy drinks has not been adequately researched to understand the potential toxicity levels and contraindications of substances with other beverages, products, and medications [23]. It is unclear what kind of impact certain brands of energy drinks can have for consumers with different characteristics. Ingredients have not been studied individually or synergistically over time to determine the extent of risk for disease or harm [30]. Therefore, need exists for research studies to be conducted to better understand the potential risks and impacts on physical and mental health from the different ingredients in energy drinks [31].

1.4 Study Significance

Examining the use of energy drinks and their self-reported impacts on health among Emirati

university students contributes to the literature and understanding for the local context and gives insights into energy drink consumption patterns. This information can contribute to enhancing knowledge in the region and support planning and designing innovative initiatives for ameliorating potential risks. Findings may be helpful to future researchers and clinicians and for individuals and families. This study is part of ongoing efforts to enhance understanding and the quality and relevance of public health information available and to enhance university services provided to students to enhance their development and well-being.

This applied research study examines energy drink consumption patterns among a random sample of Emirati university students among 4 campuses in the UAE. This applied research investigates and enhances understanding regarding: (a) the type and quantity of energy drinks consumed and how it varies by student characteristics, (b) the perceived benefits with drinking energy drinks, and (c) the extent that certain types of symptoms or ill health was reported and correlated with heavy energy drink consumption for at risk students.

2. METHODOLOGY

The applied research study was quantitative and was conducted from November 2016 to January 2017. It utilized a cross-sectional design and administered an electronic survey to a random sample of 1,100 Emirati males and females among 4 higher education campuses in the UAE; specifically, located in the Emirates of Al Ain, Abu Dhabi, Dubai, and Sharjah. The study collected demographic and descriptive data to help analyze survey measures. *The study helps to illuminate the monthly to daily amount and type of energy drinks consumed within the sample, the various reason for consumption, and the extent that any symptoms or adverse health impacts are self-reported associated with energy drink consumption.* Hypotheses organize the data collection and analysis. The study assumed the null hypotheses that no statistically significant relationships or differences (at or below the alpha level of .05) would be found based on gender, age, and year in university program and for statistical results pertaining to level of energy drink use, quality of health, and negative physical health symptoms or effects.

The Energy Drink Survey was designed and pilot-tested based on need to measure self-

reported prevalence of energy drink use, the type of energy drinks consumed, and self-reported effects on health. Some modifications to survey questions were made during pilot-testing and the basic questionnaire was developed. Excluded from the survey were questions about coffee or tea because their use is so prevalent and the focus of the research was on energy drinks found in local stores with high levels of caffeine, sugar content, herbal ingredients, and other substances. The assumption was that these substances would act as stimulants and have other effects on the body and possibly produce symptoms under certain conditions of use, general health, and vary by demographic factors.

The total population of Emirati students attending among the 4 different campuses in program years 1 and 2 were 3,300. Therefore, one-third of these were randomly selected. For example, from 1,100 surveys administered, 522 were completed, which yielded a +/- 3.1% margin of error based on the 95% level of confidence [32]. This was based on the traditional formula in social and behavioral sciences. From these, about 15% reported never using energy drinks; therefore, survey responses were obtained and reported for only 444 who reported low to high consumption of energy drinks. The Survey-gizmo online software was used to administer the Energy Drink Survey. The survey was voluntary, anonymous, and findings were aggregated for reporting and examined by subgroup characteristics. The study received ethical clearance and approval from the University Ethics Committee.

The statistics used were fit for the type of data, level of measurements, and study purpose. Survey results were analyzed in IBM-SPSS software version 23. Tables reported the frequency and percentage of participants with demographic characteristics and how often they consumed energy drinks. Cross-tabulation tables and chi-square determined if there were any statistically significant proportional differences in consumption based on gender, university program year, and age. Chi square determined if there were any meaningful associations between level of consumption and quality of health [32,33].

Graphs summarized the proportion of respondents with different reasons for using energy drinks and their brand preferences. After that, Independent sample t-tests determined if any statistically significant mean differences in

Grade Point Average (GPA) existed between “low to no users” (e.g., no use to a few times a month) and those that consumed “one or more” energy drinks per day; and these data are examined by gender and university program year. This is a useful inferential procedure for comparing means of a dependent variable between two groups [33,34]. No statistical assumptions were violated in this study relative to the equality variances between the groups and the normal distribution of the dependent variables. Furthermore, spearman correlations examined whether drinking 1 to 3 or more energy drinks a day was statistically correlated with negative health effects or symptoms, such as overall quality of health, feeling nervous, increased blood pressure, heart palpitations, headaches, blurred vision, feeling thirsty, feeling tired, and/or experiencing difficulties sleeping [35].

3. STUDY RESULTS

Out of 522 participants completing the Energy Drink Survey, per Table 1, 365 (69.9%) of these Emirati higher education students were female, 347 were 18 to 20 years of age, 376 were in year two of their academic program leading to a 4-year degree, and 352 (67.7%) were in “good to excellent” overall health.

Table 1. Participant characteristics

Variable	N	%
Male	157	30.1
Female	365	69.9
Age 18 to 20	347	66.5
Age 21 to 22	128	24.5
Age 23+	47	09.0
Year 1 in program	146	28.0
Year 2 in program	376	71.0
Al Ain	84	16.1
Abu Dhabi	183	35.1
Dubai	150	28.7
Sharjah	105	20.1
Poor to very poor health	41	07.9
Average health	127	24.4
Good to excellent health	352	67.7

Study results in Table 2 indicate that out of 522 students, 78 students or 14.9% never drank energy drinks, so 444 or 85.1% drank energy drinks and their consumption patterns varied. The largest proportion was 30.2% or 158 students who drank energy drinks 1–2 days per month. Examining only the 444 who reported consuming energy drinks, results indicated that

88 students or 19.8% drank 1 to 3+ energy drinks a day.

Table 2. How often energy drinks consumed

Variable	No.	%
Never	78	14.9
1 to 2 times a month	158	30.2
1 to 2 times a week	129	24.7
3 to 4 times a week	69	13.2
Once a day	30	05.7
2 energy drinks a day	20	03.8
3 or more drinks a day	38	07.2

Table 3 reveals statistically significant differences for consuming 1 to 3+ energy drinks a day. Thus (a) “slightly” greater proportions of males consumed 1 to 3+ energy drinks a day, $X^2(1, N = 444) = 43.5, P=.000, \phi = -.331$; (b) were in year 2 at the university, $X^2(1, N = 337) = 20.7, P=.000, \phi = -.248$; and (c) were 18 to 22 years of age, $X^2(1, N = 302) = 19.2, P=.000, \phi = -.252$. Whereas, (d) “moderately” greater proportions of males drank 1 to 3+ energy drinks a day in university program year one, $X^2(1, N = 107) = 25.6, P=.000, \phi = -.490$; and (e) were at or above age twenty-three, $X^2(1, N = 33) = 8.3, P=.006, \phi = -.504$.

Students reported reasons for using energy drinks. Results for 444 respondents in Fig. 1 indicated that 39.9% enjoyed the taste and 27.7% reported it gave them energy. Also, 13.1% reported it helped them study, 11.9% indicated it makes them feel better, and 7.5% reported it helped them exercise, work, and drive. A large proportion of low energy drink users did so to make them feel better (85%) and liked the taste (70%). The 123 students who reported energy drinks giving them energy when tired, 39% of these reported drinking at least 3 times a week or more. Therefore, the students reporting needing energy drinks when tired had greater frequency of consumption.

Fig. 2 displays the proportion of students out of 444 reporting an energy drink brand preference. Red Bull was reported by 253 students or 57% as most preferred. Oronamin-C was reported by 46 or 10.4%, Power Horse was reported by 42 students or 9.5%, and Burn was reported by 34 students or 7.7%. A further 15.4% reported preferring other brands, such as Jolt (4.7%), Monster (4.5%), Gold Dubai (3.6%), and Rock Star (2.6%).

Independent sample t-tests compared mean cumulative GPA in university and level of energy

drink consumption. Findings in Table 4 indicate that those consuming 1 to 3+ energy drinks a day had a lower GPA (M =2.97) than students that had “no to low” use (M = 3.14), and this result is statistically significant, $t(1, 444) = 2.99$, $P=.003$, $g =0.37$. Appropriate for two groups with different sample sizes [32], the hedges’ g effect size showed a “slight to moderate” GPA difference. No statistically significant GPA

differences were found for high levels of energy drink consumption (e.g., 1 to 3+ a day) by gender, $t(1, 86) = -.961$, $P=.339$; and year in university program, $t(1, 86) = .295$, $P=.768$. So those with higher overall frequency of energy drink consumption, regardless of gender and amount of time attending the university, had lower GPAs than students with “no to low” energy drink use.

Table 3. Drinks 1 or more a day

Variable	0 to 4 a week	1 to 3+ a day	Total	X ²	P	phi
All Males	n=88 62.0%	n=54 38%	n=142 100%	43.5	.000	-.313
All Females	n=268 88.7%	n=34 11.3%	n=302 100%			
Year 1 Males	n=08 21.6%	n=29 78.4%	n=37 100%	25.6	.000	-.490
Year 1 Females	n=51 72.9%	n=19 27.1%	n=70 100%			
Year 2 Males	n=80 76.2%	n=25 23.8%	n=105 100%	20.7	.000	-.248
Year 2 Females	n=217 93.5%	n=15 6.5%	n=232 100%			
18 to 20 Males	n=57 68.7%	n=26 31.3%	n=83 100%	19.2	.000	-.252
18 to 20 Females	n=196 89.5%	n=23 10.5%	n=219 100%			
21 to 22 Males	n=27 60%	n=18 40%	n=45 100%	12.6	.001	-.340
21 to 22 Females	n=57 89.1%	n=07 10.9%	n=64 100%			
23+ Males	n=04 28.6%	n=10 71.4%	n=14 100%	8.3	.006	-.504
23+ Females	n=15 78.9%	n=04 21.1%	n=19 100%			

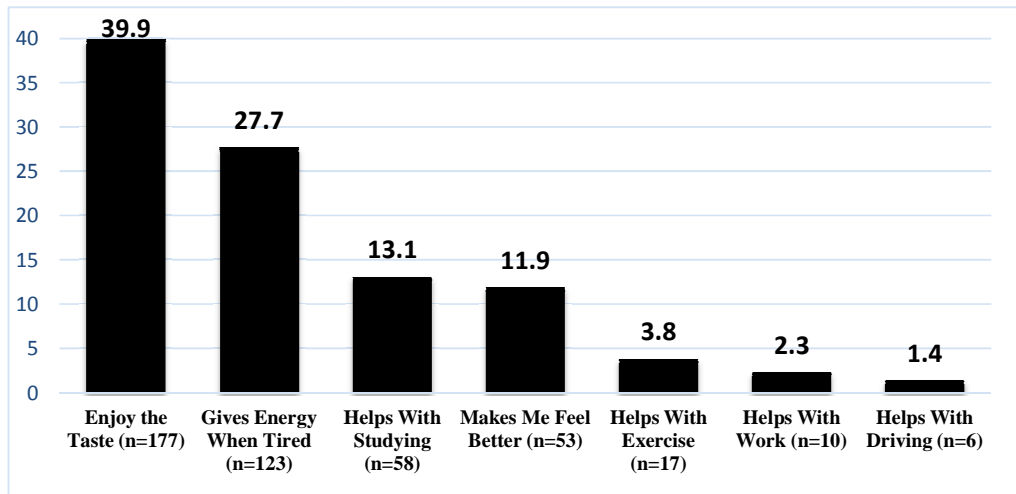


Fig. 1. Reasons given for using energy drinks

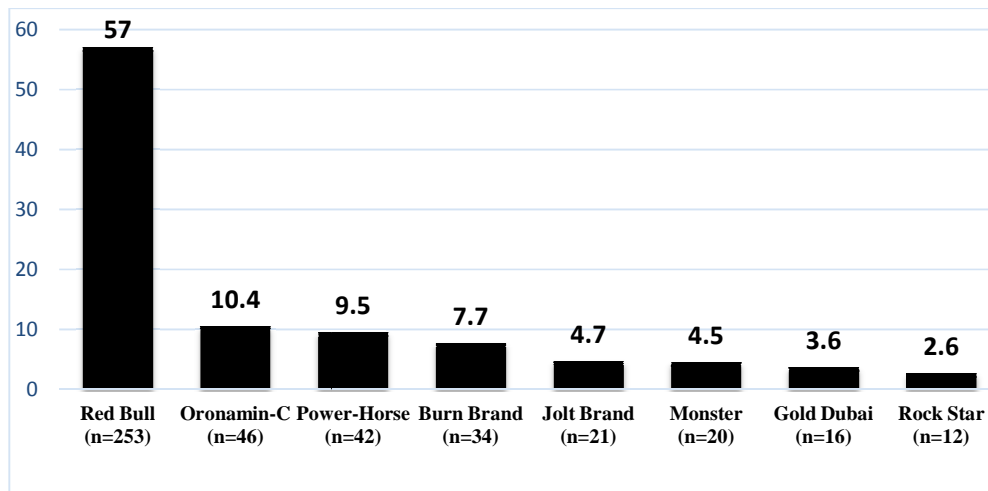


Fig. 2. Energy drink brand preference

Table 4. Drinks 1+ energy drinks a day by GPA

Group	N	M	SD	T	P
1+ a Day	88	2.97	.476	2.99	.003
Low to No Use	356	3.14	.454		
1+ a Day (Males)	54	2.94	.468	-.961	.339
1+ a Day (Females)	34	3.03	.432		
1+ a Day (Year 1)	48	2.99	.449	.295	.768
1+ a Day (Year 2)	40	2.96	.467		

Self-reported health was examined with a 5-point scale (0=Very Poor, 1=Poor, 2=Average, 3=Good, and 4=Excellent). To facilitate chi-squared analysis, the scale was recoded, as follows: 0 = (Very Poor + Poor + Average) and 1 = (Good + Excellent). For male students with “low to no” energy drink use, 83% reported “good to excellent” health; but males who drank 1 to 3+ energy drinks a day, only 40.7% reported “good to excellent” health. This result was statistically significant, $\chi^2(1, N = 142) = 26.9, P = .000, \phi = -.435$, revealing “slight to moderate” lower quality of health for males with higher energy drink consumption patterns. Statistically significant proportional differences were also found for female students, $\chi^2(1, N = 302) = 23.9, P = .000, \phi = -.282$; and for students overall, $\chi^2(1, N = 444) = 41.0, P = .000, \phi = -.304$. So lower quality of self-reported health is reported by “slightly” more females and “slight-to-moderately” more males who drank 1 to 3+ energy drinks a day.

3.1 Adverse Health Impacts

Spearman correlations were examined to determine if drinking 1 to 3+ energy drinks a day

was linked with certain types of negative health impacts or symptoms; that is, directly related to energy drink consumption [35]. The following are the statistically significant correlations identified. Table 6 results indicate that students that drank 1 to 3+ energy drinks a day were more likely to have a “slightly” lower overall health self-rating ($P = .000, r = -.304$) and “slightly” more likely to experience nervousness, ($P = .005, r = .132$). Students that experienced nervousness also had statistically significant correlations with increased blood pressure ($P = .000, r = .258$) and heart palpitations ($P = .000, r = .234$).

Table 7 summarizes additional statistically significant correlations. Findings indicated that students that drank 1 to 3+ energy drinks a day were more likely to experience headaches ($P = .000, r = .172$), blurred vision ($P = .000, r = .282$), increased feelings of thirst ($P = .000, r = .225$), and experience difficulties sleeping ($P = .000, r = .308$). Experiencing energy drink induced headaches was “moderately” correlated with experiencing blurred vision ($P = .000, r = .518$) and sleeping difficulties ($P = .000, r = .422$).

Table 5. Level of consumption by overall health

Variable	Low tone use	1 to 3+ a day	Total	X ²	P	phi
Males						
Very Poor to Avg.	n=15 17.0%	n=32 59.3%	n=47 33.1%	26.9	.000	-.435
Good to Excellent	n=73 83.0%	N=22 40.7%	n=95 66.9%			
Female						
Very Poor to Avg.	n=89 33.2%	n=26 76.5%	n=115 38.1%	23.9	.000	-.282
Good to Excellent	n=179 66.8%	N=08 23.5%	n=187 61.9%			
Overall						
Very Poor to Avg.	n=104 29.2%	n=58 65.9%	n=162 36.5%	41.0	.000	-.304
Good to Excellent	n=252 70.8%	N=30 34.1%	n=282 63.5%			

Table 6. Drinks 1 to 3+ a day and health impacts

Variable		Drinks 1 to 3+ a day	Health rating	Feeling nervous	Up blood pressure	Heart Palp.
Drinks 1 to 3+ a day.	Correlation	1.000	-.304	-.132	.044	.038
	Sig.		.000	.005	.354	.428
Health Rating	Correlation	-.304	1.000	.115	-.028	-.056
	Sig.	.000		.015	.553	.240
Feeling Nervous	Correlation	.132	.115	1.000	.258	.234
	Sig.	.005	.015		.000	.000
Up Blood Pressure	Correlation	.044	-.028	.258	1.000	.419
	Sig.	.354	.553	.000		.000
Heart Palp.	Correlation	.038	-.056	.234	.419	1.000
	Sig.	.428	.240	.000	.000	

Table 7. Additional spearman correlations

Variable		Drinks 1 to 3+ a day	Headache	Blurred vision	Feeling thirsty	Tired later	Difficulty sleeping
Drinks 1 to 3+ a day.	Correlation	1.000	.172	.282	.225	-.032	.308
	Sig.		.000	.000	.000	.497	.000
Headache	Correlation	.172	1.000	.518	.297	.309	.422
	Sig.	.000		.000	.000	.000	.000
Blurred Vision.	Correlation	.282	.518	1.000	.390	.236	.461
	Sig.	.000	.000		.000	.000	.000
Feeling Thirsty.	Correlation	.225	.297	.390	1.000	.293	.441
	Sig.	.000	.000	.000		.000	.000
Tired Later.	Correlation	-.032	.309	.236	.293	1.000	.376
	Sig.	.497	.000	.000	.000		.000
Difficulty Sleeping.	Correlation	.308	.422	.461	.441	.376	1.000
	Sig.	.000	.000	.000	.000	.000	

Fig. 3 summarizes the proportion of the 88 university students who were most impacted and at risk and who were more likely to report experiencing adverse health symptoms from drinking 1 to 3+ energy drinks a day. Difficulty sleeping, experiencing thirst, headaches, and

blurred vision were the problems reported by a large proportion of the students identified with high daily energy drink consumption. Our findings with respect to difficulties sleeping were similar with what other researchers found for university students in the UAE [10].

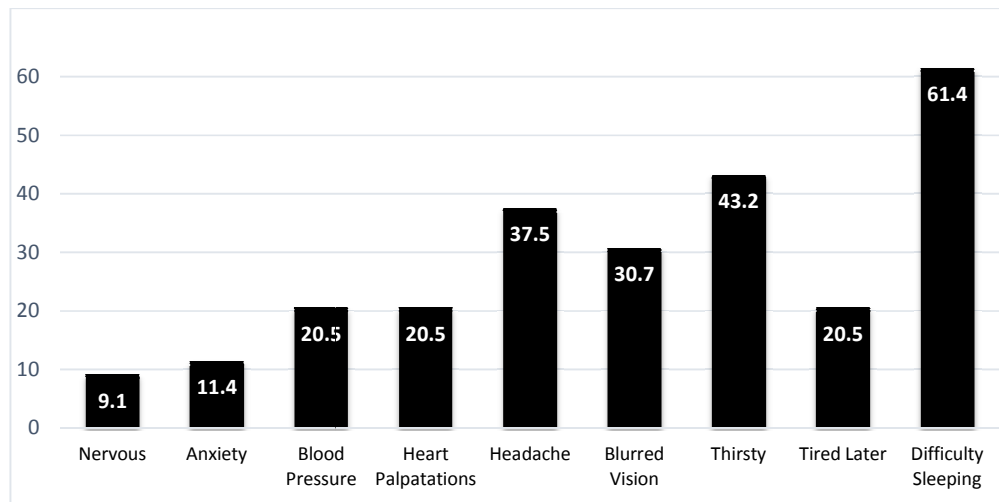


Fig. 3. Drinks 1 to 3+ energy drinks a day

4. DISCUSSION AND CONCLUSIONS

Energy drink consumption patterns have been examined using a cross-sectional design, Energy Drink Survey, and a random sample of Emirati university students across 4 university campuses in the UAE. Findings provided insight into energy drink consumption levels and associated adverse health symptoms or impacts. Like other studies published [5-10], the research has found that 85.1% of the sample reported consuming energy drinks; specifically, from 1 to 2 times a month up to 3 or more drinks daily. A greater proportion of males than females were identified as more frequent consumers of these drinks. In fact, males were found with the greatest levels of consumption based on age and year attending the university. “Moderately” greater proportions of males than females had more extensive energy drink consumption patterns in their first year at the university and among males age 23 and above. Red Bull was the brand most frequently consumed by the sample of Emirati students followed by Oronamin-C, Power Horse, Burn, Jolt, Monster, and others.

About 38% of the males and 11.3% of the females have been identified as being most at risk for the potential harm from energy drinks because they were found to consume 1 to 3 or more energy drinks a day. A serious concern exists for the health and safety of the most at risk students who engaged in daily energy drink usage when (a) two-thirds of these reported difficulties sleeping, (b) more than one-third experienced dehydration, feelings of thirst, and headaches; (c) one-third had blurred vision, and

(d) one-fifth reported increased blood pressure, heart palpitations, and post-consumption fatigue. These symptoms are often reported in the literature linked with excessive ingestion of caffeine and herbal products that have a stimulant impact on the body [6,14,23,25-27].

Concern has been expressed about the increased risk for developing tolerance and addiction related to high doses of caffeine including herbal ingredients within energy drinks [11,14,26]. The stimulant impact on the body may produce physical and psychological tolerance and addiction for some students. Not getting enough sleep due to caffeine and herbal stimulant ingestion likely causes a cycle of fatigue and health decline. Findings related to this suggest that student GPAs are “slightly” lower for those that regularly consume energy drinks. *Not clear if energy drink consumption lowered GPAs for various reasons or if the students most at risk with lower GPAs are more likely to consume energy drinks.*

The Middle East region suffers from significant prevalence of obesity, diabetes, and Cardio-Vascular Disease (CVD), hypertension, and inactive lifestyles so these significant risk factors may be made worse by energy drinks or these conditions may make reactions to energy drinks worse [36]. The fact that a large proportion of the students with the greatest use of energy drinks experienced a range of symptoms, raises concern that students are consuming excessive sugar and carbohydrates which contributes to CVD, diabetes, and declining health. The excessive thirst may mean that they are in a

dehydrated condition from the heavy doses of caffeine and herbal stimulants and/or reactions to sugars and carbohydrates. The weather is very hot at times in the region, and this places them at risk for heat stroke, heat exhaustion, fatigue, and other issues when consuming energy drinks.

Based on the statistically significant correlations found, as the frequency of self-reported consumption of energy drinks increases, self-reported negative health symptoms are more likely to occur. *Therefore, findings generally suggest that university students and young adults should not consume energy drinks daily and they need to be careful about excessive use because of the negative side effects that have been reported by a significant proportion of Emirati young adults in this study.* The reality of the potential harm that could be caused by these drinks, as reported in the peer-reviewed literature and the adverse health symptoms associated with daily use found in this study -- should cause students and the public to exercise greater caution when considering consuming energy drinks and to try and make healthier lifestyle choices to minimize risks and to maximize health and well-being.

The most at risk students are of serious concern suggesting the importance of university programs and support services to help raise awareness about risks to health and to receive counseling and medical assistance as needed. Students can benefit by receiving information about public health warnings and research evidence of the risks associated with frequent use of energy drinks [18,19,24-28]. This may help them rationalize healthier ways to deal with stress, fatigue, and university performance issues. University support programs and services can be effective when they are geared toward enhancing student self-efficacy and promoting cognitive strategies for a healthier lifestyle [37]. Information and public health awareness campaigns about energy drinks can help young people make healthy decisions, inform effective policies, and help to prevent health risks and disease [38,39].

It is a challenge for agencies, schools, and universities to persuade young people and adults to make healthy lifestyle choices and to not consume energy drinks because of the difficulties competing against the heavy business marketing of energy drinks, the popularity which exists among peers, and because use has become part of the lifestyle of many university students [2,3]. But it is important for institutions, teachers,

support staff, and families to be active and to have a positive influence on encouraging healthy thinking and decisions to reduce use of energy drinks.

We recommend that schools and universities examine their policies to ensure that energy drinks are not sold by private vendors on campus or near campuses to minors in violation of local regulations and laws. It is a good idea to understand what energy drinks are available for young adult university students and what proportion of students are regular users of these beverages to try and better understand the factors that may be impacting on the health and safety of the student population. Public health agencies as well as higher education institutions should think about increasing research collaborations and public health campaigns [38, 39]; and for high risk populations, providing counseling support and medical assistance (if needed) to help ameliorate the risks and to deal with cases of physical and psychological addiction to energy drinks that can impact on behavior, performance, and the quality of health [37].

Based on limitations of the research design and sampling used in this study, results will not represent all university students in the UAE and will not be representative of all Emirati students in higher education. While a random sample was used, findings probably only apply with caution to the populations attending the higher education campuses that participated in the research [32]. Generalizing the results is context dependent and relevant for the local communities and campuses involved in this research. Furthermore, there were consumption level differences found between the different Emirates where the samples were drawn, but due to uneven sample sizes and sampling error, conclusions were not stated in this report for specific campus locations [33]. Moreover, the energy drink brands most consumed may be related to those sold in the convenience stores, markets, and petrol stations near the campuses involved in this research and may not represent the type of energy drinks used in high proportion nationally in the UAE or throughout the Middle East.

The conclusions about adverse health impacts from energy drinks are preliminary because a cross-sectional design was used with correlational data. This was the most appropriate design based on the ethics approval obtained

from the institution and based on the objectives for deriving information that could be used for practical purposes by the institution relative to enhancing policies and student support services. While careful data collection, coding, processing, and analysis occurred, this was not a rigorous research design with enough complexity and control of variables to clearly isolate the effects of energy drink consumption on health [32,34]. Researchers should be concerned with confounding variables (antecedent, mediating, and moderating variables) that can produce errors in drawing accurate conclusions about outcomes and causation [32]. The use of correlations helped our understanding and explanation about the self-reported symptoms associated with various levels of consumption.

And finally, the health consequences of energy drinks and the differing levels and duration of consumption have not been well researched and reported on in the health science literature. Energy drink contents have not been adequately tested by many food and drug administrations throughout most of the countries where energy drinks are sold [1,2]. The safety and risks have not been well researched related to doses of herbal stimulants mixed with caffeine, sweeteners, amino acids, and b-vitamins; especially the contraindications with a range of medications, other products, and the long-term impact on health and disease [21,25]. More scientific research studies are needed in the future to determine how energy drinks may influence young adults differently based on participant characteristics and substances hypothesized to be problematic to health found in typical energy drinks in the region [4,6,11].

CONSENT

All authors hereby declare that written, informed consent was obtained from all study participants.

ETHICAL APPROVAL

All authors hereby declare that this study was conducted according to the Declaration of Helsinki guidelines and all procedures were approved by the Applied Research Ethics Committee in the higher education institutions involved in the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Pettit ML, DeBarr KA. Perceived stress, energy drink consumption, and academic performance among college students. *J Am Coll Health*. 2011;59(5):335-341.
2. Reissig CJ, Strain EC, Griffiths RR. Caffeinated energy drinks – A growing problem. *Drug Alcohol Depend*. 2009;99:1-10.
3. Deliens T, Clarys P, De Bourdeaudhuij I, Deforche B. Correlates of university students' soft and energy drink consumption according to gender and residency. *Nutrients*. 2015;7:6550-6566.
4. Malinauskas BM, Aeby VG, Overton RF, Carpenter-Aeby T, Barber-Heidal K. A survey of energy drink consumption patterns among college students. *BMC Nutr*. 2007;6:35.
5. Musaiger AO, Zagzoog N. Knowledge, attitudes and practices toward energy drinks among adolescents in Saudi Arabia. *Glob J Health Sci*. 2014;6(2):42-46.
6. Visram S, Cheetham M, Riby DM, Crossley S, Lake AA. Consumption of energy drinks by children and young people: A rapid review examining evidence of physical effects and consumer attitudes. *BMJ Open*. 2016;1-23.
7. Aluqmany R, Mansoor R, Saad U, Abdullah R, Ahmad A. Consumption of energy drinks among female secondary school students, Kingdom of Saudi Arabia. *J Taibah Univ Sci*. 2013;8:60–65.
8. Alsunni A, Badar A. Energy consumption pattern, perceived benefits and associated adverse effects amongst students of University of Dammam, Saudi Arabia. *J Ayub Med Coll Abbottabad*. 2011;23:3-9.
9. Faris MAE, Jahrami H, Al-Hilali MM, Chehyber NJ, Ali SO, Shahda SD, et al. Energy drink consumption is associated with reduced sleep quality among college students: A cross-sectional study. *Nutr Diet*; 2016. DOI: 10.1111/1747-0080.12289.
10. Jacob S, Tambawel J, Trooshi FM, Alkhoury Y. Consumption pattern of nutritional health drinks and energy drinks among university students in Ajman, UAE. *Gulf Medical Journal*. 2013;2(1):22-26. Accessed 19 December 2016. Available: [www.gulfmedicaljournal.com/download/Volume2/gmj13%20\(9\).pdf](http://www.gulfmedicaljournal.com/download/Volume2/gmj13%20(9).pdf)
11. Attila SP, Cakir B. Energy-drink consumption in college students and

- associated factors. *Nutrition*. 2011;27:316-322. Accessed 19 December 2016. Available:<https://www.ncbi.nlm.nih.gov/pubmed/20579846>
12. Alhyas, L, El Kashef A, AlGhafer H. Energy drinks in the Gulf Cooperation Council states: A review. *JRSM Open*. 2015;0(0):1-12.
 13. Al-Hazza H, Abahussain N, Al-Sobayel H, Qahwaji D, Musaiger A. Physical activity, sedentary behaviors and dietary habits among Saudi adolescents relative to age, gender and region. *Int J Behav Nutr Phys Act*. 2011;8:140.
 14. Bawazeer NA, AlSobahi NA. Prevalence and side effects of energy drink consumption among medical students at Umm Al-Qura University, Saudi Arabia. *IJMS*. 2013;1(3):104-108.
 15. Ibrahim N, Iftikhar R, Murad M, Fida H, Abalkaeil B. Energy drinks consumption amongst medical students and interns from three colleges in Jeddah, Saudi Arabia. *Journal of Food Nutrition Research*. 2014;1:174–179. Accessed 19 December 2016. Available:<http://pubs.sciepub.com/jfnr/2/4/7>
 16. Faris MAE, Epuru S, Al-Shimmari S, Al-Shimmari E. Alarming high levels of energy drinks consumption among school children in Hail, Northern Saudi Arabia. *Int J Child Health Nutr*. 2015;4:1-13.
 17. Kilani H, Al-Hazaa H, Waly M, Musaiger A. Diet, physical activity and sleep duration Among Omani adolescents. *Sultan Qaboos Univ Med J*. 2013;13:510–519.
 18. Masudi F. Energy drink age limit under review. *Gulf News*; 2014. Available:<http://gulfnews.com/news/uae/general/energy-drink-age-limit-under-review-1.1384054>
 19. Zriqat T. Sharjah's ban on energy drinks welcomed by parents and doctors. *The UAE National*, August 13, 2015. Accessed 19 December 2016. Available:<http://www.thenational.ae/uae/sharjahs-ban-on-energy-drinks-welcomed-by-parents-and-doctors>
 20. Saadi D. UAE excise tax may lead to some products disappearing from shop shelves. Accessed 1 June 2017. Available:<http://www.thenational.ae/uae/uae-excise-tax-may-lead-to-some-products-disappearing-from-shop-shelves>
 21. Joao BJ, Whiting SH, Encarnacao R, Norberg S, Jones R, Reinap M, et al. Energy drink consumption in Europe: A review of the risks, adverse health effects, and policy options to respond. *Front Public Health*. 2014;2(134):1-5.
 22. Higgins JP, Ortiz BL. Energy Drink Ingredients and their Effect on Endothelial Function: A Review. *Int J Clin Cardiol*. 2014;1:1-6. Available:<https://www.clinmedjournals.org/articles/ijcc/ijcc-1-006.pdf>
 23. Gunja N, Brown JA. Energy drinks: Health risks and toxicity. *Med J Aust*. 2012;196(1):46-49.
 24. Zeidan-Chulia F, Gelain DP, Kolling ED, Rybarczyk-Filho JL, Ambrosi P, Resende TS, et al. Major components of energy drinks (caffeine, taurine, and guarana) exert cytotoxic effect on human neuronal SH-SY5Y cells by decreasing reactive oxygen species production. *Oxid Med Cell Longev*; 2013. ID 791795. Available:<https://www.hindawi.com/journal/s/omcl/2013/791795/>
 25. Leikin JB, Paloucek FP. *Poisoning and toxicology handbook* (4th Edition); 2007. Taylor and Francis Group, 1,384 pages.
 26. Astorino TA, Robertson DW. Efficacy of acute caffeine ingestion for short term high-intensity exercise performance: A systematic review. *J Strength Cond Res*. 2010;24:257-265.
 27. Nordt SP, Vilke GM, Clark RF, Cantrell FL, Chan TC, Galinato M, et al. Energy drink use and adverse effects among emergency department patients. *J Community Health*. 2012;37(5):976-981.
 28. Reuters. Energy drinks worse for your heart than caffeine alone: Study. Accessed April 26, 2017. Available:<http://www.nbcnews.com/health/health-news/energy-drinks-worse-your-heart-caffeine-alone-study-n751686>
 29. Miller K. Energy drinks, race, and problem behaviors among college students. *J Adolesc Health*. 2008;43(5):490-497.
 30. Bigard AX. Energy drinking hazards among young people risks of energy drinks in Youths. *Arch Pediatr*. 2010;17(1):1625-1631.
 31. Arria AM, O'Brien MC. The high risk of energy drinks. *J. Am. Med. Assoc*. 2011;305(6):600-601.

32. Isaac S, Michael WB. Handbook in research and evaluation (3rd Ed.); 1997; Educational and Industrial Testing Services, San Diego, California.
33. Box, GE, Hunter, JS, and Hunter, WG. Statistics for experimenters: Design, innovation, and discovery (2nd Ed.); 2005. Hoboken, New Jersey: Wiley & Sons.
34. Robby MA, Gitsaki C. Analyzing your data statistically. In J. D. Brown, & C. Coombe (Eds.), The Cambridge guide to research in language teaching and learning. Cambridge: Cambridge University Press. 2016;253-261.
35. Mukaka MM. A guide to appropriate use of correlation coefficient in medical research. Malawi Med J. 2012;24(3):69-71.
36. Mehio SA, Nasreddine L, Mokdad AH, Adra N, Tabet M, Hwalla N. Nutrition transition and cardiovascular disease risk factors in middle East and North Africa countries: Reviewing the evidence. Ann Nutr Metab. 2011;57(3-4):193-203.
37. Von Ah D, Elberts S, Ngamvitroj A, et al. Predictors of health behaviors in college students. J Advanced Nursing. 2004;48(5): 463-474.
38. Beaudoin CE, Fernandez C, Wall JL, Farley TA. Promoting healthy eating and physical activity: short-term effects of a mass media campaign. Am. J. Prev. Med. 2007;32:217–223.
39. Gordis L. Epidemiology (4th Edition); 2009. Elsevier Health Sciences. ISBN: 9781416040026.

© 2017 Robby and Sanad; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<http://sciencedomain.org/review-history/20798>