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Medical Marijuana Legalization and Cigarette and Marijuana Co-use in Adolescents and Adults

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Abstract

Background—Medical marijuana legalization is associated with a higher prevalence of marijuana use which may affect cigarette use and nicotine dependence in co-users. In the present study, we examined relationships between statewide legalization of medical marijuana and prevalence of cigarette and marijuana co-use and nicotine dependence in co-using adolescents and adults.

Methods—Data were analyzed from the 2013 National Survey on Drug Use and Health. We compared cigarette and marijuana co-use in the past 30 days across age categories (12–64 years) by statewide medical marijuana legalization. Logistic regression models were used to estimate the odds of having nicotine dependence among current cigarette smokers who also reported past 30-day marijuana use and “ever but not current” marijuana use (vs. “never” use) adjusting for covariates including statewide legalization of medical marijuana.

Results—Overall, 5.1% of the sample reported past 30-day cigarette and marijuana co-use and a higher proportion of co-users resided in states where medical marijuana was legal compared to illegal (5.8% vs. 4.8%; $p=.0011$). Co-use was associated with greater odds of having nicotine dependence compared to cigarette-only use across age categories. Odds were highest and up to 3-

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Contributors

Wang: conceived the study design, conducted data analysis, and prepared and finalized the manuscript

Ramo: gave input on study design, data analysis, and reviewed and revised subsequent drafts of the manuscript

Lisha: gave input on data analysis and reviewed and revised subsequent drafts of the manuscript

Cataldo: discussed original study design and reviewed manuscript drafts

All authors have approved the final draft of the manuscript.

Conflict of Interest

No conflict declared

times higher in adolescents aged 12–17 years (OR=3.54; 95%CI: 1.81–6.92) and adults aged 50–64 years (OR=3.08; CI: 1.45–6.55).

Conclusion—Marijuana policy could inadvertently affect cigarette and marijuana co-use and pose challenges to tobacco cessation.

Keywords

cigarette; marijuana; co-use; medical marijuana legalization; nicotine dependence; tobacco control

1. INTRODUCTION

There is a national trend toward statewide legalization of medical marijuana despite federal classification of marijuana as a Schedule I illicit drug. There are compelling arguments for and against medical marijuana legalization and its potential impact on an array of complex social issues (Bachhuber et al., 2014; Hall and Pacula, 2003; Joffe and Yancy, 2004). Residents in states where medical marijuana is legal are more likely to have tried marijuana, report current marijuana use, and be diagnosed with marijuana abuse or dependence (Cerdá et al., 2012; Wall et al., 2011). Additionally, there is preliminary evidence to suggest that there is likely a dose-response relationship between the number of years since legalization and marijuana prevalence rates (Wang and Cataldo, 2016). A key question regarding more liberal marijuana policies is whether and how they affect use of other drugs (Agrawal et al., 2004; Fergusson et al., 2006; Hall and Lynskey, 2005) including addictive and harmful substances like tobacco.

Previous studies have found a strong positive association between cigarette and marijuana use (Agrawal et al., 2012; Ramo et al., 2012; Schauer et al., 2015). Epidemiologic data indicate that the prevalence of tobacco and marijuana co-use has increased from 2003 to 2012 (Schauer et al., 2015). Moreover, the increase in co-use occurred specifically among those ages 26–34 years, and the greatest percent increase, in those ages 50 years and older (Schauer et al., 2015). It is unknown, however, if this national increase in co-use is directly associated with statewide legalization of medical marijuana. If marijuana policies are indeed associated with co-use, the current trend toward legalization of medical and/or recreational marijuana, without any regulatory action, has the potential to influence patterns of cigarette and marijuana use/co-use over time.

An increase in cigarette and marijuana co-use has the potential to create challenges for cigarette smokers who want to quit. There is evidence to suggest that cigarette and marijuana co-use is associated with greater nicotine dependence (Agrawal et al., 2008; Panlilio et al., 2013; Patton et al., 2005; Ramo et al., 2012; Timberlake et al., 2007; Wang and Cataldo, 2016). Possible explanations for this link include the role of the endocannabinoid system in nicotine metabolism (Peters et al., 2012), genetic predisposition for co-use (Agrawal et al., 2010), and various environmental and cultural influences (Agrawal and Lynskey, 2009; Brook et al., 2010; Creemers et al., 2009). The relationship between co-use and nicotine dependence, however, is understudied in adults, particularly among those ages 50 years and older. Since nicotine dependence is influenced by both nicotinic receptors and nicotine-associated metabolism that change with age (Park et al., 2012), we can expect nicotine

dependence among cigarette and marijuana co-users will also vary over the lifespan. Few studies have examined cigarette and marijuana co-use and nicotine dependence from adolescence through adulthood.

As the nation is well-past the tipping point on medical marijuana legalization, studies are needed to take a closer look into whether marijuana policies have the potential to influence tobacco control efforts at the population level. For example, over time, it is likely that greater access to legal marijuana will increase the absolute number of co-users who have greater nicotine dependence and difficulty quitting cigarettes. Such data can help to identify subset populations at higher risk of nicotine dependence and could have both policy and treatment implications in tobacco control. In this study, we sought to examine relationships between medical marijuana laws and cigarette and marijuana co-use. Additionally, we examined the likelihood of nicotine dependence in co-users. We analyzed data from the 2013 National Survey on Drug Use and Health (NSDUH) and stratified the analysis by age categories. Results from this study can inform the direction of future medical marijuana policies that may inadvertently affect tobacco control efforts.

2. METHODS

2.1. Data source

We analyzed cross-sectional data from the 2013 NSDUH conducted by the Substance Abuse Mental Health Services Administration (SAMHSA). The primary purpose of NSDUH is to measure prevalence and correlates of drug use in the civilian, non-institutionalized U.S. population aged 12 years and older. Since 1991, NSDUH has consisted of an independent multistage area probability sampling design for each state and the District of Columbia and uses a combination of the Computer-Assisted Interviewing and Automated Computer-Assisted Interviewing instruments in selected individuals and households (“dwelling units”). The survey offered \$30 in cash to participants and was conducted in 2013 by Research Triangle Institute (RTI). The final survey consisted of 67,838 CAI interviews with a weighted screening response rate of 84% and an interview response rate of 72%. The public use file consisted of 55,160 records due to a sub-sampling step which included a minimum item response requirement for weighting and further analysis. A detailed description of the questionnaire items, sampling methodology, data collection/ response rates, and sample weights is published elsewhere (Center for Behavioral Health Statistics and Quality, 2014; Research Triangle Institute, 2012). The present study was exempt from the University of California San Francisco’s Human Research Protections Program approval since data were publically available and subjects cannot be identified. In this analysis, only those with complete responses for all measures were included. Additionally, while the analysis included participants aged 50–64 years, those 65 years of age and over were excluded due to a small sample size (only 0.35% of the total 2013 NSDUH sample). The final sample included 51,993 participants.

2.2. Measures

2.2.1. Demographic and other variables—Demographic variables included age, gender, race/ethnicity, and education level. Race/ethnicity categories were Non-Hispanic

White, Hispanic, Black or African-American, Asian, and “Other” which included Native American/ Alaskan Native, Native Hawaiian/ Other Pacific Islander and those who reported more than one race. Education levels were less than high school, high school graduate, some college, and college graduate. Other potential confounding variables on study outcomes included age at first marijuana initiation; age at first cigarette initiation; and given the positive relationship between mental health disorders and substance use, lifetime depression (as told by a doctor or other medical professional; Degenhardt et al., 2001; Grant, 1995).

2.2.2. Statewide legalization of medical marijuana—Statewide legalization of medical marijuana was assessed using the variable “state medical marijuana law status at time of interview” in which respondents were categorized as either residing in a state where marijuana was approved (code=1) or not approved (code=2) for medical use at the time of the interview.

2.2.3. Marijuana and cigarette use—The item “How long has it been since you last used marijuana or hashish?” was used to classify respondents into three categories: “Within the past 30 days” (current marijuana users); “more than 30 days” (ever but not current users); and “never used marijuana” (never users). Current marijuana users reported frequency of past 30-day use [Range = 1–30 days]. Cigarette use was assessed with an item asking whether and how recently participants had smoked “part or all of a cigarette.” Past 30 day users were categorized as current cigarette smokers, other than “within the past 30 days” as former smokers, and “never used cigarettes” as never smokers. Participants were coded as co-users if they had smoked at least one cigarette in the past 30 days and used marijuana in the past 30 days. Respondents who indicated blunt use (marijuana rolled in tobacco leaf) were not included in our analysis since our analysis includes comparison of nicotine dependence in cigarette smokers who use marijuana vs. those who do not marijuana (and blunts contain both tobacco and marijuana).

2.2.4. Nicotine dependence—Nicotine (cigarette) dependence was measured in two ways: the 17-item Nicotine Dependence Syndrome Scale (NDSS; Shiffman et al., 1994) and the single “time to first cigarette” (TTFC) item from the Fagerstrom Test of Nicotine Dependence (Fagerström, 1978; Heatherton et al., 1989). Respondents’ average NDSS scores were calculated over 17 items across five aspects of dependence and current smokers with a cutoff score of 2.75 or above were categorized as nicotine dependent. Those who responded smoking cigarettes in the past month and having their first cigarette of the day within 30 minutes of waking on the TTFC were categorized as nicotine dependent. Additional information on NDSS and TTFC questionnaire items, scoring procedure, and methods used for cutoff scores are published elsewhere (Center for Behavioral Health Statistics and Quality, 2014). We examine both NDSS and TTFC scores to potentially increase the reliability of our findings.

2.3. Analysis

Descriptive statistics are reported for demographics, cigarette and marijuana use, and lifetime depression as well as chi-square tests of differences by statewide medical marijuana legalization status (legal vs. illegal). One-way ANCOVA models tested for differences in

marijuana use and cigarette and marijuana co-use in the overall sample, and separately for each age category, between states where medical marijuana was legal vs. illegal, adjusting for age (in the overall model only), gender, race/ethnicity, education, age at first cigarette initiation, age at first marijuana initiation, and lifetime depression. Additionally, we calculated mean (SE) NDSS and frequency of TTFC (“yes”) scores by statewide legalization categories across age groups. In the overall sample and within each age category, two logistic regression models examined nicotine dependence, as measured by NDSS and TTFC scores, in cigarette and marijuana co-users (12 models total). Models were adjusted for age (in the overall model only), gender, race/ethnicity, education, lifetime depression, and statewide medical marijuana legalization status. Bonferroni adjustments were applied to all models with over five independent variables (Holm, 1979). In this analysis, we used the Taylor series method for replication (re-sampling) methods to estimate sampling errors of estimators based on complex sample designs. The regression coefficient estimators were computed by generalized least squares estimation using element-wise regression. The procedure assumes that the regression coefficients are the same across strata and primarily sampling units (PSUs). All models were run in SAS 9.4 using the SURVEY procedures to obtain weighted estimates to increase the generalizability of the findings (SAS, 2014).

3. RESULTS

3.1. Sample characteristics

The study sample was approximately half male, majority non-Hispanic White (62%), and more than a quarter was college-educated (Table 1). States where medical marijuana was illegal had higher proportions of non-Hispanic Whites and Blacks/ African-Americans and a slightly higher proportion of college graduates. In this analysis, 8.7% (SE=0.2) of the sample reported current marijuana use and 23.3% (SE=0.3) reported current cigarette use. As expected, there was a higher prevalence of current marijuana use in states that have legalized medical marijuana (11.0%) compared to those where medical marijuana was illegal (7.6%; $p < .001$), and this association was stable and significant across age categories, even after adjusting for covariates and applying a Bonferroni’s correction to account for multiple comparisons ($p < .01$) (data not shown). Cigarette use was significantly lower in medical marijuana legal states (20.4%) compared to medical marijuana illegal states (24.7%; $p < .001$).

3.2. Cigarette and marijuana co-use

Overall, 5.1% (SE=0.2) of the sample reported both cigarette and marijuana use in the past 30 days and the prevalence of co-use was higher among those who resided in states where medical marijuana was legal (5.8%; SE=0.3) vs. illegal (4.8%; SE=0.2) ($p = .0011$) (Table 2). Higher prevalence of co-use in states where medical marijuana was legal vs. illegal was stable across age categories from 18–49 years although this association was only statistically significant after adjusting for multiple comparisons among (i) 18–25 year olds (13.3% vs. 10.9%; $p = .0037$) and (ii) 26–34 year olds (9.4% vs. 7.5%; $p = .0093$).

3.3. Nicotine dependence in co-users

In current cigarette smokers, 30% reported marijuana use in the past 30 days. Compared to cigarette smokers who reported never using marijuana, co-users were more likely to have nicotine dependence according to both their NDSS (OR=1.87; 95% CI 1.47–2.39) and TTFC (OR=1.43; CI: 1.20–1.71) scores (Table 3). According to participants' NDSS scores, the odds of having nicotine dependence was higher in co-users across all age categories and this association was significant after adjusting for Bonferroni's correction among 12–17 year olds (OR=3.54; CI: 1.47–2.39); 18–25 year olds (OR=1.42; CI: 1.14–1.77); and 50–64 year olds (OR=3.08; CI: 1.45–6.55). TTFC, the odds ratio of having nicotine dependence were higher only in adult co-users but after accounting for multiple comparisons this was significant in 50–64 year olds. Overall, in cigarette smokers who reported ever but not current marijuana use, the odds of having nicotine dependence were greater among those who never used marijuana and lower among current marijuana users: (i) NDSS, OR=1.76; CI: 1.41–2.19 and (ii) TTFC, OR=1.17; CI: 0.98–1.40. However, overlapping confidence intervals indicate further study is needed to elucidate these findings. In these models we accounted for statewide legalization of medical marijuana and additional analyses indicated no significant differences in NDSS or TTFC scores overall or across age categories by statewide legalization of medical marijuana (see supplemental table¹).

4. DISCUSSION

Findings indicate an association between statewide legalization of medical marijuana and cigarette and marijuana co-use despite lower cigarette prevalence in states where medical marijuana was legal. Co-use was particularly robust among 18–34 year olds. Overall, co-users were more likely to be nicotine dependent compared to those who did not use marijuana, and 12–17 year old adolescent and 50–64 year old adult co-users were 3-times more likely to have nicotine dependence (compared to cigarette smokers who have never used marijuana). These data suggest that medical marijuana legalization could inadvertently affect prevalence of co-use, which is linked to greater nicotine dependence, and the potential to create more barriers to smoking cessation (Baker et al., 2007; Piper et al., 2008). As more states pass marijuana laws, and the legal marijuana industry is poised to cultivate a landscape of greater access and exposure to marijuana (Barry et al., 2014), it is recommended that stakeholders in tobacco control prepare for any unintended effects on tobacco use including the possibility of tobacco initiation/ reinitiation among former smokers and greater nicotine dependence in current smokers (Agrawal et al., 2008; Panlilio et al., 2013; Patton et al., 2005; Timberlake et al., 2007; Wang and Cataldo, 2016). Longitudinal research is needed to evaluate the effect of state marijuana policy on tobacco use and marijuana and tobacco co-use.

Co-use was higher and cigarette prevalence was lower in states where medical marijuana was legal. Given the nationwide increase in co-use (Schauer et al., 2015), there may be uptake of marijuana use among cigarette users as states, change their marijuana policies and cigarettes smokers gain greater exposure and access to legal marijuana. It is possible that

¹Supplementary material can be found by accessing the online version of this paper at <http://dx.doi.org> and by entering doi:...

medical marijuana may be providing cigarette smokers with an alternative to tobacco especially as the stigma associated with tobacco continues to rise (Berg et al., 2015; Lloyd Johnston et al., 2010) and the perceived harmfulness of marijuana decreases with legalization (Schuermeyer et al., 2014). Further, it might be perceived that the effects of marijuana can curb nicotine cravings and withdrawal symptoms to aid in smoking cessation (Le Foll et al., 2008). Finally, alternative tobacco products such as electronic nicotine delivery systems, which are commonly promoted as cessation aids and “safe” alternatives to smoking cigarettes (Grana et al., 2014; Grana and Ling, 2014), might also promote use of marijuana and THC oil with vaporizers (Budney et al., 2015, 2007). Co-use should therefore be monitored over time and examined in response to changes in marijuana policies that will further propel industry promotion of co-use and vaping.

As expected, the prevalence of cigarette and marijuana co-use differed according to age. The positive association between medical marijuana legalization and co-use was greatest among 18–34 year olds. Previous studies with adolescents have reported greater prevalence but no increase in marijuana use or changes in permissive attitudes in states where medical marijuana was legal (Choo et al., 2014; Hasin et al., 2015; Lynne-Landsman et al., 2013; Schmidt et al. 2016), suggesting that greater marijuana use, and therefore greater co-use, preceded medical marijuana legalization. However, most published studies have focused only on adolescents under the age of 18 years and do not reflect the adult population to which medical marijuana policies apply (since most states limit medical marijuana to those ages 18 years and over). Therefore, long-term longitudinal studies are needed to monitor the effects of marijuana legalization, marijuana initiation/ re-initiation, cigarette initiation/ re-initiation, and patterns of co-use across all age categories. Additionally, it is recommended that such studies take into account statewide variables including number of years since the policy went into effect to adequately capture any measurable changes. These data are needed to explore the growing evidence and public health concerns about the potential “gateway” effect of marijuana on cigarette initiation and nicotine dependence in adolescents and young adults (Agrawal et al., 2008; Humfleet and Haas, 2004; Panlilio et al., 2013; Patton et al., 2005) in addition to the potential for re-initiation of cigarettes among former tobacco users.

As more states pass marijuana policies, potential increases in co-use could have important treatment implications. Cigarette smokers who also reported current marijuana use were more likely to have nicotine dependence, which is a known predictor of smoking and quitting behavior (Baker et al., 2007; Piper et al., 2008; Shiffman et al., 2004; Sterling et al., 2009). The positive link between co-use and nicotine dependence was observed across age categories but these associations differed across measures of dependence (NDSS vs. TTFC). We analyzed both NDSS and TTFC. NDSS scores might have been a better measure of nicotine dependence in our comparison across age groups since the scale addresses five aspects of dependence (i.e., smoking drive, nicotine tolerance, continuous smoking, behavioral priority, and stereotypy; Center for Behavioral Health Statistics and Quality, 2014). In comparison, the TTFC single-item scores might not have captured dependency, particularly in adolescent and young adult populations, who have yet to become regular and established smokers. Other studies have shown problems in using TTFC as a measure of dependence in young adults (Ramo et al., 2011). Since our analysis included both adolescents and adults, we report both NDSS and TTFC measures of nicotine dependence.

In addition, in the present study, cigarette smokers who reported ever but not current marijuana use were at greater risk of having nicotine dependence compared to never marijuana users. This finding supports that the effect of THC exposure on nicotine receptors may be irreversible (Panlilio et al., 2013). Studies are needed to further examine both short-term and possibly even the long-term effects of THC and nicotine exposure on nicotine dependence and tobacco cessation.

In this analysis, 12–17 year old adolescent and 50–64 year old cigarette and marijuana co-users had the highest odds of having nicotine dependence. These findings support previous studies linking co-use and nicotine dependence in adolescents and young adults (Ramo and Prochaska, 2012; Ramo et al., 2013, 2012) and add to preliminary data that this association was also stable in adults (Wang and Cataldo, 2016) and, surprisingly, particularly robust in 50–64 year old adults. These findings reflect evidence of a U-shaped effect between age and nicotine dependence which peaks at age 50 years due to changes in nicotinic receptors and nicotine-associated metabolism with age (Park et al., 2012), and suggest that this relationship was stable among co-users. Studies are needed to determine the extent to which THC exposure and/or current marijuana use add to this effect (if at all). Additionally, 50–64 year olds may represent a unique birth cohort who spent their formative years during the 1960's and 1970's with minimal tobacco regulations (Cataldo and Malone, 2008) coupled with a counterculture that promoted marijuana use among a large population (Colliver et al., 2006). More studies on the Baby Boomer generation, specifically, their perceptions about marijuana, current marijuana use including purpose of use (medicinal vs. recreational), modality, cigarette co-use, and health outcomes could provide a glimpse into the future as continued legalization will likely influence social norms across the general population (Khatapoush and Hallfors, 2004). As more states adopt liberal marijuana policies, more studies are needed to understand co-use including the relationship between THC and nicotine in addition to other individual-level factors such as genetics and personality traits that might influence dependence and cessation (Peters et al., 2012).

We found higher percentages of non-Hispanic Whites and Blacks/ African-Americans (and lower percentages of other race/ ethnicity categories) in states where medical marijuana was illegal. In this study, these results may be attenuated since our analysis comparing nicotine dependence depended on exclusion of blunt use. The American Civil Liberties Union report data from the NSDUH and Uniform Crime Reporting Data (United States) showing that Black males were no more likely to report marijuana use, but 4-times more likely to be incarcerated for marijuana possession compared to their non-Hispanic White male counterparts (ACLU, 2013). Epidemiologic data have shown a linear increase in cigarette and marijuana co-use in Whites, Blacks/ African-Americans, and Hispanics with the fastest rate of increase among Blacks/ African-Americans (Schauer et al., 2015). Among Blacks/ African-Americans, it is possible that statewide legalization of medical marijuana could help to reduce marijuana-related incarcerations, and at the same time, influence the rate of co-use. We are cognizant of the many layers that add to the complexities around the issue of marijuana legalization that are well beyond the scope of our study. We recommend future research will assess potential and actual benefits/ costs of marijuana legalization to society at large, and in states where marijuana is legal, identify issues that can be addressed with specific regulatory measures (rather than taking an “all or nothing” approach).

Study limitations include the cross sectional nature of these analyses which limits our ability to infer causality. Interpretation of our findings is limited to cigarette smokers which is distinct from those who reported other tobacco products (e.g., cigars, smokeless, hookah). We were unable to examine statewide legalization of medical marijuana by the number of years the policy went into effect using the NSDUH to account for time lags from adoption to full implementation. The NSDUH public dataset only provides a binary categorization of states that were legal vs. illegal that lumps states that just passed the law (< 1 year) with long-term legalization states (> 10 years) limits our ability to detect long-term effects and may have attenuated our findings. Further study is needed to examine the effect of combusted vs. non-combusted marijuana use on nicotine given increasing prevalence of edible and aerosolized delivery of marijuana with vaporizers (Budney et al., 2015). At present, the NSDUH does not ask respondents to indicate whether use was combusted and/or non-combusted and we recommend that future surveys collect information on marijuana modality to elucidate the relationship between various forms of marijuana intake and nicotine and/or THC dependence. Data on combusted vs. non-combusted THC intake can also help to identify if there might be differences in health effects across marijuana use modality. In addition, the present study did not examine population density (i.e. rural, suburban, or urban community) which might be a potential covariate for marijuana use. Strengths of the study were use of a large national dataset representative of the U.S. population and internal validity of nicotine dependence comparisons across age categories using the same dataset, which eliminates methodological variations from one study to another.

Medical marijuana legalization was positively associated with cigarette and marijuana co-use and co-users were at greater risk for nicotine dependence. Long-term longitudinal data across age groups are needed to elucidate these results. In the meantime, it is recommended that stakeholders in tobacco control participate in policy discussions involving marijuana legalization including regulatory measures to prevent further co-use and develop novel cessation treatments to help co-users who may have a harder time with quitting.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Author Disclosures

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Highlights

- Cigarette and marijuana co-use was higher where medical marijuana was legal
- Co-users were at greater risk of nicotine dependence across age categories
- Marijuana policies could inadvertently affect co-use and tobacco control

Sample characteristics by statewide legalization of medical marijuana in the 2013 National Survey on Drug Use and Health, N = 51,993

Table 1

	State Medical Marijuana Policy						P-value
	All (N=51,993)		Legal (n=17,746)		Illegal (n=34,247)		
	N	% (SE)	n	% (SE)	n	% (SE)	
Age, years							
12–17	17,323	11.2 (0.2)	5,881	11.1 (0.3)	11,442	11.3 (0.2)	.96
18–25	17,853	15.8 (0.3)	6,116	15.8 (0.5)	11,737	15.8 (0.3)	
26–34	5,414	17.1 (0.4)	1,869	17.3 (0.7)	3,545	17.0 (0.4)	
35–49	7,489	28.0 (0.4)	2,576	28.2 (0.9)	4,913	27.8 (0.5)	
50–64	3,914	27.9 (0.6)	1,304	27.5 (1.0)	2,610	28.1 (0.7)	
Gender							
Male	24,910	49.3 (0.4)	8,561	49.5 (0.8)	16,349	49.1 (0.4)	.67
Female	27,083	50.7 (0.4)	9,185	50.5 (0.8)	17,898	50.9 (0.4)	
Race/Ethnicity							
Non-Hispanic White	30,527	62.2 (0.5)	9,410	56.0 (1.0)	21,117	65.2 (0.6)	<.0001
Hispanic	9,355	17.3 (0.4)	4,080	24.4 (0.9)	5,275	13.7 (0.4)	
Black or African-American	6,916	12.5 (0.4)	1,679	6.8 (0.4)	5,237	15.3 (0.4)	
Asian	2,207	5.6 (0.3)	1,158	9.0 (0.7)	1,049	3.9 (0.3)	
Other	2,988	2.5 (0.1)	1,419	3.7 (0.3)	1,569	1.9 (0.1)	
Education							
12–17 year olds	17,323	11.2 (0.2)	5,881	11.1 (0.3)	11,442	11.3 (0.2)	.0012
Less than high school	5,165	10.9 (0.3)	1,728	10.5 (0.6)	3,437	11.1 (0.4)	
High school graduate	10,900	25.4 (0.4)	3,707	23.7 (0.8)	7,193	26.3 (0.5)	
Some college	10,770	25.0 (0.4)	3,610	24.7 (0.9)	7,160	25.1 (0.4)	
College graduate	7,835	27.4 (0.4)	2,820	30.0 (0.9)	5,015	26.2 (0.5)	
Marijuana Use							
Current (past 30 days)	5,885	8.7 (0.2)	2,514	11.0 (0.4)	3,371	7.6 (0.3)	<.0001
Other, non-past 30 days	15,293	39.8 (0.5)	5,492	41.3 (0.7)	9,801	39.0 (0.7)	
Never	30,815	51.5 (0.5)	9,740	47.7 (0.8)	21,075	53.4 (0.7)	

	State Medical Marijuana Policy						P-value
	All (N=51,993)		Legal (n=17,746)		Illegal (n=34,247)		
	N	% (SE)	n	% (SE)	n	% (SE)	
Cigarette Use							
Current (past 30 days)	11,535	23.3 (0.3)	3775	20.4 (0.6)	7760	24.7 (0.4)	<.0001
Other, non-past 30-days	13,431	37.7 (0.4)	4733	38.8 (0.9)	8698	37.1 (0.5)	
Never	27,027	39.0 (0.4)	9238	40.8 (0.8)	17789	38.1 (0.6)	
Age at first marijuana initiation							
Never	30,815	51.6 (0.5)	9,740	47.8 (0.8)	21,075	53.5 (0.7)	<.0001
12–17 years	14,486	29.0 (0.4)	5,615	32.1 (0.9)	8,871	27.5 (0.5)	
18 years	6,596	19.3 (0.4)	2,353	20.1 (0.7)	4,243	19.0 (0.5)	
Age at first cigarette initiation							
Never	27,003	39.1 (0.4)	9,231	40.9 (0.8)	17,772	38.2 (0.6)	.01
12–17 years	6,487	15.8 (0.3)	2,109	14.7 (0.6)	4,378	16.4 (0.4)	
18 years	18,407	45.1 (0.4)	6,368	44.4 (1.0)	12,039	45.5 (0.5)	
Lifetime Depression							
Yes	5,784	13.3 (0.3)	2052	13.6 (0.5)	3732	13.1 (0.4)	.39
No	45,069	86.7 (0.3)	15,267	86.5 (0.5)	29,802	86.9 (0.4)	

Notes:

- (1) Chi-square was used to examine differences between states with and without marijuana legalization
- (2) Participants 17 years of age were excluded in the education category
- (3) Prevalence=weighted percentage; N's=unweighted figures

Prevalence of cigarette and marijuana co-use in the past 30-days by age group and statewide medical marijuana policy (N=51,993)

Table 2

	Co-Users All		States Medical MJ Legal		States Medical MJ Illegal		P-value
	N	% (SE)	n	% (SE)	n	% (SE)	
Overall	3,376	5.1 (0.2)	1,343	5.8 (0.3)	2,033	4.8 (0.2)	.0011**
Age Category							
12–17 years	554	2.7 (0.2)	216	2.9 (0.4)	338	2.7 (0.2)	.36
18–25 years	2,012	11.7 (0.4)	784	13.3 (0.8)	1,228	10.9 (0.5)	.0037**
26–34 years	416	8.1 (0.5)	172	9.4 (1.0)	244	7.5 (0.5)	.0093**
35–49 years	300	3.5 (0.2)	127	4.1 (0.5)	173	3.1 (0.3)	.0186
50–64 years	94	2.2 (0.3)	44	2.2 (0.4)	50	2.2 (0.4)	.7684

Notes:

- (1) ANCOVA models were adjusted for age (for overall study only), gender, race/ethnicity, education, age at first cigarette initiation, age at first marijuana initiation, and lifetime depression
- (2) Abbreviations: “MJ” = marijuana
- (3) Age category 65 years was excluded in this analysis due to insufficient n’s to calculate standard errors
- (4) $P < .05$, **Bonferroni’s correction was applied to models for each age category; adjusted α -level: $P < .01$

Odds ratios of having nicotine dependence in cigarette smokers who reported never using marijuana (reference), ever but not current past 30-day marijuana use, and current past 30-day marijuana use (N=11,535)

Table 3

	Nicotine Dependence Scale						
	N	OR	95% CI	P-value	OR	95% CI	P-value
Overall							
Never	2,673	-	-	-	-	-	-
Ever but not current	5,486	1.76	1.41-2.19		1.17	0.98-1.40	
Current (past 30 days)	3,376	1.87	1.47-2.39	<.0001**	1.43	1.20-1.71	.0008**
Age categories							
12-17 years							
Never	226	-	-	-	-	-	-
Ever but not current	295	2.90	1.27-6.64		0.87	0.51-1.48	
Current (past 30 days)	554	3.54	1.81-6.92	.0016**	0.98	0.58-1.67	.84
18-25 years							
Never	1,197	-	-	-	-	-	-
Ever but not current	2,473	1.46	1.16-1.85		0.91	0.75-1.11	
Current (past 30 days)	2,012	1.42	1.14-1.77	.0042**	0.96	0.76-1.18	.58
26-34 years							
Never	403	-	-	-	-	-	-
Ever but not current	1,051	1.64	1.09-2.47		1.19	0.87-1.63	
Current (past 30 days)	416	1.71	1.12-2.61	.04*	1.05	0.75-1.48	.49
35-49 years							
Never	563	-	-	-	-	-	-
Ever but not current	1,154	1.50	1.10-2.06		1.15	0.87-1.51	
Current (past 30 days)	300	1.81	1.14-2.89	.02*	2.03	1.39-2.95	.001**
50-64 years							
Never	284	-	-	-	-	-	-
Ever but not current	513	2.43	1.53-3.87		1.22	0.76-1.95	

		Nicotine Dependence Scale		
		NDSS		TTFC
	N	OR	95% CI	P-value
Current (past 30 days)	94	3.08	1.45–6.55	.0005***
				2.61
				1.23–5.55
				.05

Notes:

- (1) Logistic regression models were adjusted for age (for overall only), gender, race/ethnicity, education, lifetime depression, and statewide legalization of medical marijuana
 - (2) Abbreviations: “MJ” = marijuana; “NDSS” = Nicotine Dependence Syndrome Scale; “TTFC” = “Time to first cigarette” item from the Fagerstrom Test for Nicotine Dependence
 - (3) Age category 65 years was excluded in this analysis due to insufficient n’s to calculate 95% confidence intervals
 - (4) NDSS, an average score using a cutoff of greater or equal to 2.75 was used to define “having nicotine dependence”
 - (5) TTFC, a single item was used to define “having nicotine dependence,” specifically, having the first cigarette of the day within 30 minutes of waking from the Fagerstrom Test for Nicotine Dependence
- * $P < .05$,
 *** Bonferroni’s correction was applied to models for each age category; adjusted α -level: $P < .01$