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Energy Drinks, Race, and Problem Behaviors among College Students

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Abstract

Purpose—This study examined relationships between energy drink consumption and problem behaviors among adolescents and emerging adults. It was hypothesized that frequent consumption of energy drinks would be positively associated with substance abuse and other risky behaviors and that these relationships would be moderated by race.

Methods—Cross-sectional, self-report survey data were collected from 602 Western New York undergraduate students in the spring of 2006. Differences in problem behaviors by frequency of energy drink consumption were assessed with multivariate linear and logistic regressions, controlling for gender, race, age, parental education, and college grade point average. Follow-up regressions were conducted to test for a moderating effect of race.

Results—Frequency of energy drink consumption was positively associated with marijuana use, sexual risk-taking, fighting, seatbelt omission, and taking risks on a dare for the sample as a whole, and associated with smoking, drinking, alcohol problems, and illicit prescription drug use for white students but not for black students.

Conclusions—These findings suggest that energy drink consumption is closely associated with a problem behavior syndrome, particularly among whites. Frequent consumption of energy drinks may serve as a useful screening indicator to identify students at risk for substance use and/or other health-compromising behavior.

Over the last decade, energy drinks such as Red Bull, Monster, and Rockstar have catapulted to prominence in the daily routines of adolescent and emerging adult consumers [1]. Designed to enhance alertness or provide a short-term energy boost [2-3], these drinks have become nearly ubiquitous on college campuses and recreational hot spots. However, few empirical studies to date have examined the demographics of energy drink consumption, particularly with respect to racial differences in the prevalence or correlates of consumption. About half of college students in one recent survey used energy drinks at least once a month, primarily to compensate for insufficient sleep, increase energy, or mix with alcohol when partying. Female students reported higher rates of consumption than male students; however, racial/ethnic differences were not assessed. [4]

Energy drinks derive their energy-boosting properties chiefly from sugar and caffeine. An eight-ounce energy drink typically contains 80mg of caffeine (although some brands may contain several times that amount), approximately comparable to one strong cup of coffee or two twelve-ounce caffeinated soft drinks [3,4]. Because energy drinks also contain sugar, taurine, and other substances that may have synergistic pharmacological effects beyond those of caffeine alone, a few researchers have assessed the impact of energy drinks on physiological

and cognitive performance, with inconsistent results.[5-9] Some studies have linked energy drink consumption with moderate improvements in physical endurance, alertness, and psychomotor performance [5] as well as enhanced visual information processing, attention and verbal reasoning [9]. Other studies have found no significant effects on either physical or cognitive outcomes [2,10].

Thus far, little attention has been devoted to exploring the nexus of energy drink consumption and other substance use. This empirical gap belies new concerns over the increasing popularity of energy drinks as mixers with alcoholic beverages; a recent survey of Italian college students found that 85% of energy drink consumers had mixed these substances with alcohol within the past month [11]. Combining the stimulant effect of caffeine and the depressant effect of alcohol reduces the symptomatic lethargy associated with drunkenness, leading drinkers to underestimate their levels of intoxication [11-12]. In one study of the interaction of energy drinks and alcohol, consumers of an alcoholic energy drink cocktail perceived less impaired coordination, headache, weakness, and dry mouth than consumers of alcohol alone, while objective impairment of visual reaction time, motor coordination, and breath alcohol concentration remained the same [13]. This combination may magnify the potential lethality of unintentionally excessive drinking [14], with consequences ranging from sexual victimization to alcohol-related motor vehicle accidents [15]. In at least one recent study, white college students reported significantly higher rates of mixed energy drink consumption than their nonwhite peers [16].

Energy drink consumption has been linked to a “toxic jock” identity, comprised of a pattern of risk-taking, self-identification as a “jock,” and endorsement of conventionally masculine norms, in college undergraduates of both genders [16]. Because jock identity is also associated with problem drinking [17], sexual risk-taking [18], delinquency [19], and interpersonal violence [20], frequent consumption of energy drinks may signal an elevated risk for health-compromising behaviors [16]. Advertising strategies for energy drinks have consistently emphasized extreme or high-risk activities [21-23] and several manufacturers have even used brand names such as Bong Water or Cocaine [24-25]. However, the links between energy drink consumption, substance use, and other problem behaviors remain largely unexplored.

The present analysis is grounded in problem behavior theory, which explains risk-taking and unconventional lifestyles in terms of three interactive systems of psychosocial influence: personality, perceived environment, and behavior [26-27]. Substance use and other risk behaviors generally occupy parallel locations in the social ecology of adolescent and emerging adult life; they are learned together and are normatively expected to be performed together, in what has been described as a problem behavior syndrome including (but not limited to) smoking, drinking, illicit drug use, sexual precocity and risk-taking, and delinquency [28-29]. Because conventional marketing strategies explicitly tie energy drinks to an extreme or high-risk lifestyle, it was hypothesized that they would occupy a niche in the constellation of health-compromising activities that make up this syndrome. However, while early tests of problem behavior theory drew largely from homogeneous white adolescent samples, subsequent analyses have raised questions about the applicability of this syndrome across racial lines. Problem behavior theory may provide a more compelling explanation for the behaviors of whites than blacks [30-32].

This study examined the relationships among energy drink consumption and several problem behaviors, including substance use (i.e., tobacco, alcohol, marijuana, and other illicit drugs), alcohol problems, and risk-taking in white and black undergraduate students. Black adolescents and young adults have markedly lower rates of substance use [33-35] than their white peers but higher rates of sexual risk-taking [36], further suggesting that the nature and composition of the problem behavior syndrome may be race-specific. With lower consumption rates for

alcoholic energy mixed drinks, blacks may also be less susceptible to the development of a high-risk “toxic jock” identity that has elsewhere been linked with drinking Red Bull and its equivalents [16]. Therefore, it was hypothesized that frequency of energy drink consumption would be more closely associated with problem behaviors in white college students than in their black counterparts.

METHODS

Data

In the spring of 2006, data were collected from undergraduates in introductory courses at a large public university. In return for completing a 45-minute anonymous questionnaire, participants received \$10.00 compensation for their time and effort; for students in some courses, the study also counted for research credit that could be applied toward fulfillment of a course requirement. Informed consent was obtained from all participants in accordance with the university’s Social and Behavioral Sciences Institutional Review Board for the protection of human subjects.

Approximately 1500 students were invited to participate in the study overall. Viable questionnaires were submitted by 795 students, yielding an estimated response rate of 52%. The sample closely resembled the demographics of the larger undergraduate university population except for an overrepresentation of nonblack students of color. A large but indeterminate number of the self-reported Asian/Pacific Islander or “other race” students in the sample were foreign students whose inclusion in the analysis could potentially confound the disparate influences of race and nationality on energy drink consumption and problem behavior; however, the survey design did not include any measures that would permit disaggregation by nationality. In order to facilitate straightforward and theoretically interpretable testing of race moderation effects, therefore, only white ($n=523$) or black students ($n=79$) were included in the present analysis.

Measures

Problem behaviors—Ten problem-behavior outcomes were measured: smoking, drinking, and alcohol-related problems, use of marijuana or prescription drugs without a prescription, sexual risk-taking, and four other types of risk behavior (physical fighting, seatbelt omission, doing something risky on a dare, and participating in an extreme sport).

Respondents were asked a series of questions about past-month frequency of use and abuse of legal substances (“In the past 30 days, on how many days did you...”). The present analysis includes measures of smoking (“...smoke at least one cigarette?”), drinking (“...drink any alcohol—beer, wine, wine cooler, liquor, mixed drink, hard lemonade, etc.?”), and five problem drinking behaviors (binge drinking; getting drunk; driving while intoxicated; arguing with family, friends, or partner over drinking; and doing something one later regretted because of drinking). Response options, recoded to the midpoint of each category, included 0 (0 days); 1.5 (1-2 days); 4 (3-5 days); 7.5 (6-9 days); 14.5 (10-19 days); 24.5 (20-29 days); and 30 (all 30 days). The five problem drinking behaviors were summed into a single scale (Cronbach’s $\alpha=.71$), with responses ranging from 0 (0 days for all five behaviors) to 150 (30 days for all five behaviors).

Another series of questions asked about past-year frequency of use of a series of illicit drugs (“In the past 12 months, how often did you use...”), with response options that included 0 (0 times), 1.5 (1-2 times), 7 (3-11 times), 31 (12-50 times), and 60 (more than 50 times). The present analysis uses a measure of marijuana use and a measure of prescription drugs used without prescriptions. A log transformation was applied to the prescription drug measure

(skewness=5.71, kurtosis=35.28 pre-transformation; skewness=2.12, kurtosis=2.92 post-transformation) in order to normalize its distribution.

A third series of questions about risk-taking during respondents' most recent sexual intercourse asked if they had used a condom; if they or their partners were drunk or high; if they were in an exclusive relationship, or did not know their partner very well; if they regretted the experience later; and if they were in love with their partner. These seven yes/no items were recoded and summed into a single measure ($\alpha=.71$), with a score of 0 indicating the lowest possible level of risk (e.g., a mutually sober encounter between exclusive partners using redundant methods of birth control) and a score of 7 indicating the highest level of risk (e.g., a drunken fling with a stranger, using no barrier protection or other contraceptives).

Finally, in order to assess nonsexual risk-taking, subjects were asked a series of questions (0=no, 1=yes) about past-year risky behaviors. The present analysis included four of these measures: being in a serious physical fight; riding in a car without wearing a seatbelt; doing something dangerous on a dare (like taking a risk or breaking a law) that you would not have done otherwise; and participating in an "extreme" sport (like snowboarding or bungee jumping).

Independent variables—Participants were also asked how frequently in the past month they had consumed Red Bull or a similar energy drink, using the same set of response options as those for the questions on smoking, drinking, and alcohol-related problems. This continuous measure was used in all multivariate analyses. However, it is also useful to contrast the typical characteristics of respondents scoring at or near each end of the continuum (i.e., high vs. low energy drink consumption). Therefore, consumption frequency was also dichotomized into discrete high/low categories distinguishing respondents who consumed energy drinks at least once or twice a week (6 or more days) in the past month from those reporting less frequent consumption. This dichotomous measure, used in Table 2 only, offers greater intuitive ease of descriptive comparison.

Additional control data were collected on gender (male = 0; female = 1), race (0=white, 1=black), age, parental education (a proxy for social class), and college grade point average. Students identified each parent's highest level of education from among five options: did not finish high school (coded as 10 years); high school degree or GED (12 years); some college or technical certification (14 years); bachelor's degree (16 years); and post-graduate or professional degree, e.g., MA, MBA, PhD, or MD (18 years). Parental educational achievement was coded as the higher available response if mother's and father's education levels differed, or if the respondent provided data for only one parent. College grade point average was self-reported. Cases with missing data on parental educational history ($n=6$) or GPA ($n=6$) were recoded to their respective sample means.

Analysis

First, bivariate correlations were calculated (Table 1), confirming that energy drink consumption was positively and significantly correlated with each of the ten problem behaviors of interest. Second, ANOVAs were performed in order to test for significant differences in unadjusted mean scores for energy drink consumption and each problem behavior across two dimensions: race (black students were compared to white students) and high/low energy drink consumption (students who consumed energy drinks on six or more of the past 30 days were compared with those who consumed them less frequently or not at all). Third, each problem behavior was regressed on energy drink consumption frequency for the sample as a whole, controlling for gender, race, age, parental education, and GPA. A second model for each regression equation included a product term in order to determine if race moderated the

relationship between frequency of energy drink consumption and the problem behavior in question. Race-specific analyses were then conducted to probe any significant interactions.

RESULTS

Bivariate Descriptive Analyses

Table 2 presents overall descriptive statistics for the sample, as well as mean comparisons by race and low/high level of energy drink consumption. Of the 602 students included in this analysis, 48% were female and 13% were black. Mean parental education was 15.63 years, indicating at least some college experience. More than a third of respondents reported consuming at least one energy drink in the past month, with an average consumption of 1.85 drinks and significantly higher rates for whites than for blacks.

Bivariate mean comparisons showed the racial demographic patterns of problem behavior distribution in this sample. Blacks reported lower levels of substance-related problem behaviors than whites and were significantly less likely to have participated in an extreme sport in the previous year. However, the most notable indicator of all ten outcomes was frequent (six or more days a month) energy drink consumption. Frequent consumers reported drinking and having alcohol-related problems more than twice as often as less frequent consumers or nonconsumers, and were approximately three times as likely to have smoked cigarettes, abused prescription drugs, been in a serious physical fight, or done something risky on a dare in the year prior to the survey.

Multivariate Analyses

Linear or logistic regressions of each problem behavior on energy drink consumption, controlling for race, gender, age, parental education, and college grade point average, confirmed the positive link between energy drink consumption, legal and illicit substance use, and risky behavior, sexual or otherwise (Tables 3 and 4). As hypothesized, frequency of energy drink consumption was significantly and positively associated with nine of the ten problem behavior outcomes. For the most part, relationships between control variables and outcomes were consistent with findings in the extant research literature. Being female was associated with reduced frequency of alcohol use or alcohol-related problems, marijuana use, and sexual and other risk-taking scores. Being black was associated with reduced risk for substance use and substance-related problem behavior as well as extreme sport participation. Being older was associated with increased frequency of cigarette smoking but reduced the likelihood of risk-taking on a dare or participation in an extreme sport. Respondents' college GPA was inversely related to alcohol and drug use, sexual risk-taking, and seatbelt omission. However, parental education, a proxy for social class, was associated with greater sexual risk-taking.

As hypothesized, race moderated the relationships between energy drink consumption and four of the ten problem behavior outcomes. Therefore, exploratory analyses were conducted separately for whites and for blacks to probe the four significant interactions (see Table 5). These findings must be interpreted more cautiously in light of the comparatively small number of black students in the analyses ($n=77$). Nevertheless, the pattern was clear: energy drink consumption was strongly and positively associated with smoking, drinking, alcohol problems, and prescription drug abuse for whites but not for blacks.

DISCUSSION

Because energy drinks have only recently attained prominence in the young adult market, few studies have yet examined their implications for public health. Measuring consumption patterns has largely been the purview of marketers [1,22]; efforts to identify the demographics of young

adult energy drink consumption, including the present study, have so far been confined to nongeneralizable regional samples [4,11,16]. Other than studies assessing the accuracy of claims regarding these products' capacity to enhance physiological or cognitive performance [2,5-10], few researchers have explored the potential negative health implications of the energy drink phenomenon. Several threads of research are needed.

First, there is a distinct shortage of large-scale, generalizable studies that map out overall prevalence as well as demographically-specific consumption patterns, particularly with respect to racial differences. The present analysis offers preliminary data toward that end, but its generalizability is limited by the regional nature of the sample, which draws respondents from a single university. Until nationally representative data sets such as Monitoring the Future [36], the National Survey on Drug Use and Health [37], or the Centers for Disease Control and Prevention's Youth Risk Behavior Survey [38] begin monitoring energy drink use along with other substances, a substantial knowledge deficit will remain. Moreover, the motivations for energy drink use remain unclear; some researchers find that these substances chiefly serve as antidotes for sleep deprivation or as adjuncts to alcohol consumption [4], whereas others have linked caffeine intake with sensation-seeking [39]. These early findings call for replication and extension.

Second, we need to examine relationships between energy drink consumption and other problem behaviors. The present study has shed some much-needed light in this area. The analysis provided strong support for the hypothesis that energy drink consumption is a part of the problem behavior syndrome, co-occurring with substance use and other forms of risk-taking net of the effects of race, gender, age, parental education, and college grade performance. Moreover, the relationship between energy drink consumption and problem behaviors was significantly moderated by race; energy drinks were linked with smoking, drinking, alcohol problems, and prescription drug abuse in white but not black students. However, the cross-sectional data did not permit tests for causality or direction of the relationships in question. Although energy drink consumption has been conceptualized as a predictor of other problem behaviors, it does not necessarily follow that drinking these substances is a gateway behavior for more serious health-compromising activities; it is possible that a common factor such as sensation-seeking or involvement in risk-oriented peer subcultures is a distal cause of both. Future studies will need to employ a longitudinal design in order to assess the relative merits of causality versus selection in dissecting the relationship between energy drink consumption and problem behaviors.

Although most reports to date have been anecdotal and/or reflected isolated incidents, there is growing empirical support for a linkage between energy drink consumption, particularly in large quantities, and negative health consequences [40-42]. Recent investigations have led to the regulation of these substances in Ireland, Sweden, Canada, and Norway, and their outright ban in Denmark and France. A number of other countries now require energy drinks to carry health warning labels [3,12,14]. Perhaps in part because they remain unregulated in the United States, however, energy drinks have not thus far been subject to the same empirical scrutiny here as other legal but deleterious substances such as tobacco or alcohol. On the face of it, this distinction has merit. Whereas hundreds of thousands die every year from tobacco- or alcohol-related causes [43-44], making these the first and third leading causes of death in the U.S., the vast majority of energy drink consumers suffer no appreciable health consequences. Nor is this behavior an alarmingly strong indicator of overall risk. In the current study, along with sociodemographic controls, energy drink consumption explained a relatively small proportion of the variance in each of the ten domains of problem behavior examined ($R^2 = .23$ or less).

Nevertheless, the consistent covariance of energy drink consumption and other problem behaviors demands further investigation. In particular, there is a need to sort out why this

relationship is stronger for whites than for blacks. The moderation of the link between energy drinks and risk by race raises questions about the applicability of the problem behavior syndrome to young adults of color. Although several explanations for this difference have been suggested, including racial disparities in the importance of family structure [30] or parental support [31] in explaining patterns of risk behavior, these explanations are unsatisfying when considering race-specific linkages between energy drink consumption and other problem behaviors. Analyses that more clearly disaggregate the influence of personality (e.g., sensation-seeking) from that of perceived environment (e.g., peer-based normative expectations) may shed some light on how these factors differentially impact behavior across racial lines. Future researchers studying the constellation of substance use and other forms of risk-taking may thus wish to spotlight race as a key component of the contexts within which these behaviors occur. At least with respect to white students, frequent consumption of energy drinks may serve as a useful screening indicator for identifying at-risk students.

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Table 1

Bivariate Correlations Among Variables

	1	2	3	4	5	6	7	8	9	10	11
1. Energy Drink Frequency											
2. Cigarette Use	.23***										
3. Alcohol Use	.29***	.35***									
4. Alcohol Problems	.33***	.35***	.79***								
5. Marijuana Use	.19***	.36***	.37***	.47***							
6. Prescription Drug Use	.15***	.20***	.29***	.34***	.35***						
7. Sexual Risk Scale	.13***	.27***	.32***	.35***	.37***	.22***					
8. Serious Physical Fight	.21***	.15***	.24***	.28***	.17***	.19***	.15***				
9. Seatbelt Omission	.12***	.09*	.16***	.18***	.14***	.14***	.22***	.15***			
10. Risk on a Dare	.27***	.16***	.32***	.36***	.24***	.13***	.21***	.28***	.24***		
11. Extreme Sport	.10*	.10*	.21***	.17***	.12**	.07 ⁺	.11**	.18***	.06	.17***	

*** p<.001

** p<.01

* p<.05

+ p<.10

Table 2 Unadjusted Mean Comparisons by Race and Level of Energy Drink Consumption

	Race			Energy Drink Consumption	
	Total (n=602)	Whites (n=523)	Blacks (n=79)	Low (n=538)	High (n=60)
Race (1=nonwhite)	.13	----	-----	.14	.07
Sex (1=female)	.48	.49	.47	.52	***
Age	19.98	19.94	20.23	19.96	20.12
Years Parental Education	15.63	15.73	15.01**	15.61	15.90
College GPA (1.00-4.00)	2.98	3.02	2.74***	3.00	2.86+
Energy Drink Frequency	1.85	1.91	1.47	.68	12.38***
Any Energy Drink, past month (=1)	.38	.40	.25*	.31	1.00***
Cigarette Use	4.47	5.02	.89***	3.72	11.37***
Alcohol Use	7.31	8.00	2.72***	6.65	13.20***
Alcohol Problems (5 items)	11.16	12.38	3.04***	9.79	23.07***
Marijuana Use	13.13	14.35	5.11***	12.13	21.86**
Prescription Drug Use	1.81	1.95	.87	1.41	5.02***
Sexual Risk-taking (7 items)	1.66	1.66	1.59	1.57	2.38***
Serious Physical Fight (=1)	.16	.16	.15	.13	.42***
Seatbelt Omission (=1)	.66	.66	.70	.64	.82**
Risk on a Dare (=1)	.27	.28	.20	.23	.63***
Extreme Sport (=1)	.29	.32	.11***	.27	.48***

Total N for high/low energy drink consumption is only 598 due to missing cases.

*** p<.001
 ** p<.01
 * p<.05
 + p<.10

Table 3
 Linear Regressions of Problem Behaviors on Energy Drink Consumption (Standardized Parameter Estimates)

	Cigarette Use	Alcohol Use	Alcohol Problems	Marijuana Use	Prescription Drug Use	Sexual Risk
	β	β	β	β	β	β
MODEL 1						
Race	-.15***	-.26***	-.23***	-.17***	-.13**	-.03
Sex	-.05	-.11**	-.15***	-.08*	-.05	-.13**
Age	.15***	.03	-.00	-.04	-.01	.03
Parental Education	-.02	-.01	.02	.03	.01	.09*
College GPA	-.02	-.11**	-.10*	-.14***	-.11*	-.15***
Energy Drink Frequency	.22***	.25***	.28***	.16***	.19***	.09*
R ²	.10	.17	.19	.09	.07	.07
MODEL 2						
Race	-.12**	-.11*	-.14**	.01	-.13**	-.04
R ²	.11	.18	.20	.09	.08	.07

Model 1 includes only main effects; Model 2 includes both main effects and product terms. Only highest-order results are shown for each model.

- *** p<.001
- ** p<.01
- * p<.05
- + p<.10

Table 4
 Logistic Regressions of Past-Year Risk Behaviors on Energy Drink Consumption (N=598)

	Serious Physical Fight		Seatbelt Omission		Risk on a Dare		Extreme Sport	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
MODEL 1								
Race	.97	(.48-1.98)	1.06	(.61-1.82)	.65	(.34-1.26)	.27**	(.13-.58)
Sex	.24***	(.14-.42)	.55**	(.38-.79)	.21***	(.13-.32)	.40***	(.27-.59)
Age	.96	(.84-1.09)	.93+	(.85-1.01)	.85*	(.75-.97)	.88*	(.78-.99)
Parental Education	1.04	(.93-1.16)	1.02	(.94-1.11)	.99	(.90-1.09)	1.01	(.92-1.10)
College GPA	.85	(.55-1.31)	.55**	(.39-.79)	.98	(.67-1.43)	1.01	(.71-1.45)
Energy Drink Frequency	1.08***	(1.04-1.13)	1.06*	(1.00-1.12)	1.13***	(1.07-1.19)	1.03	(.99-1.08)
Nagelkerke R ²	.15		.09		.23		.11	
MODEL 2								
Race * Energy Drink Frequency	.94	(.84-1.06)	.94	(.82-1.08)	.91+	(.81-1.02)	.73	(.35-1.52)
Nagelkerke R ²	.15		.09		.24		.12	

*** p<.001

** p<.01

* p<.05

+ p<.10

Table 5
Race-Specific Regressions of Problem Behaviors on Energy Drink Consumption (Standardized Parameter Estimates)

	Cigarette Use		Alcohol Use		Alcohol Problems		Prescription Drug Use	
	Whites	Blacks	Whites	Blacks	Whites	Blacks	Whites	Blacks
	β	β	β	β	β	β	β	β
Sex	-.04	-.11	-.12**	-.01	-.16***	-.07	-.03	-.20 ⁺
Age	.11*	.56***	.02	.11	-.01	.01	-.03	-.05
Parental Education	.04	.01	-.03	.21 ⁺	.01	.19	.00	.13
College GPA	-.04	.06	-.12**	-.17	-.11**	-.08	-.13**	.00
Energy Drink Frequency	.25***	.04	.28***	.09	.32***	.10	.23***	-.08
R ²	.09	.32	.13	.09	.17	.07	.08	.06

*** p<.001

** p<.01

* p<.05

+ p<.10