

Published in final edited form as:

J Pediatr. 2014 December ; 165(6): 1194–1200. doi:10.1016/j.jpeds.2014.08.050.

Energy drink consumption and the risk of alcohol use disorder among a national sample of adolescents and young adults

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Abstract

Objective—To assess the association between energy drink use and hazardous alcohol use among a national sample of adolescents and young adults.

Study design—Cross-sectional analysis of 3,342 youth aged 15-23 years recruited for a national survey about media and alcohol use. Energy drink use was defined as recent use or ever mixed-use with alcohol. Outcomes were ever alcohol use and three hazardous alcohol use outcomes measured with the Alcohol Use Disorders Identification Test (AUDIT): ever consuming 6 or more drinks at once (6+ binge drinking) and clinical criteria for hazardous alcohol use as defined for adults (8+AUDIT) and for adolescents (4+AUDIT).

Results—Among 15-17 year olds (n=1,508), 13.3% recently consumed an energy drink, 9.7% ever consumed an energy drink mixed with alcohol, and 47.1% ever drank alcohol. Recent energy drink use predicted ever alcohol use among 15-17 years olds only (OR: 2.58; 95% CI: 1.77-3.77). Of these 15-17 year olds, 17% met the 6+ binge drinking criteria, 7.2% met the 8+AUDIT criteria, and 16.0% met the 4+AUDIT criteria. Rates of energy drink use and all alcohol use outcomes increased with age. Ever mixed-use with alcohol predicted 6+ binge drinking (OR 4.69; 95% CI: 3.70-5.94), 8+AUDIT (OR 3.25; 95% CI: 2.51-4.21), and 4+AUDIT (OR 4.15; 95% CI: 3.27-5.25) criteria in adjusted models among all participants, with no evidence of modification by age.

Conclusions—Positive associations between energy drink use and hazardous alcohol use behaviors are not limited to youth in college settings.

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Study design; conduct of the study; data collection, management, and analysis; and manuscript preparation, review, and approval were provided by <> (CA077026, AA015591 and AA021347). Data analysis, and manuscript preparation, review, and approval was provided by the Norris Cotton Cancer Center.

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Underage drinking is a major public health problem in the U.S.¹ More than 27% of 12-20 year olds drink alcohol in any month, averaging 4.9 drinks per session.² Binge drinking increases the risk of acute and chronic alcohol-related problems¹ including injury, risky sexual behaviors, and driving while intoxicated.¹ Those who begin drinking alcohol before the age of 18 are more likely to develop symptoms of alcohol abuse and dependence as an adult than their peers who abstain,^{3,4} associations that are largely mediated by increased rates of binge drinking.^{3,5} In 2007 the U.S. Surgeon General's Office issued a Call to Action to reduce underage drinking.¹ However, emergency room visits for alcohol-related injuries among 12-20 year olds have been steady since 2007, with estimates from 2009 documenting nearly 200,000 visits.⁶

Energy drinks are caffeinated beverages, shots, or drops that contain a mix of other energy promoting ingredients (eg, taurine, ginseng, guarana, B-vitamins) and frequently sugar. Caffeine contents of popular energy drinks range from 70 mg per one 8-ounce serving to 200 mg per one 16-ounce serving;⁷ concentrations similar to that of a strong cup of coffee. Energy drinks are becoming increasingly popular among US adolescents.⁸⁻¹³ The American Academy of Pediatrics discourages adolescents from consuming energy drinks stating such drinks have no therapeutic benefits.¹⁵ Even as some have criticized those calls as scaremongering,¹⁶ energy drink use among adolescents deserves attention given the common practice of mixing energy drinks with alcohol among young adults.^{17,18}

Many college students consume energy drinks mixed with alcohol¹⁹⁻³² often with the intent to consume excessive amounts of alcohol during one session.^{22,25} Energy drinks consumed with alcohol result in the user feeling less intoxicated^{26,33,34} although they do not lessen alcohol's effects on objective measures of impairment.³³⁻³⁵ Consuming energy drinks with alcohol is positively associated with binge drinking and alcohol-related aggressive behaviors, risky sexual behaviors, and the need for medical attention among college students.¹⁹⁻²⁹ One study of adolescents reported a positive association between frequency of energy drink consumption and past 30-day alcohol use.¹⁰ Another reported a positive association between ever use of energy drinks mixed with alcohol and binge drinking or alcohol-related fights or injuries.¹²

We studied the prevalence of energy drink consumption among a national sample of U.S. adolescents and young adults, and assessed whether energy drink consumption is associated with problematic alcohol use.

Methods

Data are from a national cohort study that enrolled youth aged 15-23 years to assess media use, marketing exposures, and alcohol use.³⁶ Participants were recruited via a random-digit dialing protocol using both landline and cell phone numbers during 2010. Households with children aged 15-23 were eligible for the study; one participant per household was selected for enrollment. Of the 60,189 households screened, 6,783 included a family member in the target age range and 3,342 (49.3%) agreed to complete the telephone survey. All U.S. states and the District of Columbia were represented in the final sample. Participants completed a computer-assisted telephone interview conducted by trained study interviewers (Westat,

Rockville, MD). Participants 18 years gave verbal consent; parental and adolescent assent were required for participants <18. Participants could enter responses to sensitive questions using the touch-tone keypad of their phone for privacy. The Committees for the Protection of Human Subjects at Dartmouth College and at Westat approved all study activities.

Assessment of energy drink use

Recent energy drink use was assessed as: “During the past seven days, how many times did you drink a can, bottle, or glass of an energy drink like Red Bull or Monster (0, 1 to 3 times in past seven days, 4 to 6 times in past seven days, 1 time per day, 2 times per day, 3 times per day, or 4 or more times per day)?” Participants were also asked about mixed-use of energy drinks with alcohol: “Have you ever consumed an energy drink with or after alcohol (yes, no, I don't drink energy drinks)?”

Alcohol use outcomes

Four alcohol use outcomes were included in this analysis: ever drinking alcohol and hazardous use of alcohol within the past year. Ever drinking alcohol was assessed as: “Have you ever had a whole drink of alcohol more than a sip or taste (yes, no)?” Participants who responded yes were further administered the Alcohol Use Disorders Identification Test (AUDIT),³⁷ a 10-item scale (total score ranges from 0-40) assessing three domains of alcohol use and abuse: hazardous alcohol use (e.g., see 6+ binge drinking below), dependence symptoms (e.g., How often during the last year have you found that you were not able to stop drinking once you had started?), and harmful alcohol use (e.g., “Have you or someone else been injured as a result of your drinking?”). The AUDIT is a validated scale used worldwide to identify individuals with hazardous alcohol use patterns and is used to identify individuals at risk of alcohol use disorder.³⁸ In this current study, participants were asked to recall behaviors over the past year. One item included in the AUDIT assessed binge drinking (6+ binge drinking): “How often do you consume six or more drinks on one occasion (never, less than monthly, monthly, weekly, daily or almost daily)?” Responses were dichotomized as never versus ever. Several large surveys in the U.S. including the Monitoring the Future study³⁹ define binge drinking among adolescents as 5 or more drinks on one occasion, and even lower age- and sex-specific thresholds have been suggested based on estimated blood alcohol concentrations.⁴⁰ The use of 6 or more drinks as a binge-drinking criterion is thus conservative for an adolescent population.

The AUDIT total score was used to assess the risk of alcohol use disorder. A score of 8 or more is suggested for identifying hazardous drinking behaviors among adults,³⁸ and a score of 4 or more is suggested for identifying hazardous drinking behaviors among adolescents as young as 13.^{41,42} Both outcomes (8+AUDIT and 4+AUDIT, respectively) were used to assess hazardous alcohol use.

Additional Measures

Additional measures included demographic characteristics of the child (age, sex, race, ethnicity, and educational or employment status) and measures likely associated with both energy drink and alcohol use (number of friends who drink alcohol, frequency of parental/guardian consumption of alcohol). Sensation seeking was assessed with a six-item sensation

seeking score (e.g., I would like to explore strange places: strongly agree, agree, disagree, strongly disagree, and don't know; Cronbach alpha = 0.72) based on the constructs Zuckerman⁴³ and Arnett.⁴⁴ Responses over the six items were combined into a one, scaled sensation seeking propensity score (range 1-4), where higher scores reflect greater propensity for sensation seeking behaviors. Previous work by our group has demonstrated that the sensation seeking propensity score has moderate predictive ability for 6+ binge drinking (area under the ROC 0.71).⁴⁵

Statistical Analyses

Bivariate analyses compared the frequency of energy drink use in the past seven days and each of the four alcohol use outcomes by baseline characteristics. Multivariate logistic regression was used to fit each of the four alcohol use outcomes on energy drink use measures; models for the three hazardous alcohol use outcomes were limited to participants who reported ever drinking alcohol. Model covariates were those variables with bivariate-level of associations ($p < 0.10$). Analyses were completed overall and stratified by age, specifically adolescents (15-17 years), underage young-adults (18-20 years), and young adults of legal drinking age (21-23 years). Statistical significance of interactions by age was assessed using likelihood ratio tests comparing two nested models with and without an age/energy drink interaction term. All analyses were completed with the R Language and Environment for Statistical Computing, version 3.0.1.⁴⁶

Results

Among this sample of youth, most (45.1%) were 15-17 years old, 32.7% were 18-20 years old, and 22.1% were at least 21 years of age; 51% of the subjects were male. Most participants were White, non-Hispanic (66.6%), with 9.4% identifying as Black, non-Hispanic, 13.6% Hispanic, and 2.9% Asian. Seven percent of participants identified as another race, largely attributed to self-identifying as mixed race ($n=163$). Approximately one-half (52.0%) of participants were in high school, 27.4% in college or a trade school, 13.7% working, and 6.6% unemployed.

Approximately one in six participants (16.2%) had used an energy drink at least once in the past seven days (Table I), with most of those participants ($n=428$, 79.0%) having consumed between 1-3 energy drinks. At the bivariate level, older participants, males, those working or unemployed compared with those in school, and those with a higher propensity for sensation seeking were more likely to have recently consumed energy drinks (each $p < 0.001$). Recent energy drink use remained significantly independently associated with older age, male sex, and higher propensity for sensation seeking in an adjusted logistic regression model that included all measures related to recent energy drink use at the bivariate level (data not shown).

Overall, 63.1% ($n=2,110$) of participants had ever consumed alcohol (Table II). Bivariate analyses showed that age, sensation seeking, the number of friends who drink alcohol, and the frequency of parental alcohol drinking were each positively associated with ever drinking alcohol (data not shown, all $p < 0.001$). Rates of ever drinking alcohol were also statistically different by race and ethnicity, with rates highest among Hispanic (69.3%) and

non-Hispanic White participants (63.8%; $p < 0.001$). Alcohol use was more common among those who reported any energy drink use in the past seven days (80.1%) compared with those who did not (59.9%; $p < 0.001$; Table II). In a logistic regression adjusted for sex, race/ethnicity, number of friends who drink, parental drinking frequency, and sensation seeking, recent energy drink use remained significantly, positively associated with the likelihood of ever drinking alcohol among 15-17 year olds only (OR 2.58; 95% CI: 1.77-3.77) as judged with a likelihood ratio test comparing two nested models: one with an interaction term of age and recent energy drink use and one without such an interaction term ($p = 0.007$).

Rates for each of the three hazardous alcohol outcomes overall and stratified by age are also presented in Table II. Among adolescents aged 15-17 years old, 7.2% met the 8+AUDIT criterion for hazardous alcohol use, and 16.0% met the 4+AUDIT criterion. Notably, 866 (84.7%) of participants who met the 4+AUDIT criteria also met the 6+ binge drinking criterion. Rates of each hazardous alcohol outcome increased with age, with 24.3% of 21-23 year olds meeting the 8+AUDIT criteria and 52.6% meeting the 4+AUDIT criteria. The rates of 6+ binge drinking also increased with age. Energy drink use in the past seven days was significantly positively associated with each of the three hazardous alcohol use outcomes (Table II) overall and within each age group.

Energy drink use in the past seven days was significantly and positively associated with ever mixed-use of an energy drink with alcohol for all age groups (Figure), and the positive associations between recent energy drink use and each of the three hazardous alcohol outcomes as reported in Table II appeared mediated by ever mixed-use of an energy drink with alcohol (Table III). Among all participants who ever reported drinking alcohol, ever mixed-use of an energy drink with alcohol was strongly associated with the likelihood of each of the three hazardous alcohol outcomes adjusted for relevant covariates, and inclusion of ever mixed-use of an energy drink with alcohol attenuated the positive associations between recent energy drink use and each of the three hazardous alcohol outcomes (Table III). Importantly, those positive associations did not differ with age (all likelihood ratio test p -values > 0.300).

Discussion

In this national study of 15-23 year olds, recent use of energy drinks was associated with ever drinking alcohol among adolescents, suggesting recent energy drink use may identify those with an early-onset of alcohol use. Ever mixed-use of energy drinks with alcohol strongly predicted hazardous alcohol use among all age groups after adjusting for a number of established risk factors for alcohol problem drinking. Specifically, those who ever consumed energy drinks with alcohol were more than four times as likely to have ever engaged in hazardous binge drinking of 6 more drinks, three times as likely to meet the AUDIT criterion for hazardous alcohol use as defined for an adult population (8+AUDIT), and four times as likely to meet the AUDIT criterion as defined for an adolescent population (4+AUDIT)^{41,42} as compared with their peers who had never consumed an energy drink mixed with alcohol.

Our findings are consistent with the many studies reporting positive associations between mixed-use of energy drinks with alcohol and alcohol abuse among college students, and also two studies among adolescents and young adults. Specifically, one national survey reported that regular energy drink use strongly predicted past 30-day alcohol use among 8th graders (adjusted odds ratio 3.3) and 10th and 12th graders (adjusted odds ratios 2.1)¹⁰. Another study of 13-20 year olds who consume alcohol reported a 6-fold increase in the likelihood of binge drinking among participants who consumed energy drinks, shots, or caffeine pills with alcohol in the past 30 days compared with their peers who did not report such mixed-use¹². Our study reports a positive association between mixed-use of energy drinks with alcohol and an increased risk of alcohol use disorder as defined by a clinically valid scale (ie, AUDIT) among adolescents and young adults. Our results further highlight that the problematic associations between energy drink use and alcohol abuse are not limited to youth in a college setting.

Pairing energy drinks with alcohol may increase the risk of binge drinking due to a high intake of caffeine, which lowers the subjective level of impairment due to alcohol and reduces one's perception of intoxication.^{18,26} Caffeine may also counter the depressant effects of alcohol, increasing alertness and leading to a longer time frame of drinking.^{18,26} Although the caffeine content of one energy drink may be similar to that of a cup of strong coffee, many adolescents and young adults are likely to consume more than one energy drink when drinking alcohol. Malinauskas et al surveyed 496 undergraduate college students and found that of those who consumed energy drinks with alcohol in the past month (n=139), 49% consumed three or more energy drinks with alcohol at any one occasion; 73% consumed two or more²².

Other mechanisms may be in play. Caffeine is generally a rewarding stimulant and caffeine use during adolescence may prime the brain to the additional rewarding effects of other stimulants.⁴⁷ Alcoholic beverages consumed with caffeine may also result in an increased desire for continued consumption of alcohol as compared with alcoholic beverages not consumed with caffeine.⁴⁸ It is also likely that energy drink consumption is associated with a general risk-taking profile that is independently associated with hazardous alcohol use.³¹ Such associations have been reported among college students.^{24,31} Among a national sample of adolescents in middle and high school from the Monitoring the Future study, it was reported that not only did any energy drink use on a typical day predict past 30-day alcohol use, but past 30-day use of cigarettes, marijuana, and amphetamines.¹⁰ These findings are consistent with those reported for a college population.⁴⁸ Although this current study tried to control for general risk taking propensity (sensation seeking), continued studies are needed to specifically address how energy drinks may affect hazardous drinking⁴⁹.

In this study, recent energy drink use predicted hazardous alcohol use (6+ binge drinking and 8+AUDIT), associations largely mediated by ever mixed-use of an energy drink with alcohol. Thus, recent energy drink use may positively identify adolescents and young adults at risk for hazardous alcohol use. If prospective studies confirm such associations, recent energy drink use and the mixed-use of energy drinks with alcohol may be useful additions to alcohol screeners for a clinical setting to enhance the identification of adolescents and young adults at risk for hazardous alcohol use⁵⁰. For the individual clinician, asking adolescents

about recent energy drink use may be a non-confrontational way to begin conversations about alcohol use.

This study has strengths and limitations. Strengths include the large sample size recruited nationally, and the rates of energy drink use in the past 7 days among 15-17 year olds (13.3%) were similar to the rates among 815 12-17 year olds¹⁴ from a 2011 cross-sectional study (8.5% reported any use in the past 7 days) and among 2,793 adolescents in 6th to 12th grade (14.7% consumed at least one energy drink per week).⁴⁸ However, our current study is cross-sectional we cannot prove causality between energy drink use and alcohol outcomes. Further, we cannot confirm that mixed-use of an energy drink with alcohol occurred during the same occasion as any binge or hazardous drinking. This study underestimates the rates of binge drinking in our adolescent population by defining binge drinking with a conservative criterion of 6 or more drinks in one session. Thus, our effect size estimates of energy drink use on binge drinking are conservative given the young age of the sample population. Particularly, important differences related to energy drink use and alcohol misuse by age may have been obscured. Also, this study assessed hazardous alcohol outcomes in reference to the past year, yet measured ever use of an energy drink mixed with alcohol. Finally, we measured recent energy drink use as any use in the past 7 days, and recent use was positively associated with alcohol use outcomes in unadjusted models. Several previous studies have measured recent energy drink use as use in the past 30 days, and it is worthwhile to consider how a longer time frame for recent use may associate with hazardous alcohol use independently of mixed use with alcohol.

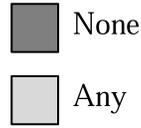
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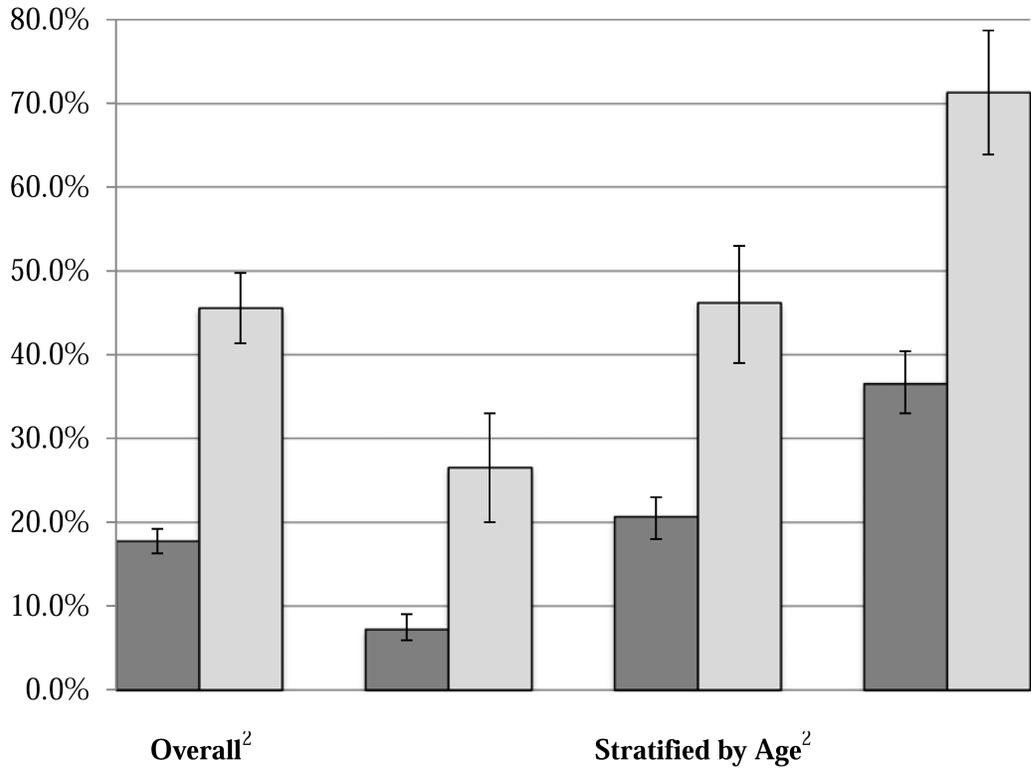
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Energy drink use in past seven days



% Ever consumed an energy drink mixed with alcohol
% (95% confidence interval)



| | Age 15-23 | | Age 15-17 | | Age 18-20 | | Age 21-23 | |
|------------|-----------|-------|-----------|-------|-----------|-------|-----------|-------|
| N, Overall | 2800 | 542 | 1308 | 200 | 895 | 199 | 597 | 143 |
| N, Event | 497 | 247 | 94 | 53 | 185 | 92 | 218 | 102 |
| %, Event | 17.8% | 45.6% | 7.2% | 26.5% | 20.7% | 46.2% | 36.5% | 71.3% |

Figure 1. Unadjusted prevalence rates of ever mixed-use of an energy drink with alcohol by energy drink use in the past seven days, overall and stratified by age among a sample of adolescents and young adults.^{1,2}

¹ Among N=3,342 participants who completed a telephone based survey.
² Rates of ever mixed-use of an energy drink with alcohol by recent energy drink use significantly different overall or within each age strata (all p<0.001).

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Table 1

Energy drink use in past seven days by baseline characteristics among a sample of adolescents and young adults.¹

| | Energy drink use in past 7 days | | p-value ² |
|---------------------------------|---------------------------------|--------------|----------------------|
| | None N (%) | Any N (%) | |
| Overall | 2800 (83.8%) | 542 (16.2%) | -- |
| Energy drink frequency | | | |
| 1-3 times in past 7 days | -- | 428 (12.8%) | -- |
| 4-6 times in past 7 days | -- | 42 (1.3%) | |
| Daily in past 7 days | -- | 47 (1.4%) | |
| More than daily in past 7 days | -- | 25 (0.7%) | |
| Age, years | | | |
| 15-17 | 1308 (86.7%) | 200 (13.3%) | <0.001 |
| 18-20 | 895 (81.8%) | 199 (18.2%) | |
| 21-23 | 597 (80.7%) | 143 (19.3%) | |
| Sex | | | |
| Female | 1433 (87.4%) | 206 (12.6%) | <0.001 |
| Male | 1367 (80.3%) | 336 (19.7%) | |
| Race, ethnicity | | | |
| White, non-Hispanic | 1856 (83.4%) | 370 (16.6%) | 0.169 |
| Black, non-Hispanic | 277 (88.2%) | 37 (11.8%) | |
| Asian | 79 (82.3%) | 17 (17.8%) | |
| Hispanic | 379 (83.1%) | 77 (16.9%) | |
| Other ³ | 209 (83.6%) | 41 (16.4%) | |
| Education/employment status | | | |
| High school student | 1493 (85.9%) | 245 (14.1%) | <0.001 |
| College or trade school student | 764 (83.4%) | 152 (16.6%) | |
| Working, non-student | 356 (77.7%) | 102 (22.3%) | |
| Unemployed, non-student | 178 (81.3%) | 41 (18.7%) | |
| Sensation seeking ³ | | | |
| Below median | 1381 (90.4%) | 146 (9.6%) | <0.001 |
| Above median | 1419 (78.2%) | 396 (21.8%) | |

¹ Among N=3,342 participants who completed a telephone based survey.

² p-value from Chi-Square tests for categorical measures or Student T-test for continuous measures.

³ Other includes American Indian/Alaska Native (N=14), Native Hawaiian / Pacific Islander (N=9), more than one race (N=163), other (N=13), or refused to answer (N=51).

³ Sensation seeking dichotomized at the median of 2.3, range 1-4.

Table 2

Unadjusted prevalence rates for hazardous alcohol use outcomes by energy drink use in past seven days among a sample of adolescents and young adults.^{1,2,3}

| | Hazardous Alcohol Use Outcomes ² | | | |
|--|---|----------------------------|-------------------|-------------------|
| | Ever Alcohol Use N (%) | 6+ Binge Drinking N (%) | 8+AUDIT N (%) | 4+AUDIT N (%) |
| Overall | | | | |
| <u>Age 15-23 years</u> | | | | |
| Overall (N=3,342) | 2110 (63.1%) | 1067 (31.9%) | 473 (14.2%) | 1022 (30.6%) |
| By energy drink use in past seven days | | | | |
| None (N=2800) | 1676 (59.9%) | 795 (28.4%) | 329 (11.8%) | 769 (27.5%) |
| Any (N=542) | 434 (80.1%) | 269 (49.6%) | 144 (26.6%) | 253 (46.7%) |
| <i>Chi-Square test p-value:</i> | <i>p<0.001</i> | <i>p<0.001</i> | <i>p<0.001</i> | <i>p<0.001</i> |
| Stratified by Age | | | | |
| <u>Age 15-17 years</u> | | | | |
| Overall (N=1508) | 711 (47.1%) | 258 (17.1%) | 108 (7.2%) | 241 (16.0%) |
| By energy drink use in past seven days | | | | |
| None (N=1308) | 567 (43.3%) | 190 (14.5%) | 74 (14.1%) | 179 (13.7%) |
| Any (N=200) | 144 (72.0%) | 68 (34.0%) | 34 (26.8%) | 62 (31.0%) |
| <i>Chi-Square test p-value:</i> | <i>p<0.001</i> | <i>p<0.001</i> | <i>p<0.001</i> | <i>p<0.001</i> |
| <u>Age 18-20 years</u> | | | | |
| Overall (N=1094) | 745 (68.1%) | 419 (38.3%) | 185 (16.9%) | 392 (35.8%) |
| By energy drink use in past seven days | | | | |
| None (N=895) | 592 (43.3%) | 316 (35.3%) | 126 (14.1%) | 295 (33.0%) |
| Any (N=199) | 153 (76.9%) | 103 (51.8%) | 59 (29.6%) | 97 (48.7%) |
| <i>Chi-Square test p-value:</i> | <i>p=0.004</i> | <i>p<0.001</i> | <i>p<0.001</i> | <i>p<0.001</i> |
| <u>Age 21-23 years</u> | | | | |
| Overall (N=740) | 654 (88.4%) | 387 (52.3%) | 180 (24.3%) | 389 (52.6%) |
| By energy drink use in past seven days | | | | |
| None (N=597) | 517 (86.6%) | 289 (48.4%) | 129 (21.6%) | 295 (49.4%) |
| Any (N=143) | 137 (95.8%) | 98 (68.5%) | 51 (35.7%) | 94 (65.7%) |
| <i>Chi-Square test p-value:</i> | <i>p=0.003</i> | <i>p<0.001</i> | <i>p<0.001</i> | <i>p<0.001</i> |

¹ Among N=3,342 participants who completed telephone based survey.

² Alcohol use outcomes include ever consuming alcohol, ever consuming 6 or more alcohol drinks in one setting (6+ binge drinking), scoring an 8 or greater (8+AUDIT) or scoring a 4 or greater (4+AUDIT) on the Alcohol Use Disorders Identification Test.

³ Chi-square p-values presented for comparison of distribution of each specific alcohol outcome within age group.

Adjusted likelihood of alcohol use outcomes by energy drink use among a sample of adolescents and young adults, limited to those who ever drank alcohol.^{1,2,3}

Table 3

| | 6+ Binge Drinking | | 8+AUDIT | | 4+AUDIT | |
|---|-------------------|---------|------------------|---------|------------------|---------|
| | OR (95% CI) | p-value | OR (95% CI) | p-value | OR (95% CI) | p-value |
| Base model ³ | | | | | | |
| Energy drink use in past seven days | 1.34 (1.05-1.71) | 0.020 | 1.41 (1.08-1.84) | 0.010 | 1.18 (0.91-1.52) | 0.207 |
| Further adjusted for mixed-use ³ | | | | | | |
| Energy drink use in past seven days | 1.01 (0.77-1.32) | 0.960 | 1.07 (0.81-1.42) | 0.635 | 0.85 (0.65-1.13) | 0.268 |
| Ever mixed-use of energy drink with alcohol | 4.69 (3.70-5.94) | <0.001 | 3.25 (2.51-4.21) | <0.001 | 4.15 (3.27-5.25) | <0.001 |
| Likelihood ratio test for interaction between mixed-use and age on alcohol outcome: | <i>p</i> =0.487 | | <i>p</i> =0.308 | | <i>p</i> =0.894 | |

¹ Subset of N=2,110 from full sample of N=3,342 participants who completed a telephone based survey.

² Hazardous alcohol use outcomes include ever consuming 6 or more alcohol drinks in one setting (6+ binge drinking), scoring an 8 or greater (8+AUDIT) or scoring a 4 or greater (4+AUDIT) on the Alcohol Use Disorders Identification Test.

³ All models adjusted for age, gender, race/ethnicity, number of friends who drink, parental drinking frequency, and sensation seeking.