Short Communication

Mixing alcohol with artificially sweetened beverages: Prevalence and correlates among college students

Amy L. Stamates [a], Ashley N. Linden-Carmichael [a], Cathy Lau-Barraco [a,b,*]

[a] Old Dominion University, USA
[b] Virginia Consortium Program in Clinical Psychology, USA

HIGHLIGHTS

- Approximately one-third of our sample reported mixing alcohol with diet beverages
- Compared to non-users, users experienced more problems, above typical alcohol use and sensation seeking.
- No differences were observed on gender, eating behaviors while drinking, and BMI.
- Mixing alcohol with diet beverages may pose as a risk-factor for experiencing alcohol-related harms.

ARTICLE INFO

ABSTRACT

Mixing alcohol with diet beverages, as compared to mixing the same amount of alcohol with a regular beverage, is associated with greater intoxication. This may occur because diet mixers increase alcohol absorption rates. Thus, it is plausible that the use of diet mixers may increase the risk of alcohol-related harms. The current study sought to (1) determine the rate/frequency of use in among college students, (2) examine the relationship between mixing alcohol with diet beverages and alcohol-related problems, above typical alcohol use and sensation seeking, and (3) explore key traits (gender, restricting food while drinking, and body mass index [BMI]) that may characterize users. Participants were 686 (73% female) undergraduate students who completed self-reports of alcohol use (including diet mixer use), alcohol-related problems, eating behaviors while drinking, sensation seeking, and demographic information. Results revealed that about 36% of the sample reported consuming alcohol with diet mixers, and users typically consumed this beverage at least once a month. Students who reported mixing alcohol with diet beverages experienced more alcohol-related problems. And, the more frequently one consumed this beverage, the more problems were reported. These associations were found after controlling for typical level of alcohol use and sensation seeking. No differences were observed between user-status on gender, eating behaviors while drinking, and BMI. Our findings suggest that mixing alcohol with diet beverages could be a risk factor for experiencing more alcohol-related harms. Further research is needed to understand this relationship, as it may help guide intervening efforts aimed to reduce alcohol-related risks.

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1. Introduction

Mixing alcohol with artificial sweeteners (i.e., diet beverages) has been linked to greater objective levels of intoxication, such as higher breath alcohol concentrations (BrACs; Irwin, Shum, Desbrow, & Leveritt, 2014; Marczinski & Stamates, 2013; Stamates, Maloney, & Marczinski, 2015) and blood alcohol concentrations (BACs; Wu et al., 2006). This may be because diet mixers facilitate faster alcohol absorption rates (see Marczinski & Stamates, 2013 for discussion). For

example, participants consuming diet mixed beverages report faster gastric emptying times (i.e., their stomachs processed the beverage more quickly) than when given a regular mixed beverage (Wu et al., 2006). Faster gastric emptying times in combination with higher BACs suggest that a diet mixer may offer no buffer in the stomach; thus, alcohol is more quickly able to be absorbed in the small intestine and into the bloodstream. Field research (Rossheim & Thombs, 2011) and within-in-subject experiments support associations between diet mixers and greater intoxication (Irwin et al., 2014; Marczinski & Stamates, 2013), even at varying doses of alcohol (Stamates et al., 2015). Importantly, drinkers are unaware of differences in intoxication between these beverages, as studies indicated no difference in subjective impairment and willingness to drive (Irwin et al., 2014; Marczinski & Stamates, 2013).

* Corresponding author at: Old Dominion University, 244D Mills Godwin Building, Norfolk, VA 23529-0267, USA.
E-mail address: cbarraco@odu.edu (C. Lau-Barraco).

Although evidence supports that diet mixers can increase one's level of intoxication, no research has explored whether consumers of alcohol with diet beverages are at greater risk for more global alcohol-related harms. Given the physiological evidence that diet mixers increase intoxication, it is plausible that its consumers may be at greater risk for experiencing negative consequences.

In addition to understanding the relationship between mixing alcohol with diet beverages and harms, identifying characteristics of consumers may help determine one's likelihood of use. Potential characteristics may include gender, eating while drinking behaviors, and BMI. Women may be more likely to be consumers (Rossheim & Thombs, 2011), as they are more likely to report consuming diet beverages in general (Fowler et al., 2008) potentially due to weight concerns (i.e., limiting calories consumed; Levy & Heaton, 1993). Relatedly, it also may be possible that consumers engage in other compensatory eating behaviors that affect intoxication, such as restricting food prior to/ while drinking (e.g., Bryant, Darkes, & Rahal, 2012; Luce, Crowther, Leahey, & Buchholz, 2013). Moreover, given that diet mixers may be a calorie-conscious choice, it is possible that differences in BMI may exist between users and non-users. Consuming alcohol with diet mixers in addition to these characteristics could be a risky combination that leads to unintended quicker alcohol absorption and subsequently greater intoxication.

The present study examined the use of diet beverage mixers with alcohol among college students. Although evidence has indicated that mixing alcohol with diet beverages can result in elevated intoxication, no research has examined its relationship with alcohol-related problems. Furthermore, no studies have investigated how frequently alcohol with diet mixers are consumed. Such information could inform whether education on this drinking behavior is warranted. Consequently, the current study had the following aims: (1) to determine the rate of use in a college student sample, (2) to examine the relationship between diet mixer use and alcohol-related problems, while controlling for sensation seeking (a risky drinking correlate characterized by seeking out novel/thrilling activities; Peacock & Bruno, 2013) and typical alcohol use and (3) to explore relevant key traits (gender, restricting food while drinking, BMI) that may be characteristic of consumers.

2. Method

2.1. Participants and procedure

Participants were 686 (501 female) young adult (i.e., 18 to 25 years) college student drinkers recruited from an undergraduate psychology research pool at a mid-size East Coast university. Mean age was 20.28 ($SD = 1.96$) years. Class standing was freshmen (30.3%), sophomores (22.3%), juniors (22.0%), seniors (23.5%), "other" (1.3%), and 0.6% did not respond. The sample's ethnicity was Caucasian/White (48.0%), African American/Black (35.3%), Asian/Pacific Islander (5.4%), Hispanic/Latino (5.0%), Native American/Indian (1.0%), self-identified as "other" (5.2%), and 0.1% did not respond. Average overall alcohol consumption was 10.63 ($SD = 9.21$) drinks per week and average BMI was 24.86 ($SD = 4.96$).

Data collection was administered online via a psychology research system. All participants provided informed consent, completed a battery of self-report questionnaires, and were awarded course credit. The present study was approved by the university's institutional review board and followed American Psychological Association (2010) guidelines.

2.2. Measures

To assess diet user status, participants were asked, "Do you mix alcohol with diet mixers?" Participants were provided examples (e.g., rum/ diet soda, diet energy drinks/vodka). Diet user status was coded as non-

user (0) or user (1). For frequency, participants were asked how often they consumed alcohol with diet mixers in the past year. Participants could choose from eight responses that ranged from I don't drink alcohol with diet mixers (1) to every day or nearly every day (8). Those who reported that they did not drink diet mixers were excluded from analyses involving frequency. Alcohol use was assessed with the Daily Drinking Questionnaire (DDQ; Collins, Parks, & Marlatt, 1985) where participants were asked to report the number of all standard alcoholic beverages they consumed during a typical week in the past three months. Quantity (i.e., total number of drinks consumed during an average week) was used as an indicator of alcohol use. We also included a question to calculate peak estimated BAC (eBAC; i.e., "In the past 30 days, on my heaviest drinking day I consumed ___ drinks over ___ hours") using a modified formula (Piasecki, Wood, Shiffman, Sher, & Heath, 2012). The 48-item Young Adult Alcohol Consequences Questionnaire (YAACQ; Read, Kahler, Strong, & Colder, 2006) was used to measure past-year alcohol-related problems with yes (2) or no (1) response options with the following subscales: social/interpersonal, self-perception, self-care, risky behavior, academic/occupational, physical dependence, blackout drinking, and impaired control. Internal consistency was 0.95. A modified version of the Eating Habits Before and During Drinking subscale from the Eating and Alcohol Use Questionnaire (EAUQ; Lloyd-Richardson, Lucero, DiBello, Jacobson, & Wing, 2008) measured participants' eating and drinking before/during a drinking episode with response options of much less than usual (-2) to much more than usual (2). The 8-item Brief Sensation Seeking Scale (BSSS; Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002) was used to measure sensation seeking. Participants report the extent to which they strongly disagree (1) to strongly agree (5) with statements such as, "I get restless when I spend too much time at home." Internal consistency was $\alpha = 0.83$. Finally, participants completed demographic information including gender, height, and weight to calculate BMI and eBAC.

3. Results

Prior to conducting analyses, data were inspected for outliers and missing data. Extreme outliers were transformed to match the next highest score to reduce their impact (Barnett & Lewis, 1994). Missing data ranged from 0% to 11.7% across study variables.

Descriptive statistics revealed that 36.2% of our sample reported drinking alcohol with diet mixers. Among users, most reported using two or three times a week (28.5%). Other responses were less than once a month (23.4%), about once a month (19.5%), once or twice a week (16.4%), not in the last year (6.6%), three or four times a week (3.9%), and every day or nearly every day (1.6%).

A multivariate analysis of covariance was used to test differences between users and non-users on all YAACQ subscales while controlling for sensation seeking and typical alcohol use. The overall effect was significant, Pillai's Trace (V) = 0.07, $F(8, 528) = 4.97$, $p < 0.001$, partial $\eta^2 = 0.070$. Follow-up analyses indicated that users experienced greater alcohol-related problems than non-users across all subscales, except risky behaviors (see Table 1). A hierarchical linear regression indicated that more frequent use of alcohol with diet mixers was associated with higher total YAACQ scores after controlling for covariates, $B = 1.99$, $\beta = 0.26$, $SE = 0.54$, $p < 0.001$.

Users were compared to non-users regarding alcohol use, eating and alcohol use behaviors before and after drinking, BMI, and gender (see Table 2). Independent t-tests revealed that users reported heavier alcohol use quantity and peak eBAC in the past month. Users did not differ from non-users on eating behaviors or BMI. A chi-square test user status did not vary by gender, $\chi^2 (1, N = 685) = 1.30$, $p = 0.254$. Among men, 32.6% ($n = 60$) reported as users and among women, 37.3% ($n = 187$) reported as users. Men ($M = 4.52$, $SD = 1.50$) and women ($M = 4.40$, $SD = 1.32$) did not differ in diet use frequency, $t(253) = 0.63$, $p = 0.527$.