



Full length article

Alcohol mixed with energy drinks: Associations with risky drinking and functioning in high school

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ABSTRACT

Background: Mixing alcohol with energy drinks is associated with heavier drinking and related problems among college students. However, little is known about how high school drinkers who mix alcohol with energy drinks (AmED) compare to those who do not (AwoED). This study compares high school AmED and AwoED users on their alcohol use during middle and high school, as well as key domains of functioning in high school.

Methods: Two surveys were conducted three years apart in adolescents initially recruited from 16 middle schools in Southern California. The analytic sample consists of 696 past month drinkers. Multivariable models compared AmED and AwoED users on alcohol use, mental health, social functioning, academic orientation, delinquency and other substance use at age 17, and on their alcohol use and related cognitions at age 14.

Results: AmED was reported by 13% of past month drinkers. AmED and AwoED users did not differ on alcohol use or cognitions in middle school, but AmED users drank more often, more heavily, and reported more negative consequences in high school. AmED users were also more likely to report poor grades, delinquent behavior, substance use-related unsafe driving, public intoxication, and drug use than AwoED users in high school. Group differences were not found on mental health, social functioning, or academic aspirations.

Conclusions: AmED use is common among high school drinkers. The higher risk behavioral profile of these young AmED users, which includes drug use and substance use-related unsafe driving, is a significant cause for concern and warrants further attention.

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1. Introduction

Both alcohol use and energy drink consumption are widespread among high school students. According to national data, 37% of 12th graders report drinking alcohol in the past 30 days (Miech et al., 2015), and 30% report consuming energy drinks or shots (Terry-McElrath et al., 2014). Energy drink consumption poses its own health risks for young people (Arria et al., 2011; Seifert et al., 2011), but using it as a mixer for alcoholic beverages (e.g., Red Bull with vodka) has been identified as a particularly high-risk drinking behavior (Marczinski and Fillmore, 2014; McKetin et al., 2015). Despite a ban on the marketing and distribution of prepackaged caffeinated alcoholic drinks by the U.S. Food and Drug Administration (FDA), adolescents' consumption of alcohol mixed with energy

drinks (AmED) is likely to be a continuing public health concern for the foreseeable future.

Although there has been little research on AmED use among adolescents, studies of college students provide valuable insights into the reasons why young people engage in AmED use and the behavioral correlates of this drinking behavior (Striley and Khan, 2014). Various motivations and expectancies for using AmEDs have been reported by college students (Droste et al., 2014). Some of these are neutral with regard to alcohol use, such as liking the taste of AmEDs, using it to celebrate a special occasion, and wanting to drink something different (Verster et al., 2014). However, other expectations are more negative in terms of their expected effects on alcohol consumption, such as AmED use hastening the onset of intoxication (Marczinski et al., 2011), reducing the sedative effects of drunkenness (Marczinski et al., 2011), and being able to sober up more quickly (Woolsey et al., 2010). Expectations that some of the potential deterrents to alcohol use are ameliorated by mixing it with energy drinks may lead some young people to engage in

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riskier drinking when mixing alcohol with energy drinks. This is consistent with results from studies of college students which have consistently shown that AmED users engage in heavier drinking, experience more frequent drunkenness, and have more negative alcohol-related outcomes compared to those who consume alcohol without energy drinks (AwoED; e.g., Brache and Stockwell, 2011; Mallett et al., 2015; Patrick and Maggs, 2014; Woolsey et al., 2010, 2015).

In addition to its association with heavier drinking and alcohol-related negative outcomes, college students who engage in AmED use are more likely to report engagement in other problem behaviors such as illicit drug use (Brache and Stockwell, 2011; Snipes and Benotsch, 2013) and high-risk sexual behavior (Snipes and Benotsch, 2013). There is also some limited evidence for impairment in social functioning, as AmED users have a higher likelihood of being involved in verbal altercations with others (Brache and Stockwell, 2011). For at least some of these problem behaviors, the association appears to be due to a higher general risk taking tendency among AmED users (Brache and Stockwell, 2011).

Despite approximately 25% of high school seniors in the U.S. reporting AmED use in the past year (Martz et al., 2015), few studies have focused on AmED use or its correlates in this younger age group. National data comparing 12th graders who had engaged in past year AmED use to those who had not found that AmED users were more likely to be male and non-Hispanic white, have academic problems (poor grades, cutting class), and engage in heavy drinking and drug use (Martz et al., 2015). Two additional studies focused specifically on lifetime alcohol users, comparing those who had ever engaged in AmED use and those who had not. One of these studies involved a U.S. national sample of 15–23 year olds, finding that AmED users were more likely to engage in hazardous alcohol use, with no evidence that this differed by age (Emond et al., 2014). The other study involved a survey of 15–19 year olds in the South of Italy (Flotta et al., 2014), finding that AmED users were more likely to be male, and to have a greater number of sex partners, ever used marijuana, and ridden with a driver who had been drinking alcohol. Another study of past month alcohol users between ages of 13–18 found that AmED use was associated with tobacco and marijuana use and nonmedical use of prescription stimulants (Khan et al., 2016). Finally, a study of 16–17 year olds in Iceland found a strong association between lifetime frequency of AmED use and lifetime frequency of drunkenness (Kristjansson et al., 2015). Together, this small literature suggests that the higher risk profile of AmED users is not limited to college students, but is found among adolescent AmED users as well in the areas of alcohol and illicit drug use, academic disengagement, and social activities.

The present study significantly extends these few cross-sectional studies on AmED use among high school students in several respects. Focusing on current (past month) alcohol users, we first compare those who mix alcohol with energy drinks (AmEDs) and those who do not (AwoEDs) on demographic characteristics (race/ethnicity, gender, maternal education, and household composition). The racial/ethnic comparison is particularly important given that previous studies, both of adolescents and college students, have tended to use predominantly non-Hispanic White samples. Using longitudinal data, we then compared these two groups on their alcohol behaviors and cognitions three years earlier to examine whether AmED users would already be showing a higher risk profile in middle school. Finally, we compared AmED and AwoED users on their current alcohol use, as well as a range of other indicators of functioning that included mental health, social functioning, academic orientation, delinquency, and other substance use. We hypothesized that AmED users would report

heavier drinking, more negative alcohol-related consequences, and poorer functioning in high school compared to AwoED users.

2. Methods

2.1. Participants and procedures

Participants originated from 16 middle schools across three school districts in southern California that were part of a large, ongoing longitudinal study with a voluntary after-school substance use prevention intervention that occurred in 2008 (D'Amico et al., 2012). As previously reported, 92% of parents returned a consent form at the baseline, 71% of parents gave permission for their child to participate in the original study, and 94% of consented students completed the baseline survey (D'Amico et al., 2012). We continued to follow two cohorts of youth (the original 6th grade cohort, and the original 7th grade cohort) throughout middle school (Waves 2–5) and into late adolescence (Waves 6–7). The survey for the current study was administered online between May 2014 and May 2015 (Wave 7) when the energy drink measures were added to the survey and youth were on average 17.3 years old ($n=2493$). The analytic sample for the cross-sectional late adolescence analyses was restricted to $n=696$ youth who reported having at least one drink of alcohol in the past 30 days on the Wave 7 survey. The analytic sample for the longitudinal analyses, which was further restricted to those with middle school data (Wave 5), was $n=537$ with a mean age of 14.3 years old. Missingness was less than 0.5% for all variables except mother's education (which was 4.5%).

2.2. Measures

2.2.1. Covariates. These included race/ethnicity, age, gender, mother's education, family structure, and an indicator for whether the student had attended one of the original intervention schools. Based on the distributions for race/ethnicity, participants were classified as non-Hispanic white, Hispanic, Asian, and Multiracial/Other (African American, American Indian, Native Hawaiian, or Multiracial).

2.2.2. Alcohol use. Past month drinking was assessed with separate items asking how many days they consumed: (a) at least one drink of alcohol; and (b) at least one energy drink mixed with alcohol ($0=0$ days to $6=20-30$ days) (Ellickson et al., 2003; WestEd, 2008). Participants were included in the analyses if they reported any past month alcohol use. They were then classified in terms of whether they mixed alcohol with energy drinks in the past month based on the latter item. Quantity of use was assessed by asking how many drinks they have on the days they drink alcohol. We also examined two indicators of potential higher-risk drinking: whether they ever drank alcohol while alone (Tucker et al., 2006a, 2014) and age of alcohol use initiation.

2.2.2. Alcohol cognitions. Positive expectancies about alcohol (e.g., "alcohol relaxes you"), negative expectancies about alcohol (e.g., "alcohol makes you do things you might regret"), and resistance self-efficacy (RSE) for alcohol use were measured with scales developed in Project ALERT (Ellickson et al., 2003). Items were rated on a scale from 1 = *strongly disagree* to 4 = *strongly agree* (Orlando et al., 2005), with average higher scores indicating stronger agreement with the expectancies (positive $\alpha=0.79$; negative $\alpha=0.77$). RSE consisted of three items assessing the respondent's ability to refuse alcohol if offered in different social situations ($1=I$ would definitely use to $4=I$ would definitely not use), with average higher scores indicating higher RSE ($\alpha=0.95$). Perceived peer prevalence of alcohol use was assessed by asking how many of their peers out of 100 they thought had consumed at least one drink in the past month

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