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Event-Level Associations of Marijuana and Heavy Alcohol Use with Intercourse and
Condom Use

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Abstract

Objective: The associations substance use has with sex and condom use among college students appear to be well-documented and of clear public health significance. However, few event-level studies examine marijuana or heavy alcohol use, control for temporal patterns shared among these behaviors, or consider differences by relationship status.

Method: We recruited 284 18 to 22 year old undergraduate men and women (79%), 61% of whom were in a serious relationship. For 24 consecutive days, participants reported on their prior day marijuana use, heavy alcohol use, vaginal intercourse, and condom use.

Results: Most intercourse events (86%) were reported by participants in a serious relationship, and most (62%) were not protected by a condom. Hierarchical generalized linear models indicated participants in a serious relationship were more likely to report intercourse than were others. Adjusting for weekly patterns in intercourse, odds of intercourse were higher on days participants reported marijuana or heavy alcohol use; the latter effect was stronger for single participants. Being drunk during sex, being in a serious relationship, and use of non-condom birth control were associated with less condom use. **Conclusions:** Models distinguish among multiple potential influences on undergraduates' sexual behavior. Findings suggest greater attention to the relationship and other contexts of marijuana and alcohol use may be relevant to understanding young adults' sexual behavior and preventing health-risking or nonconsensual sex.

Introduction

Among young adults in the U.S. 28% report heavy alcohol use¹ in the past 30 days (CDC, 2012), and 30.2% report marijuana use in the past year (Johnston et al., 2013). Heavy alcohol use is linked with unintended pregnancy (Naimi et al., 2003), regretted and unwanted sex (Flack et al., 2007; LaBrie et al., 2014), sex with a poorly known partner (Howells & Orcutt, 2014), and perpetrating and experiencing coerced sex (Neal & Fromme, 2007). Relations substance use has with intercourse are relevant to these outcomes, as intoxication may influence risk perception, health risk behavior, perception of partner consent, and capacity to give legal consent.

Alcohol-myopia and expectancy theories posit a causal link between alcohol use and intercourse (Cooper, 2002; 2006). However, although some event-level studies support proximal temporal relations between alcohol use and same-day sex among adolescents and young adults (Hensel et al., 2011; Patrick et al., 2014), others do not (Neal and Fromm, 2007a; Shrier et al., 2012). Additionally, the few event-level studies of whether alcohol use is linked to unprotected sex have yielded inconsistent findings. Neal and Fromme (2007) found that college students' higher blood alcohol concentration was associated with increased risk for same-day unsafe sex. But Hensel and colleagues (2011) reported that late adolescent women were *more* likely to use condoms on days they used alcohol than on other days. Others have found no direct link between alcohol and condom use (Howells & Orcutt, 2014; Parks et al., 2012; Shrier et al., 2012; Walsh et al., 2014). More research is needed on whether heavy alcohol use, in particular, is associated with the likelihood of intercourse and condom use.

¹ Or what is termed "binge drinking" in much of the literature on college students.

As with alcohol, marijuana use frequency is positively associated with social and sexual facilitation expectancies (Buckner et al., 2013). However, unlike alcohol, marijuana may cause users to compensate for impairments in inhibitory control by changing decision-making and risk perception (e.g., Metrik et al., 2012). Indeed, Hensel and colleagues (2011) found that adolescent women's marijuana use was associated with greater likelihood of same-day sex, but not with condom use. Similarly, other event-level studies have not found clear effects of marijuana use on condom use or risky sex (Brodbeck et al., 2006; Parks et al., 2012; Shrier et al., 2012). Yet, more research is needed, given that prior studies have focused on special populations, situations, or long-term retrospection.

Researchers rarely have tested whether substance use plays a different role in facilitating sex among single versus committed young adults. Singles may seek out alcohol use contexts to meet new partners (i.e., reverse causation). Additionally, having sex with a new or uncommitted partner likely carries more uncertainty and risk for negative consequences than sex with a committed partner; if so, substance myopia should be more dramatic for singles. Indeed, heavy alcohol use has been found to be more strongly associated with sex among single than other young adults (Patrick et al., 2014). Whether the finding will replicate and extend to marijuana use is unknown.

Hypotheses

We build on the few event-level studies of these phenomena by using 24 consecutive one-day recollections to examine: undergraduates' marijuana and heavy alcohol use in relation to same-day sex; controls for shared weekly trends in rates of all three behaviors (e.g., Beets et al., 2009); and moderation by relationship status.

First, we predict intercourse will be more probable on days participants report marijuana or heavy alcohol use, and among participants in serious relationships and those with higher rates of use. We expect substance use and same-day intercourse will be most strongly associated among single students.

Second, condom use will be less probable when participants experience alcohol intoxication, controlling for effects of relationship status, use of other forms of birth control (Walsh et al., 2014), and higher average rates of substance use. Relations between marijuana intoxication and condom use are not expected, given prior studies.

Method

Participants

Undergraduates ($n = 284$; 79.2% women) with a lifetime history of consensual vaginal intercourse were drawn from a larger study ($n = 405$). Freshmen (41.2%), sophomores (28.2%), juniors (13.7%), or seniors (16.9%) at a large public university enrolled in cohorts across the first seven weeks of Fall ($n = 139$), Winter ($n = 64$) or Spring ($n = 81$) terms of 2009-2011, when recreational marijuana use was illegal in the state.

Most participants (78.2%) were under the legal drinking age of 21 [age = 18-22; mean (SD) = 19.44 (1.20) years]. Race/ethnicities (non-exclusive) were White/Caucasian (81.7%), Asian (9.2%), Native American (1.8%), Black/African-American (2.5%), Pacific Islander (2.1%), Hispanic (8.1%), and “other” (2.1%). Most participants were in a serious relationship (60.6%) and had used alcohol (96.8%) or marijuana (60.2%).

Procedures

All procedures were IRB-approved. Participants were recruited from a psychology department subject pool and received extra credit for participation. Students who were at least 18 and not currently pregnant were eligible; substance use and being sexually active were not eligibility criteria.

Participants completed a baseline questionnaire, and then on the next Friday completed 24 consecutive daily web-based surveys delivered by email (i.e., four Thursdays-Saturdays, and three Sundays-Wednesdays). Surveys were emailed at 7am and inquired about the past 24 hours (“7am yesterday to 6:59am today”). Survey links expired after 24 hours, to minimize recall errors.

Daily completion rates ranged from 81.3% to 97.2%, and were consistent over time (e.g., 91.5%, 91.7%, and 92.0% across surveys 1-8, 9-16, and 17-24). Furthermore, 39.4% of participants completed all 24 surveys, 73.2% completed 22 or more, 93.3% completed 18 or more, and only 2.5% completed 14 or fewer.

Measures

Within-subjects (Level 1) variables.

Day of the week. The day on which behaviors occurred was recorded. Exploratory analyses (not shown) indicated that rates of intercourse, alcohol, and marijuana use varied in similar ways by day of the week, and that three dummy coded variables captured these patterns²: Thursday (1), Sunday (1), and Monday-Wednesday (1) versus the referent (0) of Friday-Saturday.

² Cell counts of intercourse, heavy alcohol use, and marijuana use, respectively, by day of the week were 62, 10, and 53 of 799 for Monday (8%, 1% and 7%); 58, 12, and 48 of 788 for Tuesday (7%, 2% and 6%); 79, 24, and 65 of 783 for Wednesday (10%, 3% and 8%); 120, 158, and 84 of 1,009 for Thursday (12%, 16% and 8%); 152, 191, and 88 of 944 for Friday (16%, 20% and 9%), 187, 251, and 94 of 1,023 for Saturday (18%, 25% and 9%), and 132, 27, and 53 of 799 for Sunday (17%, 3% and 7%).

Intercourse, marijuana use, and heavy alcohol use. Daily dichotomous variables were created [yes (1), no (0)] from responses to: “Did you have vaginal intercourse (that is, penis in vagina) on [day]?”; “Did you use marijuana on [day]?”; and “How many alcoholic beverages did you drink on [day]?” Heavy alcohol use was defined separately for men (≥ 5) and women (≥ 4).

Between-subjects (Level 2) variables.

Gender. Coding was man (1) or woman (0).

Class. Coding was freshman/sophomore (0) or junior/senior (1).

Relationship status. Participants reported whether they were (1) or were not (0) married ($n = 2$) or seriously dating.

Term. Academic term of participation was dummy-coded in two variables: Winter (1) and Spring (1), versus Fall (0).

Proportions of marijuana use and heavy alcohol use days. Proportions of use days to participation days were calculated.

Intercourse event level variables.

Participants indicated [yes (1), no (0)] whether, “when we had sex”: “I was high on marijuana;” “I was drunk;” [we] “used a condom;” and [we] “used another kind of birth control.”

Data analysis plan

Multilevel logistic regression models with random intercepts were run in Stata 13.1 (StataCorp, 2013). To test our first hypothesis we predicted vaginal intercourse from level 1 (same-day heavy alcohol use and marijuana use, and day of the week) and level 2 variables (relationship status, proportions of use days) and controls (class, term, and

gender) given prior studies. Significant ($p < .10$) two-way interactions among predictors were retained in the final model.

Then we tested our second hypothesis that, within all intercourse events, concurrent alcohol intoxication would be associated with condom non-use, controlling for relationship status, gender, class, and other birth control use. As there were fewer observations in this analysis and low cell numbers in many two-way tabulations, we only tested level-2 predictors and did not test interactions.

Results

Descriptive statistics

Many participants reported intercourse (64.7%, $n = 184$), heavy alcohol use (84.2%, $n = 239$), or marijuana use (30.6%, $n = 87$) at least once during follow-up; these behaviors were reported on 790 (12.6%), 673 (11.0%), and 477 (7.8%) of the 6,145 person-day observations, respectively.

During the 790 intercourse events, participants used a condom (38%, $n = 298$), other birth control (63%, $n = 501$), or no protection (18%, $n = 146$). Most events (86%, $n = 679$) were reported by participants in a serious relationship, and condom use was less common for them (35.1%; $n = 238$ of 679 events) compared to singles (54.1%; $n = 60$ of 111).

A condom was used in 31% ($n = 155$ of 501) of the intercourse events when another form of birth control was used, and 49% ($n = 143$ of 289) of events when other birth control use was denied. Same-day heavy alcohol (17.1%, $n = 135$) or marijuana use (9.4%, $n = 74$) was reported for few of the 790 intercourse events, as was being drunk (10%, $n = 78$) or high (5%, $n = 39$) during sex.

Prediction model for vaginal intercourse.

As reported in Table 1 the odds of intercourse were higher on marijuana use days [Odds ratio (OR) = 2.38], especially in Winter versus Fall (interaction OR = 3.37). The association of same-day heavy alcohol use with intercourse probability was conditioned on relationship status (interaction OR = .33); use was linked with a higher odds of intercourse for single participants (OR = 4.62) than others (OR = 1.52³). The model accounted for the lower odds of intercourse on Mondays-Wednesdays and Thursdays than on Fridays-Saturdays, a pattern that was less pronounced in Spring versus Fall.

At level 2, odds of intercourse were higher among participants in a serious relationship (OR = 7.88) relative to others, but did not differ by term or class. Trends suggestive of gender interactions with proportions of days of substance use and with term were not significant ($p < .10$). Primary findings are plotted in a figure available at <insert_JSAD_supplement_link>.

Prediction model for condom use.

Next, we predicted condom use [model $n = 184$ participants, 790 observations; Intercept B (SE) = 3.35 (1.26), $p < .01$; Random intercept SD (SE) = 4.72 (.65)]. Being drunk [B (SE) = -.40 (.20), OR = .67, $p < .05$]⁴, in a serious relationship [B (SE) = -3.20 (1.21), OR = .04, $p < .01$], and using other birth control [B (SE) = -3.95 (1.22), OR = .02, $p < .01$] were associated with decreased odds of condom use. Being high, gender, and

³ Derived from the exponentiated sum of coefficients for heavy alcohol use (B = 1.53) and its interaction with relationship status (B = -1.11).

⁴ Proportions of heavy alcohol use and marijuana use days across the follow-up did not predict condom use, and when added to the model reduced the significance ($p = .09$) but not the magnitude (from OR = .67 to .71) of the effect of drunkenness during sex on condom use. Thus, the event-level effect of heavy alcohol use on condom use was not explained by a tendency for heavy alcohol users to infrequently use condoms.

class did not predict condom use [B (SE) = .20 (.24), .50 (.99), and -.14 (.82); OR = 1.23, 1.64, and .87, respectively].

Discussion

Undergraduates were more likely to have intercourse on days they reported heavy alcohol use than on other days. This effect was independent of the increased tendency for both behaviors to occur on weekends and for students who drank more to have sex more. Thus, our study is one of only a handful (e.g., Neal & Fromme, 2007) to disentangle key within- and between-person effects that are confounded in many cross-sectional studies.

Also consistent with prior work (Patrick et al., 2014) the associations heavy alcohol use had with same-day intercourse were strongest among single undergraduates. For those in a serious relationship, having sex may be less influenced by alcohol's disinhibiting and expectancy effects, and reverse causation may be less relevant than for singles. The association heavy alcohol use has with sex among single students has potential public health implications as alcohol intoxication may impact decision-making, consent, and regret regarding intercourse (Flack et al., 2007; Labrie et al., 2014; Neal & Fromme, 2007), and interfere with protection against pregnancy and STI.

Indeed, we found that alcohol intoxication was linked with decreased condom use. Prior studies of this issue have not yielded consistent results (e.g., Hensel et al., 2011; Howells & Orcutt, 2014; Neal and Fromme, 2007). However, the topic requires further study given that our models did not compare individuals' rates of condom use when they were versus weren't intoxicated (i.e., within-subjects).

As predicted, undergraduates' marijuana use also was associated with increased probability of same-day intercourse. The effect was robust to controls for shared weekly

trends in the rates of these behaviors, and for effects of heavy alcohol use at the between-subjects and event levels. The independent associations of marijuana and heavy alcohol use with sex are consistent with the notions that use of these substances occurs in different social contexts and that they have different intoxicative and expectancy effects (Metrik et al., 2012). Marijuana use may lead to sex through increased arousal and disinhibition, and/or may be sought out to facilitate meeting a partner and to enhance pleasure (i.e., reverse causation). Notably, condom use was no less probable when respondents were high on marijuana during sex than when they were not and was not associated with overall rates of marijuana use across the follow-up period. In all, findings are consistent with Hensel and colleagues' (2011) event-level study and with experimental work suggesting decision-making impairments may be mild following marijuana use and that cognitive compensation may occur (e.g., Metrik et al., 2012).

Two additional sets of findings deserve comment. First, "hook ups" or casual sex are an important focus of sexual health promotion. However, most intercourse events (86%) we observed occurred in a serious relationship. Participants in a serious relationship (compared to singles) had about eight times the odds of having sex on a given day, and when they did had 25 times the odds of not using a condom. Relatedly, the odds of condom use were reduced by a factor of 52 when another other birth control was used, even though non-condom methods do not protect against STI. Findings may reflect college students' greater concern with preventing pregnancy than STI, and that being in a serious relationship may inappropriately decrease perceptions of STI risk (see Walsh et al., 2014). Thus, targeting beliefs and behaviors that are relevant to sex in committed relationships may be an effective focus of STI prevention. Additionally, perhaps

pregnancy and STI prevention should be approached as distinct topics of health promotion. For example, STI counseling of men and women may be appropriate when prescription contraception is started or refilled.

Second, single students' intercourse was generally confined to only part of the week (Thursday-Saturday) and was especially probable on heavy alcohol use days. This contextual specificity suggests prevention programs can be supplemented with sexual health messaging and distribution of condoms at the times and places single undergraduates gather to seek out sex.

Limitations

Generalizability may be limited by the: use of a convenience sample; underrepresentation of students of color and men; and focus on heterosexual vaginal intercourse events. Additionally, measures did not establish whether substance use preceded intercourse. Finally, the relative infrequency of intercourse precluded analysis of within-subjects effects of substance use on condom use.

Conclusions

Undergraduates more often had intercourse on days when they used marijuana or alcohol. Alcohol (but not marijuana) intoxication and use of non-condom birth control are linked with less condom use. Yet, most sex that is unprotected against STI occurs among sober partners in serious relationships. These findings imply a different prevention focus than do stereotypes about drunk, casual sex during college.

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Table 1. Prediction of vaginal intercourse from event- and person-level variables.

Level 1	B	OR	SE	
Intercept	-3.47	--	0.29	***
Sunday ^a	0.14	1.15	0.18	
Monday-Wednesday ^a	-1.05	0.35	0.16	***
Thursday ^a	-0.39	0.68	0.17	*
Heavy alcohol use	1.53	4.62	0.26	***
Marijuana use	0.87	2.38	0.30	**
Heavy alcohol X Relationship status ^b	-1.11	0.33	0.31	***
Marijuana X Winter ^c	1.22	3.37	0.59	*
Marijuana X Spring ^c	-0.54	0.58	0.55	
Sunday X Winter ^c	-0.51	0.60	0.36	
Mon-Wed X Winter ^c	0.13	1.14	0.29	
Thurs X Winter ^c	-0.35	0.71	0.35	
Sunday X Spring ^c	0.16	1.18	0.30	
Mon-Wed X Spring ^c	0.65	1.92	0.25	**
Thurs X Spring ^c	-0.14	0.87	0.31	
Level 2	B	OR	SE	
% days heavy alcohol use	0.02	1.02	0.08	
% days marijuana use	0.03	1.03	0.07	
Relationship status ^b	2.06	7.88	0.22	***
Male gender	-0.21	0.81	0.41	
Winter term ^c	-0.49	0.61	0.30	
Spring term ^c	-0.27	0.76	0.28	
Junior/Senior ^d	0.02	1.02	0.21	
% days heavy alcohol X Male	0.28	1.32	0.15	†
% days marijuana X Male	-0.22	0.81	0.11	†
Male X Winter	1.11	3.05	0.63	†
Male X Spring	-0.18	0.83	0.55	
	SD		SE	
Random Intercept	1.26		0.10	

ICC 0.33 0.03

Note: ^a Friday/Saturday, ^b single relationship status, ^c Fall term, and

^d freshman/sophomore were the referents. $n = 284$ participants with 6145 observations.

See figure depicting primary findings at: <insert_JSAD_supplement_link>.

† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Associations between substance type and vaginal intercourse probability by day of the week for participants who are single (panel A) or in a serious relationship (panel B).

