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EXAMINING THE RELATIONSHIP BETWEEN THE PHYSICAL AVAILABILITY OF MEDICAL MARIJUANA AND MARIJUANA USE ACROSS FIFTY CALIFORNIA CITIES

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Abstract

Background—The purpose of the current study is to assess statistical associations between individual demographic and personality characteristics, the city-level physical availability of medical marijuana (as measured through densities per roadway mile of storefront dispensaries and delivery services), and the incidence and prevalence of marijuana use.

Method—Individual level data on marijuana use were collected during a telephone survey of 8,853 respondents living in 50 mid-size cities in California. Data on medical marijuana dispensaries and delivery services were obtained via six different websites and official city lists. Three outcome variables pertaining to lifetime, past year use, and frequency of past year use were analyzed using random effects logistic models (for lifetime and past year use) and random effects tobit models (for frequency of past 365-day use).

Results—The current study finds that the total physical availability of medical marijuana through dispensaries and delivery services per roadway mile at the city-level is positively related to current marijuana use and greater frequency of use, controlling for a variety of demographic and personality characteristics. As expected, current physical availability of medical marijuana was unrelated to lifetime use.

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Conflict of Interest No conflict declared.

Conclusions—Regulations on the number and densities of marijuana outlets may be a sufficient means to restrain overall levels of marijuana use within cities. However, alternative use of delivery services may also provide easy access to marijuana and mitigate these effects.

Keywords

medical marijuana dispensaries; marijuana use; cannabis use; marijuana delivery services

1. INTRODUCTION

The use of marijuana to treat medical conditions continues to be a controversial topic across the United States. Under Proposition 215 in 1996, California became the first state to decriminalize marijuana use for medical purposes. Before 2002 there were very few dispensaries operating in California; however that changed with SB 420 (Medical Marijuana Program Act) was enacted in 2003 (Graves, 2011). This legislation developed a program where individuals could voluntary register as medical marijuana patients to make it easier for law enforcement to identify legitimate marijuana use and allowed greater access of medical marijuana through dispensaries but did not create any specific guidelines for regulating them. Regulation was left to local jurisdictions. Despite the political uncertainty and volatile landscape within which policies are being created that allow or prohibit marijuana use for treatment of medical conditions, the number of marijuana dispensaries in California has grown with no documentation of relationships of dispensaries to use.

1.1 State Medical Marijuana Laws and Marijuana Use

The primary concern of public health research has been to ascertain whether the legalization of marijuana use will lead to greater use among more, and particularly younger, people. Several studies have found that marijuana use is higher in states that have passed laws that allow medical use of marijuana for both adults and adolescents (Cerdá et al., 2012; Harper et al., 2012; Khatapoush and Halfors, 2004; Wall et al., 2011). But it appears that populations of these states also had higher rates of marijuana use to begin with and may have perceived use as less risky (Wall et al., 2011). The prevalence of marijuana abuse and dependence did not differ in states with medical marijuana laws among current marijuana users (Cerdá et al., 2012).

Gorman and Huber (2006), using time-series data, found that marijuana use did not increase in response the enactment of legislation allowing for medical use of marijuana among a sample of arrestees in seven cities using two different datasets. In a more extensive state-level study of specific aspects of medical marijuana laws and their impacts on use over time, Pacula et al. (2013) found that states that allowed medical marijuana distribution through dispensaries or home cultivation had higher levels of past month marijuana use estimated from the Youth Behavioral Risk Survey and the National Longitudinal Youth Survey Sample (dispensaries only) and more heavy marijuana use (home cultivation only).

1.2 Local Access and Use

These do not provide the more local information necessary to ascertain how these laws affect access to and use of marijuana within the specific communities and neighborhoods in

which marijuana outlets are located. This information is particularly important in states like California which allow marijuana use for medical purposes but devolve regulatory control of dispensaries to local jurisdictions. As a consequence the range of local regulation of marijuana outlets runs from no regulation, to limits on the number and density of dispensaries, to complete bans on dispensary operations (Freisthler et al., 2013). Uneven access to marijuana at "store front" dispensaries exists depending upon the city in which a person lives. Bans on store front dispensaries have given rise to another form of availability, medical marijuana delivery services. These services enable patients to register on-line with a dispensary to allow marijuana deliveries to the patient's home.

Very little is known at the local level about local access to marijuana through dispensaries and corresponding patterns of use. Estimates indicate that medical marijuana users are primarily male, Caucasian, lower income, have health insurance and are about 40 years of age (Ogborne et al., 2000; Ware et al., 2005; Swift et al., 2005; Reiman, 2007; O'Connell and Bou-Matar, 2007). Importantly, these demographic characteristics do not appear to be different from those of other recreational marijuana users of the drug (Ogborne et al., 2000). Noting that these demographic characteristics are likely to represent "market potentials" for marijuana use, surrogates for marijuana demand, Morrison et al (2014) demonstrate that marijuana dispensaries are more likely to be found in Census block groups.

Psychosocial characteristics of individuals related to marijuana use include impulsivity (Brook et al., 2011; Dougherty et al., 2013) and tolerance of deviance (Brook et al., 2011). The assessment of the individual characteristics in this study allows us to accommodate the wide variety of individual and psychosocial characteristics related to marijuana use. Localities that ban dispensaries outright may have more social capital than those that do not. For example those cities with more collective efficacy (willingness to intervene on behalf of neighbors) may have been more proactive in creating bans or density limits on medical marijuana dispensaries. Social disorder and neighborhood disorganization is related to alcohol and other drug use, in general (Bloomfield and Stock, 2013) and cannabis use, in particular (Furr-Holden et al., 2011).

The current study assesses associations between measures of marijuana use and availability across 50 cities in California by considering availability of medical marijuana through store-front dispensaries and delivery services and relating these to individual self-reports of marijuana use. The assessment of two types of physical availability of medical marijuana allows us to better understand how regulatory practices (e.g., banning dispensaries) may affect marijuana use across jurisdictions.

2. METHODS

A general population telephone survey of 8,790 adults 18 years of age and older was conducted across 50 cities in California. Due to missing data, the final sample size for this study is 8,553 respondents. The cities were selected from 138 cities between 50,000 and 500,000 population. Cities were randomly selected with the restriction that each be separated by at least two unselected city or county areas. A list-assisted stratified random sample of adults 18 years of age or older from households in the 50 cities was surveyed

using a computer-assisted telephone interview. Random digit dialing techniques have been preferred in the past, but are no longer feasible for geographically targeted samples in California. List-assisted samples differ little from samples developed using random digit dialing (Brick et al., 1995; Kempf and Remington, 2007; Tucker et al., 2002). Prospective respondents were sent a pre-announcement letter describing the study and were given the option to opt out by contacting the survey research firm. Surveys were conducted from January 1, 2009 to March 14, 2010 in either English or Spanish and averaged 24 minutes in length. Translation and back-translation to Spanish was conducted by local Spanish speaking respondents well acquainted with Spanish dialects spoken in California.

Respondents gave verbal consent to participate and received no remuneration. The response rate for the survey was calculated to be 48.0% using standard definitions of the American Association of Public Opinion Research (2002). Residential locations of respondents were geocoded to Census block groups using spatial adaptive mask procedures to preclude identification by residential address (Armstrong et al., 1999; Kwan et al., 2004).

Low telephone survey response rates are currently a common problem among social surveys and non-response bias a topic of intense research and debate (Kempf and Remington, 2007). This is a particular problem in general population surveys which sample from large populations of unscreened adults. Partially correcting for potential non-response bias, post-stratification survey weights were constructed in reference to the population of 138 cities based upon population size of persons 18 years of age and older classified by racial and ethnic group membership, gender, and age-groups. Demographic characteristics of the sample well-reflected those of the 50 cities, with 90% of survey weights falling between 0.90 and 1.10. These weights were applied in all of the analyses reported below.

2.1 Measures

Three dependent measures on marijuana use were utilized in the current study: lifetime use, past year use, and frequency of past year use. These measures were constructed based on responses to the following questions: “Have you ever, even once, used marijuana or hashish?” and “On how many days in the past twelve months did you use marijuana or hashish?” These measures have been used previously in the National Survey on Drug Use and Health (Substance Abuse and Mental Health Services Administration, 2005). The second measure provided a dichotomous assessment of whether or not the participant used marijuana in the past year and frequency of past year use.

The key independent measure for the study was the density of the physical availability of medical marijuana through storefront dispensaries and delivery services. Delivery services are an alternative means of availability of medical marijuana. These services can be available in any of the 50 cities, but are the primary source of medical marijuana in cities that do not allow distribution through dispensaries. Data on medical marijuana dispensaries and delivery services were obtained from six different websites (Weedmaps, CANORML, puffpuff411, medicalmarijuanalocators, thcfinders, and Yelp). listing the information for these businesses and official city lists in March – April, 2012. The websites were obtained by conducting a comprehensive search of such databases available on the web and by asking dispensary owners where they advertise their services. Given the flux of locations of

dispensaries in some cities, using a city-level count (as opposed to counts at the Census tract or zip code level) provides greater confidence that we have correctly differentiated between cities with high and low physical availability of medical marijuana. A premise survey of dispensaries in Sacramento, CA (one of the fifty cities in this study) in March, 2013 that visited all locations of dispensaries on these lists found that the on-line data sources were more up-to-date (Lipperman-Kreda et al., 2014). These city lists may not be regularly updated like websites are, but this study is unable to assess potential biases based on one a premise survey in one city.

Three measures of the physical availability of medical marijuana were developed. The first was a measure of total availability creating by summing the number storefront dispensaries and number of delivery services and dividing by roadway mile per city. Roadway miles were chosen (rather than land area or population) because it better approximates how individuals access dispensaries (e.g., they travel to dispensaries via roads, Gruenewald et al., 1996). The remaining two measures assessed each type of availability separately. The correlation between storefront dispensaries and delivery services per roadway mile was relatively low ($\rho = .083$).

Measures of collective efficacy and social disorder were included at the city-level. These items were asked of each survey respondent. Means for each city was created by summing the total for each individual in the city and dividing by the number of respondents for the city. Collective efficacy was measured using three items from the frequency of social exchange scale developed for the Project on Human Development in Chicago Neighborhoods project by Sampson et al. (1999): a) frequency of favors by respondent and neighbors, b) frequency of get togethers or parties with neighbors, and c) visit each other's homes (internal consistency = .76). Five items were selected from the perceived neighborhood disorder scale to measure social disorder. Respondents were asked to rate their neighborhood in terms of assaults and muggings; drug dealing in the open; gangs; heavy traffic; and drug use. Each item was measured on a 3-point Likert-type scale from not a problem to a big problem and summed to create an index of problems.

Covariates include impulsivity, tolerance of deviance, and a variety of demographic variables. Impulsivity was measured using a modified version of Dickman's Dysfunctional Impulsivity Scales (Dickman, 1990). Dysfunctional impulsivity, measured by 7 items, refers to acting rapidly and inaccurately (e.g., I often get into trouble because I don't think before I act). Yes/no responses were summed with higher values indicating higher levels of impulsivity (Cronbach's $\alpha = 0.72$). Tolerance of deviance was assessed using a 4 item scale modified from a version previously used in studies of adolescent and young adult drinkers (Donovan, 1993; Bingham et al., 2006). The four measures asked respondents to rate how wrong they felts it was to commit four individual behaviors (e.g., steal, hit someone) on a Likert-type scale from 1 (not wrong) to 4 (very wrong) (Cronbach's $\alpha = 0.78$).

Demographic control variables included gender, race/ethnicity, age, marital status, education, whether or not the respondent was an immigrant, household income, number of adults in the home and household income. Race/ethnicity was coded into African American, Latino or Hispanic, Caucasian, Asian American, and other. Three categories were used to

denote marital status: single; currently married; and separated, widowed or divorced. Education was recoded to less than high school education, high school diploma, college graduate, and post graduate education. Employment status was measured as being employed full time, being unemployed, or being employed part-time or homemaker. Income categories included less than $20,000, $20,000 – $60,000, $60,000 to $100,000 and greater than $100,000. Demographic control variables were effects coded.

2.2 Statistical approach

Data were analyzed using multilevel logistic random effects models for lifetime and past year marijuana use. These models account for the nested sampling design (individuals within cities) for binary measures. Variables measured at the city level include all three measures of medical marijuana availability (total density, density of storefront dispensaries, density of delivery services) and the two measures of neighborhood structural characteristics (collective efficacy and disorganization). The remaining variables were all measured at the individual level. Data for the outcome variable representing frequency of marijuana use (number of times used in the past 365 days) were analyzed using a multilevel censored (Tobit) random effects model (Greene, 2012). This model was chosen to account for the left censoring of the dependent variable (i.e., no values were below 0 days).

3. RESULTS

Four analysis models are presented in each of three tables corresponding to lifetime, current, and frequency of use. Model 1 presents results examining associations between individual demographic and psychosocial characteristics and city level physical availability of medical marijuana. Model 2 separates effects related to storefront dispensaries and delivery services. Models 3 and 4 provide incorporate two additional city level variables related to collective efficacy and social disorder. On average, 5.4% of survey participants used marijuana per city (Range: 1.1%–19.3%) and a total availability of medical marijuana of .02 per roadway mile (Range: .00–.07). Respondents used marijuana on average 3.02 times per year (Range: 0–365).

3.1 Lifetime Marijuana Use

Due to concerns that the official city lists may not be accurate, we conducted the analyses with and without these lists. The primary results of the paper did not change. This suggests that, at the city level, differences in physical availability of medical marijuana by source of data (web vs. city lists) may not change the relative distribution of medical marijuana availability compared to other cities. None of the measures denoting physical availability of medical marijuana were related to lifetime use of marijuana. Respondents who were white, male, had a high school diploma, college education, or post graduate education, worked full time or were unemployed, had incomes of $20,000 to $60,000, $60,000 to $100,000, or greater than $100,000, and were in the age ranges of 30 to 45 or 46 to 59 were more likely to have used marijuana during their lifetime. Married respondents, Latinos, born outside of the United States, married or separate, widowed, or divorced, and those older than 60 years of age were less likely to have engaged in lifetime marijuana use. Greater impulsivity and tolerance of deviance were also related to greater likelihoods of using marijuana at some

point in the respondent's life. Respondents living in cities with greater values on collective efficacy and social disorder had greater likelihoods of reporting lifetime marijuana use.

3.2 Current Marijuana Use

As shown in Table 2, males, whites, and higher income ($60,000 to $100,000 and greater than $100,000) respondents were more likely to report marijuana use in the past year. Respondents who were married, not born in the United States, and in age groups older than 18 to 29 years were less likely to report use of marijuana in the past year. Respondents reporting greater levels of impulsivity and tolerance of deviance were more likely to report current marijuana use. Collective efficacy and social disorder were positively related to past year marijuana use in Models 3 and 4.

In Models 1 and 3 (i.e., with and without city-level structural characteristics), higher total density of medical marijuana dispensaries was related to greater likelihood of past year use of marijuana. In Model 2, density of delivery services per roadway mile was related to greater likelihood of current marijuana use. When controlling for city-level structural characteristics, this relationship was no longer statistically significant.

3.3 Frequency of current marijuana use

Table 3 presents the results of the Tobit models for frequency of past 365 day marijuana use. Respondents who were male, white, had incomes of $60,001 to $100,000 or greater than $100,000 reported using marijuana more frequently. Married, separated, divorced, or widowed respondents between the ages of 30 and 45, 46 and 60, and greater than 60 years old, or born outside of the United States reported less frequent use of marijuana. Respondents with greater levels of impulsivity and tolerance of deviance were more frequent users of marijuana. In Models 3 and 4, collective efficacy and social disorder were positively related to frequency of marijuana use.

Similar to the models of current use, total density of dispensaries was related to more frequent use of marijuana. Density of delivery services was related to more frequent marijuana use in Model 2. However, when controlling for city-level structural factors, density of storefront dispensaries was positively related to frequency of marijuana use.

4. DISCUSSION

This study advances our understanding of the relationship between the physical availability of medical marijuana by studying the variations in availability within one state that has allowed marijuana for medical use for over 15 years. The total physical availability of medical marijuana was consistently related to current and frequency of marijuana. However, distinguishing between types of physical availability of medical marijuana (e.g., storefront dispensaries and delivery services) resulted in differential relationships to marijuana use not consistent with our original hypotheses.

Higher marijuana use were positively related to having state-level policies allowing marijuana use for medical purposes (Cerdá et al., 2012; Harper et al., 2012; Khatapoush and Halfors, 2004; Wall et al., 2011). States that allow for dispensaries in their legislation had

more marijuana use at the state-level (Pacula et al., 2013). Here total availability of medical marijuana (through dispensaries and delivery services per roadway mile) at the city-level is positively related to current marijuana use and higher frequency of use, but is not related to lifetime use of marijuana in California.

Density of delivery services was related to greater likelihood of current use and more frequent use before city-level structural characteristics were controlled. After controlling for city-level social disorder and efficacy (Model 4), density of storefront dispensaries were positively related to frequency of marijuana use. Density of delivery services was no longer associated with any of the outcomes. This finding may indicate that storefront availability follows a pattern that differs from disorder and efficacy, and that delivery dispensaries are more relevant in certain types of cities.

At the city-level, those jurisdictions with higher levels of collective efficacy and higher levels of social disorder consistently reported higher levels of lifetime, current, and frequent use of marijuana. The results related to social disorder are consistent with previous work (Bloomfield and Stock, 2013). The relationship of collective efficacy to marijuana use conforms to expectations about the roles of wealth (income) in stabilizing neighborhoods and increasing demand for marijuana (Morrison et al., 2013). A word of caution when interpreting these measures: they have been primarily used to describe local neighborhood characteristics and might not accurately depict city-level processes.

Cities with higher levels of medical marijuana availability (regardless of type) had more current marijuana use and more frequent use. In other words, banning or regulating the number and density of storefront dispensaries is not a sufficient means to have lower marijuana use. Greater physical availability is likely to result in more marijuana being available to medical and recreational users alike. These results may be indicative of a supply-demand relationship where dispensaries and delivery services operate in locations with higher demand. This study cannot assess this relationship directly, but does point to future directions for research.

Across all outcomes respondents who were men, white, had higher incomes, higher levels of impulsivity, and tolerance of deviance were more likely to have ever, to currently, and more frequently use marijuana. Those who were Latino, Asian, married, separated, widowed, or divorced (compared to single individuals), and born outside the United States were less likely to have ever, currently, or frequently used marijuana. Those with higher levels of education, employed full time or were unemployed (compared to part time employment or staying at home) were more likely to report lifetime marijuana use. Education and employment were not related to current marijuana use.

Most results for the sociodemographic and personality characteristics were similar across all three outcomes; the results for age differed and show a changing demographic of marijuana use. All age groups over the age of 30 were less likely to report current and more frequent marijuana use compared to 18 to 29 year olds. Thus, the age of current marijuana users falls within the young adult age range. However, age groups 30 to 45 and 46 to 59 years were more likely to report lifetime marijuana use compared to 18 to 29 year olds. The oldest age

category (60 years and older) were less likely than 18 to 29 years to report having used marijuana in their lifetime. These results may help explain why the norms around marijuana use for medicinal or recreational use are changing. More importantly, these results suggest that concerns around access to marijuana by youth populations may be warranted. Further the key demographic of users according to this study are young, white males and those with higher incomes which is not consistent with previous studies of dispensary patients (Ogborne et al., 2000; Ware et al., 2005; Swift et al., 2005; Reiman 2007; O'Connell and Bou-Matar, 2007).

The current study examines marijuana use using a general population survey across fifty cities in California, a state with a patchwork of policies designed to reduce or eliminate availability of medical marijuana through storefront dispensaries. Although this study provides a more nuanced understanding of the role of storefront dispensaries and delivery services on marijuana use, respondents are not asked whether or not they have a doctor's recommendation for marijuana. Thus the more people using and more frequent use of marijuana could be a function of the number of doctor's recommendations for medical marijuana at the city-level.

This study is only able to identify associations between availability and marijuana use. Only by following changing regulations, changing physical availability, and changes in marijuana use over time, can we identify any causal relationships between the physical availability of marijuana and marijuana use. Similarly, this study only examines physical availability as measured by storefront dispensaries and delivery services. We do not include information on places that grow marijuana or social availability through family, friends, and acquaintances or marijuana available through underground sources. Data on location of dispensaries was collected between 1.5–2 years after the survey administration. Thus the numbers of dispensaries and delivery services may not be completely accurate. However, the relative distribution (low vs. high) across cities has remained relatively stable during this period.

Finally, the decline in use of land lines has been well documented (see methods) and thus our findings may not be generalizable to cell phone only household or households without any phones or jurisdictions outside of California. Some populations of people may be less prone to have land lines (e.g., younger populations, poor) also affecting generalizability.

Despite these limitations, our study provides empirical evidence about the relationship between the physical availability of medical marijuana and marijuana use within these cities. As such, it begs the question of whether or not having more dispensaries and delivery services in a jurisdiction increases not only medical use of marijuana, but recreational use as well. The importance of this question cannot be understated as two states (Colorado and Washington) allow marijuana use by recreational users.

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Total physical availability of medical marijuana was related to current use.

Total physical availability of medical marijuana was related to more frequent use.

Alternative use of delivery services may provide easy access to marijuana.

Table 1

Logistic Random Effects Model of Medical Marijuana Availability and Lifetime Marijuana Use (n = 8553)

	Model 1			Model 2			Model 3			Model 4		
Variable Name	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**
Constant	0.009	0.097		0.012	0.097		−1.288	0.296	***	−1.184	0.283	***
Male	0.173	0.019	***	0.171	0.019	***	0.191	0.020	***	0.173	0.019	***
Race/Ethnicity (Comparison: Other)												
African American	0.131	0.077		0.127	0.076		0.146	0.081		0.133	0.077	
Hispanic	−0.156	0.051	**	−0.153	0.050	**	−0.178	0.053	***	−0.162	0.051	**
White	0.255	0.040	***	0.252	0.040	***	0.265	0.043	***	0.239	0.041	***
Asian	−0.432	0.085	***	−0.426	0.085	***	−0.442	0.090	***	−0.399	0.086	***
Education (Comparison: < HS Diploma)												
High School diploma	0.214	0.043	***	0.212	0.042	***	0.231	0.044	***	0.211	0.042	***
College graduate	0.194	0.045	***	0.193	0.045	***	0.206	0.047	***	0.189	0.045	***
Post graduate	0.181	0.047	***	0.180	0.047	***	0.189	0.049	***	0.174	0.047	***
Marital Status (Comparison: Single)												
Married	−0.202	0.027	***	−0.201	0.027	***	−0.217	0.028	***	−0.198	0.027	***
Separated, widowed, or divorced	−0.074	0.030	*	−0.073	0.030	*	−0.077	0.032	*	−0.070	0.030	*
Born outside of the U.S.	−0.490	0.028	***	−0.486	0.027	***	−0.525	0.029	***	−0.483	0.027	***
Number of adults in the household	−0.028	0.022		−0.027	0.022		−0.025	0.023		−0.024	0.022	
Age Groups (Comparison: 18–29 years)												
30–45 years	0.096	0.040	*	0.096	0.040	*	0.103	0.042	*	0.097	0.040	*
46–59 years	0.264	0.039	***	0.262	0.039	***	0.289	0.041	***	0.265	0.039	***
60 years +	−0.239	0.040	***	−0.236	0.040	***	−0.258	0.042	***	−0.233	0.040	***
Employment (Comparison: Part time or homemaker)												
Full time Employment	0.082	0.022	***	0.081	0.022	***	0.090	0.023	***	0.082	0.022	***
Unemployed	0.125	0.038	**	0.124	0.038	**	0.142	0.040	***	0.129	0.038	***
Income Groups (Comparison < $20,000)												
$20,000 – $60,000	0.120	0.026	***	0.118	0.026	***	0.131	0.027	***	0.120	0.026	***
$60,001 – $100,000	0.219	0.030	***	0.216	0.030	***	0.243	0.032	***	0.220	0.030	***
$100,001 +	0.264	0.033	***	0.262	0.032	***	0.294	0.034	***	0.266	0.033	***
Impulsivity	0.054	0.014	***	0.053	0.014	***	0.058	0.014	***	0.053	0.014	***

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	Model 1			Model 2			Model 3			Model 4		
Variable Name	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**
Tolerance of deviance	0.040	0.014	**	0.040	0.014	**	0.042	0.015	**	0.039	0.014	**
Level 2 Variables (City-Level)												
Collective Efficacy							0.246	0.055	***	0.227	0.052	***
Social Disorder							0.166	0.048	***	0.153	0.046	***
Density of Dispensaries (per roadway mile)												
Total dispensaries	0.166	1.142					−0.090	1.204				
Storefront dispensaries				0.640	1.639					0.734	1.644	
Delivery dispensaries				−0.252	1.630					−0.756	1.652	
City-level random effect	0.170	0.018	***	0.057	0.018	**	0.507	0.021	***	0.054	0.018	**

* $p < .05$,

** $p < .01$,

*** $p < .001$

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Table 2

Logistic Random Effects Model of Medical Marijuana Availability and Past 28 Day Marijuana Use (n = 8553)

	Model 1			Model 2			Model 3			Model 4		
Variable Name	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**
Constant	−3.644	0.228	***	−3.167	0.210	***	−5.334	0.547	***	−5.263	0.548	***
Male	0.163	0.043	***	0.143	0.040	***	0.150	0.041	***	0.148	0.041	***
Race/Ethnicity (Comparison: Other)												
African American	−0.205	0.197		−0.185	0.188		−0.177	0.190		−0.171	0.190	
Hispanic	−0.019	0.127		−0.015	0.120		−0.005	0.121		−0.007	0.121	
White	0.462	0.102	***	0.399	0.097	***	0.386	0.099	***	0.382	0.099	***
Asian	−0.247	0.234		−0.221	0.223		−0.200	0.223		−0.191	0.223	
Education (Comparison: < HS Diploma)												
High School diploma	0.144	0.112		0.108	0.104		0.105	0.107		0.105	0.106	
College graduate	0.163	0.117		0.123	0.108		0.111	0.112		0.114	0.111	
Post graduate	0.116	0.122		0.082	0.113		0.059	0.117		0.063	0.116	
Marital Status (Comparison: Single)												
Married	−0.349	0.054	***	−0.303	0.050	***	−0.313	0.051	***	−0.308	0.051	***
Separated, widowed, or divorced	−0.109	0.062		−0.087	0.058		−0.087	0.059		−0.084	0.059	
Born outside of the U.S.	−0.656	0.083	***	−0.611	0.080	***	−0.617	0.081	***	−0.611	0.081	***
Number of adults in the household	−0.098	0.056		−0.090	0.052		−0.086	0.053		−0.087	0.053	
Age Groups (Comparison: 18–29 years)												
30–45 years	−0.338	0.073	***	−0.298	0.068	***	−0.314	0.069	***	−0.310	0.069	***
46–59 years	−0.334	0.070	***	−0.292	0.065	***	−0.298	0.066	***	−0.293	0.066	***
60 years +	−0.812	0.081	***	−0.724	0.076	***	−0.739	0.077	***	−0.731	0.077	***
Employment (Comparison: Part time or homemaker)												
Full time Employment	−0.025	0.048		−0.023	0.045		−0.019	0.046		−0.019	0.045	
Unemployed	0.120	0.072		0.104	0.068		0.115	0.069		0.113	0.068	
Income Groups (Comparison < $20,000)												
$20,000 – $60,000	0.072	0.061		0.066	0.057		0.074	0.058		0.072	0.058	
$60,001 – $100,000	0.166	0.070	*	0.146	0.066	*	0.156	0.067	*	0.154	0.067	*
$100,001 +	0.279	0.072	***	0.243	0.068	***	0.263	0.069	***	0.256	0.070	***
Impulsivity	0.113	0.028	***	0.100	0.026	***	0.105	0.026	***	0.104	0.026	***

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	Model 1			Model 2			Model 3			Model 4		
Variable Name	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**
Tolerance of deviance	0.135	0.028	***	0.116	0.026	***	0.116	0.026	***	0.114	0.026	***
Level 2 Variables (City-Level)												
Collective Efficacy							0.405	0.103	***	0.399	0.104	***
Social Disorder							0.197	0.091	*	0.197	0.091	*
Density of Dispensaries (per roadway mile)												
Total dispensaries	7.283	2.474	***				5.630	2.477	*			
Storefront dispensaries				5.482	3.197					5.458	3.243	
Delivery dispensaries				7.464	3.348	*				5.746	3.623	
City-level random effect	0.937	0.047	***	0.394	0.038	***	0.554	0.040	***	0.499	0.040	***

* $p < .05$,

** $p < .01$,

*** $p < .001$

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Table 3

Tobit Random Effects Model of Medical Marijuana Availability and Frequency of Past 28 Day Marijuana Use (n = 8553)

	Model 1			Model 2			Model 3			Model 4		
Variable Name	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**
Constant	−21.575	1.341	***	−21.606	1.384	***	−34.659	3.374	***	−34.601	3.206	***
Male	1.121	0.261	***	1.118	0.263	***	1.121	0.264	***	1.128	0.245	***
Race/Ethnicity (Comparison: Other)												
African American	−1.502	1.231		−1.503	1.251		−1.414	1.231		−1.420	1.167	
Hispanic	−0.425	0.734		−0.427	0.739		−0.420	0.734		−0.489	0.693	
White	2.366	0.589	***	2.365	0.595	***	2.193	0.596	***	2.156	0.561	***
Asian	−1.250	1.338		−1.264	1.351		−1.027	1.337		−1.006	1.259	
Education (Comparison: < HS Diploma)												
High School diploma	0.663	0.619		0.679	0.625		0.597	0.619		0.586	0.584	
College graduate	0.671	0.653		0.687	0.659		0.558	0.656		0.569	0.619	
Post graduate	0.360	0.688		0.376	0.697		0.182	0.691		0.178	0.652	
Marital Status (Comparison: Single)												
Married	−2.107	0.323	***	−2.104	0.327	***	−2.090	0.327	***	−2.056	0.307	***
Separated, widowed, or divorced	−0.785	0.374	*	−0.783	0.376	*	−0.754	0.378	*	−0.715	0.353	*
Born outside of the U.S.	−3.471	0.464	***	−3.467	0.466	***	−3.419	0.469	***	−3.392	0.445	***
Number of adults in the household	−0.512	0.344		−0.505	0.346		−0.478	0.348		−0.462	0.324	
Age Groups (Comparison: 18–29 years)												
30–45 years	−1.762	0.468	***	−1.775	0.472	***	−1.786	0.474	***	−1.798	0.437	***
46–59 years	−1.658	0.451	***	−1.665	0.455	***	−1.641	0.457	***	−1.678	0.422	***
60 years +	−4.304	0.522	***	−4.312	0.525	***	−4.281	0.526	***	−4.297	0.487	***
Employment (Comparison: Part time or homemaker)												
Full time Employment	−0.312	0.293		−0.306	0.296		−0.291	0.294		−0.272	0.275	
Unemployed	0.524	0.440		0.523	0.444		0.579	0.444		0.587	0.415	
Income Groups (Comparison < $20,000)												
$20,000 – $60,000	0.458	0.361		0.455	0.363		0.489	0.363		0.471	0.341	
$60,001 – $100,000	1.109	0.416	**	1.105	0.422	**	1.158	0.418	***	1.140	0.395	***
$100,001 +	1.574	0.447	***	1.573	0.457	***	1.647	0.448	***	1.618	0.426	***
Impulsivity	0.592	0.179	***	0.595	0.180	***	0.602	0.179	***	0.599	0.167	***

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	Model 1			Model 2			Model 3			Model 4		
Variable Name	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**	**B**	**SE**	**p**
Tolerance of deviance	0.822	0.164	***	0.816	0.165	***	0.784	0.166	***	0.790	0.156	***
Level 2 Variables (City-Level)												
Collective Efficacy							2.546	0.628	***	2.553	0.604	***
Social Disorder							1.479	0.575	*	1.473	0.540	***
Density of Dispensaries (per roadway mile)												
Total dispensaries	3.424	1.185	**				2.801	1.273	*			
Storefront dispensaries				3.173	1.681					3.101	1.554	*
Delivery dispensaries				3.656	1.721	*				2.618	1.742	
City-level random effect	1.940	0.235	***	1.350	0.237	***	0.543	0.237	*	4.416	0.221	***

* p < .05,

** p < .01,

*** p < .001

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