

# Abstracts from the 2021 Virtual Scientific Meeting of the Research Society on Marijuana July 23<sup>rd</sup>, 2021

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## KEYNOTE ADDRESS

**The Unparalleled Evils of Cannabis**  
Mitch Earleywine  
University at Albany, SUNY

## POSTER PRESENTATIONS

*All poster presentations and symposia were peer-reviewed by the 2021 Conference Program Committee of the Research Society on Marijuana (RSMj) (Bradley T. Conner, Colorado State University, Benjamin O. Ladd, Washington State University Vancouver, Kristina T. Phillips, Kaiser Permanente, Verlin Joseph, University of New Mexico). All abstracts below were approved and voluntarily submitted for publication in Cannabis by the presenting or contact author.*

### **The effects tailored interventions on cannabis use motives**

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**Background:** The motives for cannabis affect on cannabis use and cannabis use consequences. Coping with stress is among the frequent motives for cannabis use. However, non stressed youth may use cannabis for self-enhancing motives like boosting confidence. Both motives are associated with higher frequency of cannabis use and more negative consequences (e.g., effects on schoolwork quality). Interventions targeting these distinctive motives may need to be tailored to assist youth trying to reduce cannabis use. The purposes of this study were: to examine the effect of cannabis use interventions on the change in motives of use; and whether motives for use are associated with hours per week using cannabis.

**Methods:** Participants were from a cross national study including US and Canadian youth (n= 781). Participants included in the current analysis were from two Canadian Universities (n = 397, 54% female, median age = 21) were randomized into either the Cannabis eCHECKUP TO GO or Healthy Stress Management (HSM) intervention. Both interventions were administrated online and assessed at baseline and at a 4- to 6-week follow-up. Eligible youth reported using cannabis more than once a week and wanted to reduce their cannabis use. The 19 items to the question “what do you like about cannabis” were used as an assessment of motives for use (e.g., I feel more courageous, I feel more confident, cannabis helps me reduce stress, cannabis helps me sleep). Confirmatory Factor Analysis showed that a 2-factor model of cannabis use motives (self-confidence and stress-coping) fit the data adequately (CFI = 0.795, RMSEA [90% CI] = .063 [.057, .069]) after removing 2 poorly fitting items. **Results:** Across conditions self-confidence motives (T1: eCHECKUP condition M = 4.05(2.55), HSM condition M = 4.13(2.43); T2: eCHECKUP condition M = 4.09(2.50), HSM condition M = 4.36(2.28)) were endorse less than stress-coping motives (T1: eCHECKUP condition M = 6.48(1.92), HSM condition M = 6.25(1.78); T2: eCHECKUP condition M = 6.20(1.99), HSM condition M = 6.32(1.96)). Stress-coping motives were significantly correlated with the time spent high (hours a week) (T1 r= .21, T2: r=.26). A repeated measures MANOVA showed a significant interaction between time and intervention condition for the stress-coping motives only (F(1)= 4.08, p = .04). Participants in the Healthy Stress Management condition reported a significant decrease in the amount of stress-coping motives at the follow-up.

**Conclusions:** These results demonstrate that motives of cannabis use can change over the course of a short online intervention for students seeking to reduce their use. In particular, the

Healthy Stress Management condition helped participants reduce their stress-coping motives at T2. Neither intervention affected self confidence motives in the short term. These may be harder to address and may fuel continued use over time, even for youth hoping to change.

### **Associations of Cannabis Use Motives and Cannabis Demand in Young Adults**

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**Background:** Cannabis is the most commonly used illicit substance among young adults and is associated with a variety of negative consequences. Studies have shown that both cannabis demand and certain cannabis motives are associated with higher levels and frequency of cannabis use, as well as associated problems. No study has yet to examine the relationship between cannabis use motives and cannabis demand. The purpose of the current study was to examine the associations between individual cannabis motives and cannabis demand.

**Methods:** Data were collected from 95 young adult cannabis users who reported using cannabis at least once in the last 30 days. (M age = 20.63; Female = 50.5%; M cannabis use days per month = 14.64). Participants completed questionnaires assessing cannabis use frequency, cannabis use motives, and a cannabis purchase task. Amplitude, representative of the amount consumed at an unrestricted price, and persistence, representative of sensitivity to escalating price, were calculated and used in the analyses.

**Results:** Initial correlational analyses demonstrated significant relationships between demand and total number of cannabis motives and conformity, enjoyment, coping, experimentation, boredom, celebration, and sleep motives ( $ps < .05$ ). A series of hierarchical linear regressions were conducted to determine the specific associations between the aforementioned individual cannabis motives and amplitude and persistence. Step one controlled for age, gender, and cannabis use frequency, and the motives were added in step two. Regression models indicated that total number of motives, enjoyment,

conformity, and coping motives were significant predictors of persistence even after controlling for cannabis use frequency. Motives were not significant predictors of amplitude.

**Conclusion:** Findings from this study suggest that young adults who use cannabis for enjoyment, conformity, or coping reasons may experience greater reinforcement efficacy of cannabis which may place them at increased risk to develop cannabis use disorder or other related problems associated with their use. Further, young adults with these cannabis use motives may be less sensitive to increases in price and continue to purchase cannabis at higher prices. These findings can be used to inform cannabis interventions by targeting specific motives for use.

### **Just Say No: The Relationship between Conformity Motives, Refusal Self-Efficacy, and Cannabis-Related Consequences**

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Faith Shank  
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Cannabis use on college campuses is common, with more than half of students reporting use within the past year (Schulenberg, et. al, 2020). Additionally, a 2017 study found that approximately 90% of past-month cannabis users reported having experienced at least one negative consequence (Pearson, Liese, & Dvorak, 2017). Numerous studies have evaluated the association between conformity motives and cannabis-related consequences such as driving under the influence or poor academic performance (Glodosky & Cuttler, 2019; Lee, Neighbors, & Woods, 2007). Research suggests that while those users who endorse conformity motives generally report lower use and frequency (Zvolensky et al., 2007), they may be at high risk of experiencing negative cannabis-related consequences (Buckner, Walukevich, & Lewis, 2019). One construct that has been shown to predict lower cannabis-related problems in young adults is refusal self-efficacy (Papinczak, Connor, Harnett, & Gullo, 2018; Hayaki et al., 2011). Refusal self-efficacy in relation to cannabis use is one's belief that they will be able to resist, refuse, or turn down cannabis when offered. As refusal self-efficacy is prominent in conformity-driven situations, it is

important to understand how refusal self-efficacy may mediate the relationship between conformity motives and cannabis-related consequences. As this relationship has not yet been tested we aim to examine this mediational relationship.

We hypothesized that refusal self-efficacy mediates the relationship between motives and cannabis-related problems, such that refusal self-efficacy explains the preexisting relationship between conformity motives and problems related to cannabis use.

Participants included 567 undergraduate students (49.02% White, 77.21% female). Cannabis use prevalence among the sample was 61.25% lifetime, 36.53% within the past 6 months, and 28.92% within the past 30 days. The relationship between conformity motives, refusal self-efficacy, and problems was examined using structural equation modeling in STATA Version 15.1. Results found that The relationship between conformity motives and cannabis-related problems was partially mediated by cannabis refusal self-efficacy. The direct path from conformity motives to problems was significant and positive ( $B = .167$ ,  $SE = .063$ ), indicating a competitive mediation (Zhao, Lynch, & Chen, 2010). The standardized regression coefficient between conformity motives and refusal self-efficacy was statistically significant ( $B = -.337$ ,  $SE = .053$ ), as was the standardized regression coefficient between refusal self-efficacy and cannabis-related problems ( $B = -.411$ ,  $SE = .06$ ). We tested the significance of the indirect effect using bootstrapping procedures. Unstandardized indirect effects were computed for each of the 5,000 bootstrapped samples. The bootstrapped unstandardized indirect effect was .357, and the 95% confidence interval ranged from .180, .533. Thus, the indirect effect was statistically significant. This indicates that part of the reason that those with conformity motives have cannabis-related problems is due to their inability to refuse cannabis when offered. However, due to the fact that this was a partial mediation, there are other potential mediators to be accounted for, such as social anxiety (Buckner & Schmidt, 2008).

### **Elucidating the Nature of the Links Between Cannabis Use and Attention**

Deficit/Hyperactivity Disorder  
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Many individuals with mental health disorders use cannabis to self-medicate for their symptoms. Attention-deficit/hyperactivity disorder (ADHD) is a neurological disorder associated with increased cannabis use but, relative to other mental disorders (e.g., anxiety, psychosis, post-traumatic stress disorder), far less attention has been paid to examining cannabis use by people with ADHD. Nevertheless, there is some limited evidence to suggest that people with ADHD might use cannabis to self-medicate for their symptoms and that they perceive it to be beneficial for this purpose. The goal of this study was to better understand the nature of the relationships between cannabis use and A total of 1,382 undergraduate students completed an online survey measuring their ADHD symptoms, and cannabis use patterns. Participants who reported they have used cannabis to manage their ADHD were further asked to report their perceptions of whether acute and/or chronic cannabis use improves, worsens, or has no effect on their ADHD symptoms. Participants who reported they have been prescribed ADHD medication and use cannabis also reported their perception of how cannabis use affects the effectiveness of their medication, and ADHD medication side effects. Evidence from this study revealed that ADHD symptom severity is associated with consuming cannabis more frequently and with more severe symptoms of cannabis use disorder. Participants with ADHD reported that cannabis has acute detrimental effects on memory but beneficial effects on many of their other core symptoms of ADHD, including hyperactivity, impulsivity, restlessness, and mental frustration. While most participants on ADHD medications reported that cannabis does not influence their medication effectiveness, they did report that cannabis helps with many of the side effects associated with their ADHD medications including headaches, loss of appetite, sleep disturbances, moodiness/irritability, and anxiety. The knowledge gained from this study will help people with ADHD and their healthcare providers by providing them with a better understanding of the use of cannabis by individuals with ADHD including the possible risks and benefits of such use on cannabis use disorder, ADHD symptoms, and medication side effects.

**Solitary Cannabis Use during the COVID-19  
Pandemic: Associations with Affect, Social  
Factors, and Pandemic-Related Stress**

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**Introduction:** Emerging evidence suggests that cannabis use has increased since the start of the COVID-19 pandemic. Many cannabis users report using at a greater frequency and attribute this change in part to a desire to cope with changes to mental health (e.g., depression, social anxiety) and stress associated with the pandemic. Despite increases in social isolation due to quarantine and social-distancing requirements, little is known about how the social context of cannabis use (i.e., how much cannabis use is conducted with others vs. alone) may be associated with affective and social factors as well as cannabis-related consequences. This cross-sectional study explored associations of solitary cannabis use frequency with depression, social anxiety, loneliness, interpersonal sensitivity, pandemic-related stress, and cannabis use consequences.

**Method:** Participants (N = 168; 53% female, mean age = 18.71 [SD = 0.99]; 67% White, 11% Hispanic/Latinx) were college students who reported lifetime cannabis use. Participants completed a single-wave online survey assessing solitary and overall cannabis use frequency, depression, social anxiety, loneliness, interpersonal sensitivity, pandemic-related stress, and cannabis consequences. First, independent-samples t-tests and zero-inflated negative binomial regression were used to explore associations of at-least monthly solitary (vs. exclusively or majority social use) cannabis use with proposed correlates and cannabis use consequences, respectively. Second, all affective factors were entered into a multinomial logistic regression predicting past-year (but no past-month) and past-month solitary cannabis use (with no past-year solitary use as reference). Age and sex were controlled for given prior associations with solitary cannabis use and cannabis use consequences.

**Results:** Compared to exclusively or predominantly social use, past-month solitary cannabis use was independently associated with greater depression ( $t[166]=2.49$ , Cohen's  $d=0.41$ ), interpersonal sensitivity ( $t[166]=3.09$ , Cohen's  $d=0.51$ ), pandemic-related stress ( $t[166]=3.95$ ,  $d=0.67$ ), and cannabis use consequences ( $IRR=2.28$ ,  $<.001$ ). Results from the multinomial regression showed that male sex

( $OR=3.48$ ,  $p=.032$ ) and greater pandemic-related stress ( $OR=1.41$ ,  $p=.001$ ) were associated with higher odds of past-year solitary use, while male sex ( $OR=2.98$ ,  $p=.016$ ), greater interpersonal sensitivity ( $OR=1.12$ ,  $p=.044$ ), and greater pandemic stress ( $OR=1.34$ ,  $p<.001$ ) was associated with higher odds of past-month solitary use.

**Conclusion:** Findings expand upon pre-pandemic findings that solitary cannabis use is associated with social anxiety and cannabis use consequences, and further emphasize associations of frequent solitary cannabis use with greater cannabis consequences. Findings further implicate interpersonal sensitivity and pandemic-related stress as risk factors for higher frequency solitary cannabis use. Taken together, findings suggest a) screening for solitary use may have utility for identifying higher-risk users among college students and b) individuals who use cannabis alone may benefit from treatment targeting concurrent issues with stress management and interpersonal sensitivity.

**Marijuana, Social Isolation, and Loneliness  
Among Older Adults: Results from the 2018  
Health and Retirement Study**

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Center)

**Introduction:** Marijuana is the most used substance across all age groups and as of recently, there has been a significant increase in use among older adults (i.e. individuals ages 65+). Moreover, older adults also report higher levels of loneliness and social isolation, which are significant risk factors for initiation of marijuana use. However, these relationships have yet to be examined among older adults. The purpose of the present study was to examine whether social isolation and loneliness predicted marijuana use among a national sample of US older adults and examine differences in past-year use.

**Methods:** A secondary data analysis of the 2018 Health and Retirement Study was conducted. The Health and Retirement Study is a national study examining health, income, retirement, and other psychosocial variables. For the present study, we utilized the newest marijuana module. We created a Loneliness scale ( $\alpha = .88$ ), social isolation scale

( $\alpha = .85$ ), and assessed differences based on demographics and perceptions of marijuana. Weighted logistic regression models were built to determine conditional associations to past-year marijuana use. The level of significance was set at  $p < .05$ .

**Results:** A total of 1,661 adults ages 65+ was the final analytic sample. Nearly 1 in 10 (9.85%) adults reported past-year use of marijuana. Neither loneliness ( $p = .43$ ) or social isolation ( $p = .39$ ) were significant predictors of marijuana use. Adjusting for demographics, adults who reported past year drinking (aOR: 7.84, 95% 2.13, 28.9) were more likely to report use. Individuals who thought marijuana should be legalized for medicinal purposes were 44.6 times more likely to report past year use.

**Discussion:** To our knowledge, this is one of the first studies to examine loneliness, social isolation, and its association with past-year marijuana use among a large sample of older adults in the United States. Findings from the present study can inform policy prevention efforts, address facets in Healthy People 2030, and clinical interventions.

#### **Assessment of Impaired Control Over Cannabis Consumption: Psychometric Properties of the Impaired Control Scale-Cannabis (ICS-C)**

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**Background:** Impaired control over substance use is a construct that is central to addiction and appears to play an early role in the development of addictive behaviors. The Impaired Control Scale (ICS) was developed to measure impaired control over alcohol, which has been associated with problem drinking and alcohol-related problems in young adults. However, there is relatively less research regarding impaired control over cannabis, and currently there is a lack of a comprehensive and valid scale that specifically measures this construct. This study addresses this gap in the literature by introducing the Impaired Control Scale-Cannabis (ICS-C), an

adaptation of the ICS designed to measure impaired control over cannabis. We conducted a preliminary examination of the factor structure, reliability, and validity of the ICS-C.

**Methods:** An online survey was administered to introductory psychology students ( $N=362$ ; 63% women; 66% White, mean age=19.91) at two Canadian Universities who reported using cannabis at least once in the past month (average frequency = 9.34 days;  $SD = 9.60$ ). All participants completed the ICS and ICS-C along with measures of cannabis use and problems, including the Impaired Control subscale of the Marijuana Consequences Questionnaire (MACQ-IC). A subset of participants completed additional measures of impulsivity and self-regulation.

**Results:** An exploratory factor analysis (EFA, with an oblique rotation) of the 25 items of the ICS-C yielded 3 factors, one of which was comprised solely of reverse keyed items (despite reverse coding items prior to the EFA). These items were trimmed from the measure and the EFA was rerun. Two factors emerged: Attempted Control (i.e., frequency of attempts to control cannabis use) and a factor comprised of items assessing both Failed Control (i.e., unsuccessful attempts in limiting cannabis use) and Perceived Control (i.e., beliefs about the ability to control cannabis use in the future). Given that the Failed and Perceived Control items unexpectedly loaded on the same factor, suggesting high redundancy in the concepts of Failed and Perceived control, the items assessing Perceived Control were dropped from subsequent analyses. The final solution consisted of two factors, Attempted Control ( $\alpha=0.96$ ) and Failed control ( $\alpha=0.88$ ). High correlations between the MACQ-IC and ICS-C Attempted Control ( $r=0.42$ ,  $p<.001$ ) and Failed Control ( $r=0.67$ ,  $p<.001$ ) scales provided evidence for convergent validity. Weaker correlations between ICS (alcohol version) and ICS-C Attempted Control ( $r=0.36$ ,  $p<.001$ ) and Failed Control ( $r=0.34$ ,  $p<.001$ ) scales supported discriminant validity. Concurrent validity was demonstrated based on the moderate and statistically significant correlations of the ICS-C Failed Control subscale and frequency of cannabis use ( $r=0.47$ ,  $p<.001$ ) and grams of cannabis used ( $r=0.44$ ,  $p<.001$ ). Additional evidence for concurrent and discriminant validity were also found in the patterns of correlations between the

ICS-C subscales and measures of impulsivity and self-regulation.

Conclusions: ICS-C is a promising tool that can be used to assess impaired control over cannabis in young adults. Future research should confirm the factor structure of the ICS-C and examine its utility to screen for impaired control in the context of prevention and early intervention for cannabis-related problems.

**Unplanned vs. planned simultaneous alcohol and cannabis use in daily life: What are the motives, contexts, and outcomes?**

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Alcohol and cannabis are commonly used by U.S. college students and often used simultaneously (simultaneous alcohol and marijuana [SAM] use). Better understanding situations in which SAM use is planned or unplanned and related consequences of these distinct SAM use events will inform prevention and intervention efforts. We extended previous daily-level research by examining motives and contexts (social, physical) as indicators of unplanned vs. planned SAM use occasions, as well as by parsing specific plans for alcohol use and for cannabis use on SAM use occasions. Specifically, we examined: unplanned alcohol and marijuana (UAM) use, planned mono-substance (either alcohol or cannabis but not both) use (MSU), and planned SAM use. College student SAM users (N=341; 53% women) were recruited from three U.S. universities and completed 56 days of data collection with five repeated surveys each day. Most SAM use occasions were planned (73% of occasions), followed by planned MSU (18%), and by UAM use (10%). Two-level generalized linear mixed-effects models were conducted to account for nesting of occasions within persons and the three-category nominal outcome. All models included age, sex, recruitment site (school), weekend, and other drug use as covariates. At the within-person level,

using for social or enhancement reasons was related to higher odds of planned SAM use (vs. UAM use). These reasons for use were also related to planned SAM use when compared to planned MSU, whereas using because it was offered or to cope was related to lower odds of planned SAM use (vs. planned MSU). Using at home or alone was linked to lower odds of planned SAM use (vs. UAM use), and using at a party, friend's place, with friends, with more intoxicated people, and with more people using cannabis was associated with higher odds of planned SAM use. An identical pattern was found when comparing planned SAM use to planned MSU. When disaggregating "planned MSU" into planned alcohol use-unplanned cannabis use vs. planned cannabis use-unplanned alcohol use, using for social or enhancement reasons was related to higher odds of planned alcohol-only use. Likewise, using at a party, with friends, with strangers/acquaintances, with more intoxicated people, and with more people using cannabis were related to higher odds of planned alcohol-only use. Using at home or alone was linked to lower odds of planned alcohol-only use. Findings suggest that interventions should target days when college students are planning for SAM use. Mobile health interventions could also focus on higher risk motives (e.g., social) and contexts (e.g., party) that were indicators of planned SAM use, as well as target individuals who endorse using substances to cope or because substances were offered, with these latter individuals being at risk for unplanned SAM use when only MSU was originally planned. Specifically, ecological momentary interventions and just-in-time adaptive interventions could send protective behavioral strategies to individuals endorsing intentions for use and high-risk motives or contexts to reduce the heavy alcohol and cannabis consumption that was associated with planned SAM use.

**Differences in Marijuana Use, Consequences, and Motives based on Young Adults' Interest in Reducing their Marijuana Use or Consequences: May 2021 Data from a High-risk Community Sample**

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**Purpose.** This study contributes to our understanding of the factors associated with young adults' interest in reducing their marijuana use or consequences during the COVID-19 pandemic. This study compared high-risk young adults who indicated they were open to or thinking about changing their marijuana use to those who were satisfied with their marijuana use. These two groups were compared on biological sex, age, marijuana use, consequences, and 12 motives. **Method.** The data were part of a larger longitudinal study that recruited a community sample of young adults from the Seattle WA area (ages 18-25 at recruitment), who reported recent alcohol use and also simultaneous alcohol and marijuana use. Participants were recruited through various methods including social media and Craigslist advertisements. Participants completed a baseline survey and six 2-week bursts of online daily surveys across two years as well as other follow-up surveys. Data presented here were collected in May 2021, the final follow-up assessment point. May 2021 data were collected from 376 participants (92% of the original recruited sample), and the current analyses focus on the 265 participants who reported using marijuana in the past month (50.6% females, 48.68% non-Hispanic/Latinx White, mean age = 24.58 (SD = 2.20). **Results.** Over one-third (37.7%, n = 100) indicated they were open to changing or currently thinking about changing their marijuana use by using less or by reducing marijuana's negative effects. Almost two-thirds (60.4%, n = 160) indicated they were satisfied with their use of marijuana, 1.5% (n = 4) indicated they were currently seeking or in treatment for marijuana use, and 0.4% (n = 1) did not provide a response. More men (44.60%) than women (32.30%) indicated they were open to changing or currently thinking about changing their marijuana use by using less or by reducing marijuana's negative effects. Young adults who indicated they were open to or thinking about changing their use reported significantly more hours high in a typical week and more marijuana consequences than those who were satisfied with their use of marijuana. Finally, young adults who indicated they were open to or thinking about changing their use reported significantly higher scores for the following seven marijuana motives: coping, boredom, altered perceptions, social anxiety, perceived low risk, sleep, and

availability. No differences were found for five marijuana motives: enjoyment, conformity, experimentation, alcohol-related, and celebration. **Conclusions.** Findings underscore the potential role of negative consequences as a motivator for young adults' interest in reducing their marijuana use. Coping motives, social anxiety motives, and sleep motives may be of particular importance with respect to young adults' self-motivation to change and facilitating the process of change.

### **Mobile app detection of THC-related cognitive impairment in heavy users**

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The degree to which frequent users of cannabis experience cognitive impairment from acute self-administration has been questioned on the basis of behavioral tolerance to THC. "Indicator" is a downloadable mobile software app that assesses cognitive, perceptual, and motor skills using a variety of brief videogames. In the course of one month (April 2021), the app was used by 199 adult users who self-identified as either use cannabis "frequently" or "continuously." Sixty-one of these heavy users played at least two of the videogames available in the app while sober, and this was on the first occasion of using the app. Ninety-six used the app while intoxicated by cannabis, and also on their first instance of using the app. Independent-samples t-test was performed to compare sober-versus-intoxicated performance on each of two separate videogames, and these videogames specifically assessed (a) time perception and (b) reaction speed and accuracy. Clear evidence of cannabis-related impairment was evident for both videogames ( $p < 0.05$ ) for this heavy-using population. This evidence suggests that neurocognitive performance-related deficits are apparent in a population of users who are well-accustomed to the psychopharmacological influence of THC.

### **Anecdotes Ushered in Marijuana Legalization: A Machine Learning-aided Big Data Analysis of Reddit Discourse (2008-2019)**

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At least two fundamental types of evidence feature in attempts to persuade: Anecdotal and generalized (Baesler & Burgoon, 1994). Experimental research has found anecdotal evidence more effective at changing attitudes in issues marked by personal significance and health-relevance (Freling et al., 2020). These apply to marijuana legalization, where a massive shift in American attitudes (from 35% to 67% in favor during 2008-2019; Pew Research Center, 2019) was followed by rapid legalization. However, no research to date has examined whether the movement benefited from anecdotal framing.

Since the attitude shift coincided with the rise of social media, we developed the largest corpus of marijuana legalization discussions from Reddit to address this gap (more than 3M comments from 2008-2019, comprising more than 300M words). The dataset is the first to separate marijuana legalization discourse from general mentions of cannabis (e.g., product advertisements) across an entire popular platform. We then developed neural network models to distinguish anecdotal from generalized text in the dataset based on three clause-level features derived from linguistic theory: Whether a clause is about a generic kind rather than specific instances, whether it presents a reliable state or an event, and whether events are bounded in time. Principal Components Analysis provided a reliable composite score of the three features, treated as a measure of the degree to which major themes of discourse are anecdotal versus generalized. We combined topic modeling (Latent Dirichlet Allocation; Blei et al., 2003) with hierarchical clustering and smoothed polynomial regressions to track themes' prominence over time and bin them into broader categories.

Anecdotal themes were less prevalent but present in most comments. We trained separate neural networks on human annotations of attitude and persuasion attempt. Within non-argumentative discourse, anecdotes became more prominent only later in time, presumably as a consequence of softening societal attitudes. But they played a more prominent role throughout in arguments favoring legalization, suggesting that they were

actively used to persuade others. Were such anecdotal arguments timed in a way that benefitted legalization ballot initiatives?

To answer, we inferred user locations and compared the rate of anecdotal themes before and after legalization in comments from pioneering states. Despite the experimental evidence favoring anecdotal argumentation, we found that the 2012 and 2016 legal milestones followed short-term increases in generalized arguments instead. The particular content, however, varied between the two periods. Character judgments were prominent in 2012, while crime and politics took center-stage in 2016. The generalized precedents of legalization in leading states were argumentative and moralistic but had distinctive clause-level profiles. Meanwhile, legal and medical arguments were sidelined, meaning the novel consensus was not informed by much of the relevant information, anecdotal or otherwise.

Together, our results show that while the emerging consensus probably benefited from anecdotal argumentation, the legalization movement's success happened despite its reliance on less effective generalized discussions with less concrete information content. Addressing this discrepancy between experimental research and the direction of societal discourse may help bring about more informed discussions while better enabling the changing of attitudes.

#### **Initial validation of a brief assessment of cannabis demand among young adult college students**

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Behavioral economic models of addiction posit that cannabis's reinforcing value (demand) is linked to use. The Marijuana Purchase Task (MPT; Aston et al., 2015) quantifies demand by assessing hypothetical cannabis consumption across escalating price points. Indices generated from MPT performance include intensity (i.e., amount consumed when free), Omax (i.e., peak expenditure), Pmax (i.e., price at peak

expenditure), elasticity (i.e., degree that consumption decreases as price increases), and breakpoint (i.e., cost suppressing consumption to zero). Cannabis demand is linked to engagement in risky behaviors and cannabis use disorder (CUD) symptomology. However, the length of the MPT makes repeated assessment of state-dependent changes in cannabis demand difficult, which limits clinical utility. Brief assessments of alcohol and cigarette demand exist that measure intensity, Omax, and breakpoint. Thus, the aim of the current study was to develop and validate a brief assessment of cannabis demand.

College students (N=211, Mage=19.91, SD=1.44; 63% Female; 56.4% Non-Hispanic Caucasian) who reported past-month cannabis use  $\geq 3$  times completed an online survey. Participants completed the MPT, a 3-item brief assessment of marijuana demand (BAMD) assessing intensity, Omax, and breakpoint, and measures of demographics, cannabis use frequency, cannabis-related negative consequences, CUD symptomology based on DSM-5 criteria, and cannabis craving. Convergent validity was examined via bivariate correlations of demand indices on the BAMD, MPT, and cannabis outcome measures. Divergent validity was assessed via independent samples t-tests to examine whether demand indices on the BAMD differed based on the presentation or absence of CUD. A one-way between-subjects ANOVA with planned comparisons was tested to compare effects of CUD severity (mild/moderate/severe) on BAMD demand indices.

Intensity, Omax, and breakpoint were significantly correlated across the MPT and BAMD ( $r_s = .30 - .79$ ,  $p_s < .01$ ). Intensity, Omax, and breakpoint on the MPT and BAMD were significantly correlated with current cannabis craving, CUD severity, and cannabis-related negative consequences ( $r_s = .18 - .48$ ,  $p_s < .05$ ). Only intensity and Omax were significantly correlated with cannabis use ( $r_s = .16 - .43$ ,  $p_s < .01$ ). Individuals with (versus without) a CUD reported significantly greater intensity and Omax ( $p_s < .01$ ), but not breakpoint, on the MPT and BAMD. There were significant effects of CUD severity on B-MPT demand indices ( $p_s < .05$ ). Planned comparisons revealed that individuals with a moderate or severe CUD had significantly elevated intensity, Omax, and breakpoint on the BAMD compared to individuals with a mild CUD.

Only breakpoint differentiated individuals with a moderate and severe CUD.

This is the first study to validate a brief assessment of cannabis demand. Consistent with prior alcohol and tobacco research, the BAMD espoused convergent validity with the MPT and divergent validity by differentiating individuals with and without a CUD and along the CUD severity continuum. Thus, the BAMD may be a useful tool to assess links between specific indices of cannabis demand and clinically-relevant outcomes over time and in real-world settings. However, given the rise in novel cannabis products with different modes of administration and varying potencies, future research should examine whether demand differs based on these factors. Further, replicating these findings among more diverse populations is essential.

#### **Development and Initial Validation of Marijuana Identity Implicit Associations Tests among Late Adolescents in Washington State**

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The current climate surrounding adolescent marijuana use in the U.S. is facing unprecedented circumstances. Rates of daily use are at or near all-time highs and perceptions of risk are at an all-time low in the history of the Monitoring the Future study among 8th, 10th, and 12th graders. These rates are occurring despite research demonstrating worse long-term health outcomes associated with earlier age of marijuana use onset and increasing THC levels among marijuana products. As a result, there is an urgent need to identify risk factors that may represent screening markers of risk or targets for prevention and intervention among adolescents. One important risk factor for alcohol and tobacco is the extent to which one identifies with each substance. This aspect of identity can be measured with adaptations of the Implicit Association Test (IAT), a reaction time measure that aims to assess associations held in memory between constructs (e.g., marijuana and one's self-concept). The aim of the current study was to develop and test two Marijuana Identity IATs among late adolescents in Washington State, one using images and another using words to represent marijuana and its control category. The current study included

169 adolescents between the ages of 15-18 (Mean age = 16.9, SD age = 0.9, 50% female, 66% high school student) with recruitment stratified by marijuana use (to include participants that range from non-users to heavy users) and gender. Data described here come from the online baseline assessment that included the Marijuana Identity IATs and self-report measures of marijuana use, consequences, and explicit (i.e., self-reported) marijuana identification. Results from the IATs reveal two normal distributions of IAT scores that were both positive on average indicating faster reaction times when marijuana was categorized with the self (and a neutral category categorized with other people). Split-half reliabilities of the IATs revealed internal consistencies in the range of previous substance-related IATs (word-based IAT,  $r = 0.52$ ; imaged-based IAT,  $r = 0.40$ ). In negative binomial regression models that controlled for age and sex, both IATs were significantly associated with use and consequences such that faster reaction times categorizing marijuana with the self were associated with more marijuana use and consequences ( $ps < .01$ ). When controlling for self-reported identification marijuana, only the image-based IAT was significantly associated with marijuana use and consequences ( $ps < .05$ ). The findings demonstrate relationships between IAT performance and marijuana use outcomes that compare favorably to past marijuana-related IATs lending support to implicit associations between the marijuana and the self as an important marker of marijuana use behaviors. Despite this promise, the relative inferiority of the internal consistency of these IATs to self-report measures may limit their utility as tools for screening. Future experimental and longitudinal research is warranted however, to examine identification with marijuana as a causal candidate for marijuana misuse to examine its potential as a prevention and intervention target.

**Prevalence and Correlates of Cannabis Use and Co-use in Cigarette Smokers and Non-Smokers: An Emergency Department Study**

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Harrison Alter  
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**Background:** Compared to the general household population, elevated rates of cannabis and cigarette smoking are found among adults seeking medical care at urban safety-net hospital Emergency Departments (ED). The goal of this study is to assess the prevalence and identify the demographic and psychosocial correlates of cannabis use with and without cigarette co-use in comparison to non-cannabis/tobacco users in an urban ED population.

**Methods:** Secondary analysis was conducted on cross-sectional data collected in 2017 for a study on intimate partner violence, drinking and drug use among married/partnered adults ages 18-50 who were English or Spanish speakers seeking non-acute care at an urban ED (N=1,037; 53% female). Face-to-face survey interviews were conducted after obtaining informed consent from participants. We measured past 12-month cannabis use and past 30-day cigarette smoking. Data were collected on demographic (age, gender, level of education, race/ethnicity) and mental health factors (anxiety, depression, PTSD, past 12-month risky drinking [females/males drank 4+/5+ drinks]). Study participants were categorized as tobacco users without cannabis use (13.5%); cannabis users without tobacco use (13.8%); cannabis users with tobacco use (13.3%); and those who used neither substance (59.5%). We conducted chi-square analysis to examine the relationship between demographic and psychosocial factors and cannabis/tobacco co-use status, and multinomial logistic regression to estimate the factors associated with each type of cannabis/tobacco co-use category relative to non-users.

**Results:** Approximately half of cannabis users smoked cigarettes. Compared to women, men had greater odds of smoking cigarettes without cannabis (aOR=3.26; 95% CI 2.12, 5.00), using cannabis without cigarettes (aOR=2.38; 95% CI 1.54, 3.69), or being a cannabis/tobacco co-user (aOR=3.72; 95% CI 2.30, 6.02). Latinx participants were less likely to smoke cigarettes without cannabis (aOR=0.24; 95% CI 0.10, 0.56), use cannabis without cigarettes (aOR=0.18; 95% CI 0.08, 0.42), or co-use cannabis/tobacco (aOR=0.05; 95% CI 0.02, 0.11) than white participants. Participant age was inversely associated with using cannabis without cigarettes (aOR=0.93; 95% CI 0.91, 0.96) and being a cannabis/tobacco co-user (aOR=0.95; 95% CI 0.93,

0.98). Regarding psychosocial factors, those who screened positively for anxiety had greater odds for using cannabis without cigarettes (aOR=1.93; 95% CI 1.20, 3.10) and being a cannabis/tobacco co-user (aOR=3.40; 95% CI 2.04, 5.66) compared to those who screened negatively. Those who screened positively for PTSD had elevated odds for using cannabis without cigarettes (aOR=1.65; 95% CI 1.00, 2.75) compared to those who screened negatively. Those who had engaged in risky drinking had greater odds of smoking cigarettes without cannabis (aOR=2.27; 95% CI 1.47, 3.48), using cannabis without cigarettes (aOR=2.54; 95% CI 1.61, 4.02), or being a cannabis/tobacco co-user (aOR=4.34; 95% CI 2.71, 6.97) compared to those who had not engaged in this behavior.

**Conclusions:** Over one quarter of an urban ED sample used cannabis either with or without cigarettes. The results suggest that there are distinct demographic and mental health risk and protective factors associated with cannabis use and co-use in cigarette smokers and non-smokers. Cannabis users who smoke cigarettes may be especially vulnerable to mental health problems.

**Reasons for individual and concurrent use of vaped nicotine and cannabis: their similarities, differences, and association with product use**

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**Background:** Understanding similarities, differences, and associations between reasons people use vaped nicotine and cannabis may be important for identifying underlying contributors to co-use.

**Methods:** A cross-sectional survey of n=112 co-users of vaped nicotine and cannabis was conducted in 2020. Participants reported on their use of nicotine and cannabis products (vaped and smoked), along with reasons for individual product use, nicotine-cannabis co-use, and engagement with sequential use and co-administration.

**Results:** Cannabis vaping and smoking exhibited similar ratings for user experience and product/substance-related reasons for use. Reasons related to product utility were similar for cannabis vaping and nicotine vaping. Ratings for utility-related reasons for use were significantly higher for cannabis vaping than cannabis smoking (mean (SD):3.6(±1.0) vs. 2.6(±1.2), difference=0.98, t=7.84, p<0.0001). Harm reduction-related reasons for use were rated higher for nicotine vaping than cannabis vaping (2.4(±1.6) vs. 1.8(±1.4), difference=0.65, t=4.24, p<0.0001). Regression models showed higher ratings for utility-related and harm reduction-related reasons for nicotine vaping were significantly associated with more frequent nicotine vaping (both p<0.05). Greater endorsement of instrumentality-related reasons for co-use corresponded with more frequent monthly nicotine vaping and a three-fold increase in odds of ever chasing cannabis with nicotine.

**Conclusions:** Vaping serves purposes that differ by substance; nicotine vaping was more closely related to reducing tobacco smoking-related harms, and cannabis vaping was more closely related to circumventing social problems posed by cannabis smoking. Lifetime sequential co-use practices and more frequent nicotine vaping were associated with enhancing the intoxicating effects of cannabis. Findings have implications for understanding nicotine and cannabis co-use.

**Associations between use patterns for inhaled nicotine and cannabis products among adults who vape both substances**

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**Background:** Co-occurring use (co-use) of nicotine and cannabis is common, and represents a broad range of use behaviors, including concurrent use, sequential use, and co-administration. Co-use has primarily been examined through the lens of smoked tobacco and cannabis. Little is known

about those who co-use vaped nicotine and cannabis, and the degree to which specific co-use behaviors are associated, based on mode of use and/or substance.

**Methods:** We conducted an online pilot survey on use behaviors related to inhaled forms of nicotine and cannabis. The survey was administered to 112 concurrent vapers of these substances. Descriptive analyses examined sample characteristics and co-administered vaping and smoking behaviors. Logistic regressions examined associations in use behaviors by mode and substance.

**Results:** Participants who vaped nicotine and cannabis monthly also reported monthly smoking of cannabis (100%), and cigarettes (58%). Most exhibited moderate-to-high degrees of mental health and substance use problems. Monthly concurrent use exhibited weaker associations by mode, and stronger associations by substance. Specific sequential use practices showed mode-specific associations; with greater frequency of cigarette smoking and nicotine vaping. Co-administration was associated with more frequent tobacco and cannabis smoking.

**Conclusions:** Those who regularly vape nicotine and cannabis tend to engage in some form of smoking. Different subsets of nicotine and cannabis co-use behaviors showed different associations with patterns of use and modes of drug delivery. Findings underscore the diversity of nicotine and cannabis use behaviors among co-users, and the importance of considering influences by both substance and mode of use.

**The relationship between anxiety status and cannabis use among OEF/OIF veterans: Somatization as a moderator**

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American veterans are vulnerable to high rates of anxiety and substance use. Notably, veterans with mental health challenges report higher rates of cannabis use than those without mental health concerns. In the general population, anxiety often overlaps with a variety of somatic symptoms. However, less is known regarding the effects of both anxiety and somatization on cannabis use behaviors in veterans. Online surveys were completed by 1006 veterans (Mage=34.74, 75.1%

male) with a three-month follow-up. Negative binomial regression was used to test whether baseline somatization moderated the relationship between baseline anxiety and frequency of past 30-day cannabis use three months later at follow-up. Compared to those who screened negative, those who screened positive for anxiety reported greater past 30-day cannabis use rates at follow-up (IRR=6.74; 95% CI [4.68, 9.71]). Higher levels of somatization also predicted greater past 30-day cannabis use rates (IRR=1.30; 95% CI [1.24, 1.36]). Somatization moderated the relationship between anxiety and past 30-day cannabis use frequency. At both low and high levels of somatization, those who screened positive for anxiety reported greater cannabis use days compared to those who screened negative for anxiety. However, among those who screened negative for a probable anxiety disorder, an increase in somatization is associated with an increase in past 30-day cannabis use frequency. Findings suggest that those who screen positive for anxiety and those who screen negative for anxiety, but endorse high levels of somatization, may likely benefit most from cannabis use prevention and/or intervention.

**Self-determination theory correlates of cannabis-related outcomes among a large, multi-site sample of college student**

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**Background:** Self-determination theory (SDT) is a general theory of human motivation that has been applied to understand why people engage in healthy behaviors. That is, more autonomous reasons for engaging in healthy behaviors is associated with an increased likelihood of initiating and maintaining healthy behaviors. Recent research has shown that this framework is useful for understanding engagement in harm reduction behaviors for alcohol among college students. It stands to reason that this framework may be equally useful for cannabis with the potential to inform intervention efforts for reducing harms associated with unhealthy

cannabis use. In the present study, we examined autonomous functioning and psychological need satisfaction per SDT as correlates of cannabis-related outcomes among a large, multi-site sample of college students who use cannabis.

**Method:** Participants were 5497 students recruited from Psychology Department participant pools at 10 universities in 8 states across the U.S (AK, CA, CO, ID NM, TX, VA, WA) who completed an online survey for partial course credit. We restricted analyses to those who reported consuming cannabis at least once in the past month (n=1398, about one-fourth of the total sample). The analytic sample was 20.25 years of age on average (SD=3.88) and mostly female (68.9%) and non-Hispanic white (59.4%). Participants completed measures assessing the three facets of autonomous functioning (authorship, interest-taking, and susceptibility to control) and satisfaction and frustration of the psychological needs for autonomy, competence, and relatedness, as well as a variety of measures assessing cannabis-related outcomes, including severity of use (i.e., Cannabis Use Disorder Identification Test [CUDIT]), negative consequences (i.e., Marijuana Consequences Questionnaire [MACQ]), and harm reduction behaviors (i.e., Protective Behavioral Strategies for Marijuana [PBSM]).

**Results:** Consistent with hypotheses, overall autonomous functioning was positively correlated with PBSM ( $r=.179$ ,  $p<.001$ ) and negatively correlated with CUDIT ( $r=-.160$ ,  $p<.001$ ) and MACQ ( $r=-.092$ ,  $p=.017$ ). Separating autonomous functioning by subscale (i.e., domain), the correlations were largest in magnitude for the authorship domain ( $r=.250$ ,  $r=-.240$ , and  $r=-.168$ , respectively,  $p<.001$ ). Also consistent with hypotheses, greater satisfaction of each psychological need was positively correlated with PBSM ( $.149<r<.203$ ,  $ps<.001$ ) and negatively correlated with CUDIT ( $-.146<r<-.120$ ,  $ps<.01$ ) and MACQ ( $-.171<r<-.132$ ,  $ps<.01$ ); generally, these correlations were largest in magnitude for relatedness satisfaction. In contrast, greater frustration of each psychological need was negatively correlated with PBSM ( $-.144<r<-.121$ ,  $ps<.001$ ) and positively correlated with CUDIT ( $.199<r<.229$ ,  $ps<.001$ ) and MACQ ( $.133<r<.215$ ,  $ps<.01$ ); the correlations were largest in magnitude for relatedness frustration with PBSM

and competence frustration with CUDIT and MACQ.

**Conclusions:** The present study is the first to demonstrate that higher autonomous functioning and greater psychological need satisfaction are protective factors for cannabis-related outcomes, including less consumption, fewer negative consequences, and more frequent use of harm reduction behaviors. SDT provides a rich framework for understanding not only why college students may engage in healthy cannabis-related behaviors, but also the conditions that foster that engagement, making it an ideal theory to inform cannabis interventions. The present findings warrant replication but suggest promise for SDT as a framework for understanding cannabis-related outcomes that future research should investigate further.

**Early Birds and Night Owls: Distinguishing Profiles of Cannabis Use Habits by Use Times with Latent Class Analysis**

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Negative consequences associated with excessive use of cannabis are well documented. Previous findings indicate timing of use is an important factor when assessing severity of dependence for use of substances including alcohol and cigarettes. However, little attention in the academic literature has been paid to timing of cannabis use and its associations with negative consequences. The present study employed a latent class analysis on data collected from college students who use cannabis, located across four U.S. universities in four different states (N = 1,122). The goal was to examine whether distinct classifications of cannabis use exist based on timing (i.e., hour of day and day of week), and whether these classifications differ on cannabis use indicators (Marijuana Use Grid; MUG), cannabis-related negative consequences (Marijuana Consequences Questionnaire;

MACQ), and cannabis use disorder symptoms (Cannabis Use Disorder Identification Test-Revised; CUDIT-R). The MUG assesses the amount (in grams) of cannabis used during a week of typical marijuana use in the past 30 days on each of the seven days per week (Monday-Sunday) during each of six 4-hour time periods (12a-4a, 4a-8a, 8a-12p, 12p-4p, 4p-8p, 8p-12p). By summing across time periods for each day, we binarized the presence of cannabis use (0 = no use, 1 = use) for each day of the week. By summing across days for each time period, we binarized the presence of cannabis use for each time period. Based on the Lo-Mendell-Rubin Likelihood Ratio Test (LRT) and other fit indices, we found support for a 4-class solution with high classification precision (relative entropy = .905). The four classes were characterized as follows: (1) daily (greater than 98% of the class endorsed use on each day of the week), common morning use (N = 140.17, 12.5%), (2) daily (greater than 88% of the class endorsed use each day of the week), uncommon morning use (N = 241.02, 21.5%), (3) weekend, common morning use (N = 72.22, 6.4%), and (4) weekend, uncommon morning use (N = 668.59, 59.6%). Individuals reporting daily, common morning use experienced the highest cannabis-related negative consequences (MACQ M = 7.53) and reported the highest levels of cannabis use disorder symptoms (CUDIT-R M = 15.74), whereas individuals reporting weekend, uncommon morning use experienced few cannabis-related negative consequences (MACQ M = 2.24) and reported low cannabis use disorder symptoms (CUDIT-R M = 5.45). Taken together, our classes were defined by crossing the presence/absence of morning cannabis use by the presence/absence of weekday cannabis use, and we found evidence that both the timing of week and timing of day contribute to the level of cannabis-related harms that individuals experience. Additional research is needed to explore the unique contributions of time of week and time of day while controlling for other characteristics of one's cannabis use (i.e., frequency, quantity, product type, route of administration, etc.).

**Cannabis Demand and Use among Veterans: A Prospective Examination**

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**Background:** Cannabis demand (i.e., relative value), assessed cross-sectionally via a hypothetical marijuana purchase task (MPT), has been associated with cannabis use, problems, and dependence symptoms, among others. However, neither the prospective stability of the MPT, nor the cyclical relationship between demand and use over time has been investigated. Moreover, cannabis demand among cannabis using veterans has yet to be examined.

**Method:** Two waves of data from a veteran sample (N=133) reporting current (past 6-month) cannabis use were analyzed to assess stability and change in cannabis demand over six months. Autoregressive cross-lagged panel models assessed the longitudinal associations between demand indices (i.e., intensity, Omax, Pmax, breakpoint) and cannabis use.

**Results:** Models revealed unique directions of effects for each demand index. Baseline cannabis use predicted greater intensity ( $\beta = .32, p < .001$ ), Omax ( $\beta = .37, p < .001$ ), breakpoint ( $\beta = .28, p < .001$ ), and Pmax ( $\beta = .21, p = .017$ ) at 6-months. Conversely, baseline intensity ( $\beta = .14, p = .028$ ), breakpoint ( $\beta = .12, p = .038$ ), and Pmax ( $\beta = .12, p = .043$ ), but not Omax, predicted greater use at 6-months.

**Discussion:** Cannabis demand indices demonstrated prospective stability over six months and varied along with natural changes in cannabis use. Importantly, intensity, Pmax, and breakpoint displayed bidirectional predictive associations with cannabis use, and across indices, the prospective pathway from use to demand was consistently stronger. Findings highlight the value of assessing cannabis demand longitudinally, particularly among clinical samples, to determine how demand fluctuates in response to experimental manipulation, intervention, and treatment.

**The Relationship Between Mental Health Symptoms and marijuana consequences mediated by coping motives for marijuana use**  
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As marijuana continues to be legalized across the United States, it is imperative to investigate risk factors and consequences related to use. Previous studies among adult samples have found that mental health symptoms, including both depression and anxiety symptoms, are significant predictors of increased frequency of marijuana use. Little is known however regarding mental health symptoms and marijuana use among adolescents. This risk is particularly salient for adolescents given that many mental health disorders, like depression and anxiety, begin to emerge during this developmental period, and because earlier of age of marijuana use onset is associated with worse prospective health outcomes. Further, coping motives for marijuana use (i.e., using marijuana as an external avoidance or escape-based strategy) may serve as a mechanism for some adolescents to avoid distressing anxiety and depressive states. To address this gap in research, the aims of the current analysis were to 1) examine associations between mental health symptoms, marijuana use, and consequences among adolescents, and 2) examine coping motives as a mediator between mental health symptoms and marijuana outcomes. The current study included 107 late adolescents (15-18 years old,  $M_{age} = 17.01$ ,  $SD_{age} = 0.92$ , 51% female, 85% White/Caucasian, 60% high school student, 27% college student) recruited from Washington State. The sample was stratified by gender and marijuana use such that participants ranged from reporting infrequent to daily marijuana use. Participants were asked to complete three online assessments across six months. These included the PHQ-4, a 4-item measure of depression and anxiety symptoms in the past 2 weeks, in addition to measures of marijuana use, marijuana-related consequences, and marijuana use motives. We conducted two separate mediator models to examine if baseline mental health symptoms were mediated by coping motives at month 3 on (1) marijuana use and (2) marijuana-related consequences both reported at month 6. There was no significant mediation effect for baseline mental health symptoms predicting overall marijuana use at month 6 ( $B = .27$ ,  $SE = .25$ , 95% CI  $[-.23, .76]$ ,  $p = .28$ ). For the second model, motives at month 3 fully mediated the relationship between mental health symptoms at baseline and marijuana-related consequences at month 6 ( $B = .71$ ,  $SE = .27$ , 95%

CI  $[.17, 1.24]$ ,  $p \leq .01$ ). Thus, higher levels of mental health symptoms at baseline were associated with higher marijuana-related consequences as mediated by coping motives reported at month 3. Our results suggest that adolescents who experience more mental health symptoms do not use marijuana more than others who report fewer symptoms. However, these individuals may be at greater risk for experiencing negative consequences that result from their use. Further, results also suggest that the relationship between mental health symptoms and negative consequences may be largely accounted for by stronger motives to use marijuana to cope with mental health. Screening for mental health symptoms during adolescence may be beneficial in preventing negative outcomes by providing early interventions for healthy coping strategies for anxiety and depression.

#### **Health warnings on cannabis dispensary websites**

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Cannabis users are increasingly turning towards the Internet for information about cannabis, especially medicinal patients, who generally have low to moderate knowledge of important aspects of cannabis like medicinal effectiveness. Potential for misuse of cannabis is much higher when there is a lack of accurate information (Kruger et al., 2020). Overuse of cannabis can be associated with discontinued enrollment in school, trouble dealing with anxiety and stress, and an increased risk of schizotypy (Blavos et al., 2017). Cannabinoid exposure during pregnancy has been shown to have negative effects on the fetal immune system (Dong et al., 2019), is associated with low birth weight, stunted development (Gusstafson & Jacobsson, 2019), and cognitive impairment (Grant et al., 2018).

Cannabis dispensary employees have been found to make health suggestions without proper qualifications (Dickson 2018), and advertising on dispensary websites often suggests strains for specific medical conditions, despite the lack of

empirical evidence supporting these claims (Kruger et al., 2020; Luc 2020). This increasing medicalization of cannabis by those unqualified to do so is concerning in such a fast-growing field. The present study assesses the presence of health warnings on cannabis dispensary websites, specifically (a) the presence of facts or warnings about potential psychological consequences (e.g., paranoia, increased vulnerability to psychosis), (b) facts or warnings about use in pregnant women, and (c) general dosage warnings.

Dispensaries were selected at random in all states that have legal cannabis. 15 dispensaries were selected from each state. If the state had less than 15, all dispensaries in the state were included in coding, for a total of 389 dispensary websites. Dispensaries were identified via informal cannabis websites like leafly.com and potguides.com, as the purpose of the study was to identify dispensary websites that the average person would find when searching the Internet. Previous studies have utilized state agency lists and informal lists (Cavazos-Rehg et al., 2019). Three trained research assistants coded each website for the relevant information.

30% of websites coded had psychological consequence warnings ( $n = 111$ ), 21.53% had gynecological health warnings, and 45.65% had general use warnings. Three separate logistic regression analyses were performed with the three types of health warnings as the binary outcome variable (the information is either present = 1, or not present = 0) and legality status as the predictor. Legality status had no impact on the presence of psychological consequence information ( $OR = .737$ ,  $SE = .174$ ,  $p = .196$ ) or general dosage information ( $OR = .786$ ,  $SE = .479$ ,  $p = .279$ ), but legality did have a significant influence on the presence of gynecological consequences ( $OR = .499$ ,  $SE = .129$ ,  $p = .007$ ), indicating that when cannabis was recreationally legal, the state was less likely to have information about gynecological health consequences on their dispensary websites. This is troubling, because cannabis is much more easily accessible in states with recreational legalization than medicinal, and the consequences of cannabis use during pregnancy can be severe.

### **Trends in cannabis use among US adults amid the COVID-19 pandemic**

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**Background:** The COVID-19 pandemic has had an impact on mental health and alcohol use in the US, however there is little research on its impacts on cannabis use. Considering the role of cannabis as a coping strategy or self-medicating behavior, there is a need to understand how individuals who use cannabis have adapted their use amid the pandemic. Therefore, this study examined changes in self-reported cannabis use among US adults in the context of COVID-19 pandemic by (1) describing trends of use during the first 8 months of the pandemic among adults who used cannabis in this period; and (2) characterizing trajectories of use within sociodemographic subgroups and by state cannabis policy status.

**Methods and Findings:** The sample consisted of 1,761 US adults who used cannabis at least once during the 8 month study period from the nationally representative Understanding America Study. Linear mixed-effect models were used to model changes in the number of days of past-week cannabis use across 16 waves from March 10, 2020, to November 11, 2020.

Compared to early March, the number of days cannabis was used per week was significantly higher at the start of April ( $\beta=0.11$ , 95% CI=0.03, 0.18) and May ( $\beta=0.21$ , 95% CI=0.05, 0.36). In subsequent months (June - November), the number of days of cannabis use returned to levels comparable to early March. Trajectories of cannabis use across the study period generally did not differ across sociodemographic groups.

**Conclusions:** In the US, adults who used cannabis reported statistically significant increases in cannabis use days at the start of the pandemic (April - May 2020), compared to March 2020, in the overall sample and among several sociodemographic groups. In Summer and Fall 2020, cannabis use days attenuated to levels comparable to March. Though increases in use were marginal among many groups, the evolving pandemic and the growing concern for the mental health of segments of the U.S. population warrant close monitoring of coping behaviors, including substance use.

### **Parental Rejection, Cannabis Craving, and Alcohol Craving among Sexual Minority Youth**

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Parental rejection is associated with poor mental health and addiction liability outcomes for sexual minority youth (SMY; e.g., lesbian, gay, bisexual). Theoretical models purport that SMY who experience greater parental rejection and non-acceptance related to their sexual orientation may have greater risk for substance use, including cannabis and alcohol use. Cross-sectional and longitudinal studies provide initial support for this contention by showing that SMY who perceive heterosexual rejection from their parents have greater substance use as young adults. However, research has yet to examine whether experiencing greater parental rejection is associated with drug craving as an adolescent. Understanding the impact of parental rejection at this level may be of particular importance, as sexual minority young adults report greater alcohol craving in response to heterosexual stigma, above and beyond general negative mood. Since adolescent cannabis and alcohol use are influenced by contextual factors (e.g., availability), craving has been examined as a salient proxy for substance use in this population. This study leveraged data collected from ecological momentary assessment (EMA) to examine how varying levels of heterosexual parental rejection may influence in-the-moment levels of cannabis and alcohol craving. SMY who used nicotine were recruited for an EMA study. Participants completed a baseline survey measuring lifetime parent rejection experiences ( $M = 0.34$ ,  $SD = 0.33$ ) and a timeline followback of past-month substance use. Next, participants completed a 30-day EMA period where they responded to approximately 5 random prompts per day measuring current level of cannabis and alcohol craving (range 0 to 10). The analytic sample included a subset of SMY who reported baseline cannabis ( $n = 37$ ) or alcohol ( $n = 32$ ) use. Craving was dichotomized to either no craving (0)

or any craving (1). Multilevel logistic regression was conducted using  $N = 2,885$  observations to examine the associations between baseline parental rejection and momentary substance craving, controlling for baseline substance use frequency, weekday versus weekend, time of day, age, and presence of peers. Results indicated that greater baseline parental rejection was associated with greater odds of reporting momentary cannabis craving ( $b = 1.71$ ,  $p = .05$ ,  $OR = 5.51$ ) and alcohol craving ( $b = 2.53$ ,  $p = .035$ ,  $OR = 12.55$ ) in the natural environment. Findings underscore the influence of parental rejection on adolescent substance craving. SMY who experience greater parental rejection likely perceive having less supportive parental relationships. Consistent with the minority stress model, SMY may be more likely to experience identity-related distress (e.g., heterosexual parental rejection) and, in turn, may use cannabis and alcohol to cope. This may explain why parental rejection experiences were related to greater day-to-day substance cravings. Clinical implications support the importance of providing family interventions to reduce parental rejection for SMY, as these may result in a myriad of benefits, possibly including reduced substance use craving. Future research should examine how lifetime versus recent parental rejection experiences may influence SMY substance craving.

### **Distress Tolerance and Hazardous Cannabis Use: Does the Form of Cannabis Matter?**

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Objectives. Among cannabis users, low distress tolerance may result in greater vulnerability for hazardous cannabis use and cannabis use disorder. Although this relationship has been reported in the past, the role of primary form of cannabis used has not been examined as a moderator of this association. While marijuana flower remains the preferred form of cannabis used, there has been an increasing popularity of other forms of cannabis, including concentrates and edibles. The aim of the current study was to examine the association between distress tolerance and hazardous cannabis use, as well as to determine whether the primary form of cannabis used would have a moderating effect on this relationship.

**Methods.** Participants completed a survey on cannabis use, including questionnaires on distress tolerance and hazardous cannabis use. 695 (67.60% male) past-month cannabis users were included in the current analyses. Multiple linear regressions were used to assess whether distress tolerance, primary form of cannabis used, and their interaction were associated with hazardous cannabis use, while controlling for covariates such as demographic variables and past 30-day alcohol and cannabis use frequency.

**Results.** There was a significant regression equation ( $F(13, 681) = 33.31, p < .001, R^2 = 0.39$ ) that included a main effect for distress tolerance ( $b = 0.64, p < 0.001$ ), indicating that lower tolerance for distress was significantly related to hazardous cannabis use. There was also a main effect for primary form of cannabis used, where preference for using concentrates compared to marijuana flower was associated with hazardous cannabis use ( $b = 1.38, p = 0.006$ ), preference for using marijuana flower compared to edibles was associated with hazardous cannabis use ( $b = -4.39, p < 0.001$ ), and preference for using concentrates compared to edibles was associated with hazardous cannabis use ( $b = -5.76, p < 0.001$ ). Furthermore, the primary form of cannabis used significantly moderated the relationship between distress tolerance and hazardous cannabis use ( $F(2, 681) = 3.77, p = 0.024, R^2 \text{ change} = 0.01$ ). Specifically, the relationship between low distress tolerance and more hazardous cannabis use was moderated by preference for marijuana flower ( $b = 0.64, p < 0.001$ ) and concentrates ( $b = 0.69, p < 0.001$ ), but was not moderated by preference for using edibles as the primary form of cannabis ( $b = 0.18, p = 0.25$ ).

**Conclusions.** By determining which particular cannabis users have the strongest relationship between lower tolerance for distress and hazardous cannabis use, these findings can help inform interventions geared towards aiding individuals to better tolerate stressful situations so as to minimize their hazardous cannabis use.

### **Israel: the land of milk, honey and cannabis**

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Cannabis use in Israel has escalated exponentially leading to paralleled increases in psychiatric disorders and admissions to residential drug treatment facilities. Our data from the Israeli Ministry of Health Department for the Treatment of Substance Abuse shows that mental and behavioral disorders due to cannabis use have gone up 825% between 2010 and 2019. Also in 2019, amongst drug and alcohol residential treatment centers, where polysubstance use has become the norm, cannabis was reported as the primary substance leading to treatment admission. 52% of those admitted to treatment listed cannabis as their drug of choice, with a huge gap between cannabis and alcohol in second place at 21%. These statistics are particularly concerning since cannabis is currently available not only in the black market and online in Israel, but also as "medical cannabis." The most alarming issue is that Israel will most likely become the 3rd nation in the world to officially legalize cannabis within the next year.

### **Marijuana Use Among Persons Living with Chronic Pain: A Qualitative Study**

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Chronic pain is presently the most expensive disease condition in the United States; with roughly 1 in 5 Americans currently reporting chronic pain. Traditionally, clinicians and patients have utilized prescription medications to manage chronic pain, however, attitudes towards standardized prescription treatment have waned due to a number of factors including the recent opioid epidemic. Consequently, attitudes towards marijuana use as an alternative pain therapy have continued to grow with 36 states approving use for medical purposes. Clinical trials have reported lower pain severity scores among participants receiving marijuana for pain compared to participants in the control arms. However, little is known regarding the psychological/physiological mechanisms by which marijuana provides relief for chronic pain. Research is also needed to identify how current marijuana users developed optimal patterns (i.e. dose, frequency, and quantity) of use for chronic

pain. We sought to address these scientific gaps by conducting semi-structured interviews among community members. Participants (N=13) were eligible for participation if they reported having any pain during the previous 3 months and if they reported past 30-day marijuana use. The interviews lasted approximately 60 minutes following a semi-structured interview guide over Zoom telecommunications. Each interview was subsequently transcribed and then analyzed using Atlas T.I. A summary of each code was developed and key themes regarding marijuana use and pain were summarized. Multiple themes emerged including mechanism of pain relief (physical, mental, or both), patterns of marijuana use for pain relief, other benefits of marijuana use, comparisons to prescription drug use, descriptions of pain, and side effects of marijuana use. Our analysis identified several themes that add to the growing literature concerning marijuana use for chronic pain. These qualitative data indicate current marijuana users' favorable opinions towards using marijuana as an alternative pain therapy. As legislation legalizing marijuana use for medicinal purposes continues to expand, qualitative studies are needed to examine the extent to which marijuana use is effective in managing pain.

### **Effort-Based Decision Making and Self-Reported Apathy in Frequent Cannabis Users and Healthy Controls**

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(Oregon State University)

**Background:** Cannabis use rates have been escalating in recent years within the United States, and the effects of cannabis on motivation and effort-based decision making have been of increased interest. Amotivational syndrome is a term used to refer to lack of motivation, passive personality, non-productive behavior, and lower educational attainment related to chronic cannabis use. However, past literature has reported mixed findings for the effects of cannabis on motivation across both behavioral and self-report studies; therefore, the current study aimed to evaluate the association between frequent cannabis use, motivated behavior, and self-reported apathy in individuals 18 years and older.

**Methods:** Cannabis users who reported, on average, 3 or more days/week of cannabis use over the past year, and healthy controls who reported once/month or less cannabis use over the past year were recruited. Participants withheld from substance use 12 hours prior to the study visit. They completed a breathalyzer test, urine toxicology screen, the Apathy Evaluation Scale (AES), and the Effort Expenditure for Rewards Task (EEfRT), a computerized button-pressing task that measures effort-based decision making whereby individuals must increase effort for monetary reward. There were no significant differences between groups on any demographic characteristics except for past 30-day alcohol use ( $p = 0.001$ ), and depression scores ( $p = 0.005$ ; determined by the Beck Depression Inventory-II), which were both greater in cannabis users relative to healthy controls. A repeated measures analysis of covariance (ANCOVA) was used to examine the effects of Group, reward magnitude, probability, and their interaction on hard task selections on the EEfRT, controlling for alcohol and depressive symptoms. A separate ANCOVA examined between-group differences on the AES with the same covariates.

**Results:** The main results indicated that relative to healthy controls, cannabis users were significantly more likely to select hard tasks on the EEfRT regardless of reward magnitude or probability of winning the reward ( $p = 0.014$ , partial  $\eta^2=0.10$ ). Self-reported apathy was higher in cannabis users relative to controls ( $p = 0.02$ ), but after controlling for alcohol use and depressive symptoms, these group differences were no longer significant ( $p = 0.46$ ). Furthermore, the number of hard task selections on the EEfRT was not significantly related to self-reported apathy in cannabis users ( $p = 0.68$ ), or healthy controls ( $p = 0.52$ ).

**Conclusions:** These findings indicate that cannabis users exhibit a greater likelihood of exerting more effort for reward, suggesting enhanced motivation relative to healthy controls. Thus, the current results do not support the amotivation hypothesis in adult frequent cannabis users. Despite some harms of frequent cannabis use, amotivation may not be among them.

**Differential effects of urgency and sensation seeking on cannabis use and related problems via motives**

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The Stimulant Norms and Prevalence Study  
Team

A reliable predictor of substance use is impulsivity, a multidimensional construct in which specific facets demonstrate differential associations with aspects of substance use. Though research has delineated the association between substance use and impulsivity generally, work examining facets and their relation to cannabis use specifically is more limited. Additionally, motivational models of substance use suggest that an individual's reasons for use are the most proximal predictors of substance use, serving as a mediating mechanism by which other variables operate to influence use and related behaviors. To obtain a more comprehensive understanding of the mechanisms underlying cannabis use, the current study assessed the relation between three facets of impulsivity that have demonstrated compelling associations with cannabis (i.e., positive urgency, negative urgency; and sensation seeking) and their association with frequency of cannabis use and related consequences via motives. College students ( $N = 652$ ,  $M_{age} = 19.59$ , 72.2% female) from seven universities that reported past-month cannabis use completed an online survey assessing frequency of past-month cannabis use, number of related problems, facets of impulsivity, and cannabis use motives. A bootstrapped path analysis was conducted, in which negative urgency, positive urgency, and sensation seeking were modeled as simultaneous predictors of past-month cannabis-related problems via parallel mediators of enjoyment, coping, and social anxiety motives, and via past-month days of cannabis use. Positive and negative urgency were significant mediators in the same pathways: 1) social anxiety motives positively mediated the association between urgency and frequency of past-month cannabis use (negative urgency:  $\beta=0.37$ , 95% CI [0.046, 0.86]; positive urgency:  $\beta=0.87$ , 95% CI [0.44, 1.43]); 2) coping motives positively mediated the association between urgency and cannabis-related problems (negative urgency:  $\beta=0.47$ , 95% CI [0.28, 0.71]; positive urgency:  $\beta=0.31$ , 95% CI

[0.11, 0.55]; and 3) a serial mediation effect such that urgency was positively associated with anxiety motives, which in turn were associated with higher frequency of past-month use, which was associated with greater cannabis-related problems (negative urgency:  $\beta=0.05$ , 95% CI [0.01, 0.12]; positive urgency:  $\beta=0.12$ , 95% CI [0.06, 0.21]). Further, two indirect effects were found for sensation seeking: 1) enjoyment motives positively mediated the association between sensation seeking and frequency of past-month use ( $\beta=0.23$ , 95% CI [0.40, 0.53]); and 2) a serial mediation effect such that sensation seeking was positively associated with enjoyment motives, which in turn were associated with higher frequency of past-month use, which in turn was associated with greater cannabis-related problems ( $\beta=0.03$ , 95% CI [0.005, 0.01]). Results appear to suggest that individuals high in urgency using to avoid or cope with negative affect or social anxiety and individuals high in sensation seeking endorsing use to feel good or enhance mood may be at greater risk of cannabis-related problems, providing evidence that cannabis use a means of improving emotional experience may not be an adequate emotion regulation strategy.

**Do consumers seek out terpenes in their vaping products? Findings from a pilot study of concurrent vapers of nicotine and cannabis**

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Background: Terpenes are aromatic compounds found in nicotine and cannabis vaping products. Terpenes are promoted by the cannabis industry as having beneficial health effects, yet the evidence on this topic is still evolving. We examined whether vapers consider terpenes as a factor in their cannabis purchasing decisions, and their awareness of terpenes in their vaping products.

Methods: We used Amazon Mechanical Turk to administer a survey on nicotine and cannabis use to 112 concurrent vapers of both substances, who resided in legal cannabis policy environments.

Participants were asked to select from a list of 14 non-mutually exclusive factors that influence their cannabis purchases, including terpene content. Those who endorsed terpenes as a factor in their cannabis purchases were asked to identify specific terpenes they sought. A subset of vapers who used cannabis e-liquids ( $n = 86$ ) were asked to identify ingredients present in their products from a list of six pre-specified constituents, including terpenes. Responses were assessed using descriptive statistics.

**Results:** The top five factors influencing cannabis purchasing decisions were THC content (83%), price (79%), smell/taste (59%), availability (58%), and strain (47%); terpene content ranked 11th (13%) out of the list of 14 purchase-related factors. Among those who sought out terpenes ( $n = 13$ ), most reported seeking products containing limonene (67%), terpinolene (40%), myrcene (40%), and linalool (33%). Terpenes were the most frequently reported individual e-liquid constituent among participants who vaped cannabis oils in an e-cigarette, with nearly one-quarter (24%) of participants selecting this option. **Conclusions:** In this sample of co-users, most vaping consumers did not cite terpenes as a major factor in their cannabis purchases. Among the few who did, limonene was the most commonly sought after terpene, which is also present in many nicotine containing e-liquids. Nearly one-quarter of those vaping cannabis oils reported awareness of terpenes as a constituent in their vaping product. Findings support monitoring consumer awareness of terpene-containing products as well as any increases in use as the cannabis vaping market evolves.

### **Sex Moderates Associations Between Dimensions of Emotion Dysregulation and Problematic Cannabis Use**

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**Background.** Research consistently finds that male cannabis users report greater problematic cannabis use (i.e., negative outcomes related to one's cannabis use), compared to female cannabis users. Further, emotion dysregulation is a transdiagnostic risk factor for substance use and addiction and is associated with greater problematic cannabis use. Therefore, the current study examined whether sex moderates

associations between emotion dysregulation (overall and dimensions of emotion dysregulation) and problematic cannabis use.

**Methods.** 741 adults reporting past-month cannabis use (31.44% female) completed an online anonymous survey, including questions on demographics, substance use, problematic cannabis use (via the Marijuana Problem Scale) and emotion dysregulation (via the Difficulties in Emotion Regulation Scale). Independent samples t-tests and hierarchical multiple linear regressions were performed.

**Results.** Male cannabis users reported significantly higher scores on overall emotion dysregulation and five of six dimensions (nonacceptance, impulse, awareness, strategies, and clarity) compared to female cannabis users. Further, sex moderated associations between emotion dysregulation (overall, nonacceptance, goals, impulse, awareness, and strategies) and problematic cannabis use. Overall, nonacceptance, goals, impulse, and strategies were positively associated with problematic cannabis use, and these relationships were stronger in male cannabis users. Lack of emotional awareness was negatively associated with problematic cannabis use in male cannabis users and no relationship was found for female cannabis users.

**Conclusions.** Overall, these results denote the importance of examining individual differences in emotion dysregulation as they relate to problematic cannabis use. Interventions and treatments may need to be tailored for male cannabis users with a focus on specific emotion dysregulation dimensions.

### **Product text labels indicate the presence of other pharmacologically active ingredients in many OTC hemp- and CBD-containing preparations**

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**Introduction:** The 2018 Farm Bill changed the legal status of cannabis plants that meet the definition of industrial hemp and allowed for the rapid expansion of hemp-based products into commercial spaces. With an emphasis on industrial hemp as the source of naturally-

occurring cannabinoid compounds, a niche market for cannabidiol (CBD)-containing products was quickly established in pharmacies and grocery stores. Although the U.S. Food and Drug Administration (FDA) has retained oversight of all cannabis-based products, labelling of hemp-derived products for retail markets remains largely unregulated. Under federal law, CBD cannot be added to foods, beverages, sold as a dietary supplement or marketed for a therapeutic benefit, however the perceived health benefits of CBD as an acceptable and safe ingredient contribute to the growing market for these health products.

**Objective:** The objective of this study was to evaluate the range of over-the-counter (OTC) hemp- and CBD-based products available to consumers and determine the prevalence of other pharmacologically active agents identified as ingredients in these products. Labels were scored for the presence of: active and inactive ingredients, percent CBD, full-spectrum hemp, full-spectrum CBD or CBD isolate.

**Methods:** Two large pharmacy chains and one medium-sized grocery store located in the Pacific Northwest were surveyed between May 2020 and February 2021 and OTC hemp-derived products on display were recorded. Identification of pharmacologically active ingredients on the product label was validated using the National Medicines Comprehensive Database. Products that were noted to have CBD or hemp ingredients were included in the study, while any products that did not accurately report the amount of CBD in the product were excluded. Products that did not list the total weight of the product were excluded from the analysis.

**Results:** Thirty-three unique products were recorded from 19 different manufacturers. 39% of product labels indicated the presence of Full-Spectrum Hemp as part of the base product, while 66% of products listed Hemp Extract as the base product. Text labels on CBD-containing products, on average, indicated more than 3 additional pharmacologically active ingredients were contained in each product. Topical CBD products were more likely to have other ingredients such as arnica montana, menthol and camphor, whereas products for oral ingestion were more likely to have only CBD as the primary active ingredient. Text labels on 52% of topical CBD products listed the presence of 10% menthol. Average

concentrations of CBD in OTC products was found to be  $1.12\% \pm 1.48\%$ , based on dry weight.

**Conclusion:** Product text labels on OTC hemp- and CBD-containing preparations is varied and presented in a non-standardized format. Topical CBD products were more likely to contain other pharmacologically active natural products that can be used for the treatment of pain symptoms. Concentrations of arnica montana, menthol and camphor were as much as 10-fold higher than the proportion of CBD contained in these products. The absence of a standard format for labelling of OTC hemp- and CBD-derived products and the frequent presence of other active ingredients has the potential to create confusion and risk for the consumer.

#### **Young adults' perceptions of cannabis risks, benefits, and quality of life by chronic pain status**

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Many young adults experience chronic pain and may be more likely to self-medicate with cannabis. The present study examined perceptions of personal risks and benefits of cannabis use among young adult users, assessed if these perceptions varied by chronic pain status, and identified relationships among perceived risks and benefits, health-related quality of life, and cannabis-related problems. Young adult regular cannabis users ( $n=176$ ), half of whom met criteria for chronic pain, reported their perceptions of lifetime risks and benefits associated with cannabis use, as well as their physical and mental health-related quality of life and cannabis-related problems. Overall, participants perceived low risk associated with their cannabis use and moderate benefits. Perceived risks and benefits of cannabis use were associated with mental, but not physical health-related quality of life. Only perceived risk was associated with cannabis-related problems. Cannabis use, problems, risks, and benefits did not differ by chronic pain status. As expected, young adults without chronic pain reported better physical and mental health-related quality of life than those with chronic pain. Finally, chronic pain status moderated the relationships between perceived benefits and physical health-related quality of life and cannabis problems. The current study offers insight into the role of perceived risks

and benefits in young adults' cannabis use and associations with physical and mental health outcomes. The effects of perceived benefits on physical health-related quality of life and cannabis-related problems may be conditional based on chronic pain status. Future research should further explore the relationship of perceived benefits of cannabis use on health outcomes and cannabis-related problems.

### **Unwitting Adult Marijuana Poisoning: A Case Series**

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**Study purpose:** With increasing state legalization, marijuana use has become commonplace throughout much of the United States. This has resulted in expected and potentially dangerous consequences. Existing literature on unintentional exposure focuses primarily on the pediatric population. Despite mounting cases of unintentional exposure to marijuana, minimal research has been published on the effects of non-consensual marijuana consumption in adults. Here, we report on a cluster of adults with unwitting marijuana exposure.

**Methods:** A cluster of patients who presented to the Emergency Department (ED) within one hour of ingesting marijuana-contaminated food at a wedding reception event were subsequently referred to the Medical Toxicology Service. We conducted a retrospective analysis of twelve subject charts who were exposed to the marijuana-contaminated food and a qualitative analysis of six of the 12 subjects' experiences who willingly consented to be interviewed. The interviews were then analyzed and coded to categorize common themes within the subjects' experiences. Themes categorically selected throughout the interview analysis included "Thoughts & Feelings" and "Effect on Work." The study was approved by the Institutional Review Board.

**Results:** Three of the subjects (25%) required prolonged observation due to persistent symptoms of acute marijuana intoxication. Eleven (92%) were urine immunoassay positive for tetrahydrocannabinol (THC). Two subjects (17%) tested positive for ethanol in their blood. None of the subjects reported a prior history of marijuana use. Common symptoms experienced by the subjects included confusion (50%), difficulty speaking (67%), nausea (25%), tremors (17%), and feelings of unreality (33%). All interviewed subjects reported sleepiness and three (50%) reported a negative impact on work. Subjects also reported multiple emotions, including anger, confusion, disbelief, and helplessness. None of the cases resulted in admission to the intensive care unit or death.

**Conclusions:** Our case series illuminates the effects of unwitting and/or unintentional marijuana exposure in adults, with sufficient systemic effects resulting in individuals seeking emergency care. Legal and ethical barriers have limited the study of marijuana outside of controlled conditions. While the exposure in this study did not result in admission to the ICU or death, it did result in psychological distress and reported symptoms lasting weeks after the incident. As marijuana becomes readily available, the potential as an unwitting or even malicious intoxicant may increase.

### **Differences in Marijuana Motivations, Use, and Consequences among 2- and 4-year College Students**

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**Purpose:** As marijuana laws in the U.S. have become more liberal, marijuana use among college students has increased (Schulenberg et al., 2020). While nearly 40% of college students in the U.S. attend 2-year institutions, little is known about marijuana use and risk factors for use among 2-year students relative to 4-year students. College-aged adults that use marijuana report many motivations for use (e.g., enhancement, conformity, coping motives) which are related to both the frequency of use and the likelihood of experiencing related consequences (Lee et al., 2009). This study examines differences in

marijuana motivations, use, and consequences between 2- and 4- year college students and tests whether college status moderates associations between marijuana motives and marijuana outcomes.

**Method:** Participants included a sample of 1402 undergraduate students (35% 2-year; 59% female) aged 18-25 ( $M=20.53$ ,  $SD=1.72$ ) who completed a screening survey for a longitudinal study examining alcohol expectancies and use. Participants reported past-month motives for marijuana use, number of occasions of past-month and past-year marijuana use, and two marijuana-related consequences (i.e., number of times they drove to/from campus high and/or attended class high). Independent sample t-tests were conducted to assess mean differences between 2- and 4-year students in marijuana use and consequences, and also motives for use, including social, enhancement, conformity, coping, and boredom motives. Controlling for gender, age, college status, and academic quarter, Poisson regression analyses were conducted to examine associations between marijuana motives and use and negative binomial regression analyses were conducted to examine links between marijuana motives and consequences. Subsidiary analyses examined if links between marijuana motives and outcomes were moderated by college status.

**Results:** On average, participants reported using marijuana 6-9 times in the past month ( $SD=1.79$ ) and 10-19 times in the past year ( $SD=1.61$ ). Over 15% ( $n=213$ ) reported they had driven to/from campus high at least once and 40% ( $n=565$ ) reported they had attended class high. Relative to 4-year students, 2-year students reported greater past-month and past-year marijuana use, and were more likely to have driven to/from campus high and to have attended class high ( $ps<.05$ ). Two-year students reported greater coping motives but decreased social and conformity motives compared to 4-year students ( $ps<.05$ ). In regression analyses controlling for co-variates, enhancement, boredom, and coping motives were associated with increased past-month and past-year marijuana use, whereas social and conformity motives were associated with decreased past-month and past-year use ( $ps<.05$ ). Coping and boredom motives were positively associated with driving to/from campus high and coping and enhancement motives were positively associated with attending class high ( $ps<.05$ ). In

tests of moderation, associations between coping, boredom, and conformity motives and driving to/from campus high were more pronounced for 2-year relative to 4-year students.

**Conclusions:** Two-year students endorsed marijuana motives differently than 4-year students and reported greater marijuana use and marijuana-related consequences. Two-year status moderated associations between motives and driving to or from campus high and 2-year students were more likely than 4-year students to endorse coping motives for using marijuana. As such, marijuana and mental health interventions targeting 2-year college students are needed.

### **Patterns of Expectancies Held Among Simultaneous Alcohol and Marijuana (SAM) Users**

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Stimulant Norms and Prevalence (SNAP) Study  
Team  
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Simultaneous alcohol and marijuana (SAM) use (i.e., using the two substances during the same period of time so that their effects overlap) is common among young adults. SAM use tends to be associated with greater negative consequences compared to the use of only one drug. Thus, understanding factors that may influence SAM use is necessary to inform interventions and limit harm. Substance use expectancies (i.e., beliefs regarding the anticipated positive and negative outcomes of engaging in a substance) are a strong predictor of alcohol and marijuana consumption and consequences, and may similarly explain SAM use. Positive expectancies (i.e., wanted outcomes, such as sociability) tend to predict the frequency of both alcohol and marijuana use, while negative expectancies (i.e., unwanted outcomes, such as cognitive and behavioral impairment) have been found to predict abstinence and a lower likelihood of use. Yet, alcohol and marijuana expectancies have not been sufficiently examined as related to SAM use. To address this gap in the literature, the present study examined 1012 college students (70.9% female, 51.8% white,  $M_{age} = 19.63$ ) from seven US universities who reported past-month alcohol and marijuana use (77.2% of the sample reported SAM use). Participants completed expectancy

measures for alcohol (7 factors) and marijuana (6 factors), and past-month SAM frequency. Collapsing individual expectancy factors into positive and negative expectancies by drug, a hierarchical multiple regression revealed that positive expectancies ( $F(2,1005) = 6.11, p = .002$ ), but not negative expectancies ( $F(2,1003) = 0.04, p = .96$ ), were significant predictors of SAM frequency above and beyond quantity and frequency of alcohol and marijuana use. Specifically, higher frequency of SAM use was associated with weaker positive alcohol ( $\beta = -0.08, p = .038$ ) and stronger positive marijuana expectancies ( $\beta = 0.11, p = .003$ ). A second hierarchical multiple regression examined which specific alcohol and marijuana expectancy factors accounted for these effects. After accounting for use variables, SAM frequency was associated with weaker social alcohol expectancies ( $\beta = -0.14, p = .007$ ) and stronger sexual and social facilitation marijuana expectancies ( $\beta = 0.11, p = .009$ ). Again, no negative expectancy factors were significant predictors of SAM frequency, nor did they incrementally contribute to model improvement. Contrary to the general expectancy literature, positive expectancies do not uniformly appear related to increased SAM use, as positive alcohol expectancies were inversely related to use. Positive marijuana expectancies, specifically social expectancies, on the other hand, were positively associated with SAM use. It is possible that individuals with strong social marijuana expectancies may add marijuana to their alcohol when they want to enhance socialization, perhaps, even more so when they believe that alcohol alone is not sufficient for obtaining optimal social functioning. Future research should further examine these relationships to understand whether these patterns of expectancies are causally related to SAM use or occur consequentially. Moreover, given the positive associations between SAM use and positive marijuana expectancies, it may be efficacious to target positive marijuana expectancies when implementing intervention efforts that are designed to reduce SAM use.

**Weeding out the Stigma: Experiences Shared by Older Veterans**

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**Background:** Cannabis use today is the highest it has been in three decades, approaching 36.5% prevalence for past year use (Schulenberg et al., 2017). From a 2014 nationwide sample of Veterans over 18, approximately 9% reported past year cannabis use (Davis et al., 2018). It also showed that in states where medical cannabis was legal, 41% of Veterans who used cannabis in the past year reported doing so for medical purposes. Modern research findings continue to point to medical cannabis as a potentially effective alternative to prescription medications (i.e., opioids and benzodiazepines) for treating a broad range of medical conditions.

**Aims:** The goal of our larger study was to develop a deeper understanding of cannabis use in US older Veterans (60 years +) who are using cannabis as a substitute or complement for opioids and/or benzodiazepines. While research exists on the use levels of cannabis, to our knowledge, limited research on the perceived stigma of using cannabis among older Veterans exists. For the current study, we sought to develop an understanding of stigma associated with older Veterans using cannabis.

**Methodology:** We surveyed 121 older Veterans who were enrolled in the Illinois Medical Cannabis Patient Program during fall 2020. We then used maximum variation sampling to select a subset of 32 Veterans who completed the initial online survey. From November 2020 to February 2021, two researchers conducted 30-minute audiotaped semi-structured interviews. Participants represented diversity regarding the age of cannabis initiation, type of cannabis user, military branch, type of healthcare provider, and race/ethnicity. Interview topics included (1) use of cannabis, opioids, and benzodiazepines, (2) interactions with medical providers, (3) stigma regarding cannabis use, and (4) educational materials for older Veterans. For the current study, we present findings from the third topic regarding stigma associated with using cannabis. The interviews were transcribed verbatim for data analysis purposes. Weekly meetings among two coders ensued to debrief on coding procedures, reflect on biases and interpretations, and reach consensus regarding coding discrepancies. The

final codebook reached an 87% inter-rater reliability. Then, the two coders independently coded the transcripts and employed a rigorous thematic analysis approach using NVivo12 QSR. A narrative was woven together with exemplary quotes to illustrate major themes.

**Findings:** We identified three stigma focused themes: (1) stereotypes regarding people who use cannabis, (2) hesitation of disclosing cannabis use with others, and (3) media portrayal (i.e., movies, television shows) of cannabis users.

**Implications:** Stigma creates situations in which older Veterans are hesitant to disclose their use of cannabis with physicians and friends/family which can be dangerous and also socially isolating. Additionally, older Veterans may benefit from shared experiences about cannabis use for medical purposes, but this often does not occur. The empirically-based insights gained from this work have the potential to inform public health leaders, healthcare administrators, and public messaging regarding the use of medical cannabis. Additional research is needed to expand upon our findings with more generalizable methods and a representative sample of older Veterans.

**Preliminary Effects of a Facebook Intervention on Polysubstance Use and Transdiagnostic Psychological Symptoms Among Adults With Cannabis Use Disorder and Major Depression**

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**Purpose:** Cannabis Use Disorders are associated with a quadrupling of the risk of developing depression, and the use of cannabis to alleviate depressive symptoms is increasingly widespread. Despite high rates of cannabis use among individuals with affective disorders, those who suffer from depression do not frequently access traditional treatment. Our prior work has

demonstrated that a technology- and social media-assisted intervention combining cognitive behavioral therapy (CBT), motivational enhancement therapy (MET), and social media support via Facebook showed promise in changing cannabis use and mood symptoms among depressed individuals with cannabis use disorder (CUD). The current project examined alcohol co-use and anxiety in this population, effectiveness of this approach in changing drinking behaviors and anxiety, and perceived helpfulness of the intervention.

**Methods:** In a 10-week pilot intervention study, adults (N=20) with CUD and Major Depressive Disorder (MDD) received an intervention combining computer-assisted CBT/MET targeting depression and cannabis use with peer and therapist support via Facebook, Connected Cannabis Users' Network for Enhancement of Cognitive Therapy (CONNECT).

Self-reported past 30 day alcohol and cannabis use was assessed using a calendar-assisted timeline follow back interview at baseline and treatment-end. Anxiety was measured using the GAD-7. Perceived helpfulness of the intervention was evaluated qualitatively in individual participant interviews.

**Results:** From baseline to treatment-end, CONNECT participants reduced the frequency of both cannabis use (M=24 vs. 8.9 days,  $p<0.05$ ) and heavy alcohol use (M=1.7 vs. 0.4 days,  $p<0.05$ ). Anxiety also declined over the course of treatment (M=5.4 vs. 3.2,  $p<0.05$ ). More than half (57%) of CONNECT participants reported the social media intervention was helpful for their mood as well as cannabis use, and 72% indicated that they would recommend it to a friend. Qualitative data indicate that CONNECT was most helpful in 3 core areas: (1) social support/not feeling alone with their problems, (2) CBT skills training, (3) bolstering motivation to change substance use.

**Conclusion:** Combining technology-assisted and social media interventions may be an effective strategy for populations struggling with concurrent depression and CUD. Beyond primary outcome variables (i.e., depression and cannabis use), participants also reported reductions in heavy alcohol use and anxiety, indicating that this intervention may effectively produce transdiagnostic process changes. In light of the growing demand for telemedicine and digital health interventions in the wake of COVID-19,

further research and potential dissemination of this approach appears warranted.

### **Cannabis Use in Pregnancy**

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Concern for adverse effects of prenatal cannabis use (PCU) is warranted. The American Academy of Pediatrics recommends refraining from PCU, because  $\Delta^9$ -tetrahydrocannabinol (THC) crosses the placenta at approximately 10% of maternal levels, which can result in adverse offspring outcomes. Little is known about patterns and contexts of PCU; to advance this effort, 64 pregnant women who use cannabis were recruited from Amazon's Mechanical Turk for a study of PCU thoughts and behaviors.

Women were, on average, 22 years of age (range 22-49); mean income was ~\$44,000 (range \$0-\$150,000). 53.3% of respondents were in the first trimester, 43.3% were in the second and 3.4% were in the third. Polysubstance use was common; 25% reported prenatal alcohol use and 64% reported prenatal tobacco use. Approximately 40% reported using about the same amount of cannabis as before pregnancy. Regarding availability and patterns, approximately 44% indicated that cannabis was "somewhat" or "very" easy to get. Women in the third trimester reported the most frequent PCU. Across all trimesters, the majority of women reported using cannabis with roughly equal parts THC and cannabidiol and PCU primarily consisted of consumption of leaf and concentrates. The most common modes of administration were joints in the first trimester and hand pipes in the second and third trimesters. On a typical PCU day, approximately 70% of participants reported consuming  $\frac{1}{4}$  gram of flower or less, 73% reported taking 5 or fewer hits of concentrates, and 85% reported ingesting 10 milligrams of THC or less in edibles. PCU among social networks was prevalent; over 50% reported that their spouse/partner used cannabis during their pregnancy and approximately 80% reported that a few, several, or most of their family and friends use cannabis. Regarding contexts, during a typical week, women reported PCU in their homes (alone [30%], with others [54.7%]), at friends' or family members' homes (alone [28%], with others [39%]), in bars/nightclubs/restaurants/breweries (alone [30%], with others [34%]), as well as outdoors

(alone [34%], with others [33%]), at work (alone [34%], with others [36%]), at school (alone [23%], with others [36%]), in the car (alone [31%], with others [36%]) or elsewhere (alone [23%], with others [39%]). PCU was perceived as 'highly effective' (as reported by 75-95%) at managing nausea, distress (anxiety, depression), and physical discomfort (e.g., backaches). Perceived harm of PCU was low, more than half of participants believed PCU would harm the fetus (~60%) or herself (~64%) "not at all" or "a little."

In conclusion, polysubstance use, particularly tobacco use, is common among women who use cannabis during pregnancy. Although quantity of PCU consumption was relatively low in our sample, any amount is concerning and may have negative impact on the developing fetus. The majority of women's social networks used cannabis and, in all contexts (with the exception of outdoor use), PCU was typically in the company of others. Perceived efficacy of PCU for symptom modulation was high across a variety of conditions, and risk perceptions were low, both of which may result in riskier use trajectories.

### **Dispositional Mindfulness Profiles and Cannabis Use among College Students**

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The benefits of mindfulness have been well documented across several domains, including stress reduction, coping with chronic diseases, and relationship satisfaction. Previous research cites mindfulness as a protective factor against risky substance use, but the specific association between dispositional mindfulness (also known as trait mindfulness) and cannabis use has been inconsistent, with some studies finding a negative association and one reporting no significant relationship. Notably, much of the previous research has relied on variable-centered approaches. Only a handful of prior studies within the marijuana literature have utilized person-centered approaches, and only one has specifically examined dispositional mindfulness in relation to patterns of use. The present work advances scientific understanding by using a latent profile analysis to identify subtypes of dispositional mindfulness and their relation to cannabis use behaviors (i.e., cannabis use frequency, cannabis

problems, and hazardous cannabis use) in a sample of college students. College students from seven universities across six states participated in an online survey of substance use and risk/protective factors. The current sample comprised 2,249 students who completed the Five Facet Mindfulness Questionnaire (FFMQ) and measures of cannabis use. Findings revealed four discrete profiles of dispositional mindfulness: High-Traits profile (13%; characterized by high scores across all dispositional mindfulness facets), a Moderate-Traits profile (65%; characterized by moderate scores across all dispositional mindfulness facets), a Non-Judgmentally Aware profile (10%; marked by low scores on observing and nonreactivity, but high scores on non-judgment and acting with awareness), and an Observing Nonreactive profile (12%; composed of individuals with high scores on observing and nonreactivity). The Observing Nonreactive class reported the highest levels of marijuana consequences and hazardous use, while the remaining three groups did not differ significantly from one another in terms of problematic use. However, the Moderate-Traits class reported significantly more consequences than those in the High Traits and Non-Judgmentally Aware profiles. These results build upon the only known study that investigates how dispositional mindfulness relates to cannabis use. We found four homogenous profiles rather than three, including two classes that were previously uncovered (High Traits and Non-Judgmentally Aware). This research lends support to the finding that distinct facets of dispositional mindfulness differentially relate to cannabis use. Specifically, whereas high levels of the nonjudgmental and awareness facets appear protective against risky cannabis use, the observing and nonreactive facets appear related to risky cannabis use, and thus, merit further scrutinization. Further research is needed to elucidate the relationship between the five facets of dispositional mindfulness and cannabis use—gaining clarity on how the facets predict marijuana outcomes can help guide the substance use field toward more effective prevention and treatment of cannabis misuse and cannabis use disorder.

**Partner Incarceration and Maternal Substance Use: Investigating the Mediating Effects of Social Support and Neighborhood Cohesion**

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**Introduction:** The United States is responsible for the highest rate of incarceration globally. The impacts of incarceration extend beyond those incarcerated and can result in adverse outcomes for chosen romantic or life partners and the family unit. This study aimed to explore the impact of partner incarceration on maternal substance use and whether the relationship between partner incarceration and maternal substance use is mediated by financial support, emergency social support, or neighborhood cohesion.

**Methods:** Using data from the Fragile Families and Child Wellbeing Study, a longitudinal cohort following new parents and children, this analysis quantifies the relationship between paternal incarceration and maternal substance use (N=2246). Responses from mothers at years 3 (2001-2003), 5 (2003-2006), 9 (2007-2010), and 15 (2014-2017) were assessed, restricted to mothers who responded across waves. The exposure, partner incarceration, was operationalized as mothers reporting their current partner or child's father to be ever incarcerated at year 3. The outcome, substance use in the past year (yes vs. no), was assessed at each time point. Respondents were asked whether they used marijuana, sedatives, tranquilizers, amphetamines, prescription painkillers, inhalants, cocaine, hallucinogens, or heroin. Three mediators were investigated at years 5 and 9: neighborhood cohesion, financial support, and emergency social support. Confirmatory factor analysis (CFA) was employed to construct support-related mediators. Counting on someone to loan \$200, providing a temporary place to stay, and providing emergency childcare were hypothesized to load onto one factor (emergency social support) and counting on someone to loan \$1000, co-sign a bank loan for \$1000 and co-sign a bank loan for \$5000 were hypothesized to load onto a separate factor (financial support). Items were weighted by factor loadings and responses were summed to create a scale for financial support and emergency social support, with a higher score denoting greater degree of support. Impact of partner incarceration and maternal substance use was modeled using multilevel modeling to account for repeated measures, adjusting for appropriate confounders

(age of mother at child's birth, race, education, employment, and history of intimate partner violence).

Results: Nearly half (42.7%, N=958) of participants reported partner incarceration. Among mothers who described partner incarceration, the odds of reporting substance use are 96% (adjusted Odds Ratio [aOR]: 1.96; 95% Confidence Interval (CI):1.56-2.46) greater in comparison to those who reported no partner incarceration. Financial support at year 5 mediated 17% of the relationship between partner incarceration at year 3 and substance use at year 9 (p-value = 0.006); financial support at year 9 was not a significant mediator of the relationship between partner incarceration at year 3 and substance use at year 15. Neither emergency social support nor neighborhood cohesion were significant mediators at either year 5 or year 9.

Conclusions: These findings demonstrate that partner incarceration impacts maternal substance use. Financial support acts as a partial mediator in the short term, which has important implications for families disrupted by mass incarceration.

### **Leveraging Mobile Technology: A systematic review of mHealth interventions with Cannabis Users**

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Cannabis is commonly used by young adults (18-25), and these transitional years can be crucial as they tend to have the highest rates (5%; 1.8 million in the U.S.) of Cannabis Use Disorder (CUD; SAMHSA, 2016). Current survey data suggest 25% of university students use cannabis monthly or greater and 6% daily (Schulenberg et al., 2019) and even higher (38-39%) in states with legal recreational cannabis use (Pearson et al., 2017). Burgeoning research has shown that chronic, heavy cannabis use is associated with a host of negative consequences, including symptoms/diagnosis of CUD, as well as anxiety, depression, and psychosis, among other health issues (Arseneault et al., 2002; Buckner et al., 2010; Degenhardt et al., 2003; Midanik, Tam, & Weisner, 2007; Simons et al., 2010; Solowij & Pesa, 2010). With the number of young adults diagnosed with CUD, there is a growing need for

intervention strategies. However, rates of individuals seeking formal treatment for cannabis use has been low (Prince et al., 2020). With widespread access, it has become easier to employ mobile technology for health interventions (Kumar et al., 2013). The overall objective of this systematic review was to explore the utilization of different mHealth interventions for cannabis users to investigate different types and ways these interventions are implemented, targeted outcomes, along with the types of studies being conducted (e.g., RCT, feasibility, interviews, usability, etc.).

Methods: A search of PsycInfo and PubMed was conducted for relevant articles with the following search terms: mHealth app/web-based intervention/internet-based intervention/telehealth/JITAI/EMI/Ecological Momentary Intervention/Just-in-Time Adaptive Intervention/in the moment/Mobile Intervention/Smartphone Intervention/Wearable Devices AND Cannabis/Marijuana Peer-reviewed original research in English was targeted, which focused on mHealth interventions for adults (over 18 years of age) targeting cannabis use and needed both a mobile intervention and provided data on at least one outcome (e.g., reduced craving or cannabis use) or feasibility of intervention. Qualitative, quantitative, and mixed methods were all included.

Results: The total number of records identified that fit the criteria based on a review of titles and abstracts were 33 (9 from PsycInfo and 24 from PubMed). After duplicates were removed, 27 were screened and 9 records were excluded for failure to meet search criteria after full review of the articles. The remaining records (n=18) were assessed for eligibility and data were extracted.

Based on preliminary findings, the majority have been feasibility and usability studies (83%). Roughly half were conducted in the U.S., with the rest in European countries, and one in Singapore. The timeframe for using the mobile intervention ranged from 1-hour (for usability studies) to 8 months in duration. The types of mobile interventions have varied from text messaging, using a smartphone app, to directing individuals to websites. Roughly 50% have been standalone mHealth interventions, while the other half have been paired with face-to-face counseling sessions. The majority of these interventions have

personalized intervention strategies for their participants.

### **Validation of the Marijuana Purchase Task Among Adolescent Marijuana Users**

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Marijuana is the most commonly used illicit substance, with daily use rising among 8th and 10th graders. Adolescents view marijuana use as carrying minimal risk despite a host of associated psychosocial consequences. Within the behavioral economic framework, the Marijuana Purchase Task (MPT) has been used to understand demand (i.e., relative value) for marijuana. The MPT is a hypothetical purchase task that produces five demand indices reflective of the relative reinforcing value of marijuana and include intensity (i.e., amount consumed at zero cost), Omax (i.e., maximum expenditure), Pmax (i.e., price at maximum expenditure), breakpoint (i.e., cost at which consumption is suppressed to zero), and elasticity (i.e., rate at which consumption decreases as price increases). To date, the MPT has only been validated with adult samples; thus, the current study aimed to validate the MPT with a late adolescent sample who presumably have less experience in purchasing and using marijuana relative to adult users. Convergent validity was established via correlations between demand indices and marijuana outcomes (i.e., marijuana use, consequences, craving, and recent marijuana expenditures). Divergent validity was established via t-tests to examine group differences between hazardous and non-hazardous users as differentiated by the Cannabis Use Disorders Identification Test-Revised (CUDIT-R; scores of 8 or greater indicate hazardous use). Participants were 115 adolescents ( $M_{\text{age}} = 16.94$ ,  $SD_{\text{age}} = 0.88$ ; 52% female; 64% high school student) between the ages of 15-18 who reported lifetime marijuana use and current marijuana demand. As expected, results showed that as price increased,

hypothetical marijuana use decreased. Convergent validity was established via significant associations between demand indices and marijuana outcomes. Omax, breakpoint, and elasticity were significantly correlated with marijuana use outcomes in predicted directions such that greater demand was associated with more use, consequences, craving, and recent expenditures ( $ps < .05$ ). Intensity was positively correlated with craving and expenditures ( $ps < .05$ ). Pmax was not significantly correlated with any marijuana use outcome. Divergent validity was also established; compared to non-hazardous users ( $n = 39$ ), hazardous users ( $n = 76$ ) exhibited significantly higher Omax ( $t = 3.11$ ,  $p < .01$ ), Pmax ( $t = 2.08$ ,  $p < .05$ ), breakpoint ( $t = 3.71$ ,  $p < .001$ ), and elasticity ( $t = 3.11$ ,  $p < .01$ ). There was no difference in intensity across user types. Findings from the current study are unique in several ways. First, in contrast with previous literature, intensity was less consistently associated with marijuana outcomes. However, indices related to price sensitivity are important metrics in this age group, as evidenced by significant associations between Omax, breakpoint, and elasticity and marijuana outcomes. These findings are further evidenced by the ability of Omax, Pmax, breakpoint, and elasticity to differentiate non-hazardous versus hazardous users. Together, these findings suggest that the MPT is a valid measure for assessing the reinforcing value of marijuana among adolescents. Future research should replicate these findings, as well as examine the factor structure of the MPT among adolescents.

### **Probability and Predictors of Cannabis Use Disorder Among Cannabis Users with Depressive Disorders**

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**Introduction and Aims:** Cannabis use and cannabis use disorders (CUD) have been increasing in the US. Recent studies have aimed to assess the rates of transition from cannabis use to CUD over time across several sociodemographic correlates (e.g., age and sex). Depressive disorders are a strong clinical correlate of cannabis use, and carry a substantial burden of disease. The underlying mechanisms involved in the relationship between depression and cannabis use

are still not fully understood. While certain studies have examined changes in rates of cannabis among depressed and non-depressed individuals over time, no studies have quantified the effect of depressive disorders on cannabis users' transition rates to CUD.

**Methods:** Participants were individuals  $\geq 18$  years interviewed in the National Epidemiologic Survey on Alcohol and Related Conditions-III in 2012–2013. Survival plots assessed the probability of transition from cannabis use to CUD over time. Differences in probability of transition to CUD was assessed among cannabis users with and without predisposing depressive disorders (major depressive disorder or dysthymia with an initial diagnosis prior to onset of cannabis use).

**Results:** Among lifetime cannabis users ( $N = 11,272$ ), the 5-year probability of transition to CUD was approximately 3.9% for cannabis users without depressive disorders and 7.3% for those with a depressive disorder. A higher probability of transition from cannabis use to CUD among those with a predisposing depressive disorder was observed over all time points that were examined in the study. Cannabis users with depressive disorders who were male and belonging to an early-onset of cannabis use age group ( $< 16$ ) transitioned significantly more rapidly to CUD than females and those with a later-onset of cannabis use.

**Conclusions:** This is the first study to explore the effect of depressive disorders on rates of transition from cannabis use to the DSM-5 CUD diagnosis. The current study identified specific predictors of this transition. Findings inform clinicians who treat individuals with depressive disorders that initiate cannabis use as to the risk of developing CUD and the need for harm prevention targeted at this specific population.

**Sleep-Related Cannabis Expectancies  
Questionnaire (SR-CEQ): Replication and  
Psychometric Validation among College Students  
using Cannabis for Sleep Aid**

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**Introduction:** Emerging evidence suggests that cannabis is commonly used to aid sleep among college students. Although outcome expectancies have been associated with the progression of

cannabis use, sleep-related expectancies have not been included in widely-used cannabis expectancy measures. Recently, the Sleep-Related Cannabis Expectancies Questionnaire (SR-CEQ; Goodhines et al., 2020) was developed and initial evidence for its 2-factor structure was obtained in a general college sample (including non-cannabis users). However, the SR-CEQ's associations with sleep and cannabis use behaviors among cannabis sleep aid users is unknown. This study aimed to replicate the previous factor structure and test construct and concurrent validity of the SR-CEQ among college students using cannabis for sleep aid.

**Method:** Cross-sectional data were drawn from 94 college students reporting at least bimonthly cannabis use for sleep aid. Five multivariate outliers on the SR-CEQ were excluded, resulting in an analytic sample of 89 ( $M_{age} = 19.92$  [ $SD = 1.19$ ; range = 18–22]; 66% female; 72% White, 12% Multiracial, 7% Asian, 5% Black or African-American, 1% self-reported Other and 3% did not disclose; 14% Hispanic/Latinx). Students completed an online survey of sleep and substance use behaviors. A confirmatory factor analysis (CFA) replicated the 2-factor structure (Positive and Negative Sleep-Related Cannabis Expectancies), bivariate correlations tested associations with related constructs (sleep and cannabis use behaviors/beliefs), and independent-samples t-tests further explicated relevant group differences.

**Results:** After dropping item 5 (factor loading  $< .40$ ), CFA with a 2-factor structure indicated good fit to the data ( $\chi^2(41) = 66.76$ ,  $p = .01$ ; CFI = 0.94; SRMR = 0.07; RMSEA = 0.08 [90% CI = 0.05, 0.12]). Positive sleep-related cannabis expectancies ( $\alpha = .84$ ) were associated with dysfunctional beliefs about sleep ( $r = .24$ ,  $p = .02$ ), but not insomnia symptoms, poor sleep quality, or frequencies of cannabis use ( $p > .05$ ). Students who used cannabis more frequently in general ( $\geq 36$  of 60 days, per median split) reported more positive sleep-related cannabis expectancies ( $t[86] = 1.99$ ,  $p = .05$ , Cohen's  $d = 0.42$ ). Negative sleep-related cannabis expectancies ( $\alpha = .80$ ) were not associated with any cannabis or sleep variables assessed ( $p > .05$ ). Negative sleep-related cannabis expectancies were marginally lower among students with greater frequency of general cannabis use ( $t[87] = -1.89$ ,  $p = .06$ , Cohen's  $d = 0.40$ ) and cannabis use for sleep aid ( $\geq 3$

times/week, per median split;  $t[87]=-1.87$ ,  $p=.06$ , Cohen's  $d=0.40$ ). Further, greater negative sleep-related cannabis expectancies were reported among male (versus female) students ( $t[87]=2.30$ ,  $p=.02$ , Cohen's  $d=0.51$ ).

**Conclusion:** Overall, replication of this 2-factor structure showed good fit to the data and both subscales demonstrated good internal consistency. Although replication is needed, results suggest that college students using cannabis for sleep aid may have less negative sleep-related expectancies about sleep. Positive sleep-related cannabis expectancies were associated with dysfunctional beliefs about sleep, but not sleep behaviors or cannabis use. Current novel findings extend existing knowledge of general non-sleep related cannabis expectancies among cannabis users in terms of cannabis use correlates. Findings can help identify at-risk students and modifiable risk factors that can be targeted to minimize harm with cannabis sleep aid use. Future research is needed among larger samples to (a) assess generalizability to varied populations and (b) clarify temporal sequencing of potential consequences through longitudinal designs.

### **Early cannabis initiation is associated with dual simultaneous substance use and tri-use**

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**Introduction:** Cannabis use combined with other substances, such as tobacco and/or alcohol, is related to heavy patterns of substance use and adverse social outcomes. We aimed to examine whether early age of cannabis initiation was associated with dual simultaneous substance (tobacco + cannabis / alcohol + cannabis) use and tri-use (tobacco + alcohol + cannabis).

**Methods:** We included participants aged between 12-21 years old ( $n=21,127$ ) that reported any cannabis use in the 2016-2019 National Survey on Drug Use and Health. Blunt use was defined as smoking part of a cigar with cannabis in it ("taking some tobacco out of a cigar and replace it with marijuana") and simultaneous alcohol/cannabis use as "using marijuana/hashish at the same time or within a couple of hours of last alcohol use". We created four-level categorical

variables, one for the exposure (age of cannabis initiation) and one for the outcome (simultaneous use). The exposure variable was comprised of the following levels based on different adolescent developmental stages: 1) 12-13 years old; 2) 14-15 years old, 3) 16-18 years old, and 4) 19-21 years old. The four outcome categories were defined as: 1) cannabis use only (no simultaneous use), 2) blunt use (simultaneous cannabis and tobacco use), 3) simultaneous alcohol/cannabis, and 4) tri-use (tobacco, cannabis and alcohol). Weighted multinomial logistic regression was used to obtain adjusted odds ratios (aOR) for categories of use, adjusting for sociodemographic characteristics (reference outcome category: cannabis use only).

**Results:** Most participants were 16+ years old (88%), non-Hispanic white (56%), with a family income equal or higher than \$40K (54%) and a mean age of cannabis initiation of 15 years old. When examining simultaneous use outcomes, 70% of the participants reported some form of simultaneous use (54.85% blunt use, 14.72% tri-use, and 1.12% simultaneous alcohol/cannabis). Regarding age of cannabis initiation, 18.97% started at age 12-13, 31.85% at age 14-15, 42.18% at age 16-18 and 7.00% at age 19-21.

Cannabis initiation in early adolescence (< 16 years old) was associated with simultaneous use outcomes when compared to cannabis initiation at age 16 and older. More specifically, when comparing with cannabis initiation at age 19-21, individuals reporting cannabis initiation at age 12-13 had 24.26 times the likelihood of tri-use (95% CI=17.33-33.95); and 6.64 times the likelihood of blunt use (95% CI=5.15-8.55), however, no associations were found with simultaneous alcohol/cannabis use (aOR 2.98, 95% CI= 0.94-9.37). When using cannabis initiation at age 16-18 as reference, cannabis initiation at age 12-13 was associated with six times the likelihood of tri-use (95% CI= 5.02-7.86), three times of blunt (95% CI= 2.42-3.71), and twice of simultaneous alcohol/cannabis use (95% CI= 1.26-4.40).

**Conclusions:** Cannabis initiation in early adolescence was associated with dual and tri-simultaneous substance use. Interventions focused on delaying cannabis initiation could have a positive impact on decreasing dual and tri-substance use. Considering that 1 in 5 individuals reporting cannabis use started in early

adolescence, primary prevention strategies should start before the age of 12.

**Military sexual violence and cannabis use disorder among OEF/OIF veterans**

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Sexual violence experienced during military service can have lasting negative psychosocial effects on veterans long after service ends. Current research reports veterans who have experienced military sexual violence are more likely to develop mental health and substance use disorders. Little is known, though, about the relationship between military sexual violence and subsequent cannabis use disorder (CUD). The current study investigated prevalence of military sexual violence among a large sample of OEF/OIF veterans (N = 1,005), its effect on later CUD, and the potential moderating role of resilience. First, t-tests examined differences in experience of military sexual violence between LGBTQ vs. heterosexual and female vs. male veterans. Then, using logistic regressions controlling for sex, sexual orientation, and race/ethnicity, we assessed the effects of sexual violence on CUD (Cannabis Use Disorder Identification Test score of 12 or higher), followed by adding resilience into the model to examine independent and moderation effects. T-test results indicated that female ( $t(99) = -7.46, p < 0.001$ ) and LGBTQ veterans ( $t(38) = -3.85, p < 0.001$ ) were significantly more likely to experience military sexual violence. Veterans who experienced military sexual violence had higher odds of screening for CUD (OR = 3.37; 95% CI = [1.76, 6.45]). Greater resilience was associated with lower odds of CUD (OR = 0.40; 95% CI = [0.23, 0.70]), but it did not moderate the relationship between sexual violence and CUD. Our findings are in line with prior work that female and LGBTQ veterans may experience sexual violence during military service at higher rates. We also showed that veterans who experience military sexual violence are at increased risk for subsequent CUD. This suggests the importance of screening for military sexual violence among veterans, including among those seeking care for CUD, as well as screening for CUD symptoms among those who have experienced military sexual violence.

Since we found that greater levels of resilience were associated with lower odds of CUD, programs and treatments aimed at building resilience to adverse events may have independent protective effects on CUD.

**Exploring sensation-seeking and first cannabis use experiences as correlates of current cannabis use problems in young adult cannabis and tobacco co-users.**

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**Introduction:** Current cannabis use is high in young adults (ages 18-24) and cannabis use disorder (CUD) rates have increased over the last decade. Subjective responses to one's first use of cannabis may explain continued use, wherein more positive first use experiences influence progression to regular and problematic use. Sensation seeking is associated with cannabis use and may also influence cannabis problem severity. This study examined the relationship between subjective experiences at first cannabis use and sensation seeking on cannabis use behavior and CUD diagnosis.

**Method:** Participants were 97 young adult current cannabis and tobacco co-users (55.7% male, 50.5% White) who completed the baseline survey of a longitudinal study examining daily patterns of tobacco and cannabis use and co-use. Participants completed the 4-item Brief Sensation Seeking Scale and indicated intensity of 15 sensations at first cannabis use (1 = not at all to 5 = intense): dizziness, lightheadedness, nausea, paranoia, confusion, happiness, anxiety, taste, smell, relaxation, energy, difficulty inhaling, coughing or choking, giddiness or laughter, and rush or "buzz." Cannabis use outcomes included: (1) past 30-day number of days used cannabis; (2) past 30-day cannabis intoxication intensity (1 = not at all high to 10 = extremely high); and (3) likelihood of a CUD (score  $\geq 12$  on the Cannabis Use Disorder Identification Test- Revised).

**Analyses:** A principal components analysis (PCA) reduced the 15 sensations into factors. Next, separate regression analyses (linear or binary logistic) were conducted to examine the associations of the PCA-derived factors and sensation seeking on the cannabis outcomes, controlling for gender, race, and age at first cannabis use.

Results: Over half (61.9%) of the participants met criteria for a CUD. PCA results indicated a 4-factor solution: (1) “positive emotional experiences” (e.g., happy); (2) “negative physical experiences” (e.g., dizzy); (3) “negative emotional experiences” (e.g., paranoia); and (4) “taste and smell.” Regression results indicated greater negative physical experiences were associated with an increased likelihood of a CUD diagnosis (AOR = 1.93,  $p = .038$ ) and lower average cannabis intoxication ( $b = -0.343$ ,  $p = .049$ ). Greater negative emotional experiences at first use were associated with less frequent cannabis use in the past 30 days ( $b = -2.043$ ,  $p = .028$ ).

Conclusion: Negative emotional experiences associated with first use of cannabis may impede continued use. Negative physical experiences (e.g. nausea, lightheadedness) may be variable in perception, which could explain the inconsistent associations of this factor with CUD diagnosis and past 30-day use. Understanding subjective experiences of first cannabis use could be used as a treatment target by helping patients identify reinforcing sensations associated with their use, and guiding them to sober activities with similar sensations.

#### **Unexpected Public Health Emergencies—A Descriptive Analysis of Trends in the Massachusetts Medical and Adult-use Cannabis Markets**

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In the United States (U.S.), access to legal cannabis through regulated state markets is rapidly changing, but little is known about consumer behavior when states with legal access choose to restrict access due to public health or safety concerns. This exploratory study examines the Massachusetts recreational (“adult-use”) and medical cannabis markets before and during two major public health crises that changed consumer access: (1) the e-cigarette or vaping use-associated lung injury (“EVALI”) crisis and state requirements to stop vape product sales in the adult-use and medical markets from 9/24/2019-

12/12/2019, and (2) the SARS-CoV-2 (“COVID-19”) crisis and state emergency order that temporarily halted all adult-use retail sales but not medical sales from 3/24/20-5/24/20. We used the Massachusetts seed-to-sale tracking system (i.e., Metrc) to run descriptive statistics examining medical sales for patients and all adult-use sales across the largest product segments: buds, vapes and concentrate (each), edibles, and other categories (i.e., prerolls, concentrate, infused nonedible, infused beverage, kief, shake/trim, suppository) spanning May 2019-December 2020. To account for classification changes in the dataset, sales for vape products and concentrate (each) product were summed into a single category. We further examined trends in registered patients and “per patient” spending across cannabis product types (i.e., monthly sales per product category divided by monthly registered patients). Our findings showed a decline in market share for the vape and concentrate (each) product category in the adult and medical markets during the EVALI crisis when sales were halted, while buds, followed by edibles and other products increased in market share during this time. After vape products could be sold again, the market share of vape and concentrate (each) products rose but did not return to pre-EVALI levels. We did not observe an overall shift in market share by product type in the medical market during the COVID-19 adult-use store closure. Although gross medical sales trended upward, increases in the medical market did not account for the vast majority of prior spending in the adult-use market during the market’s closure. The number of registered active patients also trended upward. From December 2020 to December 2021, there was a 56% increase in patients (59,173 to 92,148 patients), and we observed a marked increase following the temporary halt of adult-use sales. During and prior to halted adult-use sales, we observed an increase in per patient monthly spending for cannabis products. This was particularly salient for buds. Per patient monthly spending for buds peaked in May 2020. Study limitations include a single state sample and that this study does not examine changes to the illicit market. We cannot make any causal claims and any long-term implications of trends observed during the EVALI and COVID-19 crises are unknown. Our exploratory findings suggest that there are a

range of consumer responses in the legal market in response to temporary loss of access, including evidence of consumers changing legal markets (i.e., adult-use to medical) and changing product types. More research is needed, particularly to understand potential concurrent changes in the illicit market during these crises.

**Patterns of marijuana use and sexual violence among sexual minority high school students: Perspectives from the California Healthy Kids Survey**

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**Background:** Sexual minority students are at risk for adverse outcomes associated with substance use and violence. The vast majority of research literature, however, has focused on university students and alcohol consumption. There is an increased need to understand the distinct vulnerabilities of youth who have a non-heterosexual sexual orientation, and marijuana use as more state legalize and normalize the recreational use of marijuana in various forms. This study examines marijuana use and sexual victimization among high school students by sexual minority status.

**Methods:** We analyzed data from 9th (n=50,973) and 11th (n=41,692) graders who participated in the California Healthy Kids Survey during the 2018-2019 school year. Students were asked to report their sexual identity and orientation ('straight,' 'gay/lesbian,' 'bisexual,' 'something else,' 'I am not sure yet', 'decline to respond'), whether they had ever been sexually assaulted, marijuana use in their lifetime and past 30 days, and demographic characteristics. We conducted multi-level logistic regression analysis to assess relationships between lifetime and past-30-day marijuana use, sexual minority status and sexual victimization (SV). Analyses were performed using Stata, version 15.1.

**Results:** The initial model indicated that the interaction terms for sexual minority status and sexual assault were not significantly associated with lifetime and past 30-day marijuana use. Analyses without the interaction terms suggest that students who identify as gay or lesbian, and who selected 'I am not sure yet' and 'something

else' had higher odds of reporting past-30-day marijuana use than their 'straight' peers (OR=1.50 p<0.01 95%CI: 1.15, 1.96; OR=1.34 p<0.01 95%CI: 1.20, 1.50; OR=2.33 p<0.01 95%CI: 2.11, 2.59). Results also suggested that students who identified as gay or lesbian, bisexual, and students who selected 'something else' as their sexual orientation had higher odds to report lifetime marijuana use than their 'straight' peers (OR=1.90 p<0.01 95%CI: 1.43, 2.52; OR=1.45 p<0.05 95%CI: 1.03, 2.04; OR=1.57 p<0.01 95%CI: 1.29, 1.92). However, students who declined to respond about their sexuality are less likely to report lifetime marijuana use than their 'straight' peers (OR=0.82 p<0.05 95%CI: .68, .99). Additionally, students who reported sexual assault have almost six times higher odds of reporting lifetime and past-30-day and lifetime marijuana use (OR=6.68 p<0.01 95%CI: 3.99, 11.20; OR=6.03 p<0.01 95%CI: 3.80, 9.56). Overall, students who are in 11th grade, are male, and Hispanic have higher odds of reporting marijuana use.

**Conclusion:** Overall, risks of marijuana use tend to be more pronounced among sexual minority students who have experienced sexual violence. Our findings suggest that students who identified as 'something else' may be at particular risk. These results are congruent with prior research on college populations that have identified undergraduate students who are bisexual and unsure of their sexual identity at heightened risk for SA. Greater efforts are needed to examine the intersection of substance use and sexual victimization and the disproportionate burden facing adolescents across multiple categories of sexual orientation.

**Legalization of "smokable" medical marijuana was associated with significantly increased THC use per certified patient in the Florida medical marijuana program: An interrupted time series analysis**

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**Background/Objective:** Tetrahydrocannabinol (THC) is the primary psychoactive cannabinoid in cannabis. THC has potential therapeutic efficacy for some conditions but can lead to adverse drug events when used in higher concentrations.

Higher concentrations are typical for smokable medical marijuana (MMJ) products which often contain 20 % THC or more. On March 18, 2019, Florida Senate Bill 182 (SB182) authorized cannabis flower for smoking. The objective of this study was to assess the effect of SB182 on the weekly dispensed amount of THC per certified MMJ patient in Florida. Methods: Data were obtained from the Florida Department of Health Office of Medical Marijuana Use (OMMU) weekly reports, which detailed aggregate MMJ utilization from 04/06/2018 (onset of reporting) until 03/13/2020 (onset of COVID-19 emergency orders). We calculated the weekly amount of dispensed THC per certified patient by summing the total weekly amount of THC in dispensed MMJ across all non-smokable and smokable routes of administration in the pre- and post-periods. These totals were divided by total certified MMJ patients in that week. Given the lack of information of THC content in smokable MMJ products in Florida, we calculated THC amounts using averages of THC concentrations in smokable products (10% and 20%) based on published estimates from other states with MMJ programs. Interrupted time series analysis without control was conducted by fitting a generalized least squares linear model to estimate changes in the overall trend and changes in the level after SB182. We used a phase-in period to allow for time between the first dispensed MMJ products in a form of smoking (3/22/2019), and measurable effects of SB182 (07/19/2019). Autocorrelation and moving averages were ruled out by using autocorrelation and partial autocorrelation plots. Results: In the scenario with 10% average THC in smokable products, SB182 led to a significant level increase of 35.1 mg (95% CI: 4.85-56.34 mg) in the weekly dispensed amount of THC per MMJ patient. This was an increase of roughly 10.7% compared to the estimated amount in the week before the phase-in period (328.20 mg). In the same scenario, a continuously increased trend of 2.23 mg per week (95% CI: 1.16-3.31 mg) was observed in the 35 weeks following SB182. In the second scenario (assumed 20% average THC in smokable products), SB182 was associated with a level increase of 138.4 mg (95% CI: 102.14-174.75 mg) in the weekly dispensed amount of THC per MMJ patient, which corresponds to an increase of 42.2%, compared to 328.20 mg, and a trend

increase of 5.62 mg (95% CI: 4.33-5.61 mg) per week in the following 35 weeks from law implementation. Conclusion: The inclusion of smokable MMJ in the Florida MMJ program was associated with a significant increase of the weekly dispensed amount of THC per certified MMJ patient, by increasing the level, as well as the overall trend following law implementation. Further studies should investigate the potential health and safety impacts of increases in dispensed THC in MMJ programs.

### **Exploring Social Support as a Moderator between Adverse Childhood Experiences and Cannabis Use**

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Background: Research shows that unresolved childhood trauma can lead to an abundance of health disparities and increase the risk for problematic substance use in adulthood, particularly problematic cannabis use. Individuals who have experienced four or more adverse childhood experiences (ACEs) double their risk of problematic substance use, but research has shown that protective factors, such as social support, can buffer against this cumulative risk. Although past research has found that social support can buffer against problematic alcohol use, there is a need to understand how social support relates to ACEs and problematic cannabis use. The present study aims to identify if perceived social support moderates the association between ACEs and cannabis use. In addition to overall perceived social support, various domains of perceived social support (friends, family, and significant other support) were examined to determine whether these domains differentially impacted the association between ACEs and cannabis use.

Methods: Data were collected using a university online subject pool (n = 382) from a college student sample from a mid-southern university (75% Caucasian, 78% female). The participants completed a battery of measures assessing perceived social support (i.e., the Multidimensional Scale of Perceived Social Support; MSPSS), childhood trauma (i.e., the Adverse Childhood Experiences Scale; ACEs), and

the number of days of cannabis use in the past month (i.e., the Drug Use Questionnaire).

Results: Moderation analyses were used to analyze if overall perceived social support and the various domains of MSPSS (family, friend, and significant other) moderated the relation between ACEs and cannabis use. Findings revealed that perceived support from a significant other significantly moderated the association between ACEs and cannabis use ( $b = .17, p = .04$ ) such that the relation between ACEs and cannabis use was stronger when there was higher perceived support from a significant other. Overall social support and support from friends and family members did not moderate this association.

Discussion: Overall, these findings contradict the previous literature in that more support from a significant other did not buffer the association between ACEs and cannabis use. Rather, the relation between ACEs and cannabis use was strongest at higher levels of significant other support. This suggests that perceived social support may play a unique role alternative to buffering the relationship between ACEs and cannabis use. Future work is needed to examine factors such as level of cannabis use within a trauma survivor's social network or significant other accommodation of symptoms, which may enhance perceptions of support but also encourage cannabis use.

**Driving Under the Influence of Cannabis:  
Associations with Latent Profiles of Substance  
Use and Executive Cognitive Functioning**

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Background: Driving under the influence of cannabis (DUIC) almost doubles car crash risk (odds ratios range: 1.28-2.49). Known DUIC correlates include male gender, low perceived danger of DUIC, and greater frequency of cannabis and other drug use. Less is known about the role of executive cognitive functioning (e.g., skills in planning, organization) as a correlate of DUIC. Deficits in executive cognitive functioning could precede, and be exacerbated by heavy cannabis use, potentially contributing to DUIC risk. Objectives: This cross-sectional survey study used a person-centered analysis (latent profile analysis) to (1) identify prototypical profiles representing aspects of executive functioning and

substance use in young adults, and (2) determine which profiles were associated with self-report of DUIC. We hypothesized that at least two profiles would be identified: mainly or only cannabis use vs polysubstance use. We also predicted that the polysubstance use profile would be associated with worse executive functioning and self-report of DUIC. Method: Young adults ( $N=69$ ; ages 18-25; mean age=20.0 [ $SD=1.9$ ]; 62.3% female; 75.4% White, 13.0% Black, 11.6% Other race/ethnicity) who reported weekly cannabis use were recruited from the community in Pittsburgh, PA to participate in a study of cannabis effects on cognition. Baseline collected demographics, self-reported age of cannabis use onset (age <16 vs age >16), NIDA modified ASSIST, Marijuana Withdrawal Checklist, Alcohol Use Disorders Identification Test (AUDIT), Behavior Rating Inventory of Executive Functioning (BRIEF) (working memory, organization/planning scales), and Marijuana Consequences Questionnaire (item on "driven a car when high" in past 6 months). Latent profile analysis (LatentGold 5.1) was used to identify distinct classes, testing the fit of 1-5 classes. Each model included 10 indicators: age of cannabis use onset, frequency of cannabis and tobacco use, cannabis withdrawal severity, ASSIST scores for cannabis, cocaine and hallucinogens (the substances most often reported), AUDIT score, and BRIEF working memory, and organization/planning scores. For the best fitting model, covariates (i.e., self-report of DUIC, age, gender) were examined as profile correlates in a separate, final step. Results: A model with 3 latent profiles was selected (see Figure). The profiles represented "Polysubstance Use" (40.8%), "Primary Cannabis" (22.3%), and "Later Onset Cannabis" (36.9%). Polysubstance use profile reported more cannabis-related problems and other drug use, and more problems with executive functioning than the other profiles ( $p<.05$ ). Later Onset (vs Polysubstance Use) profile had older onset age ( $p<.05$ ), and had the lowest level of cannabis involvement. Primary Cannabis and Later Onset profiles did not differ in report of problems with executive functioning. DUIC in the past 6 months (reported by 50.7% of the total sample) was more likely to be reported by Polysubstance use than Later Onset profile ( $p<.01$ ). Polysubstance use profile was younger than Primary Cannabis profile ( $p<.05$ ). The profiles did not differ by gender. Conclusions: As

hypothesized, Polysubstance Use profile (which reported early cannabis use onset; and worse executive functioning, including problems with memory, planning/ organization) was associated with self-report of DUIC. Results highlight the role of self-reported executive functioning difficulties in DUIC risk, and the importance of targeting polysubstance use in preventing DUIC.

### **Frequency of Cannabis Use and Pain Intensity: Results from a National Sample**

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**Background:** Chronic pain has become a leading public health concern with roughly 20% of Americans currently living with chronic pain. Individuals living with chronic pain are more likely to report lower quality of life, additional comorbidity, and increased medical expenditures than individuals without pain. Many individuals have initiated cannabis use to manage their pain as an alternative to opioid use. However, studies examining associations between cannabis use and pain intensity rarely include the frequency of cannabis.

**Aim:** Our study aim was to address this scientific gap by elucidating the frequency of cannabis use and its association with pain intensity in an adult sample from across the United States.

**Methods:** In a cross-sectional study, we surveyed N=2,206 adults using three sampling approaches, a national panel, a Florida panel, and a community-engaged sample. Participants completed surveys including pain and substance use. Pain intensity was measured using the Pain Intensity Number Scale (PINS, 0-10 scale) by asking participants to rate their current pain and least and worst in the past 24 hours. Average Pain Intensity (API) was the mean of the aforementioned PINS scores. Frequency of cannabis use was measured by asking individuals to indicate any past 30 day use and to indicate how often they currently use cannabis: once a month, more than once a month but less than weekly, 1 to 6 days a week, or every day. Bivariate and multiple linear regressions were utilized to

identify associations between pain intensity, cannabis use, and sociodemographic factors.

**Results:** Our sample was majority female (54.1%), non-Hispanic White (63.1%), and  $45.9 \pm 17.60$  (SD) years of age. Participants reported an API score of  $1.50 \pm 2.49$ . For the 35.3% reporting pain greater than 0, the API score was  $4.26 \pm 2.40$ . Of the responding participants (n=600), 52% reported they never used cannabis and 25% indicated current cannabis use; with 9.0% of our sample indicating use once a month, 5.7% indicating use more than once a month but less than weekly, 4.0% reporting use 1 to 6 days a week, and 6.1% reporting using every day. Sociodemographic factors including race/ethnicity, education, and employment were associated with pain intensity at the bivariate level. Substance use factors including frequency of cannabis use and alcohol use were also associated with pain intensity at the bivariate level. After controlling for sociodemographic and substance use factors, using cannabis once a month ( $\beta=1.879$ ), more than once a month but less than weekly ( $\beta=0.981$ ), 1 to 6 days a week ( $\beta=1.830$ ), and every day ( $\beta=1.491$ ) were associated with API ( $p<.001$ ). Additionally, having a disability ( $\beta=1.965$ ) was associated with API ( $p<.001$ ).

**Discussion:** We found above average pain intensity in this sample and about 48% of respondents were using cannabis. Increased frequency of cannabis use was statistically associated with higher average pain intensity after controlling for sociodemographic and substance use factors. As individuals continue to use cannabis, researchers should continue to assess frequency of cannabis use within the context of pain.

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