

Longitudinal Patterns of Alcohol Mixed With Energy Drink Use Among College Students and Their Associations With Risky Drinking and Problems

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ABSTRACT. Objective: The consumption of alcohol mixed with energy drinks (AmEDs) is a form of risky drinking among college students, a population already in danger of heavy drinking and associated consequences. The goals of the current longitudinal study were to (a) identify types of AmED users between the first and second year of college and (b) examine differences among these groups in rates of high-risk drinking and consequences over time. **Method:** A random sample of college student drinkers ($n = 1,710$; 57.7% female) completed baseline and 6-month follow-up measures assessing alcohol-related behaviors. **Results:** AmED use was endorsed by 40% of participants during the course of the study. As anticipated, four distinct groups of AmED users were identified (nonusers, initiators, discontinuers, and continuous users) and were significantly different from one another on drinking and

consequence outcomes. Further, significant Time \times Group interaction effects were observed for drinking and overall consequences. Generally, across all outcomes and time points, nonusers reported the lowest rates of drinking and consequences, whereas continuous users consistently reported the highest rates of drinking and consequences. Students who initiated AmED use during the course of the study also reported an abrupt increase in alcohol use and reported consequences. **Conclusions:** Findings suggest students who consistently engage in and initiate AmED use also engage in riskier drinking behaviors and experience higher rates of consequences. Interventions that specifically target AmED use may be warranted and have the potential to reduce alcohol-related consequences. (*J. Stud. Alcohol Drugs*, 76, 389–396, 2015)

COLLEGE STUDENT HEAVY DRINKING and related consequences continue to be major public health concerns on campuses across the nation (Mallett et al., 2013; National Institute on Alcohol Abuse and Alcoholism, 2006; Perkins, 2002). A fairly recent and risky drinking behavior that is gaining popularity among college students is the use of alcohol mixed with energy drinks (AmEDs) (O'Brien et al., 2008). AmEDs are heavily caffeinated beverages combined with alcohol (e.g., Red Bull mixed with vodka). The increased popularity of AmEDs on college campuses has mirrored the growth of the energy drink market, which has risen in the United States from \$400 million in 2001 to \$9 billion in 2011 and is estimated to reach \$21 billion by 2017 (PRWeb, 2013).

Research has indicated that rates of AmED use are four times higher among college students relative to community samples, with approximately 25%–30% of student drinkers reporting AmED use during a typical month (Marzell et al., 2014; O'Brien et al., 2008; Patrick & Maggs, 2014). These findings are problematic considering AmED use has been as-

sociated with impaired behavioral control, increased desire to consume alcohol, high-risk drinking styles, heavier drinking patterns, and higher rates of general risk-taking tendencies (Mallett et al., 2013; Miller, 2008a, 2008b; Varvil-Weld et al., 2013). Epidemiological studies have shown that AmED users drink increased amounts of alcohol and experience more consequences compared with alcohol-only users (Berger et al., 2011; Brache & Stockwell, 2011; Marzell et al., 2014). Further, individuals who consume AmEDs report doing so to enhance their ability to consume more alcohol and to stay awake longer (Marczinski et al., 2011; O'Brien et al., 2008; Peacock et al., 2012). Research examining AmED consumption using a daily diary approach has found that students who used energy drinks and alcohol on the same day tended to drink more, spend more time drinking, and report increased short-term consequences compared with days involving alcohol-only consumption (Patrick & Maggs, 2014).

Although overall rates and risks of AmED use among college students have been identified, the consistency in patterns of use are not well understood. Research has shown that AmED consumption is associated with moderate and heavy alcohol consumption patterns rather than light drinking (Mallett et al., 2014); however, longitudinal rates of students' AmED initiation, discontinuation, or consistent use or non-use have not been examined. For instance, some individuals may engage in AmED use earlier in college, but for others, initiation may occur later as alcohol use escalates. It is also unclear if students' AmED use is short-lived and experimental in nature or if it becomes part of a more stable drinking

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pattern. Whereas little is known about AmED initiation, less is understood about the rate at which students spontaneously discontinue using AmEDs and how changes in AmED use relate to alcohol consumption and consequences.

Longitudinal research has shown that AmED use during the freshman year of college predicted alcohol-related consequences during the sophomore year (Marzell et al., 2014). However, the proportion of students who maintained or changed their AmED use was not examined. Information about the consistency of use as well as the impact of initiation and discontinued AmED use on alcohol-related problems is needed to inform both timing and content of intervention efforts. Currently, no evidence-based interventions specifically target AmED use, primarily because of the lack of information about this high-risk behavior.

Current study

The focus of the present study was to address gaps in the literature pertaining to the longitudinal stability of AmED use and how changes in use coincide with alcohol consumption and related problems over time. The specific aims of the study were twofold. First, we examined the prevalence of four AmED use patterns between the first and second years of college. Specifically, we examined the number of students who (a) initiated use of AmEDs, (b) discontinued AmED use, (c) continuously used AmEDs, and (d) never used AmEDs during the course of the study. Based on previous studies (Marzell et al., 2014; O'Brien et al., 2008; Patrick & Maggs, 2014), we hypothesized that the majority of student drinkers (approximately 70%) would not endorse AmED use, whereas about 30% would report that they consumed AmEDs at any given time point.

Second, for each of the four AmED groups, we examined differences in rates of high-risk drinking behaviors and reported consequences over time. First, based on previous work (e.g., Cadigan et al., 2013; Turrise et al., 2009), we anticipated observing a main effect of time, resulting in general increases in alcohol consumption and reported consequences over time, regardless of AmED group. Based on previous AmED studies (Mallett et al., 2014; Marzell et al., 2014; O'Brien, 2008), we also hypothesized a main effect of group, such that individuals who endorsed never using AmEDs would report significantly lower rates of alcohol consumption and consequences compared with all other AmED user groups. Further, we hypothesized a significant interaction between group membership and changes in drinking and consequences over time. Individuals who initiated AmED use during the study would have a more abrupt increase in alcohol consumption and related consequences relative to continuous AmED users and nonusers who would report a more stable pattern. Last, among those who discontinued AmED use, we expected to observe decreased rates of drinking and consequences over time.

Method

Participants and procedures

During the fall semester of their freshman year, a random sample of college student drinkers was selected from the university registrar's database of first-year students attending a large public university in the northeastern United States as part of a larger longitudinal study. Participants received a pre-notification letter and an email invitation describing the study and inviting their participation. All recruitment materials (a pre-notification letter, an invitation email, and up to seven reminder emails) included a URL and a personal identification number for accessing the survey. Informed consent information was presented to students upon their login to the initial baseline survey. Students were eligible for the study if they reported drinking within the past 30 days. If ineligible, students were thanked for their time and their participation concluded. Otherwise, students were thanked for their time and were reminded that a similar survey would be available the following semester. For the current study, participants completed measures assessing alcohol-related behaviors during the spring semester (April) of their freshman year ($n = 1,864$) and a follow-up survey during the fall semester (October) of their sophomore year ($n = 1,765$). Retention from the 6-month spring to fall follow-up was 94.7%. To be eligible for participation, individuals had to provide information about AmED use at both time points. AmED use was not significantly associated with attrition ($p > .05$) at Time 2. The final sample consisted of 1,710 college students reporting a mean age of 18.56 ($SD = 0.50$) years old, with the majority identifying as female (57.7%) and White (87.3%). A significant minority of participants identified as Hispanic (4.9%), Asian (4.7%), African American (3.3%), or multiracial (3.0%).

Students who were invited to participate received both a mailed pre-notification letter and an email invitation describing the study. Students received \$25 for completing the first survey and \$30 for completing the second, plus a \$5 bonus if they completed each survey within 5 days of receiving the email invitation. Thus, participants had the potential to earn up to \$65 if they completed both surveys within 5 days of initial invitation. All procedures were approved by the university's institutional review board.

Measures

Participants were measured in April (Time 1) and October (Time 2) during the respective semesters, and at both time points participants reported their typical and peak AmED use, typical and heavy drinking behaviors, and alcohol-related consequences using the current semester as the time referent. All measures are described below.

Drinking behaviors. Drinking behaviors consisted of two measures designed to capture “typical” and “heavy” drinking, for both drinking in general and for AmED use. One standard drink of alcohol was defined as 12 oz. of beer or wine cooler, 8.5 oz. of malt liquor, 4 oz. of wine, 3.5 oz. of fortified wine, or 1.5 oz. of distilled spirits.

Alcohol use. Typical alcohol use was assessed using the Daily Drinking Questionnaire (DDQ; Collins et al., 1985), which asked participants to consider a typical week during the current semester and then indicate how many drinks of alcohol they consumed on each day of a typical week. Responses were summed to indicate the number of drinks one typically consumed each week at T1 ($M = 10.63$, $SD = 9.31$; $\alpha = .76$) and at T2 ($M = 12.45$, $SD = 10.79$; $\alpha = .77$). Heavy drinking was assessed using a single item adapted from the Quantity, Frequency, Peak scale (Dimeff et al., 1999). Participants indicated how many times in the past month they had been drunk or “very high” from alcohol. Response options ranged from *never* to *nine or more times*.

AmED use. Similarly, typical AmED use was assessed with an adaptation of the DDQ, where participants indicated the number of AmEDs they consumed on each day of a typical week during the current semester. AmED was operationalized as the number of alcoholic energy drinks or alcohol combined with energy drinks (e.g., Red Bull and vodka, Jägerbombs [a shot of Jägermeister combined with an energy drink]) typically consumed on each day of the week. They reported an average of 1.59 AmED drinks per week ($SD = 5.02$; $\alpha = .79$) at T1 and an average of 1.26 at T2 ($SD = 4.57$; $\alpha = .77$). Peak AmED use was reported as the number of AmEDs consumed on the occasion in the past month that they drank the most alcohol, which, at T1 was an average of 0.55 ($SD = 1.66$) AmEDs and at T2 was an average of 0.52 ($SD = 1.55$) AmEDs.

Consequences. A subset of 18 items from the Young Adult Alcohol Consequences Questionnaire (Read et al., 2006) was used to examine a range of physical, academic, and social consequences. An additional four items were used to measure sexual consequences (Young Adult Alcohol Problems Screening Test; Hurlbut & Sher, 1992; Larimer et al., 1999). Participants were asked to indicate how many times in the current semester they had experienced each consequence, with response options ranging on an 11-point scale from 0 (*not at all*) to 10 (≥ 40 times). Together, these items demonstrated good internal reliability ($\alpha = .92$), and, when summed, participants reported a range from 0 to 62 ($M = 12.56$, $SD = 13.60$).

Analytic procedure

Preliminary analyses. Missing data were minimal (<1%) on all variables examined in the current study. Preliminary analysis revealed the measures of typical drinking (DDQ), peak drinking, and overall consequences were positively

skewed. Appropriate outlier adjustments (using $\pm 3.29*SD$) were made before hypotheses were tested (Tabachnick & Fidell, 2001). All analyses were conducted using IBM’s Statistical Package for the Social Sciences (SPSS, Version 21; IBM Corp, Armonk, NY).

Describing patterns of AmED use. Participants were assigned to one of four mutually exclusive AmED use groups (nonusers, initiators, discontinuous users, and continuous users) based on their typical and peak AmED endorsement at both T1 and T2. To create the AmED use groups for analyses, variables were created at both time points for any AmED use versus no AmED use, such that if AmED DDQ or peak AmED was greater than 0, use was set to 1; if AmED DDQ and peak AmED were both 0, use was set to 0. Next, participants were categorized according to the following: (a) those who stayed 0 at both time points were labeled nonusers; (b) those who transitioned from 0 to 1 were labeled initiators; (c) those who transitioned from 1 to 0 were labeled discontinuers; and (d) those who stayed at 1 during both time points were labeled continuous users. Frequencies, chi-square analysis, and descriptive statistics were used to examine gender composition and AmED use behaviors (typical weekly AmED consumption and proportion of users who consume AmEDs on risky drinking occasions) within each group.

Examining effects of AmED use on drinking behaviors and consequences over time. A series of 2 (Time: T1 and T2) \times 4 (AmED Group: nonusers, initiators, discontinuous users, and continuous users) mixed analyses of variance were used to examine changes in drinking behaviors (typical drinking, frequency of drunkenness) and consequences from first to second year of college. For each outcome, we examined (a) the main effect of time, (b) the main effect of AmED group, and (c) the interaction effect of AmED Group \times Time. All significant effects were further explored with Tukey’s honestly significant difference (HSD) post hoc tests to compare mean differences. Preliminary examination of the outcome variables revealed significant differences between males and females, such that males tended to drink more and experience more consequences relative to females (all $ps < .05$). To control for these differences, participants’ self-identified birth sex was included as a covariate in all subsequent analyses. To reduce the probability of type I errors, we applied a Bonferroni correction that set the alpha level required for significance to .01 (Miller, 1981).

Results

AmED use patterns

Among the students who provided AmED data at both T1 and T2 ($n = 1,710$), 27.2% reported AmED use at T1, and 24.0% endorsed use at T2. Examination of use patterns at both time points revealed 60.4% ($n = 1,033$; 57.2% female) remained nonusers from freshman to sophomore

TABLE 1. Main effects of time and AmED group on drinking and consequences

Variable	Typical weekly drinking <i>M (SE)</i>	Frequency of drunkenness <i>M (SE)</i>	Consequences <i>M (SE)</i>
Main effect of time			
Time 1	12.230 ^a (0.266)	2.272 ^a (0.044)	14.732 ^a (0.391)
Time 2	14.217 ^b (0.303)	2.673 ^b (0.047)	15.222 ^a (0.382)
Main effect of AmED group			
Nonusers	9.792 ^a (0.272)	1.912 ^a (0.043)	9.903 ^a (0.368)
Initiators	13.561 ^b (0.601)	2.559 ^b (0.094)	15.172 ^b (0.811)
Discontinuers	13.030 ^c (0.535)	2.469 ^c (0.084)	13.960 ^c (0.725)
Continuers	16.511 ^d (0.621)	2.950 ^d (0.097)	20.871 ^d (0.840)

Notes: Within each panel, uncommon superscripts within a column indicate significant mean differences. AmEDs = Alcohol mixed with energy drinks. Critical differences for significance were as follows: typical weekly drinking = .443; frequency of drunkenness = .077; consequences = .604.

year, whereas 39.6% of students reported AmED consumption during the course of the study. Specifically, 12.4% ($n = 212$; 57.5% female) initiated use at T2, 15.6% ($n = 266$; 63.5% female) endorsed discontinuous use (i.e., they used at T1 but not at T2), and 11.6% ($n = 199$; 51.3% female) endorsed continuous use across both time points. A chi-square analysis of the gender proportions within each AmED use group revealed percentages similar to those found within the overall sample, with the exception of the discontinued user group, which included a higher-than-expected proportion of women, $\chi^2(3) = 7.11$, $p = .07$. In terms of AmED consumption, continuous users reported consuming more AmEDs in a typical week at both T1 ($M = 6.29$, $SD = 8.38$) and T2 ($M = 6.59$, $SD = 9.04$), relative to discontinuous users at T1 ($M = 5.52$, $SD = 8.14$) and initiators at T2 ($M = 4.04$, $SD = 6.98$).

Examining the effects of AmED use on drinking and consequences over time

Main effects of time on drinking and consequences. Results revealed a significant main effect of time on all examined outcome variables: typical weekly drinking, $F(1, 1701) = 108.51$, $p < .001$, $\eta^2 = .060$; frequency of drunkenness, $F(1, 1701) = 83.70$, $p < .001$, $\eta^2 = .047$; and consequences,

$F(1, 1701) = 12.54$, $p < .001$, $\eta^2 = .007$. On average, typical weekly drinking (DDQ) and frequency of drunkenness increased from T1 to T2. Despite the significant main effect observed for consequences, examination of the Critical Difference for Significance determined by Tukey's HSD (critical difference [CD] = .604), the difference between the mean number of consequences experienced at T1 did not differ significantly from those experienced at T2. Means and standard errors for each outcome are presented in top half of Table 1.

Main effects of AmED group on drinking and consequences. Significant main effects of AmED group on all drinking and consequence outcomes were observed: typical weekly drinking, $F(3, 1701) = 41.57$, $p < .001$, $\eta^2 = .068$; frequency of drunkenness, $F(3, 1704) = 43.16$, $p < .001$, $\eta^2 = .071$; and consequences, $F(3, 1702) = 54.73$, $p < .001$, $\eta^2 = .088$. Further examination using Tukey's HSD revealed significant differences between all four groups on typical weekly drinking (CD = .443), frequency of drunkenness (CD = .077), and consequences (CD = .604). Across these three outcomes, nonusers drank the least and experienced the fewest consequences, followed by discontinuous users, initiators, and continuous users. Means and standard errors for each group are shown in bottom half of Table 1.

Interaction effects of AmED group and time on drinking and consequences. Significant Time \times Group interaction effects were observed for typical weekly drinking, $F(3, 1703) = 3.83$, $p = .009$, $\eta^2 = .007$; frequency of drunkenness, $F(3, 1704) = 8.53$, $p < .001$, $\eta^2 = .015$; and overall consequences, $F(3, 1702) = 7.21$, $p < .001$, $\eta^2 = .013$. Means and standard errors for each group are listed in Table 2. Across all outcomes and time points, nonusers reported the lowest rates of drinking and consequences, whereas continuous users consistently reported the highest rates of drinking and consequences. For typical weekly drinking, initiators and discontinuous users were only significantly different from each other at T2. Examination of Figure 1 (Panel A) reveals consistent increases in weekly drinking over time among nonusers, initiators, and continuous users. The rate of increase among discontinuous users from T1 to T2, although significant (CD = .443), was less pronounced. When examining frequency of drunkenness, significant differences between all four groups were observed at both time points. Although all four groups increased in their

TABLE 2. Time \times AmED Group interaction effects on drinking and consequences

Group	Typical weekly drinking		Frequency of drunkenness		Consequences	
	T1 <i>M (SE)</i>	T2 <i>M (SE)</i>	T1 <i>M (SE)</i>	T2 <i>M (SE)</i>	T1 <i>M (SE)</i>	T2 <i>M (SE)</i>
Nonusers	8.935^a (0.275)	10.649^a (0.314)	1.723^a (0.046)	2.101^a (0.048)	9.908 ^a (0.404)	9.980 ^a (0.396)
Initiators	12.402^b (0.609)	14.271^b (0.693)	2.179^b (0.102)	2.938^b (0.107)	13.748^b (0.891)	16.597^b (0.872)
Discontinuers	12.611^b (0.543)	13.449^c (0.618)	2.380^c (0.091)	2.558^c (0.095)	14.643^c (0.796)	13.278^c (0.780)
Continuers	14.972^c (0.629)	18.050^d (0.618)	2.804^d (0.105)	3.096^d (0.110)	20.629 ^d (0.923)	21.113 ^d (0.904)

Notes: Uncommon superscripts within a column indicate significant mean differences between groups; **bold** pairs indicate significant mean differences within a group from T1 to T2. AmEDs = Alcohol mixed with energy drinks; T1 = Time 1; T2 = Time 2. Critical differences for significance were as follows: typical weekly drinking = .443; frequency of drunkenness = .077; consequences = .604.

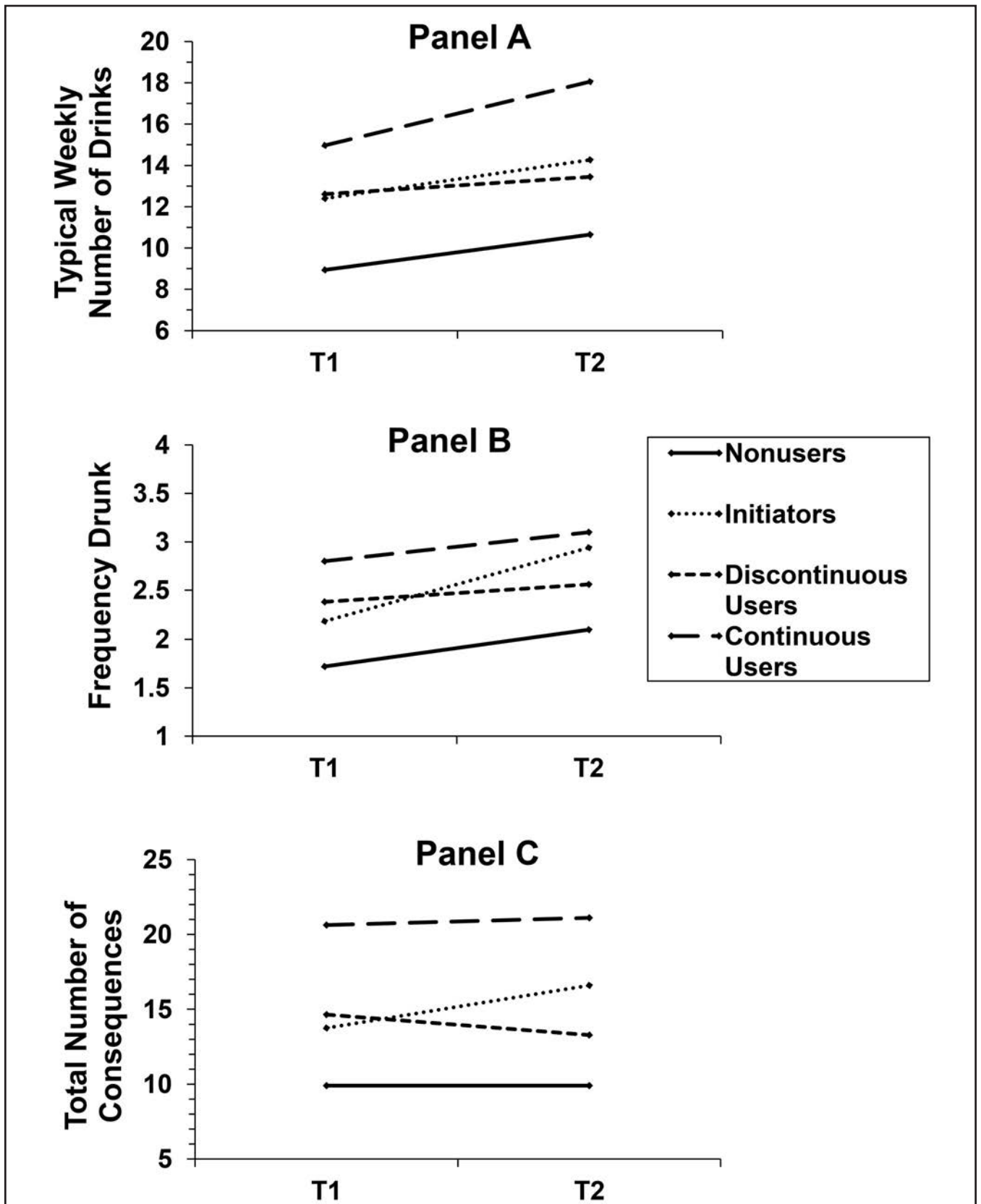


FIGURE 1. Alcohol Mixed With Energy Drink Group \times Time interactions for typical weekly drinking, frequency of drunkenness, and consequences. T1 = Time 1; T2 = Time 2.

frequency of drunkenness over time, the rate at which initiators increased was noticeably steeper relative to nonusers, discontinuous users, and continuous users (Figure 1, Panel B). Last, the examination of group differences over time for consequences again revealed significant differences between all four groups at both time points. However, nonusers and continuous users remained stable from T1 to T2, whereas initiators reported increased consequences from T1 to T2, and discontinuous users reported a decrease in consequences from T1 to T2 (Figure 1, Panel C).

Discussion

The current study examined the prevalence of four AmED use patterns between the first and second year of college and how these patterns varied with respect to drinking behaviors and reported consequences over time. We hypothesized that 30% of the sample would report they consumed AmEDs at any given time point; however, we observed approximately 40% of participants endorsed AmED use during the course of the study. Our rates were higher in comparison with other research (e.g., Mallett et al., 2014; Marzell et al., 2014; O'Brien et al., 2008; Patrick & Maggs, 2014), which may have been because these studies did not examine initiation or discontinuation of use across time. Our findings suggest that AmED use is more prevalent than earlier work estimated or that AmED use is on the rise.

AmED use patterns

As expected, four distinct groups of AmED users were identified and consisted of student drinkers who (a) never used AmEDs, (b) initiated use of AmEDs during the study, (c) discontinued AmED use during the study, and (d) continuously used AmEDs between their first and second year of college. The largest proportion of students (60%) did not endorse AmED use at any point during or preceding the study. Approximately 12% of students initiated AmED use during their second year of college, suggesting that individuals may experiment with AmEDs long after alcohol use has been initiated. Nearly 16% of the sample reported AmED use during their freshman year but discontinued use as sophomores, suggesting that AmED use may be experimental and short lived for some students. However, it is unclear whether students permanently discontinued use or resumed use after the study was completed. Last, the nearly 12% who reported continuous use consumed the most AmEDs in a typical week relative to other AmED user types.

AmED use patterns and time in relation to drinking behaviors and consequences

All four groups of AmED users were significantly different from one another when examining rates of drinking

and reported consequences. As expected and consistent with previous work, a significant main effect of AmED group on drinking and consequences was observed (Mallett et al., 2014; Marzell et al., 2014; O'Brien, 2008). Students who endorsed never using AmEDs reported significantly lower rates of alcohol consumption and consequences compared with all other AmED user groups, whereas continuous users reported the highest rates. Initiators reported higher rates of drinking and consequences compared with discontinuers and nonusers. Next, the study examined drinking and consequences as a function of time. As expected, a significant main effect of time was observed showing that, overall, participants reported more alcohol consumption and a higher frequency of drunkenness at follow-up. This finding is consistent with previous research showing an escalation of alcohol use across the freshman year of college and beyond among a variety of student drinkers (e.g., Cadigan et al., 2013; Turrissi et al., 2009).

Further, the examination of the interaction between time and AmED group in relation to drinking and consequences resulted in novel and interesting findings. First, a similar pattern of results was observed for students who engaged in consistent patterns of AmED use and nonuse across time. Although continuous users drank significantly more than nonusers, both groups showed consistent increases in drinking behaviors; however, consequences remained stable across both time points.

Next, as hypothesized, AmED initiators and discontinuers exhibited unique patterns with regard to drinking patterns and consequences. Specifically, initiators showed a significant increase in consequences in addition to drinking patterns across time. In contrast, although discontinuers showed significant increases in drinking despite lack of AmED use, they reported a significant decrease in consequences at Time 2. Further, discontinuers drank significantly more and had a higher frequency of drunkenness than initiators at Time 1 (when they reported consuming AmEDs), whereas the reverse relationship was observed at Time 2. Taken together, these findings were consistent with our main hypotheses and demonstrate a significant association between AmED use and both riskier drinking behaviors and increased consequences. Further, although an increase in drinking behaviors was observed for all groups across time, the most abrupt increase was observed among AmED initiators, indicating a relationship between AmED use and increased alcohol consumption.

Individuals who discontinue use of AmEDs may be fundamentally different from those who are continuous users. Based on previous alcohol use-only studies, it is possible that discontinuous users may have experienced outcomes after consuming AmEDs that they deemed aversive and modified their behavior by stopping AmED use, whereas continuous users evaluated related consequences as less aversive or nonaversive and continued to use AmEDs regardless

of the outcomes (Mallett et al., 2008, 2011; Merrill et al., 2013). Further, our results demonstrated that discontinuous users showed a decrease in consequences but an increase in overall alcohol consumption. Discontinuous users may have modified their behavior by taking precautionary and planned steps to avoid consequences in addition to ceasing the use of AmEDs, such as implementing additional protective behaviors (Martens et al., 2004). Future work is needed that examines subjective evaluations of consequences, the use of protective behaviors, and subsequent AmED use.

Limitations and future directions

Our data provide evidence of the unique association between AmED use and consequences; however, the findings are not without some limitations. Possible third variable explanations may play a role in the observed relationships (e.g., individual differences or context). For example, individuals who consume AmEDs tend to have higher risk-taking tendencies (Miller, 2008b). Such tendencies are also associated with high-risk drinking and consequences (e.g., Mastroleo et al., 2013). Thus, it is possible that the observed associations could be attributable in part to the shared relationships with personality. Relatedly, individuals tend to consume AmEDs when they are motivated to drink for longer periods (Marzell et al., 2014). Individuals also tend to consume more alcohol in contexts where drinking occurs over longer periods (e.g., tailgate parties, holidays; see Neighbors et al., 2007). It is therefore possible that the associations could be in part attributable to the shared associations with drinking contexts where consumption takes place over longer periods. Understanding the interplay between individual-based variables and contextual variables may help elucidate information pertaining to causal mechanisms. Further, a more comprehensive multilevel theoretical and empirical analysis of the unique relationships between (a) specific consequences and the different substance use behaviors (alcohol-only, AmED, and polysubstance use) and (b) the different substance use behaviors and their unique theoretical determinants (peer influence, motives, expectancies, personality, and context) seems warranted.

Additional study limitations should be noted. First, the sample consisted of a large majority of White students. Although the sample demographics were reflective of the university population, future studies would benefit from examining AmED use among more diverse samples. Second, the current study examined students across the first and second years of college, thereby limiting our understanding of AmED use across later years. Although this study was an important first step in understanding AmED initiation, continuous use, and spontaneous discontinuation, additional work is needed to examine additional cycles of use and how turning 21 and drinking in bars affects AmED consumption. Studies that explore predictors of AmED use and nonuse

are also needed to better understand mechanisms of natural change in order to inform intervention efforts.

Conclusion

Findings from our study identified four types of AmED users (nonusers, initiators, discontinuers, and continuous users) and alcohol behaviors and problems associated with each. Forty percent of students endorsed using AmEDs over the course of two semesters. Continuous AmED use was associated with the highest and most consistent rates of drinking and reported consequences, whereas nonuse was associated with the lowest rates. Individuals who initiated AmED use showed an abrupt increase in drinking and reported significantly more consequences compared with their pre-AmED-use drinking patterns and other groups of AmED users. Students who discontinued AmED use reported significantly fewer consequences despite a slight increase in alcohol use behaviors. Although the study cannot determine a causal relationship between AmED use, heavier drinking, and increased consequences, it highlights the positive relationship between these behavioral patterns over time. Taken together, the significant association between AmED consumption and increased risk of experiencing alcohol-related consequences suggests that more research is needed to evaluate the potential benefits of implementing AmED-specific intervention efforts.

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