



Research Paper

Medical marijuana laws and workplace fatalities in the United States

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ABSTRACT

Aims: The aim of this research was to determine the association between legalizing medical marijuana and workplace fatalities.**Design:** Repeated cross-sectional data on workplace fatalities at the state-year level were analyzed using a multivariate Poisson regression.**Setting:** To date, 29 states and the District of Columbia have legalized the use of marijuana for medicinal purposes. Although there is increasing concern that legalizing medical marijuana will make workplaces more dangerous, little is known about the relationship between medical marijuana laws (MMLs) and workplace fatalities.**Participants:** All 50 states and the District of Columbia for the period 1992–2015.**Measurements:** Workplace fatalities by state and year were obtained from the Bureau of Labor Statistics. Regression models were adjusted for state demographics, the unemployment rate, state fixed effects, and year fixed effects.**Findings:** Legalizing medical marijuana was associated with a 19.5% reduction in the expected number of workplace fatalities among workers aged 25–44 (incident rate ratio [IRR], 0.805; 95% CI, .662–.979). The association between legalizing medical marijuana and workplace fatalities among workers aged 16–24, although negative, was not statistically significant at conventional levels. The association between legalizing medical marijuana and workplace fatalities among workers aged 25–44 grew stronger over time. Five years after coming into effect, MMLs were associated with a 33.7% reduction in the expected number of workplace fatalities (IRR, 0.663; 95% CI, .482–.912). MMLs that listed pain as a qualifying condition or allowed collective cultivation were associated with larger reductions in fatalities among workers aged 25–44 than those that did not.**Conclusions:** The results provide evidence that legalizing medical marijuana improved workplace safety for workers aged 25–44. Further investigation is required to determine whether this result is attributable to reductions in the consumption of alcohol and other substances that impair cognitive function, memory, and motor skills.

Introduction

Although marijuana remains illegal under federal law, 29 states and the District of Columbia have passed laws legalizing its use for medicinal purposes (State Medical Marijuana Laws, 2017). Medical marijuana laws (hereafter MMLs) remove state-level penalties for using and possessing marijuana for medical purposes. Patients are required to obtain approval or certification from a physician, and physicians who recommend marijuana to their patients are immune from criminal prosecution.

Increasingly, concerns are being raised over the potential impact of MMLs on workplace safety (Goldsmith et al., 2015; Parnes, Bravo,

Conner, & Pearson, 2018; Phillips et al., 2015; Schwartz, 2017). As a backdrop to these concerns, there are important legal issues surrounding workplace safety and the use of medical marijuana that remain unresolved. For instance, in many states it is unclear whether employers can impose sanctions on registered medical marijuana patients who test positive for tetrahydrocannabinol (the psychoactive component in marijuana), or whether insurance companies can claim marijuana as the cause of injury or death in the workplace (Deitchler, 2015; Hickox, 2012; Olafson, 2016).

There is strong evidence that legalizing medical marijuana leads to a decrease in the price of marijuana and an increase in its consumption, presumably due to diversion from the medical to the recreational

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market (Anderson, Hansen, & Rees, 2013; Chu, 2014, 2015). However, the association between legalization and workplace safety could, in theory, be negative or positive. On the one hand, extensive research has demonstrated that there are important short-term effects of marijuana use on psychomotor performance and cognition that could lead to more on-the-job accidents, including impairments in memory function, information processing, hand-eye coordination, and reaction times (Hall, 2009; Hartman & Huestis, 2013; Marijuana, 2017; Ramaekers, Berghaus, van Laar, & Drummer, 2004). On the other hand, previous studies have found that the legalization of medical marijuana leads to substantial reductions in the consumption of alcohol, opioids and other substances, (Anderson et al., 2013; Bachhuber, Saloner, Cunningham, & Barry, 2014; Bradford & Bradford, 2016; Reiman, 2009; Sabia, Swigert, & Young, 2017), which could lead to safer workplaces and fewer accidents.

Drawing on data at the state-year level collected by the Bureau of Labor Statistics for the period 1992–2015, the relationship between legalizing medical marijuana and workplace fatalities was examined. Multivariate Poisson regression analysis was used to adjust for demographics, income, the unemployment rate, legalization of recreational marijuana, decriminalization of marijuana, state fixed effects, and year fixed effects. No previously published study has examined the relationship between MMLs and workplace fatalities.

Methods

Panel data on workplace fatalities at the state-year level came from Census of Fatal Occupational Injuries (CFOI). These data are produced by the Occupational Safety and Health Statistics (OSHS) program, which is administered by the Bureau of Labor Statistics (BLS). The CFOI provides counts of all fatal work injuries occurring in the U.S. during each calendar year. The OSHS program uses diverse state, federal, and independent data sources to identify, verify, and describe fatal work injuries, ensuring that counts are as complete and accurate as possible. The CFOI data are publicly available from the BLS for the period under study, 1992–2015, and have been used by previous researchers interested in the determinants of workplace safety (Mendeloff & Staetsky, 2014; Morantz, 2009; Smith, 2015). Total workplace fatality counts by state and year, as well as counts for different age groups are available. Twenty-four years multiplied by 51 (50 states and the District of Columbia) yielded a total of 1224 observations for analysis. Data on nonfatal workplace injuries and illnesses are also available from the BLS. However, due to the well-known under-reporting issues with these data, we opted to focus solely on workplace fatalities (Leigh, Du, & McCurdy, 2014; Rosenman et al., 2006; Ruser, 2008; Spieler & Wagner, 2014).

Information on the state-level legalization of medical marijuana is reported in Table 1. During the period under study, 24 states and the District of Columbia adopted MMLs, although medical marijuana programs were not yet operational in four of these states (Maryland, Minnesota, New Hampshire, and New York). Sixteen of the remaining 20 states permitted patients to register on the basis of pain, which (because pain cannot be objectively confirmed) could encourage recreational use (Williams, Olfson, Kim, Martins, & Kleber, 2016). Twelve of the 20 states that legalized medical marijuana during the period under study prohibited collective cultivation, also known as “group growing”, either by limiting caregivers to one patient or restricting where and how marijuana can be grown. Law enforcement authorities assert that there is more diversion from the medicinal market to the recreational market in states that allow collective cultivation (Selecky, 2008).

Multivariate Poisson regression analysis was used to estimate the association between an indicator (i.e., a 0/1 variable) of medical marijuana legalization, *MML*, and the expected number of workplace fatalities in a given state and year. An advantage of the Poisson model is that the inclusion of fixed effects does not lead to an incidental

Table 1
Medical Marijuana Laws 1992–2015.

	Effective date	Pain listed as qualifying condition	Collective cultivation allowed
Alaska	March 4, 1999	Yes	No
Arizona	April 14, 2011	Yes	Yes
California	November 6, 1996	Yes	Yes
Colorado	June 1, 2001	Yes	Yes
Connecticut	August 20, 2014 ^a	No	No
Delaware	June 26, 2015 ^a	Yes	No
D. C.	July 30, 2013 ^a	No	No
Hawaii	December 28, 2000	Yes	No
Illinois	November 9, 2015 ^a	No	No
Maine	December 22, 1999	Yes	No
Maryland	Passed but not operational ^b		
Massachusetts	January 1, 2013	No	No
Michigan	December 4, 2008	Yes	Yes
Minnesota	Passed but not operational ^b		
Montana	November 2, 2004	Yes	No ^c
Nevada	October 1, 2001	Yes	Yes
New Hampshire	Passed but not operational ^b		
New Jersey	December 6, 2012 ^a	Yes	No
New Mexico	July 1, 2007	No	No
New York	Passed but not operational ^b		
Oregon	December 3, 1998	Yes	Yes
Rhode Island	January 3, 2006	Yes	Yes
Vermont	July 1, 2004	Yes ^d	No
Washington	November 3, 1998	Yes	Yes

^a Date on which first medical marijuana dispensary opened.

^b MML passed during period 1992–2015, but first dispensary did not open until after 2015.

^c Prior to Senate Bill 423 (July 1, 2011), Montana allowed for collective cultivation.

^d “Pain” added to list of qualifying conditions in 2007.

parameters problem (Cameron & Trivedi, 2018). The natural logarithm of the number of workers was used as an offset variable. If a MML came into effect after January 1, it was coded as a fraction for that year (e.g., it was coded as 0.5 if the law came into effect on July 1). Incident rate ratios (IRRs) were considered statistically significant if their 95% confidence interval (CI) did not include the value of one. We corrected standard errors (which were used to calculate CIs and p-values) for clustering at the state level (Bertrand, Duflo, & Mullainathan, 2004).

Following previous studies in this area of research (Anderson et al., 2013; Bachhuber et al., 2014; Bradford & Bradford, 2016; Chu, 2014, 2015; Sabia et al., 2017), 50 state indicators were included as covariates in the regression analysis. Their inclusion on the right-hand side of the regression model accounted for the influence of time-invariant factors at the state level (i.e., state “fixed effects”) such as rules and regulations pertaining to workplace safety and ensured that estimates of the association between legalizing medical marijuana and workplace fatalities were identified using only within-state variation over time. Again, following previous studies in this area of research (Anderson et al., 2013; Bachhuber et al., 2014; Bradford & Bradford, 2016; Chu, 2014, 2015; Sabia et al., 2017), 23 year indicators were included to account for year-to-year changes in workplace fatalities that were common across all 50 states and the District of Columbia due to, for instance, changes in federal regulations or technology. Given the inclusion of state and year fixed effects, the regression model represents a difference-in-differences specification, which relies on the parallel trends assumption being satisfied. In Fig. 1, we plot workplace fatality trends for the treated and control states prior to MMLs going into effect.

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