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Alcohol and marijuana use predicting next-day absenteeism and engagement at school and work: A daily study of young adults

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Abstract

This study examined effects of alcohol and marijuana use on next-day absenteeism and engagement at work and school among young adults (18–25 years old) who reported past-month alcohol use and simultaneous alcohol and marijuana use. Participants completed twice daily surveys for five, 14-day bursts. The analytic sample was 409 [64% were enrolled in university (*N*=263) and 95% were employed (*N*=387) in at least one burst]. Daily measures included: any alcohol or marijuana use, quantity of alcohol or marijuana use (i.e., number of drinks, number of hours high), attendance at work or school, and engagement (i.e., attentiveness, productivity) at school or work. Multilevel models examined between- and within-person associations between alcohol and marijuana use and next-day absenteeism and engagement at school or work. Between-persons, the proportion of days of alcohol use days was positively associated with next-day absence from school, consuming more drinks was positively associated with next-day absence from work, and the proportion of days of marijuana use was positively associated with next-day engagement at work. At the daily-level, when individuals consumed any alcohol and when they consumed more drinks than average, they reported lower next-day engagement during school and work. When individuals used marijuana and when they were high for more hours than average, they reported lower next-day engagement during school. Findings suggest alcohol and marijuana use consequences include next-day absence and decrements in next-day engagement at school

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and work, which could be included in interventions aimed at ameliorating harmful impacts of substance use among young adults.

1. Introduction

Alcohol and marijuana are the most commonly used psychoactive substances among young adults in the US (Schulenberg et al., 2021). Approximately 47% of young adults report past-month alcohol consumption, with estimates slightly higher among college students compared to their non-college peers (SAMHSA, 2019). These data also show that nearly 23% of young adults report past-month marijuana use, but in contrast to alcohol, marijuana use is higher among non-college young adults compared to college-aged peers. Alcohol and marijuana misuse are associated with negative consequences, including increased risk of injury or fatality, health problems, and developing comorbid psychiatric conditions, including substance use disorders (Hasin, 2018; White and Hingson, 2013). Given that young adulthood is a developmental period associated with academic and employment transitions (Cadigan et al., 2019; Roisman et al., 2004), effects of alcohol or marijuana use on absenteeism and engagement (i.e., defined here as attention and productivity) at school and work is of growing concern, particularly underlying mechanisms that contribute to poor outcomes.

It is well-established that the psychoactive properties of alcohol and marijuana produce cognitive deficits such as impaired attentiveness, concentration, and memory - cognitive skills important for engagement in a variety of settings, including school and work (Bourque and Potvin, 2021; Lisdahl and Price, 2012; Shillington and Clapp, 2001). Impairment can occur within hours of use and persist the following day and for weeks to months (Berre et al., 2017; Crean et al., 2011; Stavro et al., 2013; Wade et al., 2020). However, not all cognitive abilities are affected equally over time and depend on a complex interplay of factors, including age of use initiation, as well as quantity and frequency of use (Bourque & Potvin, 2021 Wade et al., 2020; Willford et al., 2021). For example, in a recent systematic review and meta-analyses, Gunn and colleagues (2018) examined associations between heavy drinking and next-day cognitive performance. Findings indicated that cognitive function, including sustained attention and psychomotor speed, and performance of daily tasks, such as driving, were impaired the day following heavy alcohol use. However, results were mixed for some cognitive functions such as working memory, and no effects were found for other cognitive functions such as divided attention. Overall, results revealed that heavy alcohol use impairs specific aspects of next-day cognitive function and performance. In a separate study, researchers reviewed acute and long-term effects of marijuana use, finding that attentional and information processing abilities may improve after a period of abstinence, whereas decision-making and risk-taking deficits may persist (Crean et al., 2011).

Although the short- and long-term effects of alcohol and marijuana on cognition is a complex interplay of biological and environment conditions, a growing body of research suggests alcohol and marijuana use are linked with decreased engagement and poor outcomes (e.g., job loss, school drop-out) at school and work (e.g., Arria et al., 2015;

Gubbels et al., 2019; Okechukwu et al., 2019). Prior research suggests engagement is a multifaceted construct comprising at least two key components - cognitive engagement (e.g., attentiveness, motivation) and behavioral engagement (e.g., productivity, effort; Kahn, 1990; Wang & Eccles, 2013). Deficits in engagement associated with alcohol and marijuana use are predictive of poor outcomes, such as reduced motivation (Cherek et al., 2002; Lane et al., 2005) and decreased work performance (Bernerth & Walker, 2020; Thørrisen et al., 2019), lower grade point averages (Martinez et al., 2015; Pascarella et al., 2007; Paschall and Freisthler, 2015; Suerken et al., 2016), poor performance on assignments (Patte et al., 2017; Shillington and Clapp, 2001), dropping out of college (Arria, Garnier-Dykstra, Caldeira et al., 2013; Fleming et al., 2012; Hunt et al., 2010), underemployment (Arria, Garnier-Dykstra, Cook et al., 2013; Boden et al., 2017), and absenteeism (Schou & Moan, 2016). Together, these findings suggest that alcohol and marijuana negatively impact engagement broadly across settings and behavioral outcomes. While these are important findings, additional research to differentiate the effects of alcohol versus marijuana on the cognitive and behavioral components of engagement (i.e., attention and productivity) is warranted.

While the extant literature supports an association between substance use and academic and work-related outcomes, the bulk of research regarding these associations has come from cross-sectional research, which limits our ability to understand the temporal ordering of relationships (Lynskey and Hall, 2000) and impedes are our ability to develop adaptive prevention and intervention efforts. Additionally, few studies have simultaneously assessed the potential mechanisms (e.g., attentiveness, productivity) underlying these associations using methodologies capable of examining their unique contributions to outcomes across settings. Examining daily-level associations between substance use and academic- and work-related outcomes would allow better distinction between specific use-outcome associations, including their temporal ordering (Allen et al., 2020; Phillips et al., 2015). For instance, in a daily study of undergraduate students who use marijuana, marijuana craving was negatively associated with self-reported academic motivation in the moment (i.e., motivation to complete schoolwork) and with time spent studying at the next assessment point (i.e., later that day or the following day; Phillips et al., 2015). Further, average time spent smoking marijuana was negatively associated with cumulative GPA. In a similar daily study, college students were more likely to skip class and less likely to engage in schoolwork the day after engaging in heavy episodic (4+/5+ drinks for women/men) and high-intensity drinking (8+/10+ drinks for women/men), suggesting consequences extend to the following day (Allen et al., 2020).

Together, these studies highlight alcohol and marijuana use as important antecedents to engagement in tasks necessary for success, which has important implications for prevention and intervention efforts aimed at reducing risks associated with substance use. For example, better establishment of the temporal relationship between substance use and cognitive-behavioral outcomes could allow for adaptive, in-the-moment interventions to reduce risky or harmful use that could impede next-day engagement. However, more research is needed to better understand these complex and dynamic associations and potential mechanisms underlying these associations. The aims of the present study are to examine between- and within-person associations between 1) alcohol use and next-day

absenteeism and engagement at school and work, and 2) marijuana use and next-day absenteeism and engagement at school and work among a community sample of young adults who use alcohol and marijuana. Consistent with previous research (Kahn, 1990; Wang & Eccles, 2013), we operationalized engagement as the combination of perceived attention and productivity, with attention representing one aspect of cognitive engagement and productivity representing one aspect of behavioral engagement. We hypothesized that at the between- and within-person level any and greater alcohol and marijuana use would be associated with increased next-day absenteeism and decreased next-day engagement at school and work.

2. Methods

2.1. Participants and procedures

Young adults were recruited from the community for a longitudinal study examining daily behaviors and health-related experiences (N = 409). Participants were recruited in the greater Seattle Washington area using a variety of methods, such as social media and Craigslist advertisements, newspaper advertisements in community and college newspapers, flyering or community postings, and in-person outreach. Eligibility criteria included being 18–25 years old; reporting simultaneous use of alcohol and marijuana 1+ times in the past month; reporting drinking alcohol 3+ times in the past month; living within 60 miles of the study office; being willing to complete online daily surveys; being willing to receive study-related text messages; and attending an in-person session for consent, identity/age verification, and an online baseline survey. Online surveys were administered twice a day (morning and afternoon) in six 14-day bursts across 2 years (for further details, see Lee et al., 2020). To ensure that all daily data used here were collected prior to March 2020 (i.e., before the COVID-19 pandemic and primarily in 2018–2019), current analyses use data from the morning and afternoon surveys collected in the first 5 bursts as well as demographic data collected at baseline.

Morning surveys in bursts 1–5 were completed either in whole (79.64%) or in part (2.35%); afternoon surveys in bursts 1–5 were completed either in whole (80.07%) or in part (2.16%). Participants earned $2.50 for each completed survey and a bonus of $10 for each burst if at least 25 surveys (out of 28) were completed for a possible total of $80 paid in Amazon e-gift cards. The University IRB approved this study and no adverse events were reported.

The analytic sample included 409 young adults and two sets of analyses were conducted: one set of analyses examining participants who were enrolled in college/university and another set examining participants who were employed full-time (see Table 1 for sample characteristics).

2.2. Measures

2.2.1. Morning survey

2.2.1.1. Alcohol use yesterday: In the morning surveys, participants were asked “Did you drink any alcohol yesterday?” (0=*no*, 1=*yes*) where yesterday was defined as “from the time you woke up until the time you went to sleep.” If they used alcohol the prior day, they were

asked “How many total drinks did you have yesterday?” Response options ranged from “1 drink” (coded 1) to “25 or more drinks” (coded 25).

2.2.1.2. Marijuana use yesterday: In the morning surveys, participants were asked “Did you use any marijuana yesterday?” (0=*no*, 1=*yes*). If they used marijuana the prior day, they were asked “How many total hours were you high yesterday?” Response options ranged from “<1 hour” (coded 0) to “23–24 hours” (coded 23). Recent research suggests that number of hours high can be used as a proxy for quantity of marijuana use among young adults (Calhoun et al., 2022).

2.2.2. Afternoon survey

2.2.2.1. Alcohol and marijuana use yesterday: If participants missed the morning survey, they were asked about their alcohol and marijuana use in the afternoon survey. Similar to the morning survey, participants were asked if they drank any alcohol yesterday, how many total drinks they drank yesterday, if they used any marijuana yesterday, and how many total hours they were high yesterday.

2.2.2.2. Absence at school and work: Absence at school and work were assessed similarly. For school, in the afternoon surveys participants were asked whether they have school the following day (0=*no*, 1=*yes*) and then also if they attended school yesterday (0=*no*, 1=*yes*). Once reference days were realigned, responses indicating that they had school but did not attend were coded as absent from school. For absence at work, parallel items were used where ‘school’ was replaced with ‘work.’

2.2.2.3. Engagement at school and work: Engagement at school and work were assessed similarly. For school, in the afternoon participants were asked whether they went to school yesterday (0=*no*, 1=*yes*). If they went to school yesterday, they were asked about their attentiveness (“Yesterday, how present or attentive were you at school?”) and productivity (“Yesterday, how productive were you at school?”). Response options for both items ranged from 1 “Very slightly or not at all” to 5 “Extremely.” The two items assessing attentiveness and productivity were summed and divided by 2 so that scores for “engagement” at school ranged from 0 to 5. For engagement at work, parallel items were used where ‘school’ was replaced with ‘work’ and the two items were summed and divided by 2 to reflect engagement at work.

2.2.3. Baseline survey

2.2.3.1. Demographics: Demographic information was collected at baseline and used as covariates, including participant age, biological sex, race, and ethnicity. Ethnicity and race were coded with “non-Hispanic/Latinx White” as the reference group and contrasted with “non-Hispanic/Latinx Asian or South Asian” and “non-Hispanic/Latinx Other” (i.e., Black/African American; American Indian or Alaskan Native; Native Hawaiian or other Pacific Islander; Arab, Middle Eastern or North African; more than one race; and Other). Education status was collected at the beginning of each burst and was included in analyses for school engagement (1=*4-year college student*, 0=*other type of college student*).

2.3. Analytic Plan

Analyses were conducted in R, and multilevel modelling was done using the 'nlme' package (Pinheiro et al., 2020). First, all predictor and outcome variables were examined descriptively. To examine Aim 1a, estimating associations between alcohol use and absenteeism at school and work, multilevel logistic regression analyses were conducted examining if any alcohol use (dichotomized) was associated with next-day absenteeism at school (Model 1) and work (Model 2). To examine Aim 2b, estimating associations between alcohol use and engagement at school and work, multilevel regression analyses were conducted examining if any alcohol use was associated with next-day engagement at school (Model 3) and work (Model 4). Next, models were fit specific to alcohol use days to examine linear associations between amount of alcohol use and next-day absenteeism at school (Model 5) and work (Model 6), and next-day engagement at school (Model 7) and work (Model 8). To disentangle between- and within-person effects, alcohol use variables were decomposed into a time-fixed between-person variable and a time-varying within-person (i.e., daily-level) variable. In the model examining associations between amount of alcohol use and next-day engagement, number of drinks was person-mean centered to examine daily deviations from a participants' average number of drinks consumed on drinking days (Enders and Tofighi, 2007).

To examine Aim 2, multilevel regression analyses were conducted examining if any marijuana use or more hours high were associated with next-day absenteeism at school or work, and next-day engagement at school and work. Similar to the alcohol models, models tested the effects of any marijuana use on next-day absenteeism at school (Model 9) and work (Model 10), and next-day engagement at school (Model 11) and work (Model 12), as well as the effects of number of hours high on next-day absenteeism at school (Model 13) and work (Model 14, and next-day engagement at school (Model 15) and work (Model 16). Marijuana use was decomposed into between- and within-person levels as described above.

All models controlled for participant age at baseline, birth sex (0=*male*; 1=*female*), and race/ethnicity, burst number (i.e., 1–5), day of the week (0=*Monday*; 1=*Tuesday*; 2=*Wednesday*; 3=*Thursday*; 4=*Friday*; 5=*Saturday*; 6=*Sunday*), and day number within burst (i.e., 1–14). For school outcomes, educational status was controlled for at the within-burst level. Because few students attended school on Saturday or Sunday (n = 8 participants), reports of engagement at school on Saturdays or Sundays were not included in the school models.

Multilevel models with daily survey responses are highly flexible in handling missing data at the day- and burst-levels (Kwok et al., 2008). Moreover missing data was accounted for using the robust maximum likelihood estimator, which should provide unbiased estimates in the presence of missing data assuming data are missing at random (MAR); that is, missingness is not due to unmeasured variables (Atkins, 2005). Consistent with MAR assumption, daily-level missingness was not significantly predicted by previous day alcohol or marijuana use (p's>.05).

3.0. Results

3.1 Descriptive statistics

Descriptive statistics are presented in Table 1. Across the analytic sample (n = 409) and across all possible response days (n = 28,630), average daily-level missingness (i.e., not completing either daily survey) was 10% of days (SD = 0.18). The proportion of alcohol use days and the proportion of marijuana use days were not significantly associated with daily-level missingness (p's < .05). Fifty-five percent of the sample (n = 225) reported that they were both working and going to school during at least one burst. Responses for absenteeism at school were recorded on 2,669 days and included 239 participants; responses for absenteeism at work were recorded on 5,961 days and included 370 participants. Responses for engagement at school were recorded on 3,348 days and include 263 participants; responses for engagement at work were recorded on 7,670 days and include 387 participants.

On average, participants reported drinking on 27.66% and 36.6% of the days prior to a day they were supposed to attend school and work (i.e., the day before), respectively, and on 22.65% and 33.62% of the days prior to a day that they did attend school and work, respectively. When participants drank alcohol the day prior to a day they were supposed to attend school or work, they consumed an average of 3.37 (SD = 2.63) and 3.7 (SD = 2.84) drinks, respectively. When participants drank alcohol the day prior to a day they did attend school or work, they consumed an average of 3.04 (SD = 2.42) and 3.15 (SD = 2.46) drinks, respectively.

Participants reported using marijuana on 35.23% and 38.59% of the days prior to a day they were supposed to attend school and work, respectively, and on 31.79% and 37.87% of the days prior to a day they did attend school and work, respectively. When participants used marijuana the day prior to a day they were supposed to attend school or work, they reported an average of 3.08 (SD = 2.41) and 3.14 (SD = 2.49) hours high, respectively. When participants used marijuana the day prior to a day they did attend school or work, they reported an average of 2.68 (SD = 2.10) and 2.98 (SD = 2.36) hours high, respectively. Participants reported they were absent from school and work on 12.29% and 6.75% of days in which they were supposed to attend school and work, respectively. On average, across all school/work days, participants reported being moderately engaged at school [M (SD) = 3.38 (0.92)] and work [M (SD) = 3.49 (0.90)].

3.2. Aim 1: Associations between alcohol use and next-day absenteeism and engagement at school and work

Results from multilevel models estimating associations between any alcohol use and next-day absenteeism at school (Model 1) and work (Model 2), and next-day engagement at school (Model 3) and work (Model 4) are presented in Table 2; results from multilevel models estimating associations between number of drinks and next-day absenteeism at school (Model 5) and work (Model 6), and next-day engagement at school (Model 7) and work (Model 8) are presented in Table 3. For absenteeism outcomes, between-persons and controlling for relevant covariates, those with a greater proportion of alcohol use days

(relative to no alcohol use days) had increased odds of absence from school [(OR (95%CI) = 1.61 (1.12–2.31)] and those who generally consumed more drinks, on average across all study days, had increased odds of absence from work [(OR (95%CI) = 1.16 (1.04–1.29)]. That is, those participants who drank more frequently had more absences from school the next day and those who drank greater quantities had more absences from work the next day.

For engagement outcomes, at the daily-level, alcohol use (relative to no alcohol use) was associated with lower next-day engagement at school ($b = -0.11$; $p < .001$) and work ($b = -0.05$; $p = .019$) and greater number of drinks, relative to participants' average number of drinks consumed on drinking days, was negatively associated with next-day engagement at school ($b = -0.07$; $p = .028$) and work ($b = -0.03$; $p <. 001$). That is, drinking any alcohol and drinking more than one's usual amount was associated with lower levels of next-day engagement at school and work.

3.3 Aim 2: Associations between marijuana use and engagement at school and work

Results from multilevel models estimating associations between any marijuana use and next-day absenteeism at school (Model 9) and work (Model 10), and next-day engagement at school (Model 11) and work (Model 12) are presented in Table 4; results from multilevel models estimating associations between number of hours high and next-day absenteeism at school (Model 13) and work (Model 14), and next-day engagement at school (Model 15) and work (Model 16) are presented in Table 5. Marijuana use was not associated with next-day absence from school or work at either the between- or within-person level. For engagement outcomes, between-persons, the proportion of days of marijuana use was positively associated with next-day engagement at work ($b = 0.27$; $p = .002$). At the daily-level, marijuana use (relative to no marijuana use) was associated with lower next-day engagement at school ($b = -0.12$; $p = .003$). More hours high, relative to participants' average hours high on marijuana use days, was negatively associated with next-day engagement at school ($b = -0.05$; $p = .013$).

4. Discussion

The present study utilized a rigorous longitudinal design to examine the relationship between alcohol and marijuana use and next-day absenteeism and engagement at school and work among a community sample of young adults. Alcohol and marijuana use were commonly reported in our sample on days prior to attending both school and work. Alcohol use was positively associated with next-day absenteeism at school and work and negatively associated with next-day engagement at school and work. Marijuana use was negatively associated with next-day engagement at school.

These findings support and extend previous cross-sectional findings relating substance use to increased absenteeism and decreased cognitive and behavioral engagement in academics and at work (e.g., Ansari et al., 2013; Buvik et al., 2018; Mekonen et al., 2017; Schou & Moan, 2016) at the person-level (i.e., individuals who engaged in substance use also reported increased absence and/or decreased engagement at work and school). At the daily-level, we found that alcohol use (any and greater quantities) was associated with lower next-day engagement (i.e., the combination of perceived attention and productivity) at school and

work. That is, on days individuals used any alcohol and on days when they consumed more drinks than average, they reported lower next-day engagement during school and work. Findings may be explained by hangovers or residual alcohol-related cognitive impairment (Gunn et al., 2018) which reduces an individuals' ability to focus on and perform school- and work-related tasks. Studies have also found links between alcohol use and disrupted sleep (He et al., 2019; Schierenbeck et al., 2008), which could also explain associations between drinking and decreased next-day engagement at school and work. For marijuana use, any use and being high for longer than average was also associated with decreased next-day engagement at school, which may also be explained by residual marijuana-related cognitive impairment and/or disrupted sleep (Crean et al., 2011; Phillips et al., 2015). Although a single day of decreased engagement at work or school may not negatively impact long-term educational and occupational outcomes, persistent decreased academic and occupational engagement could have a negative impact on longer-term academic and career achievement.

Marijuana use was not associated with next-day absence or engagement at work at the daily-level. Further research is needed to better understand daily-level associations between marijuana use and how engaged one feels at work the following day, including potential moderators of associations. For example, it may be that THC content moderates associations between marijuana use and next-day engagement at work such that such that using marijuana with high levels of THC may have a stronger impact on next-day engagement at work than using marijuana with lower levels of THC. Surprisingly, between-person analyses indicated that individuals who reported greater number of days using marijuana also reported *greater* next-day engagement at work. While more research is needed to understand this association, motivations for use may help explain this finding. For instance, although research suggests marijuana use may negatively impact one's sleep (Schierenbeck et al., 2008), some young adults report that they use marijuana to help them sleep and to relax (Lee et al., 2009). Thus, it may be that between-persons, marijuana use is positively related to next-day engagement at work due to the perception of better sleep or to increased relaxation (Winiger et al., 2021). Future studies could include assessment of motives to help clarify these associations.

The current study has important implications for students and employees as well as for the institutions where they study or work. Education and messaging around the next-day impacts of alcohol or marijuana may prove effective in prevention efforts. For instance, Larimer and colleagues (2012) developed an intervention aimed at decreasing college student drinking which included education around the effects of alcohol at various blood alcohol levels. Findings indicated the intervention was associated with decreased alcohol use and heavy episodic drinking among college students, as well as increased use of positive behavioral strategies to reduce drinking-related consequences.

We also found burst-level was positively associated with engagement across substance use variables. That is, engagement at school and work increased in subsequent waves of data collection, suggesting participants may be maturing as they go further into their educational or vocational path. This is consistent with data showing high-intensity alcohol use (10+ drinks) and daily marijuana use both peak at age 21 to 22 (Schulenberg et al., 2021), and

highlights the importance of controlling for burst number in daily-level data collected at multiple bursts, especially when main effects may differ as a function of age.

4.1. Limitations and Future Directions

This study should be considered in light of important limitations. We examined a community sample of young adults that live in a state where non-medical marijuana use is legal for individuals aged 21 and older. While legalization is increasingly common, findings may not generalize to states with different marijuana-related laws. This study relied solely on self-report for substance use and engagement and may be subject to recall bias. Furthermore, given the repeated daily assessments, we used short retrospective daily measures for engagement at work and school to reduce participant burden, but this may have limited our ability to detect variability. Future studies could seek to use more objective and/or comprehensive measures of how engaged individuals were while at school/work such as the amount or proportion of time spent on task at work/school or valid and reliable multidimensional measures assessing engagement at work (e.g., Utrecht Work Engagement Scale; Mills et al., 2012) and school (e.g., the School Engagement Measure; Fredricks & McColskey, 2012). We also did not examine concurrent or simultaneous alcohol and marijuana use, and future studies could examine whether these behaviors are associated with next-day absenteeism and engagement at school and work. We also did not include time of substance use in the models, which may have helped explain associations with next-day work/school functioning, and we did not examine use on the days the participants were working or going to school. Future work could examine patterns of use on work- and school-days. Finally, while the study controlled for different types of college students (4-year vs. other type of college student) in analyses, it did not

control for different types of employment (e.g., manual labor vs. desk job), which could impact between-person associations, including our finding that the proportion of days of marijuana use was related to increased next-day engagement at work, as reviewed above. However, assuming participants do not change occupations frequently throughout the study period, controlling for occupational categories is not anticipated to have influenced within-person associations that are central to the current study. Nevertheless, alcohol or marijuana use may have a greater impact on next-day engagement in jobs that require higher degrees of focus, requiring future work to include cross-level interaction estimates by occupational category.

4.1. Conclusions

The present study examined links between alcohol and marijuana use and next-day absenteeism and engagement at school and work among a community sample of young adults using an intensive longitudinal design. At the daily-level, alcohol use was associated with decreased next-day engagement at school and work and marijuana use was associated with decreased next-day engagement at school. Young adults may benefit from education around next-day impacts of alcohol and marijuana use.

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Highlights

- Alcohol use was negatively related to next-day absenteeism at school and work.
- Alcohol use was negatively related to next-day engagement at school and work.
- Marijuana use was negatively related to next-day engagement at school.
- Academic and work performance may be compromised the day after alcohol or marijuana use.

Table 1.

Descriptive statistics.

Predictor	School Sample		Work Sample	
	N	*M* (*SD*) or %	*N*	*M* (*SD*) or %
Level 3 variables: Between-person				
Baseline age	263	20.75 (2.11)	387	22.16 (2.00)
Female	263	50.12%	387	54.86%
Race/ethnicity	263		387	
Non-Hispanic White		42.83%		49.91%
Non-Hispanic Asian		20.88%		15.71%
Non-Hispanic Other		20.73%		18.77%
Hispanic		15.56%		15.68%
Level-2 variables: Burst-level 4-year college student	3345	73.36%	--	--
Level-1 variables: Within-person Day of week	3348		7670	
Monday		21.62%		18.16%
Tuesday		22.19%		17.28%
Wednesday		22.10%		16.62%
Thursday		19.92%		17.25%
Friday		14.16%		15.78%
Saturday	--	--		7.47%
Sunday	--	--		7.44%
Alcohol use	3258	22.65%	7492	33.62%
Number of drinks	743	3.04 (2.42)	2518	3.15 (2.46)
Marijuana use	2733	31.79%	7484	37.87%
Number of hours high	918	2.68 (2.10)	2745	2.98 (2.36)
Absenteeism	377	6.75%	282	10.57%
Engagement (range 1–5)	3348	3.38 (0.92)	7670	3.49 (0.90)

Table 2

Results from multilevel mixed effects models of alcohol use predicting next-day absenteeism at school (Model 1) and work (Model 2), and next-day engagement at school (Model 3) and work (Model 4).

Predictor	**School Absenteeism N 233 participants (2,597 days)**		**Work Absenteeism N 367 participants (5,877 days)**		**School Engagement N = 2S8 participants (3,258 days)**		**Work Engagement N — 384 participants (7,492 days)**	
	OR (95 % CI)	***p-value***	***OR (95 % CI)***	***p- value***	***b (SE)***	***p- value***	***b (SE)***	***p-value***
Intercept	0.17(0.01.5.74)	0.326	0.51 (0.08. 3.28)	0.477	**3.72**	**<0.001**	**4.03**	**<0.001**
Level-3 Variables: Between person								
Baseline age	0.93 (0.8. 1.09)	0.378	0.92 (0.85. 1.0)	0.057	−0.02	0.377	**−0.03**	**0.019**
Female	0.96 (0.62. 1.56)	0.952	**0.71 (0.5. 0.99)**	**0.047**	−0.07	0.352	0.04	0.461
Race/ethnicity								
Kon-Hspanic White	(ref)		(ref)		(ref)		(ref)	
Nan-Hispanic Asian	**2.0(1.07. 3.73)**	**0.029**	1.51 (0.95. 2.41)	0.085	−0.13	0.242	−0.07	0.379
Non-Hispanic Other	**2.62(1.45, 4.73)**	**0.001**	1.38 (0.88.2.17)	0.164	−0.09	0.393	0.02	0.761
Hispanic	1.02(0.5.2.31)	0.966	1.17(0.71, 1.93)	0.527	0.10	0.386	0.12	0.129
Proportion of days of alcohol use	**1.61 (1.12. 2.31)**	**0.1**	1.02 (0.77. 1.35)	0.874	−0.08	0.675	0.14	0.236
Level-2 Variables: Burst-Level								
Burst number	0.96 (0.85. 1.09)	0.564	0.94 (0.86. 1.03)	0.17	**0.04**	**<0.001**	**0.03**	**<0.001**
4-year college student	1.52 (0.75. 3.08)	0.225	-	-	−0.11	0.808	-	-
Level-1 Variables: Within person								
Day of Week								
Monday	(ref)		(ref)		(ref)		(ref)	
Tuesday	0.75 (0.5. 1.13)	0.169	0.77 (0.53. 1.13)	0.178	−0.05	0.221	−0.01	0.669
Wednesday	**0.61 (0.4. 0.93)**	**0.022**	**0.65 (0.44. 0.97)**	0.035	−0.03	0.510	0.01	0.644
Thursday	**0.63 (0.41.0.96)**	**0.033**	0.78 (0.53. 1.13)	0.188	0.00	0.926	0.00	0.964
Friday	1.01 (0.65, 1.57)	0.977	0.97 (0.67. 1.40)	0.859	−0.06	0.152	0.02	0.494
Saturday	-	-	1.35 (0.86.2.1)	0.188			0.03	0.400
Sunday	-	-	1.26 (0.80. 1.99)	0.326			**−0.08**	**0.046**
Day number within burst	1.0. (0.96. 1.04)	0.981	0.99 (0.86. 1.03)	0.476	**0.02**	**<0.001**	0.00	0.578
Any alcohol use	1.45(1.12.2.31)	0.521	0.5 (0.22. 1.13)	0.094	**−0.11**	**<0.001**	**−0.05**	**0.019**

Predictor	School Absenteeism N 233 participants (2,597 days)		Work Absenteeism N 367 participants (5,877 days)		School Engagement N = 2S8 participants (3,258 days)		Work Engagement N — 384 participants (7,492 days)	
	OR (95 % CI)	*p-value*	*OR (95 % CI)*	*p- value*	*b (SE)*	*p- value*	*b (SE)*	*p-value*
Autocorrelation Parameter Estimate					φ−0,141		φ−0.189	

Note: School engagement = (school attentiveness + school productivity)/2.

Note: Work engagement = (work attentiveness + work productivity)/2.

Note: Models estimating associations with engagement (continuous outcome) were specified with a first-order autocorrelation error structure, but absenteeism models (binary outcome) did not converge when specifying autocorrelation.

Note: Weekend days were removed from the school models.

Table 3

Results from multilevel mixed effects models of number of drinks predicting next-day absenteeism at school (Model 5) and work (Model 6), and next-day engagement at school (Model 7) and work (Model 8).

Predictor	School Absenteeism N = 163 participants (593 days)		Work Absenteeism N = 303 participants (1.887 days)		School Engagement N = 195 participants (743 days)		Work Engagement N = 336 participants (2.518 days)	
	OR *(95* % CI)	*p*-value	OR (95 *%* CI)	*p*-value	*b* (SE)	*p*-value	*b*(SE)	*p*-value
Intercept	0.01 (0.0. 6.3)	0.148	0.07 (0.0. 3.33)	0.179	**3.19**	**<0.001**	**4.25**	**<0.001**
Level-3 Variables Between person								
Baseline age	1.02 (0.77. 1.35)	0.872	0.97 (0.83. 1.14)	0.745	−0.01	0.828	−0.03	0.058
Female	1.19(0.5.2.80)	0.696	0.63 (0.34. 1.17)	0.142	−0.05	0.658	0.05	0.464
Race/ethnicity								
Non-Hispanic White	(ref)		(ref)		(ref)		(ref)	
Non-Hispanic Asian	1.78 (037. 2.8)	0.318	1.69 (0.73. 3.94)	0.221	0.08	0.608	−0.04	0.671
Non-Hispanic Other	1.27(0.44. 3.71)	0.661	1.28 (0.55. 2.96)	0.563	0.23	0.081	0.03	0.761
Hispanic	0.42 (0.12. 1.49)	0.178	1.69 (0.76. 3.76)	0.196	0.18	0.213	0.16	0.089
Average number of drinks	1.04 (0.89. 1.22)	0.603	**1.16(1.04. 1.29)**	**0.007**	−0.01	0.601	−0.02	0.363
Level-2 Variables: Bum- Level								
Bum number	1.21 (0.92. 1.6)	0.176	0.91 (0.76. 1.08)	0.269	**0.07**	**0.005**	0.01	0.666
4-year college student	3.11 (0.83. 11.69)	0.092	-	-	0.12	0.346	-	-
Level-1 Variables: Within person								
Day of Week								
Monday	(ref)		(ref)		(ref)		(ref)	
Tuesday	0.90 (0.37. 2.19)	0.824	0.95 (0.44. 2.04)	0.891	−0.05	0.588	−0.05	0354
Wednesday	0.45 (0.18. 1.13)	0.09	0.5 (0.22. 1.14)	0.098	−0.13	0.172	−0.01	0.925
Thursday	0.44(0.17. 1.15)	0.093	0.98 (0.49. 1.98)	0.957	−0.14	0.140	−0.01	0.865
Friday	0.78 (0.3. 2.04)	0.618	0.58(0.26. 1.28)	0.176	−0.10	0.319	−0.04	0.490
Saturday	-	-	0.89 (0.39. 2.04)	0.778	-	-	−0.02	0.820
Sunday	-	-	1.06(0.48. 2.36)	0.881	-	-	**−0.14**	**0.035**
Day number within burst	1.07 (0.97. 1.17)	0.189	1.02(0.96. 1.08)	0.568	0.02	0.099	0.00	0.507
Lfeviation in number of drinks	1.17(0.92. 1.48)	0.195	1.03 (0.85. 1.24)	0.769	**−0.07**	**0.028**	**−0.03**	**<0.001**
Autocorrelation Parameter Estimate					φ = 0.049		*φ* = 0.021	

Note: School engagement = (school attentiveness + school productivity)/2.

Note: Work engagement = (work attentiveness + work productivity)/2.

Note: Models estimating associations with engagement (continuous outcome) were specified with a first-order autocorrelation error structure, but absenteeism models (binary outcome) did not converge when specifying autocorrelation.

Note: Weekend days were removed from the school models.

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Table 4

Results from multilevel mixed effects models of marijuana use predicting next-day absenteeism at school (Model 9) and work (Model 10), and next-day engagement at school (Model 11) and work (Model 12).

Predictor	**School Absenteeism N = 163 participants (2,100 days)**		**Work Absenteeism N = 303 participants (5.428 days)**		**School Engagement N = 195 participants (2,733 days)**		**Work Engagement N = 336 participants (7.153 days)**	
	OR (95 % CI)	***p-value***	***OR (95 % CI)***	***p-value***	***b (SE)***	***p-value***	***b (SE)***	***p-value***
Intercept	0.26 (0.0, 19.9)	0.544	0.2 (0.03. 1.55)	0.124	**3.38**	**<0.001**	**3.85**	**<0.001**
Level-3 Variables: Between person								
Baseline age	0.91 (0.76. 1.09)	0.299	0.94 (0.86. 1.03)	0.19	−0.01	0.737	−0.03	0.05S
Female	1.12 (0.65. 1.92)	0.683	0.77(0.53. 1.11)	0.16	0.04	0.656	0.09	0.125
Race/ethnicity								
Non-Hispanic White	(ref)		(ref)		(ref)		(ref)	
Non-Hispanic Asian	**2.27(1.1.4.7)**	**0.026**	1.62 (0.99. 2.65)	0.057	0.09	0.489	−0.01	0.908
Non-Hispanic Other	**2.2(1.13. 4.29)**	**0.021**	1.40(0.85.2.3)	0.181	−0.10	0.387	0.02	0.813
Hispanic	1.01 (0.46. 2.2S)	0.976	1.32 (0.8,2.19)	0.279	0.05	0.707	0.08	0.319
Proportion of days of	0.97 (0.62. 1.52)	0.889	1.18(0.83. 1.67)	0.355	0.15	0.293	**0.27**	**0.002**
marijuana use								
Lencl-2 Variables: Burst Lewi								
Burst number	0.99(0.86. 1.14)	0.887	0.93 (0.84. 1.03)	0.851	**0.03**	**0.015**	**0.03**	**<0.001**
4-year college student	1.45(0.61.3.44)	0.394	-	-	−0.01	0.883	-	-
Level-1 Variables: Within person								
Day of Week								
Monday	(ref)		(ref)		(ref)		(ref)	
Tuesday	0.79 (0.51. 1.25)	0.316	0.79(0.52. 1.19)	0.262	0.08	0.086	0.00	0.904
Wednesday	0.59 (0.37. 0.94)	**0.027**	0.65 (0.42. 1.0)	0.053	−0.07	0.103	0.01	0.680
Thursday	0.59 (0.36. 0.96)	**0.033**	0.85 (0.57. 1.27)	0.422	−0.02	0.666	0.01	0.862
Friday	0.84 (0.51. 1.39)	0.499	1.01 (0.68. 1.5)	0.973	0.08	0.122	−0.01	0.755
Saturday	-	-	1.4 (0.87. 2.23)	0.164	-	-	0.02	0.619
Sunday	-	-	1.34 (0.83.2.17)	0.236	-		**−0.08**	**0.045**
Day number within burst	1.02 (0.97. 1.07)	0.407	1.0(0.84. 1.03)	0.851	**0.02**	**<0.001**	0.00	0.732
Any marijuana use	1.81 (0.72. 4.52)	0.206	0.87 (0.46. 1.65)	0.678	**−0.12**	**0.003**	−0.03	0.275

Predictor	School Absenteeism N = 163 participants (2,100 days)		Work Absenteeism N = 303 participants (5.428 days)		School Engagement N = 195 participants (2,733 days)		Work Engagement N = 336 participants (7.153 days)	
	OR (95 % CI)	*p-value*	*OR (95 % CI)*	*p-value*	*b (SE)*	*p-value*	*b (SE)*	*p-value*
Autocorrelation Parameter Estimate	-		-		φ = 0.012		φ = − 0.002	

Note: School engagement = (school attentiveness + school productivity)/2.

Note: Work engagement = (work attentiveness + work productivity)/2.

Note: Models estimating associations with engagement (continuous outcome) were specified with a first-order autocorrelation error structure, but absenteeism models (binary outcome) did not converge when specifying autocorrelation.

Note: Weekend days were removed from the school models.

Table 5

Results from multilevel mixed effects models of number of hours high predicting next-day absenteeism at school (Model 13) and work (Model 14), and next-day engagement at school (Model 15) and work (Model 16).

Predictor	School Absenteeism N = 114 participants (689 days)		Work Absenteeism N = 238 participants (1.983 days)		School Engagement N = 144 participants (918 days)		Work Engagement N = 280 participants (2.745 days)	
	OR (95 % CI)	*p*-value	OR (95% CI)	*p*-value	b(SE)	*p*-value	*b* (SE)	*p*-value
Intercept	0.0 (0.0,8.05)	0.176	0.01 (0.0, 0.28)	0.006	**2.83**	**<0.001**	**3.73**	**<0.001**
Lewi-3 Variables: Between person								
Baseline age	1.07 (0.8. 1.42)	0.656	1.07 (0.94. 1.22)	0.989	0.01	0.711	−0.02	0.216
Female	1.28 (0.6. 2.74)	0.52	0.76 (0.44.1.31)	0.314	−0.07	0.715	0.06	0.364
Race/ethnicity								
Nan-Hispanic White	(ref)		(ref)		(ref)		(ref)	
Non-Hispanic Asian	1.8 (0.6, 5.39)	0.292	0.76(0.31. 1.86)	0.546	0.09	0.623	0.09	0.444
Non-Hispanic Other	1.44 (5.42. 3.84)	0.462	0.91 (0.45. 1.85)	0.793	−0.13	0.379	0.11	0.243
Hispanic	1.06 (0.38. 2.98)	0.91	1.22 (0.62.2.41)	0.571	0.02	0.897	0.09	0.343
Average number of hours high	1.04 (0.86. 1.27)	0.669	1.07(0.94. 1.21)	0.284	−0.01	0.795	0.04	0.104
Level-2 Variables: Burst-Lewi								
Burst number	0.99 (0.78. 1.26)	0.951	0.96(0.82. 1.12)	0.705	**0.05**	**0.039**	**0.03**	**0.002**
4-year college student	2.86(0.74. 11.0)	0.127	-	-	0.19	0.175	-	
Level-1 Variables: Within person								
Day of Week								
Monday	(ref)		(ref)		(ref)		(ref)	
Tuesday	0.68 (0.31. 1.46)	0.318	0.97 (0.5, 1.87)	0.93	**−0.21**	**0.008**	−0.02	0.630
Wednesday	0.96(0.44. 2.1)	0.921	0.84 (0.42. 1.67)	0.614	**−0.19**	**0.019**	−0.04	0.423
Thursday	0.79 (0.36. 1.72)	0.553	0.95 (0.5. 1.82)	0.88	−0.14	0.094	−0.03	0.570
Friday	0.65 (0.27. 1.55)	0.332	1.0(0.52. 1.93)	0.991	**−0.23**	**0.009**	0.06	0.281
Saturday	-	-	0.77 (0.32. 1.83)	0.55	-	-	−0.09	0.148
Sunday	-	-	1.52 (0.74. 3.12)	0.252	-		**−0.14**	**0.024**
Day number within burst	0.97 (0.89. 1.05)	0.423	1.01 (0.96. 1.07)	0.705	**0.02**	**0.008**	0.00	0.299
Deviation in number of hours high	1.07 (0.84. 1.36)	0.591	1.0 (0.85, 1.17)	0.989	**−0.05**	**0.013**	−0.02	0.052

Predictor	School Absenteeism N = 114 participants (689 days)		Work Absenteeism N = 238 participants (1.983 days)		School Engagement N = 144 participants (918 days)		Work Engagement N = 280 participants (2.745 days)	
	OR (95 % CI)	*p*-value	OR (95% CI)	*p*-value	b(SE)	*p*-value	*b* (SE)	*p*-value
Autocorrelation Parameter Estimate					φ = - 0.053		φ = - 0.009	

Note: School engagement = (school attentiveness + school productivity)/2.

Note: Work engagement = (work attentiveness + work productivity)/2.

Note: Models estimating associations with engagement (continuous outcome) were specified with a first-order autocorrelation error structure, but absenteeism models (binary outcome) did not converge when specifying autocorrelation.

Note: Weekend days were removed from the school models.