Full length article

Trends in and correlates of medical marijuana use among adults in the United States

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ABSTRACT

Background: Trends in and correlates of medical marijuana use are important to inform ongoing clinical, research, policy, and programmatic efforts. This study assessed trends in and correlates of medical marijuana use among U.S. adults.
Methods: We analyzed data from approximately 147,200 U.S. civilians aged 18 or older who participated in the 2013-2015 National Surveys on Drug Use and Health. Descriptive analyses, multivariable logistic regressions, and zero-truncated native binomial regressions were applied.
Results: Among U.S. adults, the prevalence of medical marijuana use increased from 1.2% in 2013 to 1.6% in 2015 ($p = 0.0007$). After adjusting for covariates, adults residing in medical marijuana states (states with legalized medical marijuana use) were 1.3 times more likely to use marijuana medically in 2015 than in 2013 (adjusted odds ratio (AOR) = 1.3, 95% confidence interval (CI) = 1.03-1.61), and adults in nonmedical marijuana states were 1.4 times more likely to report medical marijuana use in 2015 than in 2013 (AOR = 1.4, 95% CI = 1.05-1.90). Among adults who used marijuana exclusively for medical purposes in the past 12 months, trends in 12-month cannabis use disorders, daily or near daily use, and the number of days of marijuana use remained unchanged during 2013-2015. We identified how correlates of medical marijuana use among adults in medical marijuana states differed from their counterparts in nonmedical marijuana states.
Conclusions: Adults were more likely to use marijuana medically in 2015 than in 2013 in both medical and nonmedical marijuana states. Clinicians need to learn about and address evolving patterns of medical marijuana use in patients.

1. Introduction

Laws and policies related to marijuana use are shifting markedly in the U.S. By 2017, 29 states and the District of Columbia (DC) legalized medical marijuana use and several states and DC had legalized marijuana for nonmedical use (Hasin et al., 2015a, 2016b, 2017; Pacula and Sevigny, 2014; ProCon.org, 2017; Roy-Byrne et al., 2015). Most of the existing research has focused primarily on the impact of marijuana legalization on marijuana use prevalence among adults and youth in states that passed these laws compared to other states (Hasin et al., 2015a, 2015b, 2017; Martins et al., 2016; Pacula and Sevigny, 2014; Pacula et al., 2015; Silins et al., 2014; Wen et al., 2015; Wong and Clarke, 2015). Little is known about trends in medical marijuana use that is recommended by a doctor or other health care professional, especially trends in marijuana used exclusively for medical purposes (hereafter referred to as "medical-only") among U.S. adults.

Marijuana use may help improve symptoms related to some medical conditions and psychiatric disorders (D'Souza and Ranganathan, 2015; Hill, 2015; Whiting et al., 2015).; however, heavy marijuana use is associated with adverse health consequences (e.g., cancer, chronic obstructive pulmonary disease, and heart disease), unemployment, lower income, diminished life satisfaction, and criminal behavior (Schauer et al., 2016; Volkow et al., 2014).

Using state registration data to track trends in registered medical marijuana participation, an earlier study found significant variations by state and within states over time (Fairman, 2016). A recent study found that 17% of marijuana users residing in medical marijuana states reported use for medical purposes (Lin et al., 2016). Recognizing that a physician might recommend medical marijuana use to a patient regardless of their residing state (Chaudhry et al., 2016; ProCon.org, 2017), another recent study reported that 21.2% of medical marijuana users resided in states that had not legalized such use (Compton et al., 2017).

As medical marijuana laws and practices evolve (Fairman, 2016;

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Pacula and Sevigny, 2014; Pacula et al., 2015), it is likely that there will be changes in the prevalence and correlates of medical marijuana use recommended by a doctor or other health care professional among adults in the U.S., in states with legalization of medical marijuana use (hereafter referred to as "medical marijuana states"), and in states without legalization of medical marijuana use (hereafter referred to as "nonmedical marijuana states"). Examining these trends and correlates over 3 years is the main purpose of this study. In addition, because individuals are not always aware of their state's laws, we assessed whether and how self-reported marijuana use recommended by a doctor or other health care professional varied by the actual and the perceived medical marijuana legalization in their residing state. Our results may help inform ongoing marijuana policy discussions, help clinicians provide optimal care for patients using marijuana, and inform future research, public health messages, and programmatic efforts. We addressed the following questions:

1. What are the prevalence of any medical marijuana use and of medical-only marijuana use among adults in each U.S. state? Have there been changes in the prevalence of any medical marijuana use and of medical-only marijuana use among all adults and among adult marijuana users in the U.S.?
2. What are the correlates of any medical marijuana use and medical-only marijuana use among U.S. adults? Is perceived medical marijuana legalization in the residing state associated with any medical marijuana use and medical-only marijuana use? Do the correlates of any medical marijuana use and medical-only marijuana use differ by legalization status of medical marijuana use in the residing state?
3. What are the prevalence and correlates of cannabis use disorders and of marijuana use frequency in the past 12 months among adults who used marijuana only for medical purposes ("medical-only marijuana users") in the U.S.? Do they differ by legalization status of medical marijuana use in their residing state?

2. Methods

2.1. Study population

We examined data from adults aged 18 or older who participated in the 2013-2015 National Surveys on Drug Use and Health (NSDUH), a face-to-face yearly survey conducted by the Substance Abuse and Mental Health Services Administration (SAMHSA). NSDUH provides national and state representative data on marijuana and other substance use and use disorders among the U.S. civilian, non-institutionalized population aged 12 or older (SAMHSA, 2017).

NSDUH employed a state-based design with an independent, multistage area probability sample within each state and the District of Columbia. Data were collected by interviewers during personal visits to households and non-institutional group quarters. The interview averaged about an hour. Audio computer-assisted self-administered interviewing (ACASI) was used, providing respondents with a private, confidential way to record answers. The annual mean weighted response rate for the 2013-2015 NSDUH was 57.9% (2013 NSDUH: 60.2%; 2014 NSDUH: 58.3%; 2015 NSDUH: 55.2%) (SAMHSA, 2017). Details regarding NSDUH methods are provided elsewhere (SAMHSA, 2017).

2.2. Measures

2.2.1. Outcome measures

NSDUH collected whether a respondent resided in a state in which medical marijuana use was legal at the time of the survey interview, a time-dependent variable determined by (1) the respondent's date of interview, (2) the respondent's current state of residence, and (3) an external source (ProCon.org, 2017) containing the most recent list of states with medical marijuana laws along the exact date (mm/dd/yyyy) the law went into effect. If the respondent had moved from one

residence to another within the 12 months prior to the survey interview, NSDUH collected the state in which the respondent lived 12 months previously.

Beginning in 2013, NSDUH respondents who reported using marijuana in the past 12 months (12-month marijuana users) were asked if *any* marijuana use in the past 12 months was recommended by a doctor or other health care professional and if "yes", whether *all* marijuana use in the past 12 months was recommended by a doctor or other health care professional. If users reported that any marijuana use was recommended by a doctor or other health care professional, they were coded as "any medical marijuana use". If users reported that all marijuana use was recommended by a doctor or other health care professional, they were coded as "medical-only marijuana use". NSDUH asked 12-month marijuana users to state the number of days they used marijuana. "Daily or near daily users" were those reporting on average using 5 days + per week, 20 days + per month, or 240 days + in the past 12 months. In addition, NSDUH respondents were queried on whether they thought that medical marijuana use was legal in their residing state (SAMHSA, 2017).

2.2.2. Measures of correlates

Our rationale for examining potential correlates was based on the clinical purposes for this study as well as the existing literature on medical and medical-only marijuana use. To help provide optimal care for patients using marijuana, it is important for clinicians to understand the sociodemographic characteristics (age, sex, race/ethnicity, education, employment status, family income, health insurance, marital status, metropolitan statistical area (MSA), region), health status (self-rated health, the number of past-year emergency room (ER) visits), behavioral health status (major depressive episode (MDE), suicidal ideation, nicotine dependence, alcohol use disorders, cannabis use disorders, cocaine use, heroin use), and specific medical marijuana use factors (residing in a medical marijuana state and perceived medical marijuana legalization in residing state) of their patients who use marijuana medically. Understanding these correlates can help clinicians identify patients at risks for behavioral health problems and develop appropriate treatment plans and intervention strategies. Knowledge of related characteristics can help inform marijuana policy discussions, public health messages, and future research.

In particular, a recent study (Compton et al., 2017) reported that the following marijuana users were less likely to have medical-only marijuana use: users aged 18-29; users residing in non-West regions; users who reported non-fair/poor self-rated health; and users with heavy alcohol use. In contrast, the following marijuana users tended to have medical-only marijuana use: users disabled for work; those without health insurance or with Medicaid; users residing in large MSA; users residing in a state with legalization of medical marijuana use; and users perceiving state legalization of medical marijuana use (Compton et al., 2017). Those who reported medical marijuana use also had more medical problems and psychiatric disorders (Roy-Byrne et al., 2015; D'Souza and Ranganathan, 2015; Hill, 2015; Whiting et al., 2015).

The 2013-2015 NSDUH assessed use of alcohol, tobacco, marijuana, cocaine, and heroin in the past 12 months from all respondents. NSDUH assessed MDE, cannabis use disorders, and alcohol use disorders in the past 12 months based on assessments of individual diagnostic criteria from the DSM-IV (American Psychiatry Association, 1994). Nicotine dependence among cigarette smokers was assessed using the Nicotine Dependence Syndrome Scale (Shiffman et al., 2004). These measures have good validity and reliability (Grucza et al., 2007; Jordan et al., 2008; SAMHSA, 2010). The 2013-2015 NSDUH asked all adult respondents about suicidal ideation: "At any time during the past 12 months, did you seriously think about trying to kill yourself?"

2.3. Statistical analysis

First, we estimated the annual average prevalence of any medical

marijuana use and medical-only marijuana use among adults in the U.S. by state.

Second, we assessed trends in the 12-month prevalence of any medical marijuana use and medical-only marijuana use among all adults and among 12-month adult marijuana users in the U.S. We conducted sensitivity analyses by examining these trends (a) after excluding those who lived in another state 12 months prior to the survey interview and (b) after excluding adult respondents residing in Colorado or Washington State, where recreational marijuana use was legalized in 2012. Bivariate logistic regression models were applied to assess the unadjusted annual prevalence, to test for differences between the 2013 estimate and each estimate during 2014-2015 (using PRED-MARG and PRED_EFF statements in SUDAAN (Bieler et al., 2010; Research Triangle Institute, 2015), 2-sided t test with a significance level of 0.05), and to test p values of beta coefficients of the year variable.

Third, bivariate and multivariable logistic regression models were applied to examine correlates of any medical marijuana use and medical-only marijuana use in the past 12 months among adults in the U.S and correlates of cannabis use disorders and daily or nearly daily marijuana use in the past 12 months among 12-month medical-only marijuana users in the U.S. All analyses above were conducted with SUDAAN software (Research Triangle Institute, 2015).

Fourth, bivariate and multivariable zero-truncated negative binomial regression models were applied to examine factors associated with the number of days of medical-only marijuana use among 12-month medical-only marijuana users in the U.S. Stata (Hilbe, 2007; StataCorp, 2014) was used for a zero-truncated negative binomial regression function.

For the multivariable models above, we examined potential interactions between examined factors, including interactions between residing in medical marijuana states (yes/no) and other covariates. Backward stepwise procedures were applied to remove nonsignificant interactions. Using variance inflation factors, multicollinearity was assessed during modeling and was not found in the final multivariable models. All of the analyses of this study accounted for the complex sample design and sample weights of NSDUH.

3. Results

3.1. Prevalence of any medical and of medical-only marijuana use among adults by state

Based on the 147,200 sampled persons aged 18 or older from the 2013-2015 NSDUH, we estimated the annual average prevalence of any medical and of medical-only marijuana use among adults in the U.S. by state (Fig. 1). Despite state-by-state variations, the prevalence of each was generally much higher in medical marijuana states than nonmedical marijuana states.

3.2. Trend in and correlates of any medical marijuana use among adults

The 12-month prevalence of any medical marijuana use among adults in the U.S. increased by 34.2%, from 1.17% in 2013 to 1.57% in 2015 ($p = 0.0007$; Table 1). Moreover, the 12-month prevalence of any medical marijuana use among 12-month adult marijuana users in the U.S. increased by 23.1%, from 9.32% in 2013 to 11.47% in 2015 ($p = 0.0116$). Appendix Tables 1-2 shows our sensitivity analyses in which we (a) excluded those who lived in another state 12 months prior to the survey interview and (b) excluded adult respondents residing in Colorado or Washington State where recreational marijuana use was legalized in 2012. These results did not differ significantly from the main analysis reported above.

The final multivariable logistic regression pooled model simultaneously tested and identified five significant interactions between the status of residing medical marijuana state and other factors (Table 2). Stratified multivariable logistic regression models by legalization status

of medical marijuana use of the residing state were conducted to help understand differences in correlates of 12-month any medical marijuana use in medical and nonmedical marijuana states.

After adjusting for covariates, adults residing in medical marijuana states were 1.3 times more likely to report any medical marijuana use in 2015 than in 2013 (Table 2: adjusted odds ratios (AOR) = 1.3, 95% confidence interval (CI) = 1.03-1.61). Compared to each corresponding reference group, young age, male, high school or more education, part-time employment, being disabled for work, uninsured, Medicaid beneficiaries, divorced or separated, reporting worse than very good health, having 2 or more 12-month ER visits, having suicidal ideation, cannabis use disorders, and 12-month cocaine use were positively associated with any medical marijuana use. Compared to non-Hispanic whites, Hispanics and non-Hispanic others were less likely to use marijuana medically (AORs = 0.6).

After controlling for covariates, adults residing in nonmedical marijuana states were 1.4 (AOR = 1.4, 95% CI = 1.05-1.90) times more likely to report any medical marijuana use in 2015 than in 2013 (Table 2). While most correlates of medical marijuana use among adults were similar in medical and nonmedical marijuana states, the strengths of some associations differed by the state legalization status of medical marijuana use as indicated by the significant interaction effects identified in the pooled model and presented in the stratified models (Table 2), They reveal five points: (1) Compared to adults residing in nonmetropolitan areas, adults residing in large metropolitan areas of nonmedical marijuana states were more likely (AOR = 1.7, 95% CI = 1.15-2.56) to use marijuana medically than their counterparts of medical marijuana states (AOR = 1.6, 95% CI = 1.13-2.19 vs. AOR = 1.0, 95% CI = 0.76-1.24). (2) compared to adults residing in the Northeast region, adults residing in the West region in medical marijuana states were more likely (AOR = 2.9, 95% CI = 1.47-5.69) to use marijuana medically than their counterparts in nonmedical marijuana states (AOR = 3.3, 95% CI = 2.62-4.26 vs. AOR = 1.1, 95% CI = 0.56-2.02). (3) Compared to adults without MDE, adults with MDE in nonmedical marijuana states were more likely (AOR = 1.8, 95% CI = 1.33-2.94) to use marijuana medically than their counterparts in medical marijuana states (AOR = 1.6, 95% CI = 1.06-2.27 vs. AOR = 0.9, 95% CI = 0.68-1.17). (4) Compared to adults without nicotine dependence, adults with nicotine dependence in nonmedical marijuana states were more likely (AOR = 1.5, 95% CI = 1.05-2.04) to use marijuana medically than their counterparts in medical marijuana states (AOR = 2.3, 95% CI = 1.69-3.12 vs. AOR = 1.5, 95% CI = 1.23-1.88). (5) Compared to adults who perceived no legalization of medical marijuana use in their residing states, adults of medical marijuana states who perceived legalization were more likely (AOR = 3.4, 95% CI = 2.13-5.56) to use marijuana medically than their counterparts in nonmedical marijuana states (AOR = 4.1, 95% CI = 3.20-5.37 vs. AOR = 1.2, 95% CI = 0.80-1.72).

3.3. Trends in and correlates of medical-only marijuana use among adults

The 12-month prevalence of medical-only marijuana use among adults in the U.S. increased by 40.5%, from 0.74% in 2013 to 1.04% in 2015 ($p = 0.0024$) (Table 1). Moreover, the 12-month prevalence of medical-only marijuana use among adult marijuana users increased by 29.6%, from 5.84% in 2013 to 7.57% in 2015 ($p = 0.0179$). Appendix Table 1 shows our sensitivity analyses, in which we excluded those who lived in another state 12 months prior to the survey interview. These results did not differ significantly from the main analysis reported above.

The final multivariable logistic regression pooled model simultaneously tested 4 significant interactions between medical marijuana state residence (yes/no) and other factors (Table 3). Stratified multivariable logistic regression models by state legalization status of medical marijuana use were conducted to help understand differences in correlates of 12-month medical-only marijuana use in medical and

nonmedical marijuana states. After adjusting for covariates, adults residing in medical marijuana states were 1.3 times more likely to report medical-only marijuana use in 2015 than in 2013 (Table 3: AOR = 1.3, 95% CI = 1.03-1.73). In contrast, trends in medical-only marijuana use among adults residing in nonmedical marijuana states remained stable during 2013-2015. Correlates of medical-only marijuana use among adults in medical marijuana states were similar to corresponding correlates of any medical marijuana use, with the following exceptions: marital status, the number of ER visits, and suicidal ideation were not associated with medical-only marijuana use in medical marijuana states. Correlates of medical-only marijuana use among adults in nonmedical marijuana states were similar to the corresponding correlates of any medical marijuana use, with the following exceptions: age, sex, race/ethnicity, marital status, MDE, suicidal ideation, and cocaine use were not associated with medical-only marijuana use in nonmedical marijuana states.

Significant interactions identified in the pooled model and presented in stratified models revealed that the strengths of the following associations of medical-only marijuana use differed by the state legalization status of medical marijuana use (Table 3): (1) Compared to adults residing in the Northeast region, adults residing in the West region in medical marijuana states were more likely (AOR = 4.6, 95% CI = 1.99-14.25) to use marijuana medically-only than their counterparts in nonmedical marijuana states (AOR = 5.1, 95% CI = 3.69-7.04 vs. AOR = 1.1, 95% CI = 0.44-2.99). (2) Compared to adults reporting excellent health, adults reporting good health in medical marijuana states were more likely (AOR = 3.0, 95% CI = 1.63-5.51) to use marijuana medically-only than their counterparts in nonmedical marijuana states (AOR = 1.8, 95% CI = 1.36-2.43 vs. AOR = 0.6, 95% CI = 0.38-1.08). (3) Although MDE was not associated with medical-only marijuana use in both medical and nonmedical marijuana states, its effect sizes differed (AOR = 0.4, 95% CI = 0.18-0.67) between medical and nonmedical marijuana states (AOR = 0.8, 95% CI = 0.57-1.12 vs. AOR = 1.8, 95% CI = 0.93-3.62). (4) Compared to adults who

perceived no legalization of medical marijuana use in their residing states, adults of medical marijuana states who perceived legalization were more likely (AOR = 4.2, 95% CI = 2.01-8.61) to use marijuana medically-only than their counterparts of nonmedical marijuana states (AOR = 5.6, 95% CI = 3.86-8.17 vs. AOR = 1.3, 95% CI = 0.70-2.44).

3.4. Prevalence and correlates of cannabis use disorders, daily or near daily use, and the number of days of marijuana use among medical-only marijuana users

Among adults with medical-only marijuana use, the prevalence of cannabis use disorders was 10.4% (standard error (SE) = 2.06%) in 2013, which was not significantly different from the 10.1% (SE = 1.73%) in 2015; Among those medical-only marijuana users, 53.4% (SE = 4.30%) used marijuana daily or near daily in 2013, which did not significantly differ from the 45.9% (SE = 3.16%) in 2015; and their average number of days of marijuana use was 214.7 days (SE = 12.18 days) in 2013, which was not significantly different from the 191.8 days (SE = 8.64 days) in 2015. However, the annual average number of days of marijuana use during 2013-2015 was approximately 212.8 days (SE = 6.14 days) among those residing in medical marijuana states, which was significantly higher than the 147.8 days (SE = 14.41 days) among those residing in nonmedical marijuana states. Results of multivariable logistic regression models and the zero-truncated negative binomial regression model suggested that, after adjusting for other covariates, trends in cannabis use disorders, daily or near daily use, and the number of days of marijuana use in the past 12 months were unchanged from 2013 to 2015 among 12-month medical-only marijuana users (Table 4). Moreover, our multivariable results showed that, among medical-only marijuana users, residing in a medical marijuana state or not was not associated with their cannabis use disorders and daily or near daily use of marijuana, but was associated with their marijuana use frequency. The frequency of marijuana use among medical-only marijuana users was significantly higher among
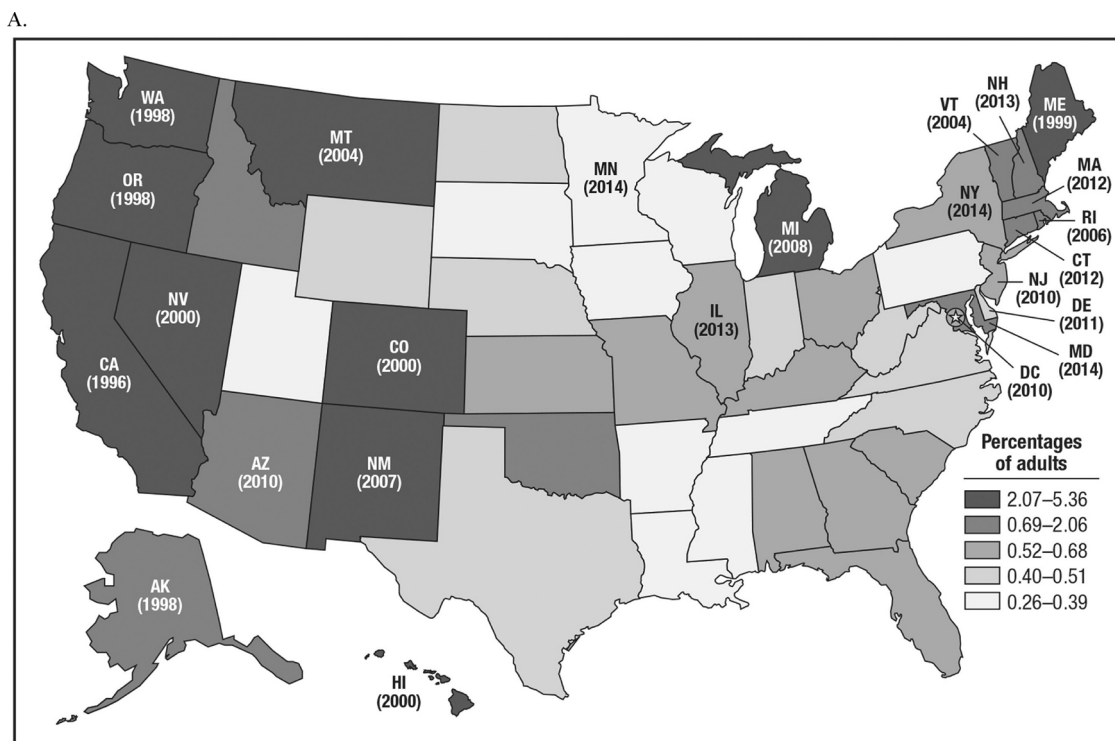
A.

Fig. 1. 12-month prevalence of any marijuana use for medical purposes and 12-month prevalence of medical-only marijuana use among adults aged 18 or older in the U.S. by state. A: 12-month prevalence of any marijuana use for medical purposes among adults aged 18 or older in the U.S. by state, annual average weighted percentage, 2013-2015. Medical marijuana states with years of passage of medical marijuana laws through 2015. B: 12-month prevalence of marijuana use exclusively for medical purposes among adults aged 18 or older in the U.S. by state, annual average weighted percentage, 2013-2015. Medical marijuana states with years of passage of medical marijuana laws through 2015.
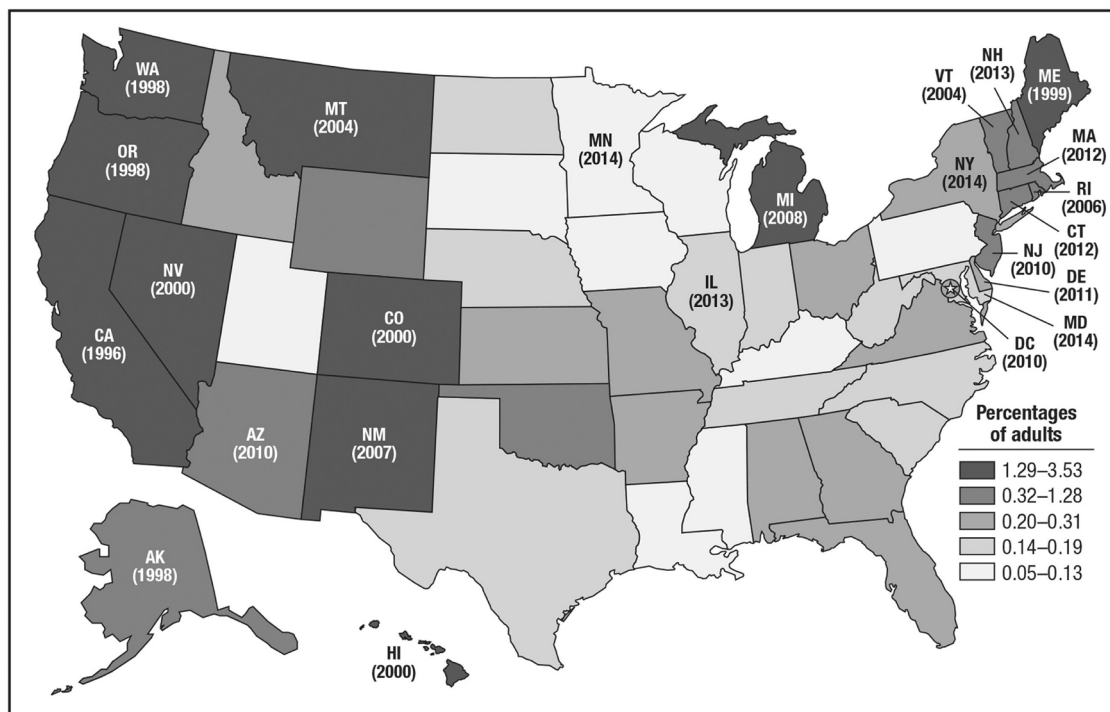
B.

Fig. 1. (*continued*)

Table 1
Trends in the 12-month prevalence of any medical marijuana use and medical-only marijuana use among all adults and among past-year adult marijuana users in the U.S., weighted percentage (standard error), 2013-2015.

12-month prevalence	2013	2014	2015	*p* value for the trend
any medical marijuana use among all adults (n = 147,200)	1.17 (0.07)	1.36 (0.09)	1.57 (0.09) +	0.0007
medical-only marijuana use among all adults (n = 147,200)	0.74 (0.06)	0.87 (0.06)	1.04 (0.08) +	0.0024
any medical marijuana use among adult marijuana users (n = 28,400)	9.32 (0.57)	10.17 (0.53)	11.47 (0.64) +	0.0116
medical-only marijuana use among adult marijuana users (n = 28,400)	5.84 (0.47)	6.55 (0.46)	7.57 (0.57) +	0.0179

Data Source: The 2013-2015 National Surveys on Drug Use and Health. SAMHSA requires that any description of overall sample size based on the restricted-use data files be rounded to the nearest 100 to minimize potential disclosure risk. +: This estimate is statistically significantly different from the estimate in 2013.

those residing in medical marijuana states than those residing in non-medical marijuana states.

Among adult medical-only marijuana users, compared with each corresponding reference group, males, those with 2 ER visits, those residing in the South or West region, those with alcohol use disorders, cocaine use, and those with daily/near daily marijuana use were more likely to have cannabis use disorders; adults with heroin use and adults who initiated marijuana use before age 18 were more likely to use marijuana daily or near daily; divorced or separated adults, heroin users, adults who initiated marijuana use before age 18, and those residing in medical marijuana states used marijuana more frequently. Additionally, Hispanic medical-only marijuana users were less likely to use marijuana daily or near daily than non-Hispanic whites.

4. Discussion

We found significant increases in any medical marijuana use as well as medical-only marijuana use among adults generally and among adult marijuana users during 2013-2015. For example, between 2013 and 2015, medical-only marijuana use increased by 41% among U.S. adults and increased by 30% among U.S. adult marijuana users (though it should be noted that the prevalence of each was generally low, and modest absolute differences produced these large relative changes). Moreover, the prevalence of any medical and of medical-only

marijuana use varied significantly by state, and they were generally higher in medical marijuana states than nonmedical marijuana states. Importantly, even after controlling for covariates, our results suggest that adults were more likely to use marijuana medically in 2015 than in 2013 in both medical and nonmedical marijuana states and were more likely to use marijuana medically-only in 2015 than in 2013 in the U.S. and in medical marijuana states. Non-significant interaction effects between residing in medical marijuana states or not and year on any medical marijuana use and medical-only marijuana use indicate that, although the prevalence of medical and of medical-only marijuana use were higher in medical marijuana states than nonmedical marijuana states, relative changes in medical and medical-only use from 2013 to 2015 were similar in medical and nonmedical marijuana states. Given the increasing medical marijuana use identified during 2013-2015 and the likely continued changes in state laws and policies, clinicians practicing in either medical or nonmedical marijuana states should learn about and address the evolving patterns of medical marijuana use in their patients.

Our results may help clinicians and researchers understand characteristics of adults with medical marijuana use at the national level and in both medical and nonmedical marijuana states. Given that perceived medical marijuana legalization in the residing state is a stronger predictor of any medical marijuana use than the actual legal status of medical marijuana use in the residing state, it may be useful for

Table 2
Trends and other correlates of any medical marijuana use in the past 12 months among adults in U.S. and in states with and without legalized medical marijuana use.

Characteristics	Pooled model In all states of the U.S. N = 147,200 Adjusted odds ratio (95% CI)	In states with legalization of medical marijuana use N1 = 62,400 Adjusted odds ratio (95% CI)	In states without legalization of medical marijuana use N2 = 84,800 Adjusted odds ratio (95% CI)
Year			
2013[+]	1.0	1.0	1.0
2014	1.1 (0.95-1.35)	1.2 (1.00-1.52)	0.9 (0.62-1.17)
2015	**1.3 (1.09-1.56)**	**1.3 (1.03-1.61)**	**1.4 (1.05-1.90)**
Age			
18-29	2.2 (1.73-2.82)	2.0 (1.52-2.70)	2.9 (1.88-4.60)
30-49	**1.8 (1.49-2.27)**	**1.7 (1.34-2.17)**	**2.4 (1.54-3.60)**
≥50[+]	1.0	1.0	1.0
Sex			
Male	1.7 (1.44-1.92)	1.7 (1.42-1.98)	1.6 (1.22-2.13)
Female[+]	1.0	1.0	1.0
Race/ethnicity			
NH white[+]	1.0	1.0	1.0
NH black	0.8 (0.63-1.01)	0.9 (0.65-1.20)	0.7 (0.48-0.97)
Hispanic	0.6 (0.50-0.76)	0.6 (0.47-0.75)	0.7 (0.48-1.16)
NH other	**0.6 (0.46-0.78)**	**0.6 (0.44-0.80)**	**0.7 (0.42-0.99)**
Education			
Less than high school[+]	1.0	1.0	1.0
High school	1.4 (1.11-1.70)	1.5 (1.12-1.87)	1.2 (0.81-1.70)
Some college	1.7 (1.36-2.14)	1.7 (1.30-2.26)	1.7 (1.14-2.47)
College graduate	**1.5 (1.16-2.03)**	**1.5 (1.06-2.04)**	**1.9 (1.20-2.97)**
Employment status			
Full-time employed[+]	1.0	1.0	1.0
Part-time employed	1.3 (1.07-1.60)	1.3 (1.06-1.69)	1.2 (0.83-1.81)
Disabled for work	2.8 (2.19-3.61)	2.9 (2.13-3.86)	2.7 (1.70-4.42)
Unemployed	1.1 (0.89-1.42)	1.2 (0.89-1.52)	1.0 (0.65-1.57)
Family income			
Less than $20,000	1.2 (0.95-1.45)	1.1 (0.83-1.35)	1.6 (1.06-2.36)
$20,000-$49,999	1.2 (0.95-1.39)	1.2 (0.93-1.43)	1.2 (0.79-1.67)
$50,000-$74,999	1.2 (0.92-1.46)	1.1 (0.87-1.46)	1.3 (0.77-2.03)
$75,000 or more[+]	1.0	1.0	1.0
Health insurance			
Private only[+]	1.0	1.0	1.0
No insurance coverage	1.4 (1.13-1.69)	1.4 (1.09-1.77)	1.3 (0.96-1.88)
Medicaid	1.6 (1.31-2.02)	1.7 (1.34-2.19)	1.4 (0.91-2.15)
Other	1.0 (0.79-1.29)	1.0 (0.73-1.30)	1.1 (0.69-1.85)
Marital status			
Married[+]	1.0	1.0	1.0
Widowed	1.5 (0.94-2.31)	1.5 (0.87-2.47)	1.5 (0.64-3.52)
Divorced/Separated	1.5 (1.21-1.89)	1.4 (1.06-1.83)	1.9 (1.28-2.94)
Never married	**1.3 (1.05-1.51)**	1.2 (0.99-1.53)	1.4 (0.99-1.99)
Metropolitan statistical area (MSA)			
Large	1.7 (1.20-2.26)	1.0 (0.76-1.24)∇	1.6 (1.13-2.19)∇
Small	**1.4 (1.02-1.94)**	1.1 (0.79-1.44)	1.4 (0.99-1.88)
Nonmetropolitan[+]	1.0	1.0	1.0
Region			
Northeast[+]	1.0	1.0	1.0
Midwest	0.9 (0.58-1.50)	1.2 (0.91-1.60)	0.9 (0.57-1.48)
South	1.0 (0.65-1.58)	1.4 (0.79-2.51)	1.0 (0.64-1.56)
West	1.2 (0.61-2.17)	3.3 (2.62-4.26)∇	1.1 (0.56-2.02)∇
Self-rated health			
Excellent[+]	1.0	1.0	1.0
Very good	1.0 (0.79-1.16)	1.0 (0.81-1.27)	0.8 (0.53-1.07)
Good	1.6 (1.27-1.88)	1.7 (1.37-2.18)	1.0 (0.71-1.43)
Fair or poor	**2.0 (1.55-2.51)**	**2.0 (1.54-2.69)**	**1.7 (1.06-2.63)**
Number of 12-month emergency room visits			
0[+]	1.0	1.0	1.0
1	1.1 (0.91-1.35)	1.1 (0.91-1.43)	1.1 (0.72-1.43)
2	1.5 (1.18-1.82)	1.5 (1.12-1.89)	1.4 (0.97-2.15)
≥3	**1.4 (1.10-1.82)**	**1.5 (1.06-1.97)**	1.3 (0.83-1.96)
Major depressive episode (MDE)			
Yes	1.7 (1.21-2.43)	0.9 (0.68-1.17)∇	1.6 (1.06-2.27)∇
Unknown	1.4 (0.58-3.42)	1.6 (0.87-2.77)	1.4 (0.57-3.40)
No[+]	1.0	1.0	1.0
Suicidal ideation			
Yes	1.5 (1.18-1.89)	1.4 (1.06-1.95)	1.6 (1.14-2.32)
No[+]	1.0	1.0	1.0
Nicotine dependence (ND)			
Yes	2.2 (1.68-2.92)	1.5 (1.23-1.88)∇	2.3 (1.69-3.12)∇
No[+]	1.0	1.0	1.0
Alcohol use disorders			
Yes	1.2 (0.97-1.43)	1.1 (0.90-1.43)	1.3 (0.92-1.85)
No[+]	1.0	1.0	1.0
Cannabis use disorders			
Yes	4.0 (3.25-5.05)	4.0 (3.09-5.19)	4.4 (2.89-6.61)
No[+]	1.0	1.0	1.0
Cocaine use			
Yes	2.0 (1.60-2.54)	2.2 (1.61-2.77)	1.8 (1.15-2.80)
No[+]	1.0	1.0	1.0
Heroin use			
Yes	0.8 (0.53-1.37)	0.7 (0.38-1.32)	1.4 (0.70-2.62)
No[+]	1.0	1.0	1.0
Residing in a medical marijuana state			
Yes	1.5 (0.78-2.80)		
No[+]	1.0		
Perceived medical marijuana legalization in residing state			
Yes	1.2 (0.82-1.75)	4.1 (3.20-5.37)∇	1.2 (0.80-1.72)∇
Not sure	**0.3 (0.16-0.64)**	**0.4 (0.21-0.85)**	**0.3 (0.16-0.66)**
No[+]	1.0	1.0	1.0
Interaction: Residing in a medical marijuana state & MSA	p = 0.0249		
Interaction: Residing in a medical marijuana state & region	p = 0.0165		
Interaction: Residing in a medical marijuana state & MDE	p = 0.0032		
Interaction: Residing in a medical marijuana state & ND	p = 0.0254		
Interaction: Residing in a medical marijuana state & perceived medical marijuana legalization in a residing state	p < 0.0001		

Data. Source: The 2013-2015 National Surveys on Drug Use and Health.
∇The difference between the two effect sizes was statistically significant at .05 level or lower, which was tested in the final logistic regression pooled model identifying 5 significant interactions. Each **bolded** adjusted odds ratio is significantly different (p < 0.05) from the corresponding reference group (with + sign).

researchers to consider subjects' perceptions about the legal status of marijuana use in their work. Clinicians may also query their patients as to whether they think medical marijuana use is legal in their residing state and about their medical and nonmedical marijuana use. However, because some characteristics varied in specific ways between medical and nonmedical marijuana states, clinicians also may need to take their local legal status of medical marijuana use into account. For instance, any medical marijuana use was more common in large metropolitan than nonmetropolitan areas in nonmedical marijuana states, but no

Table 3
Trends and other correlates of medical-only marijuana use in the past 12 months among adults in all states of the U.S. and in states with or without legalization of medical marijuana use.

Characteristics	In all states of the U.S. N = 147,200 Adjusted odds ratio (95% CI)	In states with legalization of medical marijuana use, N1 = 62,400 Adjusted odds ratio (95% CI)	In states without legalization of medical marijuana use, N2 = 84,800 Adjusted odds ratio (95% CI)
Year			
2013[+]	1.0	1.0	1.0
2014	1.2 (0.92-1.44)	1.2 (0.96-1.58)	0.7 (0.41-1.30)
2015	**1.3 (1.06-1.67)**	**1.3 (1.03-1.73)**	1.4 (0.86-2.23)
Age			
18-29	1.8 (1.36-2.49)	1.8 (1.32-2.57)	1.7 (0.85-3.43)
30-49	**1.9 (1.43-2.39)**	**1.9 (1.41-2.47)**	1.7 (0.89-3.06)
≥50[+]	1.0	1.0	1.0
Sex			
Male	1.7 (1.44-2.09)	1.8 (1.49-2.22)	1.3 (0.79-2.11)
Female[+]	1.0	1.0	1.0
Race/ethnicity			
NH white[+]	1.0	1.0	1.0
NH black	0.9 (0.66-1.27)	1.0 (0.68-1.43)	0.8 (0.41-1.45)
Hispanic	0.6 (0.49-0.82)	0.6 (0.47-0.81)	0.7 (0.33-1.38)
NH other	**0.6 (0.47-0.87)**	**0.6 (0.46-0.90)**	0.6 (0.33-1.15)
Education			
Less than high school[+]	1.0	1.0	1.0
High school	1.6 (1.21-2.16)	1.6 (1.17-2.19)	1.7 (0.77-3.62)
Some college	1.9 (1.42-2.60)	1.8 (1.32-2.57)	2.4 (1.07-5.17)
College graduate	**1.7 (1.16-2.45)**	1.5 (0.96-2.20)	**2.4 (1.56-4.71)**
Employment status			
Full-time employed[+]	1.0	1.0	1.0
Part-time employed	1.5 (1.14-1.93)	1.5 (1.14-1.99)	1.3 (0.56-3.13)
Disabled for work	3.6 (2.63-4.94)	3.4 (2.43-4.75)	4.6 (1.93-11.15)
Unemployed	1.1 (0.84-1.53)	1.2 (0.83-1.60)	1.0 (0.54-2.00)
Family income			
Less than $20,000	1.2 (0.92-1.55)	1.1 (0.82-1.44)	2.2 (1.06-4.34)
$20,000-$49,999	1.2 (0.91-1.49)	1.1 (0.86-1.46)	1.6 (0.86-2.84)
$50,000-$74,999	1.3 (0.98-1.72)	1.2 (0.89-1.62)	2.1 (0.98-4.28)
$75,000 or more[+]	1.0	1.0	1.0
Health insurance			
Private only[+]	1.0	1.0	1.0
No insurance coverage	1.3 (1.02-1.73)	1.4 (1.06-1.88)	1.0 (0.54-1.80)
Medicaid	1.7 (1.31-2.28)	1.8 (1.34-2.44)	1.2 (0.65-2.39)
Other	1.0 (0.70-1.33)	0.9 (0.67-1.34)	1.1 (0.50-2.32)
Marital status			
Married[+]	1.0	1.0	1.0
Widowed	1.4 (0.75-2.50)	1.4 (0.69-2.64)	1.4 (0.37-5.44)
Divorced/Separated	1.4 (1.03-1.77)	1.3 (0.93-1.69)	1.9 (0.91-3.78)
Never married	1.1 (0.90-1.41)	1.1 (0.87-1.41)	1.3 (0.77-2.34)
Metropolitan statistical area			
Large	1.1 (0.83-1.50)	1.0 (0.72-1.40)	1.6 (0.88-2.96)
Small	1.2 (0.86-1.67)	1.1 (0.76-1.66)	1.4 (0.77-2.49)
Nonmetropolitan[+]	1.0	1.0	1.0
Region			
Northeast[+]	1.0	1.0	1.0
Midwest	0.8 (0.34-1.67)	1.7 (1.20-2.44)	0.8 (0.34-1.82)
South	0.9 (0.44-1.95)	0.8 (0.35-1.93)	1.0 (0.46-2.10)
West	1.0 (0.38-2.43)	5.1 (3.69-7.04)∇	1.1 (0.44-2.99)∇
Self-rated health (SRH)			
Excellent[+]	1.0	1.0	1.0
Very good	0.6 (0.32-0.95)	1.0 (0.72-1.25)	0.6 (0.32-0.98)
Good	0.6 (0.36-1.05)	**1.8 (1.36-2.43)∇**	0.6 (0.38-1.08)∇
Fair or poor	1.1 (0.58-2.21)	**2.2 (1.61-3.05)**	1.0 (0.44-2.44)
Number of past-year emergency room visits			
0[+]	1.0	1.0	1.0
1	1.1 (0.82-1.33)	1.1 (0.85-1.43)	0.8 (0.42-1.34)
2	1.2 (0.92-1.63)	1.3 (0.92-1.70)	1.2 (0.51-2.59)
≥3	1.2 (0.87-1.68)	1.2 (0.81-1.75)	1.2 (0.61-2.42)
Major depressive episode (MDE)			

Table 3 (*continued*)

Characteristics	In all states of the U.S. N = 147,200 Adjusted odds ratio (95% CI)	In states with legalization of medical marijuana use, N1 = 62,400 Adjusted odds ratio (95% CI)	In states without legalization of medical marijuana use, N2 = 84,800 Adjusted odds ratio (95% CI)
Yes	2.2 (1.22-4.03)	0.8 (0.57-1.12)∇	1.8 (0.93-3.62)∇
Unknown	1.1 (0.35-3.48)	1.5 (0.77-3.05)	1.0 (0.32-2.84)
No[+]	1.0	1.0	1.0
Suicidal ideation			
Yes	1.3 (0.95-1.84)	1.3 (0.89-1.93)	1.4 (0.77-2.52)
No[+]	1.0	1.0	1.0
Nicotine dependence			
Yes	1.5 (1.18-1.86)	1.4 (1.10-1.82)	2.0 (1.14-3.44)
No[+]	1.0	1.0	1.0
Alcohol use disorders			
Yes	1.1 (0.82-1.41)	1.1 (0.77-1.41)	1.3 (0.70-2.26)
No[+]	1.0	1.0	1.0
Cannabis use disorders			
Yes	3.5 (2.56-4.75)	3.6 (2.56-4.95)	3.4 (1.41-8.32)
No[+]	1.0	1.0	1.0
Cocaine use			
Yes	1.9 (1.34-2.80)	2.0 (1.31-2.95)	1.7 (0.62-4.39)
No[+]	1.0	1.0	1.0
Heroin use			
Yes	0.5 (0.23-1.00)	0.5 (0.21-1.08)	0.6 (0.14-2.82)
No[+]	1.0	1.0	1.0
Residing in a medical marijuana state			
Yes	0.4 (0.16-1.01)		
No[+]	1.0		
Perceived medical marijuana legalization in residing state			
Yes	1.3 (0.71-2.51)	**5.6 (3.86-8.17)∇**	1.3 (0.70-2.44)∇
Not sure	0.4 (0.16-1.14)	**0.4 (0.13-1.24)**	0.4 (0.16-1.15)
No[+]	1.0	**1.0**	1.0
Interaction: Residing in a medical marijuana state & region	p = 0.0011		
Interaction: Residing in a medical marijuana state & SRH	p = 0.0057		
Interaction: Residing in a medical marijuana state & MDE	p = 0.0042		
Interaction: Residing in medical marijuana state & perceived legalization of medical marijuana use in the residing state	p = 0.0013		

DataSource: The 2013-2015 National Surveys on Drug Use and Health.
∇The difference between the two effect sizes was statistically significant at .05 level or lower, which was tested in the final logistic regression pooled model identifying 4 significant interactions. Each bolded adjusted odds ratio is significantly different (p < 0.05) from the corresponding reference group (with + sign).

such association was found for medical marijuana states, suggesting that clinicians in large, urban areas in nonmedical marijuana states may particularly need to attend to issues of medical marijuana use. Similarly, clinicians in nonmedical marijuana states may particularly need to screen for MDE and nicotine dependence when patients report marijuana use for medical purposes. In addition, regardless of the legal status of marijuana use in the residing state, our findings on similar associations between any medical marijuana use and suicidal ideation, cannabis use disorders, and cocaine use suggest increasing needs for clinical screening for behavioral health problems among patients with medical marijuana use.

Table 4

Correlates of cannabis use disorders, daily or near daily use, and the number of days of marijuana use among medical-only marijuana users (N = 1,200).

Characteristics	cannabis use disorders in the past 12 months Adjusted odds ratio (95% CI)	daily or nearly medical-only marijuana use in the past 12 months Adjusted odds ratio (95% CI)	number of days of medical-only marijuana use in the past 12 months Adjusted incidence rate ratio (95% CI)
Year			
2013[+]	1.0	1.0	1.0
2014	1.6 (0.77-3.11)	0.9 (0.54-1.35)	1.0 (0.83-1.12)
2015	1.0 (0.51-1.95)	0.8 (0.49-1.23)	0.9 (0.79-1.09)
Age			
18-29	2.7 (1.00-7.00)	1.6 (0.89-2.99)	1.2 (0.97-1.51)
30-49	1.1 (0.51-2.43)	0.8 (0.48-1.33)	1.0 (0.79-1.19)
≥50[+]	1.0	1.0	1.0
Sex			
Male	4.0 (2.13-7.40)	1.2 (0.84-1.74)	1.1 (0.98-1.28)
Female[+]	1.0	1.0	1.0
Race/ethnicity			
NH white[+]	1.0	1.0	1.0
NH black	1.2 (0.53-2.60)	1.5 (0.78-2.75)	1.2 (0.96-1.47
Hispanic	1.0 (0.54-1.98)	0.6 (0.37-0.95)	) 0.9 (0.74-1.01)
NH other	0.9 (0.42-2.00)	0.7 (0.34-1.32)	1.0 (0.81-1.22)
Education			
Less than high school[+]	1.0	1.0	1.0
High school	1.6 (0.71-3.40)	1.1 (0.63-1.87)	1.0 (0.86-1.25)
Some college	1.8 (0.79-4.16)	1.4 (0.84-2.35)	1.1 (0.92-1.31)
College graduate	2.8 (0.97-8.02)	1.0 (0.54-1.83)	0.9 (0.74-1.15)
Employment status	1.0	1.0	1.0
Full-time employed[+]			
Part-time employed	0.7 (0.30-1.39)	1.0 (0.57-1.62)	1.0 (0.79-1.18)
Disabled for work	1.0 (0.38-2.68)	1.2 (0.64-2.35)	1.0 (0.85-1.30)
Unemployed	2.2 (0.80-5.77)	0.9 (0.45-1.74)	1.0 (0.84-1.20)
Family income			
Less than $20,000	0.5 (0.20-1.17)	1.1 (0.63-2.05)	1.0 (0.79-1.15)
$20,000-$49,999	0.7 (0.32-1.69)	1.0 (0.60-1.71)	1.0 (0.81-1.16)
$50,000-$74,999	0.5 (0.19-1.20)	0.9 (0.49-1.72)	0.9 (0.74-1.18)
$75,000 or more[+]	1.0	1.0	1.0
Health insurance			
Private only[+]	1.0	1.0	1.0
No insurance coverage	1.8 (0.84-3.98)	1.0 (0.63-1.71)	1.1 (0.90-1.23)
Medicaid	1.6 (0.70-3.78)	1.1 (0.66-1.86)	1.0 (0.87-1.20)
Other	0.6 (0.21-1.50)	1.0 (0.54-1.80)	1.0 (0.78-1.22)
Marital status			
Married[+]	1.0	1.0	1.0
Widowed	0.2 (0.05-0.99)	2.0 (0.56-6.93)	1.2 (0.76-1.82)
Divorced/Separated	0.9 (0.42-1.88)	1.6 (0.91-2.74)	1.3 (1.05-1.50)
Never married	0.5 (0.25-1.12)	1.2 (0.75-1.93)	1.1 (0.94-1.28)
Metropolitan statistical area			
Large	0.7 (0.30-1.76)	1.1 (0.69-1.89)	0.9 (0.81-1.11)
Small	0.6 (0.23-1.63)	1.3 (0.75-2.14)	0.9 (0.80-1.11)
Nonmetropolitan +	1.0	1.0	1.0
Region			
Northeast[+]	1.0	1.0	1.0
Midwest	2.7 (0.90-8.04)	1.0 (0.50-2.19)	1.1 (0.84-1.48)
South	7.3 (1.49-36.06)	1.1 (0.38-3.17)	1.2 (0.77-1.84)
West	2.8 (1.04-7.47)	1.6 (0.83-2.92)	1.2 (0.98-1.56)
Self-rated health			
Excellent[+]	1.0	1.0	1.0
Very good	1.1 (0.50-2.36)	1.1 (0.65-1.90)	1.0 (0.85-1.24)
Good	1.0 (0.48-2.10)	1.0 (0.56-1.62)	1.0 (0.79-1.15)
Fair or poor	1.2 (0.44-3.18)	1.0 (0.52-1.88)	1.0 (0.81-1.28)
Number of past-year emergency room visits			
0[+]	1.0	1.0	1.0
1	1.5 (0.77-2.94)	1.0 (0.64-1.60)	1.0 (0.86-1.18)
2	2.6 (1.36-4.80)	0.7 (0.36-1.16)	0.8 (0.64-1.01)
≥3	1.0 (0.38-2.67)	1.0 (0.50-1.99)	1.0 (0.78-1.37)
Major depressive episode (MDE)			
Yes	1.9 (0.81-4.36)	1.0 (0.54-1.74)	1.0 (0.82-1.27)
Unknown	0.3 (0.08-1.49)	0.4 (0.12-1.38)	0.7 (0.39-1.10)
No[+]	1.0	1.0	1.0
Suicidal ideation			
Yes	1.7 (0.79-3.54)	1.2 (0.73-2.06)	1.1 (0.93-1.29)
No[+]	1.0	1.0	1.0
Nicotine dependence			
Yes	0.8 (0.41-1.42)	1.5 (0.97-2.28)	1.1 (0.98-1.30)
No[+]	1.0	1.0	1.0
Alcohol use disorders			

Table 4 (*continued*)

Characteristics	cannabis use disorders in the past 12 months Adjusted odds ratio (95% CI)	daily or nearly medical-only marijuana use in the past 12 months Adjusted odds ratio (95% CI)	number of days of medical-only marijuana use in the past 12 months Adjusted incidence rate ratio (95% CI)
Yes	2.6 (1.51-4.63)	1.0 (0.64-1.60)	1.0 (0.89-1.19)
No[+]	1.0	1.0	1.0
Cocaine use			
Yes	2.9 (1.34-6.18)	0.8 (0.40-1.49)	0.9 (0.74-1.17)
No[+]	1.0	1.0	1.0
Heroin use			
Yes	1.3 (0.12-14.30)	5.5 (1.09-27.90)	1.3 (1.11-1.64)
No[+]	1.0	1.0	1.0
Age of first marijuana use			
< 18	1.3 (0.74-2.42)	1.8 (1.27-2.64)	1.3 (1.13-1.51)
≥18[+]	1.0	1.0	1.0
Daily or near daily marijuana use			
Yes	1.9 (1.08-3.22)		
No[+]	1.0		
Residing in a state with legalization of medical marijuana use			
Yes	1.7 (0.39-7.36)	2.0 (0.89-4.37)	1.4 (1.04-2.01)
No[+]	1.0	1.0	1.0

Data Source: The 2013-2015 National Surveys on Drug Use and Health. CI = confidence interval. Each bolded adjusted odds ratio or adjusted incidence rate ratio is significantly different (p < 0.05) from the corresponding reference group (with + sign).

Among adults who used marijuana exclusively for medical purposes in the past year, our descriptive and multivariable results consistently showed that the prevalence of cannabis use disorders, daily or near daily use of marijuana, and the number of days of marijuana use in the past year remained unchanged between 2013 and 2015 and that the frequency of marijuana use was significantly higher among those residing in medical marijuana states than those residing in nonmedical marijuana states. These results indicate that while the prevalence of medical-only marijuana use increased in the U.S. and in medical marijuana states, the patterns of high-intensity marijuana use remained stable at high levels of intensity among medical-only marijuana users in both medical and nonmedical marijuana states. Given this high frequency of marijuana use and use disorders among medical-only marijuana users, clinicians may need to query marijuana use frequency as well as screen for and address cannabis use disorders in their patients reporting medical-only marijuana use.

This study has several limitations. NSDUH does not cover homeless persons not living in shelters, active-duty military, or those residing in institutions. Moreover, the 2013-2015 NSDUH did not collect relevant medical conditions and psychiatric disorders for which marijuana use may be associated with improvement in related symptoms (D'Souza and Ranganathan, 2015; Hill, 2015; Whiting et al., 2015). Because of the cross-sectional nature of NSDUH data, this study could not establish temporal or causal relationships. For example, this study cannot conclude whether increases in medical marijuana use among adults in both medical and nonmedical marijuana states are caused directly by the increases in states with legalization of medical marijuana use. Although marijuana use based on NSDUH data declined among youth (Han et al., 2017) and increased among adults (Compton et al., 2016), NSDUH response rates declined among youth and adults during this time period. We are not aware of any evidence showing that increases in medical marijuana use were due to the declining NSDUH response rate. Additionally, questions about medical marijuana recommendations are limited and, like other questions in NSDUH, are subject to recall and social-desirability biases.

5. Conclusions

The 12-month prevalence of any medical and of medical-only marijuana use varied significantly by state and were generally much higher in medical marijuana states than nonmedical marijuana states. Adults were more likely to use marijuana medically in 2015 than in

2013 in both medical and nonmedical marijuana states, and adults were more likely to use marijuana medically-only in 2015 than in 2013 in the U.S. and in medical marijuana states. Among adults who used marijuana exclusively for medical purposes, the prevalence of cannabis use disorders and of daily or near daily use as well as the number of days of marijuana use in the past 12 months remained stable from 2013 to 2015, and the frequency of marijuana use was significantly higher among those residing in medical marijuana states than those residing in nonmedical marijuana states. Clinicians are suggested to screen for potential cannabis use disorders as well as co-occurring behavioral health conditions in their patients who report medical marijuana use and reside in either medical or nonmedical marijuana states.

Contributors

Drs. Han and Compton designed the study. Dr. Han completed statistical analyses and originated and drafted the manuscript. All authors contributed to and have approved the final manuscript.

Role of Funding Source

Nothing declared.

Conflict of Interest

Unrelated to the submitted work, Compton reports ownership of stock in General Electric Co., 3 M Co., and Pfizer Inc., and Blanco reports ownership of stock in General Electric Co., Sanofi, and Eli Lilly Inc. Han and Jones have no conflicts to disclose.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.drugalcdep.2018.01.022.

References

American Psychiatry Association, 1994. Diagnostic and Statistical Manual of Mental Disorders, 4th ed. APA, Washington, DC.
Bieler, G.S., Brown, G.G., Williams, R.L., Brogan, D.L., 2010. Estimating model-adjusted risks, risk differences, and risk ratio from complex survey data. Am. J. Epidemiol. 171, 618–623.
Chaudhry, H.J., Hengerer, A.S., Snyder, G.B., 2016. Medical board expectations for physicians recommending marijuana. JAMA 316, 577–578.

D'Souza, D.C., Ranganathan, M., 2015. Medical marijuana: Is the cart before the horse? JAMA 313, 2431–2432.

Compton, W.M., Han, B., Hughes, A., Jones, C.M., Blanco, C., 2017. Use of marijuana for medical purposes among adults in the United States. JAMA 317, 209–211.

Compton, W.M., Han, B., Jones, C.M., Blanco, C., Hughes, A., 2016. Marijuana use and use disorders in adults in the USA, 2002-14: analysis of annual cross-sectional surveys. Lancet Psychiatry 3, 954–964.

Fairman, B.J., 2016. Trends in registered medical marijuana participation across 13 US states and District of Columbia. Drug Alcohol Depend. 159, 72–79.

Grucza, R.A., Abbacchi, A.M., Przybeck, T.R., Gfroerer, J.C., 2007. Discrepancies in estimates of prevalence and correlates of substance use and disorders between two national surveys. Addiction 102, 623–629.

Han, B., Compton, W.M., Jones, C.M., Blanco, C., 2017. Cannabis use and cannabis use disorders among youth in the United States, 2002-2014. J. Clin. Psychiatry 78, 1404–1413. http://dx.doi.org/10.4088/JCP.16m10948.

Hasin, D.S., Wall, M., Keyes, K.M., Cerdá, M., Schulenberg, J., O'Malley, P.M., Galea, S., Pacula, R., Feng, T., 2015a. Medical marijuana laws and adolescent marijuana use in the USA from 1991 to 2014: Results from annual, repeated cross-sectional surveys. Lancet Psychiatry 2, 601–608.

Hasin, D.S., Saha, T.D., Kerridge, B.T., Goldstein, R.B., Chou, S.P., Zhang, H., Jung, J., Pickering, R.P., Ruan, W.J., Smith, S.M., Huang, B., Grant, B.F., 2015b. Prevalence of marijuana use disorders in the United States between 2001-2002 and 2012-2013. JAMA Psychiatry 72, 1235–1242.

Hasin, D.S., Sarvet, A.L., Cerdá, M., Keyes, K.M., Stohl, M., Galea, S., Wall, M.M., 2017. US adult illicit cannabis use, cannabis use disorder, and medical marijuana laws: 1991-1992 to 2012-2013. JAMA Psychiatry 74, 579–588.

Hilbe, J.M., 2007. Negative Binomial Regression. Cambridge University Press, Cambridge, UK.

Hill, K.P., 2015. Medical marijuana for treatment of chronic pain and other medical and psychiatric problems: A clinical review. JAMA 313, 2474–2483.

Jordan, B.K., Karg, R., Batts, K.R., Epstein, J.F., Wiesen, C., 2008. A clinical validation of the National Survey on Drug Use and Health assessment of substance use disorders. Addict. Behav. 33, 782–798.

Lin, L.A., Ilgen, M.A., Jannausch, M., Bohnert, K.M., 2016. Comparing adults how use cannabis medically with those who use recreationally: Results from a national sample. Addict. Behav. 61, 99–103.

Martins, S.S., Mauro, C.M., Santaella-Tenorio, J., Kim, J.H., Cerda, M., Keyes, K.M., Hasin, D.S., Galea, S., Wall, M., 2016. State-level medical marijuana laws, marijuana use and perceived availability of marijuana among the general U.S. population. Drug Alcohol Depend. 169, 26–32.

Pacula, R.L., Powell, D., Heaton, P., Sevigny, E.L., 2015. Assessing the effects of medical marijuana laws on marijuana use: The devil is in the details. J. Pol. Anal. Manage. 34, 7–31.

Pacula, R.L., Sevigny, E.L., 2014. Marijuana liberalization policies: Why we can't learn much from policy still in motion. J. Pol. Anal. Manage. 33, 212–221.

ProCon.org, 2017. 29 Legal Medical Marijuana States and DC. Last updated on April 20, 2017. http://medicalmarijuana.procon.org/view.resource.php?resourceID=000881. Accessed on September 19, 2017.

Roy-Byrne, P., Maynard, C., Bumgardner, K., Krupski, A., Dunn, C., West, I.I., Donovan, D., Atkins, D.C., Ries, R., 2015. Are medical marijuana users different from recreational users?: The view from primary care. Am. J. Addict. 24, 599–606.

Schauer, G.L., King, B.A., Bunnell, R.E., Promoff, G., McAfee, T.A., 2016. Toking, vaping, and eating for health or fun: Marijuana use patterns in adults, U.S., 2014. Am. J. Prev Med. 50, 1–8.

Shiffman, S., Waters, A., Hickcox, M., 2004. The nicotine dependence syndrome scale: a multidimensional measure of nicotine dependence. Nicotine Tob. Res. 6, 327–348.

Silins, E., Horwood, L.J., Patton, G.C., Fergusson, D.M., Olsson, C.A., Hutchinson, D.M., Spry, E., Toumbourou, J.W., Degenhardt, L., Swift, W., Coffey, C., Tait, R.J., Letcher, P., Copeland, J., Mattick, R.P., 2014. Young adult sequelae of adolescent cannabis use: An integrative analysis. Lancet Psychiatry 1, 286–292.

StataCorp, 2014. STATA Statistical Software: Release 13. StataCorp LP, College Station, TX.

Substance Abuse and Mental Health Services Administration, 2017. National Survey on Drug Use and Health. http://www.samhsa.gov/data/population-data-nsduh/reports. Accessedon June 13, 2017.

Substance Abuse, Mental Health Services Administration, 2010. Reliability of key measures in the National Survey on Drug Use and Health (Methodology Series M-8, HHS Publication No. SMA 09-4425). Office of Applied Studies, Rockville, MD.

Research Triangle Institute, 2015. SUDAAN Release 11.0.1. RTI International, Research Triangle Park, NC.

Volkow, N.D., Baler, R.D., Compton, W.M., Weiss, S.R.B., 2014. Adverse health effects of marijuana use: State of the science. N. Eng. J. Med. 370, 2219–2227.

Wen, H., Hockenberry, J.M., Cummings, J.R., 2015. The effect of medical marijuana laws on adolescent and adult use of marijuana, alcohol, and other substances. J. Health Econ. 42, 64–80.

Whiting, P.F., Wolff, R.F., Deshpande, S., Di Nisio, M., Duffy, S., Hernandez, A.V., Keurentjes, J.C., Lang, S., Misso, K., Ryder, S., Schmidlkofer, S., Westwood, M., Kleijnen, J., 2015. Cannabinoids for medical use: A systematic review and meta-analysis. JAMA 313, 2456–2473.

Wong, K., Clarke, C., 2015. The legalization of marijuana in Colorado: The impact. Rockville Mountain High Intensity Drug Trafficking Area 3 (September) http://www.rmhidta.org/html/august%202014%20legalization%20of%20mj%20in%20colorado%20the%20impact.pdf. Accessed on October 31, 2016.