

# Demographics, Health, and Risk Behaviors of Young Adults Who Drink Energy Drinks and Coffee Beverages

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**Objective:** The present study investigates risk behaviors, sleep habits, and mental health factors associated with caffeinated beverage use in young adults.

**Materials and Methods:** Students from a midsize private university ( $n = 159$ ) completed a 15-minute anonymous questionnaire, including questions on risk behaviors, sleep habits, alcohol, and caffeine consumption. We compared behaviors between the top ~15% (“high end”) of energy drink users ( $\geq 3$ /month) and coffee users ( $\geq 16$ /month) to those with less frequent or no caffeine consumption.

**Results:** Caffeine consumption was frequent among young adults. In the last month, 36% of students had an energy drink, 69% had coffee or espresso, and 86% reported having any caffeine; however, the majority of students were unaware of the caffeine content in these beverages. High-end energy drink consumers reported more risk-taking behaviors (increased drug and alcohol use and less frequent seat belt use), sleep disturbances (later bedtimes, harder time falling asleep, and more all-nighters), and higher frequency of mental illness diagnoses than those who consumed fewer energy drinks. In contrast, the frequency of most risk behaviors, sleep disturbances, and mental illness diagnoses was not significantly different between the high-end and general population of coffee drinkers.

**Conclusion:** Students with delayed sleep patterns, mental illness, and higher frequency of substance use and risk behaviors were more likely to be regular energy drink users but not regular coffee drinkers. It is unclear whether the psychoactive content in energy drinks results in different behavioral effects than just caffeine in coffee, and/or different personality/health populations are drawn to the two types of beverages.

## Introduction

YOUNG ADULTS STRUGGLE with sleep difficulties; data from the Spring 2014 American College Health Association (ACHA) National College Health Assessment II show that 28% of undergraduate students report sleep as being “traumatic or difficult to handle,” and students rank sleep problems second only to stress and anxiety in factors that negatively impact academic performance.<sup>1</sup> One popular coping mechanism for excessive sleepiness is consumption of caffeinated beverages.<sup>2,3</sup> Coffee is a mainstay in campus dining halls, and now, campuses are seeing a dramatic increase in the popularity of energy drinks. However, these drinks are under scrutiny for their association with cardiovascular side effects and high-risk alcohol consumption.<sup>4</sup>

The energy drink market grew by 60% from 2008 to 2013, and sales are estimated to grow from \$12.5 billion in 2012 to \$21.5 billion in 2017.<sup>5</sup> Young adults between the ages of 18–34 years are the target demographic for

energy drink companies and the largest users.<sup>6,7</sup> Fifty-one percentage of U.S. college students have reported using energy drinks at least once in the current semester, and 36% of students have consumed one within the past 2 weeks.<sup>2,8</sup> To reach their target audience more directly, energy drink companies use “student ambassadors” and “student brand managers” to give away energy drinks on campuses and promote them at athletic events and social gatherings.<sup>9,10</sup>

Although popular with students, energy drinks, compared to coffee beverages, pose health risks due to their relative lack of regulation and less available health safety information.<sup>4,11,12</sup> Because energy drinks can be classified as dietary supplements rather than beverages, health claims about the drinks do not need to be approved by the Food and Drug Administration (FDA), and caffeine content and warning labels do not need to be listed with the beverage product information.<sup>13</sup> Up to 400 mg of caffeine per day is considered safe for healthy adults,<sup>13</sup> but

the caffeine content in a single energy drink can range from 70 to 500 mg, whereas a cup of coffee is usually around 100 mg.<sup>14</sup> Along with high amounts of caffeine, energy drinks often contain nutritional supplements, such as taurine, L-carnitine, guarana, and ginseng,<sup>15</sup> which pose additional pharmacological risks for those with cardiac conditions, epilepsy, and sleep and mental disorders.<sup>4</sup> Emergency room visits associated with energy drink consumption are on the rise, from 10,068 visits in 2007 to 20,783 in 2011.<sup>16</sup> Physical adverse reactions experienced by energy drink users include nausea, dizziness, anxiety, sleep problems, seizures, arrhythmia, and death.<sup>17–21</sup> Impairments in cognitive processes, such as behavioral regulation and metacognition, have also been associated with regular energy drink use in adolescents.<sup>22</sup> Due to these health risks, countries, such as Denmark, France, Uruguay, Iceland, Norway, and Turkey, have banned high-caffeine and taurine drinks altogether.<sup>23</sup> Sweden allows energy drink sales only in pharmacies, whereas Canada requires energy drinks to have clear warning labels discouraging their use by children and pregnant women, as well as their use with alcohol or in large quantities.<sup>23</sup> However, in the United States, these products are sold with minimal or no oversight by purchasing or health departments; they are sold in convenience and grocery stores and restaurants and often given away as promotional items in areas where young adults congregate.

One of the major well-documented safety risks of energy drinks involves the simultaneous consumption of alcohol and energy drinks as the stimulant effects of energy drinks have the ability to mask the perception of intoxication, leading to increased alcohol consumption and impaired decision making.<sup>8</sup> This practice is common among college students; ~25% of students reported mixing energy drinks with alcohol in the past 30 days, and 75% of students have combined the two in their lifetime.<sup>24–28</sup> Young adults who drink alcohol mixed with energy drinks have a higher likelihood of reporting high-risk sexual behaviors, such as having unprotected sex and being a victim or perpetrator of sexual assault.<sup>25,28,29</sup> These studies document other high-risk behaviors associated with alcohol mixed with energy drinks, including needing medical treatment, riding with an intoxicated driver, and increased illicit drug and alcohol use. A field study of young adults leaving a bar found that those who had energy drinks mixed with alcohol that night were three times more likely to have a blood alcohol level greater than 0.08 and also four times more likely to drive while intoxicated upon leaving the bar than those who drank alcohol without an energy drink.<sup>30</sup>

Even without the addition of alcohol, energy drink consumption is positively correlated with risky behaviors (e.g., extreme sports, casual sex, aggressive behaviors, and doing things on a dare) in young adults.<sup>27,31</sup> It is unknown whether caffeine consumption alone, or caffeine in conjunction with other stimulants found in energy drinks, might contribute to increases in risk taking. The direction-

ality of these relationships is unclear: Students prone to risk behaviors could also be drawn to energy drinks, and/or the stimulant effects of energy drinks might directly contribute to increasing risk behaviors. Currently, there is little published research regarding the demographics of or motivations for energy drink consumption in young adults, which could lend some clarity to these relationships. This study aims to extend the literature by comparing prevalence of mental illness, risk behaviors, sleep quality, and alcohol and caffeine consumption of high-end users and less frequent/nonusers of energy drinks and coffee beverages. This information can serve to broaden health educator and clinician knowledge to better address the complex relationships between caffeine consumption, physical and mental health, inadequate sleep, and high-risk behaviors in adolescents and young adults.

### Materials and Methods

A sample of 159 undergraduate students from a mid-size private university in the Midwest completed the online anonymous survey, which was approved by the campus Institutional Review Board. Participants were recruited to take a “Health Habits and Behaviors” survey through the psychology department’s research participant recruitment tool. Some students received course credit for completing the survey. The survey took ~15 minutes to complete. See Table 1 for demographic information.

TABLE 1. SAMPLE DEMOGRAPHICS

<i>Factor</i>	<i>Mean (SD)</i>
Age ( <i>n</i> = 155)	19.9 (1.6)
GPA ( <i>n</i> = 157)	3.35/4.0 (0.4)
Body mass index	23.0 (4.5)
Female (%)	77.2
Caucasian (%)	88.0
Class year (%)	
Freshman	28.3
Sophomore	21.4
Junior	35.8
Senior	14.5
Self-reported general health (%)	
Very poor	0.0
Poor	6.9
Good	67.3
Very good	25.8
Stress level (%)	
Less than average	5.7
Average	27.7
More than average	52.2
Tremendous	14.5
Diagnosed mental disorders (%)	
ADHD ( <i>n</i> = 13)	8.1
Mood-anxiety disorders ( <i>n</i> = 36)	22.4
Any eating disorder ( <i>n</i> = 8)	5.0
No psychiatric disorder ( <i>n</i> = 93)	58.5

ADHD, attention deficit hyperactivity disorder; GPA, grade point average.

### Survey questions

The survey included original and published questions regarding a range of health topics, including general health; risk-taking behaviors; sleep habits; alcohol, caffeine, and other drug consumption; and demographic information.

**General health.** This section contained six questions pertaining to self-assessment of general health, exercise frequency, fruit and vegetable consumption, and stress level.

**Caffeine consumption.** Students provided information about their frequency of caffeine use in the past 30 days and the source of caffeine (energy drink, coffee, espresso shot, tea, or other caffeinated beverage). Three additional questions specific to energy drinks were asked to assess students' motivations and experiences with the beverages (e.g., "What factors do you consider when buying energy drinks?"; "In what situations have you consumed an energy drink?"; and "Which of the following side effects have you experienced after consuming an energy drink?").<sup>2</sup> Students also answered questions about their combined use of alcohol and energy drinks (e.g., frequency of mixing alcohol with energy drinks, their motivations to do so, and whether it changes the perceived effect of alcohol). The survey also included the age of first use for coffee, tea, other caffeinated beverages, energy drinks, and alcohol. To assess students' knowledge of caffeine content in common beverages, students were asked to estimate the caffeine amounts in common beverages (coffee, energy drinks, tea, etc.) on a scale from 0 to >250 mg in 50-mg increments, given that a cup of coffee generally contains 135 mg of caffeine.

**Risk behaviors.** This section included 20 questions assessing risk behaviors, which were modeled after surveys created by McLeod *et al.*,<sup>32</sup> Miller,<sup>27</sup> and the National College Health Assessment II by the American College Health Association.<sup>33</sup> A mixture of four yes/no (e.g., "In the past year were you in a physical fight or assaulted?" "... ticketed for speeding?") and four frequency questions (e.g., "In the past year, how often did you wear a seatbelt when you rode in a car?; ... wear a helmet when you rode a bike, a motorcycle, or skateboard?") with answers ranging from "not applicable," "never," "rarely," "sometimes," "most of the time" to "always" were used to assess risk-taking behaviors.

**Sleep habits.** Students were asked questions about their sleep schedules (e.g., bedtime and rise time on weekend and weekdays, nap frequencies, and number of all-nighters in the past semester) and the frequency of sleep disturbances (e.g., days per week students had a hard time falling asleep or fell asleep in class). The Epworth Sleepiness Scale, a brief survey with a high reliability and validity for assessing persistent daytime sleepiness

in adults, consists of eight questions scored from zero to three of the likelihood of falling asleep in various situations (e.g., What are the chances you would doze or fall asleep during the following: sitting and reading and watching TV).<sup>34</sup> Scores range from 0 to 24, with scores more than 10 indicating excessive daytime sleepiness.<sup>35</sup>

**Alcohol/other drug consumption.** Students reported the frequency of use in the last year ("never," "a few times per year," "about once a month," "a few times a month," "once a week," or "several days a week or more") of alcohol, cigarettes, marijuana, nonprescribed prescription drugs, and any other illegal drug.

**Demographic information.** Students provided information, including age, sex, race, class year, grade point average (GPA), height, weight, military status, and whether they had been diagnosed with or treated for a mental illness (Table 1). Students with psychiatric diagnoses were grouped by disorder type: eating disorder, attention deficit hyperactivity disorder (ADHD), and mood-anxiety disorders. Due to the high comorbidity of depression and anxiety,<sup>36</sup> these two disorders were combined for data analyses.

### Data analyses

The data analysis program IBM SPSS Statistics 22 was used for all statistical analyses. Those who drank espresso were combined with those who drank coffee and are referred to here as coffee drinkers. To better understand the unique traits of those who consumed significantly more caffeinated beverages than the general young adult population, we compared high-end caffeinated beverage drinkers with those with no or casual use. High-end users were defined as those who consumed caffeinated beverages at a frequency greater than or equal to one standard deviation above the mean. High-end energy drink users consumed three or more energy drinks in the last month ( $n=23$ , 14.7% of total population), and high-end coffee drinkers consumed more than 16 coffee beverages in the last month ( $n=25$ , 16% of total population). Between-subjects *t*-tests (two tailed,  $\alpha=0.1$ , with Bonferroni-type corrections to address type I errors) were performed to assess for differences in health behaviors between the high-end energy drink and coffee users and the remaining population (those consuming <3 energy drinks/month and <16 coffee drinks/month). For categorical data, one-tailed chi-square analyses were used ( $\alpha=0.05$ ).

### Results

Most young adults reported recent consumption of some form of caffeine. Eighty-six percent reported caffeine use in the past 30 days, 64% had coffee, 30% had espresso, and 36% of students had at least one energy drink. There was a wide range of caffeine use: 33%

TABLE 2. FREQUENCY OF CAFFEINATED BEVERAGE CONSUMPTION IN PAST 30 DAYS

<i>Consumption in the past 30 days (times)</i>	<i>Coffee/espresso (%)</i>	<i>Energy drinks (%)</i>
0	31.2	63.5
1-2	11.5	21.8
3-5	18.5	5.8
6-9	16.5	5.1
10-15	6.4	2.6
16-20	9.5	0.6
21-25	3.2	0.0
>26	3.2	0.6

had never had an energy drink, and 23% had never had coffee or espresso. Consumption frequency of these drinks in the past 30 days is shown in Table 2. More young adults had tried energy drinks before the age of 14 years (7%), compared to coffee (6%), and by the age of 16 years, 38% had used an energy drink, whereas only 29% had consumed a coffee beverage (Table 3).

Of those who reported using an energy drink in the last month, the most common reported reactions to the drinks were increased alertness (60%), increased heart rate (48%), enhanced academic performance (33%), and increased anxiety (27%). Students reported consuming energy drinks most often in the following circumstances: long drives, hangovers, with alcohol, and when experiencing insufficient sleep (Table 4). When asked about reasons for purchasing a particular brand of energy drink, almost 75% of students reported price as the most important factor, whereas only a third took health information into account (Table 5). In general, students were largely unaware of the caffeine content in typical beverages. Results showed the majority of students tended to overestimate the amount of caffeine in each type of beverage (Table 6).

#### *Risk behaviors*

Among energy drink users, only 36.2% had never mixed alcohol with energy drinks, 17.1% reported mixing only rarely (about once a year), 29.5% reported mixing once every few months, 11.4% reported mixing about once a month, and 5.7% of students mixed almost every time they drank alcohol. There was a negative correlation

TABLE 3. AGE DISTRIBUTIONS FOR ENERGY DRINKS AND COFFEE

<i>Age first started drinking (years)</i>	<i>Energy drink (%)</i>	<i>Coffee (%)</i>
<14	7	6
14-16	31	23
17-20	25	42
>21	4	5
Never	33	24

TABLE 4. STUDENTS' MOTIVATIONS FOR CONSUMING AN ENERGY DRINK

<i>Motivating situations to drink energy drinks</i>	<i>Students who identify (%)</i>
Long drive	69
Hangover	67
With alcohol	63
Insufficient sleep	63
Studying	61
More energy in general	61
Taste	58
Long work shift	50
Enhanced athletic performance	30

This is limited to students who indicated that they had consumed an energy drink in the last month ( $n=57$ ). Question was check all that apply.

between the age of first energy drink and the frequency of mixing alcohol and energy drinks in the last month ( $r = -0.20$ ,  $n = 105$ ,  $p < 0.05$ ). The most common reasons students endorsed for mixing energy drinks with alcohol were the taste (30.5%), no particular reason (9.6%), to stay awake while drinking alcohol (7.2%), the feeling of being more intoxicated (6%), and cost-effectiveness (1.8%). No student reported feeling less drunk after mixing energy drinks with alcohol.

Table 7 shows how engagement in different risk behaviors differed between the high-end ( $\geq 3$ ) energy drink users or high-end ( $\geq 16$ ) coffee drinkers and those with less frequent or no caffeine consumption. Students who had at least three energy drinks in the last month were significantly less likely to wear a seat belt than the less frequent energy drink users. High-end energy drink users also reported more frequent use of alcohol, cigarettes, marijuana, hookah, and illicit prescription drugs than those reporting less than three energy drinks in the last month. In comparison, high-end coffee drinkers only showed slightly higher rates of cigarette use and motorcycle riding than the comparison group. Of the high-end energy drink users, 45.5% of students said they never kept track of how many alcoholic drinks

TABLE 5. MOTIVATIONS TO BUY A PARTICULAR BRAND OF ENERGY DRINK

<i>Motivating factors</i>	<i>Students who identify (%)</i>
Price	71
Attractive label	57
Calorie content	57
Taste	56
Caffeine content	54
Health information	33

This is limited to students who indicated that they had consumed an energy drink in the last month ( $n=57$ ). Question was check all that apply.

TABLE 6. STUDENTS' ESTIMATED CAFFEINE CONTENT IN DIFFERENT BEVERAGES

Beverage (actual caffeine content)	Perceived caffeine content (mg)					>250
	0-50	51-100	101-150	151-200	201-250	
8 oz Green tea (35 mg), %	<b>27.5</b>	32.3	26.3	9	0.6	0
12 oz Mountain Dew (48 mg), %	<b>9</b>	8.4	19.2	24.0	16.8	18
16 oz Latte (150 mg), %	10.8	4.8	<b>10.8</b>	22.8	25.1	21.6
8.4 oz Red Bull (80 mg), %	9	<b>2.4</b>	8.4	10.2	29.3	35.9
2 oz 5-hour Energy Shot (207 mg), %	11.4	3	13.2	16.2	<b>19.8</b>	32.3

The percentage of students who accurately identified the amount of caffeine in beverages is indicated in bold.

TABLE 7. RISK BEHAVIORS ASSOCIATED WITH ENERGY DRINK OR COFFEE CONSUMPTION IN THE LAST MONTH

Risk behavior	<3 Energy drinks in the last month (n=136), mean (SD)		≥3 Energy drinks in the last month (n=23), mean (SD)		<16 Coffee drinks in the last month (n=133), mean (SD)		≥16 Coffee drinks in the last month (n=27), mean (SD)		T
	mean (SD)	T	mean (SD)	T	mean (SD)	T	mean (SD)	T	
Most money gambled in one sitting <sup>a</sup>	2.53 (1.99)	-2.00*	3.6 (1.80)	-2.00*	2.56 (1.97)	3.28 (1.91)	3.28 (1.91)	-1.74*	
Seat belt use <sup>b</sup>	4.88 (0.32)	4.12**	4.39 (1.16)	4.12**	4.83 (0.53)	4.74 (0.66)	4.74 (0.66)	NS	
Bike helmet use <sup>b</sup>	2.75 (1.48)	2.41*	1.96 (1.07)	2.41*	2.64 (1.47)	2.63 (1.39)	2.63 (1.39)	NS	
Alcohol consumption <sup>c</sup>	3.71 (1.65)	-2.43*	4.61 (1.64)	-2.43*	3.74 (1.67)	4.30 (1.64)	4.30 (1.64)	NS	
Cigarette use <sup>c</sup>	1.34 (0.99)	-4.86**	2.65 (2.06)	-4.86**	1.43 (1.16)	2.04 (1.68)	2.04 (1.68)	-2.29*	
Marijuana use <sup>c</sup>	1.68 (1.30)	-3.33**	2.74 (1.94)	-3.33**	1.81 (1.48)	1.96 (1.34)	1.96 (1.34)	NS	
Hookah use <sup>c</sup>	1.49 (0.90)	-3.25**	2.22 (1.41)	-3.25**	1.59 (1.06)	1.63 (0.84)	1.63 (0.84)	NS	
Illicit prescription drug use <sup>c</sup>	1.04 (0.24)	-4.30**	1.48 (1.04)	-4.30**	1.08 (0.37)	1.22 (0.80)	1.22 (0.80)	NS	
Drove after drinking alcohol (%)	19.5	NS	31.8	NS	20.0	28.0	28.0	NS	
Rode motorcycle <sup>d</sup>	16.9%	χ <sup>2</sup> =4.0*	34.8%	χ <sup>2</sup> =4.0*	16.7%	33.3%	33.3%	χ <sup>2</sup> =3.97*	

<sup>a</sup>1 (<\$10), 2 (\$10-20), 3 (\$21-30), 4 (\$31-40), 5 (\$41-50), 6 (\$51-100), 7 (\$101-500), and 8 (≥\$500).

<sup>b</sup>1 (Never), 2 (rarely), 3 (sometimes), 4 (most of the times), and 5 (always).

<sup>c</sup>1 (Never), 2 (few times/year), 3 (once/month), 4 (few times/month), 5 (once/week), and 6 (several days/week or more).

<sup>d</sup>In the last year.

\**p*<0.1, experiment-wise error; \*\**p*<0.01, Bonferroni-type correction.

NS, nonsignificant.

they consumed, whereas 19.5% of the less frequent or nonusers did. In comparison, only 28% of high-end coffee drinkers never kept track of the number of alcoholic drinks they consumed versus 23% of less frequent or noncoffee users.

### Physical health

Both high-end energy drink and coffee users were equally as likely as the comparison groups to participate in club and varsity sports, engage in cardiovascular or strength training exercise, and consume fruits and vegetables. High-end energy drink users reported more sleep scheduling problems than less frequent energy drink users (Table 8). Young adults who consumed at least three energy drinks in the last month were significantly more likely to report having a hard time getting to sleep, having a later bedtime on the weekend, rising later on the weekend, and staying up all night more often throughout the semester than those who had fewer than three energy drinks. In comparison, high-end coffee drinkers reported feeling more tired throughout the week compared to those who drank <16 coffee beverages.

### Mental health

Overall, students diagnosed with a mental disorder were more likely to be high-end energy drink users. Students with a formal diagnosis of a mental disorder were twice as likely to have consumed three or more energy drinks in the last month than those without a disorder (9.1% vs. 21.2%),  $\chi^2(1, N=159)=4.15, p<0.05$ . Specifically, 14.7% of students with depression and/or anxiety, 75% of students with eating disorders, and 15.4% of students with ADHD reported drinking three or more energy drinks per month. High-end coffee users showed a similar but less robust pattern; 12.9% of students without a diagnosed disorder reported consuming more than 16 coffee drinks a month, whereas 22.2% of students with a diagnosed disorder reported consuming more than 16 coffee beverages a month,  $\chi^2(1, N=159)=2.64, p<0.10$ . Specifically, 20.6% of students with depression and/or anxiety, 25% of students with an eating disorder, and 23.1% of students with ADHD reported drinking 16 or more coffee drinks per month versus 13.1% of the general population. High-end energy drink users, but not high-end coffee consumers, were also more likely to report significantly higher levels of overall stress than the general population [4.26 vs. 3.67 on a 5-point scale,  $t(157)=3.54, p<0.01$ ].

### Discussion

Both energy drinks and coffee beverages were commonly used by young adults. Those who drank at least three energy drinks in the last month experienced significantly more disturbed sleep, displayed more risk behaviors, and were more likely to be diagnosed with a mental

TABLE 8. SLEEP BEHAVIORS ASSOCIATED WITH ENERGY DRINK OR COFFEE CONSUMPTION IN THE LAST MONTH

Behavior	<3 Energy drinks in the last month (n = 136), mean (SD)	≥3 Energy drinks in the last month (n = 23), mean (SD)	T	<16 Coffee drinks in the last month (n = 133), mean (SD)	≥16 Coffee drinks in the last month (n = 27), mean (SD)	T
Woke up too early <sup>a</sup>	2.06 (1.46)	2.04 (1.36)	NS	2.02 (1.38)	2.26 (1.70)	NS
Felt tired during day <sup>a</sup>	5.50 (2.00)	5.65 (2.19)	NS	5.33 (1.96)	6.48 (2.06)	-3.59**
Napped <sup>a</sup>	2.93 (2.48)	2.01 (1.20)	NS	2.90 (1.92)	2.70 (1.96)	NS
Hard time getting to sleep <sup>a</sup>	2.19 (1.71)	3.30 (2.49)	-2.69**	2.30 (1.87)	2.59 (1.93)	NS
Fell asleep in class <sup>a</sup>	1.49 (1.34)	1.30 (0.77)	NS	1.39 (1.11)	1.81 (1.86)	-1.78*
Up until at least 3:00 AM <sup>a</sup>	2.28 (1.65)	3.30 (2.49)	-2.53*	2.39 (1.81)	2.63 (1.93)	NS
Epworth Sleepiness Scale	7.93 (4.25)	7.74 (3.74)	NS	7.71 (4.24)	8.81 (3.74)	-1.81*
Typical bedtime on weekday	11:56 PM (73 min)	12:44 AM (86 min)	-2.66*	12:07 AM (74 min)	12:01 AM (88 min)	NS
Typical rise time on weekday	7:39 AM (80 min)	7:51 AM (89 min)	NS	7:44 AM (85 min)	7:28 AM (63 min)	NS
Total sleep time on weekday	7.66 h (91 min)	7.11 h (94 min)	NS	7.61 h (96 min)	7.44 h (65 min)	NS
Typical bedtime on weekend	1:41 AM (80 min)	2:31 AM (103 min)	-2.70**	1:48 AM (78 min)	1:47 AM (113 min)	NS
Typical rise time on weekend	10:04 AM (91 min)	10:39 AM (112 min)	-1.69*	10:15 AM (90 min)	9:39 AM (113 min)	1.72*
Total sleep time on weekend	8.39 h (80 min)	8.13 (97 min)	NS	8.44 h (77 min)	7.88 h (101 min)	1.99*
Number of all-nighters per semester	3.15 (1.61)	4.39 (2.13)	-3.26**	3.27 (1.73)	3.59 (1.82)	NS

<sup>a</sup>Days per week.

\*\* $p<0.1$ , experiment-wise error; \* $p<0.007$ , Bonferroni-type correction.

disorder than those with less frequent or no energy drink consumption. Likewise, those who drank at least 16 coffee drinks in the last month showed similar patterns in behaviors but to a much lesser degree. Most students were unaware of the caffeine content in different beverages and were motivated by price and taste rather than health information when buying energy drinks. These results support previous findings by Peacock *et al.*,<sup>37</sup> who found that pleasurable taste and low cost were primary factors young adults use when choosing energy drinks. Between the lack of knowledge about caffeine content and the lack of regulation regarding caffeine and ingredient labeling for nutritional supplement beverages, young adults with caffeine sensitivities (e.g., those with cardiac conditions, anxiety disorders, and sleep problems) are especially vulnerable to the negative effects of energy drinks. We also found that more young adults started drinking energy drinks at a younger age compared to coffee beverages. Many studies have emphasized a positive correlation between energy drink consumption, alcohol use, and other risk behaviors,<sup>6,8,24–28,38</sup> but here, we add to the literature by demonstrating that preexisting health factors, such as sleep problems and mental illness, also predict frequency of energy drink use.

#### *Limitations*

There are several limitations with the present study. The sample size is relatively small and only from one private midsize university. The sample population had more females, Caucasians, and higher reporting of mental illness compared to national norms, so comparisons might not be generalizable to all young adults. However, the frequency of energy drink use in our study is comparable to other published reports.<sup>2,8</sup> As with all survey designs, we do not have physiological or medical record data to confirm self-reported drug, caffeine, and alcohol use, sleep behaviors, or mental health diagnoses.

#### *Risk behaviors*

Previous literature shows strong positive correlations between energy drink consumption and risk behaviors, such as binge drinking, illicit drug use, casual sex, and aggressive behavior.<sup>31,38,39–41</sup> Adolescents who consumed energy drinks more often were also more likely to have experienced a brain injury.<sup>42</sup> The present study supports these findings; high-end energy drinkers reported engaging more often in risk behaviors, such as not wearing a seat belt and more frequent alcohol and other drug use. Conversely, high-end coffee drinkers did not engage in any behaviors significantly more often than the comparison population. It is unclear whether frequent energy drink users have personality characteristics that make them more prone to consuming energy drinks or if energy drinks, beyond caffeine in general, actually induce cognitive changes that promote more risk-taking behaviors.

#### *Sleep patterns*

Sleep patterns differed between high-end energy drink users, high-end coffee drinkers, and casual/nonusers. High-end energy drink users reported typical night owl or delayed phase sleep disorder problems (e.g., sleep-onset insomnia, later bedtime and rise times, and more frequent all-nighters). In comparison, high-end coffee drinkers reported more daytime tiredness than the general population. Previous research supports these findings; caffeine reduces sleep quality,<sup>43</sup> which can consequently lead people to feel more tired.

#### *Mental illness*

Previous research has documented links between energy drink consumption and several mental disorders. Adult males with anxiety disorders were significantly more likely to consume energy drinks than the general population.<sup>44</sup> Soldiers who reported daily mixing of alcohol and energy drinks were three times more likely to report suicidal thoughts or attempts in the last month than nondaily alcohol and energy drink users.<sup>45</sup> Jeffers *et al.* found a positive correlation between energy drink consumption and disordered eating behaviors.<sup>46</sup> Our results add to these findings; the high-end energy drink population was significantly more likely to have a mental illness (particularly eating disorders) than the general population. Although not significant, the high-end coffee population also tended to have a higher prevalence of mental illness diagnosis. Although the participants reported using caffeinated beverages to increase mood and alertness, this practice might exacerbate mental health problems through disturbed sleep.

#### **Conclusion**

High-end energy drink users and high-end coffee users captured remarkably distinct populations. The vast majority of high-end coffee drinkers did not regularly consume energy drinks and vice versa. Overall, high-end caffeine users, and particularly energy drink users, showed more risk-taking behaviors, disturbed sleep, stress, mental illness, and drug and alcohol use than did less frequent or nonusers. It is unlikely that the few times per month students were consuming energy drinks explained the consistent patterns of risk behavior, drug and alcohol use, and delayed sleep schedules. Rather, it is more likely that students with preexisting sleep problems, mental illnesses, and/or certain personality characteristics (e.g., sensation seeking and low conscientiousness) are more drawn to energy drinks than is the general population.

The caffeine and other stimulants in energy drinks could also be used as a coping mechanism for mental health issues by masking hunger and tiredness in eating disorders and compensating for decreased enthusiasm in mood disorders.<sup>47</sup> Pettit and DeBarr found a significant positive correlation between perceived stress and number

of days students drank at least one energy drink in the last month.<sup>48</sup> Caffeine increases anxiety and decreases sleep quality, which in turn can amplify psychological distress.<sup>49,50</sup> This pattern of risk behaviors, psychological distress, and energy drink consumption does not seem to start in college; about 20% of high school students report using energy drinks at least once in the last month, with sensation seeking, depression, and substance abuse higher among adolescent energy drink users.<sup>51</sup> Future studies should investigate the complex relationship between sleep disturbances, stress, risk behaviors, mental illness, and energy drink consumption in adolescents and young adults.

### Author Disclosure Statement

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