

Published in final edited form as:

Addict Behav. 2014 January ; 39(1): . doi:10.1016/j.addbeh.2013.10.006.

The use of caffeinated alcoholic beverages among underage drinkers: Results of a national survey

Kalé Z. Kponee^a, Michael Siegel^{a,*}, and David H. Jernigan^b

^aDepartment of Community Health Sciences, Boston University School of Public Health, 801 Massachusetts Avenue, 3rd Floor, Boston, MA 02118, USA

^bDepartment of Health, Behavior, and Society, Johns Hopkins Bloomberg School of Public Health, 624 West Broadway, Room 292, Baltimore, MD 21205, USA

Abstract

Objective—The mixing of alcoholic beverages with caffeine has been identified as a public health problem among college students; however, little is known about the consumption of such drinks among younger adolescents. We estimated the prevalence of caffeinated alcoholic beverage (CAB) use among a wide age range of underage drinkers, examined differences in traditional (i.e. self-mixed alcoholic beverages with soda, coffee and tea) and non-traditional CAB use (pre-mixed caffeinated alcoholic beverages or self-mixed alcoholic beverages with energy drinks or energy shots) among underage drinkers by age and other demographic characteristics, and examined differences in hazardous drinking behavior between CAB and non-CAB users.

Methods—We used an existing internet panel maintained by Knowledge Networks, Inc. to assess the use of pre-mixed and self-mixed CABs in the past 30 days among a national sample of 1,031 youth drinkers ages 13–20. We conducted logistic regression analyses to estimate the relationship between traditional and non-traditional CAB use and risky drinking behavior as well as adverse outcomes of drinking, while controlling for age, gender, race/ethnicity, income, and general risk-taking (seat belt use).

Results—The overall prevalence of CAB use in the sample of underage drinkers was 52.4% (95% confidence interval [CI], 47.4%–57.4%). CAB prevalence was 48.4% among 13–15 year-old drinkers, 45.3% among 16–18 year-old drinkers, and 58.4% among 19–20 year-old drinkers. After controlling for other variables, we found a continuum of risk with non-traditional CAB use most significantly associated with binge drinking (odds ratio [OR] = 6.3), fighting (OR = 4.4), and alcohol-related injuries (OR = 5.6)

Conclusions—The problem of caffeinated alcoholic beverage use is not restricted to college-aged youth. The prevalence of CAB use among underage drinkers is higher than previously

© 2013 Elsevier Ltd. All rights reserved.

Corresponding author: Dr. Michael Siegel, Professor, Department of Community Health Sciences, Boston University School of Public Health, 801 Massachusetts Avenue, 3rd Floor, Boston, MA 02118 (phone: 617-638-5167; fax: 617-638-4483; mbsiegel@bu.edu).

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Contributors

Ms. Kponee, Dr. Siegel, and Dr. Jernigan contributed to the study design, collection, analysis and interpretation of the data, writing the manuscript, and the decision to submit the manuscript for publication.

Conflict of Interest

All authors declare that they have no conflict of interest.

thought and begins in early adolescence. Adolescents who consume CABs, and particularly non-traditional CABs, are at increased risk of adverse outcomes.

Keywords

Energy drink; Alcohol use; Alcohol drinking pattern; Adverse outcomes; Youth

1. Introduction

Underage drinking is a widespread public health problem that can lead to binge drinking, alcohol dependence, and other comorbidities in teenagers (Arria et al., 2011; Marczynski et al., 2009). Research has speculated that heavy episodic binge drinking is highly correlated with neurocognitive deficits, and contributes to preventable morbidity and mortality in college-aged students (Courtney & Polich, 2009). Alcohol causes 4,700 deaths per year among persons under 21 (CDC ARDI), and alcohol use among high school students has been associated with a range of health risk behaviors such as current sexual activity, being a victim of dating violence, attempting suicide, and using illicit drugs, with risk increasing with frequency of heavy episodic binge drinking (Miller et al., 2007). An emerging problem in underage drinking is the consumption of caffeinated alcoholic beverages including the combination of energy drinks with alcohol (Berger et al., 2010; Miller, 2008; O'Brien et al., 2008). The mixture of energy drinks and alcohol is particularly concerning because of evidence that youth who consume these drinks are at an increased risk of adverse outcomes (O'Brien et al., 2008; Thombs et al., 2010).

1.1 Energy drinks and alcohol

Energy drinks are beverages that claim to contain energy-providing ingredients by using a combination of caffeine, plant-based stimulants, simple sugars, glucuronolactone, amino acids, herbs and vitamins (O'Brien et al., 2008). The caffeine content in energy drinks is not regulated by the U.S Food and Drug Administration (FDA), in effect permitting the caffeine contents of some beverages to be 150%–300% greater than the amount of caffeine the FDA allows for cola beverages (Marczynski et al., 2006). The growing popularity of energy drinks has coincided with an increase in the prevalence among young people of mixing of these energy beverages with alcoholic drinks. A 2006 survey of college students found that 24% of them reported mixing energy drinks with their alcohol intake during the past month (Howland et al., 2011).

Research has demonstrated several adverse outcomes that may be associated with the use of caffeinated alcoholic beverages, especially among adolescents. Ferreira et al. noted that caffeinated alcoholic beverage consumption may decrease subjective feelings of being intoxicated (Ferreira et al., 2006). Individuals consuming these beverages may mistakenly believe that they are less intoxicated than they are and more capable of engaging in behaviors that require fine motor control such as driving a car (Brach & Stockwell, 2011). A 2012 study by Marczynski et al. found that while caffeinated alcoholic beverage consumption did not alter impairment when compared to alcohol alone, it did reduce subjective feelings of mental fatigue and increase feelings of stimulation. In addition to CABs being associated with higher risk-taking behaviors, research has found the weekly or daily use of these beverages to be associated with alcohol dependence (Arria et al., 2011). The use of CABs may enable adolescents to drink more than they usually would by masking the feeling of intoxication.

1.2 The use of non-energy drink caffeinated alcohol among young people

Thombs et al. (2011) recently questioned the exclusive focus on alcohol mixed with energy drinks, pointing out that several studies have documented the popularity of more “traditional” combinations of alcohol and caffeine, such as mixing alcohol with caffeinated soft drinks like cola (Rossheim & Thombs, 2011; Thombs et al., 2011). These non-energy drink combinations of alcohol with caffeinated beverages, which we will term “traditional CABs”, are concerning for three reasons. First, there is evidence that consumption of cola-caffeinated alcoholic drinks leads to equivalent levels of intoxication among young people as the consumption of alcohol mixed with energy drinks (Thombs et al., 2011). Second, there is evidence that for at least on-premise use, these traditional CABs may be more popular than alcohol mixed with energy drinks (Rossheim & Thombs, 2011). Third, while alcohol mixed with energy drinks has received much attention, the potential self-mixing of traditional caffeinated beverages such as soda and iced tea with alcohol may have fallen off the public health radar screen. Thombs et al. (2011, p.32) note, for example, that “previous research has failed to measure popular, non-energy drink, caffeinated mixers such as cola soda. This is problematic because if caffeine is responsible for facilitating heavy drinking, then consumption of alcoholic beverages mixed with cola soda should also be associated with higher levels of intoxication.”

1.3 Existing literature on the use of CABs among underage youth

Recent research literature on caffeinated alcoholic beverages has focused mainly on the use of alcoholic energy drinks among the collegiate population (Arria et al. 2011; Berger et al, 2011; Brache & Stockwell, 2011; Ferreira et al. 2006; Howland et al, 2010; Howland & Rohsenow, 2012; Marczynski, 2011; O’Brien et al, 2008; Snipes & Benotsch, 2013). We are aware of four studies that have estimated the prevalence of the use of alcoholic energy drinks among college students (Brache & Stockwell, 2011; Marczynski, 2011; O’Brien et al., 2008; Snipes & Benotsch, 2013). However, we found no studies that have examined the use of alcoholic energy drinks among pre-college adolescents. Furthermore, we are aware of no studies that have examined the use of traditional CABs among either college or teenage youth, nor any studies that have compared the effects of traditional CAB use (alcohol mixed with soda, tea, or coffee) and non-traditional CAB use (alcohol mixed with energy drinks, energy shots, or energy pills). These gaps in research are important because: (1) the pre-college demographic is a particularly vulnerable population; (2) the previous estimates of CAB use among college students have been based on samples at a single university; and (3) it is not known whether there are differences in risk associated with various types of caffeinated alcohol beverages.

1.4 Present study

In this study, we conducted an analysis of the use of CABs among underage youth ages 13–20 by using a survey of a nationally representative sample of underage youth drinkers. This study adds to the previous literature by: (1) estimating the prevalence of CAB use among pre-college adolescents; (2) estimating the prevalence of CAB use among older adolescents using a national sample; (3) estimating the prevalence of traditional and non-traditional CAB use among pre-college and older adolescents; and (4) comparing the adverse outcomes of traditional and non-traditional CAB use among pre-college and older adolescent drinkers.

2. Methods

The Youth Alcohol Brand Study has been reported in detail elsewhere (Siegel et al., 2013). In summary, an internet panel maintained by Knowledge Networks, Inc. was used to obtain a nationally representative sample of 1,031 youth ages 13–20 who had consumed at least one drink of alcohol in the past 30 days (Siegel et al., 2013). An online survey administered

to these youth assessed which brands of alcohol they had used in the past 30 days, the number of days they consumed each brand, and the typical number of drinks of that specific brand that they consumed on those days.

The 18–20 year old respondents received an email invitation asking for their participation while individuals aged 13–17 were identified by asking adult panelists to report if they had children in that age group. Respondents who agreed to participate in the study were emailed a link to a secure survey website. This protocol was approved by the Institutional Review Board of the Boston University Medical Center. The overall response rate for youth aged 18–20 was 43.4%, and the overall response rate for youth aged 13–17 was 44.4%.

Validation studies have demonstrated that behavioral data obtained from the Knowledge Networks panel compare closely with estimates derived from more traditional survey techniques, such as national household, telephone, or in-person surveys (Siegel et al., 2013). We have previously shown that estimates of current drinking obtained through a survey conducted by Knowledge Networks were similar to those from the National Epidemiologic Survey on Alcohol and Related Conditions, or NESARC (Heeren et al., 2008). Thus, the Knowledge Networks panel is a less expensive, viable alternative to telephone and in-person surveys for assessing drinking behavior.

Nevertheless, the survey response rate of 43% introduces the possibility of sampling bias. To assess this possibility, we compared 18–20 year-old respondents and non-respondents on basic demographic factors to help assess the nature of potential non-response bias, using a chi-square test to assess the significance of observed differences. The non-respondents were slightly older ($p < 0.05$), but similar in gender ($p = 0.41$). Non-respondents were more likely to be Black ($p < 0.0001$), to come from lower income households ($p < 0.01$), and not to have internet access ($p < 0.0001$). There were no substantial differences by region ($p = 0.11$). Thus, the main concern regarding sampling bias is the possibility that we obtained an under-sample of Black and lower-income adolescents.

While many caffeinated alcoholic beverage brands have been removed from the market or re-formulated without caffeine (e.g., Four Loko), there are still a number of spirits-based energy drinks on the market. Our survey measured the past 30-day consumption of 10 such brands. In addition, respondents were asked if they themselves added any caffeinated beverages to their alcohol within the past 30 days, and if so, on how many days they consumed such beverages during the past 30 days. Respondents were also asked to indicate what type of caffeinated products they added to their alcohol. In order to include caffeine mixed directly with alcohol as well as caffeine ingested immediately before or after the alcohol, the question was: “Please select all the substances that you remember adding to the alcohol you drank during the past 30 days or that you remember having immediately before or after drinking alcohol during the past 30 days.”

We defined traditional CABs as alcoholic beverages mixed with coffee, tea, or soda. We defined non-traditional CABs as pre-packaged alcoholic energy drinks or self-mixed alcoholic beverages containing energy drinks, energy shots, or caffeine pills.

We examined differences between traditional, non-traditional, and non-CAB users in risky drinking and other behaviors. These included: (1) number of drinking days per month; (2) average number of drinks per day; (3) total number of drinks per month; (4) binge drinking, (5) fighting (getting into a physical fight during the past 12 months); (6) alcohol related injury (sustaining an injury while drinking in the past 12 months); and (7) severity of alcohol related injury (having to see a medical professional for the injury). For the latter four outcomes, we conducted logistic regression analyses to estimate the relationship between traditional and non-traditional CAB use and these outcomes, while controlling for age,

gender, race/ethnicity, income, and general risk-taking (seat belt use, defined as always or nearly always wearing a seatbelt).

Knowledge Networks applied statistical weighting adjustments to account for selection bias, non-response to panel recruitment, and panel attrition. Post-stratification adjustments were made based on demographic distributions from the Current Population Survey (CPS). These adjustments were made for gender, age, race/ethnicity, census region, household income, home ownership status, metropolitan area, and household size.

3. Results

3.1 Prevalence of CAB consumption

Of the 1,031 participants in the study, 52.4% reported CAB consumption in the past 30 days (Table 1). Prevalence of CAB use by females and males was similar at 51.2% and 53.5% respectively. Chi-square test analyses revealed significant differences in CAB consumption among the different age groups ($p < 0.02$). There were no significant differences in CAB consumption by race/ethnicity and income.

3.2 Traditional vs. Non-traditional CAB use

The prevalence of traditional CAB use (45.6%) was much greater than that of non-traditional CAB use (19.6%) (Table 1). Most youth (65.0%) who consumed non-traditional CABs were also drinking traditional CABs. Older youth (ages 19–20) were significantly more likely to consume both traditional CABs ($p < 0.02$) and non-traditional CABs ($p < 0.04$) than youths ages 13–15 or 16–17. There were no significant differences in traditional or non-traditional CAB use by sex, race/ethnicity, or income.

3.3 Type of beverages or substances mixed with alcohol

Only 10.5% of the study subjects reported consuming pre-packaged caffeinated alcoholic beverages, while 50.6% reported self-mixing their alcohol with a caffeinated beverage (Table 2). The most common beverage added to alcohol was soda (40.7%), followed by energy drinks (11.6%), tea (8.2%), and coffee (6.5%). Caffeine pills had the lowest proportion of users (0.7%).

3.4 Drinking behavior

Teenagers who reported non-traditional CAB use in the past 30 days had significantly higher average days of drinking compared to traditional CAB users and non-CAB users (Table 3). The frequency of drinking among traditional CAB users was in between that of non-CAB users and non-traditional CAB users. A similar pattern was found for the average number of drinks consumed per day. Chi-square analyses revealed that both traditional and non-traditional CAB use were significantly associated with binge drinking behavior. More than three-quarters (77.8%) of non-traditional CAB users were binge drinkers compared to 63.5% of traditional CAB users and only 36.6% of non-CAB users. After controlling for age, sex, race/ethnicity, income, and seat belt use, non-traditional CAB users were over six times more likely to engage in binge drinking compared to non-CAB users (odds ratio [OR] = 6.3; 95% confidence interval [CI], 4.1–9.6; $p < 0.001$). Traditional CAB users were three times more likely to engage in binge drinking compared to non-CAB users (odds ratio [OR] = 3.1; 95% CI, 2.3–4.2; $p < 0.001$).

3.5 Adverse outcomes

Teenagers who consumed non-traditional CABS in the past 30 days thirty days had a higher proportion of adverse outcomes than teenagers who consumed traditional CABS or did not

consume CABS at all (Table 4). Adverse outcomes for traditional CAB users were in between those of non-CAB users and non-traditional CAB users. Chi-square analyses revealed a statistically significant association between CAB use and fighting (22.9% of non-traditional CAB users vs. 11.4% of traditional CAB users and 6.7% of non-CAB users). More than forty percent (41.2%) of non-traditional CAB users had alcohol-related injuries in comparison to 21.2% of traditional CAB users and 11.2% of non-CAB users. Chi-square analyses revealed a statistically significant association between traditional and non-traditional CAB use and sustaining injuries. Chi-square analyses also revealed a statistically significant relationship between non-traditional CAB use and having an injury requiring a doctor's visit. After controlling for age, sex, race/ethnicity, income, and seat belt use, youths who consumed non-traditional CABS were more than four times as likely to have engaged in fighting (OR = 4.4; 95% CI, 2.4–8.1), over five times as likely to have sustained an alcohol-related injury (OR=5.6, 95% CI, 3.6–8.7), but not more likely to have had an injury requiring a doctor's visit (OR=1.9, 95% CI, 0.8–4.4) when compared to non-CAB users. Traditional CAB users were more likely to have engaged in fighting than non-CAB users (OR=1.7, 95% CI, 1.0–2.9; $p<0.001$), twice as likely to have sustained an alcohol-related injury (OR = 2.0, 95% CI, 1.3–2.9; $p<0.001$), but less likely to have had an injury requiring a doctor's visit (OR = 0.3, 95% CI, 0.1–0.9; $p<0.001$).

4. Discussion

To the best of our knowledge, this is the first study to report CAB use among pre-collegiate adolescent drinkers and to differentiate between traditional and non-traditional CAB use. Previous studies have focused mainly on CAB use among college students. Approximately 48.4% of adolescent drinkers ages 13–15 and 45.3% of adolescent drinkers ages 16–18 reported CAB consumption in the past 30 days, compared to 58.4% of those ages 19–20. These findings suggest that CAB consumption among underage youth is not a phenomenon restricted to college-aged students. We found that the proportion of CAB use was substantial among drinkers in all age groups.

Our estimate of the use of non-traditional CABS among college-aged drinkers (19.6%) is similar to estimates reported in previous studies: 26% (Brache & Stockwell, 2011), 29% (Snipes & Benotsch, 2013), and 24% (O'Brien et al., 2008). We also found traditional CAB use to be considerably higher than non-traditional CAB use (45.6%). Most non-traditional CAB users were also consuming traditional CABS and it may be that consumption of traditional CABS lies along a pathway of progression towards the use of non-traditional CABS.

These results are particularly concerning because we also found that adolescents who consumed CABS (traditional and non-traditional) were more likely to drink larger amounts of alcohol, to drink more days in a month, and to engage in binge-drinking behavior. The results were particularly striking among non-traditional CAB users. In our study, adolescents who consumed alcohol mixed with energy drinks (non-traditional CAB users) had significantly more drinking days per month than traditional CAB users and almost twice the average drinking days per month as non-CAB users. Non-traditional CAB users also consumed almost triple the total number of drinks per month compared to non-CAB users, and had almost double the total number of drinks per month when compared to traditional CAB users. CAB users in our study were also more likely to experience adverse outcomes associated with drinking such as engaging in fights and sustaining alcohol-related injuries. Non-traditional CAB users were at higher risk for adverse outcomes than traditional CAB users.

The results from our study are consistent with evidence that caffeine use may alter drinking patterns in adolescents (Arria et al., 2010, 2011; Brach & Stockwell, 2011; O'Brien et al., 2008; Oteri et al., 2007; Simon & Mosher, 2007). While traditional caffeinated alcoholic beverage use (the mixture of alcohol with soda, tea, or coffee) is associated with heavier drinking patterns and greater risk of adverse outcomes, these risks are even higher when non-traditional caffeinated alcoholic beverage use is introduced. Our findings are consistent with previous evidence that mixing energy drinks with alcohol is associated with a greater risk for adverse outcomes of drinking and increased risk-taking behaviors (Brach & Stockwell, 2011; Marcinzki et al., 2011; O'Brien et al., 2008). Our findings extend the previous results by demonstrating that these relationships exist among young adolescents in addition to the college-aged population, and that non-traditional CAB use has greater adverse effects than traditional CAB use. This is alarming because earlier initiation of high-risk drinking among adolescents may lead to more adverse and prolonged outcomes later in life such as heavy episodic drinking, alcohol tolerance, alcoholism, risky behavior, and adverse health outcomes (Hingson et al., 2009).

Our results suggest that the majority of CAB use is attributable to self-mixing of CABs by the adolescents themselves, and that soda is the most commonly used caffeine additive to alcohol. This may reflect the widespread availability of soda and perhaps the ability to hide the use of alcohol by making it look like a youth is consuming soda.

The findings of this study, considered in light of the existing literature, suggest that CAB use, especially non-traditional CAB use, should be considered “high-risk” drinking for all underage youth. Efforts should be made to discourage the combined use of these substances. Previous attempts to address this problem have focused on the marketing of pre-mixed CABs (FDA, 2009, 2010; Health Canada, 2005; Jones & Barrie, 2009; Levy & Tapsell, 2007; Seetharaman, 2009). While it is important to regulate the sale of pre-mixed caffeinated alcoholic beverages, our study suggests that these concoctions are still available to many teenage drinkers who prefer to mix their caffeinated alcoholic beverages themselves instead of buying them pre-mixed. The use of self-mixed caffeinated alcoholic beverages suggests a more insidious problem that will prove difficult to regulate. Efforts targeted at educating teenagers about the effects of consuming CABs are therefore necessary.

4.1 Limitations

This study relied on cross-sectional data which prevents us from drawing any causal conclusion from our study. Specifically, we cannot determine whether the observed relationship between CAB use and risky drinking behavior and adverse outcomes is a causal one. While it is possible that engaging in CAB use causes the higher rate of adverse outcomes observed among these youth, it is also possible that an underlying predisposition to risky behavior precedes and causes the CAB use (Howland et al., 2010; Howland & Rohsenow, 2012). To answer this question, studies are needed which compare drinking and risk-taking behaviors in the same individuals when consuming alcohol with and without caffeine (Howland & Rohsenow, 2012).

In addition, the possibility of sampling bias must be considered. Our survey experienced differentially low response rates among Black and lower income adolescents. Therefore, the observed results may be under-representative of CAB use among these subpopulations. Because we found CAB use to be higher among Black and lower-income adolescents, we are most likely underestimating overall CAB use in the population of underage drinkers nationally.

4.2 Conclusions

Caffeinated alcoholic beverage use is common among pre-collegiate as well as collegiate adolescents who drink and consists primarily of the self-mixing of caffeine and alcohol. A novel and emerging public health concern is non-traditional caffeinated alcoholic beverage use. Adolescents who use non-traditional CABs are more likely to engage in heavier drinking, including binge drinking, and are also at increased risk for adverse alcohol-related outcomes compared to traditional and non-CAB users. Pre-collegiate adolescents are particularly vulnerable to the risks of earlier and risky drinking behavior. Future research is needed to investigate the location and contexts associated with traditional and non-traditional CAB use among underage youth, motivations for traditional and non-traditional CAB use among these youth, and the effectiveness of interventions designed to reduce non-traditional and traditional CAB use in this population.

Acknowledgments

Role of Funding Sources

Funding for this study was provided by the National Institute on Alcohol Abuse and Alcoholism Grant # R01 AA020309-01. The National Institute on Alcohol Abuse and Alcoholism had no role in the study design, collection, analysis or interpretation on the data, writing the manuscript, or the decision to submit a paper for publication.

Abbreviations

CAB Caffeinated alcoholic beverage

References

- Arria AM, Caldeira KM, Kasperski SJ, et al. Increased alcohol consumption, nonmedical prescription drug use, and illicit drug use are associated with energy drink consumption among college students. *Journal of Addiction Medicine*. 2010; 4:74–80. [PubMed: 20729975]
- Arria AM, Caldeira KM, Kasperski SJ, et al. Energy drink consumption and increased risk for alcohol dependence. *Alcoholism: Clinical and Experimental Research*. 2011; 35:365–375.
- Berger LK, Fendrich M, Chen H, Arria A, Cisler RA. Sociodemographic correlates of energy drink consumption with and without alcohol: Results of a community survey. *Addictive Behaviors*. 2011; 36:516–519. [PubMed: 21276661]
- Brach K, Stockwell T. Drinking patterns and risk behaviors associated with combined alcohol and energy drink consumption in college drinkers. *Addictive Behaviors*. 2011; 36:1133–1140. [PubMed: 21840130]
- Brache, K.; Stockwell, T. Patterns, settings, and functions of simultaneous use of alcohol and psychostimulants: a literature review; Canada. Paper presented at the 34th Annual Alcohol Epidemiology Symposium of the Kettil Brunn Society for Social and Epidemiologic Research on Alcohol, Victoria; 2008.
- Burns M, Moskowitz H. Two experiments on alcohol-caffeine interaction. *Alcohol, Drugs, and Driving*. 1990; 5:303–315.
- Centers for Disease Control and Prevention. Alcohol-related Disease Impact (ARDI). 2013. <http://apps.nccd.cdc.gov/ardi/homepage.aspx> June 1, 2013
- Courtney K, Polich J. Binge drinking in young adults: Data, definitions, and determinants. *Psychological Bulletin*. 2009; 135:142–156. [PubMed: 19210057]
- Ferreira SE, de Mello MT, Pompeia S, de Souza-Formigoni ML. Effects of energy drink ingestion on alcohol intoxication. *Alcoholism: Clinical and Experimental Research*. 2006; 30:598–605.
- Food and Drug Administration. FDA to look into safety of caffeinated alcoholic beverages: agency sends letters to nearly 30 manufacturers. 2009. <http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/2009/ucm1904427.htm> June 1, 2013

- Health Canada. Safe use of energy drinks. 2005. http://www.hc-sc.gc.ca/hl-vs/air_formats/pacrb-dgapcr/pdg/iyh-vsv/prod/energy-energie-eng.pdf June 1, 2013
- Heeren T, Edwards EM, Dennis JM, Rodkin S, Hingson RW, Rosenbloom DL. A comparison of results from an alcohol survey of a prerecruited internet panel and the National Epidemiologic Survey on Alcohol and Related Conditions. *Alcoholism: Clinical & Experimental Research*. 2008; 32:222–229.
- Hingson RW, Edwards EM, Heeren T, Rosenbloom D. Age of drinking onset and injuries, motor vehicle crashes, and physical fights after drinking and when not drinking. *Alcoholism: Clinical & Experimental Research*. 2009; 33:783–390.
- Howland J, Rohsenow JD, Arnedt T, et al. The acute effects of caffeinated versus non-caffeinated alcoholic beverage on driving performance and attention/reaction time. *Addiction*. 2010; 106:335–341. [PubMed: 21134017]
- Jones, SC.; Barrie, L. Alcohol-energy drinks: Engaging young consumers in co-creation of alcohol related harm; Proceedings of the Australian and New Zealand Market Academy Conference (AnZMaC); 2009. p. 1-81.
- Levy G, Tapsell L. Shifts in purchasing patterns of non-alcoholic, water based beverages in Australia, 1997–2006. *Nutrition and Dietetics*. 2007; 64:268–279.
- Marcinzi CA, Filmore MT, Bardgett ME, Howard MA. Effects of energy drinks mixed with alcohol on Behavioral control: Risks for college students consuming trendy cocktails. *Alcoholism: Clinical and Experimental Research*. 2011; 35:1–11.
- Mayberger, CL. Four Loko a.k.a blackout in a can: The federal regulation of caffeinated alcoholic beverages. Cambridge, MA: Harvard University; 2011. <http://dash.harvard.edu/bitstream/handle/1/8592152/Mayberger.Food%20and%20Drug%20Law%20Paper.Caffeinated%20Alcoholic%20Beverages.pdf?sequence=1> June 1, 2013
- Miller JW, Naimi TS, Brewer RD, Jones SE. Binge drinking and associated health risk behaviors among high school students. *Pediatrics*. 2007; 119:76–85. [PubMed: 17200273]
- O'Brien MC, McCoy TP, Rodes SD, Wagone A, Wolfson M. Caffeinated cocktails: energy drink consumption, high-risk drinking, and alcohol-related consequences among college students. *Academic and Emergency Medicine*. 2008; 15:453–360.
- Reissig CJ, Strain EC, Griffiths RR. Caffeinated energy drinks-A growing problem. *Drug Alcohol Dependence*. 2009; 99:1–10. [PubMed: 18809264]
- Rossheim ME, Thombs DL. Artificial sweeteners, caffeine, and alcohol intoxication in bar patrons. *Alcoholism: Clinical & Experimental Research*. 2011; 35:1891–1896.
- Seetharaman, D. FDA killing buzz on alcohol and energy drinks. *National Post*. 2009. <http://www.nationapost.com/life/health/story.html?id=ac50aba2-6b6c-4135-a333-cf6ed75cfcdb> June 1, 2013
- Siegel M, DeJong W, Naimi T, et al. Brand-specific consumption of alcohol among underage youth in the United States. *Alcoholism: Clinical and Experimental Research*. 2013; 37:1195–1203.
- Simon, M.; Mosher, J. Alcohol, energy drinks, and youth: A dangerous mix. San Rafael, CA: Marin Institute; 2007.
- Thombs DL, O'Mara RJ, Tsukamoto M, et al. Event-level analyses of energy drink consumption and alcohol intoxication in bar patrols. *Addictive Behaviors*. 2010; 35:325–330. [PubMed: 19954894]
- Thombs DL, Rossheim M, Barnett TE, Weiler RM, Moorhouse MD, Coleman BN. Is there a misplaced focus on AmED? Associations between caffeine mixers and bar patron intoxication. *Drug and Alcohol Dependence*. 2011; 116:31–36. [PubMed: 21177047]
- U.S. Food and Drug Administration. FDA warning letters issued to four makers of caffeinated alcoholic beverages. FDA News Release. 2010. <http://www.fda.gov/NewsEvents/newsroom/PressAnnouncements/ucm234109.htm> June 1, 2013

Highlights

- We surveyed a nationally representative sample of 1,031 underage drinkers.
- We measured caffeinated alcoholic beverage (CAB) use in the past 30 days.
- The overall prevalence of CAB use was 52.4%; 48.4% among 13–15 year-olds.
- The prevalence of non-traditional CAB use was 19.6%; 17.1% among 13–15 year-olds.
- The use of CABs was associated with heavier drinking and adverse consequences.

Table 1

Prevalence of CAB consumption in the past 30 days among underage drinkers.

	Overall CAB Use			Traditional CAB Use ^a			Non-traditional CAB Use ^a		
	Percent (%)	95% CI	Percent (%)	95% CI	Percent (%)	95% CI	Percent (%)	95% CI	
Total (N=1,031)	52.4	(47.4, 57.4)	45.6	(40.5, 50.6)	19.6	(15.5, 23.8)			
Sex									
Male (N=428)	53.5	(46.2, 60.9)	45.4	(37.9, 52.9)	23.0	(16.6, 29.4)			
Female (N=603)	51.2	(44.6, 57.9)	45.7	(39.0, 52.4)	16.1	(10.9, 21.3)			
Age									
13–15 (N=117)	48.4*	(36.5, 60.2)	42.4*	(30.8, 54.0)	17.1*	(7.4, 26.9)			
16–18 (N=461)	45.3*	(39.2, 51.4)	38.3*	(32.3, 44.4)	14.4*	(10.4, 18.5)			
19–20 (N=453)	58.4*	(50.4, 66.5)	51.5*	(43.3, 59.7)	24.0*	(16.8, 31.1)			
Race/Ethnicity									
Black Non-Hispanic (N=126)	53.4	(38.1, 68.8)	49.2	(33.5, 64.9)	28.6	(13.4, 43.8)			
White Non-Hispanic (N=592)	49.5	(43.1, 56.0)	42.1	(35.7, 48.5)	15.5	(10.4, 20.6)			
Hispanic (N=214)	54.9	(44.3, 65.5)	46.8	(35.9, 57.7)	21.9	(13.2, 30.7)			
Income									
Less than 15,000 (N=235)	59.2	(48.0, 70.5)	51.7	(40.3, 63.1)	30.4	(19.4, 41.4)			
15,000–39,999 (N=270)	53.1	(42.7, 63.6)	46.5	(35.8, 57.3)	19.2	(11.1, 27.3)			
40,000–99,999 (N=365)	50.8	(43.0, 58.5)	41.3	(33.5, 49.1)	18.8	(12.3, 25.3)			
100,000 or more (N=161)	50.3	(39.0, 61.6)	48.2	(36.8, 59.6)	14.5	(5.6, 23.4)			

^aTraditional CAB use = self-mixed alcohol with soda, coffee, or tea. Non-traditional CAB use = Pre-packed alcoholic energy drinks and self-mixed alcohol and energy drink, energy shot, or caffeine pill.

* Differences in proportions are significant by chi-square test at p<.05.

Table 2

CAB use among underage drinkers: Overall and by sex and age (n=1,031) (% and 95% confidence intervals).

	Total	Males	Females	13-15	16-18	19-20
Any CAB use	52.4 (47.4, 57.5)	53.5 (46.2, 60.9)	51.2 (44.6, 57.9)	48.3 (36.4, 60.3)	45.3 (39.2, 51.5)	58.4 (50.4, 66.5)
Pre-Packaged	10.5 (7.2, 13.9)	12.3 (7.2, 17.3)	8.8 (4.3, 13.2)	12.5 (3.2, 12.8)	7.5 (4.3, 10.8)	12.3 (6.5, 18.2)
Self-Mixed	50.6 (45.6, 55.5)	51.0 (43.7, 58.5)	50.0 (43.3, 56.7)	43.6 (31.8, 55.4)	43.3 (37.2, 49.3)	57.2 (49.2, 65.4)
Soda	40.7 (35.7, 45.6)	40.8 (33.3, 48.3)	40.5 (34.0, 47.0)	38.3 (26.8, 49.8)	34.3 (28.4, 40.2)	45.8 (37.6, 54.0)
Energy Drink	11.6 (8.3, 14.9)	12.1 (7.2, 17.0)	11.1 (6.6, 15.5)	7.7 (0.78, 14.6)	7.4 (4.5, 10.3)	15.5 (9.7, 21.3)
Energy shot	3.1 (1.4, 4.9)	4.7 (1.6, 7.9)	1.5 (.26, 2.7)	0.9 (0.0, 2.4)	3.3 (1.1, 5.4)	3.5 (0.6, 6.4)
Coffee	6.5 (3.9, 9.1)	6.6 (2.8, 10.4)	6.4 (2.9, 9.9)	7.7 (1.8, 13.7)	5.6 (2.3, 9.0)	6.9 (2.7, 11.1)
Tea	8.2 (5.4, 11.1)	9.3 (5.0, 13.6)	7.1 (3.3, 10.9)	7.4 (1.8, 13.1)	6.0 (3.0, 8.9)	10.0 (5.0, 15.0)
Caffeine pill	0.7 (0.0, 1.5)	0.7 (.55, 1.8)	0.8 (0.0, 1.8)	0.6 (0.0, 1.7)	0.3 (0.0, 0.7)	1.1 (0.0, 2.5)

Table 3

Relationship of CAB use to risky drinking behavior.

	Average days of drinking per month (standard error)*	Average drinks per day (standard error)*	Average total number of drinks per month (standard error)*	% Binge drinkers	Adjusted odds ratio (95% CI) ^a for binge drinking
Non-Traditional CAB Users ^b	7.8* (0.6)	4.0* (0.3)	38.8* (4.0)	77.8**	6.3 (4.1, 9.6)
Traditional CAB users only	5.5*(0.3)	3.5* (0.2)	22.3* (1.6)	63.5**	3.1 (2.3, 4.2)
Non-CAB Users	4.3* (0.2)	2.8* (0.1)	13.7* (1.1)	36.6**	1.0

^a Odds ratio adjusted for age, gender, race/ethnicity, income, and seat belt use.

^b Includes respondents who consumed both non-traditional and traditional CABs.

* Differences in means are significant by t-test procedure at p<.05. Means for each group are significantly different than those for each other group.

** Differences in proportions are significant by logistic regression analyses at p<.05. Proportions for each group are significantly different than those for each other group.

Table 4

Adverse outcomes associated with CAB use.

	Fighting, %	Adjusted odds ratio (95% confidence interval) ^a for fighting	Alcohol-related injury, %	Adjusted odds ratio (95% confidence interval) ^a for alcohol-related injury	Injury requiring doctor visit, %	Adjusted odds ratio (95% confidence interval) ^a for injury requiring doctor visit
Non-traditional CAB user ^b	22.9 ^{cd}	4.4 (2.4-8.1)	41.8 ^c	5.6 (3.6, 8.7)	8.1 ^{cd}	1.9 (0.8, 4.4)
Traditional CAB user only	11.4 ^d	1.7 (1.0-2.9)	21.2 ^c	2.0 (1.3, 2.9)	1.2 ^d	0.3 (0.1, 0.9)
Non-CAB user	6.7 ^c	1.0	11.2 ^c	1.0	3.4 ^c	1.0

^aOdds ratio adjusted for age, sex, race/ethnicity, income, and seat belt use.

^bIncludes respondents who consumed both non-traditional and traditional CABs.

^{cd}Letters which appear in two different rows indicate that differences in proportions between those two rows are statistically significant at p<0.05 level.