A Puff of Smoke:
Medical Marijuana Laws and Tobacco Use[*]

Anna Choi
Department of Policy Analysis and Management
Cornell University

Dhaval Dave
Department of Economics
Bentley College and National Bureau of Economic Research

Joseph J. Sabia
Department of Economics
San Diego State University

September 2014

[*] The authors thank Tim Young and Tam Nguyen for excellent research assistance.

A Puff of Smoke:
Medical Marijuana Laws and Tobacco Use

Using repeated cross-sectional data from three national datasets—the Behavioral Risk Factor Surveillance Survey, the Current Population Survey Tobacco Use Supplements, and the National Survey on Drug Use and Health—this study is the first to comprehensively examine the relationship between medical marijuana laws (MMLs) and adult tobacco consumption. Preliminary difference-in-difference estimates suggest that MMLs are associated with an increase in cigarette consumption at both the extensive and intensive margins for adult males. Our findings are robust to the inclusion of controls for state-level anti-marijuana sentiment, state-specific time trends, policy leads, and the use of a synthetic control for each treatment state. We find less consistent evidence that MMLs affect tobacco use among females.

Keywords: medical marijuana laws; cigarette consumption; tobacco

I. Introduction

Cigarette consumption has been documented to be the number one cause of lung cancer and emphysema in the United States (CDC 2004).The annual public health costs of tobacco consumption have been estimated to be $96 billion (CDC 2008) and the external costs of secondhand smoke exposure to be $5 to $11 billion (Max et al. 2012; Behan et al. 2005). While a substantial body of research in the health economics and public health literatures has examined the smoking effects of tobacco control policies such as cigarette taxes (Callison and Kaestner, 2014;Cebula, Foley, and Houmes 2014; Hansen, Rees, and Sabia 2014; Carpenter and Cook 2008), health information campaigns (Adams, Faseur, and Geuens, 2011; Liu and Tan, 2009), and smoking bans (Bruderl and Ludwig2011;Demperio2013;Sari 2013), increasing attention has also been paid to spillover effects of policies related to other substances—such as alcohol (Yoruk &Yoruk, 2011 and2013; Crost and Guerrero 2012; Kelly and Rasul 2014;DiNardo and Lemieux 2001) and marijuana (Farrelly et al. 2011)—on tobacco consumption. Understanding cross-price effects of substance use policies on consumption of related substances is important to policymakers wishing to design optimal tax and regulatory policy (Pacula 1997).

The current study is the first to examine the effects of medical marijuana laws (MMLs) on tobacco consumption. As of August 2014, 22 states and the District of Columbia had adopted MMLs, which legalize the possession, use, and cultivation of marijuana for allowable medical purposes. Recent studies have documented that MMLs are associated with increased marijuana consumption among adults (Anderson and Rees 2011; Wen et al. 2014; Choi 2014). Moreover, there is evidence that MMLs affect

marijuana consumption not only in the "medical market," but also in the recreational market via supply side-induced reductions in the street price of high-grade marijuana (Anderson et al. 2013). Could MML-induced reductions in the price of marijuana affect the demand for cigarettes?

There are a number of reasons to expect that marijuana and tobacco may be substitutes. If each is consumed to achieve a similar objective, such as alleviating anxiety (Bambico, 2007) or enhancing the utility of food consumption (Riggs et al., 2012; Soria-Gomez et al., 2014), then MMLs may reduce alcohol consumption. In addition, if alcohol and marijuana are substitutes (Anderson et al. 2013; Sabia et al. 2014; CrostandGuerrero2012) while alcohol and tobacco are complements (Tauchmann et al. 2013), then MMLs may also reduce smoking. Finally, if MML-induced marijuana consumption for medical purposes leads to improvements in physical mobility (Sabia et al. 2014) or mental health (Anderson et al. 2013), these positive health effects could increase the gains to non-smoking.

On the other hand, MMLs could increase tobacco consumption if marijuana and tobacco are complements. This could be the case if both substances are consumed together as a "spliff" (Hammersley and Leon 2006) or if marijuana acts as a "gateway" for other risky health behaviors, including drinking (Wen et al. 2014; Pacula 2013; Yourk and Yourk 2013). Moreover, MML-induced improvements in health may cause individuals to indulge in compensatory unhealthy behaviors (Radtke et al. 2011).

We use repeated cross-sectional data from four data sources—the Behavioral Risk Factor Surveillance Survey (BRFSS), the Current Population Survey Tobacco Use Supplements (CPS-TUS), the National Survey on Drug Use and Health (NSDUH), and

the State and National Youth Risk Behavior Surveys (YRBS)—to comprehensively examine the relationship between MMLs and tobacco consumption. Difference-in-difference estimates suggest that the enforcement of MMLs is associated with an increase in cigarette consumption at both the extensive and intensive margins for adult males, particularly those ages 18-to-29. Our findings are robust to the inclusion of controls for state-level anti-marijuana sentiment, state-specific time trends, policy leads, and the use of a synthetic control for each treatment state. We find less consistent evidence that MMLs affect tobacco use among youths or females.

II. Background

Consumption of tobacco cigarettes has been causally linked to respiratory health problems, heart disease, stroke, and a variety of cancers, including lung cancer, liver cancer and colorectal cancer (Surgeon General's Report 2014). Tobacco smokers are 25 to 26 times more likely to suffer from lung cancer—the country's most fatal cancer—than their non-smoking counterparts (Thun et al. 1997a, b; Thun et al. 2013). Tobacco use has also been documented to increase chronic obstructive pulmonary disease (COPD), a rising cause of mortality in the United States. In addition, exposure to secondhand smoke has been linked to substantial increases in the probabilities of strokes and deaths from cardiovascular disease (CDC 2014).

Studies on the health effects of marijuana use produce less consistent evidence of adverse health effects relative to tobacco use. While there is evidence that heavy marijuana use is associated with diminished respiratory health (Joshi et al. 2014; Pletcher et al. 2012) and increased heart disease (Hodcroft et al. 2014; Jouanjus et al. 2014), the

link between marijuana use and risk of lung cancer has not yet been definitively established (Gates 2014). Moreover, there is evidence that marijuana use may be effective in treating psychological ailments (Bambico, 2007), physical pain (Fiz et al., 2011), and side effects from cancer or HIV treatments (Hall et al., 2005; Doblin and Kleinman, 1991; Vinciguerra et al., 1988).

Marijuana and Tobacco Consumption. There is a wide body of literature in public health establishing that there is a positive association between tobacco consumption and marijuana use (see, for example, Ramo et al. 2013; 2012; Beenstock and Tahov 2002; Bentler et al. 2002; Agrawal et al. 2007; Leatherdale et al. 2007). For instance, young adults ages 18 to 25 are nearly 10 times more likely to have used marijuana if they have also consumed cigarettes (Lai et al. 2000). There is also evidence that those who use marijuana in young adulthood are more likely to initiate smoking cigarettes (Agrawal et al. 2008; Behrendt et al. 2009; Okoli et al. 2008; Timberlake et al. 2003) and less likely to quit smoking cigarettes (Richter et al. 2002) than their counterparts who have abstained from marijuana.

While the public health literature has tended to characterize this pattern of results as evidence that marijuana and tobacco are complements—which could be explained by the utility gains from combining the two substances as a spliff, or a gateway or "reverse gateway" effect (Ramo et al. 2013)—caution should be taken with such an interpretation of these correlational studies. Because substance use is endogenous, the observed associations could be driven, in part or in whole, by difficult-to-measure characteristics such as personal discount rates, personality or family background characteristics or by reverse causality. Establishing the complementarity or substitutability of tobacco and

marijuana requires estimation of cross-price effects generated from exogenous changes in prices.

A number of studies by health economists have relied on changes in cigarette taxes to identify cross-price effects. Using data from the National Household Survey on Drug Abuse, Farrelly et al. (2008; 2001) finds that increases in cigarette taxes are negatively related to (i) the probability of marijuana use for 12 to 20 year-old males and (ii) the quantity of marijuana consumed by current marijuana users. Using a similar empirical approach with data from Monitoring the Future, Chaloupka et al. (1999) find that cigarette tax hikes are negatively related to intensity of marijuana use among users. Taken together, these studies provide some support for the hypothesis that marijuana and cigarettes are complements.

There is at least some evidence that this relationship may extend to adults. Using data from the Australian National Drug Strategy Household Surveys, Cameron and Williams (2001) find that higher cigarette prices are positively related to marijuana use. However, one concern with using price variation is that it may, in part, capture demand-side factors related to marijuana consumption.

Only one study of which we are aware has used marijuana-related policy changes to identify effects on tobacco use. Farrelly et al. (2008) find that while larger marijuana possession penalties are negatively related to marijuana use, they are unrelated to tobacco consumption. No study, however, has explored the effects of MMLs on tobacco consumption.

MMLs and Substance Use. There is fairly consistent evidence that MMLs are associated with increased marijuana consumption among adults (Anderson and Rees

2011; Wen et al. 2014), but not harder drugs (Wen et al. 2014; Choi 2014). Anderson and Rees (2011) and Wen et al. (2014) find that the enforcement of an MML is associated with a 16 to 19 percent increase in adult marijuana consumption. There is strong reason to suspect that not all of this increase in marijuana use is for medical purposes. A common provision of MMLs allows for "collective cultivation" of marijuana for multiple patients (Sabia et al. 2014) and there is evidence that this supply shock decreases the street price of marijuana. Anderson, Hansen and Rees (2012) collect data on street prices of high-grade marijuana prices collected from reports in *High Life* magazine and find that MMLs are associated with a 9.8 percent reduction in street marijuana prices. This suggests that MMLs have important spillover effects in the recreational market, though these effects do not appear to extend to those under age 18 (Anderson et al. 2014).[1]

While no study has, to our knowledge, examined the effect of MMLs on tobacco consumption, there are a number of studies that have examined the effects of MMLs on alcohol consumption (Pacula 2013; Anderson et al. 2014; Wen et al. 2014) and hard drugs (Wen et al. 2014; Choi 2014), each of which could affect the demand for tobacco:

> "Empirical studies show that marijuana is closely related in consumption to at least two other goods, tobacco and alcohol…As argued by Pacula (1997)…such interrelations imply cross-commodity impacts of policy changes, so that changes in one drug market are likely to have spillover effects in related markets." (Clements, Lan, and Zhao 2010; p. 204)

A number of studies have found that alcohol and tobacco are complements (Tauchmann, Lenz, Requate, & Schmidt 2013) find that higher cigarette taxes are

[1] Using data from the Youth Risk Behavior Survey (YRBS), Anderson et al. (2014) find no evidence that MMLs are associated with changes in marijuana use among high school students.

negatively related to binge drinking among young adults. Other studies find that increases in the minimum legal drinking age (Dee 1999; Yourk and Yourk 2013; Crost and Guerrero 2012; Kelly and Rasul, 2014;DiNardo and Lemieux, 2001) and beer taxes (Goodman 2009) are each negatively related to cigarette consumption. Therefore, understanding the relationship between MMLs and alcohol may be important in understanding spillover effects to the tobacco market.

There is some evidence that MMLs may induce adults to substitute away from alcohol, perhaps as individuals choose a relatively cheaper "high." Using data from the Behavioral Risk Factor Surveillance Survey, Anderson et al. (2013) and Sabia et al. (2014) find that MMLs are associated with a decline in binge drinking and number of drinks consumed.[2]

However, the evidence that MMLs reduce drinking is not uniform (see, for example, Wen et al. 2014; Pacula 2013). Wen et al. (2014) find evidence from the Nation Survey on Drug Use and Health (NSDUH) that MML changes in the mid and late 2000s were associated with increased alcohol consumption and Pacula (2013) finds that particular types of MMLs—those with dispensaries specifically written into state law—are positively related to drinking.

In summary, if alcohol and marijuana are related goods, and alcohol and cigarettes are complements, then MMLs could affect tobacco use through this indirect alcohol-related channel.

[2] Other studies have examined the effect of changes in minimum legal drinking ages and beer taxes on marijuana consumption for youths. Yoruk & Yoruk (2011), for example, found increasing the minimum legal drinking ages increase the probability of using marijuana for those who had used marijuana at least once in the previous interview by 5.6-7.3 percent.

MMLs, Physical and Mental Health. Finally, there is evidence that MMLs may improve physical health (Sabia et al. 2014) and psychological well-being (Anderson et al. 2014), each of which has been linked to tobacco consumption. The consequences of these health benefits on tobacco use are, a priori, unclear. Improved physical health—especially increased mobility from pain-alleviating effects of medical marijuana use (Sabia et al. 2014)—may increase the utility gains from smoking. Moreover, improved mental health may increase future-orientedness, leading to healthier health behaviors (Paluska 2000; Stephens 1988; Oddy et al., 2009). On the other hand, health improvements could lead to compensatory unhealthy behaviors, such as increased smoking (Radtke et al. 2011).

The current study is the first to comprehensively examine the effect of MMLs on adult and youth tobacco consumption. Moreover, given large gender-differences in spliff consumption patterns (Ramo et al. 2013), we explore whether there are gender differences in the tobacco effects of MMLs.

III. Data and Methods

Our approach will use data from three national datasets that survey adults: the Behavioral Risk Factor Surveillance System (BRFSS), the Current Population Survey Tobacco Use Supplement (CPS-TUS), and the National Survey on Drug Use and Health (NSDUH). We begin by following the approach of Wen et al. (2014) to estimate the effect of MMLs on marijuana use to establish that MMLs affect marijuana use. We then turn to our main analysis on tobacco consumption. The full sample period we examine is from 1990 to 2012.

Empirical Approach. Following Anderson et al. (2013), we begin with a difference-in-difference approach of the following form:

$$T_{ist} = \beta_0 + \beta_1 MML_{st} + \mathbf{X}_{st}\beta_2 + \mathbf{Z}_{ist}\beta_3 + \nu_s + \omega_t + \nu_s * t + \Theta_s \qquad (1)$$

where T_{ist} measures tobacco use of individual *i* residing in state *s* in year *t*; MML is an indicator for whether state *s* was enforcing an MML in year *t*; $\mathbf{X}_{st}$is a vector of state-level time-varying controls including the state unemployment rate, the prime-age (ages 25-to-54) average wage rate, beer taxes, cigarette taxes, and the presence of a marijuana decriminalization law; $\mathbf{Z}_{ist}$is a vector of individual-level time-varying controls including age, gender, race/ethnicity, marital status, and indicators for educational attainment, ν_s is a year-invariant state effect, ω_t is a state-invariant year effect, and $\nu_s * t$ is a state-specific linear time trend.

Our three key measures of tobacco use are: *Participation*, *Everyday Smoking*, and *Cigarettes*. The first of these measures are dichotomous variables. *Participation* is an indicator for whether the respondent has smoked tobacco in the last 30 days. *Everyday Smoking* is an indicator set equal to 1 if the respondent smoked in every day of the last 30 days and 0 if the respondent did not smoke in the last 30 days or had smoked fewer than 30 of the last 30 days. The final variable, *Cigarettes*, is a continuous variable measures the natural log of cigarettes consumed by smokers in a typical day (conditional on *Participation* = 1). The means of the smoking variables as well as the controls for the BRFSS data appear in Table 1 below. Note that in the BRFSS, *Participation* is available for the full 1990-2012 period, *Everyday Smoking* is available consistently from 1996 to 2012, and *Cigarettes* is available from 1990 to 2000.

Identification of β_1 in equation (1) comes from within-state over time variation in the enforcement of MMLs. Between 1990 and 2012, 18 states and the District of Columbia had enacted and were enforcing MMLs. Table 2 shows the effective dates of MMLs during the period from 1990 to 2012 as well as the sources of identifying variation in each of our four datasets.

To obtain an unbiased estimate of β_1 requires that the common trends assumption of difference-in-difference models be satisfied. While we control for other risky behavior policies (e.g. beer taxes, cigarette taxes, and marijuana decriminalization laws) in the vector $\mathbf{X}_{st}$, it may be that (i) tobacco consumption was trending differently prior to the implementation of MMLs in "treatment" versus "control" states, (ii) state-specific time-varying unobservables are correlated with both the enactment of MMLs and tobacco use, and (iii) states may implement MMLs in response to risky behavior trends.

We undertake several strategies to try to address this concern. First, we control for state-specific linear time trends to control for trends unfolding linearly. Second, following Sabia et al. (2014), we use data from the General Social Survey (GSS) to generate a measure of state-level anti-marijuana legalization sentiment. Respondents to the GSS were asked:

"Do you think the use of marijuana should be made legal or not?"[3]

Controlling for marijuana sentiment should help to address the possibility that our MML measure is simply capturing within-state changes in health sentiment as well as reduce the possibility that cultural shifts are a mechanism to explain MML effects.

[3]One limitation of this measure is that it is only available for the calendar years 1990-1991, 1993, and even-numbered years between 1994 and 2000. In those years, the data are non-missing in 79 percent of state-year cells. Anti-marijuana legalization sentiment is not measured in Nevada or Nebraska in the GSS. In total, our anti-marijuana legalization sentiment measure is available for 37 percent of our full BRFSS sample.

Our second approach is to test the robustness of our estimates of β_1 to the inclusion of policy leads. If trends in tobacco use were trending differently prior to the implementation of MMLs, controls for policy leads should have a pronounced effect on our estimate of β_1.

Finally, we test the sensitivity of our estimates to the creation of a synthetic control state for each "treatment" state that implemented an MML. This approach, pioneered by Adabe et al. (2008), is a data-driven approach that will ensure that pre-treatment levels and trends in cigarette consumption are similar in the treatment and synthetic control states. Synthetic control states are created as a linear combination of "donor" states that did not enact an MML. The weights that determine the importance of each donor state in the synthetic state are determined by observable pre-treatment variables described in the vector $\mathbf{X}_{st}$ above. Sabia et al. (2014) use this approach in their recent study exploring the body weight effects of MMLs.

IV. Preliminary Results from the BRFSS

Preliminary results from the BRFSS data appear in Tables 3-4. We focus on estimates of β_1 for ease of presentation, but estimates on the coefficients on controls are available upon request. All regressions are weighted and standard errors corrected for clustering on the state are in parentheses. The preliminary estimates include controls for full set of variables mentioned above as well as state-specific linear time trends. We present results separately for males and females.

The results in Table 3 suggest some modest evidence of a complementary relationship between marijuana and tobacco among men. We find that the enforcement of an MML is associated with a 0.006 percentage-point increase in the probability of smoking. While the signs are positive for *Everyday Smoking* and *Cigarettes*, the estimates are not statistically

distinguishable from zero at conventional levels. For females, we find some evidence of a complementary relationship between marijuana and tobacco on the intensive margin (Panel III), but otherwise, less evidence that tobacco and marijuana are complements along the extensive margin (Panel I).

When we look across the age distribution, the results suggest that the complementary relationship (along the extensive margin) for males exist mainly among younger individuals less than 40 years-old. For 25-to-39 year olds, we find that the enforcement of an MML is associated with a 1.2 percentage-point increase in the probability of smoking participation. In contrast, for women, it appears that marijuana and tobacco may be substitutes.

Future work on this paper will explore whether these gender differences persist across the CPS-TUS and NSDUH and the possible explanations for this finding. One explanation could be gender differences in preferences for spliffs. Another may be the nature of the inter-relationship between marijuana, tobacco, and alcohol, and how the relationship between marijuana and alcohol may also differ between the sexes.

References

Adams, L., Faseur, T., &Geuens, M. (2011).The Influence of the Self-Regulatory Focus on the Effectiveness of Stop-Smoking Campaigns for Young Smokers. Journal of Consumer Affairs, 45(2), 275-305.

Agrawal A, Budney AJ, Lynskey MT. The co-occurring use and misuse of cannabis and tobacco: A review. Addiction. 2012;107:1221–1233.

Bambico, Francis Rodriguez, Noam Katz, Guy Debonnel, and Gabriella Gobbi. 2007. "Cannabinoids Elicit Antidepressant-like Behavior and Activate Serotonergic Neurons through the Medial Prefrontal Cortex." The Journal of Neuroscience 27 (43) (October 24): 11700–11. doi:10.1523/JNEUROSCI.1636-07.2007. http://www.ncbi.nlm.nih.gov/pubmed/17959812.

Behan, Donald F., Michael P. Eriksen and Yijia Lin. (2005).Economic Effects of Environmental Tobacco Smoke.Society of Actuaries.

Bruderl, J., & Ludwig, V. (2011). Does a Smoking Ban Reduce Smoking? Evidence from Germany.SchmollersJahrbuch: Zeitschrift Fur Wirtschafts- Und Sozialwissenschaften/Journal Of Applied Social Science Studies, 131(2), 419-429.

Callison, K., &Kaestner, R. (2014). Do Higher Tobacco Taxes Reduce Adult Smoking? New Evidence of the Effect of Recent Cigarette Tax Increases on Adult Smoking. Economic Inquiry, 52(1), 155-172.

Cebula, R. J., Foley, M., &Houmes, R. (2014). Empirical Analysis of the Impact of Cigarette Excise Taxes on Cigarette Consumption: Estimates from Recent State-Level Data. Journal of Economics And Finance, 38(1), 164-180. doi:http://dx.doi.org.libproxy.sdsu.edu/10.1007/s12197-011-9207-6

Centers for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health Promotion. Tobacco Information and Prevention Source (TIPS). Tobacco Use in the United States. January 27, 2004.

Centers for Disease Control and Prevention. The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General, 2014. Surgeon General's Report: Rockville, MD.

Centers for Disease Control and Prevention. State-specific secondhand smoke exposure and current cigarette smoking among adults—United States, 2008. MMWR Morb Mortal Wkly Rep. 2009;58:1232–5.

Crost, B., & Guerrero, S. (2012). The Effect of Alcohol Availability on Marijuana Use: Evidence from the Minimum Legal Drinking Age. Journal Of Health Economics, 31(1), 112-121. doi:http://dx.doi.org.libproxy.sdsu.edu/10.1016/j.jhealeco.2011.12.005

Dee, T. S. (1999). The Complementarity of Teen Smoking and Drinking. Journal Of Health Economics, 18(6), 769-793.

Demperio, S. (2013, May).Cigarette Taxes, Smoking Bans, and Smoking Behavior (Dissertation). University of Virginia, 161 pages; 3570854

DiNardo, J, and T Lemieux. 2001. "Alcohol, Marijuana, and American Youth: The Unintended Consequences of Government Regulation." Journal of Health Economics 20 (6) (November): 991–1010. http://www.ncbi.nlm.nih.gov/pubmed/11758056.

Doblin, R. E., &Kleiman, M. A. 1991. "Marijuana as Antiemetic Medicine: A Survey of Oncologists' Experiences and Attitudes." Journal of Clinical Oncology 9 (7): 1314-1319.http://www.ncbi.nlm.nih.gov/pubmed/2045870

Farrelly, M. C., Bray, J. W., Zarkin, G. A., &Wendling, B. W. (2001). The Joint Demand for Cigarettes and Marijuana: Evidence from the National Household Surveys on Drug Abuse. Journal of Health Economics. Volume 20(1):51-68. doi: 10.1016/S0167-6296(00)00067-9.

Fiz, Jimena, Marta Durán, DolorsCapellà, Jordi Carbonell, and MagíFarré. 2011. "Cannabis Use in Patients with Fibromyalgia: Effect on Symptoms Relief and Health-Related Quality of Life." PloS One 6 (4) (January): e18440. doi:10.1371/journal.pone.0018440. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3080871&tool=pmcentrez&rendertype=abstract.

Gates P1, Jaffe A, Copeland J. (2014).Cannabis smoking and respiratory health: consideration of the literature. Respirology. 2014 Jul;19(5):655-62. doi: 10.1111/resp.12298. Epub 2014 May 15.

Goodman, A. C. (2009). Economic Analyses of Multiple Addictions for Men and Women. Journal Of Mental Health Policy And Economics, 12(3), 139-155.

Hall, Wayne, MacDonald Christie, and David Currow. 2005. "Cannabinoids and Cancer: Causation, Remediation, and Palliation." The Lancet Oncology 6 (1) (January): 35–42. doi:10.1016/S1470-2045(04)01711-5. http://www.ncbi.nlm.nih.gov/pubmed/15629274.

Hammersley, R.,V. Leon. (2006). Patterns of cannabis use and positive and negative experiences of use amongst university students. Addiction Research & Theory, 14 (2) , pp. 189–205Liu, H., & Tan, W. (2009). The Effect of Anti-smoking Media Campaign on Smoking Behavior: The California Experience. Annals of Economics And Finance, 10(1), 29-47.

Hodcroft CJ1, Rossiter MC2, Buch AN3. (2014). Cannabis-associated Myocardial Infarction in a Young Man with Normal Coronary Arteries. The Journal of Emergency Medicine, pii: S0736-4679(13)01403-0. doi: 10.1016/j.jemermed.2013.11.077.

Joshi M, Joshi A, Bartter T. (2014). Marijuana and lung diseases. Current Opinion in Pulmonary Medicine20(2):173-9. doi: 10.1097/MCP.0000000000000026.

Jouanjus E1, Lapeyre-Mestre M, Micallef J; French Association of the Regional Abuse and Dependence Monitoring Centres (CEIP-A) Working Group on Cannabis Complications.(2014). Cannabis use: signal of increasing risk of serious cardiovascular

disorders. Journal of the American Heart Association, 3(2):e000638. doi: 10.1161/JAHA.113.000638.

Kelly, Elaine, and Imran Rasul. 2014. “Policing Cannabis and Drug Related Hospital Admissions: Evidence from Administrative Records.” Journal of Public Economics 112 (April): 89–114. doi:10.1016/j.jpubeco.2014.01.008. http://www.sciencedirect.com/science/article/pii/S0047272714000097.

Max W, Sung HY, Shi Y. (2012 Nov). Deaths from secondhand smoke exposure in the United States: economic implications. Am J Public Health; 102(11):2173-80.

Oddy, Wendy H, Monique Robinson, Gina L Ambrosini, Therese A O’Sullivan, Nicholas H de Klerk, Lawrence J Beilin, Sven R Silburn, Stephen R Zubrick, and Fiona J Stanley. 2009. “The Association between Dietary Patterns and Mental Health in Early Adolescence.” Preventive Medicine 49 (1) (August): 39–44. doi:10.1016/j.ypmed.2009.05.009. http://www.sciencedirect.com/science/article/pii/S0091743509002643.Paluska, SA, and TL

Ramo DE, Delucchi K, Hall S, Liu H, Prochaska JJ. (2013). Marijuana and Tobacco Co-Use in Young Adults: Patterns and Thoughts about Use. Journal of Studies on Alcohol and Drugs, 74(2): 301–310.

Radtke, T., Scholz, U., Keller, R., Knäuper, B., &Hornung, R. (2011).Smoking-Specific Compensatory Health Beliefs and the Readiness to Stop Smoking in Adolescents. British Journal of Health Psychology, 16, 610-625. doi:10.1348/2044-8287.002001

Requate, T., & Schmidt, C. M. (2013). Tobacco and Alcohol: Complements or Substitutes?: A Structural Model Approach to Insufficient Price Variation in Individual-Level Data. Empirical Economics, 45(1), 539-566. doi:http://dx.doi.org.libproxy.sdsu.edu/10.1007/s00181-012-0611-3

Sari, N. (2013).On Anti-smoking Regulations and Tobacco Consumption.Journal of Socio-Economics, 4360-67. doi:http://dx.doi.org.libproxy.sdsu.edu/10.1016/j.socec.2013.01.006

Schwenk. 2000. “Physical Activity and Mental Health.” Sports Medicine 29 (3): 167–180. http://link.springer.com/article/10.2165/00007256-200029030-00003.

Stephens, Thomas. 1988. “Physical Activity and Mental Health in the United States and Canada: Evidence from Four Population Surveys.” Preventive Medicine 17 (1) (January): 35–47. doi:10.1016/0091-7435(88)90070-9. http://www.sciencedirect.com/science/article/pii/0091743588900709.Tauchmann, H., Lenz, S.,

Thun MJ, Carter BD, Feskanich D, Freedman ND, Prentice R, Lopez AD, Hartge P, Gapstur SM. (2013). 50-year trends in smoking-related mortality in the United States. New England Journal of Medicine;368(4):351–64.

Thun MJ, Heath CW Jr. (1997a). Changes in mortality from smoking in two American Cancer Society prospective studies since 1959. Preventive Medicine;26(4):422–6

Thun MJ, Lally CA, Flannery JT, Calle EE, Flanders WD, Heath CW Jr. (1997b).Cigarette smoking and changes in the histopathology of lung cancer. Journal of the National Cancer Institute;89(21):1580–6.

Yoruk, B. K., &Yoruk, C. (2013). The Impact of Minimum Legal Drinking Age Laws on Alcohol Consumption, Smoking, and Marijuana Use Revisited. Journal Of Health Economics, 32(2), 477-479. doi:http://dx.doi.org.libproxy.sdsu.edu/10.1016/j.jhealeco.2012.09.007.

Yörük, Barış K, and CerenErtanYörük. 2011. "The Impact of Minimum Legal Drinking Age Laws on Alcohol Consumption, Smoking, and Marijuana Use: Evidence from a Regression Discontinuity Design Using Exact Date of Birth." Journal of Health Economics 30 (4) (July): 740–52. doi:10.1016/j.jhealeco.2011.05.010. http://www.ncbi.nlm.nih.gov/pubmed/21719131.

Vinciguerra, V, T Moore, and E Brennan. 1988. "Inhalation Marijuana as an Antiemetic for Cancer Chemotherapy." New York State Journal of Medicine 88 (10) (October): 525–7. http://www.ncbi.nlm.nih.gov/pubmed/3231372.

Table 1. Means of Smoking Variables and Selected Controls

	BRFSS[a] (1)
Tobacco Use Measures	
Participation	0.213 (0.410) [5,656,644]
Everyday Smoking	0.156 (0.362) [5,070,737]
Cigarettes | Participation	18.37 (10.70) [262,382]
Selected Controls	
MML	0.146 (0.351)
Cigarette Taxes (2012 $)	0.851 (0.702)
Beer Taxes (2012 $)	0.340 (0.266)
Marijuana Decriminalization Statute	0.332 (0.471)
Zero Tolerance Law	0.793 (0.398)
BAC08 Law	0.630 (0.475)
Per capita income ($2012)	39,559.2 (6,241.7)
Unemployment Rate	6.14 (2.04)
Age	45.38 (17.65)
HS Degree	0.309 (0.462)
Black	0.106 (0.307)
Hispanic	0.117 (0.321)
N	5,656,644

Notes: Weighted means obtained using data drawn from the Behavioral Risk Factor Surveillance Survey (1990 to 2012), the Current Population Survey Tobacco-Use Supplements (1990 to 2012), the National Survey for Drug Use and Health (2004 to 2011), and the State and National Youth Risk Behavior Surveys (1991 to 2011). [a]Data on *Participation* are available between 1990-2012, *Everyday Smoking* between 1996-2012 and *Cigarettes* between 1990-2000 in the Behavioral Risk Factor Surveillance Survey.

Table 2. Effective Dates of Medical Marijuana Laws, 1990-2013

State	Effective Date
Alaska	March 4, 1999
Arizona	April 14, 2011
California	November 6, 1996
Colorado	June 1, 2001
Connecticut	October 1, 2012
Delaware	May 13, 2011
District of Columbia	June 27, 2010
Hawaii	December 28, 2000
Maine	December 22, 1999
Massachusetts	January 1, 2013
Michigan	December 4, 2008
Montana	November 2, 2004
Nevada	October 1, 2001
New Hampshire	July 23, 2013
New Jersey	October 1, 2010
New Mexico	July 1, 2007
Oregon	December 3, 1998
Rhode Island	January 3, 2006
Vermont	July 1, 2004
Washington	November 3, 1998

These dates are effective dates for state level medical marijuana laws and are gathered from the National Conference of State Legislatures (2014), Anderson, Hansen, and Rees (2013) and Eddy (2010).

Table 3. Difference-in-Difference Estimates of the Effect of MMLs on Tobacco Use

	BRFSS	
	Males[a]	**Females[a]**
	(1)	**(5)**
	Panel I: Participation	
MML	0.006*	-0.004
	(0.003)	(0.003)
N	2,223,520	3,433,124
	Panel II: Everyday Smoking	
MML	0.004	-0.003
	(0.004)	(0.003)
N	1,978,022	3,092,715
	Panel III: Ln (Cigarettes) | Participation = 1	
MML	0.058	0.080*
	(0.056)	(0.043)
N	117,977	144,405
State FE?	Yes	Yes
Year FE?	Yes	Yes
Controls?	Yes	Yes
State Linear Trend?	Yes	Yes

***Significant at 1% level **at 5% level *at 10% level

Notes: Weighted difference-in-difference estimates obtained from the Behavioral Risk Factor Surveillance Survey (1990 to 2012), the Current Population Survey Tobacco-Use Supplements (1990 to 2012), the National Survey for Drug Use and Health (2004 to 2011), and the State and National Youth Risk Behavior Surveys (1991 to 2011). State-specific time-varying controls include beer taxes, cigarette taxes, zero tolerance laws, blood alcohol content (.08) driving laws, marijuana decriminalization laws, average state wage rate, and the unemployment rate. Demographic controls include age, educational attainment, race/ethnicity, and marital status. [a]Data on *Participation* are available between 1990-2012, *Everyday Smoking* between 1996-2012 and *Cigarettes* between 1990-2000 in the Behavioral Risk Factor Surveillance Survey.

Table 4. Age-Specific Estimates of Effect of MMLs on *Participation*

	BRFSS	
	Males	**Females**
	(1)	**(4)**
	Panel I: Ages 18-to-24	
MML	0.005	-0.021***
	(0.010)	(0.006)
N	146,367	181,520
	Panel II: Ages 25-to-39	
MML	0.012**	-0.004
	(0.005)	(0.005)
N	495,321	733,500
	Panel III: Ages 40-to-54	
MML	-0.001	-0.007*
	(0.006)	(0.004)
N	644,455	933,371
	Panel IV: Ages 55+	
MML	0.004	-0.001
	(0.004)	(0.003)
N	926,066	1,552,527
State FE?	Yes	Yes
Year FE?	Yes	Yes
Controls?	Yes	Yes
State Linear Trend?	Yes	Yes

***Significant at 1% level **at 5% level *at 10% level

Notes: Weighted difference-in-difference estimates obtained from the Behavioral Risk Factor Surveillance Survey (1990 to 2012), the Current Population Survey Tobacco-Use Supplements (1990 to 2012), the National Survey for Drug Use and Health (2004 to 2011), and the State and National Youth Risk Behavior Surveys (1991 to 2011). State-specific time-varying controls include beer taxes, cigarette taxes, zero tolerance laws, blood alcohol content (.08) driving laws, marijuana decriminalization laws, average state wage rate, and the unemployment rate. Demographic controls include age, educational attainment, race/ethnicity, and marital status.