Medical Marijuana Laws and Suicides

Abbreviations: NVSS, National Vital Statistics System; OLS, ordinary least squares; SLEs, stressful life events

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Objectives. We estimated the association between legalizing medical marijuana and suicides.

Methods. State-level data on suicides for the period 1990-2007 were obtained from the Mortality Detail Files, produced by the National Vital Statistics System. During this period, 12 states legalized medical marijuana. The association between legalizing medical marijuana and suicides per 100,000 population was examined using regression analysis.

Results. Adjusting for economic conditions, relevant state policies and state-specific linear time trends, the association between legalizing medical marijuana and suicides per 100,000 population was not statistically significant at the 0.05 level. However, legalization of medical marijuana was associated with a 10.8% reduction in the suicide rate of 20- through 29-year-old males (95% confidence interval [CI] = -17.1%, -3.7%), and a 9.4% reduction in the suicide rate of 30- through 39-year-old males [95% CI = -16.1%, -2.4%). Estimates of the relationship between legalizing medical marijuana and suicides among females were less precise and sensitive to model specification.

Conclusions. Suicides among 20- though 39-year-old males fell after the legalization of medical marijuana as compared to suicides among 20- through 39-year-old males in states that did not legalize medical marijuana. The negative relationship between legalization and suicides among young adult males provides support for the hypothesis that marijuana can be used to cope with stressful life events. However, recent research raises the possibility that this relationship is explained by alcohol consumption. The exact mechanism through which legalizing medical marijuana reduces suicides among young adult males remains a topic for future study.

Key Words: Suicides; Medical Marijuana; Alcohol Use

Word Count: 3,493

INTRODUCTION

While marijuana remains illegal under Federal law, 21 states and the District of Columbia have legalized its use for medicinal purposes, and more than a dozen state legislatures have recently considered medical marijuana bills. Although there is evidence that the use of marijuana is associated with depression, suicidal ideation, and suicide attempts[1-3], no previous study has examined the association between legalizing medical marijuana and completed suicides, the 10th leading cause of death in the United States.[4]

Medical marijuana laws remove criminal penalties for using, possessing, and cultivating marijuana for medicinal purposes. In addition, medical marijuana laws provide doctors immunity from prosecution for recommending the use of marijuana to their patients. Because it is prohibitively expensive for the government to ensure that all marijuana ostensibly grown for the medicinal market ends up in the hands of registered patients, diversion to the recreational market almost certainly occurs. Indeed, the legalization of medical marijuana is associated with a 10% to 26% decrease in the price of high-quality marijuana.[5] It is also associated with increased use of marijuana by young adults accompanied by substantial reductions in alcohol consumption and binge drinking.[5-6]

Animal studies show that, at low doses, synthetic cannabinoid injections can have a potent anti-depressant effect[7, 8], while higher dosages reduce serotonin transmission and lead to depression-like behavior.[8, 9] Epidemiological studies provide evidence that marijuana use is associated with the symptoms of depression and suicidal ideation.[10, 11] However, any association between marijuana use and outcomes such as these could be

due to difficult-to-measure confounders at the individual level (e.g., personality) or reflect reverse causality stemming from self-medication.[10, 12, 13]

Using state-level data and an empirical approach designed to account for the influence of difficult-to-measure confounders and reverse causality, we examined the association between legalizing medical marijuana and year-to-year changes in the suicide rate. In addition, because males respond to cannabinoids differently than females[14-16], and because there are distinct age patterns to substance use[17], we examined the association between legalizing medical marijuana and suicides by gender and age.

METHODS

Data Sources and Variable Descriptions

Data on suicides for the period 1990-2007 came from the Mortality Detail Files, produced by the National Vital Statistics System (NVSS). These data contain information on year of death, sex, age group, and underlying cause of death for United States residents and are aggregated to the state level by the NVSS. Eighteen years multiplied by 51 (50 states and the District of Columbia) yielded a total of 918 observations. To compute yearly suicide rates, population estimates were obtained from the United States Census Bureau.

Information on when the legalization of medical marijuana occurred by state is reported in Appendix Table 1. During the period under study, 12 states legalized medical marijuana. All 12 of these states allowed home cultivation and permitted patients to register based on medical conditions that are difficult to confirm (e.g., chronic pain and nausea). California listed anxiety as a qualifying condition and New Mexico allowed the

use of medical marijuana to treat post-traumatic stress disorder.[18] Roughly half of the medical marijuana states in Appendix Table 1 permitted collective cultivation, while Alaska, Hawaii, Maine, New Mexico and Vermont attempted to dampen the supply response to the legalization of medical marijuana by limiting caregivers to one patient or prohibiting home cultivation. In these states, possession limits were easier to enforce and illegal suppliers were easier to identify.[19]

Information on whether a zero tolerance drunk driving law was in effect, whether a 0.08 blood alcohol content law was in effect, and whether marijuana possession was decriminalized came from published sources.[20-22] The state unemployment rate and per capita income came from the Bureau of Labor Statistics and the Bureau of Economic Analysis, respectively. Finally, information on state beer taxes was obtained from the *Brewers Almanac*, an annual publication produced by the Beer Institute. Previous studies provide evidence that stricter alcohol policies can reduce suicides.[23-26] There is also evidence that suicide rates are sensitive to measures of economic activity such as the unemployment rate.[27-30]

Data Analysis

Unadjusted suicides per 100,000 population in states that legalized medical marijuana were graphed by year and gender. These rates were compared to unadjusted suicides per 100,000 population in states that did not legalize medical marijuana during the period 1990-2007.

In addition, we estimated the association between an indicator (i.e., a 0/1 variable) of legalization and the natural log of suicides per 100,000 population (the dependent

variable) using regression analysis.[31] Following previous studies[26, 32], ordinary least squares (OLS) estimates were weighted by the specific population under study.[33] Estimated coefficients were considered statistically significant if their 95% confidence interval did not include the value 0. Standard errors (used to calculate confidence intervals and p-values) were corrected for clustering at the state level.[31]

Fifty state indicators were included as covariates in the regression analysis. These indicators accounted for so-called "state fixed effects" (i.e., time-invariant confounders at the state level). Their inclusion on the right-hand side of the regression model ensured that estimates of the association between legalizing medical marijuana and suicides were identified using only within-state variation over time.[31] Seventeen year indicators accounted for "year fixed effects" (i.e., year-to-year changes in the national suicide rate). The sensitivity of the estimates was explored by adjusting for year-to-year changes in per capita income, the unemployment rate, and relevant state policies such as the beer tax and whether a 0.08 blood alcohol content law was in effect. Finally, state-specific linear time trends were included as covariates. These time trends were intended to capture difficult-to-measure factors such as attitudes that might have evolved differently over time in states that legalized medical marijuana compared to states that did not.

RESULTS

Figures 1 and 2 compare pre- and post-legalization suicide trends by gender. The solid line represents the suicide rate for the treated states (those that legalized medical marijuana). The dashed line represents the suicide rate for the control states (those that

did not legalize medical marijuana). Year 0 on the horizontal axis represents the year in which legalization took place.

Male suicide rates in the treated states followed a similar path to those in the control states through year -1 (see Figure 1). From year -1 to year 0, male suicide rates in medical marijuana states fell, but male suicide rates remained roughly constant in the control states. After year 0, these trends continued. In fact, male suicide rates continued to fall in medical marijuana states, but increased, albeit modestly, in the control states.

Female suicide rates fell by almost 0.04 suicides per 100,000 population prior to legalization in the treated states, but remained stable in the control states (see Figure 2). After the legalization of medical marijuana, female suicide rates increased slightly in the treated states (from year -1 through year 1) and then trended downward. Female suicide rates in the control states followed a very similar trajectory.

The suicide rates in Figures 1 and 2 were unadjusted. Regression analysis was used to account for factors such as economic conditions and other relevant state policies.

The first column of Table 1 reports OLS estimates of the relationship between legalizing medical marijuana and suicides per 100,000 population. Because the dependent variable was logged, these estimates can be transformed into percentages by exponentiating, subtracting one, and multiplying by 100.

Adjusting for state and year effects, the relationship between legalizing medical marijuana and suicides, although negative, was not statistically significant at conventional levels ($P = 0.097$). Adjusting for economic conditions and polices such as whether a zero tolerance drunk driving law was in effect, the legalization of medical marijuana was associated with a 6.9% decrease in the overall suicide rate ($e^{-0.072} - 1 =$

-0.069; 95% confidence interval [CI] = -13.3%, -0.02%). When state-specific linear time trends were included, legalization was associated with a 4.8% decrease in the suicide rate ($e^{-0.049} - 1 = -0.048$). However, this estimate was not statistically significant at the 0.05 level (95% CI = -9.4%, 0.001%).

In the remaining columns of Table 1, the relationship between the legalization of medical marijuana and suicides was estimated separately by gender. Legalization was not associated with male suicides adjusting for state and year effects. However, it was associated with a 6.3% decrease in the male suicide rate after adjusting for the influence of economic conditions and relevant state policies ($e^{-0.065} - 1 = -0.063$; 95% CI = -12.0%, -0.2%). When state-specific linear time trends were included in the model, legalization was associated with a 4.8% decrease in the male suicide rate ($e^{-0.047} - 1 = -0.048$; 95% CI = -8.5%, -0.5%). The estimated relationship between the legalization of medical marijuana and the female suicide rate was negative but not statistically significant at the 0.05 level.

The upper panel of Table 2 reports the estimated relationship between the legalization of medical marijuana and male suicides by age group. The results suggest that the legalization of medical marijuana was associated with a sharp reduction in suicides among young adult males. Specifically, adjusting for state and year effects, legalizing medical marijuana was associated with a 9.2% decrease in the suicide rate of 20- through 29-year-old males ($e^{-0.096} - 1 = -0.092$; 95% CI = -13.7%, -4.4%). Including economic conditions and relevant state polices had very little impact on this estimate. When state-specific linear time trends were included in the regression model, legalization

of medical marijuana was associated with a 10.8% decrease in the suicide rate of 20- through 29-year-old males ($e^{-0.114} - 1 = -0.108$; 95% CI = -17.1%, -3.7%).

Adjusting for state and year effects, legalizing medical marijuana was associated with a 13.7% decrease in the suicide rate of 30- through 39-year-old males ($e^{-0.147} - 1 = -0.137$; 95% CI = -21.7, -5.0%). Adjusting for economic conditions and relevant state polices reduced this estimate slightly. When state-specific linear time trends were included, the estimated relationship between the legalization of medical marijuana and suicides among 30- through 39-year-old males was reduced still further but remained statistically significant at the 0.05 level. Specifically, legalization of medical marijuana was associated with a 9.4% decrease in the suicide rate of 30- through 39-year-old males ($e^{-0.099} - 1 = -0.094$; 95% CI = -16.1%, -2.4%).

Although the estimates reported in the upper panel of Table 2 were negative for 15- through 19-year-old males, they were never statistically distinguishable from zero. Likewise, the estimates for 40- through 59-year-old males were negative but not precisely estimated. For males 60 years of age and older, estimates were negative in two of the three specifications, but were not statistically significant.

The lower panel of Table 2 provides little evidence that legalization of medical marijuana was associated with suicides among females under the age of 30. The estimated relationship between legalization and suicides was stronger among older females, although it was sensitive to model specification. Adjusting for state and year effects, the legalization of medical marijuana was associated with an 11.8% decrease in the suicide rate of 30- through 39-year-old females ($e^{-0.125} - 1 = -0.118$; 95% CI = -21.6%, -0.7%). Adjusting for state effects, year effects and the covariates, the

legalization of medical marijuana was associated with a 10.4% decrease in the suicide rate of 30- through 39-year-old females ($e^{-0.110} - 1 = -0.104$; 95% CI = -19.6%, -.0.3%). However, this association lost significance when the state-specific linear time trends were included. After adjusting for state-specific linear time trends, legalization was associated with a statistically significant decrease in the suicide rate of females 60 years of age and older.

Pre- and post-legalization trends in suicides were examined by modifying the regression model described above. Specifically, the medical marijuana indicator was replaced with 3 lead indicators, an indicator for the year of the law change, and 4 lag indicators. None of the lead indicators were statistically significant predictors of male suicides, nor were the lead indicators jointly significant ($F = 0.51$; $P = .68$), a pattern of results that was consistent with the pre-legalization trends presented in Figure 1. In contrast, the medical marijuana lags were jointly significant predictors of male suicides ($F = 9.37$; $P = .00$).

Replacing the medical marijuana indicator with leads and lags provided little evidence that legalizing medical marijuana reduced female suicides. Consistent with the pre-legalization trends presented in Figure 2, the lead indicators were negative and jointly significant predictors of female suicides ($F = 2.98$; $P = .04$). Moreover, the hypothesis that the lag indicators were equal in magnitude to the lead indicators could not be rejected ($F = 3.02$; $P = .09$).

Finally, the estimated relationship between unemployment and suicides was consistently positive and significant, a pattern of results consistent with what we know from previous studies.[27, 28] Although stricter alcohol policies have been shown to reduce

suicides[23-26], beer taxes, zero tolerance laws and 0.08 BAC laws were not good predictors of suicides. In the spirit of a falsification test, the suicide rate was replaced with morality due to cardiac arrest and mortality due to cancer. There was no evidence that the legalization of medical marijuana was systematically related to these sources of mortality.

DISCUSSION

Opponents of legalizing medical marijuana point to the large number of studies showing that marijuana use is positively associated with depression, the onset of panic attacks, psychosis, schizophrenia, and suicidal ideation.[10, 11, 34-41] However, the association between marijuana use and outcomes such as these could be attributable to difficult-to-measure confounders such as personality.[12] Moreover, estimates produced by non-prospective studies could reflect reverse causation stemming from self-medication.[10, 13, 42] Although there have been attempts to account for these potential sources of statistical bias, none have been particularly convincing. In fact, a recent review of the literature noted that the majority of studies in this area "did not adequately address the problem of reverse causation as a possible alternative explanation for any association observed."[11]

The current study avoided the problems of reverse causality and difficult-to-measure confounders by examining state-level data and comparing the change in suicides per 100,000 population that occurred after the legalization of medical marijuana with the change in suicides per 100,000 population for a set of control states. This estimation approach can be thought of as exploiting a "natural experiment" unrelated to comorbidities or personality.

The graphical analysis provided evidence that, prior to legalization, male suicides in the treated states evolved in a similar fashion to male suicides in the control states. After legalization, these trends diverged. Specifically, the male suicide rate in medical marijuana states fell, but the male suicide rate increased, albeit modestly, in the control states. Formal estimates obtained using regression analysis were consistent with the graphical analysis. These estimates suggested that the legalization of medical marijuana was associated with a 9.2% to 10.8% decrease in the suicide rate of 20- through 29-year-old males, and a 9.4% to 13.7% decrease in the suicide rate of 30- through 39 year-old-males. These estimates were generally robust to adjusting for linear time trends at the state level.

The graphical analysis showed that female suicide rates in medical marijuana states and the control states followed very similar trajectories. Estimates obtained using regression analysis confirmed this result. In general, estimates of the relationship between the legalization of medical marijuana and female suicide rates were negative, but these estimates were less precise than the estimates obtained for males and were sensitive to model specification, a pattern of results due, perhaps, to gender differences in: frequency of substance use[43-45], physiological responses to cannabinoids[14-16], or underlying health conditions such as panic and personality disorders.[46] Frequency of marijuana use is associated with social anxiety[45], and prospective studies show that marijuana participation is positively related to panic attacks[40, 41], which in turn are positively associated with suicidal ideation and a history of attempted suicide.[47]

Suicide among adolescents and young adults is often triggered by stressful life events (SLEs). SLEs include, but are not limited to the breakup of a romantic

relationship[48-51], conflict with a parent or sibling[49, 51], an abortion[52, 53], and legal/disciplinary problems.[49] Among older adults, problems at work, financial difficulties, unemployment and separation/divorce are common triggers of suicide.[54-59] Among the elderly, suicide is often associated with physical illness and functional impairment.[60-64]

The results of the current study are consistent with the hypothesis that legalizing medical marijuana leads to increased marijuana use, which in turn helps individuals cope with SLEs. There is anecdotal evidence that much of the medical marijuana crop is diverted to the illegal market, increasing availability and lowering price.[65-67] This anecdotal evidence is supported by recent studies showing that the legalization of medical marijuana leads to increased arrests for marijuana possession among 18- through 39-year-olds, increased admissions to federally-funded treatment centers for marijuana use, and a 10% to 26% reduction in the price of high-quality marijuana.[5, 6] However, despite claims that marijuana can be an effective treatment for depression and panic disorders[68-70], there is no scientific evidence that it can be used to cope with SLEs.

Alcohol consumption represents an alternative route through which the legalization of medical marijuana could potentially impact suicides. A recent study showed that the legalization of medical marijuana was associated with substantial decreases in alcohol participation and binge drinking among young adults.[5] Binge drinking is considered to have "especially high social and economic costs"[71] and is associated with suicidal ideation.[72, 73] Moreover, alcoholism is more common among individuals with major depression[74], and is associated with suicidal ideation as well as attempted and completed suicides.[71, 75, 76]

Study Strengths and Weaknesses

This was the first study to examine the relationship between legalizing medical marijuana and suicides. Previous studies have documented a positive association between marijuana use and outcomes such as depression and suicidal ideation.[1-3] However, this association could be attributable to difficult-to-measure confounders or reflect self-medication.[10, 12, 13] By comparing the change in suicides after the legalization of medical marijuana with the change in suicides for a set of control states, we avoided the problems of reverse causality and difficult-to-measure confounders.

A number of important study limitations warrant mention. First, the Mortality Detail Files were available only through 2007 when the statistical analysis was conducted. Since 2007, 9 states (Arizona, Connecticut, Delaware, Illinois, New Hampshire, Maryland, Massachusetts, Michigan, and New Jersey) have legalized medical marijuana. These 9 states, although included in our sample, did not contribute to the identification of the estimates reported in Tables 1 and 2.

Second, the exact date on which any given suicide took place was not available. Therefore, if a state legalized marijuana during the middle of the year (as opposed to January 1 or December 31), then the legalization indicator was assigned a fractional value. For instance, if legalization occurred on June 30, then it took on a value 0.5. Although standard, this approach could have biased the estimates in Tables 1 and 2 towards 0 by introducing measurement error. In other words, it is possible that the impact of legalizing medical marijuana on suicides is larger than suggested by the estimates contained in Tables 1 and 2.

Third, the data on suicides from the Mortality Detail Files are at the state-year level. Although the gender and the age of individuals who committed suicide are available, nothing was known about their mental health prior to the legalization of medical marijuana nor was there information on whether an individual smoked marijuana or consumed alcohol prior to the legalization of medical marijuana.

Finally, Alaska, Hawaii, Maine, New Mexico and Vermont limited caregivers to one patient or prohibited home cultivation altogether. Distinguishing between these 5 states and states with less restrictive medical marijuana laws produced estimates that were not sufficiently precise to reject the hypothesis that legalization had a similar impact on male suicides regardless of whether caregivers were limited to one patient, a result likely driven by lack of statistical power. Because the majority of states that legalized medical marijuana during the period 1990-2007 were located in the western half of the United States, where suicide rates are highest[77], our results may not extend to other regions of the country. Several northeastern states including Connecticut, Massachusetts and New Jersey have legalized medical marijuana since 2007. Whether they will experience a reduction in suicides is an open question.

Implications and Conclusion

To date, 21 states have adopted medical marijuana laws. Although these laws almost certainly have important public health implications, we know very little about their effects.

The current study found a strong negative relationship between the legalization of medical marijuana and suicides among young adult males. This relationship is consistent

with the often-voiced, but controversial claim that marijuana can be used to cope with depression and anxiety caused by stressful life events.[37, 68-70, 78, 79] However, it may, at least in part, be attributable to the reduction in alcohol consumption among young adults that appears to accompany the legalization of medical marijuana.[5] Although marijuana and alcohol use are positively correlated in the cross-section[80, 81], there is evidence of a sharp decrease in marijuana use when individuals reach the minimum legal drinking age, suggesting that young adults substitute marijuana for alcohol.[82] There is also evidence that restricting access to alcohol leads to fewer suicides.[24-26, 83] The precise mechanism thorough which legalizing medical marijuana is related to suicides among 20- through 39-year-old males remains a topic for future study.

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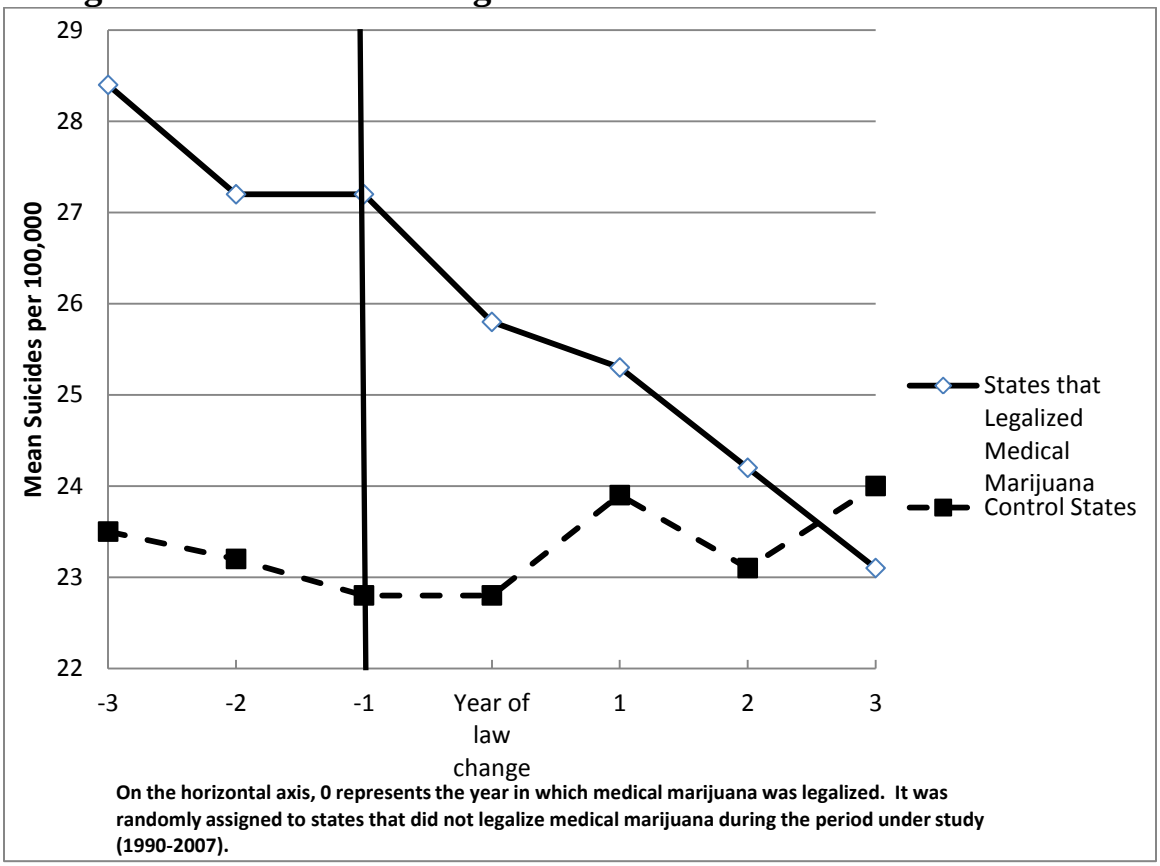
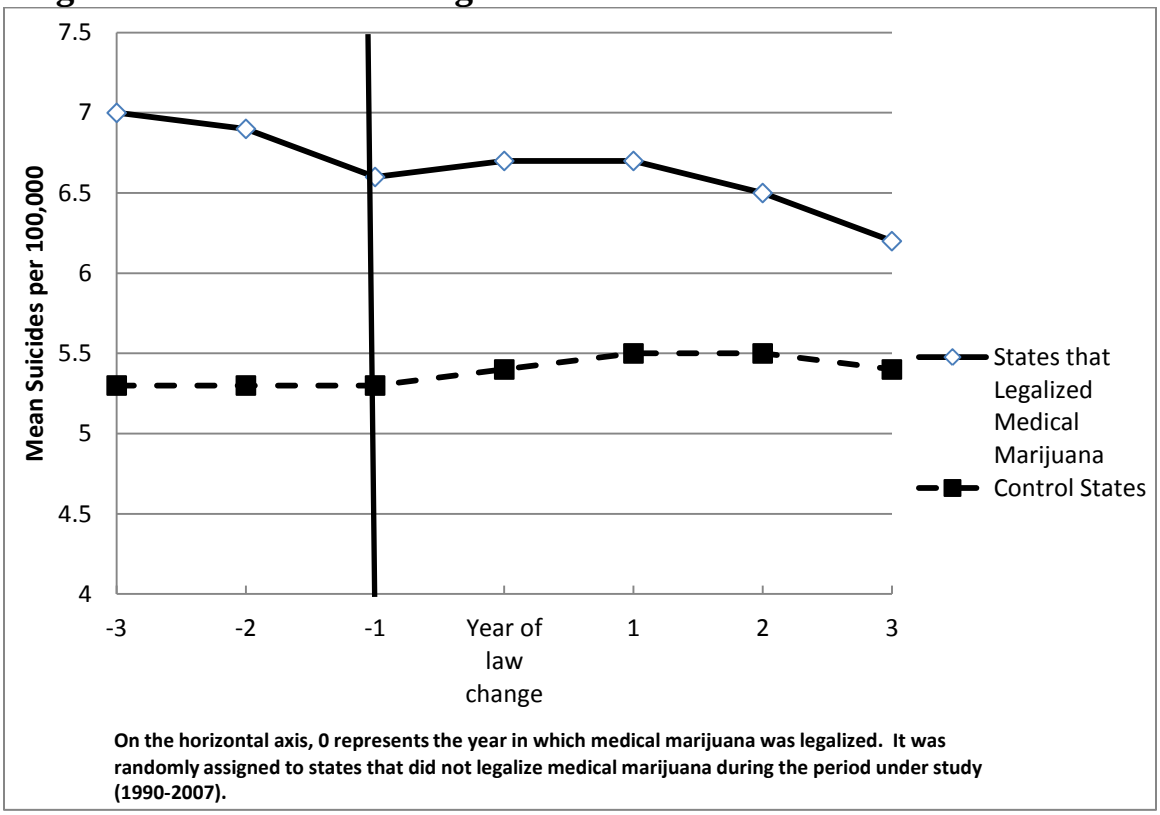
Figure 1. Pre- and Post-Legalization Trends in Male Suicide Rates



On the horizontal axis, 0 represents the year in which medical marijuana was legalized. It was randomly assigned to states that did not legalize medical marijuana during the period under study (1990-2007).

Figure 2. Pre- and Post-Legalization Trends in Female Suicide Rates



On the horizontal axis, 0 represents the year in which medical marijuana was legalized. It was randomly assigned to states that did not legalize medical marijuana during the period under study (1990-2007).

Table 1. Estimates of Relationship between Legalizing Medical Marijuana and the Natural Log of Suicides per 100,000 Population[a]

	Suicides Total	*Suicides Male*	*Suicides Female*
Adjusted for State/Year Effects	-0.084 (-0.183, 0.016)	-0.073 (-0.159, 0.014)	-0.106 (-0.247, 0.036)
Adjusted for State/Year Effects and Covariates[b]	-0.072* (-0.143, -0.0002)	-0.065* (-0.128, -0.002)	-0.080 (-0.180, 0.021)
Adjusted for State/Year Effects Covariates[b] and State Time Trends	-0.049 (-0.099, 0.001)	-0.047* (-0.089, -0.005)	-0.060 (-0.144, 0.024)

* P < 0.05; **P < 0.01.

[a] Each cell represents the results from a separate ordinary least squares regression (n = 918). The dependent variable is equal to the natural log of suicides per 100,000 population. Estimates are weighted using the relevant population. 95% confidence intervals are reported in parentheses.

[b] Covariates include: the state unemployment rate, per capita income, whether a zero tolerance drunk driving law was in effect, whether a 0.08 blood alcohol content law was in effect, whether marijuana possession was decriminalized, and the state beer tax.

Table 2. Estimates of Relationship between Legalizing Medical Marijuana and the Natural Log of Suicides per 100,000 Population by Gender and Age Group[a]

MALES

	15-19 yr.-olds	20-29 yr.-olds	30-39 yr.-olds	40-49 yr.-olds	50-59 yr.-olds	60+ yr.-olds
Adjusted for State/Year Effects	-0.077 (-0.232, 0.078)	-0.096** (-0.147, -0.045)	-0.147** (-0.244, -0.051)	-0.129 -0.297, 0.039)	-0.030 (-0.155, 0.095)	-0.008 (-0.082, 0.065)
Adjusted for State/Year Effects and Covariates[b]	-0.091 (-0.252, 0.069)	-0.096** (-0.142, -0.050)	-0.129** (-0.193, -0.065)	-0.113* (-0.223, -0.004)	-0.010 (-0.101, 0.080)	-0.010 (-0.079, 0.058)
Adjusted for State/Year Effects Covariates[b] and State TimeTrends	-0.118 (-0.348, 0.111)	-0.114** (-0.188, -0.038)	-0.099* (-0.175, -0.024)	-0.060 (-0.149, 0.030)	-0.015 (-0.099, 0.068)	0.036 (-0.020, 0.094)

FEMALES

	15-19 yr.-olds	20-29 yr.-olds	30-39 yr.-olds	40-49 yr.-olds	50-59 yr.-olds	60+ yr.-olds
Adjusted for State/Year Effects	-0.069 (-0.388, 0.249)	-0.062 (-0.185, 0.060)	-0.125* (-0.243, -0.007)	-0.120 (-0.332, 0.092)	-0.068 (-0.275, 0.140)	-0.082 (-0.208, 0.043)
Adjusted for State/Year Effects and Covariates[b]	-0.105 (-0.403, 0.225)	-0.044 (-0.174, 0.087)	-0.110* (-0.218, -0.003)	-0.078 (-0.211, 0.056)	-0.019 (-0.164, 0.125)	-0.082 (-0.199, 0.036)
Adjusted for State/Year Effects Covariates[b] and State TimeTrends	0.083 (-0.388, 0.554)	-0.008 (-0.138, 0.122)	-0.035 (-0.212, 0.141)	-0.041 (-0.151, 0.069)	-0.104 (-0.225, 0.018)	-0.121* (-0.240, -0.004)

* P < 0.05; **P < 0.01.

[a] Each cell represents the results from a separate ordinary least squares regression (n = 918). The dependent variable is equal to the natural log of suicides per 100,000 population. Estimates are weighted using the relevant population. 95% confidence intervals are reported in parentheses.

[b] Covariates include: the state unemployment rate, per capita income, whether a zero tolerance drunk driving law was in effect, whether a 0.08 blood alcohol content law was in effect, whether marijuana possession was decriminalized, and the state beer tax.

Appendix Table 1. Medical Marijuana Laws, 1990-2007[a]

	Effective date
Alaska	March 4, 1999
California	November 6, 1996
Colorado	June 1, 2001
Hawaii	December 28, 2000
Maine	December 22, 1999
Montana	November 2, 2004
Nevada	October 1, 2001
New Mexico	July 1, 2007
Oregon	December 3, 1998
Rhode Island	January 3, 2006
Vermont	July 1, 2004
Washington	November 3, 1998

[a] Arizona, Connecticut, Delaware, Maryland, Massachusetts, Michigan, New Jersey, and Washington, D.C. passed medical marijuana laws after 2007.

Appendix Table 2. Weighted Means of Dependent and Independent Variables[a]

Dependent Variables	**Mean (Standard Deviation)**
Suicides per 100,000 Population[b]	14.3 (3.47)
Male Suicide Rate	23.7 (5.72)
Ages 15-19	14.4 (6.13)
Ages 20-29	22.9 (6.92)
Ages 30-39	22.9 (6.27)
Ages 40-49	24.0 (6.19)
Ages 50-59	23.3 (6.10)
Ages 60+	30.3 (8.81)
Female Suicide Rate	5.51 (1.49)
Ages 15-19	3.09 (1.82)
Ages 20-29	4.13 (1.53)
Ages 30-39	5.79 (2.00)
Ages 40-49	7.35 (2.59)
Ages 50-59	6.97 (2.43)
Ages 60+	4.89 (1.90)
Covariates[c]	
Medical Marijuana Law	0.111 (0.311)
Marijuana Decriminalization Law	0.327 (0.469)
Ln (State Income)	10.3 (0.153)
Unemployment Rate	5.43 (1.36)
0.08 Blood Alcohol Content Law	0.509 (0.491)
Zero Tolerance Law	0.721 (0.440)
Real Beer Tax (2000 dollars)	0.252 (0.214)
n	918

[a] Means weighted by the relevant population.

[b] Data on suicides are from the Mortality Detail Files, produced by the produced by the National Vital Statistics System.

[c] Information on medical marijuana laws and decriminalization are from published sources. The state income and unemployment data are from the Bureau of Labor Statistics and the Bureau of Economic Analysis, respectively. The data on Zero Tolerance laws and beer taxes are from the National Highway Traffic Safety Administration and the Beer Institute, respectively.