An Examination of Consequences among College Student Drinkers on Occasions Involving Alcohol-Only, Marijuana-Only, or Combined Alcohol and Marijuana Use

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Abstract

This event-level study examined within-person differences in consequences for college students who engaged in alcohol-only, marijuana-only, or simultaneous alcohol and marijuana (SAM) use across 18 weekend days. Participants ($n = 451$) were asked to report consequences they experienced on each occasion across five different types of events: 1) heavier alcohol combined with marijuana; 2) lighter alcohol combined with marijuana; 3) heavier alcohol-only; 4) lighter alcohol-only; and 5) marijuana only. Occasions involving heavy drinking, alone and in combination with marijuana, were associated with higher rates of consequences relative to lighter alcohol-only occasions, lighter alcohol combined with marijuana occasions, and marijuana-only occasions. Light alcohol-only occasions did not significantly differ on consequences from lighter alcohol combined with marijuana occasions or marijuana-only occasions. Past research has shown SAM use is associated with more consequences compared to alcohol-only use. The current findings suggest that SAM use is not necessarily riskier than drinking or using marijuana alone. Results suggested that on heavy drinking occasions, the number of consequences did not significantly change by also using marijuana. Findings suggest the benefit of targeted intervention strategies to reduce harms associated with heavy drinking occasions with and without SAM use.

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Keywords

college students; alcohol; marijuana; consequences

The protective effects of having a college degree on individuals' health later in life have been well documented (Dupre, 2007; Hummer & Lariscy, 2011; Mirowsky & Ross, 1998; Schnittker, 2004). The risk factors during the college years, such as excessive substance use, are also widely acknowledged (e.g., Hingson, Zha, & Smyth, 2017; Kahler, Hustad, Barnett, Strong, & Borsari, 2008; Patrick, Schulenberg, & O'Malley, 2016). Reports routinely estimate 80% of college students report annual alcohol consumption (Schulenberg et al., 2017) and 40% engage in heavy episodic drinking (>5/4 drinks in 2 hours for males and females, respectively; Wechsler, Dowdall, Davenport, & Castillo, 1995). Marijuana is the second most frequently endorsed substance in this population with nearly 40% of students endorsing annual use. Alcohol and marijuana are the two most abused substances among college students (Lipari & Jean-Francois, 2016), and are associated with significant social, academic/work, legal, sexual, and impaired driving consequences (Copeland, Gilmour, Gates, & Swift, 2005; Pearson, Liese, Dvorak, & Marijuana Outcomes Study Team, 2017; Read, Kahler, Strong, & Colder, 2006; Simons, Dvorak, Merrill, & Read, 2012).

In 2012, the National Institutes of Health called for a more integrative framework to examine substance use and addictions research (https://www.addictionresearch.nih.gov/). As a result, three major institutes (NIAAA, NIDA, and NCI) established the Collaborative Research on Addiction (CRAN) to promote collaborative research in cross-cutting areas of substance use and related health-consequences. One area of priority was to examine outcomes associated with polysubstance use, particularly since the majority of funded studies focused only on one substance (e.g., alcohol-only) and did not examine the impact of using multiple substances on harmful consequences. As part of the scientific efforts resulting from the NIH CRAN initiative, the current study examined within-person differences in consequences for college students who engaged in alcohol-only (ALC-only), marijuana-only (MJ-only), or simultaneous alcohol and marijuana (SAM) use.

SAM use among young adults is highly prevalent and ranges from 22% to 30% (Patrick, Terry-McElrath, Lee, & Schulenberg, 2019; Terry-McElrath & Patrick, 2018). Students who use alcohol and marijuana during the same occasion, or engage in SAM use report significantly higher rates of consequences compared to alcohol-only (ALC-only) users (Brière, Fallu, Descheneaux, & Janosz, 2011; Meda et al., 2017; Midanik, Tam, & Weisner, 2007; Shillington & Clapp, 2001; Shillington & Clapp, 2006; Subbaraman & Kerr, 2015). While previous work has compared groups defined by their type of use (ALC-only vs. SAM), it is plausible that individuals who already have a history of combining alcohol with marijuana may engage in a variety of drinking patterns (i.e., lighter drinking occasions, heavier drinking occasions, no alcohol use) and experience more problems when marijuana is used on heavier drinking occasions compared to lighter drinking or marijuana-only occasions. To better elucidate within-person differences associated with the effects of adding marijuana to heavier and lighter drinking occasions or using marijuana-only, it is necessary

to compare consequences across occasions in which students who endorse use of alcohol and marijuana report different patterns of ALC-only use, MJ-only use, or SAM use.

Current Study

The present study used a longitudinal event-level design to examine consequences reported by students who endorsed a history of alcohol and marijuana use on weekend days (i.e., Thursdays, Fridays, and Saturdays) when they endorsed ALC-only, MJ-only, or SAM use. To capture variations in students' consumption (and variations in different types of SAM use), daily alcohol use was categorized into heavier alcohol occasions (H-ALC: 5+/4+ drinks for males/females) and lighter alcohol occasions (L-ALC: 4/3 or fewer drinks for males/females). Thus, this study examined the number of consequences reported by the same individuals across five different types of events: 1) heavier alcohol combined with marijuana (H-SAM); 2) lighter alcohol combined with marijuana (L-SAM); 3) heavier alcohol-only (H-ALC); 4) lighter alcohol-only (L-ALC); and 5) MJ-only.

Based on findings from prior between- and within-subject work documenting positive associations between SAM use and consequences (Linden-Carmichael, Stamates, & Lau-Barraco, 2018; Lipperman-Kreda, Gruenewald, Grube, & Bersamin, 2017; Mallett et al., 2017), it was hypothesized that among students who endorsed use of alcohol and marijuana:

1. Occasions involving H-SAM would be associated with greater numbers of consequences compared to all other types of events.

2. L-ALC would be associated with the fewest numbers of consequences compared to all other types of events.

Methods

Procedures

Third-year students ($N = 719$) from a large, public university located in the northeast were recruited from a larger longitudinal study examining college student drinkers (see Mallett et al., 2015). Students who reported both alcohol and other drug use during the previous year in the larger study were sent an email invitation to take part in the current study. Invitation emails contained a description of the study, a URL to access the consent form, and a personal identification number (PIN). Students who consented ($n = 461$) were asked to complete a total of six surveys assessing their substance use and related consequences on 18 days (i.e., Thursday, Friday, Saturday) over 6 high-risk drinking weekends (home football games, holidays [e.g., Halloween]). Students received two surveys in Fall of 2014, two in Spring of 2015, and two in Fall of 2015. Within-semester surveys were sent one week apart. Recreational marijuana use was illegal in the state where the study was conducted.

Procedures were identical for all six surveys: (a) students were sent an email and text message notifying them that the survey would be sent in three days; (b) students were emailed and texted a link to the survey on Sunday asking about behaviors related to alcohol and marijuana use and related consequences that occurred on the preceding Thursday, Friday, and Saturday; (c) one email and three text message reminders were sent to students

who did not complete the survey within a few hours; and (d) students had up to 48 hours to complete the survey. Students received $20 for each of the six surveys they submitted (up to $120). Additional details about recruitment and study procedures for this study can be found in Mallett et al. (2017). All procedures were reviewed and approved by the university's institutional review board.

Four hundred and sixty-one participants completed at least one of six surveys (64.1% response rate) (see Mallett et al., 2017). Ten participants were dropped from the present study because they did not have any ALC-only, MJ-only, or SAM use occasions. The final analytic sample included 451 participants (M_{age} = 20.13, SD_{age} = 0.34; 51.4% female, 88.9% White/Caucasian, and 96.4% Non-Hispanic).

Measures

Each of the six weekend surveys was sent on Sunday so that students could report their behavior from the previous three days. Within each survey, items were assessed separately for Thursday, Friday, and Saturday (18 days total).

Alcohol quantity.—Students who indicated that they drank on an occasion were asked to report the number of drinks they consumed on that occasion. This item was used to identify heavier drinking occasions (i.e., 5+/4+ drinks for males/females, see Wechsler et al., 1995; HALC, H-SAM) and lighter drinking occasions (i.e., <5/<4 drinks for males/females; L-ALC, LSAM).

Alcohol and marijuana use.—To identify ALC-only, MJ-only, and SAM use occasions, students were asked to indicate if they did (*Yes*) or did not (*No*) use alcohol and marijuana on each specific day (see Mallett et al., 2017). Students' reports of alcohol and marijuana use were used to calculate their average number of ALC-only (M = 0.36, SD = 0.25), MJ-only (M = 0.02, SD = 0.06), and SAM (M = 0.06, SD = 0.11) occasions across the 18 days. These variables were included in the models as a between-person measures of substance use.

Consequences.—To assess consequences, students were asked to indicate if they did (*Yes*) or did not (*No*) experience consequences on days they reported ALC-only, MJ-only, or SAM use (i.e., *Below is a list of consequences that sometimes happen to people either during or after they are under the influence. Please indicate whether or not each experience listed below occurred as a result of your substance use on [Thursday/Friday/Saturday].*). A total of 33 items were assessed on each use occasion using items from established measures (Young Adult Alcohol Problem Screening Test [YAAPST]: Hurlbut & Sher, 1992; Young Adult Alcohol Consequences Questionnaire [YAACQ]: Read et al., 2006; Marijuana Consequences Questionnaire [MACQ]: Simons et al., 2012). Items were summed to obtain the total number of consequences (α = .89) for each type reported on each of the five types of occasions. Two consequence subscales were also examined: *social* (5-items; α = .76) and *physical* (7-items; α = .73). All of the items used are listed in Table 1.

Data Analysis Plan

Models were conducted in three analytic steps using maximum likelihood (ML) estimation. First, the intraclass correlation coefficients were calculated from the unconditional means models (i.e., empty models) for total consequences (Step 1) to assess the percentage of variation accounted for at the within-person (Level 1) and between-person (Level 2) levels. Results indicated that 32% of the total variance in consequences was attributable to differences between persons, whereas the remaining 68% was attributed to within-person variability.

The second step built on the previous analysis to include the within-person variables (i.e., type of use; *day* and *semester* of diary report). Average type of use across the study and gender were included as a between-person variable in the models (covariates). To evaluate Hypothesis 1 (*H-SAM would be associated with more consequences compared to all other types of events*), L-SAM, H-ALC, L-ALC, and MJ-only occasions were compared to H-SAM (reference group) on total consequences. To evaluate Hypothesis 2 (*L-ALC would be associated with the fewest consequences compared to all other types of events*), H-SAM, L-SAM, H-ALC, and MJ-only occasions were compared to L-ALC (reference group) on total consequences. The models described above were run a total of three times to evaluate total consequences, and the social and physical consequence subscales as outcomes.

Results

Preliminary Analyses

ALC-only, MJ-only, and SAM use were endorsed for 50.3% of the occasions; no substance use was endorsed for 25.3% of the occasions; a single substance other than alcohol or marijuana was endorsed on 1.2% of the occasions (e.g., nicotine); alcohol was combined with a substance other than MJ (e.g., nicotine) for 9.8% of the occasions; and 13.4% were occasions that were left missing in diary surveys. We observed no evidence for missingness bias (e.g., analyses revealed non-significant associations between missing > 3 occasions and students' sex, X^2[1, N=451], =1.38, p=0.24, and reporting > 1 substance on at least one occasion, X^2 [1, N=451] = 0.34, p=0.55).

Percentages for each type of substance use occasion (H-SAM, L-SAM, H-ALC, L-ALC, MJ-only) are shown in Table 2. The majority of substance use occasions were H-ALC, followed by L-ALC, H-SAM, MJ-only, and L-SAM. Number of drinks consumed did not differ between H-ALC and H-SAM occasions, or between L-ALC and L-SAM occasions (*ps* > .05).

Multilevel Analyses

Hypothesis 1.—In this model, H-SAM was compared to L-SAM, L-ALC, H-ALC, and MJ-only (controlling for day, semester, average substance use, and gender) on total, physical, and social consequences reported. H-SAM occasions were associated with significantly more consequences compared to all other use occasions except H-ALC (see Table 3).

Hypothesis 2.—L-ALC was compared to H-SAM, L-SAM, H-ALC, and MJ-only (controlling for day, semester, average substance use, and gender) on total, physical, and social consequences. L-ALC occasions were associated with fewer consequences compared to H-SAM and H-ALC. Number of consequences on L-ALC occasions did not differ from L-SAM or MJ-only occasions (see Table 3).

Discussion

Past research has shown SAM use is associated with increased risk and higher consequences (e.g., Meda et al., 2017; Shillington & Clapp, 2006; Subbaraman & Kerr, 2015). Building upon previous studies, the present research examined variations in consequences across different drinking and marijuana use events for a sample of college students with a history of alcohol and/or marijuana use: 1) heavier alcohol combined with marijuana (H-SAM); 2) lighter alcohol combined with marijuana (L-SAM); 3) heavier alcohol-only (H-ALC); 4) lighter alcohol-only (L-ALC); and 5) marijuana-only (MJ-only). Findings provided partial support for the proposed hypotheses. For hypothesis 1, H-SAM occasions were associated with significantly more consequences (total, physical, and social) when compared to L-SAM, L-ALC, and MJ-only occasions; however, no differences were observed between H-SAM and H-ALC occasions. Results suggested that on heavy drinking occasions, the number of consequences did not significantly change by also using marijuana. We also found partial support for hypothesis 2, which stated L-ALC would be associated with the fewest number of consequences (total, physical, and social). While L-ALC was associated with fewer consequences than H-SAM and H-ALC, no differences in reported consequences were observed between L-ALC, L-SAM, and MJ-only occasions.

Taken together, these findings extend research comparing individuals who combine alcohol and marijuana to those who do not by examining different occasions among a high-risk sample of college students. Although past studies using between-subjects designs have shown SAM use is associated with more consequences than alcohol-only use, our findings suggest that SAM use is not necessarily riskier than drinking or using marijuana alone when using a within-person design. This conclusion is supported by an equivalent number of consequences reported between H-SAM and H-ALC occasions *and* more consequences reported on H-SAM occasions relative to L-SAM occasions. Further, our findings demonstrated that L-SAM occasions did not result in significantly higher rates of reported consequences compared to L-ALC and MJ-only occasions. Consistent with findings from adolescents aged 15 to 18 years, alcohol may be the primary factor driving the consequences associated with SAM use (Lipperman-Kreda et al., 2017). An alternative consideration is that previous work has shown that SAM use is often associated with increased alcohol consumption (e.g., Subbaraman & Kerr, 2015). This suggests that when students do engage in SAM use, they may be at a higher risk of drinking more heavily (i.e., H-SAM), and thus experience higher rates of consequences compared to L-SAM, L-ALC, and MJ-only occasions. This is consistent with the current study observation that there were more than 3 times the number of occasions involving H-SAM ($n = 433$) than L-SAM ($n = 74$).

Implications

These findings highlight the relationship between heavy alcohol use and increased rates of consequences both when used alone and in combination with marijuana for high risk students. When campus resources are limited and the target is to reduce consequences, findings suggest efforts should focus on reducing heavy alcohol consumption occasions. Studies have also shown that reducing alcohol consumption among college students results in secondary effects such as reductions in marijuana use (Grossbard et al., 2010; Magill, Barnett, Apodaca, Rohsenow, & Monti, 2009). It is important to note that previous research has shown elevated risk for impaired driving among SAM users (Terry-McElrath, O'Malley, & Johnston, 2014), highlighting the specific public health risks associated with combined use behavior. Considering there are not established limits for estimating levels of impairment associated with marijuana that parallel alcohol (i.e., BAC of .08), individuals who engage in L-SAM use may erroneously believe they are able to drive safely since they drank low levels of alcohol. Along with recent work suggesting that feelings of intoxication may differ between SAM and alcohol-only occasions (Lee, Cadigan, & Patrick, 2017), more research is needed to explore other negative outcomes that may be uniquely tied to SAM use, particularly among high-risk students. Research suggests there may be benefits for encouraging individuals to adopt simplified heuristic decision rules (e.g., McCarthy & Davis-Stober, 2018). For instance, when you consume marijuana alone or in combination with ANY amount of alcohol, do not drive.

Limitations and Future Directions

It is important to point out some of the limitations of the study. First, the dosage of marijuana was not assessed in the event-level study. Unlike BAC estimation (e.g., number of standardized drinks in an hour, breathalyzer testing), there is no standardized and valid self-report measure to accurately assess event-level marijuana use (Prince, Conner, & Pearson, 2018). Therefore, it is plausible that some of the findings of the study are related to the amount/potency of marijuana used. Second, the current study focused on student drinkers who also used marijuana rather than primary marijuana users who also drink. Additional work may be needed to examine different types of marijuana users based on their frequency or severity of use. Third, the current study defined SAM use as using alcohol and marijuana on the same day and did not examine the exact timing of SAM use to know to what extent the effects of the two substances overlapped. Future EMA studies that examine implications of using marijuana prior to, after, or in conjunction with alcohol use may be useful. Further research is also required to examine if the current findings generalize to campuses that are more racially/ethnically diverse or in states where recreational marijuana is legal.

Conclusion

Findings provide support that H-ALC and H-SAM occasions were associated with higher rates of overall consequences, while L-SAM, L-ALC, and MJ-only occasions were associated with significantly lower rates of consequences. The findings suggest that not all SAM occasions are associated with a greater risk for consequences and that heavy drinking occasions continue to increase the risk of experiencing acute consequences. Based on these

findings, targeted intervention strategies focusing on reducing heavy drinking occasions are needed to reduce harms associated with both H-ALC and H-SAM use.

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Table 1

Consequence items and measures.

Item		Measure
1.	I said or did embarrassing things.[a]	YAACQ; MACQ
2.	I passed out.[b]	YAACQ; MACQ
3.	I took foolish risks.	YAACQ; MACQ
4.	I drank more alcohol than I originally had planned.	YAACQ
5.	I became more high/intoxicated than I originally had planned.	YAACQ; MACQ
6.	I got into a physical fight.	YAACQ; MACQ
7.	I became very rude, obnoxious, or insulting.[a]	YAACQ; MACQ
8.	I damaged property, or did something disruptive such as setting off a false fire alarm, or other things like that.	YAACQ; MACQ
9.	I did not eat properly.	YAACQ; MACQ
10.	I woke up in an unexpected place.[b]	YAACQ; MACQ
11.	I neglected to protect myself, or my partner, from a sexually transmitted disease (STD) or an unwanted pregnancy.	YAACQ; MACQ
12.	I neglected my obligations to family, work, or school.	YAACQ; MACQ
13.	I found it difficult to limit how much of the substance(s) I took.	YAACQ; MACQ
14.	I experienced a sexual situation I regretted.	YAACQ; MACQ
15.	I said harsh or cruel things to someone.[a]	YAACQ; MACQ
16.	I said things that I later regretted.[a]	YAACQ; MACQ
17.	I did not sleep properly.	YAACQ; MACQ
18.	My physical appearance was harmed.	YAACQ; MACQ
19.	I was pressured or forced to have sex with someone.	YAAPST
20.	I injured someone else.	YAACQ; MACQ
21.	I had a blackout (i.e., could not remember hours at a time).	YAACQ; MACQ
22.	I felt depressed or sad.	YAACQ; MACQ
23.	I made inappropriate sexual advances toward someone.	YAAPST
24.	I was not able to do my homework or study for a test.	YAACQ
25.	I went to work or school high or intoxicated.	YAACQ
26.	My friends or relatives avoided me.[a]	YAACQ
27.	I drove a car while high or intoxicated.	YAACQ; MACQ
28.	I rode in a car with a driver who was high or intoxicated.	YAACQ
29.	I felt dizzy.[b]	YAACQ
30.	I felt anxious.[b]	YAACQ; MACQ
31.	I felt nauseous.[b]	YAACQ
32.	I had a headache.[b]	YAACQ
33.	I vomited.[b]	YAACQ; MACQ

[a]Social subscale;

[b]Physical subscale

Table 2

Frequencies for each type of substance use event across the weekend and for each day.

Event Type	Total Weekend Days (n = 4193)	Thursdays (n= 1087)	Fridays (n= 1555)	Saturdays (n = 1551)
MJ-Only (n = 185)	4.4%	8.1%	3.0%	3.2%
L-ALC (n = 619)	14.8%	21.6%	14.5%	10.3%
H-ALC (n = 2882)	68.7%	58.8%	71.0%	73.4%
L-SAM (n = 74)	1.8%	2.0%	1.7%	1.6%
H-SAM (n = 433)	10.3%	9.5%	9.8%	11.5%

Note. MJ-Only = marijuana only; L-ALC = lighter alcohol-only; H-ALC = heavier alcohol-only; L-SAM = lighter alcohol combined with marijuana; H-SAM = heavier alcohol combined with marijuana.

Table 3.

Multilevel model main effects for hypotheses 1 and 2.

	Consequences					
	Total		Social		Blackout	
	b (SE)	95% CI	b (SE)	95% CI	b (SE)	95% CI
Hypothesis 1						
Type of Occasion						
MJ-only	−1.70 (0.33)**	[−2.34, −1.06]	−0.21 (0.07)**	[−0.35, −0.08]	−0.63 (0.09)**	[−0.82, −0.45]
L-ALC	−1.75 (0.19)**	[−2.12, −1.39]	−0.24 (0.05)**	[−0.34, −0.14]	−0.64 (0.07)**	[−0.79, −0.50]
H-ALC	0.08 (0.16)	[−0.23, 0.39]	0.07 (0.04)	[−0.02, 0.15]	−0.04 (0.06)	[−0.16, 0.08]
L-SAM	−1.49 (0.33)**	[−2.15, −0.83]	−0.22 (0.09)**	[−0.40, −0.04]	−0.61 (0.13)**	[−0.87, −0.35]
H-SAM (ref)						
Hypothesis 2						
Type of Occasion						
MJ-only	0.06 (0.33)	[−0.60, 0.71]	0.03 (0.07)	[−0.11, 0.16]	0.01 (0.10)	[−0.18, 0.20]
H-ALC	1.83 (0.12)**	[1.60, 2.07]	0.31 (0.03)**	[0.24, 0.38]	0.60 (0.05)**	[0.51, 0.70]
L-SAM	0.26 (0.34)	[−0.40, 0.92]	0.02 (0.09)	[−0.16, 0.20]	0.03 (0.13)	[−0.23, 0.29]
H-SAM	1.75 (0.19)**	[1.39, 2.12]	0.24 (0.05)**	[0.14, 0.34]	0.64 (0.07)**	[0.50, 0.79]
L-ALC (ref)						
Covariates (identical for both models)						
MJ-only (Average)	−0.91 (160)	[−4.05, 2.22]	−0.46 (0.33)	[−1.11, 0.19]	−0.08 (0.53)	[−1.13, 0.97]
Alcohol-only (Average)	0.37 (0.41)	[−0.44, 1.18]	0.02 (0.09)	[−0.15, 0.19]	0.22 (0.14)	[−0.06, 0.50]
SAM (Average)	1.55 (0.93)	[−0.28, 3.38]	0.36 (0.20)	[−0.03, 0.75]	0.20 (0.32)	[−0.42, 0.82]
Female	0.47 (0.17)*	[0.13, 0.82]	0.06 (0.04)	[−0.01, 0.13]	0.15 (0.06)*	[0.04, 0.27]
Male (ref.)						
Thursday	0.18 (0.10)	[−0.02, 0.37]	−0.03 (0.03)	[−0.09, 0.02]	−0.002 (0.04)	[−0.08, 0.08]
Friday	−0.08 (0.09)	[−0.25, 0.10]	−0.04 (0.02)	[−0.09, 0.01]	0.01 (0.04)	[−0.06, 0.07]
Saturday (ref.)						
Semester	−0.22 (0.05)**	[−0.31, −0.12]	−0.04 (0.01)*	[−0.07, −0.02]	−0.08 (0.02)**	[−0.11, −0.04]

Notes. MJ-Only = marijuana-only; L-ALC = lighter alcohol-only; H-ALC = heavier alcohol-only; L-SAM = lighter alcohol combined with marijuana; H-SAM = heavier alcohol combined with marijuana. The covariates were included in analyses for both hypotheses; however, they are listed once since their values were the same in both models.

*
$p < .01$;

**
$p < .0001$