



Cannabis legalization and driving under the influence of cannabis in a national U.S. Sample

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ABSTRACT

The relationship between cannabis legalization and traffic safety remains unclear. Physiological measures of cannabis impairment remain imperfect. This analysis used self-report data to examine the relationship between cannabis legalization and driving under the influence of cannabis (DUIC)¹.

Using a cross-sectional national sample (2016–2017) of 1,249 past-30-day cannabis users, we regressed self-reported DUIC (driving within three hours of “getting high”) on cannabis legalization (recreational and medical (recreational), medical only (medical), or no legal cannabis), adjusting for demographics, days of use (past 30 days), days of use*legal status, calibration weights, and geographic clustering.

The risk of DUIC in recreational (risk ratio [RR] = 0.41, 95% confidence interval (CI):0.23–0.72) and medical (RR = 0.39, 95% CI:0.20–0.79) states was lower than in states without legal cannabis, with one exception. Among frequent cannabis users (≥ 20 days per month), there was a significantly lower risk of DUIC for those living in recreational states (RR = 0.70, 95% CI: 0.49–0.99), but not for those living in medical states (RR = 0.87, 95% CI: 0.60–1.24), compared to users living in states without legal cannabis.

The risk of self-reported DUIC was lower in recreational and medical cannabis states compared to states without legal cannabis. The only exception was for frequent users in medical states, for whom there was no difference in risk compared to frequent users living in states without legal cannabis.

1. Introduction

Cannabis legalization is rapidly spreading throughout the United States (McGinty et al., 2017). In 2010, approximately 27% of Americans lived in states with legal recreational and medical cannabis or medical cannabis only (National Conference of State Legislatures, 2018; United States Census Bureau, 2018). By 2019, this figure had increased to 58% (National Conference of State Legislatures, 2021; The United States Census Bureau, 2019). In this rapidly changing legal environment, cannabis use has shifted. According to the National Survey on Drug Use and Health (NSDUH), for adults, past-month cannabis use increased significantly between 2002 and 2016 among 18-to-25-year-olds (17.3% to 20.8%, $p < 0.05$) and adults 26 years of age and older (4.0% to 7.2%, $p < 0.05$) (SAMHSA, 2017).

Conflicting data on cannabis legalization’s impact on public health has led to a quarrelsome debate regarding the relationship between cannabis use and traffic safety. Driving simulation data suggest that

cannabis use impairs driving ability (Hartman et al., 2015). However, national Fatal Accident Reporting System (FARS) data has produced conflicting results on the effects of cannabis use on traffic safety. While one analysis of 2006–2008 FARS data found no relationship between testing positive for cannabis and traffic fatalities (Romano et al., 2014), an analysis of 2007 data did find a relationship (Li et al., 2013). A third analysis (using 2010–2014 data) found a significant positive relationship between testing positive for cannabis and the severity of the injuries from crashes (Hamzeie et al., 2017).

Research on the effects of cannabis legalization on traffic safety are similarly complex. Although two analyses of FARS data from the 1990 s and 2000 s found fewer traffic fatalities in medical cannabis states (Anderson et al., 2010; Santaella-Tenorio et al., 2017), another analysis (of 1993–2014 data) found no association between medical cannabis legalization and testing positive for THC. The only exception was in states with medical cannabis dispensaries; those states showed an increase in cannabis-positive drivers (Sevigny, 2018). Analyses in two

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¹ DUIC: Driving under the influence of cannabis.

recreational cannabis states, Colorado and Washington, suggest an association between recreational legalization and increases in self-reported driving under the influence of cannabis (DUIC) (Davis et al., 2016), the number of drivers testing positive for THC (Grondel, 2015; Salomonsen-Sautel et al., 2014), and cannabis-related traffic deaths (Salomonsen-Sautel et al., 2014; Wong et al., 2016). Similarly, insurance claims data showed 3% more collisions over time in states that legalized recreational cannabis than in neighboring control states (Highway Loss Data Institute and Insurance Institute for Highway Safety, 2017).

Several reasons exist for variable findings. Many analyses do not account for the influence of substances other than cannabis on driving (Yurasek et al., 2017). In addition, tests for cannabis impairment are limited in terms of their ability to account for frequency or dosage of use, both of which affect impairment while driving (Bondallaz et al., 2016).

Given the limitations of other data sources on DUIC, several studies have examined self-report data. For example, Fink et al. (Fink et al., 2020) combined multiple national data sources to examine changes in the prevalence of self-reported DUIC between 1991 and 1992 and 2012 to 2013. They found an increase in DUIC over time, with a larger increase occurring in states that enacted medical cannabis laws during this time period, compared to states that enacted these laws before or after the analytic time period. Lensch et al. (Lensch et al., 2020) found a higher prevalence of self-reported DUIC in states with legal recreational cannabis sales than states without them. The study also found an interaction between cannabis use and legalization, with frequent users living in recreational states being less likely to report DUIC compared to similar users living in non-recreational states. Benedetti et al. (Benedetti et al., 2021) found nonsignificant differences in the odds of self-reported past-year DUIC across states with recreational, medical, and no legal cannabis.

Although self-reported DUIC has limitations, the literature has established a link between the variable and actual engagement in risky driving behaviors (Bergeron and Paquette, 2014), which have been linked to the risk of being involved in traffic accidents (Bédard et al., 2007; Fergusson et al., 2008; Kilmer et al., 2007; Lopez-Quintero and Neumark, 2010). Validation of the relationship between self-reported and actual cannabis use using roadside studies and bioassays also supports the value of self-reported cannabis-related behaviors like DUIC (Eichelberger and Kelley-Baker, 2020). In addition, the validation of retrospective self-reported use of other impairing substances besides cannabis, such as alcohol, after an accident also lends confidence to the accuracy of self-reported DUIC (Cheripitel et al., 2007).

This analysis used national survey data to examine differences in self-reported DUIC across three legal environments. This analysis contributes to the small body of literature on self-reported DUIC and builds upon the only other study examining self-reported DUIC and both medical and recreational legalization (Benedetti et al., 2021) by accounting for cannabis use frequency, which has been established as an important determinant of this relationship (Lensch et al., 2020). The findings of this analysis are important because they have the potential to inform both medical and recreational cannabis legalization and the content of these laws. This analysis also has the potential to influence resource allocation for efforts to develop more accurate DUIC testing methods and educate the public about DUIC (e.g., through mass media campaigns).

2. Methods

2.1. Sample

Between August 2016 and May 2017, we recruited U.S. households to complete the National Cannabis Climate Survey (NCCS) through two address-based (probability) samples (ABS) and two social media (non-probability) samples. All procedures were approved by the RTI International Institutional Review Board. Recruitment methods have been described elsewhere (Dever, 2018; Dutra et al., 2021). Briefly, the

survey captured cannabis-related knowledge, behaviors, attitudes, and beliefs in states with recreational and medical cannabis (recreational), medical cannabis only (medical), and no legal cannabis (neither), using quotas to sample approximately equally across legal environments. Participants had to be 18 years of age or older and live in the continental United States. We sent out 9,149 survey invitations via ABS sampling and obtained 1,868 valid responses via paper or web. We obtained 11,957 social media responses. After applying fraud detection methods (Dutra et al., 2021), the social media sample totaled 4,779 participants. We restricted the sample to current cannabis users (participants who reported using any type of cannabis one or more days in the past 30 days), resulting in a sample size of 1,398. After dropping participants with missing values and those living in states with single participants in a given strata (Idaho, Nebraska, and Vermont), the analytic sample size was 1,249.

The methods used to weight and validate the survey have been described elsewhere (Dever, 2018; Dutra et al., 2021; Kott, 2019; Ridenhour and Kott, 2018). Briefly, we used calibration weights to calibrate the subsamples to each other (Kott, 2009). To develop the weights, we used observed differences and similarities between the subsamples, the R MatchIt package, and propensity score models. We validated the combined, weighted sample by comparing cannabis use prevalence from our survey to estimates from other surveys (Dutra et al., 2021).

2.2. Measures

2.2.1. Dependent variables

Self-reported DUIC was defined as responding “yes” to “In the past 30 days, have you driven a car within three hours of getting high?” Only participants who reported past-30-day cannabis use received this question. The survey instructed that the term “high” referred to “the effect you got from marijuana.” The item specified three hours because it captures the time period of impairment after cannabis use (Marcotte et al., 2022; Sewell et al., 2009) and accounts for the delayed onset of edibles (Cone et al., 1988).

2.3. Independent variables

2.3.1. State cannabis legal status

The primary independent variable was three-category (recreational and medical, medical only, or neither [reference]) effective cannabis legal status for participant’s self-reported state of residence (Pacula et al., 2014; Pacula et al., 2015) (Supplemental Table 1). To categorize the states, we conducted legal analyses that began with searches within LexisNexis (search criteria: Unanno(cannab! Or marijuana or marihuana /50 medical! Or medicinal! Or recreational! Or (Adult or personal! /5 use)) to identify the ballot initiative or state law that legalized cannabis. Then, we conducted quality control checks on the results of this analysis by comparing our categorization of states with coding from the National Alliance for Model State Drug Laws (NAMSDL) (National Alliance for Model State Drug Laws, 2017), the National Conference of State Legislatures (NCSL) (National Conference of State Legislatures, 2017), and the National Organization for the Reform of Marijuana Laws (NORML) (NORML, 2017).

We matched effective date of medical and recreational laws with the date that each participant’s completed survey was received. For the participant to be counted as covered by a given law, the effective date had to be at least one month prior to the date that the participant’s survey was received (Wen et al., 2015).

Given research establishing the lagged effect of legalization on cannabis use (Wen et al., 2015), we created lagged variables by adding one and two years to the effective date to account for delays in implementation of aspects of legalization, such as dispensaries (Andrews, 2018). Lagging policies is an established method that ensures policy changes precede the outcome variable and allows time for policies to

affect social norms and behavior (Dutra et al., 2017; Song et al., 2015; Wen et al., 2015).

2.4. Cultivation and dispensaries

To further account for variation in the availability of cannabis after legalization, we created variables for cultivation and dispensaries. Because of overlap in allowance in recreational and medical states, we coded both variables as allowed for medical and/or recreational versus neither. We coded these variables by effective date and tested them in the unlagged model and, after lagging them, in the one-year and two-year lagged models.

2.5. Covariates

We tested age in years, gender (male or female [reference]), race/ethnicity (non-Hispanic white [reference], non-Hispanic Black or African American, Hispanic, or non-Hispanic other race), education (high school or GED or less, some college or associate degree [reference], and college graduate or greater), and employment status (employed for wages or self-employed [reference], unemployed, student, homemaker, retired, or unable to work due to disability), poor mental health (≥ 14 days mental health “not good” in the past 30 days versus < 14 days [reference]), and political philosophy (liberal [reference], moderate, conservative, or neither) as covariates. Because of research suggesting a possible relationship between cannabis use and both legalization (Cerdeira et al., 2012) and DUI (Davis et al., 2016), we also tested frequency of cannabis use as a covariate. Frequency was assessed by asking, “During the past 30 days, on how many days did you use any type of marijuana?” Response options included 0 days, 1–2 days, 3–5 days, 6–9 days, 10–19 days, 20–29 days, or all 30 days. We tested this variable both in its original form and dichotomized at the median into above average (20–29 days or all 30 days) or below average (< 20 days) frequency of use.

2.6. Analysis

First, we used descriptive statistics (means, frequencies, and percentages) to examine the characteristics of the overall sample and prevalence of DUI. We used adjusted Wald F-tests to test for differences in other variables by legalization.

We regressed DUI on legalization using a generalized linear model (GLM; family: binomial, link: log) in Stata 15.0 (College Station, TX). We used GLM instead of logistic regression because, at over 30% prevalence for DUI, the rare outcome assumption ($< 10\%$) of the odds ratio was violated (Zou, 2004). Next, we added all demographic variables to the model, all of which we maintained because they improved model fit (as measured by Akaike Information Criterion and Bayesian Information Criterion). We then added cannabis use frequency. Because it was significant, we dichotomized frequency to test interaction terms for frequency and legal status. Because at least one term was significant, we kept the interaction in the model and stratified by cannabis use. We used the Stata “svyset” function to adjust all analyses for clustering by state and for weights.

2.7. Sensitivity analysis

We next tested one and two-year lagged versions of the final model (with the interaction term). We added the cultivation and dispensary variables to the unlagged, one-year lagged, and two-year lagged models.

3. Results

3.1. Overall characteristics of the sample

The weighted prevalence of participants by state legal status was

12.1% in recreational states ($n = 772$), 52.4% in medical only states ($n = 262$), and 35.5% ($n = 215$) in states without legal cannabis. Almost a third of current cannabis users (32.1%, $n = 369$) reported driving within three hours of “getting high” at least once in the past 30 days (Table 1). More than a third of the sample (36.5%, $n = 551$) reported using cannabis on 20 or more days in the past 30 days.

3.2. Bivariate analyses

Bivariate analyses by legalization yielded higher levels of DUI in states without legal cannabis (40.3%, $n = 72$) than in recreational (29.2%, $n = 211$) and medical (27.3%, $n = 86$) states, but this difference was not significant ($p = 0.157$). The prevalence of using cannabis 20 days or more was significantly higher in recreational (55.7%, $n = 379$) than medical (34.6%, $n = 110$) or neither (32.1%, $n = 62$) states. All covariates differed by legalization at $p < 0.100$ except for gender and political philosophy (Table 1).

3.3. Covariate-Adjusted models

3.3.1. Model with interaction terms

The risk of self-reported DUI was significantly lower in recreational (RR = 0.41, 95% CI: 0.23–0.72; Table 2) and medical (RR = 0.39, 95% CI: 0.20–0.79) states than in neither states. More frequent cannabis users had significantly higher risk of DUI (RR = 1.70, 95% CI: 1.08–2.67) than less frequent users, and the interaction for medical legal status and frequent use was significant (RR = 2.23, 95% CI: 1.01–4.91).

3.3.2. Models stratified by frequency of use

In stratified models, less frequent users (< 20 days) in recreational (RR = 0.40, 95% CI: 0.23–0.71; Table 3) or medical (RR = 0.41, 95% CI: 0.22–0.77) states had significantly lower self-reported DUI than less frequent users in neither states. Less frequent Hispanic users (RR = 0.30, 95% CI: 0.15–0.62) had significantly lower risk of self-reported DUI than less frequent non-Hispanic white users. More frequent users living in recreational states were significantly less likely to self-report DUI (RR = 0.70, 95% CI: 0.49–0.99) than more frequent users in neither states. However, more frequent users in medical states did not have a significantly different risk of self-reported DUI (RR = 0.87, 95% CI: 0.60–1.24) compared to more frequent users in neither states.

3.4. Sensitivity analyses

Lagging legalization by one year produced similar effect estimates for both recreational (RR = 0.46, 95% CI: 0.29–0.74) and medical states (RR = 0.31, 95% CI: 0.14–0.68). Lagging legalization two years produced a null result for recreational states (RR = 0.64, 95% CI: 0.37–1.09), but not medical states (RR = 0.50, 95% CI: 0.27–0.90). Cultivation ($p = 0.759$) and dispensaries ($p = 0.686$) were not significant in the unlagged model or in the one-year (cultivation: $p = 0.336$, dispensaries: $p = 0.588$) or two-year lagged models (cultivation: $p = 0.890$, dispensaries: $p = 0.639$).

4. Discussion

Current cannabis users in recreational and medical only cannabis states were significantly less likely to report driving within three hours of getting high in the past 30 days, compared to current users living in states without legal cannabis. The one exception was frequent cannabis users who lived in medical cannabis states. Their risk of DUI did not differ significantly from frequent users living in states without legal cannabis.

One potential explanation for lower prevalence of DUI in legal states is perceived safety of cannabis use, which is associated with DUI and varies by legalization (Borodovsky et al., 2020; Cantor et al., 2021; Wen et al., 2015). In legal states, cannabis users may receive more

Table 1

Demographics Characteristics of Current (Past 30-Day) Cannabis Users in the NCCS (National Data Collected Between September 2016 and May 2017).

State cannabis legal status	Recreational ^a		Medical ^b		Neither ^c		Total		p-value
	(n = 772)		(n = 262)		(n = 215)		(n = 1,249)		
	n	%	n	%	n	%	n	%	
Drove within three hours of getting high in past 30 days									
Yes	211	29.2%	86	27.3%	72	40.3%	369	32.1%	0.157
No	561	70.8%	176	72.7%	143	59.7%	880	67.9%	0.157
Days of cannabis use in past 30 days^d									
0 days	3	0.3%	1	0.4%	6	1.5%	10	0.8%	0.277
1 or 2 days	100	16.4%	32	12.6%	32	10.8%	164	12.4%	0.438
3 to 5 days	71	5.9%	42	28.4%	32	18.2%	145	22.0%	0.008
6 to 9 days	66	7.6%	38	13.7%	37	15.1%	141	13.5%	0.068
10 to 19 days	153	14.1%	39	10.3%	46	21.8%	238	14.9%	0.107
20 to 29 days	101	17.2%	33	9.3%	22	10.9%	156	10.8%	0.269
All 30 days	278	38.5%	77	25.3%	40	21.8%	395	25.7%	0.008
Age									
18–34	298	37.5%	93	48.8%	111	48.8%	502	47.4%	0.152
35–54	272	32.4%	84	26.2%	68	34.1%	424	29.8%	0.519
55+	202	30.1%	85	25.0%	36	17.1%	323	22.8%	0.092
Gender									
Female	558	45.8%	171	48.2%	140	43.3%	869	46.2%	0.861
Male	214	54.2%	91	51.8%	75	56.7%	380	53.8%	0.861
Race									
Non-Hispanic white	628	73.2%	183	50.3%	130	50.9%	941	53.3%	0.004
Non-Hispanic Black	29	4.8%	17	9.7%	19	10.3%	65	9.3%	0.211
Hispanic	68	15.2%	40	13.6%	50	29.2%	158	19.3%	0.014
Non-Hispanic other race	47	6.9%	22	26.3%	16	9.7%	85	18.1%	0.247
Education									
≤ High school degree/GED	162	23.4%	56	43.0%	50	34.4%	268	37.6%	0.057
Some college but no degree/ Associates degree	368	55.1%	138	41.0%	111	47.8%	617	45.1%	0.200
≥ College degree	242	21.5%	68	16.0%	54	17.8%	364	17.3%	0.427
Employment									
Employed	435	52.8%	156	71.3%	125	62.7%	716	66.0%	0.031
Unemployed	32	6.0%	8	4.7%	11	6.4%	51	5.5%	0.870
Student	77	5.1%	26	3.5%	29	9.8%	132	5.9%	0.056
Homemaker	45	6.0%	11	2.9%	13	3.8%	69	3.6%	0.196
Retired	98	20.5%	36	9.8%	15	7.0%	149	10.1%	0.019
Not working due to disability	85	9.6%	25	7.8%	22	10.3%	132	8.9%	0.812
Political philosophy									
Conservative	95	20.1%	34	16.4%	30	19.2%	159	17.9%	0.811
Moderate	176	22.4%	49	35.2%	49	25.7%	274	30.3%	0.500
Liberal	421	48.2%	142	32.8%	105	40.3%	668	37.3%	0.109
No Preference	80	9.4%	37	15.6%	31	14.8%	148	14.5%	0.192
Past 30-day mental health									
Poor <14 days	669	84.4%	236	94.5%	172	84.3%	1,077	89.6%	0.004
Poor 14 or more days	103	15.6%	26	5.5%	43	15.7%	172	10.4%	0.004

Abbreviations: General Educational Development degree (GED).

^a Participants living in states with legal recreational and medical cannabis in effect as of September 1, 2016 (start of data collection), when completing survey.^b Participants living in states with legal medical cannabis only in effect as of September 1, 2016.^c Participants living in states with neither legal recreational nor medical cannabis as of September 1, 2016.^d Based on the median value of 20 days for this categorical variable.

information about the risks of cannabis use from sources like physicians who issue medical cannabis cards or dispensary staff than users living in neither states. Another explanation is differences in labeling requirements. States that have not legalized cannabis cannot regulate the labeling of cannabis products, while many recreational and medical states require warning labels and instructions on products. Some edible cannabis products contain warnings about driving within a few hours of consumption. Another possibility is that current cannabis users in legal states are less likely to self-report DUI. However, given that states with legal medical and recreational cannabis have more positive social norms for cannabis use than states without legal cannabis, and research has linked social norms with DUI (Astons et al., 2016), this scenario seems unlikely.

Among frequent users, we found that the risk of self-reported DUI was lower in recreational states, but not in medical states, compared to neither states. One potential explanation is differential exposure to DUI educational campaigns by legalization. At the beginning of data collection in August 2016, only Colorado, Washington, and California had DUI educational campaigns (Governors Highway Safety Association, 2017). Colorado and Washington were recreational states at the

time, and California voted to legalize recreational cannabis during our data collection. Variation in the regulation of cannabis product labeling across medical and recreational states may also explain differences. Labeling requirements and content vary by state (Klieger et al., 2017).

We were able to locate three studies with similar analyses to ours—one that examined medical cannabis legalization, another that examined recreational cannabis sales, and a third that examined medical and recreational cannabis legalization. Fink et al.'s (Fink et al., 2020) findings varied from ours; Fink et al. found a larger increase in DUI in states that passed medical laws during the analytic time period than those that did not. One difference between Fink et al.'s study and ours is that, unlike Fink et al., we only examined differences by legalization at one time point. Similar to our findings, Lensch et al. (2020) found that daily or almost daily users living in states with legal recreational sales were less likely to report DUI compared to those living in states without legal recreational sales (Lensch et al., 2020). Unlike our analysis, however, Benedetti et al. (Benedetti et al., 2021) found no significant difference in DUI by legalization. This difference is likely due, in part, to Benedetti et al.'s lack of adjustment for frequency of cannabis use and use of past-year DUI, as opposed to past-30-day DUI (Benedetti et al.,

Table 2

Relationship between State Legal Status of Cannabis, Cannabis Use, and the Interaction of Legal Status and Use, and Driving within Three Hours of Getting High in the Past 30 Days in the NCCS (Data Collected between September 2016 and May 2017), n = 1,249^a

	RR	95% CI
State cannabis legal status^b		
Recreational and medical	0.41	[0.23,0.72]
Medical only	0.39	[0.20,0.79]
Neither	REF	REF
Days of cannabis use in the past 30 days^c		
< 20 days	REF	REF
20–30 days	1.70	[1.08,2.67]
Legalization status * Cannabis use		
Recreational * 20–30 days	1.82	[0.94,3.54]
Medical * 20–30 days	2.23	[1.01,4.91]
Neither * < 20 days	REF	REF
Age		
18–34	REF	REF
35–54	0.67	[0.48,0.94]
55+	0.91	[0.50,1.66]
Gender		
Female	REF	REF
Male	1.59	[1.13,2.26]
Race		
White	REF	REF
Non-Hispanic Black	0.82	[0.56,1.21]
Hispanic	0.45	[0.28,0.73]
Non-Hispanic other race	0.50	[0.20,1.22]
Education		
≤ High school degree/GED	REF	REF
Some college but no degree/Associates degree	0.77	[0.51,1.17]
≥ College degree	0.73	[0.47,1.15]
Employment		
Employed	REF	REF
Unemployed	0.64	[0.32,1.31]
Student	1.34	[0.76,2.37]
Homemaker	0.62	[0.30,1.27]
Retired	0.61	[0.32,1.15]
Not working due to disability	0.91	[0.57,1.46]
Political affiliation		
Conservative	0.87	[0.56,1.36]
Moderate	1.07	[0.73,1.59]
Liberal	REF	REF
No preference	0.61	[0.36,1.02]
Past 30-day mental health		
Less than 14 days not good	REF	REF
14 or more days not good	1.15	[0.80,1.65]

Abbreviations: Risk Ratio (RR), Confidence Interval (CI), Reference category (REF), General Educational Development degree (GED).

^a Model specification: negative binomial generalized linear model, adjusted by jackknife weights.

^b State legal status of cannabis in effect in participant’s state of residence for one month or more when the survey was received by study staff.

^c Based on the median value of 20 days for this categorical variable.

2021).

The results of this analysis have several implications for DUI prevention. Our findings suggest that DUI prevention is most needed in states without legalized cannabis. Because regulation of cannabis products in non-legal environments is not possible, mass media campaigns may be a good option for providing education about DUI. Extensive research has established the efficacy of mass media campaigns in affecting behavior and attitudes for the general population and specific subgroups (Crankshaw et al., 2021; Palmgreen et al., 1995; U.S. Department of Health and Human Services, 2014; Wakefield et al., 2010). Our finding for frequent cannabis users also has important implications. In medical states, medical dispensaries could play a larger

Table 3

Relationship between State Legal Status of Cannabis and Driving within Three Hours of Getting High in the Past 30 Days, Stratified by Median Days of Cannabis Used in the Past 30 Days, in the NCCS (Data Collected between September 2016 and May 2017), n = 1,249^a.

	Days of cannabis use in past 30 days			
	< 20 days ^b		20–30 days	
	RR	95% CI	RR	95% CI
State cannabis legal status^c				
Recreational and medical	0.40	[0.23,0.71]	0.70	[0.49,0.99]
Medical only	0.41	[0.22,0.77]	0.87	[0.60,1.24]
Neither	REF	REF	REF	REF
Age				
18–34	REF	REF	REF	REF
35–54	0.66	[0.35,1.27]	0.69	[0.46,1.03]
55+	1.13	[0.47,2.72]	0.58	[0.37,0.91]
Gender				
Female	REF	REF	REF	REF
Male	1.74	[0.93,3.26]	1.49	[1.06,2.10]
Race				
White	REF	REF	REF	REF
Non-Hispanic Black	0.37	[0.12,1.16]	1.11	[0.76,1.62]
Hispanic	0.30	[0.15,0.62]	0.88	[0.50,1.56]
Non-Hispanic other race	0.50	[0.17,1.49]	0.41	[0.12,1.40]
Education				
≤ High school degree/GED	REF	REF	REF	REF
Some college but no degree/Associates degree	0.59	[0.24,1.44]	1.08	[0.69,1.67]
≥ College degree	0.62	[0.27,1.45]	1.09	[0.70,1.70]
Employment				
Employed	REF	REF	REF	REF
Unemployed	0.55	[0.20,1.51]	0.82	[0.43,1.57]
Student	1.77	[0.61,5.10]	1.23	[0.78,1.94]
Homemaker	1.00	[0.33,3.05]	0.33	[0.12,0.92]
Retired	0.62	[0.20,1.96]	0.80	[0.47,1.35]
Not working due to disability	1.02	[0.49,2.10]	0.90	[0.49,1.66]
Political affiliation				
Conservative	0.71	[0.30,1.69]	0.72	[0.46,1.14]
Moderate	0.97	[0.46,2.03]	0.80	[0.56,1.15]
Liberal	REF	REF	REF	REF
No preference	0.82	[0.39,1.76]	0.52	[0.28,0.94]
Past 30-day mental health				
Less than 14 days not good	REF	REF	REF	REF
14 or more days not good	1.62	[0.87,3.00]	1.05	[0.72,1.53]

Abbreviations: Risk Ratio (RR), Confidence Interval (CI), Reference category (REF), General Educational Development degree (GED).

^a Model specification: negative binomial generalized linear model, adjusted by jackknife weights.

^b Based on the median value of 20 days for this categorical variable.

^c State legal status of cannabis in effect in participant’s state of residence for one month or more when the survey was received by study staff.

role in delivering educational information about DUI to heavier medical cannabis users, given that they are likely to frequent these locations (Capler et al., 2017; Haug et al., 2016). In neither states, given the lack of other options for targeting frequent users, mass media campaigns may be the most viable option.

5. Limitations

Self-reported driving while high is an imperfect measure of DUI. However, underreporting of DUI would only bias the relationship between legalization and DUI toward the null, which would increase confidence in our results. Cannabis use was also self-reported and is subject to the same limitations. We were unable to account for the presence of DUI educational campaigns in this analysis because these campaigns were only available in recreational cannabis states during the study period. In addition, we were not able to account for the date of opening of dispensaries; however, we tested the legalization of

dispensaries in unlagged and lagged models. We cannot eliminate the possibility that unmeasured confounders, such as other state-level factors associated with cannabis legalization, explain the differences in self-reported DUI. However, our adjustment for state decreases this possibility. Individual-level confounders, such as a tendency to engage in risky behavior (e.g., use cannabis in non-legal states and DUI), are also a possible explanation for our findings. Lastly, the time period of the data collection is a limitation. However, there is no literature suggesting that the relationship between legalization and DUI has changed as legalization has expanded in the United States.

6. Conclusion

Although all states should educate its citizens about the potential dangers of using cannabis and driving, this analysis suggests that states without legal cannabis are particularly in need of DUI prevention efforts. Our analysis also suggests that frequent users in states with medical legalization or no legal cannabis may be at particular risk for DUI. States should consider mass media campaigns as a method of reaching all cannabis users, including more frequent users, with information about the dangers of DUI. Medical states may consider targeting frequent users by disseminating information about DUI through medical dispensaries. Further research is warranted, particularly given the constantly evolving nature of cannabis legalization and the noted limitations of this analysis.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2022.101799>.

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