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Mixing Alcohol with Artificially Sweetened Beverages: Prevalence and Correlates among College Students

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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.

Keywords

alcohol consumption; artificial sweeteners; diet; alcohol problems

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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, Chaikomin, Doran, Horowitz, & Rayner, 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-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). 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, Williams, Resendez, Hunt, Hazuda, & Stern, 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 .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, Jacobsen, & 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 $\alpha = .83$. Finally, participants completed demographic information including gender, height, and weight to calculate BMI.

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) = .07, $F(8, 528) = 4.97$, $p < .001$, partial $\eta^2 = .070$. 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, $B = 1.99$, $\beta = .26$, $SE = 0.54$, $p < .001$.

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, χ^2 (1, $N = 685$) = 1.30, $p = .254$. 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, $t(253) = 0.63$, $p = .527$.

4. Discussion

The present study examined the consumption of alcohol with diet beverages among college students. Approximately one-third of our sample reported that they consumed alcohol with diet beverages. Regarding use frequency, most reported drinking diet mixers at least once a month. Users consumed more alcohol in general and reported an overall higher peak eBAC during the past month than non-users. One explanation for these findings may be that users believe that because this mixed beverage is a low-calorie choice, they can consume more alcohol with lower risk of adding unwanted calories.

We compared users and non-users on alcohol-related problems, while controlling for typical alcohol use and sensation seeking. We found that users reported more experiences with alcohol-related problems (i.e., social problems, blacking out). We also found that among users, more frequent diet mixer use is linked with more problems reported. Thus, mixing alcohol with diet beverages and mixing diet beverages more frequently is associated with greater alcohol-related harms. Users appear to be at greater risk for experiencing more harms.

Lastly, we compared users and non-users on key traits (i.e., gender, eating while drinking behaviors, and BMI). Although past research indicates that women may be more likely to consume alcohol mixed with diet beverages (Rossheim & Thombs, 2011) to limit caloric intake (Levy & Heaton, 1993), and that individuals with certain BMIs may use dietary restrictions to control calories during drinking occasions (Bryant et al., 2012; Luce et al., 2013), we found no differences between user status on these characteristics. These findings are important as each of these traits could affect intoxication, and thus contribute to alcohol harms. Given that none of these characteristics were relevant in describing users in our sample, the association between diet mixer use and harms may be the result of greater objective intoxication. This may be due to the pharmacological properties of the diet beverages, as it offers no calories to "buffer" the absorption of alcohol.

Our study findings have important implications for college drinking. In light of the present study findings in combination with prior research on this topic, efforts should be made to educate drinkers about the effects of mixing alcohol with diet beverages. Such educational materials could include information about the effect that diet mixers can have on one's intoxication and that despite the fact that greater *objective* intoxication may be achieved, one's *subjective* intoxication may not be any different (Irwin et al., 2014; Marczinski & Stamates, 2013). Also, experimental evidence (Marczinski & Stamates, 2013; Stamates et al., 2015) suggests that up to a 25% difference in greater BrACs may be observed when consuming alcohol with diet beverages. Standard drink calculators may need to be adapted so drinkers can more effectively estimate their BAC.

The present study has limitations. Our sample consisted of primarily women (73%) who were Caucasian which may limit generalizability to other populations. A cross-sectional design was used, which limits causal inferences about diet mixer use and problems and may be subject to recall biases. Furthermore, we did not collect data on the quantity of diet mixed beverages consumed. Future research may benefit from the use of more advanced methodology techniques, such as ecological momentary assessments, that may minimize potential recall biases and provide stronger conclusions regarding the relationship between mixing alcohol with diet beverages and experiencing alcohol-related harms. We also tested specific traits that may be associated with use but other traits (e.g., motives for use) that may be more applicable have yet to be explored. Lastly, self-reports were used, which may be biased due to social desirability concerns. However, this type of data is generally valid (Simons, Wills, Emery, & Marks, 2015).

This is the first study to examine the prevalence of mixing alcohol with diet beverages and its association with alcohol-related problems among college students. Approximately one-

third of our sample reported mixing alcohol with diet beverages, and these individuals reported greater experiences with alcohol-related harms than non-users, even after adjusting for typical alcohol use and sensation seeking. Thus, mixing alcohol with diet beverages may be used to target young adults at-risk for experiencing alcohol-related harms. This knowledge also could guide intervention strategies aimed to reduce alcohol harms among college students.

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References

American Psychological Association. Ethical principles of psychologists and code of conduct. 2010. Retrieved from http://www.apa.org/ethics/code/principles.pdf

Barnett, V.; Lewis, T. Outliers in statistical data. Vol. 3. New York: Wiley; 1994.

Bryant JB, Darkes J, Rahal C. College students' compensatory eating and behaviors in response to alcohol consumption. Journal of American College Health. 2012; 60:350–356. DOI: 10.1080/07448481.2011.630702 [PubMed: 22686357]

Collins RL, Parks GA, Marlatt GA. Social determinants of alcohol consumption: The effects of social interaction and model status on the self-administration of alcohol. Journal of Consulting and Clinical Psychology. 1985; 53:189–200. DOI: 10.1037/0022-006X.53.2.189 [PubMed: 3998247]

Fowler SP, Williams K, Resendez RG, Hunt KJ, Hazuda HP, Stern MP. Fueling the obesity epidemic? Artificially sweetened beverage use and long-term weight gain. Obesity. 2008; 16:1894–1900. DOI: 10.1038/oby.2008.284 [PubMed: 18535548]

Hoyle RH, Stephenson MT, Palmgreen P, Lorch EP, Donohew RL. Reliability and validity of a brief measure of sensation seeking. Personality and Individual Differences. 2002; 32:401–414. DOI: 10.1016/S0191-8869(01)00032-0

Irwin C, Shum D, Desbrow B, Leveritt M. Comparing the effects of alcohol mixed with artificially-sweetened and carbohydrate containing beverages on breath alcohol concentration. Journal of Alcohol and Drug Education. 2014; 58:27–45.

Levy AS, Heaton AW. Weight control practices of US adults trying to lose weight. Annals of Internal Medicine. 1993; 119:661–666. DOI: 10.7326/0003-4819-119-7_Part_2-199310011-00007 [PubMed: 8363193]

Lloyd-Richardson EE, Lucero ML, DiBello JR, Jacobson AE, Wing RR. The relationship between alcohol use, eating habits and weight change in college freshmen. Eating Behaviors. 2008; 9:504–508. DOI: 10.1016/j.eatbeh.2008.06.005 [PubMed: 18928916]

Luce KH, Crowther JH, Leahey T, Buchholz LJ. Do restrained eaters restrict their caloric intake prior to drinking alcohol? Eating Behaviors. 2013; 14:361–365. DOI: 10.1016/j.eatbeh.2013.06.004 [PubMed: 23910781]

Marczinski CA, Stamates AL. Artificial sweeteners versus regular mixers increase breath alcohol concentrations in male and female social drinkers. Alcoholism: Clinical and Experimental Research. 2013; 37:696–702. DOI: 10.1111/acer.12039

Peacock A, Bruno R. "High" motivation for alcohol: What are the practical effects of energy drinks on alcohol priming? Alcoholism: Clinical and Experimental Research. 2013; 37:185–187. DOI: 10.1111/acer.12021

Piasecki TM, Wood PK, Shiffman S, Sher KJ, Heath AC. Responses to alcohol and cigarette use during ecologically assessed drinking episodes. Psychopharmacology. 2012; 223:331–334. DOI: 10.1007/s00213-012-2721-1 [PubMed: 22538731]

Read JP, Kahler CW, Strong DR, Colder CR. Development and preliminary validation of the young adult alcohol consequences questionnaire. Journal of Studies on Alcohol. 2006; 67:169–177. DOI: 10.15288/jsa.2006.67.169 [PubMed: 16536141]

Rossheim ME, Thombs DL. Artificial sweeteners, caffeine, and alcohol intoxication in bar patrons. Alcoholism: Clinical and Experimental Research. 2011; 35:1891–1896. DOI: 10.1111/j.1530-0277.2011.01534.x

Simons JS, Wills TA, Emery NN, Marks RM. Quantifying alcohol consumption: Self-report, transdermal assessment, and prediction of dependence symptoms. Addictive Behaviors. 2015; 50:205–212. DOI: 10.1016/j.addbeh.2015.06.042 [PubMed: 26160523]

Stamates AL, Maloney SF, Marczinski CA. Effects of artificial sweeteners on breath alcohol concentrations in male and female social drinkers. Drug and Alcohol Dependence. 2015; 37:696–702. DOI: 10.1016/j.drugalcdep.2015.10.015

Wu KL, Chaikomin R, Doran S, Jones KL, Horowitz M, Rayner CK. Artificially sweetened versus regular mixers increase gastric emptying and alcohol absorption. The American Journal of Medicine. 2006; 119:802–804. DOI: 10.1016/j.amjmed.2006.02.005 [PubMed: 16945619]

Highlights

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

Table 1

Summary of Multiple Comparisons among Diet Alcohol Users versus Non-Users on Alcohol-related Problems

	Diet Alcohol User Status			
Dependent variable	**User**	**Non-User**	***F***	**partial η^2**
YAACQ – Social/Interpersonal	8.06 (1.78)	7.44 (1.55)	16.58*	0.02
YAACQ – Self-perception	4.88 (1.32)	4.61 (1.12)	7.38*	0.01
YAACQ – Self-care	9.78 (2.30)	8.93 (1.66)	24.46*	0.04
YAACQ – Risky Behavior	9.65 (1.95)	9.33 (1.80)	1.54	0.00
YAACQ – Academic/occupational	5.76 (1.24)	5.44 (0.97)	9.38*	0.01
YAACQ – Physical Dependence	4.60 (0.99)	4.35 (0.76)	7.43*	0.01
YAACQ – Blackout	10.43 (2.16)	9.70 (2.11)	8.86*	0.02
YAACQ – Impaired Control	7.94 (1.73)	7.35 (1.45)	16.25*	0.02

Note. YAACQ = Young Adult Alcohol Consequences Questionnaire.

* $p < .05$.

Table 2

Comparisons between Diet Alcohol Users versus Non-Users on Study Outcomes

	Diet Alcohol User Status				
Dependent variable	**User**	**Non-User**	***df***	***t***	***d***
DDQ – General Alcohol Quantity	12.02 (10.21)	9.86 (8.52)	670	2.77**	0.23
Peak eBAC	0.13 (0.09)	0.11 (0.09)	670	2.12*	0.22
EAUQ	0.47 (1.15)	0.47 (1.14)	647	0.02	0.00
BMI	24.95 (4.64)	24.81 (5.14)	677	0.35	0.03

Note. DDQ = Daily Drinking Questionnaire; eBAC = estimated blood alcohol concentration; EAUQ = Eating and Alcohol Use Questionnaire; BMI = body mass index.

** $p < .01$.

* $p < .05$.